

NUHOMS® HD SYSTEM GENERIC TECHNICAL SPECIFICATIONS

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1.0 USE AND APPLICATION

1.1 Definitions

NOTE

The defined terms of this section appear in capitalized type and are applicable throughout these Technical Specifications and Bases.

<u>Term</u>	<u>Definition</u>
ACTIONS	ACTIONS shall be that part of a Specification that prescribes Required Actions to be taken under designated Conditions within specified Completion Times.
HORIZONTAL STORAGE MODULE (HSM-H)	The HSM-H is a reinforced concrete structure for storage of a loaded 32PTH DSC at a spent fuel storage installation.
DAMAGED FUEL ASSEMBLY	A DAMAGED FUEL ASSEMBLY is a fuel assembly with known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means.
DRY SHIELDED CANISTER (32PTH DSC)	A 32PTH DSC is a welded pressure vessel that provides confinement of INTACT or DAMAGED FUEL ASSEMBLIES in an inert atmosphere.
INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)	The facility within a perimeter fence licensed for storage of spent fuel within HSM-Hs.
INTACT FUEL ASSEMBLY	Spent Nuclear Fuel Assemblies without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means.
LOADING OPERATIONS	LOADING OPERATIONS include all licensed activities on a 32PTH DSC while it is being loaded with INTACT or DAMAGED FUEL ASSEMBLIES, and in a TRANSFER CASK while it is being loaded with a 32PTH DSC containing INTACT or DAMAGED FUEL ASSEMBLIES. LOADING OPERATIONS begin when the first INTACT or DAMAGED FUEL ASSEMBLY is placed in the 32PTH DSC and end when the TRANSFER CASK is ready for TRANSFER OPERATIONS.
STORAGE OPERATIONS	STORAGE OPERATIONS include all licensed activities that are performed at the ISFSI while a 32PTH DSC containing INTACT or DAMAGED FUEL ASSEMBLIES is located in an HSM-H on the storage pad within the ISFSI perimeter.

1.1 Definitions (continued)

TRANSFER CASK (TC)	The TRANSFER CASK consists of a licensed NUHOMS® OS187H onsite transfer cask. The TRANSFER CASK will be placed on a transfer trailer for movement of a 32PTH DSC to the HSM-H.
TRANSFER OPERATIONS	TRANSFER OPERATIONS include all licensed activities involving the movement of a TRANSFER CASK loaded with a 32PTH DSC containing INTACT or DAMAGED FUEL ASSEMBLIES. TRANSFER OPERATIONS begin when the TRANSFER CASK is placed on the transfer trailer following LOADING OPERATIONS and end when the 32PTH DSC is located in an HSM-H on the storage pad within the ISFSI perimeter.
UNLOADING OPERATIONS	UNLOADING OPERATIONS include all licensed activities on a 32PTH DSC to unload INTACT or DAMAGED FUEL ASSEMBLIES. UNLOADING OPERATIONS begin when the 32PTH DSC is removed from the HSM-H and end when the last INTACT or DAMAGED FUEL ASSEMBLY has been removed from the 32PTH DSC.

1.2 Logical Connectors

PURPOSE	<p>The purpose of this section is to explain the meaning of logical connectors.</p> <p>Logical connectors are used in Technical Specifications (TS) to discriminate between, and yet connect, Discrete Conditions, Required Actions, Completion Times, Surveillances, and Frequencies. The only logical connectors that appear in TS are <u>AND</u> and <u>OR</u>. The physical arrangement of these connectors constitutes logical conventions with specific meanings.</p>
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BACKGROUND	<p>Several levels of logic may be used to state Required Actions. These levels are identified by the placement (or nesting) of the logical connectors and by the number assigned to each Required Action. The first level of logic is identified by the first digit of the number assigned to a Required Action and the placement of the logical connector in the first level of nesting (i.e., left justified with the number of the Required Action). The successive levels of logic are identified by additional digits of the Required Action number and by successive indentions of the logical connectors.</p> <p>When logical connectors are used to state a Condition, Completion Time, Surveillance, or Frequency, only the first level of logic is used, and the logical connector is left justified with the statement of the Condition, Completion Time, Surveillance, or Frequency.</p>
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EXAMPLES	The following examples illustrate the use of logical connectors:
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EXAMPLE 1.2-1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO (Limiting Condition for Operation) not met.	A.1 Verify... <u>AND</u> A.2 Restore...	

In this example the logical connector AND is used to indicate that when in Condition A, both Required Actions A.1 and A.2 must be completed.

(continued)

1.2 Logical Connectors (continued)

EXAMPLES
(continued)

EXAMPLE 1.2-2

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO not met.	A.1 Stop... <u>OR</u> A.2 A.2.1 Verify... <u>AND</u> A.2.2 A.2.2.1 Reduce... <u>OR</u> A.2.2.2 Perform... <u>OR</u> A.3 Remove...	

This example represents a more complicated use of logical connectors. Required Actions A.1, A.2, and A.3 are alternative choices, only one of which must be performed as indicated by the use of the logical connector OR and the left justified placement. Any one of these three Actions may be chosen. If A.2 is chosen, then both A.2.1 and A.2.2 must be performed as indicated by the logical connector AND. Required Action A.2.2 is met by performing A.2.2.1 or A.2.2.2. The indented position of the logical connector OR indicates that A.2.2.1 and A.2.2.2 are alternative choices, only one of which must be performed.

1.3 Completion Times

PURPOSE	The purpose of this section is to establish the Completion Time convention and to provide guidance for its use.
BACKGROUND	Limiting Conditions for Operation (LCOs) specify the lowest functional capability or performance levels of equipment required for safe operation of the facility. The ACTIONS associated with an LCO state Conditions that typically describe the ways in which the requirements of the LCO are not met. Specified with each stated Condition are Required Action(s) and Completion Times(s).
DESCRIPTION	<p>The Completion Time is the amount of time allowed for completing a Required Action. It is referenced to the time of discovery of a situation (e.g., equipment or variable not within limits) that requires entering an ACTIONS Condition unless otherwise specified, providing the facility is in a specified condition stated in the Applicability of the LCO. Required Actions must be completed prior to the expiration of the specified Completion Time. An ACTIONS Condition remains in effect and the Required Actions apply until the Condition no longer exists or the facility is not within the LCO Applicability.</p> <p>Once a Condition has been entered, subsequent subsystems, components, or variables expressed in the Condition, discovered to be not within limits, will <u>not</u> result in separate entry into the Condition unless specifically stated. The Required Actions of the Condition continue to apply to each additional failure, with Completion Times based on initial entry into the Condition.</p>
(continued)	

1.3 Completion Times (continued)

EXAMPLES

EXAMPLE 1.3-1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required Action and associated Completion Time not met.	B.1 Perform Action B.1 <u>AND</u>	12 hours
	B.2 Perform Action B.2	36 hours

Condition B has two Required Actions. Each Required Action has its own separate Completion Time. Each Completion Time is referenced to the time that Condition B is entered.

The Required Actions of Condition B are to complete action B.1 within 12 hours AND complete action B.2 within 36 hours. A total of 12 hours is allowed for completing action B.1 and a total of 36 hours (not 48 hours) is allowed for completing action B.2 from the time that Condition B was entered. If action B.1 is completed within 6 hours, the time allowed for completing action B.2 is the next 30 hours because the total time allowed for completing action B.2 is 36 hours.

EXAMPLES

EXAMPLE 1.3-2

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One system not within limit.	A.1 Restore system to within limit.	7 days
B. Required Action and associated Completion Time not met.	B.1 Perform Action B.1. <u>AND</u>	12 hours
	B.2 Perform Action B.2.	36 hours

When a system is determined to not meet the LCO, Condition A is entered. If the system is not restored within 7 days, Condition B is also entered and the Completion Time clocks for Required Actions B.1 and B.2 start. If the system is restored after Condition B is entered, Condition A and B are exited, and therefore, the Required Actions of Condition B may be terminated.

(continued)

1.3 Completion Times (continued)

EXAMPLES (continued)

EXAMPLE 1.3-3

ACTIONS

NOTE

Separate Condition entry is allowed for each component.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO not met.	A.1 Restore compliance with LCO.	4 hours
B. Required Action and associated Completion Time not met.	B.1 Perform Action B.1.	12 hours
	<u>AND</u> B.2 Perform Action B.2.	36 hours

The Note above the ACTIONS Table is a method of modifying how the Completion Time is tracked. If this method of modifying how the Completion Time is tracked was applicable only to a specific Condition, the Note would appear in that Condition rather than at the top of the ACTIONS Table.

The Note allows Condition A to be entered separately for each component, and Completion Times tracked on a per component basis. When a component is determined to not meet the LCO, Condition A is entered and its Completion Time starts. If subsequent components are determined to not meet the LCO, Condition A is entered for each component and separate Completion Times start and are tracked for each component.

IMMEDIATE COMPLETION TIME

When "Immediately" is used as a Completion Time, the Required Action should be pursued without delay and in a controlled manner.

1.4 Frequency

PURPOSE	The purpose of this section is to define the proper use and application of Frequency requirements
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DESCRIPTION	<p>Each Surveillance Requirement (SR) has a specified Frequency in which the Surveillance must be met in order to meet the associated Limiting Condition for Operation (LCO). An understanding of the correct application of the specified Frequency is necessary for compliance with the SR.</p> <p>The "Specified Frequency" is referred to throughout this section and each of the Specifications of Section 3, Surveillance Requirement (SR) Applicability. The "Specified Frequency" consists of the requirements of the Frequency column of each SR, as well as certain Notes in the Surveillance column that modify performance requirements.</p> <p>Situations where a Surveillance could be required (i.e., its Frequency could expire), but where it is not possible or not desired that it be performed until sometime after the associated LCO is within its Applicability, represent potential SR 3.0.4 conflicts. To avoid these conflicts, the SR (i.e., the Surveillance or the Frequency) is stated such that it is only "required" when it can be and should be performed. With a SR satisfied, SR 3.0.4 imposes no restriction.</p>
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(continued)

1.4 Frequency (continued)

EXAMPLES (continued)

The following examples illustrate the various ways that Frequencies are specified:

EXAMPLE 1.4-1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Verify pressure within limit.	12 hours

Example 1.4-1 contains the type of SR most often encountered in the Technical Specifications (TS). The Frequency specifies an interval (12 hours) during which the associated Surveillance must be performed at least one time. Performance of the Surveillance initiates the subsequent interval. Although the Frequency is stated as 12 hours, an extension of the time interval to 1.25 times the stated Frequency is allowed by SR 3.0.2 for operational flexibility. The measurement of this interval continues at all times, even when the SR is not required to be met per SR 3.0.1 (such as when the equipment is determined to not meet the LCO, a variable is outside specified limits, or the unit is outside the Applicability of the LCO). If the interval specified by SR 3.0.2 is exceeded while the facility is in a condition specified in the Applicability of the LCO, the LCO is not met in accordance with SR 3.0.1.

If the interval as specified by SR 3.0.2 is exceeded while the facility is not in a condition specified in the Applicability of the LCO for which performance of the SR is required, the Surveillance must be performed within the Frequency requirements of SR 3.0.2 prior to entry into the specified condition. Failure to do so would result in a violation of SR 3.0.4.

(continued)

1.4 Frequency (continued)

EXAMPLES
(continued)

EXAMPLE 1.4-2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Verify flow is within limits.	Once within 12 hours prior to starting activity <u>AND</u> 24 hours thereafter

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

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

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

(continued)

1.4 Frequency (continued)

EXAMPLES
(continued)

EXAMPLE 1.4-3

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
----- NOTE----- Not required to be met until 96 hours after verifying the helium leak rate is within limit.	Once after verifying the helium leak rate is within limit.
Verify 32PTH DSC vacuum drying pressure is within limit.	

As the Note modifies the required performance of the Surveillance, it is construed to be part of the “specified Frequency.” Should the vacuum drying pressure not be met immediately following verification of the helium leak rate while in LOADING OPERATIONS, this Note allows 96 hours to perform the Surveillance. The Surveillance is still considered to be performed within the “specified Frequency.”

Once the helium leak rate has been verified to be acceptable, 96 hours, plus the extension allowed by SR 3.0.2, would be allowed for completing the Surveillance for the vacuum drying pressure. If the Surveillance was not performed within this 96 hour interval, there would then be a failure to perform the Surveillance within the specified Frequency, and the provisions of SR 3.0.3 would apply.

2.0 FUNCTIONAL AND OPERATING LIMITS

2.1 Fuel to be Stored in the 32PTH DSC

The spent nuclear fuel to be stored in each 32PTH DSC/HSM-H at the ISFSI shall meet the following requirements:

- a. Fuel shall be INTACT FUEL ASSEMBLIES or DAMAGED FUEL ASSEMBLIES. DAMAGED FUEL ASSEMBLIES shall be placed in basket fuel compartments which contain top and bottom end caps. Damaged fuel assemblies shall be stored in the 16 inner-most basket fuel compartments, as shown in Figure 1.
- b. Fuel types shall be limited to the following:

Westinghouse 15 x 15 (WE 15 x 15) Standard Assemblies
Westinghouse Surry Improved 15 x 15 (WES 15 x 15) Assemblies
Westinghouse 17 x 17 (WE 17 x 17) Standard Assemblies
Westinghouse 17 x 17 Vantage 5H (WEV 17 x 17) Assemblies
Westinghouse 17x17 OFA Assemblies (WEO 17x17)
Framatome ANP Advanced MK BW 17 x 17 Assemblies
Combustion Engineering 14x14 (CE 14x14) Assemblies

The fuel assemblies are specified in Table 1. Equivalent reload fuel assemblies that are enveloped by the fuel assembly design characteristics listed in Table 2 for a given assembly class are also acceptable for storage.

Fuel burnup and cooling time is to be consistent with the limitations specified in Table 4.

NFHAs stored integral to the assemblies in a 32PTH DSC, shall be limited to Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Assemblies (TPAs), and Vibration Suppressor Inserts (VSIs). The NFHAs stored shall have acceptable combinations of burnup and cooling time described in Table 5. CE 14x14 fuel assemblies are to be stored without NFHAs.

(continued)

2.1 Fuel to be Stored in the 32PTH DS (continued)

- c. The maximum heat load for a single fuel assembly, including insert components, is 1.5 kW. The maximum heat load per 32PTH DSC, including any integral insert components, shall not exceed 34.8 kW for 15x15 or 17x17 assemblies and 33.8 kW for CE 14x14 assemblies. The total 32PTH DSC shielding source term is given in Table 3. Any fuel assembly that is thermally qualified from Table 4 is acceptable from a shielding perspective, since the maximum decay heat load is 1.5 kW and only 8 are allowed in the 32PTH DSC. The shielding analysis assumes 32, 1.5 kW assemblies are in the 32PTH DSC. Fuel assemblies may be qualified for four (4) heat load zones designated as Zones 1a, 1b, 2 and 3. Figure 2 shows the heat load zone locations. Table 4 identifies the acceptable combinations of enrichment, burnup and cooling times.
 - d. Fuel can be stored in the 32PTH DSC in any of the following configurations:
 - 1) A maximum of 32 INTACT fuel assemblies; or
 - 2) Up to 16 DAMAGED FUEL ASSEMBLIES, with the balance INTACT FUEL ASSEMBLIES.
 - e. Fuel dimensions and weights are provided in Table 2.
 - f. The maximum neutron and gamma source terms are provided in Table 3.
-

2.2 Functional and Operating Limits Violations

If any Functional and Operating Limit of 2.1 is violated, the following actions shall be completed:

- 2.2.1 The affected fuel assemblies shall be placed in a safe condition.
 - 2.2.2 Within 24 hours, notify the NRC Operations Center.
 - 2.2.3 Within 30 days, submit a special report which describes the cause of the violation and the actions taken to restore compliance and prevent recurrence.
-

3.0 LIMITING CONDITION FOR OPERATION (LCO) AND SURVEILLANCE REQUIREMENT (SR) APPLICABILITY

LCO 3.0.1	LCOs shall be met during specified conditions in the Applicability, except as provided in LCO 3.0.2.
LCO 3.0.2	<p>Upon discovery of a failure to meet an LCO, the Required Actions of the associated Conditions shall be met, except as provided in LCO 3.0.5.</p> <p>If the LCO is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated.</p>
LCO 3.0.3	Not applicable to a spent fuel storage cask.
LCO 3.0.4	<p>When an LCO is not met, entry into a specified condition in the Applicability shall not be made except when the associated ACTIONS to be entered permit continued operation in the specified condition in the Applicability for an unlimited period of time. This Specification shall not prevent changes in specified conditions in the Applicability that are required to comply with ACTIONS, or that are related to the unloading of a 32PTH DSC.</p> <p>Exceptions to this Specification are stated in the individual Specifications. These exceptions allow entry into specified conditions in the Applicability when the associated ACTIONS to be entered allow operation in the specified condition in the Applicability only for a limited period of time.</p>
LCO 3.0.5	Equipment removed from service or not in service in compliance with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate it meets the LCO or that other equipment meets the LCO. This is an exception to LCO 3.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate that the LCO is met.
LCO 3.0.6	Not applicable to a spent fuel storage cask.
LCO 3.0.7	Not applicable to a spent fuel storage cask.

(continued)

3.0 Limiting Condition for Operation (LCO) and Surveillance Requirement (SR) Applicability
(continued)

SR 3.0.1 SRs shall be met during the specified conditions in the Applicability for individual LCOs, unless otherwise stated in the SR. Failure to meet a Surveillance, whether such failure is experienced during the performance of the Surveillance or between performances of the Surveillance, shall be failure to meet the LCO. Failure to perform a Surveillance within the specified Frequency shall be failure to meet the LCO except as provided in SR 3.0.3. Surveillances do not have to be performed on equipment or variables outside specified limits.

SR 3.0.2 The specified Frequency for each SR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met.

For Frequencies specified as "once," the above interval extension does not apply. If a Completion Time requires periodic performance on a "once per . . ." basis, the above Frequency extension applies to each performance after the initial performance.

Exceptions to this Specification are stated in the individual Specifications.

SR 3.0.3 If it is discovered that a Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the LCO not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified Frequency, whichever is less. This delay period is permitted to allow performance of the Surveillance.

If the Surveillance is not performed within the delay period, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered.

When the Surveillance is performed within the delay period and the Surveillance is not met, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered.

SR 3.0.4 Entry into a specified condition in the Applicability of an LCO shall not be made unless the LCO's Surveillances have been met within their specified Frequency. This provision shall not prevent entry into specified conditions in the Applicability that are required to comply with ACTIONS or that are related to the unloading of a 32PTH DSC.

3.1 32PTH DSC Fuel Integrity

3.1.1 32PTH DSC Vacuum Drying Time (Duration) and Pressure

LCO 3.1.1

Duration: Vacuum Drying of the 32PTH DSC shall be achieved within the following time durations after drainage of bulk water (blowdown):

- Notes:
1. The DSC shall be backfilled with nitrogen or helium after drainage of bulk water.
 2. Nitrogen or helium will be used to assist the removal of water prior to welding the inner top cover.

Procedure A – Water in the TC cavity/annulus remains below 180°F

Heat Load (kW)	Time Limit
$\text{kW} \leq 23.2$	No limit
$23.2 < \text{kW} \leq 34.8$	36 hours after DSC water drainage
$23.2 < \text{kW} \leq 34.8$	No limit if helium backfill after DSC water drainage

Procedure B – Water in the TC cavity/annulus is drained when it exceeds 180°F

Heat Load (kW)	Time Limit
$\text{kW} \leq 16.0$	No limit
$16.0 < \text{kW} \leq 34.8$	28 hours after DSC water drainage or 14 hours after drainage of TC cavity/annulus water, which ever is limiting

Procedure C – Water in the TC cavity/annulus is drained when it exceeds 180°F and after DSC water drainage the DSC is backfilled with helium.

Heat Load (kW)	Time Limit
$\text{kW} \leq 22.4$	No limit
$22.4 < \text{kW} \leq 34.8$	42 hours after DSC water drainage or 28 hours after drainage of TC cavity/annulus water, which ever is limiting

Pressure: The 32PTH DSC vacuum drying pressure shall be sustained at or below 3 Torr (3 mm Hg) absolute for a period of at least 30 minutes following stepped evacuation.

APPLICABILITY: During LOADING OPERATIONS.

3.1 32PTH DSC Fuel Integrity (continued)

ACTIONS

-----NOTE-----

This specification is applicable to all 32PTH DSCs.

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>A. 32PTH DSC vacuum drying pressure limit not met:</p> <p><u>Procedure A</u>, within 30 hours for a DSC with heat load greater than 23.2 kW.</p> <p><u>Procedure B</u>, within either 22 hours after DSC water drainage or 8 hours after annulus water drainage for a DSC with heat load greater than 16.0 kW.</p> <p><u>Procedure C</u>, within either 36 hours after DSC water drainage or 22 hours after annulus water drainage for a DSC with heat load greater than 22.4 kW.</p>	<p>A.1 Establish helium pressure of at least 0.5 atm and no greater than 20 psig in the 32PTH DSC.</p> <p><u>OR</u></p> <p>A.2 Flood the DSC with water submerging all fuel assemblies.</p>	<p>6 hours</p> <p>6 hours</p>

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>S.R.3.1.1 Verify that the 32PTH DSC vacuum pressure is less than, or equal to, 3 Torr (3 mm Hg) absolute for at least 30 minutes, within the specified total time duration based on heat load.</p>	<p>Once per 32PTH DSC, after an acceptable NDE of the top shield plug weld.</p>

3.1.2 32PTH DSC Helium Backfill Pressure

LCO 3.1.2 32PTH DSC helium backfill pressure shall be 2.5 ± 1 psig (stable for 30 minutes after filling) after completion of vacuum drying.

APPLICABILITY: During LOADING OPERATIONS.

ACTIONS

----- NOTE -----
This specification is applicable to all 32PTH DSCs.

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p><i>Note: Not applicable until SR 3.1.2 is performed.</i></p> <p>A. The required backfill pressure cannot be obtained or stabilized.</p>	A.1 Establish the 32PTH DSC helium backfill pressure to within the limit.	24 hours
	<u>OR</u>	
	A.2 Flood the DSC with water submerging all fuel assemblies.	24 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
S.R.3.1.2 Verify that the 32PTH DSC helium backfill pressure is 2.5 ± 1 psig.	Once per 32PTH DSC, after the completion of TS 3.1.1 actions.

3.1.3 Transfer Cask Cavity Helium Backfill Pressure

LCO 3.1.3 OS187H transfer cask cavity/annulus helium backfill shall be initiated within 9 hours after completion of 32PTH DSC helium backfill and the pressure shall be 2.0 ± 1 psig.

APPLICABILITY: During LOADING OPERATIONS.

ACTIONS

NOTE

This specification is applicable to all 32PTH DSCs/OS187H TC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>NOTE</p> <p>Note: Not applicable until SR 3.1.3 is performed.</p>		
A. The transfer cask annulus helium backfill can't be initiated within 8 hrs of 32PTH DSC helium backfill completion.	A.1 Flood the TC cavity/annulus with water	1 hour
B. The required backfill pressure cannot be obtained or stabilized.	B.1 Establish the TC cavity/annulus helium backfill pressure to within the limit.	18 hours
	<p><u>OR</u></p> <p>B.2 Flood the TC cavity/annulus with water.</p>	18 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
S.R.3.1.3 Verify that the OS187H cavity/annulus helium backfill pressure is 2.0 ± 1 psig.	Once per 32PTH DSC, after the completion of TS 3.1.2 actions or after the installation of TC lid.

3.2 Cask Criticality Control

LCO 3.2 The dissolved boron concentration of the spent fuel pool water and the water added to the cavity of a loaded DSC shall be at least the boron concentration shown in Table 7 for the basket type and fuel enrichment selected.

APPLICABILITY: During LOADING and UNLOADING OPERATIONS.

ACTIONS

----- NOTE -----
This specification is applicable to all 32PTH DSCs/OS187H TC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Dissolved boron concentration limit not meet.	A.1 Suspend loading of fuel assemblies into DSC	Immediately
	<u>AND</u> A.2 Remove all fuel assemblies from DSC	24 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.2.1 Verify dissolved boron concentration limit in spent fuel pool water and water to be added to the DSC cavity is met using two independent measurements.	Within 4 hours prior to commencing LOADING OPERATIONS <u>AND</u> 48 hours thereafter while the DSC is in the spent fuel pool or while water is in the DSC.
SR 3.2.2 Verify dissolved boron concentration limit in spent fuel pool water and water to be added to the DSC cavity is met using two independent measurements.	Once within 4 hours prior to flooding DSC during UNLOADING OPERATIONS <u>AND</u> 48 hours thereafter while the DSC is in the spent fuel pool or while water is in the DSC.

4.0 DESIGN FEATURES

The specifications in this section include the design characteristics of special importance to each of the physical barriers and to maintenance of safety margins in the NUHOMS® HD System design. The principal objective of this section is to describe the design envelope that may constrain any physical changes to essential equipment. Included in this section are the site environmental parameters that provide the bases for design, but are not inherently suited for description as LCOs.

4.1 Site

4.1.1 Site Location

Because this SAR is prepared for a general license, a discussion of a site-specific ISFSI location is not applicable.

4.2 Storage System Features

4.2.1 Storage Capacity

The total storage capacity of the ISFSI is governed by the plant-specific license conditions.

4.2.2 Storage Pad

For sites for which soil-structure interaction is considered important, the licensee is to perform site-specific analysis considering the effects of soil-structure interaction. Amplified seismic spectra at the location of the HSM-H center of gravity (CG) is to be developed based on the SSI responses. HSM-H seismic analysis information is provided in SAR Appendix 3.9.9.10.2.

The storage pad location shall have no potential for liquefaction at the site-specific SSE level earthquake.

Additional requirements for the pad configuration are provided in Section 4.6.2.

(continued)

4.0 Design Features (continued)

4.3 Canister Criticality Control

The NUHOMS®-32PTH is designed for unirradiated fuel with an assembly average initial enrichment of less than or equal to 5.0 wt. % U-235 taking credit for soluble boron in the DSC cavity water during loading operations and the boron content in the poison plates of the DSC basket. The 32PTH DSC has multiple basket configurations, based on the material type and boron content in the poison plates, as listed in Table 6. Table 7 defines the requirements for boron concentration in the DSC cavity water as a function of the DSC basket type for the various intact and damaged fuel classes (most reactive) authorized for storage in the 32PTH DSC.

A Type I basket contains poison plates that are either, borated aluminum or MMC while a Type II basket contains Boral® poison plates. The basket types are further defined by the B-10 areal density in the plates, ranging from the lowest, Type A to the highest, Type E.

4.4 Codes and Standards

4.4.1 Horizontal Storage Module (HSM-H)

The reinforced concrete HSM-H is designed to meet the requirements of ACI 349-97. Load combinations specified in ANSI 57.9-1984, Section 6.17.3.1 are used for combining normal operating, off-normal, and accident loads for the HSM-H.

4.4.2 Dry Shielded Canister (32PTH DSC)

The 32PTH DSC is designed, fabricated and inspected to the maximum practical extent in accordance with ASME Boiler and Pressure Vessel Code Section III, Division 1, 1998 Edition with Addenda through 2000, including exceptions allowed by Code Case N-595-3, Subsections NB, NF, and NG for Class 1 components and supports. Code alternatives are discussed in 4.4.4.

4.4.3 Transfer Cask (OS187H)

The OS187H Transfer Cask is designed, fabricated and inspected to the maximum practical extent in accordance with ASME Boiler and Pressure Vessel Code Section III, 1998 Edition with Addenda through 2000, Subsection NC for Class 2 vessels.

4.4.4 Alternatives to Codes and Standards

ASME Code exceptions for the 32PTH DSC are listed below:

DSC ASME Code Alternatives, Subsection NB

Reference ASME Code Section/Article	Code Requirement	Justification & Compensatory Measures
NCA	All	Not compliant with NCA
NB-1100	Requirements for Code Stamping of Components	The canister shell, the inner top cover/shield plug, the inner bottom cover, and the siphon/vent port cover are designed & fabricated in accordance with the ASME Code, Section III, Subsection NB to the maximum extent practical. However, Code Stamping is not required. As Code Stamping is not required, the fabricator is not required to hold an ASME "N" or "NPT" stamp, or to be ASME Certified.
NB-2130 NB-4121	Material must be supplied by ASME approved material suppliers Material Certification by Certificate Holder	Material is certified to meet all ASME Code criteria but is not eligible for certification or Code Stamping if a non-ASME fabricator is used. As the fabricator is not required to be ASME certified, material certification to NB-2130 is not possible. Material traceability & certification are maintained in accordance with TN's NRC approved QA program.
NB-4243 and NB-5230	Category C weld joints in vessels and similar weld joints in other components shall be full penetration joints. This welds shall be examined by UT or RT and either PT or MT	The joint between the outer top cover and inner top cover/shield plug and shell are design and fabricated per ASME Code Case N-595-3. The welds are partial penetration welds and the root and final layer are PT examined.
NB-2531	Vent & siphon Port Cover; straight beam UT per SA-578 for all plates for vessel	SA-578 applies to 3/8" and thicker plate only; allow alternate UT techniques to achieve meaningful UT results.
NB-6100 and 6200	All completed pressure retaining systems shall be pressure tested	The inner top cover/shield plug assembly is not pressure tested due to the manufacturing sequence. The inner top cover/shield plug assembly weld is helium leak tested when fuel is loaded and then covered with the outer top closure plate.
NB-7000	Overpressure Protection	No overpressure protection is provided for the 32PTH DSC. The function of the 32PTH DSC is to contain radioactive materials under normal, off-normal, and hypothetical accident conditions postulated to occur during transportation. The 32PTH DSC is designed to withstand the maximum internal pressure considering 100% fuel rod failure at maximum accident temperature. The 32PTH DSC is pressure tested in accordance with the requirements of 10CFR71 and TN's approved QA program.

DSC ASME Code Alternatives, Subsection NB (concluded)

Reference ASME Code Section/Article	Code Requirement	Justification & Compensatory Measures
NB-8000	Requirements for nameplates, stamping & reports per NCA-8000	The 32PTH DSC nameplates provide the information required by 10CFR71, 49CFR173, and 10CFR72 as appropriate. Code stamping is not required for the 32PTH DSC. QA Data packages are prepared in accordance with the requirements of 10CFR71, 10CFR72, and TN's approved QA program.
NB-1132	Attachments with a pressure retaining function, including stiffeners, shall be considered part of the component.	Outer bottom cover, bottom plate, bottom casing plate, side casing plate, top shield plug casing plate, lifting post, grapple ring and grapple ring support are outside code jurisdiction; these components together are much larger than required to provide stiffening for the confinement boundary cover. These component welds are subject to root and final PT examinations.

Basket ASME Code Alternatives, Subsection NG/NF

Reference ASME Code Section/Article	Code Requirement	Justification & Compensatory Measures
NCA	All	Not compliant with NCA
NG/NF-1100	Requirements for Code Stamping of Components	The 32PTH DSC baskets are designed & fabricated in accordance with the ASME Code, Section III, Subsection NG to the maximum extent practical as described in the SAR, but Code Stamping is not required. As Code Stamping is not required, the fabricator is not required to hold an ASME N or NPT stamp or be ASME Certified.
NG/NF-2130 NG/NF-4121	Material must be supplied by ASME approved material suppliers Material Certification by Certificate Holder	Material is certified to meet all ASME Code criteria but is not eligible for certification or Code Stamping if a non-ASME fabricator is used. As the fabricator is not required to be ASME certified, material certification to NG/NF-2130 is not possible. Material traceability & certification are maintained in accordance with TN's NRC approved QA program. The poison material and aluminum plates are not used for structural analysis, but to provide criticality control and heat transfer. They are not ASME Code Class I materials. See note 1.
NG/NF-8000	Requirements for nameplates, stamping & reports per NCA-8000	The 32PTH DSC nameplates provide the information required by 10CFR71, 49CFR173, and 10CFR72 as appropriate. Code stamping is not required for the 32PTH DSC. QA Data packages are prepared in accordance with the requirements of 10CFR71, 10CFR72, and TN's approved QA program.

Notes: 1. Because Subsection NCA does not apply, the NCA-3820 requirements for accreditation or qualification of material organizations do not apply. CMTR's shall be provided using NCA- 3862 for guidance.

Proposed alternatives to the ASME code, other than the aforementioned ASME Code alternatives may be used when authorized by the Director of the Office of Nuclear Material Safety and Safeguards, or designee. The applicant should demonstrate that:

1. The proposed alternatives would provide an acceptable level of quality and safety, or
2. Compliance with the specified requirements of ASME Code, Section III, 1998 Edition with Addenda through 2000 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Requests for exceptions in accordance with this section should be submitted in accordance with 10CFR 72.4.

4.0 Design Features (continued)

4.5 HSM-H Side Heat Shields

The HSM-H utilizes side heat shields to protect the HSM-H concrete surfaces and provide for enhanced heat transfer within the HSM-H. Three side heat shield configurations have been evaluated in the SAR: finned side heat shields, flat anodized aluminum plates and flat galvanized steel plates. Limits on the heat load of the DSC's shall be established for the heat shield material types and configurations used through testing or analysis.

4.6 Storage Location Design Features

The following storage location design features and parameters shall be verified by the system user to assure technical agreement with this SAR.

4.6.1 Storage Configuration

HSM-Hs are placed together in single rows or back to back arrays. An end shield wall is placed on the outside end of any loaded outside HSM-H. A rear shield wall is placed on the rear of any single row loaded HSM-H.

4.6.2 Concrete Storage Pad Properties to Limit 32PTH DSC Gravitational Loadings Due to Postulated Drops

The TC/32PTH DSC has been evaluated for drops of up to 80 inches onto a reinforced concrete storage pad. The evaluations are based on the concrete parameters specified in EPRI Report NP-7551, "Structural Design of Concrete Storage Pads for Spent Fuel Casks," August 1991.

(continued)

4.0 Design Features (continued)

4.6.3 Site Specific Parameters and Analyses

The following parameters and analyses shall be verified by the system user for applicability at their specific site. Other natural phenomena events, such as lightning, tsunamis, hurricanes, and seiches, are site specific and their effects are generally bounded by other events, but they should be evaluated by the user.

1. Tornado maximum wind speeds: 290 mph rotational
70 mph translational
 2. Flood levels up to 50 ft. and water velocity of 15 fps.
 3. One-hundred year roof snow load of 110 psf.
 4. Normal ambient temperatures of 0°F to 100°F.
 5. Off-normal ambient temperature range of –20°F without solar insulation to 115°F with full solar insulation.
 6. The potential for fires and explosions shall be addressed, based on site-specific considerations.
 7. Supplemental Shielding: In cases where engineered features (i.e., berms, shield walls) are used to ensure that the requirements of 10CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category.
 8. Seismic loads of up to 0.30g horizontal and up to 0.20 g vertical.
-

5.0 ADMINISTRATIVE CONTROLS

5.1 Procedures

Each user of the NUHOMS® HD System will prepare, review, and approve written procedures for all normal operations, maintenance, and testing at the ISFSI prior to its operation. Written procedures shall be established, implemented, and maintained covering the following activities that are important to safety:

- Organization and management
 - Routine ISFSI operations
 - Alarms and annunciators
 - Emergency operations
 - Design control and facility change/modification
 - Control of surveillances and tests
 - Control of special processes
 - Maintenance
 - Health physics, including ALARA practices
 - Special nuclear material accountability
 - Quality assurance, inspection, and audits
 - Physical security and safeguards
 - Records management
 - Reporting
 - All programs specified in Section 5.2
-

5.2 Programs

Each user of the NUHOMS® HD System will implement the following programs to ensure the safe operation and maintenance of the ISFSI:

- Safety Review Program
- Training Program
- Radiological Environmental Monitoring Program
- Radiation Protection Program
- HSM-H Thermal Monitoring Program

5.2.1 Safety Review Program

Users shall conduct safety reviews in accordance with 10CFR 72.48 to determine whether proposed changes, tests, and experiments require NRC approval before implementation. Changes to the Technical Specification Bases and other licensing basis documents will be conducted in accordance with approved administrative procedures.

Changes may be made to Technical Specification Bases and other licensing basis documents without prior NRC approval, provided the changes meet the criteria of 10CFR 72.48.

The safety review process will contain provisions to ensure that the Technical Specification Bases and other licensing basis documents are maintained consistent with the SAR.

Proposed changes that do not meet the criteria above will be reviewed and approved by the NRC before implementation. Changes to the Technical Specification Bases implemented without prior NRC approval will be provided to the NRC in accordance with 10CFR 72.48.

(continued)

5.2 Programs (continued)

5.2.2 Training Program

Training modules shall be developed as required by 10CFR 72. Training modules shall require a comprehensive program for the operation and maintenance of the NUHOMS® HD System and the independent spent fuel storage installation (ISFSI). The training modules shall include the following elements, at a minimum:

- NUHOMS® HD System design (overview)
- ISFSI Facility design (overview)
- Systems, Structures, and Components Important to Safety (overview)
- NUHOMS® HD System Safety Analysis Report (overview)
- NRC Safety Evaluation Report (overview)
- Certificate of Compliance conditions
- NUHOMS® HD System Technical Specifications
- Applicable Regulatory Requirements (e.g., 10CFR 72, Subpart K, 10CFR 20, 10 CFR Part 73)
- Required Instrumentation and Use
- Operating Experience Reviews
- NUHOMS® HD System and Maintenance procedures, including:
 - Fuel qualification and loading,
 - Rigging and handling,
 - Loading Operations as described in Chapter 8 of the SAR,
 - Unloading Operations including reflooding,
 - Auxiliary equipment operations and maintenance (i.e., welding operations, vacuum drying, helium backfilling and leak testing, reflooding),
 - Transfer operations including loading and unloading of the Transfer Vehicle,
 - ISFSI Surveillance operations,
 - Radiation Protection,
 - Maintenance, as described in Section 9.2 of the SAR,
 - Security, and
 - Off-normal and accident conditions, responses and corrective actions.

(continued)

5.2 Programs (continued)

5.2.3 Radiological Environmental Monitoring Program

- a) A radiological environmental monitoring program will be implemented to ensure that the annual dose equivalent to an individual located outside the ISFSI controlled area does not exceed the annual dose limits specified in 10CFR 72.104(a).
- b) Operation of the ISFSI will not create any radioactive materials or result in any credible liquid or gaseous effluent release.

5.2.4 Radiation Protection Program

The Radiation Protection Program will establish administrative controls to limit personnel exposure to As Low As Reasonably Achievable (ALARA) levels in accordance with 10CFR Part 20 and Part 72.

- a) As part of its evaluation pursuant to 10CFR 72.212, the licensee shall perform an analysis to confirm that the limits of 10CFR 20 and 10CFR 72.104 will be satisfied under the actual site conditions and configurations considering the planned number of 32PTH DSCs to be used and the planned fuel loading conditions.
- b) A monitoring program to ensure the annual dose equivalent to any real individual located outside the ISFSI controlled area does not exceed regulatory limits is incorporated as part of the environmental monitoring program in the Radiological Environmental Monitoring Program of Section 5.2.3.
- c) Following placement of each loaded Transfer Cask into the cask decontamination area and prior to transfer to the ISFSI, the 32PTH DSC smearable surface contamination levels on the outer surface of the 32PTH DSC shall be less than 2,200 dpm/100 cm² from beta and gamma emitting sources, and less than 220 dpm/100 cm² from alpha emitting sources.

The contamination limits specified above are based on the allowed removable external radioactive contamination specified in 49 CFR 173.443 (as referenced in 10 CFR 71.87(i)) the system provides significant additional protection for the 32PTH DSC surface than the transportation configuration. The HSM-H will protect the 32PTH DSC from direct exposure to the elements and will therefore limit potential releases of removable contamination. The probability of any removable contamination being entrapped in the HSM-H air flow path released outside the HSM-H is considered extremely small.

(continued)

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.

a) HSM-H Air Temperature Difference

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 70°F, the air inlets and exits should be checked for blockage. If after removing any blockage found, the temperature difference is still greater than that $\leq 100^\circ\text{F}$, corrective actions and analysis 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 within the $\leq 100^\circ\text{F}$, then the HSM-H and 32PTH DSC are performing as designed and no further temperature measurements are required.

b) HSM-H Air Vents

Since the HSM-Hs are located outdoors, there is a possibility that the HSM-H air inlet and outlet openings could become blocked by debris. Although the ISFSI security fence and HSM-H bird screens reduce the probability of HSM-H air vent blockage, the ISFSI SAR postulates and analyzes the effects of air vent blockage.

The HSM-H design and accident analyses demonstrate the ability of the ISFSI to function safely if obstructions in the air inlets or outlets impair airflow through the HSM-H for extended periods. This specification ensures that blockage will not exist for periods longer than assumed in the analyses.

Site personnel will conduct a daily visual inspection of the air vents to ensure that HSM-H air vents are not blocked for more than 34 hours and that blockage will not exist for periods longer than assumed in the safety analysis.

(continued)

5.3 Lifting Controls

5.3.1 Transfer Cask Lifting Heights

The lifting height of a loaded transfer cask/32PTH DSC, is limited as a function of location, as follows:

- a) The maximum lift height and handling height for all TRANSFER OPERATIONS where the TC/32PTH is in the horizontal position on the trailer shall be 80 inches.
- b) The maximum lift height of the transfer cask/32PTH DSC shall be restricted by site (10CFR50) limits for all handling operations except those listed in 5.3.1a above. An evaluation of the fuel cladding structural integrity shall be performed for all credible drops under the user's 10CFR50 heavy loads program.

These restrictions ensure that any 32PTH DSC drop as a function of location is within the bounds of the accident analysis.

5.3.2 Cask Drop

Inspection Requirement

The 32PTH DSC will be inspected for damage after any transfer cask drop of fifteen inches or greater.

Background

TC/32PTH DSC handling and loading activities are controlled under the 10CFR 50 license until a loaded TC/32PTH DSC is placed on the transporter, at which time fuel handling activities are controlled under the 10CFR 72 license. Although the probability of dropping a loaded TC/32PTH DSC while en route from the Fuel Handling Building to the ISFSI is small, the potential exists to drop the cask 15 inches or more.

(continued)

5.3 Lifting Controls (continued)

5.3.2 Cask Drop (continued)

Safety Analysis

The analysis of bounding drop scenarios shows that the transfer cask will maintain the structural integrity of the 32PTH DSC confinement boundary from an analyzed side drop height of 80 inches. The 80-inch drop height envelopes the maximum height from the bottom of the transfer cask when secured to the transfer trailer while en route to the ISFSI.

Although analyses performed for cask drop accidents at various orientations indicate much greater resistance to damage, requiring the inspection of the DSC after a drop of 15 inches or greater ensures that:

1. The DSC will continue to provide confinement.
 2. The transfer cask can continue to perform its design function regarding DSC transfer and shielding.
-

5.4 HSM Dose Rate Evaluation Program

This program provides a means to help ensure that the cask (DSC) is loaded properly and that the facility will meet the off-site dose requirements of 72.104(a).

1. As part of its evaluation pursuant to 10 CFR 72.212, the licensee shall perform an analysis to confirm that the limits of 10 CFR Part 20 and 10 CFR 72.104 will be satisfied under the actual site conditions and configurations considering the planned number of HSMs to be used and the planned fuel loading conditions.
 2. On the basis of the analysis in TS 5.4.1, the licensee shall establish a set of HSM-H dose rate limits which are to be applied to 32PTH DSCs used at the site. Limits shall establish peak dose rates for:
 - a. HSM-H front surface,
 - b. HSM-H door centerline, and
 - c. End shield wall exterior.
 3. Notwithstanding the limits established in TS 5.4.2, the dose rate limits may not exceed the following values as calculated for a content of design basis fuel as follows:
 - a. 800 mrem/hr at the front bird screen,
 - b. 2 mrem/hr at the door centerline, and
 - c. 2 mrem/hr at the end shield wall exterior.
 4. If the measured dose rates do not meet the limits of TS 5.4.2 or TS 5.4.3, whichever are lower, the licensee shall take the following actions:
 - a. Notify the U.S. Nuclear Regulatory Commission (Director of the Office of Nuclear Material Safety and Safeguards) within 30 days,
 - b. Administratively verify that the correct fuel was loaded,
 - c. Ensure proper installation of the HSM door,
 - d. Ensure that the DSC is properly positioned on the support rails, and
 - e. Perform an analysis to determine that placement of the as-loaded DSC at the ISFSI will not cause the ISFSI to exceed the radiation exposure limits of 10 CFR Part 20 and 72 and/or provide additional shielding to assure exposure limits are not exceeded.
-

5.5 Concrete Testing

HSM-H concrete shall be tested for elevated temperatures to verify that there are no significant signs of spalling or cracking and that the concrete compressive strength is greater than that assumed in the structural analysis. Tests shall be performed at or above the calculated peak temperature and for a period no less than the 40 hour duration of HSM-H blocked vent transient for components exceeding 350 degrees F.

Table 1
Fuel Specifications

Fuel Type	Maximum Assembly Average Initial Enrichment	Cladding Material	Minimum Cooling Time	Minimum Assembly Average Initial Enrichment	Maximum Burnup
WE 15x15 WES 15x15	5.0 weight % U-235	Zircalloy-4 Zirlo	5 years	See Table 4 for Enrichment, Burnup, and Cooling Time Limits.	60 GWD/MTU
WE 17x17 WEV 17x17 WE 17x17 OFA	5.0 weight % U-235	Zircalloy-4 Zirlo	5 years	See Table 4 for Enrichment, Burnup, and Cooling Time Limits	60 GWd/MTU
Framatome MK BW 17x17	5.0 weight % U-235	M5	5 years	See Table 4 for Enrichment, Burnup, and Cooling Time Limits	60 GWd/MTU
CE 14x14	5.0 weight % U-235	Zircalloy-4 Zirlo	5 years	See Table 4 for Enrichment, Burnup, and Cooling Time Limits	60 GWd/MTU
NFHA	N/A	N/A	See Table 5		

Table 2
Fuel Dimension and Weights

Parameter	15x15 WE &WES	17 x 17 WE	17x17 MK BW	17x17 WEV	17x17 WEO	14x14 CE
Initial Enrichment, wt % U235 (max)	5.00	5.00	5.00	5.00	5.00	5.00
Clad Material	Zr-4/Zirlo	Zr-4/Zirlo	M5	Zr-4/Zirlo	Zr-4/Zirlo	Zr-4/Zirlo
No of fuel rods	204	264	264	264	264	176
No of guide/instrument tubes	21	25	25	25	25	5
Assembly Length ⁽³⁾	162.2	162.4	162.4	162.4	162.4	159.5
Max Uranium Loading (MTU)	467	467	476	467	467	385
Assembly Cross Section	8.424 x 8.424	8.426 x 8.426	8.425 x 8.425	8.426 x 8.426	8.426 x 8.426	8.25 x 8.25
Max Assembly Weight with Insert components ⁽⁴⁾	1528	1575	1554	1533	1533	1450 ⁽⁵⁾

- (1) Nominal values shown unless stated otherwise
(2) All dimensions are inches
(3) Includes allowance for irradiation growth
(4) Weights of TPAs and VSIs are enveloped by BPRAs
(5) Without NFHAs

Table 3
Maximum Neutron and Gamma Source Terms

Parameter	Framatome MK BW
Gamma Source (γ /sec/DSC)	2.22E+17
Neutron Source (n/sec/DSC)	3.52E+10

Parameter	BPRA
Gamma Source (γ /sec/assy)*	2.30E+14
Decay heat (Watts/assy)**	9

* - 30GWD/MTU cooled 4 days

** - 30GWD/MTU cooled 5 years

Table 4
Fuel Qualification Table(s)

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

$$F1 = A + B \cdot X1 + C \cdot X2 + D \cdot X1^2 + E \cdot X1 \cdot X2 + F \cdot X2^2$$

$$DH = F1 \cdot \text{Exp}(\{[1 - (5/X3)]^G\} \cdot [(X3/X1)^H] \cdot [(X2/X1)^I])$$

where,

- F1 Intermediate Function, basically the Thermal source at 5 year cooling
 X1 Assembly Burnup in GWD/MTU
 X2 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

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

Enrichment (wt. % U-235)	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)

Enrichment (wt. % U-235)	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 4
Fuel Qualification Table(s) (concluded)
Examples for Zone 2 -1100 watts (Burnup GWD/MTU)

Enrichment (wt. % U- 235)	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)

Enrichment (wt. % U- 235)	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

Table 5
NFAH Thermal Qualification

Minimum Cooling Time (years)

NFAH	30 GWD/MTU	40 GWD/MTU	50 GWD/MTU	210 GWD/MTU
BPRA/VS1	5	7	9	-
TPA				2
Criteria: Insert decay heat ≤ 9 watts				

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

Note: The applicant will qualify new neutron absorbers or changes to existing absorbers per the information provided in Chapter 9 of the safety analysis report.

Table 7
Maximum Initial Enrichment for Intact and Damaged Fuel Loading

Assembly Class and Type	Maximum 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 Fuel Assembly (Intact Fuel Loading)	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	-	-	-	-
WE 15x15 Fuel Assembly (with BPRAs)	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 Fuel Assembly (with BPRAs)	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
CE 14x14 Fuel Assembly (Damaged Fuel Loading)	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	-	-	-
WE 15x15 Fuel Assembly (with BPRAs - bounds all Damaged Fuel Loading)	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 Fuel Assembly (with BPRAs - bounds all Damaged Fuel Loading)	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

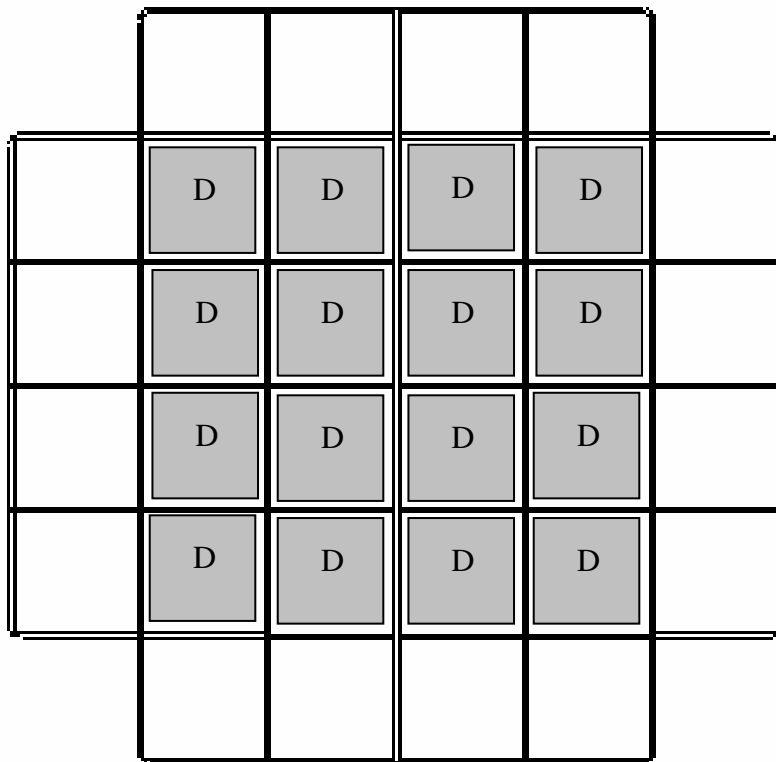
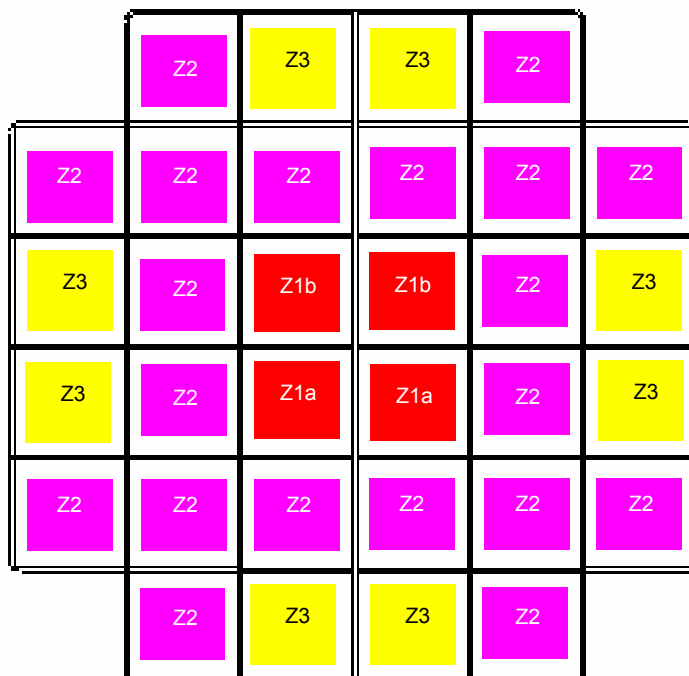


Figure 1
Damaged Fuel Assembly Locations



For CE 14x14 Assemblies

- Q_{zi} is the maximum decay heat per assembly in zone i
- Total Decay Heat ≤ 33.8 kW
- 4 fuel assemblies in zone 1 with $Q_{z1} \leq 0.775$ kW
- 20 fuel assemblies in zone 2 with $Q_{z2} \leq 1.068$ kW
- 8 fuel assemblies in zone 3 with $Q_{z3} \leq 1.5$ kW

For other Assemblies

- Q_{zi} is the maximum decay heat per assembly in zone i
- Total Decay Heat ≤ 34.8 kW
- 4 fuel assemblies in zone 1 with
 - total decay heat ≤ 3.2 kW
 - $Q_{z1a} \leq 1.05$ kW in the lower compartments
 - $Q_{z1b} \leq 0.8$ kW in the upper compartments
- 20 fuel assemblies in zone 2 with $Q_{z2} \leq 1.1$ kW
- 8 fuel assemblies in zone 3 with $Q_{z3} \leq 1.5$ kW

Figure 2
Heat Load Zones