NRC FORM 618
(8-2000)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATION NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9302	5	71-9302	USA/9302/B(U)F-96	1 OF	17

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION.

c. ISSUED TO (Name and Address)

Transnuclear, Inc.
7135 Minstrel Way, Suite 300
Columbia, MD 21045

d. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Transnuclear Inc., application dated August 17, 2011, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model Nos: NUHOMS®-MP197, NUHOMS®-MP197HB

(2) Description: NUHOMS®-MP197

The NUHOMS®-MP197 package consists of an outer packaging, into which a NUHOMS®-61BT transportable dry shielded canister (DSC) is placed. During shipment, energy-absorbing impact limiters are used for additional package protection. Additionally, a personnel barrier is mounted to the transportation frame to prevent access to the cask body. Weights and dimensions in the following discussion are approximate values, unless otherwise noted.

Cask

The NUHOMS®-MP197 transport package is fabricated primarily of stainless steel. Non-stainless steel members include the cask lead shielding between the containment boundary inner shell and the structural shell, the o-ring seals, the neutron shield, and carbon steel closure bolts. The body of the packaging consists of a 1.25 inch thick, 68 inch inside diameter, stainless steel inner (containment) shell and a 2.5 inch thick, 82 inch outside diameter stainless steel structural shell, without impact limiters which sandwich the 3.25 inch thick cast lead shielding. The overall external dimensions of the cask are 208 inches long and 91.5 inches in outer diameter. The weight of the package body is 148,840 pounds including about 10,000 pounds of neutron shield and 60,000 pounds of cast lead.

5.(a)(2) Description, NUHOMS®-MP197 (continued)

The containment system of the NUHOMS®-MP197 transportation package consists of the inner shell, a 6.50 inch thick bottom plate, 2.5 inch thick radioactive material (RAM) access closure with a diameter of approximately 24 inches, a top closure flange, a 4.5 inch thick top closure lid with closure bolts, drain port closures and bolts, and double o-ring seals for each penetration. The containment vessel prevents leakage of radioactive material from the package cavity. The package cavity is pressurized to above atmospheric pressure with an inert gas (helium). Helium assists in the heat removal. Shielding is provided by approximately 4 inches of stainless steel, 3.25 inches of lead, and approximately 4.5 inches of neutron shielding. Four removable trunnions are provided for handling and lifting of the package.

Dry Shielded Canister (DSC)

The purpose of the DSC, which is placed within the transport package, is to permit the transfer of spent fuel assemblies, into or out of a storage module, a dry transfer facility, or a pool as a unit. The DSC also provides additional axial biological shielding during handling and transport. The DSC consists of a stainless steel shell and a basket assembly. The shell has an outside diameter of about 67 inches and an external length of about 200 inches. The DSC basket assembly provides criticality control and contains a storage position for each fuel assembly. No credit is given to the DSC as a containment boundary. The basket is designed to accommodate 61 intact BWR fuel assemblies with or without fuel channels. The basket structure consists of a welded assembly of stainless steel tubes (fuel compartments) separated by poison plates and surrounded by larger stainless steel boxes and support rails.

The poison plates are constructed from borated aluminum, and provide a heat conduction path from the fuel assemblies to the canister wall, as well as the necessary criticality control.

Impact Limiters

The impact limiter shells are fabricated from stainless steel. Within that shell is a laminate of balsa wood and redwood. Each impact limiter is attached to the cask top (front) and bottom (rear) by 12 bolts. The impact limiters are provided with seven fusible plugs that are designed to melt during a fire accident, thereby relieving excessive internal pressure. Each impact limiter has two hoist rings for handling. The hoist rings are threaded into the impact limiter shell. During transportation, the impact limiter hoist rings are removed. An aluminum thermal shield is added to the bottom impact limiter to reduce the impact limiter wood temperature. The weight of the impact limiters, the thermal shield, and attachment bolts, is approximately 28,000 lbs.

5.(a)(3) Description, NUHOMS®-MP197HB

The NUHOMS®-MP197HB package consists of an outer packaging, which is used for the off-site transport of any one of the four NUHOMS® DSCs (24PT4, 61BT, 61BTH, and 69BTH). It is also used to transport a secondary container (Radioactive Waste Container (RWC)) with dry irradiated and/or contaminated non-fuel bearing solid materials. During shipment the package uses energy-absorbing impact limiters for additional package protection. Additionally, a personnel barrier is mounted to the transportation frame to prevent access to the cask body. Weights and dimensions in the following discussions are nominal values, unless otherwise noted.

Package

The MP197HB package is a modified version of the MP197 package described in 5(a)(2).

The packaging is fabricated primarily of nickel-alloy steel (NAS). Other materials include the cast lead shielding between the containment boundary inner shell and the structural shell, the O-ring seals, the resin neutron shield, and the carbon steel closure bolts. Socket headed cap screws (bolts) are used to secure the lid to the package body and the RAM access closure plate to the bottom of the package. The body of the package consists of a 1.25 inch thick, 70.5 inch inside diameter NAS inner (containment) shell, and a 2.75 inch thick, 84.5 inch outside diameter NAS structural shell which sandwiches the 3 inch thick cast lead shielding material.

The overall dimensions of the NUHOMS®-MP197HB packaging are a length of 271.25 inches and a diameter of 126 inches with both impact limiters installed. The transport package body is 210.25 inches long and 84.5 inches in diameter. The package diameter including the radial neutron shield is 97.75 inches or 104.25 inches with the fins (optional feature). The packaging cavity is 199.25 inches long and 70.5 inches in diameter without the internal sleeve (discussed below) or 68 inches in diameter with the sleeve.

The MP197HB uses an internal aluminum sleeve for smaller diameter DSCs and secondary containers. The inner sleeve is designed with slots to accommodate the existing rails inside the package and to provide rails inside the sleeve on which the smaller diameter DSCs or secondary containers slide during horizontal loading or unloading of the package.

The gross weight of the loaded package is 152 tons including a maximum payload of 56 tons. Four removable trunnions, attached to the package body, are provided for lifting and handling operations, including rotation of the packaging between the horizontal and vertical orientations.

The package containment boundary consists of the inner shell, a 6.5 inch thick bottom plate with a 28.88 inch diameter, 2.5 inch thick RAM access closure plate, a package body flange, a 4.5 inch thick lid with lid bolts, vent and drain port closures and bolts, 5.(a)(3) Description, NUHOMS®-MP197HB (continued)

and O-ring seals for each of the penetrations. The containment vessel prevents leakage of radioactive material from the package cavity. It also maintains an inert atmosphere (helium) in the package cavity. Helium assists in heat removal and provides a non-reactive environment to protect fuel assemblies against fuel cladding degradation. The cask cavity is pressurized with helium to above atmospheric pressure. Shielding is provided by approximately 4 inches of steel, 3 inches of lead and 6.25 inches of neutron shielding assembly.

To accommodate the NUHOMS®-69BTH DSC with heat loads greater than 26 kW, removable external fins are provided as an option for the package.

Dry Shielded Canister (DSC)

The function of the DSC, which is placed within the transport package, is identical to that described for the MP197 cask in paragraph 5(a)(2) above. The DSC consists of a stainless steel shell and a basket assembly. The DSC basket assembly provides criticality control and contains a storage position for each fuel assembly. No credit is taken for the DSC as a containment boundary.

There are four DSC designs and a radioactive waste canister authorized for transport in the NUHOMS®-MP197HB packaging. The MP197HB packaging cavity is designed to accommodate the larger 69.8 inch diameter DSCs (69BTH DSC). To accommodate the smaller 67.3 inch diameter DSCs (24PT4, 61BT, and 61BTH DSC) or secondary container (RWC), an aluminum inner sleeve is provided. To accommodate the varying lengths of the DSCs and secondary containers, stainless steel or aluminum spacers are provided to limit axial movement of the payload. Spacers are to be installed in the DSC cavity, if necessary, to limit the maximum axial gap between any fuel assembly and the DSC to 0.5 inches or less. Similarly, spacers are to be installed in the overpack cavity, if necessary, to limit the maximum axial gap between the DSC and the overpack to 0.5 inches or less.

The maximum weight of the payload (DSC including the fuel) is limited to 56 tons.

The DSC basket poison plates are constructed from Boral®, borated aluminum or aluminum/B_4C metal matrix composite (MMC) and provide a heat conduction path from the fuel assemblies to the canister wall, as well as the necessary criticality control.

Radioactive Waste Container (RWC)

The RWC consists of a payload of dry irradiated and/or contaminated non-fuel bearing solid materials. No credit is taken for the containment provided by the RWC.

The RWC assembly together with any appropriate cask cavity spacers shall provide an equivalent of 1.75 inches minimum steel shielding in the radial direction. A minimum of 5.75 inches equivalent steel shielding shall be provided at the bottom of the canister and a minimum of 7.00 inches equivalent steel shielding at the top of the canister. The maximum weight of the payload (RWC, including waste) is limited to 56 tons.

5.(a)(3) Description, NUHOMS®-MP197HB (continued)

Impact Limiters

Impact limiters consisting of balsa wood and redwood encased in stainless steel shells are attached at the front and rear end of the MP197HB package during shipment. Each impact limiter is attached to the package by twelve (12) attachment bolts. The impact limiters are provided with seven fusible plugs that are designed to melt during a fire accident, thereby relieving internal pressure. Each impact limiter has three hoist rings for handling, and two support angles for supporting the impact limiter in a vertical position during storage. The hoist rings are threaded into the impact limiter shell, while the support angles are welded to the shell. Prior to transport, the impact limiter hoist rings are removed and replaced with bolts. An aluminum thermal shield is added to each impact limiter to reduce the impact limiter wood temperature. The weight of the impact limiters, the thermal shield, and attachment bolts, is 25,000 lbs.

5.(a)(4) Drawings, NUHOMS®-MP197

The package shall be constructed and assembled in accordance with the following Transnuclear, Inc., Drawing numbers:

1093-71-1, Revision 0,
NUHOMS®-197 Packaging
Transport Configuration

1093-71-2, Revision 1,
NUHOMS®-197 Packaging
General Arrangement

1093-71-3, Revision 1,
NUHOMS®-MP197 Packaging
Parts List

1093-71-4, Revision 1,
NUHOMS®-MP197 Packaging
Cask Body Assembly

1093-71-5, Revision 0,
NUHOMS®-MP197 Packaging
Cask Body Details

1093-71-6, Revision 0,
NUHOMS®-MP197 Packaging
Cask Body Details

1093-71-7, Revision 0,
NUHOMS®-MP197 Packaging
Lid Assembly & Details

1093-71-8, Revision 0,
NUHOMS®-MP197 Packaging
Impact Limiter Assembly

1093-71-9, Revision 0,
NUHOMS®-MP197 Packaging
Impact Limiter Details

1093-71-10, Revision 0,
NUHOMS®-61BT Transportable
Canister for BWR Fuel Basket
Assembly

1093-71-11, Revision 1,
NUHOMS®-61BT Transportable
Canister for BWR Fuel Basket
Details

1093-71-12, Revision 0,
NUHOMS®-61BT Transportable
Canister for BWR Fuel Basket
Details

1093-71-13, Revision 1,
NUHOMS®-61BT Transportable
Canister for BWR Fuel General
Assembly

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5.(a)(4) (continued) Drawings, NUHOMS®-MP197

1093-71-14, Revision 1, NUHOMS®-61BT Transportable Canister for BWR Fuel General Assembly

1093-71-15, Revision 2, NUHOMS®-61BT Transportable Canister for BWR Fuel Shell Assembly

1093-71-16, Revision 0, NUHOMS®-61BT Transportable Canister for BWR Fuel Shell Assembly

1093-71-17, Revision 2, NUHOMS®-61BT Transportable Canister for BWR Fuel Canister Details

1093-71-18, Revision 1, NUHOMS®-61BT Transportable Canister for BWR Fuel Canister Details

1093-71-20, Revision 0, NUHOMS®-MP197 Packaging Regulatory Plate

1093-71-21, Revision 0, NUHOMS®-MP197 Packaging on Transport Skids

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5.(a)(5) Drawings, NUHOMS®-MP197HB

The NUHOMS®-MP197HB package shall be constructed and assembled in accordance with the following Transnuclear, Inc. drawings:

MP197HB-71-1001 Rev 1	NUHOMS®-MP197HB Packaging Transport Configuration (2 sheets)
MP197HB-71-1002 Rev 3	NUHOMS®-MP197HB Packaging Parts List (2 sheets)
MP197HB-71-1003 Rev 1	NUHOMS®-MP197HB Packaging General Arrangement (1 sheet)
MP197HB-71-1004 Rev 3	NUHOMS®-MP197HB Packaging Cask Body Assembly (1 sheet)
MP197HB-71-1005 Rev 2	NUHOMS®-MP197HB Packaging Cask Body Details (3 sheets)
MP197HB-71-1006 Rev 0	NUHOMS®-MP197HB Packaging Lid Assembly & Details (1 sheet)
MP197HB-71-1007 Rev 0	NUHOMS®-MP197HB Packaging Regulatory Plate (1 sheet)
MP197HB-71-1008 Rev 1	NUHOMS®-MP197HB Packaging Impact Limiter Assembly (1 sheet)
MP197HB-71-1009 Rev 1	NUHOMS®-MP197HB Packaging Impact Limiter Details (1 sheet)
MP197HB-71-1011 Rev 0	NUHOMS®-MP197HB Packaging Transport Configuration Outer Sleeve With Fins Option (1 sheet)
MP197HB-71-1014 Rev 1	NUHOMS®-MP197HB Packaging Internal Sleeve Design (2 sheets)
NUH24PT4-71-1001 Rev 0	NUHOMS® 24PT4 Transportable Canister For PWR Fuel Basket Assembly (5 sheets)
NUH24PT4-71-1002 Rev 0	NUHOMS® 24PT4 Transportable Canister For PWR Fuel Main Assembly (8 sheets)
NUH24PT4-71-1003 Rev 0	NUHOMS® 24PT4 Transportable Canister For PWR Fuel Failed Fuel Can (4 sheets)
NUH61BT-71-1000 Rev 1	NUHOMS® 61BT Transportable Canister For BWR Fuel Parts List (1 sheet)
NUH61BT-71-1001 Rev 1	NUHOMS® 61BT Transportable Canister For BWR Fuel Basket Assembly (1 sheet)
NUH61BT-71-1002 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel Basket Details (1 sheet)

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NUH61BT-71-1003 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel General Assembly (1 sheet)
NUH61BT-71-1004 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel General Assembly (1 sheet)
NUH61BT-71-1005 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel Shell Assembly (1 sheet)
NUH61BT-71-1006 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel Shell Assembly (1 sheet)
NUH61BT-71-1007 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel Canister Details (1 sheet)
NUH61BT-71-1008 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel Canister Details (1 sheet)
NUH61BT-71-1009 Rev 0	NUHOMS® 61BT Transportable Canister For BWR Fuel Basket Details (1 sheet)
NUH61BT-71-1010 Rev 1	NUHOMS® 61BT Transportable Canister For BWR Fuel Additional Basket Details – Damaged Fuel (4 sheets)
NUH61BTH-71-1000 Rev 1	NUHOMS® 61BTH Type 1 Transportable Canister For BWR Fuel Main Assembly (5 sheets)
NUH61BTH-71-1100 Rev 2	NUHOMS® 61BTH Type 2 Transportable Canister For BWR Fuel Main Assembly (7 sheets)
NUH61BTH-71-1101 Rev 1	NUHOMS® 61BTH Type 2 Transportable Canister For BWR Fuel Shell Assembly (2 sheets)
NUH61BTH-71-1102 Rev 2	NUHOMS® 61BTH Type 2 Transportable Canister For BWR Fuel Basket Assembly (8 sheets)
NUH61BTH-71-1103 Rev 1	NUHOMS® 61BTH Type 2 Transportable Canister For BWR Fuel Transition Rails (2 sheets)
NUH61BTH-71-1104 Rev 1	NUHOMS® 61BTH Type 2 Transportable Canister For BWR Fuel Damaged Fuel End Caps (1 sheet)
NUH61BTH-71-1105 Rev 1	NUHOMS® 61BTHF Type 2 Transportable Canister For BWR Fuel Failed Fuel Can (2 sheets)
NUH61BTH-71-1106 Rev 2	NUHOMS® 61BTH Type 2 Transportable Canister For BWR Fuel Top Grid Assembly Alternate 3 (2 sheets)
NUH69BTH-71-1001 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Main Assembly (4 sheets)

NUH69BTH-71-1002 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Basket – Shell Assembly (4 sheets)
NUH69BTH-71-1003 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Shell Assembly (4 sheets)
NUH69BTH-71-1004 Rev 3	NUHOMS® 69BTH Transportable Canister For BWR Fuel Alternate Top Closure (6 sheets)
NUH69BTH-71-1011 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Basket Assembly (5 sheets)
NUH69BTH-71-1012 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Transition Rail Assembly And Details (6 sheets)
NUH69BTH-71-1013 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Holddown Ring Assembly (2 sheets)
NUH69BTH-71-1014 Rev 1	NUHOMS® 69BTH Transportable Canister For BWR Fuel Damaged Fuel Modification (1 sheet)
NUH69BTH-71-1015 Rev 2	NUHOMS® 69BTH Transportable Canister For BWR Fuel Damaged Fuel End Caps (1 sheet)
NUHRWC-71-1001 Rev 1	NUHOMS® System RWC Canister - Welded Top Shield Plug Design Main Assembly (5 sheets)
NUHRWC-71-1002 Rev 1	NUHOMS® System RWC Canister - Welded Top Shield Plug Design Inner Liner (3 sheets)
NUHRWC-71-1003 Rev 0	NUHOMS® System RWC Canister - Bolted Top Shield Plug Design Main Assembly (4 sheets)

5.(b) Contents of Packaging, NUHOMS®-MP197

(1) Type and Form of Material

(a) Intact irradiated BWR fuel assemblies with or without fuel channels, with uranium oxide pellets and zircaloy cladding. Channel thickness is limited to 0.065 to 0.120 inches. Prior to irradiation, the fuel assemblies must meet the dimensions and specifications of Table 1. Assemblies containing fuel rods with no known or suspected cladding defects greater than hairline cracks or pinhole leaks are authorized when contained in the NUHOMS®-61BT DSC.

(b) The maximum burn-up and minimum cooling times for the individual assemblies shall meet the requirements of Table 2.

(b) In addition, the fuel shall have been decayed for a time sufficient to meet the thermal criteria of 5(b)(1)(c). The maximum total allowable cask heat load is 15.86 kW.

(c) The maximum assembly decay heat of an individual assembly is 260 watts.

(d) BWR fuel assembly poison material shall meet the design requirements of Table 3.

TABLE 1[1]

Assembly Type	7x7 49/0	8x8 63/1	8x8 62/2	8x8 60/4	8x8 60/1	9x9 74/2	10x10 92/2
Maximum Initial Enrichment (wt% ^{235}U)	See Table 3	See Table 3	See Table 3	See Table 3	See Table 3	See Table 3	See Table 3
Rod Pitch (in)	0.738	0.640	0.640	0.640	0.640	0.566	0.510
Number of Fuel Rods per Assembly	49	63	62	60	60	66-full 8-partial	78-full 14-partial
Fuel Rod OD (in)	0.563	0.493	0.483	0.483	0.483	0.440	0.404
Minimum Cladding Thickness (in)	0.032	0.034	0.032	0.032	0.032	0.028	0.026
Pellet Diameter	0.487	0.416	0.410	0.410	0.411	0.376	0.345
Maximum Active Fuel Length (in)	144	146	150	150	150	146-full 90-partial	150-full 93-partial

1) Maximum Co-59 content in the Top End Fitting region is 4.5 gm per assembly
Maximum Co-59 content in the Plenum region is 0.9 gm per assembly
Maximum Co-59 content in the In-Core region (including the whole fuel channel) is 4.5 gm per assembly
Maximum Co-59 content in the Bottom region is 4.1 gm per assembly

TABLE 2

Intact BWR Fuel Assembly Characteristics	
Physical Parameters:	
Fuel Design	7x7, 8x8, 9x9, or 10x10 BWR fuel assemblies manufactured by General Electric or equivalent reload fuel
Cladding Material	Zircaloy
Fuel Damage	Cladding damage in excess of pinhole leaks or hairline cracks is not authorized to be stored as “Intact BWR fuel”
Channels	Fuel may be stored with or without fuel channels
Maximum assembly weight	705 lbs
Radiological Parameters:	
Group 1:	
Maximum Burnup:	27,000 MWd/MTU
Minimum Cooling Time:	6-Years
Maximum Initial Enrichment:	See Table 3
Minimum Initial Bundle Average Enrichment:	2.0 wt.% ^{235}U
Maximum Initial Uranium Content:	198 kg/assembly
Maximum Decay Heat:	260 W/assembly
Group 2:	
Maximum Burnup:	35,000 MWd/MTU
Minimum Cooling Time:	12-Years
Maximum Initial Enrichment:	See Table 3
Minimum Initial Bundle Average Enrichment:	2.65 wt.% ^{235}U
Maximum Initial Uranium Content:	198 kg/assembly
Maximum Decay Heat:	260 W/assembly

Intact BWR Fuel Assembly Characteristics	
Radiological Parameters:	
Group 3:	
Maximum Burnup:	37,200 MWd/MTU
Minimum Cooling Time:	12-Years
Maximum Initial Enrichment:	See Table 3
Minimum Initial Bundle Average Enrichment:	3.38 wt.% ^{235}U
Maximum Initial Uranium Content:	198 kg/assembly
Maximum Decay Heat:	260 W/assembly
Group 4:	
Maximum Burnup:	40,000 MWd/MTU
Minimum Cooling Time:	15-Years
Maximum Initial Enrichment:	See Table 3
Minimum Initial Bundle Average Enrichment:	3.4 wt.% ^{235}U
Maximum Initial Uranium Content:	198 kg/assembly
Maximum Decay Heat:	260 W/assembly

TABLE 3
Minimum Boron-10 Areal Density as a Function of Maximum Fuel Assembly Lattice Average Enrichment

NUHOMS®-61BT DSC Basket Type	Maximum Fuel Assembly Lattice Average Enrichment (wt.% ^{235}U)	Minimum Boron-10 Areal Density for Boral® (g/cm^2)	Minimum Boron-10 Areal Density for Borated Aluminum, Metamic®, and Boralyn® (g/cm^2)	Areal Density Used in the Criticality Evaluation [75% Credit for Boral®] (g/cm^2)
	Intact Fuel Assemblies			
A	3.7	0.025	0.021	0.019
B	4.1	0.038	0.032	0.029
C	4.4	0.048	0.040	0.036

5.(b) Contents of Packaging, NUHOMS®-MP197 (continued)

(2) Maximum quantity of material per package

(a) The quantity of material authorized for transport is 61 intact standard BWR fuel assemblies with or without fuel channels. Where a DSC is to be loaded with fewer fuel assemblies than the DSC capacity, dummy fuel assemblies with the same nominal weight as a standard fuel assembly shall be installed in the unoccupied spaces.

(b) For material described in 5(b)(1) the approximate maximum payload is 43,505 lbs.

5.(c) Contents of Packaging, NUHOMS®-MP197HB

The MP197HB packaging is designed to transport fuel assemblies stored inside any one of the four DSCs as described in Appendices A.1 and A.7 through A.9 of this CoC. The MP197HB package is also designed to transport dry irradiated and/or contaminated nonfuel bearing solid materials in an RWC as described in Appendix A.10 of this Certificate of Compliance (CoC). Each Appendix of this CoC provides the following for each DSC:

(1) Type and Form of Material (Fuel Specification and Characteristics).

(2) Maximum quantity of material per package.

(3) The maximum length of a natural or lower than natural enriched uranium blanket shall not exceed 5% of the active fuel length at each end of the fuel assembly.

(4) The users of this packaging system shall confirm that the maximum peaking factor of the fuel assembly average burnup in all fuel contents does not exceed 1.326 and 1.152 for BWR and PWR fuel, respectively.

5.(d) Criticality Safety Index "0"

6. For the NUHOMS®-MP197 and the NUHOMS®-MP197HB packages, fuel assemblies with missing fuel rods shall not be shipped as intact fuel unless the missing fuel rods are replaced with dummy rods that displace an equal or greater amount of water.

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 below in Sections 7(a) and 7(b), while the NUHOMS®-MP197HB package shall meet the requirements listed in Sections 7(c) 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.

(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.

(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. For canisters 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 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. 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. 4 of this certificate may be used until August 31, 2013.

13. Expiration Date: August 31, 2017.

REFERENCES

Transnuclear, Inc., Safety Analysis Report for the NUHOMS®-MP197 Transport Packaging, dated August 17, 2011.

Transnuclear Inc., letters dated September 15, 2011, and July 24, 2012.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/ B. H. White for

Michael D. Waters, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Date: September 18, 2012

Attachments to CoC 9302, Revision 5:

Appendix A.1: MP197HB Packaging Contents Loaded with NUHOMS®-24PT4 DSC

Appendix A.2: NOT USED

Appendix A.3: NOT USED

Appendix A.4: NOT USED

Appendix A.5: NOT USED

Appendix A.6: NOT USED

Appendix A.7: MP197HB Packaging Contents Loaded with NUHOMS®-61BT DSC

Appendix A.8: MP197HB Packaging Contents Loaded with NUHOMS®-61BTH DSC

Appendix A.9: MP197HB Packaging Contents Loaded with NUHOMS®-69BTH DSC

Appendix A.10: MP197HB Packaging Contents Loaded with Radioactive Waste Canister (RWC)

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MP197HB Packaging Contents Loaded with NUHOMS®-24PT4 DSC

(1) Type and Form of Material

(a) Intact or damaged CE 16x16 PWR fuel assemblies which meet specifications listed in Tables A.1-1 and A.1-2, respectively, are authorized for transportation in the NUHOMS®-24PT4 DSC. Fuel debris and damaged fuel rods placed in a rod storage basket are considered as damaged fuel. Damaged fuel assemblies are to be stored in specially designed failed fuel cans [See Drawing NUH24PT4-71-1003, Rev. 0 (4 sheets)].

(b) For maximum assembly average burnup, minimum cooling time and decay heat limits, the fuel assemblies shall meet all the requirements of the cross referenced tables and figures listed in Tables A.1-1 and A.1-2. The fuel to be transported in the 24PT4 DSC is limited to a maximum initial enrichment of 4.85 wt.% ^{235}U. The maximum allowable assembly average burnup is given as a function of initial fuel enrichment but does not exceed 45,000 MWd/MTU. The minimum cooling time is 7 years.

(c) The minimum areal Boron-10 (^{10}B) densities for the standard (Type A basket) and high (Type B basket) loadings are 0.025 and 0.068 g/cm^2, respectively. Fuel to be transported in the Type A basket is limited to an initial ^{235}U enrichment of 4.1 wt.%. Fuel to be transported in the Type B basket is limited to an initial ^{235}U enrichment of 4.85 wt.%. In addition, poison rodlets shall be used per Table A.1-4.

(2) Maximum Quantity of Material per Package

(a) The quantity of material authorized for transport is 24 intact or up to 12 damaged and balance intact standard PWR fuel assemblies as shown in Figure A.1-1. Where a DSC is to be loaded with fewer fuel assemblies than the DSC capacity, dummy fuel assemblies with the same nominal weight as a standard fuel assembly shall be installed in the unoccupied spaces.

(b) For materials described in A.1(1) above, the approximate maximum payload is 36,000 lbs. (does not include the weight of the poison rodlets).

Table A.1-1
PWR Fuel Specification of Intact Fuel to be Transported in the 24PT4 DSC

Fuel Design:	Intact 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:	Fuel with known or suspected cladding damage in excess of pinhole leaks or hairline cracks or an assembly with partial and/or missing rods is not authorized to be transported as "intact PWR Fuel."
Physical Parameters(1)	
Unirradiated Length (in)	176.8
Cross Section (in)	8.290
Assembly Weight (lbs)	1500(2) (3)
Max. U Content (kg)	455.5
No. of Assemblies per DSC	≤ 24 intact assemblies
Fuel Cladding	Zircaloy-4 or ZIRLO™
Reconstituted Fuel Assemblies	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 Initial ^{235}U Enrichment (wt. %)	Per Table A.1-4 and Figure A.1-1
Fuel Assembly Average Burnup and Minimum Cooling Time(4)	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 calculated via the decay heat equation based on the restrictions provided in Figures A.1-2, A.1-3 or A.1-4.

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 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
Cross Section (in)	8.290
Assembly Weight (lbs)	1500(2) (3)
Max. U Content (kg)	455.5
No. of Assemblies per DSC	≤ 12 damaged assemblies, balance intact.
Fuel Cladding	Zircaloy-4 or ZIRLO™
Reconstituted Fuel Assemblies	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 Initial ^{235}U Enrichment (wt %)	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 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.

Table A.1-3
PWR Fuel Assembly Design Characteristics

Assembly Class	CE 16x16
Parameters[1]	
Assembly Length	See Table A.1-1or A.1-2
Max. Initial ^{235}U Enrichment (wt. %)	4.85
Fissile Material	UO_2, or (U, Er)O_2, or (U, Gd)O_2
Number of Fuel Rods	≤ 236
Fuel Rod Pitch (in)	≤ 0.506
Fuel Rod O.D. (in)	≥ 0.380
Clad Thickness (in)	≥ 0.023
Fuel Pellet O.D., (in)	≤ 0.326
Number of Guide/Instrument Tubes	≤ 5

Notes:

(1) The fuel assembly fabrication documentation may be used to demonstrate compliance with these fuel assembly parameters. The fuel assembly parameters are design nominal values. The maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within the CE 16x16 fuel assembly class.

Table A.1-4
Maximum Fuel Enrichment v/s Neutron Poison Requirements for the 24PT4 DSC

Storage Configuration	Maximum No. of Damaged Fuel Assemblies(1)	Maximum ^{235}U Fuel Enrichment (wt. %)	DSC Basket, Minimum BORAL® Areal Density (gm/cm^2)	Minimum No. of Poison Rodlets Required(2)(3)
All Intact Fuel Assemblies	0	4.1	0.025 (Type A Basket)	0
	0	4.85	0.068 (Type B Basket)	0
Combination of Damaged and Intact Fuel Assemblies	4	4.1	0.025 (Type A Basket)	0
	4	4.85	0.068 (Type B Basket)	0
	12	3.7 (damaged) 4.1 (intact)	0.025 (Type A Basket)	0
	12	4.1 (damaged) 4.85 (intact)	0.068 (Type B Basket)	0
	12	4.1	0.025 (Type A Basket)	1(2) (Located in center guide tube of each intact assembly)
	12	4.85	0.068 (Type B Basket)	5(2) (Located in all five guide tubes of each intact assembly)

Notes:

(1) See Figure A.1-1 for location of damaged fuel assemblies within the 24PT4 DSC (Zones A and/or B only).

(2) Poison rodlets are only required for a specific DSC configuration with a payload of 5-12 damaged assemblies in combination with maximum fuel enrichment levels as shown. The poison rodlets are to be located within the guide tubes of the Zone C intact assemblies as shown in Figure A.1-1.

(3) The minimum diameter of the poison rodlet is 0.55 inches (1.4 cm) with sufficient length to cover the active fuel length. The minimum diameter of the absorber material in the rodlet is 0.35 inches (0.9 cm) with a minimum linear loading of 0.70 grams B_4C per cm.

Table A.1-5
PWR Fuel Qualification Table for the 24PT4 DSC

(Minimum required years of cooling time after reactor core discharge)

BU (GWd/ MTU)	Initial Enrichment																													
	1.8	**1.9**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**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**
10	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
15	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
20	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
28	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
30	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
32	8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
34	9.5	9.5	9.0	8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
36	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
38											8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
39											9.0	8.5	8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
40											9.5	9.5	9.0	8.5	8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
41											10.5	10.0	9.5	9.0	9.0	8.5	8.5	8.5	8.5	8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
42											11.0	10.5	10.0	10.0	9.5	9.0	9.0	9.0	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.0
43																9.5	9.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	8.5	8.5	8.5	8.5
44																10.5	10.0	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.0	9.0	9.0	9.0	9.0
45																					10.0	10.0	10.0	10.0	10.0	10.0	9.5	9.5	9.5	9.5	9.5

Notes:

- BU = Assembly average burnup.
- Use burnup and enrichment to look up minimum cooling time in years. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup conservatively applied in determination of actual values for these two parameters.
- For reconstituted fuel assemblies with irradiated stainless steel rods, increase the cooling time by 1 year for fuel assemblies in the 12 peripheral locations of the canister with cooling times less than 11 years. For fuel assemblies with cooling times greater than 11 years or in the center of the basket, no adjustment is required.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with an initial enrichment either less than 1.8 or greater than 4.85 wt.% ^{235}U is unacceptable for transport.
- Fuel with a burnup greater than 45 GWd/MTU is unacceptable for transport.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for transport after 8-years cooling.
- Example: An assembly with an initial enrichment of 4.85 wt.% ^{235}U and a burnup of 41.5 GWd/MTU is acceptable for transport after a 8.0-year cooling time as defined by 4.8 wt.% ^{235}U (rounding down) and 42 GWd/MTU (rounding up) on the qualification table (other considerations not withstanding).
- When loading five or more damaged fuel assemblies per DSC, an additional cooling time of 8 years is required for only damaged fuel assemblies.

Table A.1-6
PWR Assembly Decay Heat for Heat Load Configurations

The Decay Heat (DH) in watts is expressed as:

$F1 = -44.8 + 41.6*X1 - 37.1*X2 + 0.611*X1^2 - 6.80*X1*X2 + 24.0*X2^2$
$DH = F1*Exp(\{[1-(1.8/X3)]* -0.575\}*[(X3-4.5)^{0.169}]*[(X2/X1)^{-0.147}]) + 20$

where,

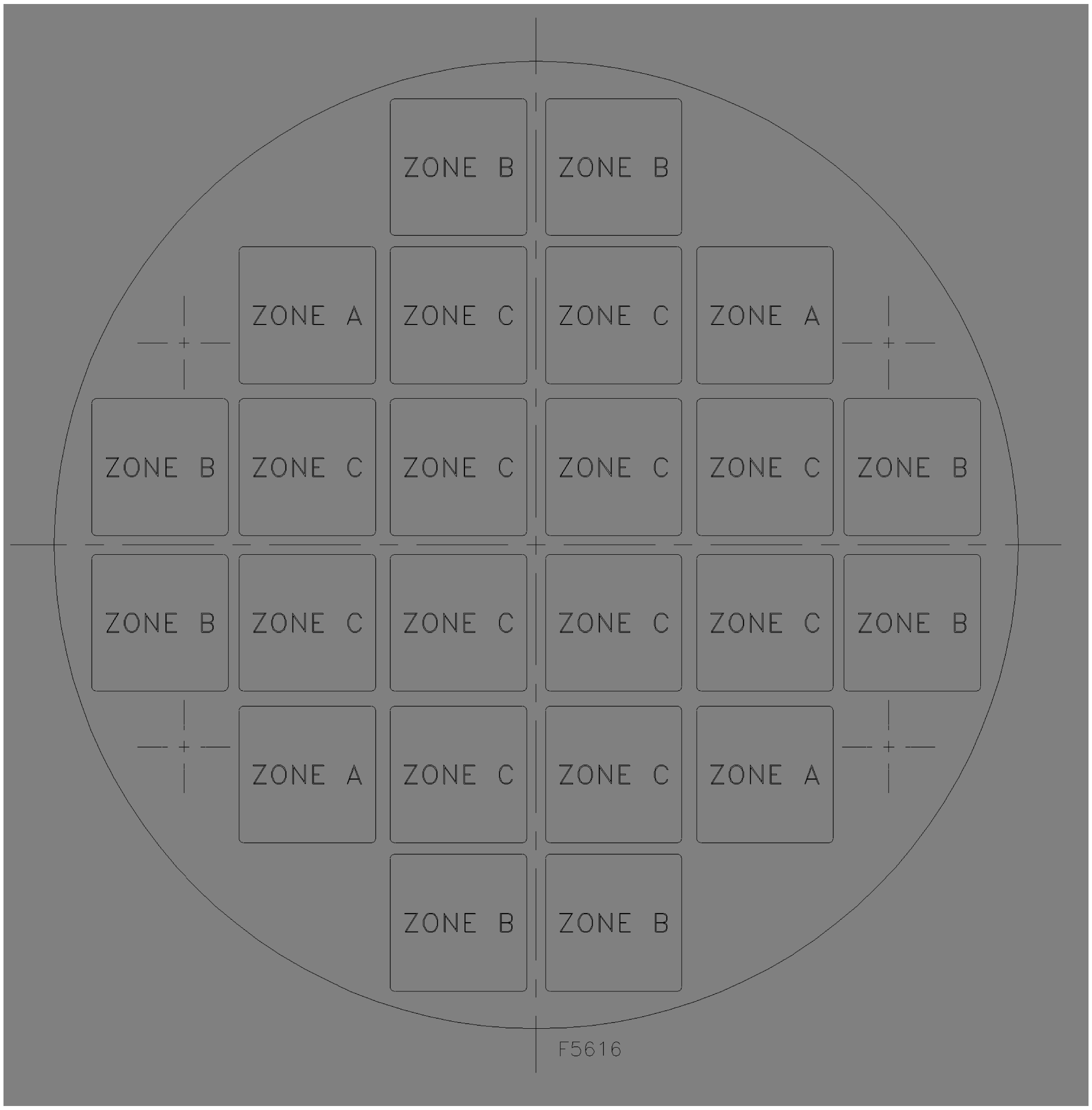
F1 Intermediate Function

X1 Assembly Burnup in GWD/MTU

X2 Initial Enrichment in wt.% ^{235}U

X3 Cooling Time in Years (minimum 7 years)

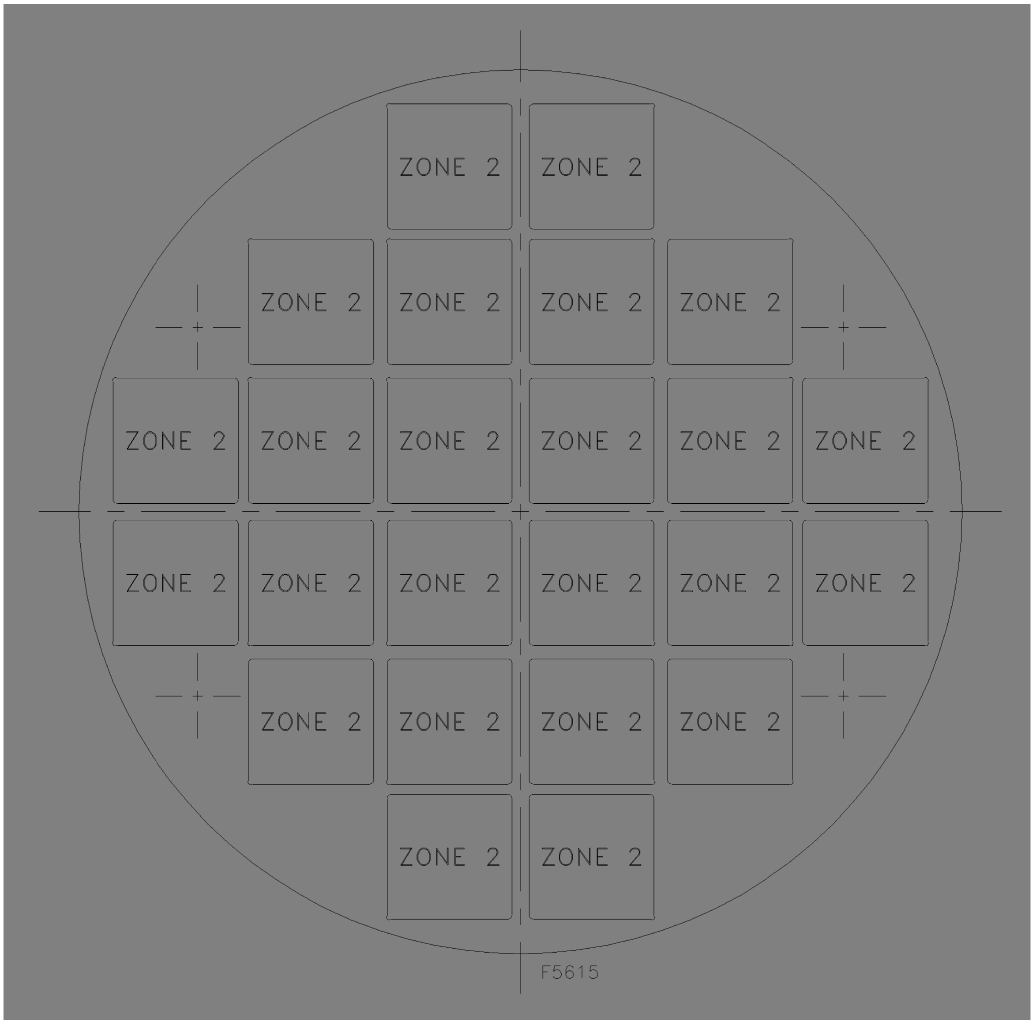
Note: Even though a minimum cooling time of 7 years is used, the minimum cooling time requirement with five or more damaged fuel assemblies from shielding requirements is per Table A.1-5.



Notes:

1. Locations identified as Zone A are for placement of up to 4 damaged fuel assemblies.
2. Locations identified as Zone B are for placement of up to 8 additional damaged fuel assemblies (Maximum of 12 damaged fuel assemblies allowed, Zones A and B combined).
3. Locations identified as Zone C are for placement of up to 12 intact fuel assemblies, including 4 empty slots in the center as shown in Figure A.1-4.
4. Poison Rodlets are to be located in the guide tubes of intact fuel assemblies placed in Zone C only per Table A.1-4.

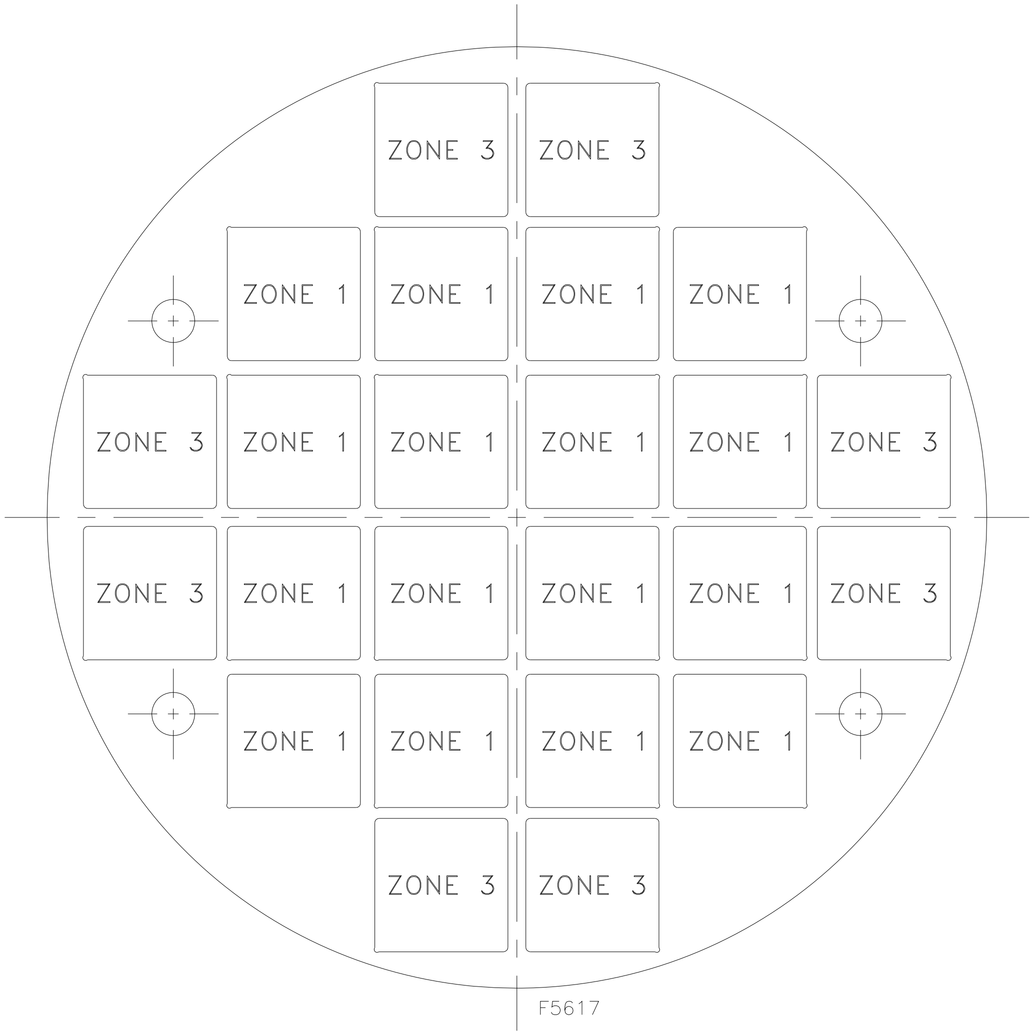
Figure A.1-1
Location of Failed Fuel Cans Inside the 24PT4 DSC



	Zone 1	Zone 2	Zone 3	Zone 4
Maximum Decay Heat (kWatts/FA)(1)	NA	1.0	NA	NA
Maximum Decay Heat per Zone (kW)	NA	24.0	NA	NA
Maximum Decay Heat per DSC (kW)	24.0			

(1) Decay heat per fuel assembly shall be determined using Table A.1-6.

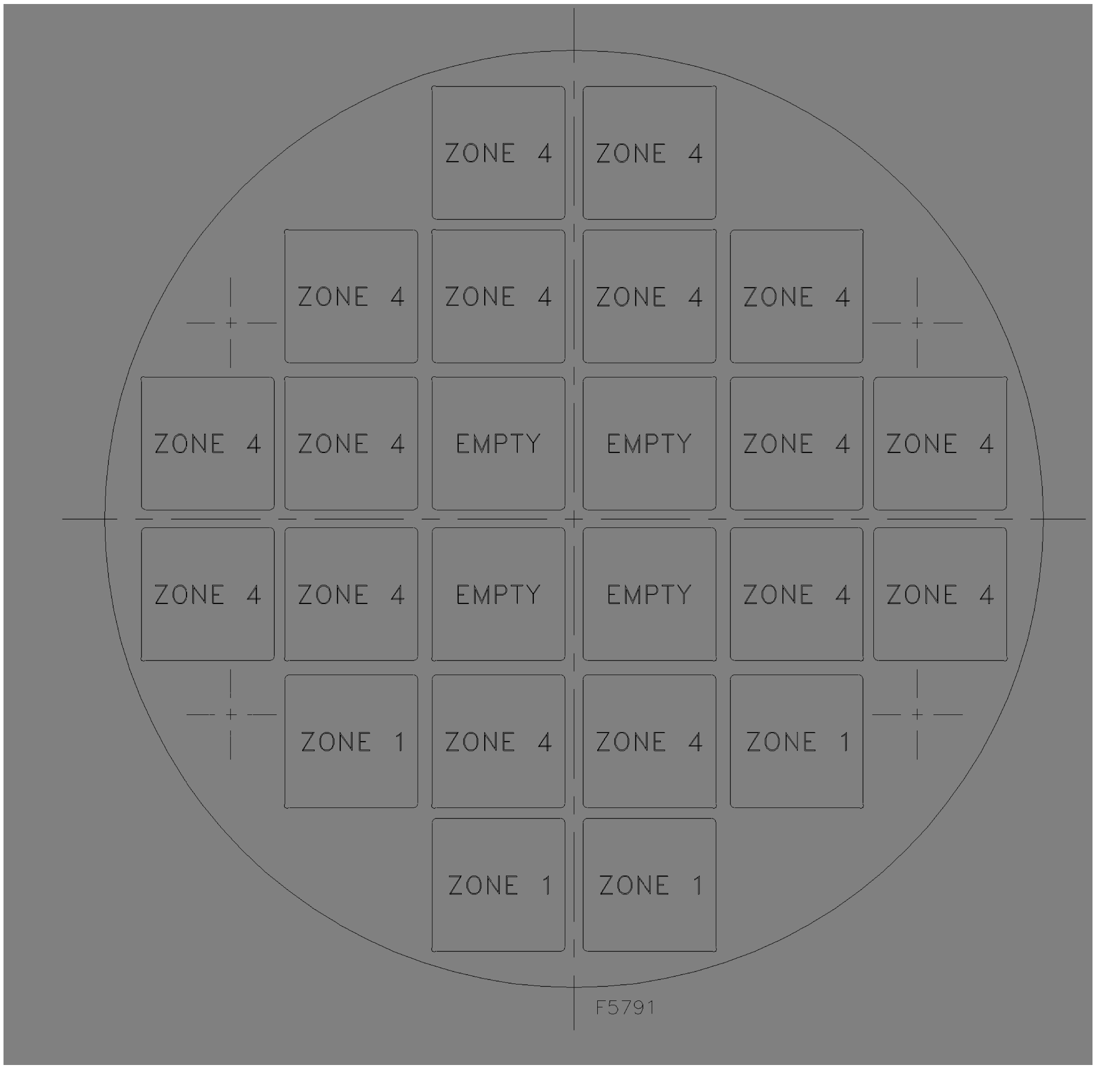
Figure A.1-2
Heat Load Configuration No. 1 for the 24PT4 DSC



	Zone 1	Zone 2	Zone 3	Zone 4
Maximum Decay Heat (kWatts/FA)[(1)]	0.9	NA	1.2	NA
Maximum Decay Heat per Zone (kW)	14.4	NA	9.6	NA
Maximum Decay Heat per DSC (kW)	24.0			

(1) Decay heat per fuel assembly shall be determined using Table A.1-6.

Figure A.1-3
Heat Load Configuration No. 2 for the 24PT4 DSC



	Zone 1	Zone 2	Zone 3	Zone 4
Maximum Decay Heat (kWatts/FA)(1)	0.9	NA	NA	1.26
Maximum Decay Heat per Zone (kW)	3.6	NA	NA	20.16
Maximum Decay Heat per DSC (kW)	24.0			

(1) Decay Heat per fuel assembly shall be determined using Table A.1-6.

Figure A.1-4
Heat Load Configuration No. 3 for the 24PT4 DSC

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MP197HB Packaging Contents Loaded with NUHOMS®-61BT DSC

(1) Type and Form of Material

(a) Intact or damaged irradiated BWR fuel assemblies with or without channels which meet specifications listed in Table A.7-1 are authorized for transportation in the NUHOMS®-61BT DSC. Damaged fuel is restricted to the 7x7 and 8x8 designs only.

(b) For maximum assembly average burnup, minimum cooling time and decay heat limits, the fuel assemblies shall meet all the requirements of the cross referenced tables listed in Table A.7-1. The fuel to be transported in the 61BT DSC is limited to a maximum lattice average initial enrichment of 4.4 wt.% ^{235}U for intact fuel (4.0 wt.% ^{235}U for damaged fuel) and a minimum of 1.4 wt.% ^{235}U. The maximum allowable assembly average burnup is given as a function of lattice average initial enrichment but does not exceed 40,000 MWd/MTU. The minimum cooling time is 7 years.

(c) The NUHOMS®-61BT DSC is authorized to transport BWR fuel assemblies arranged in one heat load zoning configuration with a maximum decay heat of 0.3 kW per assembly and a maximum heat load of 18.3 kW per canister. The heat load zoning configuration is shown in Figure A.7-1.

(d) The NUHOMS®-61BT DSC has three basket configurations: A, B and C based on the boron content in the poison plates as shown in Table A.7-3. The poison plates are constructed from borated aluminum, or an aluminum/boron carbide metal matrix composite (MMC), or Boral® and provide a heat conduction path from the fuel assemblies to the canister wall, as well as the necessary criticality control. The maximum lattice average initial enrichment authorized for Type A, B and C NUHOMS®-61BT DSCs is shown in Table A.7-3. Damaged BWR fuel assemblies shall only be transported in Type C NUHOMS®-61BT DSCs with end caps installed on each of the four corner 2x2 compartment assemblies. The locations are shown in Figure A.7-2.

(2) Maximum Quantity of Material per Package

(a) The quantity of material authorized for transport is (i) up to 61 intact or (ii) up to 16 damaged and balance intact BWR fuel assemblies with or without channels. Where a DSC is to be loaded with fewer fuel assemblies than the DSC capacity, dummy fuel assemblies with the same nominal weight as a standard fuel assembly shall be installed in the unoccupied spaces.

(b) For materials described in A.7(1) above, the approximate maximum payload is 43,005 lbs.

Table A.7-1
BWR Fuel Specification for Fuel to be Transported in the NUHOMS®-61BT DSC

PHYSICAL PARAMETERS: Fuel Design	Intact or damaged unconsolidated 7x7, 8x8, 9x9, or 10x10 intact BWR fuel assemblies manufactured by General Electric or Exxon/ANF or reload fuel manufactured by the same or other vendors that are enveloped by the fuel assembly design characteristics listed in Table A.7-2.
Fuel Damage	Damaged BWR fuel assemblies are 7x7 and 8x8 fuel assemblies containing 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 may only be transported in the "Type C" NUHOMS®-61BT Canister. Damaged fuel is restricted to the 7x7 and 8x8 designs only. Damaged fuel assemblies shall also contain top and bottom end fittings or nozzles or tie plates depending on the fuel type.
Channels	Fuel may be transported with or without fuel channels, channel fasteners, or finger springs
No. of Intact Assemblies	≤61
No. and Location of Damaged Assemblies	Up to sixteen (16) damaged fuel assemblies with balance intact or dummy assemblies, are authorized for transport in the 61BT DSCs. Damaged fuel assemblies may only be transported in the 2x2 compartments as shown in Figure A.7-2. The DSC basket cells which accommodate damaged fuel assemblies are provided with top and bottom end caps.
Maximum Assembly plus fuel channel weight	705 lbs
THERMAL/RADIOLOGICAL PARAMETERS[(1)]: Maximum Initial ^{235}U Enrichment (wt. %)	Per Table A.7-3
Fuel Assembly Average Burnup and minimum Cooling Time[(1) (3)]	Per Table A.7-4 and decay heat restrictions below
Decay Heat[(1)(2)]	0.300 kW/Assembly calculated per Table A.7-5

(1) Minimum cooling time is the longer of that given in Table A.7-4; that calculated via the decay heat equation given in Table A.7-5 to meet the 0.300 kW/assembly limit.
(2) For FANP9 9x9-2 fuel assemblies, the maximum decay heat is limited to 0.21 kW/assembly.
(3) An additional cooling time of 8 years is required for damaged fuel assemblies in addition to that obtained from Table A.7-4, when 5 or more damaged fuel assemblies are loaded.

Table A.7-2
BWR Fuel Assembly Design Characteristics(1) for the NUHOMS®-61BT DSC

Transnuclear ID	7x7-49/0	8x8-63/1	8x8-62/2	8x8-60/4	8x8-60/1	9x9-74/2
Initial Design or Reload Fuel Designation	GE1	GE4	GE-5	GE8 Type II	GE9	GE11
	GE2		GE-Pres		GE10	GE13
	GE3		GE-Barrier			
			GE8 Type I			
			FANP 8x8-2			
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 49	≤ 63	≤ 62	≤ 60	≤ 60	≤ 74
Initial Uranium Content (kg)	≤ 198	≤ 192	≤ 192	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.738	≤ 0.640	≤ 0.640	≤ 0.640	≤ 0.640	≤ 0.566
Pellet Diameter (in)	≤ 0.487	≤ 0.416	≤ 0.411	≤ 0.411	≤ 0.411	≤ 0.376
Clad Outer Diameter (in)	≥ 0.563	≥ 0.493	≥ 0.483	≥ 0.483	≥ 0.483	≥ 0.440
Clad Thickness (in)	≥ 0.032	≥ 0.034	≥ 0.032	≥ 0.032	≥ 0.032	≥ 0.028

Transnuclear ID	10x10-92/2	7x7-49/0Z	7x7-48/1Z	8x8-60/4Z	FANP 9x9	Siemens
Initial Design or Reload Fuel Designation	GE12	ENC-IIIA	ENC-III	ENC Va	FANP 9x9-72	QFA 9x9
	GE14		ENC-IIIE	ENC Vb	FANP 9x9-79	
			ENC-IIIF		FANP 9x9-80	
					FANP 9x9-81	
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 92	≤ 49	≤ 48	≤ 60	≤ 81	≤ 72
Initial Uranium Content (kg)	≤ 192	≤ 198	≤ 198	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.510	≤ 0.738	≤ 0.738	≤ 0.642	≤ 0.572	≤ 0.570
Pellet Diameter (in)	≤ 0.345	≤ 0.491	≤ 0.491	≤ 0.420	≤ 0.357	≤ 0.374
Clad Outer Diameter (in)	≥ 0.404	≥ 0.570	≥ 0.570	≥ 0.501	≥ 0.424	≥ 0.433
Clad Thickness (in)	≥ 0.026	≥ 0.035	≥ 0.035	≥ 0.035	≥ 0.030	≥ 0.026

Notes:

(1) The fuel assembly fabrication documentation may be used to demonstrate compliance with these fuel assembly parameters. The fuel assembly parameters are design nominal values. The maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a fuel assembly class (or an array type). Any fuel channel average thickness up to 0.120 inch is acceptable on any of the fuel designs.

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)	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	0.040	0.048
Five or more Damaged Assemblies			
C	3.2	0.040	0.048

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

Table A.7-4
BWR Fuel Qualification Table for the NUHOMS®-61BT DSC
(Minimum required years of cooling time after reactor core discharge)

BU (GWd/MTU)	Initial Enrichment																													
	1.4	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**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**
10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
15	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
20	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
25	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
28	**Not Acceptable or Not Analyzed**				8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
30					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
32					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
34					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
36					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
38					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
39					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
40					8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8

Notes:

- Use burnup and enrichment to look up minimum cooling time in years. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are conservatively applied in determination of actual values for these two parameters.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with an initial enrichment less than 1.4 and greater than 4.4 wt.% ^{235}U is unacceptable for transportation.
- Fuel with a burnup greater than 40 GWd/MTU is unacceptable for transportation.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for transportation after 8 years cooling.
- Example: An assembly with an initial enrichment of 4.15 wt.% ^{235}U and a burnup of 31.5 GWd/MTU is acceptable for transport after a 8-year cooling time as defined by 4.1 wt.% ^{235}U (rounding down) and 32 GWd/MTU (rounding up) on the qualification table (other considerations not withstanding).
- When loading five or more damaged fuel assemblies per DSC, an additional cooling time of 8 years is required for only damaged fuel assemblies.

Table A.7-5
BWR Assembly Decay Heat for Heat Load Configurations

The Decay Heat (DH) in watts is expressed as:

$$F1 = -59.1 + 23.4*X1 - 21.1*X2 + 0.280*X1^2 - 3.52*X1*X2 + 12.4*X2^2$$
$$DH = F1*Exp(\{[1-(1.2/X3)]* -0.720\}*[(X3-4.5)^{0.157}]*[(X2/X1)^{-0.132}]) + 10$$

where,

F1 Intermediate Function

X1 Assembly Burnup in GWD/MTU

X2 Initial Enrichment in wt.% ^{235}U

X3 Cooling Time in Years (minimum 7 years)

Note: Even though a minimum cooling time of 7 years is used, the minimum cooling time requirement with five or more damaged fuel assemblies from shielding requirements is per Table A.7-4.

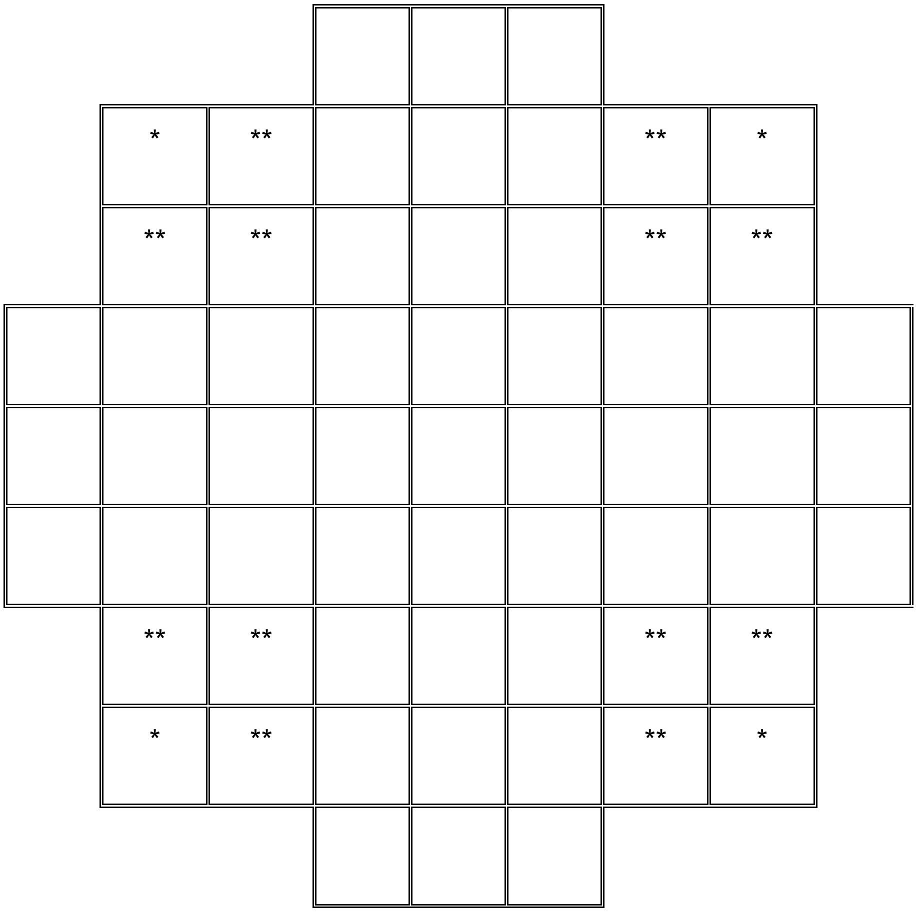
			Z1	Z1	Z1			
	Z1 *	Z1 *	Z1	Z1	Z1	Z1 *	Z1 *	
	Z1 *	Z1 *	Z1	Z1	Z1	Z1 *	Z1 *	
Z1	Z1	Z1	Z1	Z1	Z1	Z1	Z1	Z1
Z1	Z1	Z1	Z1	Z1	Z1	Z1	Z1	Z1
Z1	Z1	Z1	Z1	Z1	Z1	Z1	Z1	Z1
	Z1 *	Z1 *	Z1	Z1	Z1	Z1 *	Z1 *	
	Z1 *	Z1 *	Z1	Z1	Z1	Z1 *	Z1 *	
			Z1	Z1	Z1			

* Denotes only locations where damaged fuel assembly can be transported

	Zone 1
Maximum Decay Heat (kW/FA)[(1)]	0.30
Maximum Decay Heat per Zone (kW)	18.3
Maximum Decay Heat per DSC (kW)	18.3

(1) Decay heat per fuel assembly shall be determined per Table A.7-5.

Figure A.7-1
Heat Load Zoning Configuration for 61BT DSCs



*	Corner Locations See Note 1		**	Interior Locations See Note 2

Note 1: These corner locations shall only be used to load up to four damaged assemblies with the remaining intact in a 61BT Basket. The maximum lattice average initial enrichment of assemblies (damaged or intact transported in the 2x2 compartment assemblies) is limited to that applicable to “Up to 4 Damaged Assemblies” row of Table A.7-3.

Note 2: If loading more than four damaged assemblies, place first four damaged assemblies in the corner locations per Note 1, and up to 12 additional damaged assemblies in these interior locations, with the remaining intact in a 61BT Basket. The maximum lattice average initial enrichment of assemblies (damaged or intact transported in the 2x2 compartment assemblies) is limited to that applicable to “Five or More Damaged Assemblies” row of Table A.7-3.

Figure A.7-2
Location of Damaged and Failed Fuel Assemblies Inside 61BT DSC

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MP197HB Packaging Contents Loaded with NUHOMS®-61BTH DSC

(1) Type and Form of Material

(a) Intact or damaged or failed irradiated BWR fuel assemblies with or without channels which meet specifications listed in Table A.8-2 are authorized for transportation in the NUHOMS®-61BTH DSC. The DSC basket cells which accommodate damaged fuel assemblies are provided with top and bottom end caps to assure retrievability. Failed fuel assembly/fuel debris is to be encapsulated in an individual failed fuel can [See Drawing NUH61BTH-71-1105, Rev. 0 (2 sheets)] provided with a welded bottom closure and a removable top closure which assures retrievability of a loaded FFC.

(b) For maximum assembly average burnup, minimum cooling time and decay heat limits, the fuel assemblies shall meet the all the requirements of the cross referenced tables and figures listed in Table A.8-2. The fuel to be transported in the 61BTH DSC is limited to a maximum lattice average initial enrichment of 5.0 wt.% ^{235}U for intact fuel (a maximum of 3.6 wt.% ^{235}U for 16 damaged fuel assemblies and 3.5 wt.% ^{235}U for 4 failed fuel assemblies) and a minimum of 0.7 wt.% ^{235}U. The maximum allowable assembly average burnup is given as a function of lattice average initial enrichment but does not exceed 45,000 MWd/MTU. The minimum cooling time is 7 years.

(c) Three separate types of 61BTH DSC designs are provided. Type 1 61BTH DSC baskets have steel rails while the Type 2 61BTH DSC baskets have aluminum rails. 61BTHF DSC is a modified version of the 61BTH DSC designed to accommodate up to 4 FFCs.

(d) The NUHOMS®-61BTH Type 1 DSC is authorized to transport BWR fuel assemblies with a maximum decay heat of 0.54 kW per assembly and a maximum heat load of 22 kW per DSC in four configurations as shown in Figures A.8-1 through A.8-4. The NUHOMS®-61BTH Type 2 and NUHOMS®-61BTHF DSC are authorized to transport BWR fuel assemblies with a maximum decay heat of 0.7 kW per assembly and a maximum heat load of 24 kW per DSC in eight configurations as shown in Figures A.8-1 through A.8-8.

(e) The NUHOMS®-61BTH DSC has six basket configurations: A, B, C, D, E and F based on the boron content in the poison plates. The poison plates are constructed from borated aluminum, or an aluminum/boron carbide metal matrix composite (MMC), or Boral® and provide a heat conduction path from the fuel assemblies to the canister wall, as well as the necessary criticality control. The maximum lattice average initial enrichment authorized for Type A, B, C, D, E, and F NUHOMS®-61BTH DSCs is shown in Table A.8-4 for intact fuel and Table A.8-5 for damaged and failed fuel.

(2) Maximum Quantity of Material per Package

(a) The quantity of material authorized for transport is (i) up to 61 intact or (ii) up to 16 damaged and balance intact or (iii) up to 4 failed and up to 12 damaged and balance intact BWR fuel assemblies with or without channels. The location of damaged and failed fuel assemblies within the DSC basket are shown in Figure A.8-9. Where a DSC is to be loaded with fewer fuel assemblies than the DSC capacity, dummy fuel assemblies with the same nominal weight as a standard fuel assembly shall be installed in the unoccupied spaces.

(b) For materials described in A.8(1) above, the approximate maximum payload is 43,100 lbs

Table A.8-1

(not used)

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. 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. 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 No. of Reconstituted Assemblies per DSC with Irradiated Stainless Steel Rods • Maximum No. of Irradiated Stainless Steel Rods per Reconstituted Fuel Assembly • Maximum No. of Reconstituted Assemblies per DSC with unlimited number of low enriched UO2 rods or Zr Rods or Zr Pellets or Unirradiated Stainless Steel Rods	 4 4 61
No. 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:	
No. 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.
No. 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 Initial ^{235}U 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, Table A.8-7, and that 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.

Table A.8-3
BWR Fuel Assembly Design Characteristics(1) for the NUHOMS®-61BTH DSC
(part 1 of 2)

Transnuclear ID	7x7-49/0	8x8-63/1	8x8-62/2	8x8-60/4	8x8-60/1	9x9-74/2
Initial Design or Reload Fuel Designation	GE1	GE4	GE-5	GE8 Type II	GE9	GE11
	GE2		GE-Pres		GE10	GE13
	GE3		GE-Barrier			
			GE8 Type I			
			FANP 8x8-2			
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 49	≤ 63	≤ 62	≤ 60	≤ 60	≤ 74
Initial Uranium Content (kg)	≤ 198	≤ 192	≤ 192	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.738	≤ 0.640	≤ 0.640	≤ 0.640	≤ 0.640	≤ 0.566
Pellet Diameter (in)	≤ 0.487	≤ 0.416	≤ 0.411	≤ 0.411	≤ 0.411	≤ 0.376
Clad Outer Diameter (in)	≥ 0.563	≥ 0.493	≥ 0.483	≥ 0.483	≥ 0.483	≥ 0.440
Clad Thickness (in)	≥ 0.032	≥ 0.034	≥ 0.032	≥ 0.032	≥ 0.032	≥ 0.028

Transnuclear ID	10x10-92/2	7x7-49/0Z	7x7-48/1Z	8x8-60/4Z	FANP 9x9	Siemens
Initial Design or Reload Fuel Designation	GE12	ENC-IIIA	ENC-III	ENC Va	FANP 9x9-72	QFA 9x9
	GE14		ENC-IIIE	ENC Vb	FANP 9x9-79	
			ENC-IIIF		FANP 9x9-80	
					FANP 9x9-81	
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 92	≤ 49	≤ 48	≤ 60	≤ 81	≤ 72
Initial Uranium Content (kg)	≤ 192	≤ 198	≤ 198	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.510	≤ 0.738	≤ 0.738	≤ 0.642	≤ 0.572	≤ 0.570
Pellet Diameter (in)	≤ 0.345	≤ 0.491	≤ 0.491	≤ 0.420	≤ 0.357	≤ 0.374
Clad Outer Diameter (in)	≥ 0.404	≥ 0.570	≥ 0.570	≥ 0.501	≥ 0.424	≥ 0.433
Clad Thickness (in)	≥ 0.026	≥ 0.035	≥ 0.035	≥ 0.035	≥ 0.030	≥ 0.026

Table A.8-3
BWR Fuel Assembly Design Characteristics[(1)] for the NUHOMS®-61BTH DSC
(part 2 of 2)

Transnuclear ID	10x10-91/1	ABB-8x8	ABB-10x10-1	ABB-10x10-2
Initial Design or Reload Fuel Designation	ATRIUM-10	SVEA-64	SVEA-92	SVEA-100
	ATRIUM-10XM		SVEA-96	
			SVEA-96 +	
			OPTIMA	
			OPTIMA 2	
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 91	≤ 64	≤ 96	≤ 100
Initial Uranium Content (kg)	≤ 192	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.510	≤ 0.622	≤ 0.512	≤ 0.512
Pellet Diameter (in)	≤ 0.350	≤ 0.411	≤ 0.346	≤ 0.375
Clad Outer Diameter (in)	≥ 0.395	≥ 0.462	≥ 0.378	≥ 0.443
Clad Thickness (in)	≥ 0.023	≥ 0.027	≥ 0.024	≥ 0.024

Notes:

(1) The fuel assembly fabrication documentation may be used to demonstrate compliance with these fuel assembly parameters. The fuel assembly parameters are design nominal values. The maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a fuel assembly class (or an array type). Any fuel channel average thickness up to 0.120 inch is acceptable on any of the fuel designs.

Table A.8-4
BWR Fuel Assembly Initial Lattice Average Initial enrichment v/s Minimum B10 Requirements for the NUHOMS®-61BTH DSC Poison Plates (Intact Fuel)

61BTH DSC Type	Basket Type	Maximum Lattice Average Initial enrichment(1) (wt% ^{235}U)	Minimum B10 Areal Density, gram/cm^2	
			Borated Aluminum/MMC	Boral®
1	A	3.7	0.021	0.025
	B	4.1	0.032	0.038
	C	4.4	0.040	0.048
	D	4.6	0.048	0.058
	E	4.8	0.055	0.066
	F	5.0	0.062	0.075
2	A	3.7	0.022	0.027
	B	4.1	0.032	0.038
	C	4.4	0.042	0.050
	D	4.6	0.048	0.058
	E	4.8	0.055	0.066
	F	5.0	0.062	0.075

(1) For LaCrosse fuel assemblies, the enrichment shall be reduced by 0.1 wt.% ^{235}U.

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) (1)		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) (1)		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 LaCrosse fuel assemblies, the enrichment shall be reduced by 0.1 wt.% ^{235}U
(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
(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.

Table A.8-6
BWR Fuel Qualification Table for NUHOMS®-61BTH Type 1 DSC

(Minimum required years of cooling time after reactor core discharge)

BU, GWD/ MTU	Lattice Average Initial U-235 Enrichment, wt %																																	
	0.9	**1.2**	**1.5**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**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**
10	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
15	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
20	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
23	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
28	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
30	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
32				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
34				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
36				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
38				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
39				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
40										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
41										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
42										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
43										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
44										8.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
45										12.0	11.5	8.5	10.0	9.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Note: Explanatory notes and limitations regarding the use of this table follow Table A.8-7.

Table A.8-7
BWR Fuel Qualification Table for NUHOMS®-61BTH Type 2 DSC

(Minimum required years of cooling time after reactor core discharge)

BU, GWD/ MTU	Lattice Average Initial U-235 Enrichment, wt %																																	
	0.9	1.2	1.5	2.0	2.1	2.2	2.3	2.4	2.5	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
10	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
15	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
20	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
23	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
28	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
30	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
32				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
34				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
36				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
38				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
39				8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
40										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
41										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
42										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
43										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
44										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
45										8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Note: Explanatory notes and limitations regarding the use of this table follow Table A.8-7.

Notes: Tables A.8-6 and Table A.8-7:

- Burnup = assembly average burnup
- Use burnup and enrichment to look up minimum cooling time in years. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with a lattice average initial enrichment less than 0.9 (or less than the minimum provided above for each burnup) or greater than 5.0 wt.% ^{235}U is unacceptable for transportation.
- Fuel with a burnup greater than 45 GWd/MTU is unacceptable for transportation.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for transportation after 8-years cooling.
- For reconstituted fuel assemblies with irradiated stainless steel rods, increase the cooling time by 1 year for fuel assemblies in the 24 peripheral locations of the canister with cooling times less than 10 years. No adjustment of cooling time is required for fuel assemblies in other locations or for those that have cooled for more than 10 years.
- The cooling times for failed, damaged, and intact assemblies are identical. However, when loading five or more damaged fuel assemblies per DSC (or a combination of damaged and failed fuel assemblies, if applicable), an additional cooling time of 8 years is required for only damaged fuel assemblies (and failed fuel assemblies, if applicable).
- Example: An assembly with an initial enrichment of 4.85 wt.% ^{235}U and a burnup of 41.5 GWd/MTU is acceptable for transport after a 8-year cooling time as defined by 4.8 wt.% ^{235}U (rounding down) and 42 GWd/MTU (rounding up) on the qualification table (other considerations not withstanding).

Table A.8-8
BWR Assembly Decay Heat for Heat Load Configurations

The decay heat (DH) in watts is expressed as:

$$F1 = -59.1 + 23.4*X1 - 21.1*X2 + 0.280*X1^2 - 3.52*X1*X2 + 12.4*X2^2$$
$$DH = F1*Exp(\{[1-(1.2/X3)]* -0.720\}*[(X3-4.5)^{0.157}]*[(X2/X1)^{-0.132}]) + 10$$

where,

F1 Intermediate function

X1 Assembly burnup in GWD/MTU

X2 Initial enrichment in wt.% ^{235}U

X3 Cooling time in years (minimum 7 years)

Note: Even though a minimum cooling time of 7 years is used, the minimum cooling time requirement with five or more damaged fuel assemblies (or a combination of damaged and failed fuel assemblies, if applicable) from shielding requirements is per Table A.8-6 for Type 1 DSC and A.8-7 for Type 2 DSC.

			Z3	Z3	Z3			
	Z3	Z3	Z3	Z3	Z3	Z3	Z3	
	Z3	Z3	Z3	Z3	Z3	Z3	Z3	
Z3	Z3	Z3	Z3	Z3	Z3	Z3	Z3	Z3
Z3	Z3	Z3	Z3	Z3	Z3	Z3	Z3	Z3
Z3	Z3	Z3	Z3	Z3	Z3	Z3	Z3	Z3
	Z3	Z3	Z3	Z3	Z3	Z3	Z3	
	Z3	Z3	Z3	Z3	Z3	Z3	Z3	
			Z3	Z3	Z3			

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)(1) (3)	NA	NA	0.393	NA	NA	NA
Maximum Decay Heat per Zone (kW)	NA	NA	22.0	NA	NA	NA
Maximum Decay Heat per DSC (kW)	22.0(3)					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) This configuration is not allowed for a 61BTH Type 1 basket with MMC or Boral® Poison Plates.
(3) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 15.4 kW per DSC for HLZC No. 1.

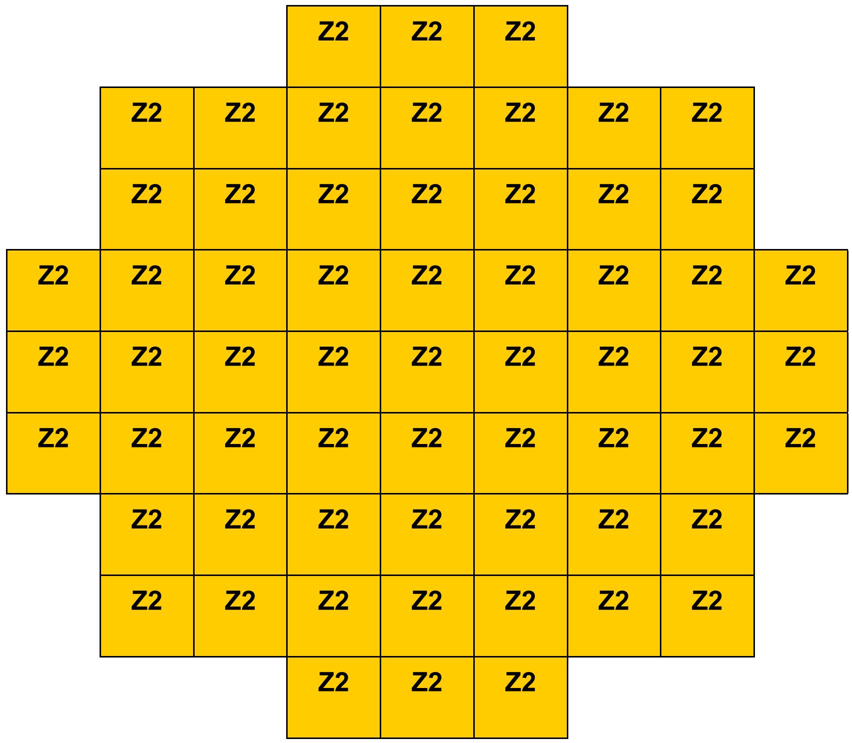
Figure A.8-1
Heat Load Zoning Configuration No. 1 for Type 1 or Type 2 61BTH DSCs(2)

			Z5	Z5	Z5			
	Z4	Z4	Z4	Z4	Z4	Z4	Z4	
	Z4	Z2	Z2	Z2	Z2	Z2	Z4	
Z5	Z4	Z2	Z2	Z2	Z2	Z2	Z4	Z5
Z5	Z4	Z2	Z2	Z2	Z2	Z2	Z4	Z5
Z5	Z4	Z2	Z2	Z2	Z2	Z2	Z4	Z5
	Z4	Z2	Z2	Z2	Z2	Z2	Z4	
	Z4	Z4	Z4	Z4	Z4	Z4	Z4	
			Z5	Z5	Z5			

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)(1) (3)	NA	0.35	NA	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	8.75	NA	11.52	6.48	NA
Maximum Decay Heat per DSC (kW)	22.0 (3)					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) This configuration is not allowed for a 61BTH Type 1 basket with MMC or Boral® Poison Plates.
(3) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 15.4 kW per DSC for HLZC No. 2.

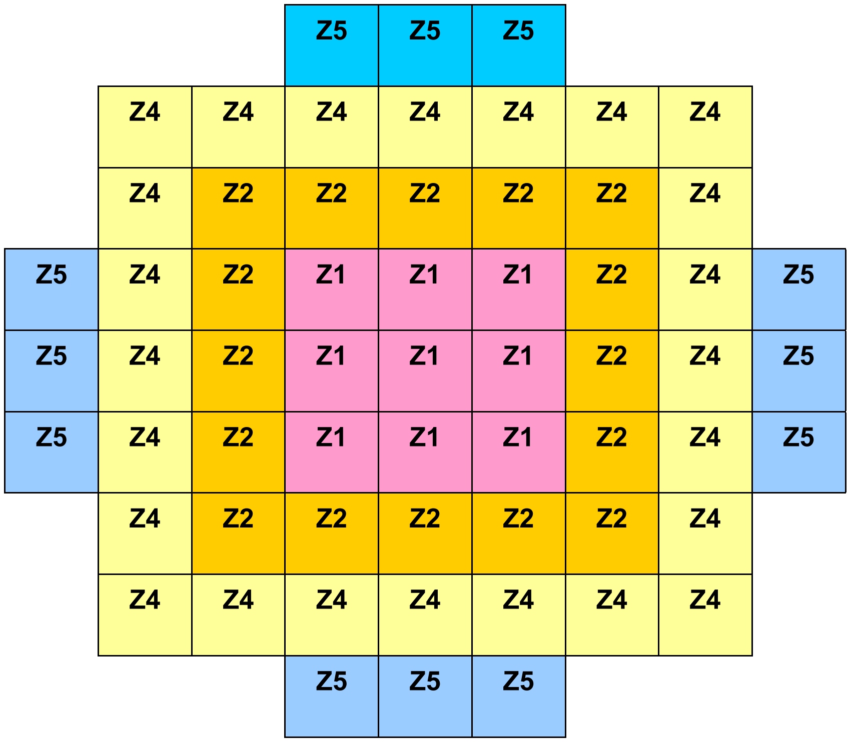
Figure A.8-2
Heat Load Zoning Configuration No. 2 for Type 1 or Type 2 61BTH DSCs(2)



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)(1) (2)	NA	0.35	NA	NA	NA	NA
Maximum Decay Heat per Zone (kW)	NA	19.4	NA	NA	NA	NA
Maximum Decay Heat per DSC (kW)	19.4(2)					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 13.58 kW per DSC for HLZC No. 3.

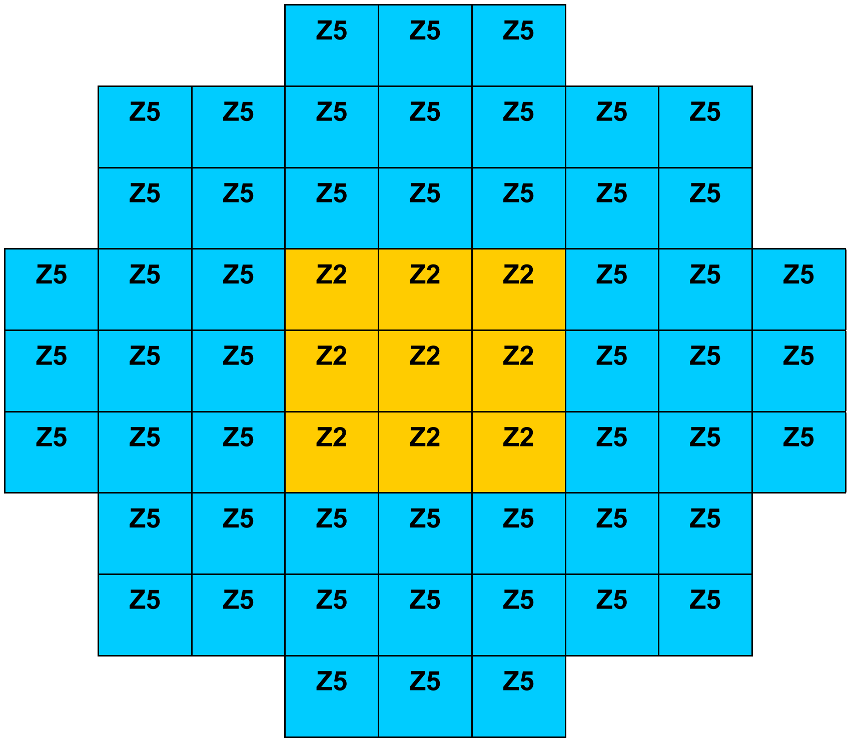
Figure A.8-3
Heat Load Zoning Configuration No. 3 for Type 1 or Type 2 61BTH DSCs



	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**
Maximum Decay Heat (kW/FA)[(1) (2)]	0.22	0.35	NA	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	1.98	5.60	NA	11.52	6.48	NA
Maximum Decay Heat per DSC (kW)	19.4[(2)]					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 13.58 kW per DSC for HLZC No. 4.

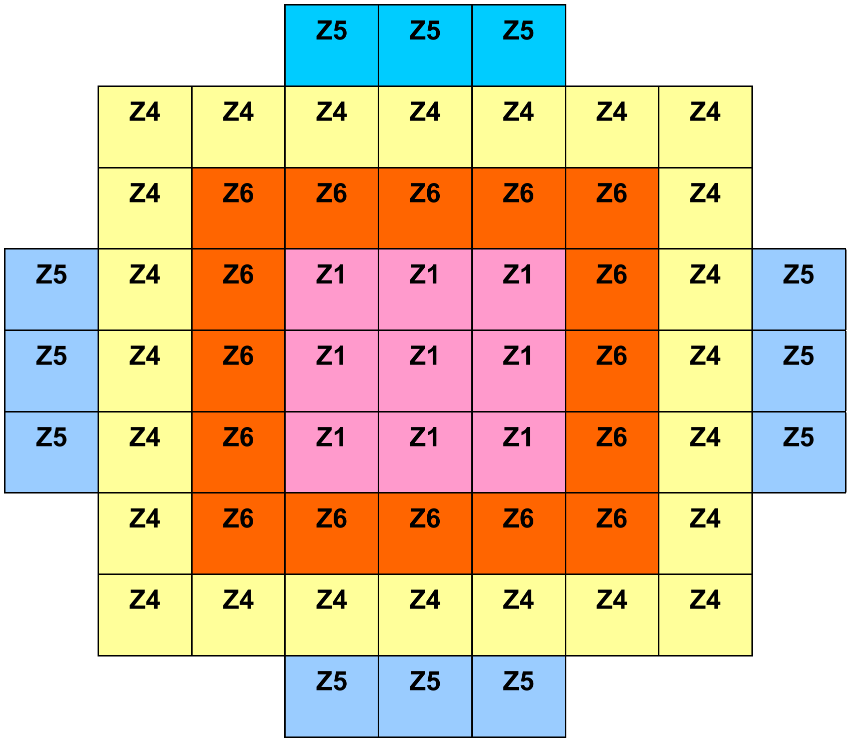
Figure A.8-4
Heat Load Zoning Configuration No. 4 for Type 1 or Type 2 61BTH DSCs



	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**
Maximum Decay Heat (kW/FA)(1) (3)	NA	0.35	NA	NA	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	3.15	NA	NA	24.0	NA
Maximum Decay Heat per DSC (kW)	24.0(3)					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) This configuration is not allowed for a 61BTH Type 2 basket with MMC or Boral® Poison Plates.
(3) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 16.8 kW per DSC for HLZC No. 5.

Figure A.8-5
Heat Load Zoning Configuration No. 5 for Type 2 61BTH DSC(2)



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)[(1) (3)]	0.22	NA	NA	0.48	0.54	0.70
Maximum Decay Heat per Zone (kW)	1.98	NA	NA	11.52	6.48	11.20
Maximum Decay Heat per DSC (kW)	24.0[(3)]					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) This configuration is not allowed for a 61BTH Type 1 basket with MMC or Boral® Poison Plates.
(3) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 16.8 kW per DSC for HLZC No. 6.

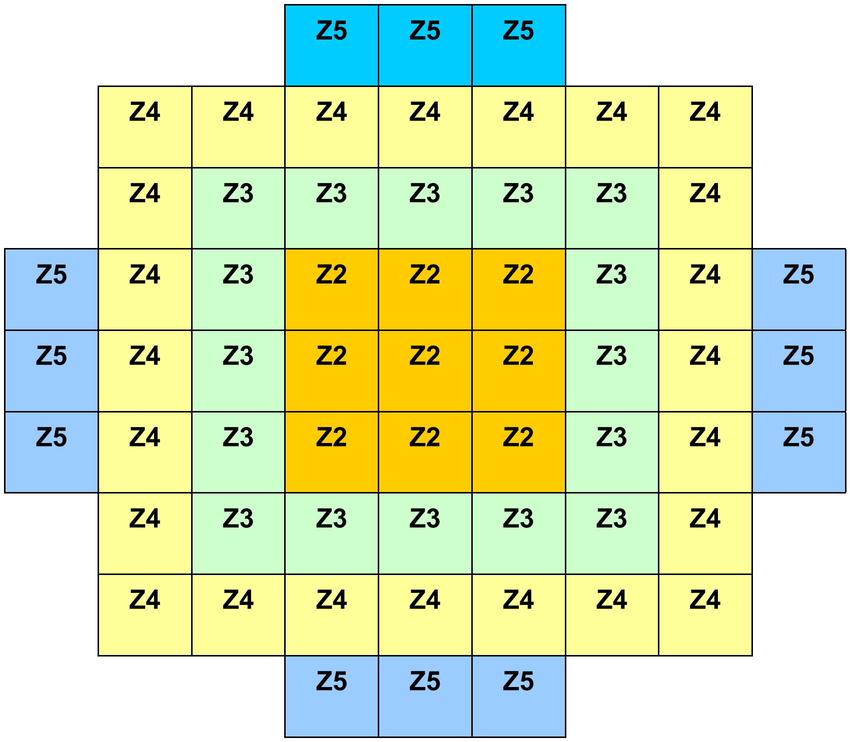
Figure A.8-6
Heat Load Zoning Configuration No. 6 for Type 2 61BTH DSC[(2)]

			Z5	Z5	Z5			
	Z5	Z5	Z5	Z5	Z5	Z5	Z5	
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
Z5	Z5	Z4	Z4	Z4	Z4	Z4	Z5	Z5
Z5	Z5	Z4	Z4	Z4	Z4	Z4	Z5	Z5
Z5	Z5	Z4	Z4	Z4	Z4	Z4	Z5	Z5
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
	Z5	Z5	Z5	Z5	Z5	Z5	Z5	
			Z5	Z5	Z5			

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)(1) (3)	NA	NA	NA	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	NA	NA	12.00	19.44	NA
Maximum Decay Heat per DSC (kW)	24.0(3)					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) This configuration is not allowed for a 61BTH Type 1 basket with MMC or Boral® Poison Plates.
(3) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 16.8 kW per DSC for HLZC No. 7.

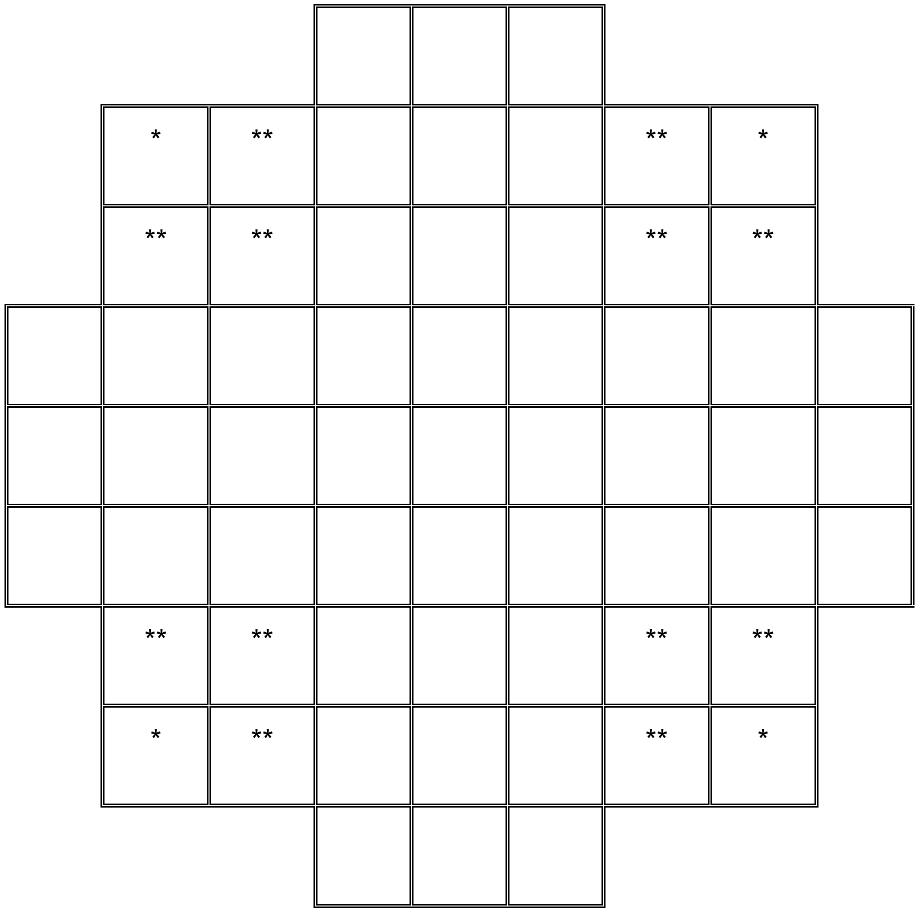
Figure A.8-7
Heat Load Zoning Configuration No. 7 for Type 2 61BTH DSC(2)



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)(1) (2)	NA	0.35	0.393	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	3.15	6.288	11.52	6.48	NA
Maximum Decay Heat per DSC (kW)	24.0(2)					

(1) Decay heat per fuel assembly shall be determined per Table A.8-8.
(2) Reduce the maximum decay heat to 70% of the listed values for LaCrosse fuel assembly. The total decay heat for LaCrosse fuel assembly is 16.8 kW per DSC for HLZC No. 8.

Figure A.8-8
Heat Load Zoning Configuration No. 8 for Type 2 61BTH DSC



*	Corner Locations See Note 1	**	Interior Locations See Note 2

Note 1: These corner locations shall only be used to load up to four damaged or failed assemblies with the remaining intact in a 61BTH Basket. The maximum lattice average initial enrichment of assemblies (damaged or intact transported in the 2x2 compartment assemblies) is limited to the “Up to 4 Damaged Assemblies” column of Table A.8-5. For the Type 2 DSC containing failed fuel assemblies, this enrichment is limited to the “Up to 4 Failed Assemblies” column of Table A.8-5.

Note 2: If loading more than four damaged assemblies, place first four damaged assemblies in the corner locations per Note 1, and up to 12 additional damaged assemblies in these interior locations, with the remaining intact in a 61BTH Basket. The maximum lattice average initial enrichment of assemblies (damaged or intact transported in the 2x2 compartment assemblies) is limited to the “Five or More Damaged Assemblies” column of Table A.8-5. For the Type 2 DSC containing failed fuel assemblies, this enrichment is limited to the “and up to 12 Damaged Assemblies” column of Table A.8-5.

Figure A.8-9
Location of Damaged and Failed Fuel Assemblies Inside 61BTH DSC

CoC 9302 Revision 5, Appendix A.9

MP197HB Packaging Contents Loaded with NUHOMS®-69BTH DSC

(1) Type and Form of Material

(a) Intact or damaged BWR fuel assemblies with or without channels which meet specifications listed in Table A.9-1 are authorized for transportation in the NUHOMS®-69BTH DSC. The DSC basket cells which accommodate damaged fuel assemblies are provided with top and bottom end caps to assure retrievability.

(b) For maximum assembly average burnup, minimum cooling times and decay heat limits, the fuel assemblies shall meet the all the requirements of the cross referenced tables and figures listed in Table A.9-1. The fuel to be transported in the 69BTH DSC is limited to a maximum lattice average initial enrichment of 5.0 wt.% ^{235}U for intact fuel (a maximum of 3.4 wt.% ^{235}U for 24 damaged fuel assemblies) and a minimum of 0.7 wt.% ^{235}U. The maximum allowable assembly average burnup is given as a function of lattice average initial enrichment but does not exceed 45,000 MWd/MTU. The minimum cooling time is 6 years.

(c) The NUHOMS®-69BTH DSC is authorized to transport BWR fuel assemblies with a maximum decay heat of 0.7 kW per assembly and a maximum heat load of 32 kW per DSC in four configurations as shown in Figures A.9-2 through A.9-5.

(d) The NUHOMS®-69BTH DSC has six basket configurations: A, B, C, D, E and F based on the boron content in the poison plates. The poison plates are constructed from borated aluminum, or boron carbide/aluminum metal matrix composite (MMC), or Boral® and provide a heat conduction path from the fuel assemblies to the canister wall, as well as the necessary criticality control. The maximum lattice average initial enrichment authorized for Type A, B, C, D, E and F NUHOMS®-69BTH DSCs is shown in Table A.9-3 for intact fuel and damaged fuel.

(2) Maximum Quantity of Material per Package

(a) The quantity of material authorized for transport is (i) up to 69 intact or (ii) up to 24 damaged and balance intact BWR fuel assemblies with or without channels. The location of damaged fuel assemblies within the DSC basket are shown in Figure A.9-1. Where a DSC is to be loaded with fewer fuel assemblies than the DSC capacity, dummy fuel assemblies with the same nominal weight as a standard fuel assembly shall be installed in the unoccupied spaces.

(b) For materials described in A.9(1) above, the approximate maximum payload is 48,700 lbs.

Table A.9-1
BWR Fuel Specification for the Fuel to be Transported in the NUHOMS®-69BTH DSC

PHYSICAL PARAMETERS: Fuel Class	Intact or damaged 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.9-2. Damaged fuel assemblies beyond the definition contained below are not authorized for transport.
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 assembly 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.
RECONSTITUTED FUEL ASSEMBLIES: • Maximum No. of Reconstituted Assemblies per DSC with Irradiated Stainless Steel Rods • Maximum No. of Irradiated Stainless Steel Rods per Reconstituted Fuel Assembly • Maximum No. of Reconstituted Assemblies per DSC with unlimited number of low enriched UO2 rods or Zr Rods or Zr Pellets or Unirradiated Stainless Steel Rods	4 4 69
No. of Intact Assemblies	≤69
No. and Location of Damaged Assemblies	Up to 24 damaged fuel assemblies, with balance intact or dummy assemblies, are authorized for transport in 69BTH DSC. Damaged fuel assemblies may only be transported in the four outer “6-compartment” arrays as shown in Figure A.9-1. The DSC basket cells which accommodate damaged fuel assemblies are provided with top and bottom end caps.
Channels	Fuel may be transported with or without channels, channel fasteners, or finger springs.
Maximum Assembly Weight with Channels	705 lbs
THERMAL/RADIOLOGICAL PARAMETERS: Maximum Initial ^{235}U Enrichment (wt. %)	Per Table A.9-3.
Allowable Heat Load Zoning Configurations for each 69BTH DSC	Per Figure A.9-2 or Figure A.9-3 or Figure A.9-4 or Figure A.9-5.
Fuel Assembly Average Burnup and minimum Cooling Time[(1)]	Per Table A.9-4
Decay Heat per DSC	Per Figure A.9-2 or Figure A.9-3 or Figure A.9-4 or Figure A.9-5.
Minimum B10 Content in Poison Plates	Per Table A.9-3.

(1) An additional cooling time of 8 years is required for damaged fuel assemblies in addition to that obtained from Table A.9-4, when five or more damaged fuel assemblies are loaded.

Table A.9-2
BWR Fuel Assembly Design Characteristics(1) for the NUHOMS®-69BTH DSC
(part 1 of 2)

Transnuclear ID	7x7-49/0	8x8-63/1	8x8-62/2	8x8-60/4	8x8-60/1	9x9-74/2
Initial Design or Reload Fuel Designation	GE1	GE4	GE-5	GE8 Type II	GE9	GE11
	GE2		GE-Pres		GE10	GE13
	GE3		GE-Barrier			
			GE8 Type I			
			FANP 8x8-2			
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 49	≤ 63	≤ 62	≤ 60	≤ 60	≤ 74
Initial Uranium Content (kg)	≤ 198	≤ 192	≤ 192	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.738	≤ 0.640	≤ 0.640	≤ 0.640	≤ 0.640	≤ 0.566
Pellet Diameter (in)	≤ 0.487	≤ 0.416	≤ 0.411	≤ 0.411	≤ 0.411	≤ 0.376
Clad Outer Diameter (in)	≥ 0.563	≥ 0.493	≥ 0.483	≥ 0.483	≥ 0.483	≥ 0.440
Clad Thickness (in)	≥ 0.032	≥ 0.034	≥ 0.032	≥ 0.032	≥ 0.032	≥ 0.028

Transnuclear ID	10x10-92/2	7x7-49/0Z	7x7-48/1Z	8x8-60/4Z	FANP 9x9	Siemens
Initial Design or Reload Fuel Designation	GE12	ENC-IIIA	ENC-III	ENC Va	FANP 9x9-72	QFA 9x9
	GE14		ENC-IIIE	ENC Vb	FANP 9x9-79	
			ENC-IIIF		FANP 9x9-80	
					FANP 9x9-81	
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 92	≤ 49	≤ 48	≤ 60	≤ 81	≤ 72
Initial Uranium Content (kg)	≤ 192	≤ 198	≤ 198	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.510	≤ 0.738	≤ 0.738	≤ 0.642	≤ 0.572	≤ 0.570
Pellet Diameter (in)	≤ 0.345	≤ 0.491	≤ 0.491	≤ 0.420	≤ 0.357	≤ 0.374
Clad Outer Diameter (in)	≥ 0.404	≥ 0.570	≥ 0.570	≥ 0.501	≥ 0.424	≥ 0.433
Clad Thickness (in)	≥ 0.026	≥ 0.035	≥ 0.035	≥ 0.035	≥ 0.030	≥ 0.026

Table A.9-2
BWR Fuel Assembly Design Characteristics[1] for the NUHOMS®-69BTH DSC
(part 2 of 2)

Transnuclear ID	10x10-91/1	ABB-8x8	ABB-10x10-1	ABB-10x10-2
Initial Design or Reload Fuel Designation	ATRIUM-10	SVEA-64	SVEA-92	SVEA-100
	ATRIUM-10XM		SVEA-96	
			SVEA-96 +	
			OPTIMA	
			OPTIMA 2	
Length (in) (Unirradiated)	≤ 176.6	≤ 176.6	≤ 176.6	≤ 176.6
Fissile Material	UO_2	UO_2	UO_2	UO_2
No. of Fuel Rods	≤ 91	≤ 64	≤ 96	≤ 100
Initial Uranium Content (kg)	≤ 192	≤ 192	≤ 192	≤ 192
Rod Pitch (in)	≤ 0.510	≤ 0.622	≤ 0.512	≤ 0.512
Pellet Diameter (in)	≤ 0.350	≤ 0.411	≤ 0.346	≤ 0.375
Clad Outer Diameter (in)	≥ 0.395	≥ 0.462	≥ 0.378	≥ 0.443
Clad Thickness (in)	≥ 0.023	≥ 0.027	≥ 0.024	≥ 0.024

Notes:

(2) The fuel assembly fabrication documentation may be used to demonstrate compliance with these fuel assembly parameters. The fuel assembly parameters are design nominal values. The maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a fuel assembly class (or an array type). Any fuel channel average thickness up to 0.120 inch is acceptable on any of the fuel designs.

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

Basket Type	Maximum Lattice Average Enrichment(1) (wt% ^{235}U)	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) (wt.% ^{235}U)			
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 LaCrosse fuel assemblies, the enrichment shall be reduced by 0.1 wt.% ^{235}U.

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

Table A.9-4
BWR Fuel Qualification Table for the NUHOMS®-69BTH DSC

(Minimum required years of cooling time after reactor core discharge)

BU, GWD/ MTU	Lattice Average Initial U-235 Enrichment, wt %																																
	0.7	1.2	1.5	2.0	2.1	2.2	2.3	2.4	2.5	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
10	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
20	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
25	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
30				6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
35				6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
39				6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
40										6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
42										6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
44										6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
45										7.5	6.5	6.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

Note: Explanatory notes and limitations regarding the use of this table follow.

Notes, Table A.9-4:

- Burnup = Assembly Average burnup.
- Use burnup and enrichment to look up minimum cooling time in years. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with a lattice average initial enrichment less than 0.7 (or less than the minimum provided above for each burnup) or greater than 5.0 wt.% ^{235}U is unacceptable for transportation.
- Fuel with a burnup greater than 45 GWd/MTU is unacceptable for transportation.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for transportation after 6-years cooling.
- For reconstituted fuel assemblies with irradiated stainless steel rods, increase the cooling time by 1 for fuel assemblies in the 24 peripheral locations of the canister with cooling times less than 10 years. No adjustment of cooling time is required for fuel assemblies in other locations or for those that have cooled for more than 10 years.
- The cooling times for damaged and intact assemblies are identical. However, when loading five or more damaged fuel assemblies per DSC, an additional cooling time of 8 years is required for only damaged fuel assemblies.
- Example: An assembly with an initial enrichment of 4.85 wt.% ^{235}U and a burnup of 41.5 GWd/MTU is acceptable for transport after a 6-year cooling time as defined by 4.8 wt.% ^{235}U (rounding down) and 42 GWd/MTU (rounding up) on the qualification table (other considerations not withstanding).

Table A.9-5
BWR Assembly Decay Heat for Heat Load Configurations

The Decay Heat (DH) in watts is expressed as:

$$F1 = -59.1 + 23.4*X1 - 21.1*X2 + 0.280*X1^2 - 3.52*X1*X2 + 12.4*X2^2$$
$$DH = F1*Exp(\{[1-(1.2/X3)]* -0.720\}*[(X3-4.5)^{0.157}]*[(X2/X1)^{-0.132}]) + 10$$

where,

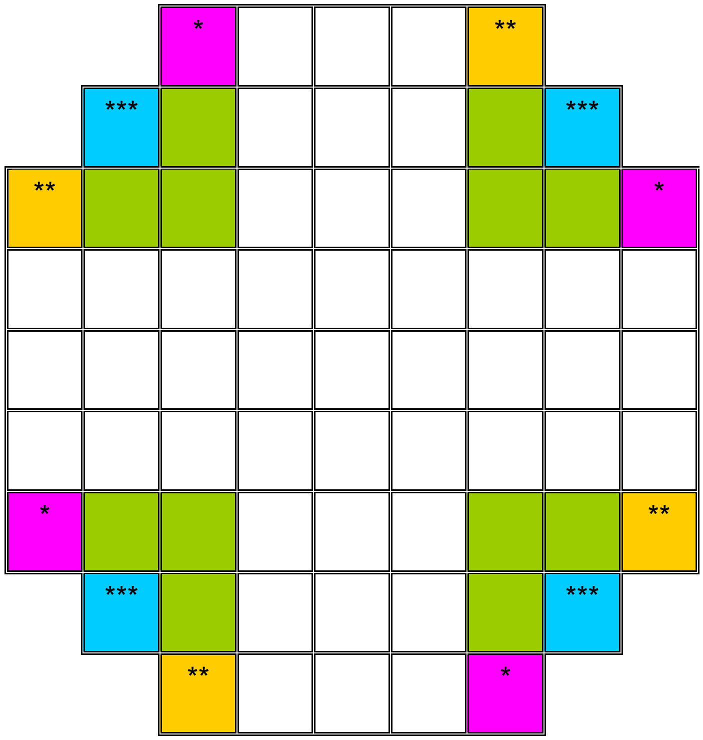
F1 Intermediate Function

X1 Assembly Burnup in GWD/MTU

X2 Initial Enrichment in wt.% ^{235}U

X3 Cooling Time in Years (minimum 6 years)

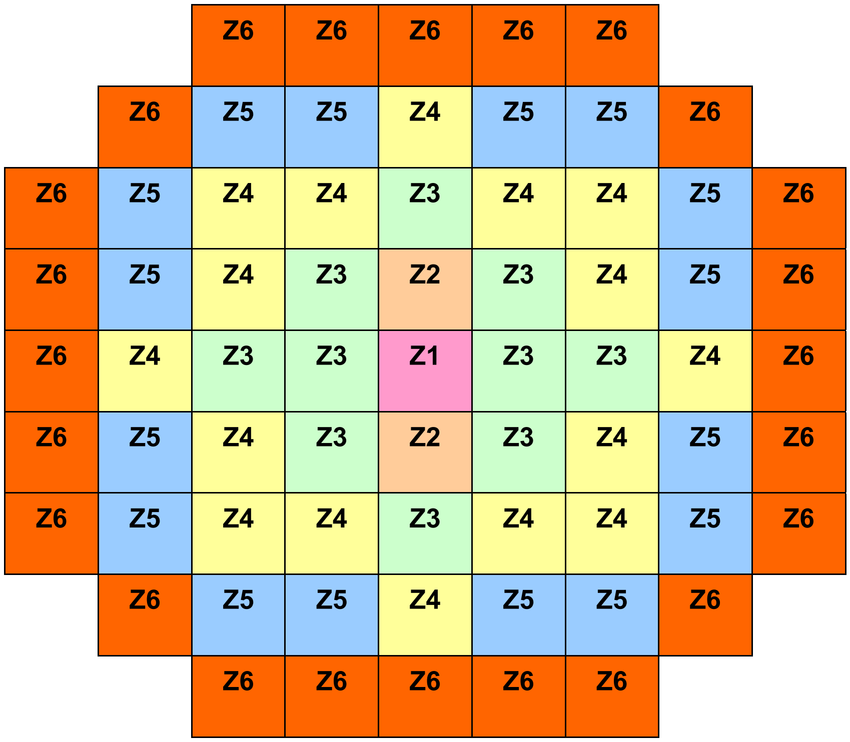
Note: Even though a minimum cooling time of 6 years is used, the minimum cooling time requirement with five or more damaged fuel assemblies from shielding requirements is per Table A.9-4.



*	Configuration 1[1]	**	Configuration 2[1]	***	Configuration 3[1]

1	Either one of these three sets of corner locations shall only be used to load up to four damaged assemblies with the remaining intact in a 69BTH Basket. The maximum lattice average initial enrichment of fuel assemblies (damaged or intact transported in either magenta set of cells for configuration 1, gold set of cells for configuration 2, or blue set of cells for configuration 3) is limited to the “up to 4 damaged assemblies” column of Table A.9-3.
	Following the placement of damaged fuel assemblies in either configuration 1 or 2, the remaining gold or magenta locations shall be used to load up to 4 additional damaged assemblies, with the remaining intact in a 69BTH Basket. The maximum lattice average initial enrichment for these fuel assemblies (damaged or intact transported in gold or magenta cells available) is limited to the “5 to 8 damaged assemblies” column of Table A.9-3.
	Following the placement of eight damaged fuel assemblies in the set of corner locations marked with a “*” (shaded in magenta) and a “**” (shaded in gold), the locations shaded in green or blue in Figure shall be used to load up to sixteen additional damaged assemblies, with the remaining intact in a 69BTH Basket. The maximum lattice average initial enrichment for all 24 fuel assemblies (damaged or intact transported in these 24 locations) is limited to the “9 to 24 Damaged Assemblies” column of Table A.9-3.

Figure A.9-1
Location of Damaged Fuel Assemblies Inside 69BTH DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Max. Decay Heat (kW/FA) (3)(4)	0.10	0.27	0.30	0.40	0.55	0.45
No. of Fuel Assemblies (1)	1	2	10	16	16	24
Max. Decay Heat per Zone (kW) (3)	0.10	0.54	3.0	6.4	8.8	10.8
Max. Decay Heat per DSC (kW)	26.0 (2) (3)					

Notes:

(1) Total number of fuel assemblies is 69 for HLZC # 1

(2) Adjust payload to maintain the total DSC heat load within the specified limit

(3) Reduce the maximum decay heat to 70% of the listed values for LaCrosse Fuel assembly. The total decay heat for LaCrosse fuel assembly is 18.2 kW per DSC for HLZC No. 1.

(4) Decay heat per fuel assembly shall be determined per Table A.9-5.

Figure A.9-2
Heat Load Zoning Configuration No. 1 for 69BTH Basket

		Z5	Z5	Z5	Z5	Z5		
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
Z5	Z4	Z4	Z3	Z3	Z3	Z4	Z4	Z5
Z5	Z4	Z3	Z2	Z2	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z1	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z2	Z2	Z3	Z4	Z5
Z5	Z4	Z4	Z3	Z3	Z3	Z4	Z4	Z5
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
		Z5	Z5	Z5	Z5	Z5		

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Max. Decay Heat (kW/FA) (4)(5)	0.25	0.0 (1)	0.40	0.60	0.50
No. of Fuel Assemblies (2)	1	0	12	24	24
Max. Decay Heat per Zone (kW) (4)	0.25	0	4.8	14.4	12.0
Max. Decay Heat per DSC (kW)	26.0 (3) (4)				

Notes:
(1) Aluminum dummy assemblies replace the fuel assemblies in zone 2
(2) Total number of fuel assemblies is 61 for HLZC # 2
(3) Adjust payload to maintain the total DSC heat load within the specified limit
(4) Reduce the maximum decay heat to 70% of the listed values for LaCrosse Fuel assembly. The total decay heat for LaCrosse fuel assembly is 18.2 kW per DSC for HLZC No. 2.
(5) Decay heat per fuel assembly shall be determined per Table A.9-5.

Figure A.9-3
Heat Load Zoning Configuration No. 2 for 69BTH Basket

		Z5	Z5	Z5	Z5	Z5		
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
Z5	Z4	Z4	Z3	Z3	Z3	Z4	Z4	Z5
Z5	Z4	Z3	Z2	Z2	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z1	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z2	Z2	Z3	Z4	Z5
Z5	Z4	Z4	Z3	Z3	Z3	Z4	Z4	Z5
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
		Z5	Z5	Z5	Z5	Z5		

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Max. Decay Heat (kW/FA) (4)(5)	0.25	0.0 (1)	0.40	0.60	0.50
No. of Fuel Assemblies (2)	1	0	12	24	24
Max. Decay Heat per Zone (kW) (4)	0.25	0	4.8	14.4	12.0
Max. Decay Heat per DSC (kW)	29.2 (3) (4)				

Notes:
(1) Aluminum dummy assemblies replace the fuel assemblies in zone 2
(2) Total number of fuel assemblies is 61 for HLZC # 3
(3) Adjust payload to maintain the total DSC heat load within the specified limit
(4) Reduce the maximum decay heat to 70% of the listed values for LaCrosse Fuel assembly. The total decay heat for LaCrosse fuel assembly is 20.4 kW per DSC for HLZC No. 3.
(5) Decay heat per fuel assembly shall be determined per Table A.9-5.

Figure A.9-4
Heat Load Zoning Configuration No. 3 for 69BTH Basket

		Z5	Z5	Z5	Z5	Z5		
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
Z5	Z4	Z3	Z3	Z3	Z3	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z2	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z1	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z2	Z2	Z2	Z3	Z4	Z5
Z5	Z4	Z3	Z3	Z3	Z3	Z3	Z4	Z5
	Z5	Z4	Z4	Z4	Z4	Z4	Z5	
		Z5	Z5	Z5	Z5	Z5		

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Max. Decay Heat (kW/FA) [(4)(5)]	0.0 [(1)]	0.45	0.0 [(2)]	0.70	0.60
No. of Fuel Assemblies [(3)]	0	8	0	20	24
Max. Decay Heat per Zone (kW) [(4)]	0	3.6	0	14.0	14.4
Max. Decay Heat per DSC (kW)	32.0 [(4)]				

Notes:
(1) The fuel compartment in zone 1 remains empty
(2) Aluminum dummy assemblies replace the fuel assemblies in zone 3
(3) Total number of fuel assemblies is 52 for HLZC # 4
(4) Reduce the maximum decay heat to 70% of the listed values for LaCrosse Fuel assembly. The total decay heat for LaCrosse fuel assembly is 22.4 kW per DSC for HLZC No. 4.
(5) Decay heat per fuel assembly shall be determined per Table A.9-5.
(6) Borated Aluminum is the only poison material allowed for HLZC #4.

Figure A.9-5
Heat Load Zoning Configuration No. 4 for 69BTH Basket

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MP197HB Packaging Contents Loaded with Radioactive Waste Canister (RWC)

(3) Type and Form of Material

(a) The NUHOMS®-MP197HB packaging is designed for shipment of various types of irradiated and contaminated reactor hardware. The payload will vary from shipment to shipment. Typical composition of the payload consists of the following components either individually or in combinations:

1. BWR Control Rod Blades
2. BWR Local Power Range Monitors (LPRMs)
3. BWR Fuel Channels
4. BWR Poison Curtains
5. PWR Burnable Poison Rod Assemblies (BPRAs)
6. PWR and BWR Reactor Vessel and Internals

(b) The decay heat load of the radioactive material is less than 5 kW.

Components with high specific activity are generally placed near the center of the cask/container. For each shipment, the cask/container is normally filled to capacity, which prevents shifting of the contents during transport. If the cask/container is not full, appropriate component spacers or shoring is used to prevent significant movement of the contents.

(4) Maximum Quantity of Material per Package

(a) The quantity of radioactive material is limited to a maximum of 8,182 A_2. The radioactive material is primarily in the form of neutron activated metals, or metal oxides in solid form. Surface contamination may also be present on the irradiated components. When a wet load procedure (i.e., in-pool) is followed for cask loading, the cask cavity and secondary container are drained and dried to ensure that there are no free liquids in the package during transport.

(b) The NUHOMS®-MP197HB packaging is designed to transport a payload of up to 56.0 tons of dry irradiated and/or contaminated non-fuel bearing solid materials in this secondary container.

(c) The maximum quantity of non-fuel bearing radioactive material loaded into a package shall not exceed 90,000 Ci of ^{60}Co. If there are other radionuclides (e.g., contaminants) in addition to ^{60}Co, the total energy release from the total waste shall not exceed 225,000 MeV/sec.