AREVA

January 10, 2014
E-37083

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Subject: Application for Revision to Certificate of Compliance No. 9302 for the Model No. NUHOMS®-MP197 Packaging, Response to the Second Request for Additional Information (Docket No. 71-9302; TAC No. L24627)

Reference: Letter from Pierre Saverot (NRC) to Dr. Jayant Bondre (AREVA TN), "Application for Revision to Certificate of Compliance No. 9302 for the Model No. NUHOMS®-MP-197HB Transportation Package, Second Request for Additional Information," November 27, 2013

This submittal provides responses to the request for additional information (RAI) forwarded by the letter referenced above.

In addition to the SAR changes associated with the RAI responses, pursuant to discussion with NRC staff, modifications are proposed to Appendix A.2.13.11 to remove discussions regarding the cladding hydride reorientation. In review of the shielding evaluations in response to RAI 5-1, an error was found and corrected, which led to an increase of cooling times by at most 0.5 year in certain fuel qualification tables in the SAR for fuel assemblies to be located in peripheral compartments. The SAR page changes and associated reasons are listed in Enclosure 3.

This submittal also proposes changes to the CoC in Enclosure 5 to include two conditions for transportation pursuant to discussion with NRC staff, to correct the error found in review of response to RAI 5-1, and to add clarifications in response to RAI 2-3 and RAI 6-2.

This submittal includes the following enclosures.

- Enclosure 1 provides an affidavit, in accordance with 10 CFR 2.390, specifically requesting that you withhold proprietary information included in Enclosures 2, 4, and 7 of this submittal from public disclosure. That information may not be used for any purpose other than to support NRC staff review of the application. Public versions of these enclosures are discussed below. Because Enclosures 2 and 7 are entirely proprietary, no public versions are provided.

AREVA TN

AREVA Inc.
7135 Minstrel Way - Suite 300 - Columbia, MD 21045 USA
Tel.: (410) 910-6900 - Fax: (410) 910-6902
us.areva.com/AREVATN

NMSS01

- Enclosure 2 provides each RAI item, followed by a response (proprietary version).
- Enclosure 3 provides a list of RAIs with indication of the associated changed SAR pages.
- Enclosure 4 provides the proprietary version of the SAR, Revision 15. The latest changed areas are indicated by revision bars in the right margin and italics for inserted text, with "Rev. 15, 12/13" in the page header.
- Enclosure 5 provides proposed changes to CoC 9302 pursuant to discussion with the NRC staff, in Condition 7 to include that the transportation using MP197HB packaging is limited to facilities that have the capabilities to handle uncanned damaged fuel assemblies, and in Condition 8 to include that the effectiveness of the inspection/verification techniques outlined in Chapter A.7, Section A.7.1.3, Step 5 must be demonstrated prior to transportation.

  This enclosure also includes proposed CoC changes in Condition 8, chloride test in response to RAI 2-3 and in Appendices A.1 and A.3 through A.9 to add clarifications and corrections to the qualified fuel assemblies in response to RAI 6-2 and to correct the error found in review of RAI 5-1.
- Enclosure 6 provides a list of computational files contained in Enclosure 7.
- Enclosure 7 is a proprietary electronic copy of computational files associated with certain RAI responses.
- Enclosure 8 provides a non-proprietary version of the changed pages of the SAR, Revision 15 with proprietary information redacted.

Should the NRC staff require additional information to support review of this application, please do not hesitate to contact Mr. Kamran Tavassoli at 410-910-6944 or me at 410-910-6820.

Sincerely,

Paul H Triska

Paul Triska
Vice President, Technical Services

cc: Pierre M. Saverot (NRC SFST) as follows:

- One paper copy of this cover letter and Enclosures 1 through 6
- One electronic copy of this cover letter and Enclosures 1 through 6 on one DVD
- One electronic copy of Enclosure 7 on a separate DVD

List of Enclosures:

1. Affidavit Pursuant to 10 CFR 2.390
2. RAI Responses (Proprietary Version)
3. List of RAIs with Indication of the Associated Changed SAR Pages
4. NUHOMS®-MP197 Transportation Package, Safety Analysis Report, Revision 15, Document No. NUH09.0101 (Proprietary Version)
5. Proposed Changes to CoC 9302
6. Listing of Computer Files Contained in Enclosure 7
7. Electronic copy (DVD) of computer input and output files listed in Enclosure 6 (Proprietary)
8. NUHOMS®-MP197 Transportation Package, Safety Analysis Report, Revision 15, Changed Pages (Non-proprietary Version)

AFFIDAVIT PURSUANT
TO 10 CFR 2.390

AREVA Inc. (successor by merger to Transnuclear, Inc.))
State of Maryland) SS.
County of Howard)

I, Paul Triska, depose and say that I am a Vice President of AREVA Inc., duly authorized to execute this affidavit, and have reviewed or caused to have reviewed the information that is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.390 of the Commission's regulations for withholding this information.

Effective January 1, 2014, Transnuclear, Inc. was merged into AREVA Inc. (formerly named AREVA NP Inc.), hence AREVA Inc. is successor by merger to Transnuclear, Inc.

The information for which proprietary treatment is sought is contained in Enclosures 2, 4, and 7 as listed below:

- Enclosure 2 - Responses to the request for additional information (RAI)
- Enclosure 4 – Portions of the Safety Analysis Report (SAR)
- Enclosure 7 – Electronic copy of computational files

These documents have been appropriately designated as proprietary.

I have personal knowledge of the criteria and procedures utilized by AREVA Inc., in designating information as a trade secret, privileged or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1) The information sought to be withheld from public disclosure involves responses to requests for additional information (RAI), portions of the Model NUHOMS®-MP197 transportation packaging SAR, and computational files associated with certain RAI responses, all related to the design of the NUHOMS®-MP197HB transportation packaging, which are owned and have been held in confidence by AREVA Inc.

2) The information is of a type customarily held in confidence by AREVA Inc., and not customarily disclosed to the public. AREVA Inc., has a rational basis for determining the types of information customarily held in confidence by it.

3) Public disclosure of the information is likely to cause substantial harm to the competitive position of AREVA Inc., because the information is related to the design of transportation packaging, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with AREVA Inc., take marketing or other actions to improve their product's position or impair the position of AREVA Inc.'s product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

Further the deponent sayeth not.

Paul Triska
Vice President, AREVA Inc.

Subscribed and sworn to me before this 10th day of January, 2014.

Notary Public

My Commission Expires 10 / 17 / 2015

ZORA M. DOUGHERTY
My Commission Expires
NOTARY
PUBLIC
10-17-2015
HOWARD COUNTY, MD

Enclosure 2 to TN E-37083

RAI Responses (Proprietary Version)

Enclosure 3 to TN E-37083

List of RAIs with Indication of the Associated Changed SAR Pages

Enclosure 3
to TN E-37083

List of RAIs with Indication of the Associated Changed SAR Pages

RAI Number	Changed SAR Page
RAI 2-1	A.7-5a, A.7-5b, and A.7-22
RAI 2-2	A.7-5b
RAI 2-3	A.7-5a, A.7-5b, and A.7-22
RAI 2-4	A.7-19 and A.7-19a
RAI 5-1	A.5-ii, A.5-iv, A.5-vi, A.5-12c, A.5-20, A.5-20a, A.5-20b, A.5-32, A.5-32a, A.5-41a, A.5-42, A.5-80t, and A.5-114
RAI 5-2	A.5-1, A.5-1a, A.5-1b, A.5-12c, A.5-12d, A.5-32, A.5-32a, A.5-32b, A.5-80o, A.5-80p, A.5-80q, A.5-80r, and A.5-80s
RAI 6-1	A.1.4.3-3, A.1.4.4-2a, A.1.4.5-2, and A.1.4.6-2
RAI 6-2	A.1.4.1-2, A.1.4.1-2a, A.1.4.1-6, A.1.4.3-3, A.1.4.3-3a, A.1.4.3-5, A.1.4.3-6, A.1.4.8-3, A.1.4.8-5, A.1.4.8-6, A.6.5.1-3, A.6.5.1-11, A.6.5.1-25, A.6.5.1-25a, A.6.5.3-2, A.6.5.3-3, A.6.5.3-14, A.6.5.3-14a, A.6.5.5-3, A.6.5.5-8a, A.6.5.5-11, and A.6.5.5-11a
RAI 6-3	A.1.4.7-5, A.1.4.8-9, A.1.4.8-10, and A.1.4.9-6
RAI 6-4	A.6.5.1-9, A.6.5.2-8, A.6.5.3-5, A.6.5.4-7, A.6.5.5-7, A.6.5.6-6, and A.6.5.7-6
RAI 6-5	A.6.5.1-19, A.6.5.1-21, A.6.5.1-22, A.6.5.1-23, A.6.5.1-27, A.6.5.1-27a, A.6.5.1-47, A.6.5.1-50, A.6.5.1-53, A.6.5.2-9, A.6.5.2-10, A.6.5.2-18, and A.6.5.2-19
RAI 6-6	A.6.5.4-i, A.6.5.4-10, A.6.5.4-10a, A.6.5.4-15, A.6.5.4-15a, A.6.5.4-17, A.6.5.4-29, A.6.5.5-10, A.6.5.5-11, and A.6.5.5-11a
RAI 6-7	A.1.4.5-14, A.6.5.4-34, A.6.5.12-i, A.6.5.12-ii, A.6.5.12-1, A.6.5.12-2, A.6.5.12-3, A.6.5.12-4, A.6.5.12-4a, A.6.5.12-16, A.6.5.12-16a, A.6.5.12-16b, A.6.5.12-17, A.6.5.12-28a, A.6.5.12-28b, A.6.5.12-29, A.6.5.12-30, and A.6.5.12-31
RAI 7-1	A.7-i, A.7-7, A.7-8, A.7-8a, A.7-14a, and A.7-23
RAI 7-2	A.7-19
RAI 7-3	A.7-19 and A.7-19a
RAI 7-4	A.7-19
Correction of error found in review of response to RAI 5-1	A.1.4.1-3, A.1.4.1-9a, A.1.4.3-3a , A.1.4.3-10a, A.1.4.4-2a, A.1.4.4-9a, A.1.4.5-i, A.1.4.5-3a, A.1.4.5-10a, A.1.4.6-3, A.1.4.6-10a, A.1.4.8-13a, A.1.4.9-i, A.1.4.9-9a, A.5-80m, and A.5-80n
Removal of discussions regarding the cladding hydride reorientation	A.2.13.11-i, A.2.13.11-ii, A.2.13.11-1, A.2.13.11-4, A.2.13.11-6, A.2.13.11-7, A.2.13.11-12 through A.2.13.11-44, Pages A.2.13.12-4a through A.2.13.11-4d are removed

Enclosure 5 to TN E-37083

Proposed Changes to CoC 9302

Proposed Changes to CoC 9302

The proposed CoC 9302 for Model Numbers NUHOMS®-MP197 / NUHOMS®-MP197HB packaging is provided in this enclosure. The latest proposed changes related to RAI responses are indicated by blue fonts.

The latest proposed changes to CoC 9302 are as follows.

- Changes to Condition 7 to include that the transportation using MP197HB packaging is limited to facilities that have the capabilities to handle uncanned damaged fuel assemblies,
- Changes to Condition 8 to include that the effectiveness of the inspection/verification techniques outlined in Chapter A.7, Section A.7.1.3, Step 5 must be demonstrated prior to transportation,
- Changes to Condition 8 for chloride test to include that the efficiency of the sample collector and its delivery system shall be demonstrated in response to RAI 2-3, and
- Changes to Appendices A.1, A.3, A.7, A.8, and A.9 in response to RAI 6-2 to add clarifications for qualified fuel assemblies.

7. For operating controls and procedures, in addition to the requirements of Subpart G of 10 CFR Part 71, the NUHOMS®-MP197 package shall meet the requirements listed in Sections 7(a) and 7(b), while the NUHOMS®-MP197HB package shall meet the requirements listed in Sections 7(c), 7(d) and 7(e) ~~and 7(d)~~.

(a) Each NUHOMS®-MP197 package shall be both prepared for shipment and operated in accordance with the Operating Procedures in Chapter 7 of the application. In addition this will include:

(1) verification of the basket type A, B, or C, by inspection of the last digit of the serial number on the grapple ring at the bottom of the DSC.

(2) verification that the fuel assemblies to be placed in the DSC meet the maximum burnup, maximum initial enrichment, minimum cooling time, and maximum decay heat limits for fuel assemblies as specified in Tables 2 and 3. The enrichment limit must correspond to the basket type determined in 7(a)(1) above.

(b) All fabrication acceptance tests and maintenance shall be performed for the NUHOMS®-MP197 in accordance with Acceptance Tests and Maintenance Program in Chapter 8 of the application, as supplemented. In addition, the package lid bolts will be replaced after 85, or fewer, round trip shipments to ensure that the allowable fatigue damage factor will not be exceeded during normal conditions of transport.

INSERT A see next page

(d) ~~(c)~~ Each MP197HB package shall be both prepared for shipment and operated in accordance with the Operating Procedures in Chapter A.7 of the application, as supplemented. Detailed site-specific procedures shall be developed to include these steps as applicable to address the particular operational considerations related to the use of the MP197HB cask. Site specific conditions and requirements may require the use of different equipment and ordering of steps to accomplish the same objectives or acceptance criteria which must be met to ensure the integrity of the package.

(e) ~~(d)~~ For the MP197HB package, fabrication acceptance tests and maintenance shall be performed in accordance with the Acceptance Test and Maintenance Program in Chapter A.8 of the application.

8. ~~8.~~ For canisters *stored under 10 CFR Part 72,* using MP197HB packaging ~~exposed to a coastal saltwater marine environment~~ prior to transportation ~~under 10 CFR Part 72~~, the package user must evaluate the condition of the canister to verify 1) that *the containment function of the canister is maintained* ~~canister degradation has not occurred to the extent that the fuel has incurred gross breaches due to oxidation~~ and 2) that degradation of neutron absorbers and basket materials has not occurred to the extent they would no longer comply with the applicable materials and dimensions specified in section 5(a)(4) and 5(a)(5) for Drawings. *The canister evaluation process for verification of the containment function shall follow the instructions outlined in Chapter A.7, section A.7.1.3, Step5.*

~~*For this evaluation: 1) the surface chemistry analysis method for the chloride test and its accuracy shall be demonstrated on coupons of mil finished stainless steel doped with a known concentration of soluble salts characteristics of ISFSI location's rainwater or aerosol measurement and*~~ *2) the NDE technique to be used must first be demonstrated* ~~*on specimen of welded austenitic stainless steel with stress corrosion cracking induced by salt spray exposure of similar means. The demonstration must also include tools such as robots used to reach the canister surfaces, deployed in mockup of NUHOMS® HSM.*~~

INSERT B

For these canisters, the aging management plan and evaluation for each canister or set of canisters shall be submitted to the NRC at least 120 days prior to shipment.

9. Transport by air is not authorized.

10. NUHOMS®-MP197 and NUHOMS®-MP197HB packages are approved for exclusive use by rail, truck, or marine transport.

11. The NUHOMS®-MP197 and NUHOMS®-MP197HB packages authorized by this certificate are hereby approved for use under the general license provisions of 10 CFR 71.17.

12. Revision No. *6*~~5~~4 of this certificate may be used until ~~August 31, 2012~~*TBD*.

13. Expiration Date: ~~August 31, 2012~~*TBD*.

INSERT A:

7(c) Transportation using MP197HB packaging is limited to facilities that have the capabilities to handle uncanned damaged fuel assemblies.

INSERT B:

Transportation of the canisters stored under 10 CFR Part 72 is not authorized until the effectiveness of the inspection/verification techniques outlined in Chapter A.7,Section A.7.1.3, Step 5 have been demonstrated on mock-ups or working systems.

Table A.1-2
PWR Fuel Specifications of Damaged Fuel to be Transported in the 24PT4 DSC

Fuel Design	Damaged CE 16x16 PWR fuel assembly or equivalent reload fuel that is enveloped by the fuel assembly design characteristics as listed in Table A.1-3 and the following requirements:
Fuel Damage	Damaged fuel may include assemblies with known or suspected cladding defects greater than pinhole leaks or hairline cracks or an assembly with partial and/or missing rods (i.e., extra water holes). Damaged fuel assemblies shall be encapsulated in individual Failed Fuel Cans and placed in Zones A and/or B as shown in Figure A.1-1. Fuel debris and damaged fuel rods that have been removed from a damaged fuel assembly and placed in a Rod Storage Basket (6) are also considered as damaged fuel. Loose fuel debris, not contained in a Rod Storage Basket may also be placed in a Failed Fuel Can for storage, provided the size of the debris is larger than the Failed Fuel Can screen mesh opening. Fuel debris may be associated with any type of UO_2 fuel provided that the maximum uranium content and initial enrichment limits are met.

Physical Parameters(1)	
Unirradiated Length (in)	176.8
Maximum Active-Fuel Length (in)	*150*
Cross Section (in)	8.290
Assembly Weight (lbs)	1500(2) (3)
Max*imum*~~.~~ *Uranium* Content (kg)	455.5
No. of Assemblies per DSC	≤ 12 damaged assemblies, balance intact.
Fuel Cladding	Zircaloy-4 or ZIRLO™
Reconstituted Fuel Assemblies *(5)*	Damaged fuel rods replaced by either stainless rods (up to 8 rods per assembly) or Zircaloy clad uranium rods (any number of rods per assembly).
Nuclear and Radiological Parameters	
Maximum *Planar Average Initial*~~Initial ^{235}U~~ Enrichment (wt. % *U-235*)	Per Table A.1-4 and Figure A.1-1
Fuel Assembly Average Burnup and Minimum Cooling Time(4)~~(5)~~	Per Table A.1-5 and decay heat restrictions below
Decay Heat(4)	Per Figures A.1-2, A.1-3 or A.1-4

Notes:

(1) Nominal values shown unless stated otherwise.
(2) Does not include weight of Poison Rodlets (25 lbs each) installed in accordance with Table A.1-4.
(3) Includes the weight of fuel assembly Poison Rods installed for 10 CFR Part 50 criticality control in spent fuel pool racks.
(4) Minimum cooling time is the longer of that given in Table A.1-5 for a given burnup and enrichment of a fuel assembly and that *required to meet*~~calculated via~~ the decay heat ~~equation based on the~~ restrictions provided in Figures A.1-2, A.1-3 or A.1-4.
(5) ~~An additional cooling time of 8 years is required for damaged fuel assemblies in addition to that obtained from Table A.1-5, when 5 or more damaged fuel assemblies are loaded.~~ *Reconstituted rods shall displace an amount of water equal to or greater than that displaced by the original fuel rods in the active fuel region of the fuel assembly.*

(6) A maximum of 100 PWR fuel rods can be stored in each rod storage basket.

Table A.1-5a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

~~BU, GWd/MTU~~	~~Assembly Average Initial Enrichment (wt. % U-235)~~										
	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~
~~56~~	~~1.0~~	~~0.5~~									
~~57~~	~~3.0~~	~~2.0~~	~~1.0~~	~~No Additional Cooling Required~~							
~~58~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~1.0~~						
~~59~~	~~5.5~~	~~5.0~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~				
~~60~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.5~~	~~1.5~~	~~0.5~~		
~~Enr. wt.%~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~

BU, GWd/MTU	*Assembly Average Initial Enrichment (wt. % U-235)*										
	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
56	1.5	0.5									
57	3.0	2.0	1.0	No Additional Cooling Required							
58	4.5	3.5	3.0	2.0	1.0						
59	6.0	5.5	4.5	3.5	2.5	2.0	1.0				
60	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0		
Enr. wt.%	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8

Table A.3-1
PWR Fuel Specification for the Fuel to be Transported in the NUHOMS®-24PTH DSC
(Part 1 of 2)

PHYSICAL PARAMETERS: *Fuel Class*	*Intact or damaged or failed unconsolidated B&W 15x15, WE 17x17, CE 15x15, WE 15x15, CE 14x14 and WE 14x14 class PWR assemblies (with or without control components) that are enveloped by the fuel assembly design characteristics listed in Table A.3-3. Equivalent reload fuel manufactured by same or other vendors but enveloped by the design characteristics listed in Table A.3-3 is also acceptable.*
Damaged Fuel	*Damaged PWR fuel assemblies are assemblies containing missing or partial fuel rods or fuel rods with known or suspected cladding defects greater than hairline cracks or pinhole leaks. The extent of cladding damage in the fuel rods is to be limited such that a fuel assembly needs to be handled by normal means. Damaged fuel assemblies shall also contain top and bottom end fittings or nozzles or tie plates depending on the fuel type.*
Failed Fuel	*Failed fuel is defined as ruptured fuel rods, severed fuel rods, loose fuel pellets, or fuel assemblies that cannot be handled by normal means. Fuel assemblies may contain breached rods, grossly breached rods, and other defects such as missing or partial rods, missing grid spacers, or damaged spacers to the extent that the assembly cannot be handled by normal means.* (3) *Fuel debris and damaged fuel rods ~~that have~~ been removed from a damaged ~~fuel~~ assembly and placed in a rod storage basket ~~are~~ also considered as damaged fuel, and therefore shall be encapsulated in individual failed fuel cans. Loose fuel debris, not contained in a rod storage basket may also be placed in a failed fuel can for storage, provided the size of the debris is larger than the failed fuel can screen mesh opening and it is located at a position of at least 10" above the top of the bottom shield plug of the DSC.* *Fuel debris may be associated with any type of UO_2 fuel provided that the maximum uranium content and initial enrichment limits are met. The total weight of each failed fuel can plus all its contents shall be less than 1682 lb.*
Partial Length Shield Assemblies (PLSAs)	*WE 15x15 class PLSAs with following characteristics are authorized:* • *Maximum burnup, 40 GWd/MTU* • *Minimum cooling time, 15 years* • *Maximum decay heat, 900 Watts*
Reconstituted Fuel Assemblies [2]:	
• *Maximum Number of Reconstituted Assemblies per DSC with Irradiated Stainless Steel Rods*	*4*
• *Maximum Number of Irradiated Stainless Steel Rods per Reconstituted Fuel Assembly*	*10*
• *Maximum Number of Reconstituted Assemblies per DSC with Unlimited Number of Low Enriched UO_2 Rods and/or Unirradiated Stainless Steel Rods and/or Zr Rods or Zr Pellets*	*24*
• *Reconstituted assemblies containing an unlimited number of replacement lower enrichment UO_2 rods which have an initial wt. % U-235 less than or equal to that specified for fresh fuel in Table A.3-8 are qualified.*	

Table A.3-1
PWR Fuel Specification for the Fuel to be Transported in the NUHOMS®-24PTH DSC
(Part 2 of 2)

Control Components (CCs)	• *Up to 24 CCs are authorized for storage in 24PTH-S, 24PTH-L, and 24PTH-S-LC DSCs.* • *Authorized CCs include burnable poison rod assemblies (BPRAs), thimble plug assemblies (TPAs), control rod assemblies (CRAs), rod cluster control assemblies (RCCAs), axial power shaping rod assemblies (APSRAs), orifice rod assemblies (ORAs), vibration suppression inserts (VSIs), neutron source assemblies (NSAs), and neutron sources. Nonfuel hardware that are positioned within the fuel assembly after the fuel assembly is discharged from the core such as Guide Tube or Instrument Tube Tie Rods or Anchors, Guide Tube Inserts, BPRA Spacer Plates or devices that are positioned and operated within the fuel assembly during reactor operation such as those listed above are also considered as CCs.* • *Design basis thermal and radiological characteristics for the CCs are listed in Table A.3-2.*
Nominal Assembly Width for Intact and Damaged Fuel Assemblies Only	*8.536 inches*
Number of Intact Assemblies	*≤24*
Number and Location of Damaged Assemblies	*Up to 12 damaged fuel assemblies. Balance may be intact fuel assemblies, empty slots, or dummy assemblies depending on the specific heat load zoning configuration.* *Damaged fuel assemblies are to be placed in Locations A and/or B as shown in Figure A.3-6. The DSC basket cells which accommodate damaged fuel assemblies are provided with top and bottom end caps.*
Number and Location of Failed Assemblies	*Up to 8 failed fuel assemblies. Balance may be intact and/or damaged fuel assemblies, empty slots, or dummy assemblies depending on the specific heat load zoning configuration.* *Failed fuel assemblies are to be placed in Location A as shown in Figure A.3-6. Failed fuel assembly/fuel debris is to be encapsulated in an individual failed fuel can (FFC) provided with a welded bottom closure and a removable top closure.*
Maximum Assembly plus CC Weight	*1682 lbs*
THERMAL/RADIOLOGICAL PARAMETERS: *Fuel Assembly Average Burnup and minimum Cooling Time(1)*	 *Per Table A.3-4, Table A.3-7, Table A.3-8 and decay heat and burnup credit restrictions below.*
Maximum Decay Heat(1) Limits for Zones 1, 2, 3, and 4 Fuel	*Per Figure A.3-1 or Figure A.3-2 or Figure A.3-3 or Figure A.3-4 or Figure A.3-5.*
Decay Heat(1) per DSC	*Type 1 Basket* *≤ 26.0 kW for 24PTH-S and 24PTH-L DSCs with decay heat limit for Zones 1, 2, 3 and 4 as specified in Figure A.3-1, or Figure A.3-2, Figure A.3-3 or Figure A.3-4.* *Type 2 Basket* *Same as Type 1 Basket except ≤ 26.0 kW/DSC and ≤ 1.3 kW kW/fuel assembly for 24PTH-S and 24PTH-L DSCs.* *≤ 24.0 kW for 24PTH-S-LC DSC with decay heat limits as≤ 24.0 kW for 24PTH-S-L DSC (Type 2 Basket) specified in Figure A.3-5.*
Burnup Credit Restrictions(1)	*Per Table A.3-7 for intact fuel assemblies and per Table A.3-8 for all fuel assemblies when damaged and/or failed fuel assemblies are loaded. The maximum cooling time shall not exceed 160 years.*

Notes:

(1) Minimum cooling time is the longer of that given in Table A.3-4; that required to meet the decay heat restrictions provided in Figures A.3-1, A.3-2, A.3-3 or A.3-4; and Table A.3-7 or Table A.3-8.

(2) Reconstituted rods shall displace an amount of water equal to or greater than that displaced by the original fuel rods in the active fuel region of the fuel assembly.

(3) A maximum of 100 PWR fuel rods can be stored in each rod storage basket.

Table A.3-4a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

~~BU, GWd/MTU~~	~~Assembly Average Initial Enrichment (wt. % U-235)~~																				
	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~
~~51~~	~~0.5~~																				
~~52~~		~~1.5~~	~~0.5~~																		
~~53~~		~~3.0~~	~~2.0~~	~~1.0~~																	
~~54~~			~~4.0~~	~~3.0~~	~~1.5~~	~~0.5~~									~~No Additional Cooling Required~~						
~~55~~			~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~													
~~56~~			~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~	~~0.5~~											
~~57~~					~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~										
~~58~~		~~Not~~			~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~1.0~~								
~~59~~		~~Analyzed~~			~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~						
~~60~~					~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.5~~	~~1.5~~	~~0.5~~				
~~61~~					~~8.5~~	~~8.0~~	~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.5~~	~~0.5~~		
~~62~~					~~9.0~~	~~8.5~~	~~8.0~~	~~8.0~~	~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.5~~	~~4.5~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.5~~	~~0.5~~
~~Enr. wt.%~~	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~

BU, GWd/MTU	*Assembly Average Initial Enrichment (wt.% U-235)*																				
	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6		4.8	4.9	5.0
51	0.5																				
52		1.5	0.5																		
53		3.0	2.0	1.0																	
54			4.0	3.0	2.0	1.0									No Additional Cooling Required						
55			5.5	4.5	3.5	2.5	1.5	0.5													
56			6.0	5.5	5.0	4.0	3.0	2.5	1.5	0.5											
57					6.0	5.5	5.0	4.0	3.0	2.0	1.0										
58		Not			6.5	6.5	6.0	5.5	4.5	3.5	3.0	2.0	1.0								
59		Analyzed			7.5	7.0	6.5	6.0	6.0	5.5	4.5	3.5	2.5	2.0	1.0						
60					7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0				
61					8.5	8.0	7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0		
62					9.0	8.5	8.0	8.0	7.5	7.5	7.0	6.5	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0
Enr. wt.%	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

Table A.4-4a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

~~BU, GWd/MTU~~	~~*Assembly Average Initial Enrichment (wt. % U-235)*~~																				
	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~
~~51~~	~~0.5~~																				
~~52~~		~~1.5~~	~~0.5~~																		
~~53~~		~~3.0~~	~~2.0~~	~~1.0~~																	
~~54~~			~~4.0~~	~~3.0~~	~~1.5~~	~~0.5~~									~~No Additional Cooling Required~~						
~~55~~			~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~													
~~56~~			~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~	~~0.5~~											
~~57~~					~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~										
~~58~~		~~Not~~			~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~1.0~~								
~~59~~		~~Analyzed~~			~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~						
~~60~~					~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.5~~	~~1.5~~	~~0.5~~				
~~Enr. wt.%~~	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~

BU, GWd/MTU	*Assembly Average Initial Enrichment (wt. % U-235)*																				
	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
51	0.5																				
52		1.5	0.5																		
53		3.0	2.0	1.0																	
54			4.0	3.0	2.0	1.0									No Additional Cooling Required						
55			5.5	4.5	3.5	2.5	1.5	0.5													
56			6.0	5.5	5.0	4.0	3.0	2.5	1.5	0.5											
57					6.0	5.5	5.0	4.0	3.0	2.0	1.0										
58		Not			6.5	6.5	6.0	5.5	4.5	3.5	3.0	2.0	1.0								
59		Analyzed			7.5	7.0	6.5	6.0	6.0	5.5	4.5	3.5	2.5	2.0	1.0						
60					7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0				
Enr. wt.%	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

Table A.5-4a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

~~BU, GWd/MTU~~	~~*Assembly Average Initial Enrichment (wt.% U-235)*~~																				
	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~
~~51~~	~~0.5~~																				
~~52~~		~~1.5~~	~~0.5~~																		
~~53~~		~~3.0~~	~~2.0~~	~~1.0~~																	
~~54~~			~~4.0~~	~~3.0~~	~~1.5~~	~~0.5~~										~~No Additional Cooling Required~~					
~~55~~			~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~													
~~56~~			~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~	~~0.5~~											
~~57~~					~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~										
~~58~~		~~Not~~			~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~1.0~~								
~~59~~		~~Analyzed~~			~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~						
~~60~~					~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.5~~	~~1.5~~	~~0.5~~				
~~61~~					~~8.5~~	~~8.0~~	~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.5~~	~~0.5~~		
~~62~~					~~9.0~~	~~8.5~~	~~8.0~~	~~8.0~~	~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.5~~	~~4.5~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.5~~	~~0.5~~
~~Enr. wt.%~~	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~

BU, GWd/MTU	*Assembly Average Initial Enrichment (wt.% U-235)*																				
	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
51	0.5																				
52		1.5	0.5																		
53		3.0	2.0	1.0																	
54			4.0	3.0	2.0	1.0										No Additional Cooling Required					
55			5.5	4.5	3.5	2.5	1.5	0.5													
56			6.0	5.5	5.0	4.0	3.0	2.5	1.5	0.5											
57					6.0	5.5	5.0	4.0	3.0	2.0	1.0										
58		Not			6.5	6.5	6.0	5.5	4.5	3.5	3.0	2.0	1.0								
59		Analyzed			7.5	7.0	6.5	6.0	6.0	5.5	4.5	3.5	2.5	2.0	1.0						
60					7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0				
61					8.5	8.0	7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0		
62					9.0	8.5	8.0	8.0	7.5	7.5	7.0	6.5	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0
Enr. wt.%	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

Table A.6-4a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

~~BU, GWd/MTU~~	~~*Assembly Average Initial Enrichment (wt. % U-235)*~~																				
	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~
~~51~~	~~0.5~~																				
~~52~~		~~1.5~~	~~0.5~~																		
~~53~~		~~3.0~~	~~2.0~~	~~1.0~~																	
~~54~~			~~4.0~~	~~3.0~~	~~1.5~~	~~0.5~~										~~No Additional Cooling Required~~					
~~55~~			~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~													
~~56~~			~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~	~~0.5~~											
~~57~~					~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.0~~										
~~58~~		~~Not~~			~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~1.0~~								
~~59~~		~~Analyzed~~			~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.5~~	~~3.5~~	~~2.5~~	~~1.5~~	~~0.5~~						
~~60~~					~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.5~~	~~1.5~~	~~0.5~~				
~~61~~					~~8.5~~	~~8.0~~	~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~6.0~~	~~5.5~~	~~5.0~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.5~~	~~0.5~~		
~~62~~					~~9.0~~	~~8.5~~	~~8.0~~	~~8.0~~	~~7.5~~	~~7.5~~	~~7.0~~	~~6.5~~	~~6.0~~	~~5.5~~	~~5.5~~	~~4.5~~	~~4.0~~	~~3.0~~	~~2.0~~	~~1.5~~	~~0.5~~
~~Enr. wt.%~~	~~3.0~~	~~3.1~~	~~3.2~~	~~3.3~~	~~3.4~~	~~3.5~~	~~3.6~~	~~3.7~~	~~3.8~~	~~3.9~~	~~4.0~~	~~4.1~~	~~4.2~~	~~4.3~~	~~4.4~~	~~4.5~~	~~4.6~~	~~4.7~~	~~4.8~~	~~4.9~~	~~5.0~~

BU, GWd/MTU	*Assembly Average Initial Enrichment (wt.% U-235)*																				
	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
51	0.5																				
52		1.5	0.5																		
53		3.0	2.0	1.0																	
54			4.0	3.0	2.0	1.0										No Additional Cooling Required					
55			5.5	4.5	3.5	2.5	1.5	0.5													
56			6.0	5.5	5.0	4.0	3.0	2.5	1.5	0.5											
57					6.0	5.5	5.0	4.0	3.0	2.0	1.0										
58		Not			6.5	6.5	6.0	5.5	4.5	3.5	3.0	2.0	1.0								
59		Analyzed			7.5	7.0	6.5	6.0	6.0	5.5	4.5	3.5	2.5	2.0	1.0						
60					7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0				
61					8.5	8.0	7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0		
62					9.0	8.5	8.0	8.0	7.5	7.5	7.0	6.5	6.5	6.0	5.5	5.0	4.0	3.5	2.5	1.5	1.0
Enr. wt.%	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

Table A.7-3
BWR Fuel Assembly Poison Material Design Requirements for 61BT DSC

NUHOMS®-61BT DSC Type	Maximum Lattice Average Enrichment[1] (wt.% ^{235}U-*235*)	Borated Aluminum or MMC Minimum B10 Content in Poison Plates (gm/cm^2)	BORAL® Minimum B10 Content in Poison Plates (gm/cm^2)
Intact Fuel Assemblies			
A	3.7	0.021	0.025
B	4.1	0.032	0.038
C	4.4	0.040	0.048
Up to 4 Damaged Assemblies			
C	4.4 (2)	0.040	0.048
Five or more Damaged Assemblies			
C	3.2 (2)	0.040	0.048

(1) Maximum pin enrichment is 5.0 wt.% ^{235}U-*235* in all cases.

(2) This value shows the enrichment limit of the damaged fuel assemblies. The enrichment limit of the complimentary intact fuels is 4.4 wt. % U-235 for Type C.

Table A.8-2
BWR Fuel Specification for the Fuel to be Transported in the NUHOMS®-61BTH DSC
(Part 1 of 2)

PHYSICAL PARAMETERS: Fuel Class	Intact or damaged or failed 7x7, 8x8, 9x9 or 10x10 BWR assemblies manufactured by General Electric or Exxon/ANF or FANP or ABB or reload fuel manufactured by same or other vendors that are enveloped by the fuel assembly design characteristics listed in Table A.8-3. Damaged fuel assemblies beyond the definition contained below are not authorized for transport in damaged fuel locations shown in Figure A.8-9.
Damaged Fuel	Damaged BWR fuel assemblies are assemblies containing fuel rods with known or suspected cladding defects greater than hairline cracks or pinhole leaks. The extent of damage in the fuel rods is to be limited such that the fuel assembly will still be able to be handled by normal means. Missing fuel rods are allowed. Damaged fuel assemblies shall also contain top and bottom end fittings or nozzles or tie plates depending on the fuel type.
Failed Fuel	Failed fuel is defined as ruptured fuel rods, severed fuel rods, loose fuel pellets, or fuel assemblies that cannot be handled by normal means. Fuel assemblies may contain breached rods, grossly breached rods, and other defects such as missing or partial rods, missing grid spacers, or damaged spacers to the extent that the assembly can-not be handled by normal means. (3) Fuel debris and damaged fuel rods that have been removed from a damaged fuel assembly and placed in a rod storage basket are also considered as failed fuel, *and therefore shall be encapsulated in individual failed fuel cans.* Loose fuel debris, not contained in a rod storage basket may also be placed in a failed fuel can for storage, provided the size of the debris is larger than the failed fuel can screen mesh opening and it is located at a position of at least 10" above the top of the bottom shield plug of the DSC. Fuel debris may be associated with any type of UO_2 fuel provided that the maximum uranium content and initial enrichment limits are met. The total weight of each failed fuel can plus all its content shall be less than 705 lb.
RECONSTITUTED FUEL ASSEMBLIES:	
• Maximum N*umber*~~o.~~ of Reconstituted Assemblies per DSC with Irradiated Stainless Steel Rods	4
• Maximum N*umber*~~o.~~ of Irradiated Stainless Steel Rods per Reconstituted Fuel Assembly	4
• Maximum N*umber*~~o.~~ of Reconstituted Assemblies per DSC with unlimited number of low enriched UO2 rods or Zr Rods or Zr Pellets or Unirradiated Stainless Steel Rods	61
N*umber*~~o.~~ of Intact Assemblies	≤61

Table A.8-2
BWR Fuel Specification for the Fuel to be Transported in the NUHOMS®-61BTH DSC
(Part 2 of 2)

PHYSICAL PARAMETERS:	
N*umber*~~o.~~ and Location of Damaged Assemblies	Up to 16 damaged fuel assemblies, with balance intact or dummy assemblies, are authorized for transport in 61BTH DSC. Damaged fuel assemblies may only be transported in the 2x2 compartments as shown in Figure A.8-9. The DSC basket cells which accommodate damaged fuel assemblies are provided with top and bottom end caps.
N*umber*~~o.~~ and Location of Failed Assemblies	Up to 4 failed fuel assemblies. Balance may be intact and/or damaged fuel assemblies, empty slots, or dummy assemblies depending on the specific heat load zoning configuration. Failed fuel assemblies are to be placed as shown in Figure A.8-9. Failed fuel assembly/fuel debris is to be encapsulated in an individual failed fuel can (FFC) provided with a welded bottom closure and a removable top closure.
Channels	Fuel may be transported with or without channels, channel fasteners, or finger springs.
Maximum Assembly Weight with Channels	705 lb
THERMAL/RADIOLOGICAL PARAMETERS[1]: Maximum *Lattice Average* Initial ~~^{235}~~U*-235* Enrichment (wt. %)	Per Table A.8-4 or Table A.8-5.
Fuel Assembly Average Burnup and minimum Cooling Time~~(2)~~	Type 1 Per Table A.8-6.
	Type 2 Per Table A.8-7.
Decay Heat per DSC	≤22.0 kW for Type 1 DSC, per Figures A.8-1 through A.8-4
	≤24.0 kW for Type 2 DSC, per Figures A.8-1 through A.8-8
Minimum B10 Content in Poison Plates	Per Table A.8-4 or Table A.8-5.

Notes:

(1) Minimum cooling time is the longer of that given in Table A.8-6 *or*~~,~~ Table A.8-7, and that *required to meet* ~~calculated via~~ the decay heat ~~equation given in Table A.8-8 based on the~~ restrictions provided in Figures A.8-1 through A.8-8.

(2) ~~An additional cooling time of 8 years is required for damaged fuel assemblies (and failed fuel assemblies, if applicable) in addition to that obtained from Table A.8-6 or Table A.8-7, when 5 or more damaged fuel assemblies (or a combination of damaged and failed fuel assemblies, if applicable) are loaded.~~ *Reconstituted rods shall displace an amount of water equal to or greater than that displaced by the original fuel rods in the active fuel region of the fuel assembly.*

(3) A maximum of 36 BWR fuel rods can be stored in each rod storage basket.

(6)

Table A.8-5
BWR Fuel Assembly Lattice Average Initial Enrichment v/s Minimum B10 Requirements for the NUHOMS®-61BTH DSC Poison Plates (Damaged/Failed Fuel)

61BTH DSC Type	Basket Type	Maximum Lattice Average Initial Enrichment (wt% ~~235~~U-*235*) (1)*(5)*		Minimum B10 Areal Density, gram/cm^2	
		Up to 4 Damaged Assemblies(2)(3)	Five or More Damaged Assemblies (16 Maximum)(2)	Borated Aluminum/MMC	Boral®
1	A	3.7	2.80	0.021	0.025
	B	4.1	3.10	0.032	0.038
	C	4.4	3.20	0.040	0.048
	D	4.6	3.40	0.048	0.058
	E	4.8	3.50	0.055	0.066
	F	5.0	3.60	0.062	0.075
2	A	3.7	2.80	0.022	0.027
	B	4.1	3.10	0.032	0.038
	C	4.4	3.20	0.042	0.050
	D	4.6	3.40	0.048	0.058
	E	4.8	3.50	0.055	0.066
	F	5.0	3.60	0.062	0.075
61BTH DSC Type	Basket Type	Maximum Lattice Average Initial Enrichment (wt% ~~235~~U-*235*) (1)*(5)*		Minimum B10 Areal Density, gram/cm^2	
		Up to 4 Failed Assemblies (Corner Locations)(3)(4)	Up to 4 Failed Assemblies (Corner Locations) and up to 12 Damaged Assemblies(2)(4)	Borated Aluminum/MMC	Boral®
2	A	3.7	2.80	0.022	0.027
	B	4.0	3.10	0.032	0.038
	C	4.4	3.20	0.042	0.050
	D	4.6	3.40	0.048	0.058
	E	4.8	3.40	0.055	0.066
	F	5.0	3.50	0.062	0.075

Note

(1) For L*ACROSSE10*~~aCrosse~~ fuel assemblies, the enrichment shall be reduced by 0.1 wt.% ~~235~~U-*235*

(2) See Figure A.8-9 for the location of damaged assemblies within the 61BTH DSC.

(3) Maximum Pellet Enrichment 5.0 wt.% ~~235~~U-*235*

(4) Failed fuel assemblies are allowed only in the 61BTH Type 2 DSC. See Figure A.8-9 for the location of failed assemblies within the 61BTH Type 2 DSC.

~~(4)~~*(5) For ABB-10x10-1 fuel assemblies with a pitch greater than 0.502 inches, the enrichment shall be reduced by 0.25 wt. % U-235.*

(6) This table shows the enrichment limits of the damaged fuel assemblies. The enrichment limits of the complementary intact fuels are shown in Table A.8-4.

Table A.8-7a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

BU, GWd/MTU	Assembly Average Initial Enrichment (wt. % U-235)																								
	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
46	2.5	1.0																							
47	4.0	3.0	1.5	0.5																					
48	5.5	4.5	3.5	2.0	1.0																				
49	7.0	6.0	5.0	4.0	3.0	2.0	0.5																		
50	8.5	7.5	6.5	5.5	4.5	3.5	2.5	1.5	0.5																
51	9.5	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0								No Additional Cooling Required							
52	11.0	10.0	9.0	8.5	7.5	6.5	5.5	4.5	3.5	2.5	1.5	0.5													
53	12.0	11.0	10.5	9.5	9.0	8.0	7.0	6.0	5.0	4.0	3.5	2.5	1.5	0.5											
54	12.5	12.0	11.5	10.5	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.0	1.0										
55	13.5	13.0	12.0	11.5	11.0	10.5	9.5	9.0	8.0	7.0	6.0	5.5	4.5	3.5	2.5	1.5	0.5								
56	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.5	1.5	0.5						
57	14.5	14.0	13.5	13.0	13.0	12.5	11.5	11.0	10.0	9.5	9.0	8.0	7.0	6.5	5.5	4.5	4.0	3.0	2.0	1.0					
58	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	8.5	7.5	7.0	6.0	5.0	4.5	3.5	2.5	1.5	1.0			
59	15.5	15.0	15.0	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.0	7.5	6.5	5.5	5.0	4.0	3.5	2.5	1.5	1.0	
60	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.0	8.5	8.0	7.0	6.0	5.5	4.5	4.0	3.0	2.0	1.5
61	16.5	16.0	16.0	15.5	15.0	15.0	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.0	7.5	7.0	6.0	5.5	4.5	3.5	3.0
62	16.5	16.5	16.0	15.5	15.5	15.0	15.0	14.5	14.0	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.0	9.5	9.0	8.0	7.5	6.5	6.0	5.0	4.5
Enr. wt.%	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

BU, GWd/MTU	Assembly Average Initial Enrichment (wt.% U-235)																								
	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
46	2.5	1.0																							
47	4.0	3.0	2.0	0.5																					
48	5.5	4.5	3.5	2.5	1.5																				
49	7.0	6.0	5.0	4.0	3.0	2.0	1.0																		
50	8.5	7.5	6.5	5.5	4.5	3.5	2.5	1.5	0.5																
51	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0									No Additional Cooling Required						
52	11.0	10.0	9.5	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.0	1.0													
53	12.0	11.0	10.5	9.5	9.0	8.0	7.0	6.5	5.5	4.5	3.5	2.5	1.5	0.5											
54	13.0	12.0	11.5	11.0	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.0	1.0										
55	13.5	13.0	12.5	12.0	11.0	10.5	9.5	9.0	8.0	7.0	6.5	5.5	4.5	3.5	2.5	2.0	1.0								
56	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	8.5	8.0	7.0	6.0	5.0	4.5	3.5	2.5	1.5	0.5						
57	14.5	14.0	14.0	13.5	13.0	12.5	11.5	11.0	10.5	9.5	9.0	8.0	7.0	6.5	5.5	5.0	4.0	3.0	2.0	1.5	0.5				
58	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	8.5	8.0	7.0	6.0	5.5	4.5	4.0	3.0	2.0	1.0	0.5		
59	15.5	15.0	15.0	14.5	14.0	13.5	13.0	13.0	12.0	11.5	11.0	10.5	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.5	3.5	2.5	2.0	1.0	
60	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.0	9.5	9.0	8.0	7.0	6.5	5.5	5.0	4.0	3.5	2.5	1.5
61	16.5	16.0	16.0	15.5	15.0	15.0	14.5	14.0	13.5	13.0	13.0	12.0	12.0	11.0	10.5	10.0	9.0	8.5	8.0	7.0	6.5	5.5	5.0	4.0	3.0
62	16.5	16.5	16.0	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.5	7.5	7.0	6.0	5.5	4.5
Enr. wt.%	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

Table A.9-3
BWR Fuel Assembly ~~Initial~~ Lattice Average *Initial* Enrichment v/s Minimum B10 Requirements for the NUHOMS®-69BTH DSC Poison Plates

Basket Type	Maximum Lattice Average *Initial* Enrichment(1) (wt% ~~235~~U-*235*)	Minimum B10 Areal Density, gram/cm^2	
		Borated Aluminum/MMC	Boral®
A	3.7	0.021	0.025
B	4.1	0.031	0.037
C	4.4	0.039	0.047
D	4.6	0.046	0.055
E	4.8	0.053	0.064
F	5.0	0.061	0.073

	Maximum Lattice Average Initial Enrichment(1)*(3)* (wt.% ~~235~~U-*235*)			
Basket Type	Intact Assemblies	Up to 4 Damaged Assemblies(2)	5 to 8 Damaged Assemblies(2)	9 to 24 Damaged Assemblies(2)
A	3.70	3.70	3.30	2.80
B	4.10	4.10	3.60	3.00
C	4.40	4.20	3.60	3.10
D	4.60	4.40	3.70	3.20
E	4.80	4.40	3.70	3.20
F	5.00	4.80	3.90	3.40

(1) For L*ACROSSE10*~~aCrosse~~ fuel assemblies, the enrichment shall be reduced by 0.1 wt.% ~~235~~U-*235*.

(2) Allowable locations in basket per Figure A.9-1.

(3) For ABB-10x10-1 fuel assemblies with a pitch greater than 0.502 inches, the enrichment shall be reduced by 0.25 wt. % U-235

This column shows the enrichment limits of the damaged fuel assemblies. The enrichment limits of the complementary intact fuel assemblies are shown in the second column.

Table A.9-5a
"B" Parameters to Determine Additional Cooling Time for Fuel in Peripheral Compartments (years)

~~BU, GWd/MTU~~	~~Assembly Average Initial Enrichment (wt. % U-235)~~																								
	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
46	2.5	1.0																							
47	4.0	3.0	1.5	0.5																					
48	5.5	4.5	3.5	2.0	1.0																				
49	7.0	6.0	5.0	4.0	3.0	2.0	0.5																		
50	8.5	7.5	6.5	5.5	4.5	3.5	2.5	1.5	0.5																
51	9.5	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0										~~No Additional Cooling Required~~					
52	11.0	10.0	9.0	8.5	7.5	6.5	6.5	4.5	3.5	2.5	1.5	0.5													
53	12.0	11.0	10.5	9.5	9.0	8.0	7.0	6.0	5.0	4.0	3.5	2.5	1.5	0.5											
54	12.5	12.0	11.5	10.5	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.0	1.0										
55	13.5	13.0	12.0	11.5	11.0	10.5	9.5	9.0	8.0	7.0	6.0	5.5	4.5	3.5	2.5	1.5	0.5								
56	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.5	1.5	0.5						
57	14.5	14.0	13.5	13.0	13.0	12.5	11.5	11.0	10.0	9.5	9.0	8.0	7.0	6.5	5.5	4.5	4.0	3.0	2.0	1.0					
58	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	8.5	7.5	7.0	6.0	5.0	4.5	3.5	2.5	1.5	1.0			
59	15.5	15.0	15.0	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.0	7.5	6.5	5.5	5.0	4.0	3.5	2.5	1.5	1.0	
60	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.0	8.5	8.0	7.0	6.0	5.5	4.5	4.0	3.0	2.0	1.5
61	16.5	16.0	16.0	15.5	15.0	15.0	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.0	7.5	7.0	6.0	5.5	4.5	3.5	3.0
62	16.5	16.5	16.0	15.5	15.5	15.0	15.0	14.5	14.0	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.0	9.5	9.0	8.0	7.5	6.5	6.0	5.0	4.5
63												13.5	13.0	13.0	12.0	11.5	11.0	10.5	10.0	9.0	8.5	8.0	7.0	6.5	6.5
64												14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.5	7.5	7.0
65												15.0	14.5	14.0	14.0	13.0	13.0	12.5	12.0	11.5	10.5	10.0	9.5	9.0	8.5
66					~~Not Analyzed~~							15.5	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.5	11.5	11.0	10.5	10.0	9.5
67												15.5	15.5	16.0	15.0	14.5	14.0	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5
68												16.0	15.5	16.5	15.5	15.0	14.5	14.5	14.0	13.5	13.0	13.0	12.5	12.0	11.5
69												16.5	16.0	16.0	15.5	15.5	15.0	15.0	14.5	14.0	14.0	13.5	13.0	12.5	12.5
70												16.5	16.5	16.0	16.0	16.0	15.5	15.5	15.0	15.0	14.5	14.0	14.0	13.5	13.0
~~Enr. wt.%~~	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

BU, GWd/MT U	Assembly Average Initial Enrichment (wt.% U-235)																								
	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
46	2.5	1.0																							
47	4.0	3.0	2.0	0.5																					
48	5.5	4.5	3.5	2.5	1.5																				
49	7.0	6.0	5.0	4.0	3.0	2.0	1.0																		
50	8.5	7.5	6.5	5.5	4.5	3.5	2.5	1.5	0.5																
51	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0									No Additional Cooling Required						
52	11.0	10.0	9.5	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.0	1.0													
53	12.0	11.0	10.5	9.5	9.0	8.0	7.0	6.5	5.5	4.5	3.5	2.5	1.5	0.5											
54	13.0	12.0	11.5	11.0	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.0	3.0	2.0	1.0										
55	13.5	13.0	12.5	12.0	11.0	10.5	9.5	9.0	8.0	7.0	6.5	5.5	4.5	3.5	2.5	2.0	1.0								
56	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	8.5	8.0	7.0	6.0	5.0	4.5	3.5	2.5	1.5	0.5						
57	14.5	14.0	14.0	13.5	13.0	12.5	11.5	11.0	10.5	9.5	9.0	8.0	7.0	6.5	5.5	5.0	4.0	3.0	2.0	1.5	0.5				
58	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	8.5	8.0	7.0	6.0	5.5	4.5	4.0	3.0	2.0	1.0	0.5		
59	15.5	15.0	15.0	14.5	14.0	13.5	13.0	13.0	12.0	11.5	11.0	10.5	10.0	9.0	8.5	7.5	6.5	6.0	5.0	4.5	3.5	2.5	2.0	1.0	
60	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.0	9.5	9.0	8.0	7.0	6.5	5.5	5.0	4.0	3.5	2.5	1.5
61	16.5	16.0	16.0	15.5	15.0	15.0	14.5	14.0	13.5	13.0	13.0	12.0	12.0	11.0	10.5	10.0	9.0	8.5	8.0	7.0	6.5	5.5	5.0	4.0	3.0
62	16.5	16.5	16.0	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	9.5	9.0	8.5	7.5	7.0	6.0	5.5	4.5
63												13.5	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	9.0	8.0	7.5	6.5	6.0
64												14.5	14.0	13.5	13.0	12.5	12.5	11.5	11.0	10.5	10.0	9.5	8.5	8.0	7.5
65												15.0	14.5	14.0	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	8.5
66						Not Analyzed						15.5	15.0	14.5	14.5	14.0	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0
67												16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.0	13.0	12.5	12.0	11.5	11.0
68												16.0	16.0	15.5	15.5	15.0	15.0	14.5	14.0	14.0	13.5	13.0	12.5	12.0	12.0
69												16.5	16.0	16.0	16.0	15.5	15.0	15.0	14.5	14.5	14.0	13.5	13.5	13.0	12.5
70												16.5	16.5	16.5	16.0	16.0	15.5	15.5	15.5	15.0	15.0	14.5	14.0	13.5	13.0
Enr. wt.%	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0

Enclosure 6 to TN E-37083

Listing of Computer Files

Contained in Enclosure 7

Listing of Computer Files

Contained in Enclosure 7
(All files are Proprietary)

Disk ID No. (size)	Discipline	System/Component	File Series (topics)	Number of files
(Enclosure 7) **One DVD** (133 MB)	**Nuclear Shielding** (57.7 MB)	Fuel reconfigurations in NCT and HAC Evaluations – MP197HB	**1-RAI_5-1- Directory**	
			1.1-Origen-ARP - Directory	
			1.1.1-2.6wt-62Bu – Folder	50
			1.1.2-5.0wt-70Bu - Folder	50
			1.2-MCNP-69BTH-neutron-2.6wt-62bu – Folder	3
			1.3-MCNP-69BTH-neutron-5.0wt-70bu – Folder	3
			2-RAI_5-2- Directory	
			2.1-HAC - Directory	
			2.1.1-69BTH-C3 - Directory	
			2.1.1.1-gamma – Folder	3
			2.1.1.2-neutron – Folder	4
			2.1.2-69BTH-C6 - Directory	
			2.1.2.1-gamma - Folder	3
			2.1.2.2-neutron – Folder	4
			2.2-NCT - Directory	
			2.2.1-69BTH-C3 - Directory	
			2.2.1.1-gamma – Folder	4
			2.2.1.2-neutron – Folder	4
			2.2.2-69BTH-C6 - Directory	
			2.2.2.1-gamma – Folder	4
			2.2.2.2-neutron - Folder	4
	Nuclear Criticality (75.2 MB)	Sensitivity and Defense-in-Depth Evaluations – MP197HB	**1-RAI_6-6 - Directory**	---
			1.1-base_case - Folder	4
			1.2-ss_variation - Folder	8
			2-RAI_6-7 - Folder	42

Enclosure 8 to TN E-37083

NUHOMS®-MP197 TRANSPORTATION PACKAGE

Safety Analysis Report, Revision 15,

Changed Pages

(Non-Proprietary Version)

Pages A.2.13.11-i through A.2.13.11-46 are proprietary information withheld pursuant to 10 CFR 2.390.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

A.6.5.1.2 Package Fuel Loading

A. 61BT DSC Contents

The NUHOMS®-61BT DSC is capable of transporting intact or damaged GE and Exxon BWR fuel assemblies with or without fuel channels as described in Chapter A.1, Appendix A.1.4.7. The fuel assemblies considered as authorized contents are listed in Table A.6.5.1-2.

Table A.6.5.1-3 lists the fuel parameters for the standard BWR fuel assemblies. Reload fuel from other manufacturers, for the same fuel assembly class, with the same parameters are also allowed. The design basis fuel chosen for the NUHOMS®-61BT system criticality analysis is the GE 10x10 fuel assembly. The GE 10x10 assembly is used because, as demonstrated in Section A.6.5.1.4, it is the most reactive assembly of those authorized to be stored in the NUHOMS®-61BT DSC.

B. 61BTH DSC Contents

The NUHOMS®-61BTH DSC is capable of transporting intact, damaged, or failed BWR fuel assemblies with or without fuel channels as described in Chapter A.1, Appendix A.1.4.8. *Loose rods can be loaded in rod storage baskets and are considered as part of failed fuel contents.* The fuel assemblies considered as authorized contents are listed in Table A.6.5.1-52. Fuel channels are required transportation of high burnup fuel assemblies.

Table A.6.5.1-53 lists the fuel parameters for the BWR fuel assemblies. Reload fuel from other manufacturers, for the same fuel assembly class, with the same parameters are also allowed. The design basis fuel chosen for the NUHOMS®-61BTH system is the GE 10x10 fuel assembly. The GE 10x10 assembly is used because, as demonstrated in Section A.6.5.1.4, it is the most reactive assembly of those authorized to be shipped in the NUHOMS®-61BTH DSC system.

A.6.5.1.3 Model Specification

The criticality Model Specification presented below is reproduced from the following sources:

- 61BT DSC from Appendix K.6 of the NUHOMS® UFSAR [5]
- 61BTH DSC from Appendix T.6 of the NUHOMS® [5]

the reactivity of the fuel lattice is maximized. In addition, rods were removed (non-mechanistically) from within the lattice to determine the optimum rod positions (and the number of rods) to bound the expected lattice configurations. This hypothetical accident case is modeled to maximize the reactivity of the damaged fuel assembly and also to qualify fuel assemblies with damaged grids and missing rods to be loaded in the damaged fuel assembly locations. Since this analysis was not performed for the NUHOMS®-61BT DSC, the NUHOMS®-61BTH DSC rod pitch variation is taken to be bounding for both DSCs.

A.6.5.1.4.1 NUHOMS®-61BT and NUHOMS®-61BTH DSC Calculational Methods

Computer Codes

The CSAS25 control module of SCALE-4.4 [1] was used to calculate the effective multiplication factor (k_{eff}) of the fuel in the cask. The CSAS25 control module allows simplified data input to the functional modules BONAMI-S, NITAWL-II, and KENO V.a. These modules process the required cross sections and calculate the k_{eff} of the system. BONAMI-S performs resonance self-shielding calculations for nuclides that have Bondarenko data associated with their cross sections. NITAWL-II applies a Nordheim resonance self-shielding correction to nuclides having resonance parameters. Finally, KENO V.a calculates the k_{eff} of a three-dimensional system. A sufficiently large number of neutron histories are run so that the standard deviation is below 0.002 (for 61BT DSC) and 0.0016 (for 61BTH DSC) calculations.

Validation and verification of the SCALE 4.4 computer system were performed. Criticality benchmarking calculations were performed.

Physical and Nuclear Data

The physical and nuclear data required for the criticality analysis include the fuel assembly data and cross-section data as described below.

Tables A.6.5.1-3 (for 61BT DSC) and A.6.5.1-53 (for 61BTH DSC) list the pertinent data for criticality analysis with the GE12 10x10 fuel assembly in the NUHOMS®-61BTH DSC as loaded in a generic cask.

The criticality analysis used the 44-group cross-section library built into the SCALE system. ORNL used ENDF/B-V data to develop this broad-group library specifically for criticality analysis of a wide variety of thermal systems.

Bases and Assumptions

The analytical results reported in Chapter A.2, Section A.2.13.7, demonstrate that the cask containment boundary and canister basket structure do not experience any significant distortion under hypothetical accident conditions. Therefore, for both normal and hypothetical accident conditions the cask geometry is identical except for the neutron shield and skin. As discussed above, the neutron shield and skin are conservatively modeled as water.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

present in the form of Boral® poison plates provided around the DSC guidesleeves and poison rodlets which are inserted in the guide tubes of certain assemblies in the basket. A dimensional analysis of potential uncovering of active fuel by the poison plate is presented in Appendix A.6.5.11. This is performed to ensure that active fuel uncovering by the poison plate does not occur under all conditions of transport for the 24PT4 DSC.

The NUHOMS® -MP197HB Cask containing the NUHOMS® -24PT4 DSC is shown to be subcritical for an infinite array of flooded undamaged casks and for an infinite array of damaged casks after being subjected to hypothetical accident conditions. "N" is equal to ∞. The cask is shown to be subcritical for five times "N" or an infinite number of undamaged packages with close full reflection between packages and no inleakage of water as required by 10 CFR Part 71.59(a)(1). In addition, as required by 10 CFR Part 71.59(a)(2), two times "N" or an infinite array of packages is shown to be subcritical with the fissile material in its most reactive configuration, optimum water moderation and close full water reflection consistent with its damaged condition. A CSI of 0 (less than 50) ensures that, per 10 CFR Part 71.59 (c)(1), the package may be shipped by a carrier in a nonexclusive conveyance.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

The results of the evaluation demonstrate that the maximum k_{eff}, including statistical uncertainty, is less than the USL determined from a statistical analysis of benchmark criticality experiments. The statistical analysis procedure includes a confidence band with an administrative safety margin of 0.05.

A.6.5.3.2 Package Fuel Loading

This section provides a summary of the maximum spent fuel loading and spent fuel parameters for the 24PT4-DSC. The allowable contents are listed in Chapter A.1, Appendix A.1.4.1.

Each 24PT4-DSC is designed to accommodate up to 12 damaged fuel assemblies in lieu of intact assemblies. The required placement of the damaged fuel assemblies is in the twelve outermost fuel assembly locations as specified in Figure A.6.5.3-18 (Zones A and/or B only). Damaged fuel includes assemblies with known or suspected cladding defects greater than hairline cracks or pinhole leaks or an assembly with partial and/or missing rods (i.e., extra water holes). Damaged fuel assemblies shall be placed in failed fuel cans which will replace basket guidesleeves. *Loose rods can be loaded in rod storage baskets and are considered as part of failed fuel contents.*

The analytical results reported in Appendix A.2.13.1 demonstrate that the cask containment boundary and canister basket structure do not experience any significant distortion under hypothetical accident conditions. The maximum local plastic deformation calculated in Appendix A.2.13.8 is less than 0.1 inch and is well below the precision of the KENO V.a models.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

The analyses performed are based on a completely flooded 24PT4-DSC. Slots are provided at the bottom of the guidesleeves and openings are provided at the bottom and sides (near the bottom) of the failed fuel cans to ensure uniform draining and filling of all areas of the 24PT4-DSC. The failed fuel can openings are screened to contain potentially loose pellets or debris.

The models developed are conservative. Major conservatisms in the models are:

- No cases have been made to model fission products, absorber materials (^{10}B, gadolinia or Erbia, etc.) in the burnable poison rods, or axial and radial variations in initial fuel enrichment. Instead, fuel assemblies have been modeled as if they were composed of only a single enrichment unirradiated fuel. This results in a very large margin of conservatism in the calculated keff.
- Only 75% credit for the boron in the Boral® panels is taken in the criticality evaluation.
- Poison rodlets are placed only in the guide tubes of the intact assemblies located in Zone C of Figure A.6.5.3-18.

The major assumptions made in the analyses are:

- No credit is taken for soluble boron in the spent fuel pool. All moderation is assumed to be from pure water. No credit is taken for neutron absorption in water impurities.
- Omission of spacer grids, spacers, and hardware in the fuel assembly. This is conservative because this material results in parasitic neutron absorption and displaces moderating material reducing the fuel assembly k_{eff}.
- The maximum fuel pin enrichment is modeled as uniform everywhere throughout the assembly. Natural uranium blankets, Erbia Rods, and axial or radial enrichment zones are modeled as fully enriched uranium. It is assumed that the fuel assemblies are of uniform enrichment everywhere. All fuel rods are assumed to be filled with 100% moderator in the fuel/cladding gap to account for the possibility of water being entrained in the fuel pin and because it has a slight positive effect on reactivity.
- The fuel assemblies are conservatively modeled as infinitely long.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

A.6.5.5.2 Package Fuel Loading

The NUHOMS® 24PTH DSC is capable of transporting and storing a maximum of 24 intact PWR fuel assemblies. In addition, a maximum of 12 damaged (up to 8 failed) and remaining intact (for a total of 24) PWR fuel assemblies can also be transported within the NUHOMS® 24PTH DSC. Reconstituted fuel assemblies, where the fuel pins are replaced by lower enriched fuel pins or non-fuel pins that displace an equal to or greater than the amount of water in the active fuel region of the fuel assembly, are considered intact fuel assemblies in the criticality evaluation. *Loose rods can be loaded in rod storage baskets and are considered as part of failed fuel contents.* A detailed listing of the contents of the NUHOMS® 24PTH DSC is provided in Table A.6.5.5-1.

For all the fuel assembly classes CCs are also included as authorized contents. The only change to the package fuel loading to evaluate the addition of these CCs is replacing the water in the guide tubes/water holes with $^{11}B_4C$. Since these CCs displace moderator in the assembly guide and or instrument tubes, an evaluation is not needed to determine the potential impact of storage of CCs that extend into the active fuel region on the system reactivity. The presence of these CCs such as CRAs, CEAs and BPRAs will result in a reduction in the reactivity of the fuel assemblies. CCs that do not extend into the active fuel region of the assembly do not have any effect on the reactivity of the system as evaluated because only the active fuel region is modeled in this evaluation with periodic boundary conditions making the model infinite in the axial direction. Additionally, the presence of non-multiplying sources like the NSAs have no impact on criticality calculations.

Therefore, any CC that is inserted into the fuel assembly such that it does or does not extend into the active fuel region is considered as authorized for transportation without adjustment to the burnup or initial enrichment as required for control components. No credit is taken for the presence of any residual absorber remaining in the CC nor is any credit taken for the displacement of fresh water from within the guide tube of the fuel assemblies containing CCs.

A.6.5.5.3 Model Specification

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Pages A.6.5.5-10 through A.6.5.5-11a are proprietary information withheld pursuant to 10 CFR 2.390.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Pages A.6.5.12-1 through A.6.5.12-4a are proprietary information withheld pursuant to 10 CFR 2.390.

Pages A.6.5.12-16 through A.6.5.12-17 are proprietary information withheld pursuant to 10 CFR 2.390.

Pages A.6.5.12-28a through A.6.5.12-31 are proprietary information withheld pursuant to 10 CFR 2.390.

Chapter A.5
Shielding Evaluation

NOTE: References in this chapter are shown as [1], [2], etc. and refer to the reference list in Section A.5.6.

This chapter describes the shielding evaluation of the NUHOMS® MP197HB transportation package. The MCNP computer program is used to calculate the dose rates using a detailed three-dimensional model [1]. The source terms are generated with TRITON/ORIGEN-ARP sequence of SCALE [2]. The dose rates are in compliance with the applicable requirements of 10 CFR *Part* 71 for exclusive-use transportation in an open transport vehicle [3].

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

A.5.1 Description of the Shielding Design

The MP197HB cask is designed to transport one of several NUHOMS® DSCs loaded with spent fuel assemblies or dry irradiated and/or contaminated non-fuel bearing solid materials in a radioactive waste canister (RWC) in accordance with the requirements of the 10 CFR 71. The authorized contents acceptable for transport are described in Chapter A.1, Section A.1.2.3, including appendices A.1.4.1 through A.1.4.9A. A complete list of the NUHOMS® DSCs authorized for transport is provided in Chapter A.1, Section A.1.2.3.1. Chapter A.1, Section A.1.2.3.2 (also in Appendix A.1.4.9A) provides a description of the irradiated and/or contaminated non-fuel bearing solid materials authorized for transport in the RWC as well as its respective physical dimensions.

Radiological sources used for the calculation of the dose rates presented in this chapter are determined through ranking using the response function methodology to develop the fuel qualification tables (FQT). Response function results are compared with direct MCNP analysis using a discrete MP197HB transportation package model as described in Section A.5.4.1.2.3.

By definition of the FQTs, the minimum cooling times are determined so that the maximum NCT dose rates for intact fuel at 2 m from the side of the vehicle are ≤ 8.2 mrem/hr. For fuel in the peripheral basket locations, additional cooling time is needed for some burnup, enrichment, and cooling time (BECT) combinations due to fuel reconfiguration, as defined using the methodology in Section A.5.4.1.3.3. Further discussion of the fuel qualification methodology is contained in Section A.5.4.1.3 and FQT results are discussed in Section A.5.5.2.

A.5.1.1 Package Design Features

Shielding for the MP197HB transportation package is provided mainly by the cask body. Shielding against gamma radiation is provided by the lead and stainless steel shells that comprise the cask wall. For the neutron shielding, a borated VYAL-B resin compound surrounds the cask body radially. Gamma shielding in the cask ends is provided by the steel top and bottom assemblies of the transportation cask and axial ends of the DSCs. Additional shielding is provided by the steel outer shell surrounding the resin layer, the steel and aluminum structure of the fuel basket and optional heat dissipation fins surrounding the cask side between impact limiters.

For transport, wood filled impact limiters are installed on either end of the cask and provide additional shielding for the ends and some radial shielding for the areas at either end of the radial neutron shield.

Important-to-shielding dimensions are shown in Table A.5-4.

Pages A.5-12c through A.5-12d are proprietary information withheld pursuant to 10 CFR 2.390.

Proprietary Information Withheld Pursuant to 10 CFR 2.390

A.5.4.1.1.6 Flux Factors

Fuel assembly hardware is also included in the source term calculation. The hardware source term is primarily due to Co-60. The fuel assembly hardware material masses are provided in Table A.5-6 and Table A.5-7 for PWR and BWR fuel, respectively, and the compositions used to compute the light element masses are provided in Table A.5-9. To account for the reduced neutron flux in the non-active fuel regions of the homogenized assembly, flux factors are employed to scale the light element masses of those regions in the ORIGEN-ARP input. The masses for the materials in the top end fitting, the plenum, and the bottom fitting regions are multiplied by 0.1, 0.2, and 0.15, respectively [15] in the BWR FA model. The PWR FA model uses the same flux factors for the top fitting and plenum, and 0.2 for the bottom fitting [15].

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Pages A.5-20a through A.5-20b are proprietary information withheld pursuant to 10 CFR 2.390.

Pages A.5-32 through A.5-32b are proprietary information withheld pursuant to 10 CFR 2.390.

Pages A.5-80m through A.5-80t are proprietary information withheld pursuant to 10 CFR 2.390.

Pages A.7-5a and A.7-5b are proprietary information withheld pursuant to 10 CFR 2.390.

Table A.7-5
The Unloading Procedure which Shall Be Part of the User's Operating Procedures

NOTE: *In the event that breach and/or reconfiguration of fuel are confirmed during unloading of high burnup fuel assemblies, a written report should be generated in accordance with 10 CFR 71.95.*

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Figure A.7-3
DSC Evaluation for Transport Flowchart

Proprietary Information Withheld Pursuant to 10 CFR 2.390

Figure A.7-4
Example of Survey Point Locations on a Transport Cask