TRANSNUCLEAR
AN AREVA COMPANY

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E-28479

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

Subject: Revision 6 to Transnuclear, Inc. (TN) Application for Amendment 1 to the NUHOMS® HD System (Docket No. 72-1030; TAC NO. L24153)

Based on recent discussions with the NRC staff, fuel qualification tables in Updated Final Safety Analysis Report (UFSAR) Chapter 2 and the corresponding Technical Specifications (TS), and TS 5.2.4 regarding horizontal storage module thermal monitoring, have been changed to improve their clarity. This submittal provides the associate changed UFSAR and Technical Specifications pages.

Enclosure 1 provides a list of Amendment 1 Revision 6 TS and UFSAR replacement pages included herein, with discussion regarding the changes. Enclosure 2 provides the TS and UFSAR Amendment 1 replacement pages.

In both the TS and the UFSAR, Amendment 1 Revisions 0, 1, 2, 3, 4, 5, and 6 changes are shown using italics for inserted text and revision bars for changed areas; however, Revision 6 changes are shaded to distinguish these new changes from Revisions 0, 1, 2, 3, 4 and 5 changes. For the UFSAR, page footers for replacement pages are annotated as "Amendment 1, Rev. 6, 9/09."

Should the NRC staff require additional information to support review of this application, please do not hesitate to contact Mr. Don Shaw at 410-910-6878 or me at 410-910-6881.

Sincerely,

Jayant Bondre

Jayant Bondre, Ph.D.
Vice President - Engineering

cc: B. Jennifer Davis (NRC SFST) (six paper copies of this cover letter and Enclosures 1 and 2, provided separately)

Enclosures:

1. List of Changed Pages and Discussion of Changes for CoC 1030 Amendment 1 Application Revision 6
2. NUHOMS® HD Amendment 1 Application Revision 6, Changed Proposed Technical Specifications and Proposed Updated Final Safety Analysis Report Pages

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List of Changed Pages and Discussion of Changes for CoC 1030 Amendment 1 Application Revision 6

Page	Discussion
TS Page ii	List of Tables Updated
TS Page 2-2	The reference for Burnup, Enrichment, and Minimum Cooling Time for the 32PTH DSC is now Table 4A, Table 4B, and Table 4C. Also, the statement "The licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification," is added.
TS Page 5-5	TS 5.2.5 changed for clarity.
TS Page 5-6	TS 5.2.5 changed for clarity.
TS Page T-4	Former Table 4 is split into three tables, for clarity. In Table 4B, the discretionary use of UFSAR Table 2-2D examples is added, for clarity.
TS Page T-5	Former Table 4 is split into three tables, for clarity.
TS Page T-6	Table 5/ Table 6 page number has changed.
TS Page T-7	Table 7 page number has changed.
TS Page T-8	Table 7 (concluded) page number has changed.
UFSAR Page 2-ii	List of Tables Updated
UFSAR Page 2-2	The table with the equation discussed on this page is now Table 2-2B
UFSAR Page 2-3	The table with the equation discussed on this page is now Table 2-2B or Table 2-2C
UFSAR Page with Table 2-1 (concluded)	The reference for Burnup, Enrichment, and Minimum Cooling Time for the 32PTH DSC is now Table 2-2A, Table 2-2B, and Table 2-2C. Also, the statement "The licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification," is added.
UFSAR Page with Table 2-2A and Table 2-2B	Former Table 2-2 is split into four tables, for clarity. In Table 2-2B, the discretionary use of Table 2-2D examples is added, for clarity.
UFSAR Page with Table 2-2C	Former Table 2-2 is split into four tables, for clarity.
UFSAR Page with Table 2-2D	Former Table 2-2 is split into four tables, for clarity. The discretionary use of these examples is added, and reference to Section 4.1.6.2 is added, for clarity.
UFSAR Page with Table 2-2D (concluded)	Former Table 2-2 is split into four tables, for clarity.

Enclosure 2 to TN E-28479

NUHOMS® HD Amendment 1 Application Revision 6, Changed Proposed Technical Specifications and Proposed Updated Final Safety Analysis Report Pages

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5.6 Hydrogen Gas Monitoring 5-11

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Figure 2 Heat Load Zones F-2

No. and Location of Damaged Assemblies	*Up to 16 damaged fuel assemblies with balance intact fuel assemblies, or dummy assemblies are authorized for storage in 32PTH DSC.* *Damaged fuel assemblies are to be placed in the center 16 locations as shown in Figure 1. The DSC basket cells which store damaged fuel assemblies are provided with top and bottom end caps to assure retrievability.*
Maximum Assembly plus CC Weight	*1585 lbs*
THERMAL/RADIOLOGICAL PARAMETERS:	
Burnup, Enrichment, and Minimum Cooling Time for the 32PTH DSC	*Per Table 4A, Table 4B, and Table 4C* *The licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.*
Maximum Assembly Average Initial Fuel Enrichment	*5.0 wt. % U-235*
Maximum Decay Heat Limits for Heat Load Zones 1a, 1b, 2 and 3 fuel.	*Per Figure 2*
Decay Heat per DSC	*≤ 34.8 kW for WE 15x15, WE 17x17 and CE 16x16 class fuel assemblies*
	≤ 33.8 kW for CE 14x14 class fuel assemblies

5.2 Programs (continued)

5.2.5 HSM-H Thermal Monitoring Program

This program provides guidance for temperature measurements that are used to monitor the thermal performance of each HSM-H. The intent of the program is to prevent conditions that could lead to exceeding the concrete and fuel clad temperature criteria. *Each user is required to implement 5.2.5a, and each user must implement 5.2.5b OR 5.2.5c.*

a) HSM-H Air Temperature Difference

The user shall develop and implement procedures to measure HSM-H air temperature differences. Following initial 32PTH DSC transfer to the HSM-H, the air temperature difference between ambient temperature and the roof vent temperature will be measured 24 hours after DSC insertion into the HSM and again 7 days after insertion into the HSM-H. If the air temperature differential is greater than 77 F, the air inlets and exits should be checked for blockage. If after removing any blockage found, the temperature difference is *greater than or equal to* 100 F, corrective actions and *evaluation* of existing conditions will be performed in accordance with the site corrective action program to confirm that conditions adversely affecting the concrete or fuel cladding do not exist.

The specified air temperature rise ensures the fuel clad and concrete temperatures are maintained at or below acceptable long-term storage limits. If the temperature rise is *less than* 100 F, then the HSM-H and 32PTH DSC are performing as designed and no further temperature measurements are required.

b) *Daily Visual Inspection of* HSM-H Inlets and Outlets (Front Wall and Roof Bird Screens)

The user shall develop and implement procedures to perform visual inspection of HSM-H inlets and outlets on a daily basis. There is a possibility that the HSM-H air inlet and outlet openings could become blocked by debris, *as postulated and analyzed in the FSAR accident analyses for air vent blockage. The procedures shall ensure that blockage will not exist for periods longer than assumed in the FSAR analyses.*

Perform a daily visual inspection of the air vents to ensure that HSM-H air vents are not blocked for more than 34 hours. *If visual inspection indicates blockage, clear air vents and replace or repair bird screens if damaged. If the air vents are blocked or could have been blocked for more than 34 hours, evaluate existing conditions in accordance with the site corrective action program to confirm that conditions adversely affecting the concrete or fuel cladding do not exist.*

c). *Daily Temperature Measurement Program*

i. The user shall develop a daily temperature measurement program to verify the thermal performance of each NUHOMS-HD system. The user shall establish administrative temperature limits to (1) detect off-normal and accident blockage conditions before the HSM-H components and fuel cladding temperatures would exceed temperature design limits and (2) ensure the HSM-H air vents are not blocked for more than 34 hours. The daily temperature measurements shall include at least one of the following three options:

1) direct measurement of the HSM-H *concrete* temperature
2) direct measurement of the DSC temperature
3) *direct measurement of* inlet and outlet air temperatures.

If the direct measurement of the inlet and outlet air temperatures (option 3) is performed, the measured temperature differences of the inlet and outlet vents of each individual HSM-H must be compared to the predicted temperature differences for each individual HSM-H during normal operations.

ii. The user shall establish in the program, measurement locations in the HSM-H that are representative of the HSM-H thermal performance and directly correlated to the predicted fuel cladding temperatures, air mass flow rates, and NUHOMS-HD temperature distributions that would occur with the off-normal and accident blockage conditions, as analyzed in the FSAR. The administrative temperature limits shall employ appropriate safety margins that ensure temperatures would not exceed design basis temperature limits in the FSAR, and be based on the FSAR methodologies used to predict thermal performance of the NUHOMS-HD system. If the direct measurement of the inlet and outlet air temperatures (option 3) is performed, the user must develop procedures to measure air temperatures that are representative of inlet and outlet air temperatures, as analyzed in the FSAR. The user must also consider site-specific environmental conditions, loaded decay heat patterns, and the proximity of adjacent HSM-H modules in the daily air temperature measurement program. The user must ensure that measured air temperatures reflect only the thermal performance of each individual module, and not the combined performance of adjacent modules.

iii. The user shall establish in the program the appropriate actions to be taken if administrative temperature criteria are exceeded. If an administrative temperature limit is exceeded during a daily measurement, the user shall inspect the vents and implement Technical Specification 5.2.5(b) for the affected system, until the cause of the excursion is determined and necessary corrective actions are completed under the site corrective action program.

iv. If measurements or other evidence indicates that the HSM-H concrete temperatures have exceeded the concrete accident criteria of 350 F for more than 24 hours, *the user shall implement Technical Specification 5.5 and perform an analysis and/or tests of the concrete* in accordance with ACI-349, appendix A.4.3. *The user shall demonstrate* that the structural strength of the HSM-H has an adequate margin of safety *and take appropriate actions to return the HSM-H to normal operating conditions.*

v. If measurements or other evidence indicates that off-normal or accident temperature limits for fuel cladding has been exceeded, verify that canister confinement is maintained and assess analytically the condition of the fuel. Within 30 days, take appropriate actions to return the spent fuel to a safe configuration.

Table 4A

Maximum Allowable Assembly Burnup as a Function of Assembly Average Initial Enrichment

Assembly Average Initial Enrichment (X2) wt.% U-235)	*Maximum Assembly Burnup (X1) (GWD/MTU)*
0.2 ≤ X2 <0.3	*20*
0.3 ≤ X2 <0.7	*25*
0.7 ≤ X2 <1.5	*32*
1.5 ≤ X2 <2.5	*55*
2.5 ≤ X2 <5.00	*60*

Table 4B

For Assembly Average Initial Enrichment Greater Than or Equal to 1.50 wt. % U-235

For an assembly average initial enrichment (wt. % U-235) greater than or equal to 1.50, the equation shown below to calculate the decay heat shall be employed. UFSAR Table 2-2D provides example tables, which may be used at the discretion of the user, to verify the proper use of the equation.

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

$$F1 = A + B*X1 + C*X2 + D*X1^2 + E*X1*X2 + F*X2^2$$
$$DH = F1*Exp(\{[1-(5/X3)]*G\}*[(X3/X1)^H]*[(X2/X1)^I])$$

where,

- F1 Intermediate Function, basically the Thermal source at 5 year cooling
- X1 Assembly Burnup in GWD/MTU
- X2 Assembly Average Initial Enrichment in wt. % U-235 (max 5%, min: Zone 1- 1.5%, Zone 2 -1.6%, Zone 3- 2.5%)
- X3 Cooling Time in Years (min 5 yrs)

A = 13.69479	B =25.79539	C = -3.547739	D = 0.307917	E = -3.809025
F = 14.00256	G = -0.831522	H = 0.078607	I = -0.095900	

All fuel assemblies that are acceptable from a thermal standpoint (heat load zone from Figure 2) are acceptable from a radiological source term standpoint. When irradiated stainless steel rods are present in the reconstituted fuel assembly, add an additional year of cooling time for cooling times less than 10 years.

Table 4C

For Assembly Average Initial Enrichment Less Than 1.50 wt. % U-235

For an assembly average initial enrichment less than 1.5 wt. % U-235, the following qualification shall be employed.

Enrichment Range (wt% U-235)	Max BU (GWD/MTU)	Cooling Time (Years)	Decay Heat (Watts)
$0.7 \leq X2 < 1.5$	32	5	1100
	32	6	900
	32	7	780
	32	10	540
$0.3 \leq X2 < 0.7$	25	5	970
	25	6	800
	25	10	620
$0.2 \leq X2 < 0.3$	20	5	652

For an assembly average enrichment between 0.2 and 0.3 wt. % U-235, fuel assemblies with a burnup below 20 GWD/MTU and a cooling time greater than 5 years are qualified for storage anywhere in the basket.

For an assembly average enrichment between 0.3 and 0.7 wt. % U-235, fuel assemblies with a burnup below 25 GWD/MTU and a cooling time greater than 6 years are qualified for storage anywhere in the basket.

For an assembly average enrichment between 0.7 and 1.5 wt. % U-235, fuel assemblies with a burnup below 32 GWD/MTU and a cooling time greater than 7 years are qualified for storage anywhere in the basket.

Table 5
NFAH Thermal Qualification

This table has been deleted and replaced by revised Technical Specification 2.1 "Fuel to be Stored in the 32PTH DSC" and Table 3.

Table 6
B10 Specification for the NUHOMS®-32PTH Poison Plates

NUHOMS®-32PTH DSC Basket Type	Minimum B10 Areal Density, gm/cm^2	
	Natural or Enriched Boron Aluminum Alloy / Metal Matrix Composite (MMC) (Type I)	Boral® (Type II)
A	0.007	0.009
B	0.015	0.019
C	0.020	0.025
D	0.032	N/A
E	0.050	N/A

Table 7
Maximum Assembly Average Initial Enrichment for Intact and Damaged Fuel Loading

Assembly Class	Maximum Assembly Average Initial Enrichment of U-235 as a Function of Soluble Boron Concentration and Fixed Poison Loading (Basket Type)				
	Basket Type	Minimum Soluble Boron Concentration			
		2000 ppm	2300 ppm	2400 ppm	2500 ppm
CE 14x14 Intact Fuel Assembly (without *CC*)	A	4.05	4.40	4.45	4.55
	B	4.55	4.90	5.00	-
	C	4.70	5.00	-	-
	D	5.00	-	-	-
	E	-	-	-	-
CE 14x14 Intact Fuel Assembly (with CC)	*A*	*3.95*	*4.25*	*4.35*	*4.45*
	B	*4.35*	*4.70*	*4.80*	*4.90*
	C	*4.50*	*4.85*	*5.00*	-
	D	*4.75*	*5.00*	-	-
	E	*5.00*	-	-	-
CE 16x16 Intact Fuel Assembly (without CC)	*A*	*3.90*	*4.10*	*4.20*	*4.30*
	B	*4.30*	*4.60*	*4.70*	*4.80*
	C	*4.50*	*4.80*	*4.90*	*5.00*
	D	*4.80*	*5.00*	*5.00*	*5.00*
	E	*5.00*	*5.00*	*5.00*	*5.00*
CE 16x16 Intact Fuel Assembly (with CC)	*A*	*3.80*	*4.00*	*4.10*	*4.20*
	B	*4.20*	*4.50*	*4.60*	*4.70*
	C	*4.40*	*4.70*	*4.80*	*4.90*
	D	*4.70*	*4.90*	*5.00*	*5.00*
	E	*4.90*	*5.00*	*5.00*	*5.00*
WE 15x15 Intact Fuel Assembly (with and without *CCs*)	A	3.50	3.70	3.80	3.90
	B	3.80	4.10	4.20	4.30
	C	3.95	4.25	4.35	4.45
	D	4.20	4.50	4.70	4.80
	E	4.50	4.80	4.90	5.00
WE 17x17 Intact Fuel Assembly (with and without *CCs*)	A	3.50	3.70	3.80	3.90
	B	3.80	4.10	4.20	4.30
	C	3.95	4.25	4.35	4.45
	D	4.20	4.50	4.60	4.70
	E	4.45	4.70	4.90	5.00

Table 7
Maximum Assembly Average Initial Enrichment for Intact and Damaged Fuel Loading (concluded)

Assembly Class	Maximum Assembly Average Initial Enrichment of U-235 as a Function of Soluble Boron Concentration and Fixed Poison Loading (Basket Type)				
	Basket Type	Minimum Soluble Boron Concentration			
		2000 ppm	2300 ppm	2400 ppm	2500 ppm
CE 14x14 Damaged Fuel Assembly (without CC)	A	3.90	4.20	4.25	4.35
	B	4.35	4.70	4.80	4.90
	C	4.50	4.85	4.95	5.00
	D	4.85	5.00	-	-
	E	5.00	-	-	-
CE 14x14 Damaged Fuel Assembly (with CC)	*A*	*3.70*	*3.95*	*4.05*	*4.10*
	B	*4.10*	*4.40*	*4.50*	*4.60*
	C	*4.20*	*4.55*	*4.65*	*4.75*
	D	*4.50*	*4.85*	*5.00*	-
	E	*4.75*	*5.00*	-	-
CE 16x16 Damaged Fuel Assembly (without CC)	*A*	*3.65*	*3.90*	*4.00*	*4.05*
	B	*4.05*	*4.30*	*4.40*	*4.50*
	C	*4.20*	*4.50*	*4.60*	*4.70*
	D	*4.50*	*4.80*	*4.90*	*5.00*
	E	*4.75*	*5.00*	*5.00*	*5.00*
CE 16x16 Damaged Fuel Assembly (with CC)	*A*	*3.60*	*3.80*	*3.90*	*4.00*
	B	*3.95*	*4.20*	*4.30*	*4.40*
	C	*4.10*	*4.40*	*4.50*	*4.60*
	D	*4.40*	*4.70*	*4.80*	*4.90*
	E	*4.65*	*4.90*	*5.00*	*5.00*
WE 15x15 Damaged Fuel Assembly (with and without CCs)	A	3.40	3.60	3.70	3.80
	B	3.75	4.00	4.10	4.20
	C	3.85	4.15	4.25	4.35
	D	4.10	4.40	4.50	4.60
	E	4.35	4.70	4.80	4.90
WE 17x17 Damaged Fuel Assembly (with and without CCs)	A	3.40	3.60	3.70	3.80
	B	3.75	4.00	4.10	4.20
	C	3.85	4.15	4.25	4.35
	D	4.10	4.40	4.50	4.60
	E	4.30	4.65	4.80	4.90

Note: '—' represents those fixed poison loading (basket type) and soluble boron concentration combinations where fuel assemblies with a maximum assembly average initial enrichment of 5.00 wt % U-235 can be loaded

LIST OF TABLES

2-1 *Fuel to be Stored in the 32PTH DSC*

2-2A ***Maximum Allowable Assembly Burnup as a Function of Assembly Average Initial Enrichment***

2-2B ***For Assembly Average Initial Enrichment Greater Than or Equal to 1.50 wt. % U-235***

2-2C ***For Assembly Average Initial Enrichment Less Than 1.50 wt. % U-235***

2-2D ***Example Tables Which May Be Used to Verify Proper Use of the Equation from Table 2-2B***

2-3 *Spent Fuel Assembly Physical Characteristics*

2-4 *Maximum Control Component Source Terms*

2-5 NUHOMS® HD System Major Components and Safety Classification

2-6 *Maximum Assembly Average Initial Enrichment for Intact and Damaged Fuel Loading*

LIST OF FIGURES

2-1 Heat Load Zones

2-2 Location of Damaged Assemblies

in Figure 2-2, which contain top and bottom end caps that confine any loose material and gross fuel particles to a known, sub-critical volume during normal, off-normal and accident conditions and to facilitate handling and retrievability. Reactor records, visual/videotape records, fuel sipping, ultrasonic examination, and radio chemistry are examples of techniques utilized by utilities to identify damaged fuel.

The end caps are sized to fit inside the fuel compartment (see drawing 10494-72-30). The bottom end cap is slid into the fuel compartment before loading the fuel, utilizing a special tool.

After fuel loading, a top end cap is placed into the fuel compartment. The end caps are not "attached" to the basket, but are a slip/friction fit into the basket compartment. The fuel assembly is thus enclosed/confined by the fuel compartment walls and the end caps. The DSC inner top cover prevents any significant movement of the top end cap. The damaged fuel assemblies can be retrieved simply by removing the top end cap and grappling the fuel assembly by normal means.

The NUHOMS®-32TH DSC basket is designed with three alternate poison materials: Borated Aluminum alloy, Boron Carbide/Aluminum Metal Matrix Composite (MMC) and Boral®.

The NUHOMS®-32PTH DSC basket is analyzed for seven alternate basket configurations, depending on the boron loadings and poison materials.

A summary of the alternate poison loadings considered for each poison material as a function of basket types is presented below:

NUHOMS®-32PTH DSC Basket Type	**Minimum B10 Areal Density, g/cm^2**	
	Natural or Enriched Boron Aluminum Alloy / Metal Matrix Composite (MMC) (Type I)	Boral® (Type II)
A	0.007	0.009
B	0.015	0.019
C	0.020	0.025
D	0.032	N/A
E	0.050	N/A

Table 2-2*B* shows a parametric equation that can be utilized to qualify spent fuel assemblies for the defined decay heat load zones. The decay heat load can be calculated based on a fuel assembly's burnup, cool time, and initial enrichment parameters. This table ensures that the fuel assembly decay heat load is within the appropriate zone. The development of this equation is provided in Appendix 4.16.2.

The maximum fuel cladding temperature limit of 400°C (752°F) is *set for* normal conditions of storage and all short term operations from *the* spent fuel pool to *the* ISFSI pad including vacuum drying and helium backfilling of the NUHOMS®-32PTH DSC per Interim Staff Guidance (ISG)

No. 11, Revision *3* [15]. In addition, the change in fuel cladding temperature *is restricted* to less than 65°C (117°F) and *is limited* to less than 10 *cycles* during DSC drying, backfilling and transfer operations *[15]*.

The maximum fuel cladding temperature limit *is set to* 570°C (1058°F) *for* accidents or off-normal thermal transients [15].

Calculations were performed to determine the fuel assembly type which was most limiting for each of the analyses including shielding, criticality, thermal and confinement. These evaluations are performed in Chapters 5 and 6. The fuel assembly classes considered are listed in Table 2-1. It was determined that the *Framatome ANP Advanced* MK BW 17x17 *(a WE 17x17 Class Assembly)* is the enveloping fuel design for the shielding, thermal and confinement source term calculation because of its total assembly weight and highest initial heavy metal loading. The bounding source term for shielding analysis is *described* in Table 2-3. Table 2-4 presents the thermal and radiological source terms for the *CCs*.

These values are consistent with the cumulative exposures and cooling times of the fuel assemblies. The gamma spectra for the bounding fuel assembly and *CCs* are presented in Chapter 5.

The shielding evaluation is performed assuming 32 fuel assemblies with the parameters *corresponding to a decay heat of* 1.5kW *per fuel assembly*. Any fuel assembly that is thermally qualified by Table 2-2*B or Table 2-2C* is also acceptable from a shielding perspective since the maximum decay heat load is 1.5 kW and only eight (8) are allowed in the 32PTH DSC. The shielding analysis assumes 32, 1.5 kW assemblies are in the 32PTH DSC. Minimum initial enrichments are defined for each of the zones to assure the shielding evaluation is bounding.

For criticality safety, the WE 17x17 is the most reactive assembly type for a given enrichment. This assembly is used to determine the most reactive configuration in the DSC. Using this most reactive configuration, criticality analysis for all other fuel assembly classes is performed to determine the maximum enrichment allowed as a function of the soluble boron concentration and fixed poison plate loading. *These results are shown in Table 2-6 and* the analyses results are presented in Chapter 6.

For calculating the maximum internal pressure in the NUHOMS®-32PTH DSC, it is assumed that 1% of the fuel rods are damaged for normal conditions, up to 10% of the fuel rods are damaged for off normal conditions, and 100% of the fuel rods will be damaged following a design basis accident event. A minimum of 100% of the fill gas and 30% of the fission gases within the ruptured fuel rods are assumed to be available for release into the DSC cavity, consistent with NUREG-1536 [17].

The maximum internal pressures used in the structural analysis for the NUHOMS®-32PTH DSC are 15 and 20 psig for normal and off-normal storage and transfer conditions respectively and 120 and 70 psig during transfer and storage accident conditions respectively.

The structural integrity of the fuel cladding due to the side drop is analyzed in Section 3.5.3. The end and corner drops are not considered credible during storage and transfer. The structural integrity of the fuel cladding due to these loads will be addressed by the users under their site license (10CFR50).

Table 2-1

Fuel to be Stored in the 32PTH DSC

(Concluded)

No. and Location of Damaged Assemblies	*Up to 16 damaged fuel assemblies with balance intact fuel assemblies, or dummy assemblies are authorized for storage in 32PTH DSC.* *Damaged fuel assemblies are to be placed in the center 16 locations as shown in Figure 2-2. The DSC basket cells which store damaged fuel assemblies are provided with top and bottom end caps to assure retrievability.*
Maximum Assembly plus CC Weight	*1585 lbs*
THERMAL/RADIOLOGICAL PARAMETERS:	
Burnup, Enrichment, and Minimum Cooling Time for the 32PTH DSC	*Per Table 2-2A, Table 2-2B, and Table 2-2C* *The licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.*
Maximum Assembly Average Initial Fuel Enrichment	*5.0 wt. % U-235*
Maximum Decay Heat Limits for Heat Load Zones 1a, 1b, 2 and 3 fuel.	*Per Figure 2-1*
Decay Heat per DSC	*≤ 34.8 kW for WE 15x15, WE 17x17 and CE 16x16 class fuel assemblies*
	≤ 33.8 kW for CE 14x14 class fuel assemblies

Table 2-2A

Maximum Allowable Assembly Burnup as a Function of Assembly Average Initial Enrichment

Assembly Average Initial Enrichment (X2) wt.% U-235)	*Maximum Assembly Burnup (X1) (GWD/MTU)*
0.2 ≤ X2 <0.3	*20*
0.3 ≤ X2 <0.7	*25*
0.7 ≤ X2 <1.5	*32*
1.5 ≤ X2 <2.5	*55*
2.5 ≤ X2 <5.00	*60*

Table 2-2B

For Assembly Average Initial Enrichment Greater Than or Equal to 1.50 wt. % U-235

For an assembly average initial enrichment (wt. % U-235) greater than or equal to 1.50, the equation shown below to calculate the decay heat shall be employed. Table 2-2D provides example tables, which may be used at the discretion of the user, to verify the proper use of the equation.

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

$$F1 = A + B*X1 + C*X2 + D*X1^2 + E*X1*X2 + F*X2^2$$
$$DH = F1*Exp(\{[1-(5/X3)]*G\}*[(X3/X1)^H]*[(X2/X1)^I])$$

where,

- F1 Intermediate Function, basically the Thermal source at 5 year cooling
- X1 Assembly Burnup in GWD/MTU
- X2 Assembly Average Initial Enrichment in wt. % U-235 (max 5%, min: Zone 1- 1.5%, Zone 2 -1.6%, Zone 3- 2.5%
- X3 Cooling Time in Years (min 5 yrs)

A = 13.69479 B=25.79539 C=-3.547739 D= 0.307917 E=-3.809025
F = 14.00256 G=-0.831522 H= 0.078607 I =-0.095900

All fuel assemblies that are acceptable from a thermal standpoint (heat load zoning from Figure 2-1) are acceptable from a radiological source term standpoint. When irradiated stainless steel rods are present in the reconstituted fuel assembly, add an additional year of cooling time for cooling times less than 10 years.

Table 2-2C

For Assembly Average Initial Enrichment Less Than 1.50 wt. % U-235

For an assembly average initial enrichment less than 1.5 wt. % U-235, the following qualification shall be employed.

Enrichment Range	*Max BU (GWD/MTU)*	*Cooling Time (Years)*	*Decay Heat (Watts)*
$0.7 \leq X2 < 1.5$	32	5	1100
	32	6	900
	32	7	780
	32	10	620
$0.3 \leq X2 < 0.7$	25	5	970
	25	6	800
	25	7	690
	25	10	540
$0.2 \leq X2 < 0.3$	20	5	652

For an assembly average enrichment between 0.2 and 0.3 wt. % U-235, fuel assemblies with a burnup below 20 GWD/MTU and a cooling time greater than 5 years are qualified for storage anywhere in the basket.

For an assembly average enrichment between 0.3 and 0.7 wt. % U-235, fuel assemblies with a burnup below 25 GWD/MTU and a cooling time greater than 6 years are qualified for storage anywhere in the basket.

For an assembly average enrichment between 0.7 and 1.5 wt. % U-235, fuel assemblies with a burnup below 32 GWD/MTU and a cooling time greater than 7 years are qualified for storage anywhere in the basket.

Table 2-2D

Example Tables Which May Be Used to Verify Proper Use of the Equation from Table 2-2B

Example fuel qualification tables for the various heat load zones that provide the maximum allowable burnup (GWD/MTU) as a function of assembly average initial enrichment (wt. % U-235) and cooling time (years) are shown below. These examples may be used at the discretion of the user to verify proper use of the equation from Table 2-2B. See Appendix 4.1.6.2 for additional details.

Examples for Zone 1a -1050 watts (Burnup GWD/MTU)

Assembly Average Initial Enrichment (wt. % U-235)	*Minimum Cooling Time*					
	5 Years	6 Years	7 Years	8 Years	10 Years	15 Years
1.50	32.8	37.2	40.7	43.7	48.1	55.2
2.50	34.7	39.2	42.7	45.6	50.0	57.0
3.00	35.5	40.1	43.6	46.5	51.0	57.9
3.50	36.2	40.9	44.5	47.4	52.0	58.9
4.00	36.8	41.5	45.3	48.3	52.8	59.9
4.50	37.2	42.1	45.9	49.0	53.7	60.0

Examples for Zone 1b -800 watts (Burnup GWD/MTU)

Assembly Average Initial Enrichment (wt. % U-235)	*Minimum Cooling Time*					
	5 Years	6 Years	7 Years	8 Years	10 Years	15 Years
1.50	26.3	30.0	32.9	35.4	39.2	45.2
2.00	27.1	30.8	33.8	36.2	40.0	46.0
2.50	27.7	31.5	34.5	37.0	40.8	46.7
3.00	28.2	32.1	35.2	37.7	41.5	47.5
3.50	28.5	32.5	35.7	38.3	42.2	48.3
4.00	28.5	32.9	36.2	38.8	42.8	49.0
4.50	28.5	33.0	36.4	39.2	43.3	49.7

Table 2-2D

Example Tables Which May Be Used to Verify Proper Use of the Equation from Table 2-2B (concluded)

Examples for Zone 2 -1100 watts (Burnup GWD/MTU)

Assembly Average Initial Enrichment (wt. % U-235)	*Minimum Cooling Time*					
	5 Years	6 Years	7 Years	8 Years	10 Years	15 Years
1.60	34.2	39.8	42.4	45.4	50.0	57.3
2.50	36.0	40.6	44.2	47.2	51.7	58.9
3.00	36.9	41.5	45.2	48.2	52.8	59.9
3.50	37.6	42.4	46.1	49.1	53.7	60.0
4.00	38.3	43.1	46.9	50.0	54.7	60.0
4.50	38.7	43.8	47.7	50.8	55.6	60.0

Examples for Zone 3 -1500 watts (Burnup GWD/MTU)

Assembly Average Initial Enrichment (wt. % U-235)	*Minimum Cooling Time*			
	5 Years	6 Years	7 Years	8 Years
3.50	47.9	53.5	57.8	60.0
4.00	48.9	54.6	59.0	60.0
4.25	49.4	55.1	59.5	60.0
4.50	49.9	55.6	60.0	60.0