PROPOSED CERTIFICATE OF COMPLIANCE NO. 1014

APPENDIX B

TECHNICAL SPECIFICATIONS

FOR THE HI-STORM 100 CASK SYSTEM

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1 DEFINITIONS, USE, AND APPLICATION

1.1 Definitions

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

Term	Definition
ACTIONS	ACTIONS shall be that part of a Specification that prescribes Required Actions to be taken under designated Conditions within specified Completion Times.
CASK TRANSFER FACILITY (CTF)	A CASK TRANSFER FACILITY is an optional aboveground or underground system used during the transfer of a loaded MPC between a transfer cask and a storage OVERPACK external to 10 CFR Part 50 controlled structures. The CASK TRANSFER FACILITY includes the following components and equipment: (1) a Cask Transfer Structure used to stabilize the OVERPACK, TRANSFER CASK and/or MPC during lifts involving spent fuel not bounded by the regulations of 10 CFR Part 50, and (2) Either a stationary lifting device or a mobile lifting device used in concert with the stationary structure to lift the OVERPACK, TRANSFER CASK, and/or MPC.
DAMAGED FUEL ASSEMBLY	DAMAGED FUEL ASSEMBLIES are fuel assemblies with known or suspected cladding defects, as determined by a review of records, greater than pinhole leaks or hairline cracks, empty fuel rod locations that are not filled with dummy fuel rods, missing structural components such as grid spacers, whose structural integrity has been impaired such that geometric rearrangement of fuel or gross failure of the cladding is expected based on engineering evaluations, or that cannot be handled by normal means. Fuel assemblies that cannot be handled by normal means due to fuel cladding damage are considered FUEL DEBRIS.

Term	Definition
DAMAGED FUEL CONTAINER (DFC)	DFCs are specially designed enclosures for DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS which permit gaseous and liquid media to escape while minimizing dispersal of gross particulates. DFCs authorized for use in the HI-STORM 100 System are as follows: 1. Holtec Dresden Unit 1/Humboldt Bay design 2. Transnuclear Dresden Unit 1 design 3. Holtec Generic BWR design 4. Holtec Generic PWR design
DAMAGED FUEL ISOLATOR (DFI)	DFIs are specially designed barriers installed at the top and bottom of the storage cell space which permit flow of gaseous and liquid media while preventing the potential migration of fissile material from fuel assemblies with cladding damage. DFIs are used ONLY with damaged fuel assemblies which can be handled by normal means and whose structural integrity is such that geometric rearrangement of fuel is not expected. Damaged fuel stored in DFIs may contain missing or partial fuel rods and/or fuel rods with known or suspected cladding defects greater than hairline cracks or pinhole leaks.
FUEL DEBRIS	FUEL DEBRIS is ruptured fuel rods, severed rods, loose fuel pellets, containers or structures that are supporting these loose fuel assembly parts, or fuel assemblies with known or suspected defects which cannot be handled by normal means due to fuel cladding damage.
FUEL BUILDING	The FUEL BUILDING is the site-specific power plant facility, governed by the regulations of 10 CFR Part 50, where the loaded OVERPACK or TRANSFER CASK is transferred to or from the transporter.

Term	Definition
GROSSLY BREACHED SPENT FUEL ROD	Spent nuclear fuel rod with a cladding defect that could lead to the release of fuel particulate greater than the average size fuel fragment for that particular assembly. A gross cladding breach may be confirmed by visual examination, through a review of reactor operating records indicating the presence of heavy metal isotopes, or other acceptable inspection means.
INTACT FUEL ASSEMBLY	INTACT FUEL ASSEMBLIES are fuel assemblies without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means. Fuel assemblies without fuel rods in fuel rod locations shall not be classified as INTACT FUEL ASSEMBLIES unless dummy fuel rods are used to displace an amount of water greater than or equal to that displaced by the fuel rod(s) in the active region. INTACT FUEL ASSEMBLIES may contain integral fuel absorber rods (IFBA) in PWR fuel, or burnable poison rods in BWR fuel.
LOADING OPERATIONS	LOADING OPERATIONS include all licensed activities on an OVERPACK or TRANSFER CASK while it is being loaded with fuel assemblies. LOADING OPERATIONS begin when the first fuel assembly is placed in the MPC and end when the OVERPACK or TRANSFER CASK is suspended from or secured on the transporter. LOADING OPERATIONS does not include MPC TRANSFER.
MINIMUM ENRICHMENT	MINIMUM ENRICHMENT is the minimum assembly average enrichment. Natural uranium and low enrichment blankets are not considered in determining minimum enrichment.
MULTI-PURPOSE CANISTER (MPC)	MPCs are the sealed spent nuclear fuel canisters which consist of a honeycombed fuel basket contained in a cylindrical canister shell which is welded to a baseplate, lid with welded port cover plates, and closure ring. The MPC provides the confinement boundary for the contained radioactive materials.

Term	Definition
MPC TRANSFER	MPC TRANSFER begins when the MPC is lifted off the TRANSFER CASK bottom lid and ends when the MPC is supported from beneath by the OVERPACK or VVM (or the reverse).
NON-FUEL HARDWARE	NON-FUEL HARDWARE is defined as Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Devices (TPDs), Control Rod Assemblies (CRAs), Axial Power Shaping Rods (APSRs), Wet Annular Burnable Absorbers (WABAs), Rod Cluster Control Assemblies (RCCAs), Control Element Assemblies (CEAs), Neutron Source Assemblies (NSAs), water displacement guide tube plugs, orifice rod assemblies, instrument tube tie rods (ITTRs), vibration suppressor inserts, and components of these devices such as individual rods.
OVERPACK	OVERPACKs are the casks which receive and contain the sealed MPCs for interim storage on the ISFSI. They provide gamma and neutron shielding, and in some versions, may provide for ventilated air flow to promote heat transfer from the MPC to the environs. The term OVERPACK does not include the TRANSFER CASK.
PLANAR-AVERAGE INITIAL ENRICHMENT	PLANAR AVERAGE INITIAL ENRICHMENT is the average of the distributed fuel rod initial enrichments within a given axial plane of the assembly lattice.
REDUNDANT PORT COVER DESIGN	REDUNDANT PORT COVER DESIGN refers to two independent port cover plates per port opening, where each port cover plate contains multiple pass closure welds.
REPAIRED/RECONSTITUTED FUEL ASSEMBLY	Spent nuclear fuel assembly which contains dummy fuel rod(s) that displaces an amount of water greater than or equal to the original fuel rod(s) and/or which contains structural repairs so it can be handled by normal means.

Term	Definition
SPENT FUEL STORAGE CASKS (SFSCs)	SFSCs are containers approved for the storage of spent fuel assemblies at the ISFSI. The HI-STORM 100 SFSC System consists of the OVERPACK/VVM and its integral MPC.
STORAGE OPERATIONS	STORAGE OPERATIONS include all licensed activities that are performed at the ISFSI while an SFSC containing spent fuel is situated within the ISFSI perimeter. STORAGE OPERATIONS does not include MPC TRANSFER.
TRANSFER CASK	TRANSFER CASKs are containers designed to contain the MPC during and after loading of spent fuel assemblies and to transfer the MPC to or from the OVERPACK/VVM. The HI-STORM 100 System employs either the 125-Ton or the 100-Ton HI-TRAC TRANSFER CASK. For use with Appendix D, the definition of TRANSFER CASK also includes the HI-TRAC MS.
TRANSPORT OPERATIONS	TRANSPORT OPERATIONS include all licensed activities performed on an OVERPACK or TRANSFER CASK loaded with one or more fuel assemblies when it is being moved after LOADING OPERATIONS or before UNLOADING OPERATIONS. TRANSPORT OPERATIONS begin when the OVERPACK or TRANSFER CASK is first suspended from or secured on the transporter and end when the OVERPACK or TRANSFER CASK is at its destination and no longer secured on or suspended from the transporter. TRANSPORT OPERATIONS includes MPC TRANSFER.

Term	Definition
UNDAMAGED FUEL ASSEMBLY	UNDAMAGED FUEL ASSEMBLY is: a) a fuel assembly without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means; or b) a BWR fuel assembly with an intact channel, a maximum planar average initial enrichment of 3.3 wt% U-235, without known or suspected GROSSLY BREACHED SPENT FUEL RODS, and which can be handled by normal means. An UNDAMAGED FUEL ASSEMBLY may be a REPAIRED/ RECONSTITUTED FUEL ASSEMBLY.
UNLOADING OPERATIONS	UNLOADING OPERATIONS include all licensed activities on an SFSC to be unloaded of the contained fuel assemblies. UNLOADING OPERATIONS begin when the OVERPACK or TRANSFER CASK is no longer suspended from or secured on the transporter and end when the last fuel assembly is removed from the SFSC. UNLOADING OPERATIONS does not include MPC TRANSFER.
UNVENTILATED OVERPACK	The UNVENTILATED OVERPACK is an aboveground OVERPACK which receives and contains the sealed MPC for interim storage at the ISFSI. The UNVENTILATED OVERPACK design is characterized by its absence of inlet and outlet ventilation passages.
VENTILATED OVERPACK	The VENTILATED OVERPACK is an aboveground OVERPACK which receives and contains the sealed MPC for interim storage at the ISFSI. The VENTILATED OVERPACK provides passages for airflow to promote heat transfer from the MPC.
VERTICAL VENTILATED MODULE (VVM) (HI-STORM 100U SYSTEM ONLY)	The VVM is a subterranean type overpack which receives and contains the sealed MPC for interim storage at the ISFSI. The VVM supports the MPC in a vertical orientation and provides air flow through cooling passages to promote heat transfer from the MPC to the environs.

Term	Definition
ZR	ZR means any zirconium-based fuel cladding or fuel channel material authorized for use in a commercial nuclear power plant reactor.

1.2 Logical Connectors

PURPOSE	The purpose of this section is to explain the meaning of logical connectors. 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 AND and OR. The physical arrangement of these connectors constitutes logical conventions with specific meanings.
BACKGROUND	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. 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.

(continued)

EXAMPLES

The following examples illustrate the use of logical connectors.

EXAMPLE 1.2-1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO not met.	A.1 VERIFY . . . AND 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)

EXAMPLES (continued)

EXAMPLE 1.2-2

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO not met.	A.1 Stop . . . OR A.2.1 Verify . . . AND A.2.2.1 Reduce . . . OR A.2.2.2 Perform . . . OR 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 can fail to be met. Specified with each stated Condition are Required Action(s) and Completion Times(s).
DESCRIPTION	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 HI-STORM 100 System 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 HI-STORM 100 System is not within the LCO Applicability. Once a Condition has been entered, subsequent subsystems, components, or variables expressed in the Condition, discovered to be not within limits, will not 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.

(continued)

EXAMPLES

The following examples illustrate the use of Completion Times with different types of Conditions and changing Conditions.

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	12 hours
	AND	
	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.

(continued)

EXAMPLES (continued)

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 Complete action B.1. AND B.2 Complete action B.2.	12 hours 36 hours

When a system is determined not to 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, Conditions A and B are exited, and therefore, the Required Actions of Condition B may be terminated.

(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 Complete action B.1. AND B.2 Complete action B.2.	6 hours 12 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.

(continued)

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.
DESCRIPTION	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. The "specified Frequency" is referred to throughout this section and each of the Specifications of Section 3.0, Surveillance Requirement (SR) Applicability. The "specified Frequency" consists of the requirements of the Frequency column of each SR. 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 an SR satisfied, SR 3.0.4 imposes no restriction.

(continued)

EXAMPLES

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 interval specified in the 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 or variables are outside specified limits, or the facility 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)

EXAMPLES

(continued)

EXAMPLE 1.4-2

SURVEILLANCE REQUIREMENTS

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

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

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

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

2 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

2.1.1 Fuel To Be Stored In The HI-STORM 100 SFSC System

a. INTACT FUEL ASSEMBLIES, UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, FUEL DEBRIS, and NON-FUEL HARDWARE meeting the limits specified in Table 2-1 and other referenced tables may be stored in the HI-STORM 100 SFSC System.

b. For MPCs partially loaded with stainless steel clad fuel assemblies, all remaining fuel assemblies in the MPC shall meet the decay heat generation limit for the stainless steel clad fuel assemblies.

c. For MPCs partially loaded with array/class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A fuel assemblies, all remaining ZR clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the 6x6A, 6x6B, 6x6C, 7x7A and 8x8A fuel assemblies.

d. All BWR fuel assemblies may be stored with or without ZR channels with the exception of array/class 10x10D and 10x10E fuel assemblies, which may be stored with or without ZR or stainless steel channels.

2.1.2 Uniform Fuel Loading

Any authorized fuel assembly may be stored in any fuel storage location, subject to other restrictions related to DAMAGED FUEL, FUEL DEBRIS, and NON-FUEL HARDWARE specified in the CoC.

2.1.3 Regionalized Fuel Loading

Users may choose to store fuel using regionalized loading in lieu of uniform loading to allow higher heat emitting fuel assemblies to be stored than would otherwise be able to be stored using uniform loading. Figures 2-1 through 2-4 define the regions for the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-32F, MPC-68, MPC-68FF, and MPC-68M models, respectively[a]. Fuel assembly decay heat limits for regionalized loading are specified in Section 2.2.2 for VENTILATED OVERPACK, and Section 2.2.5 for UNVENTILATED OVERPACK. Fuel assemblies used in regionalized loading shall meet all other applicable limits specified in Tables 2-1 through 2-3.

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[a] These figures are only intended to distinguish the fuel loading regions. Other details of the basket design are illustrative and may not reflect the actual basket design details. The design drawings should be consulted for basket design details.

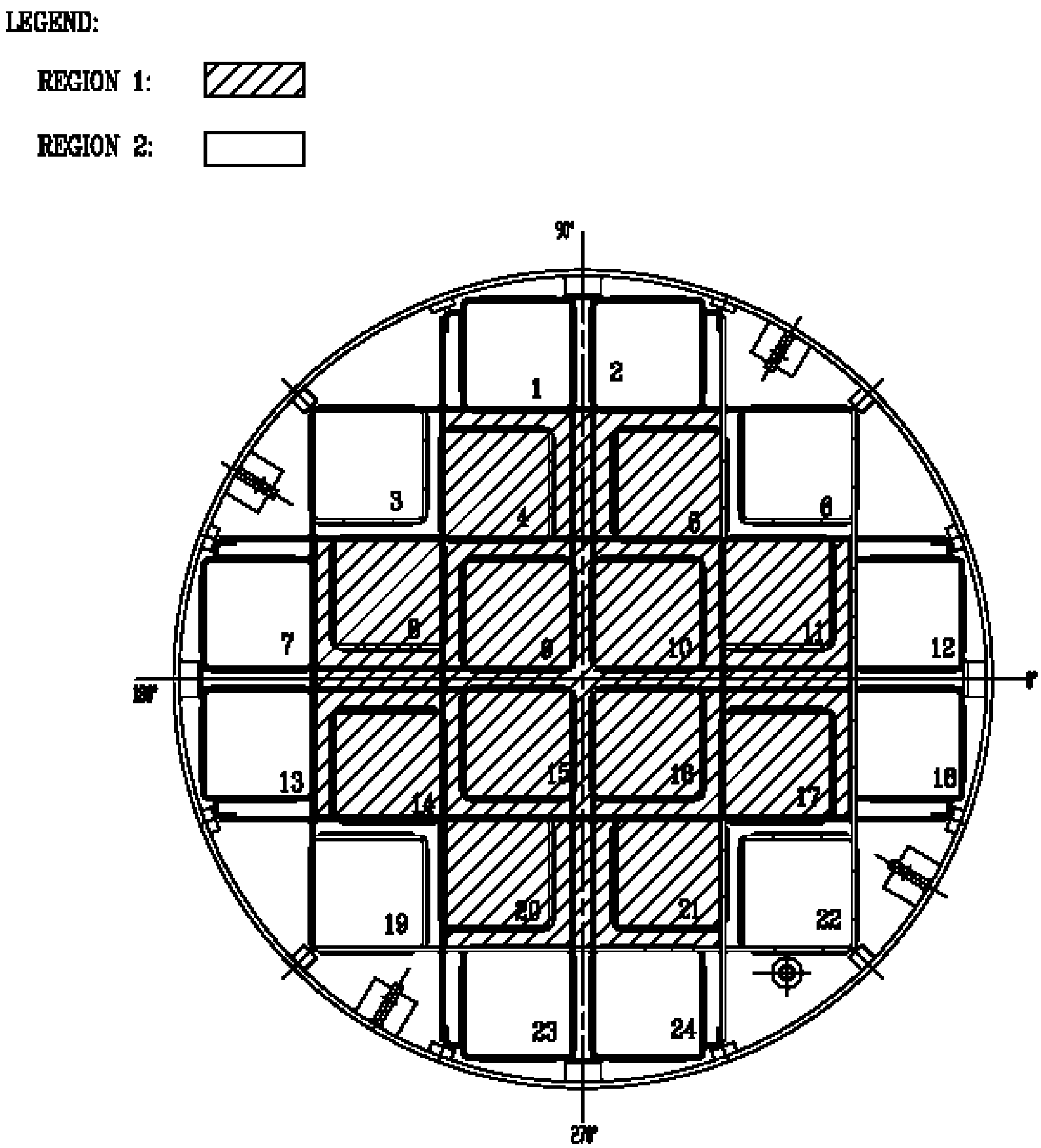

Figure 2-1: Fuel Loading Regions – MPC-24

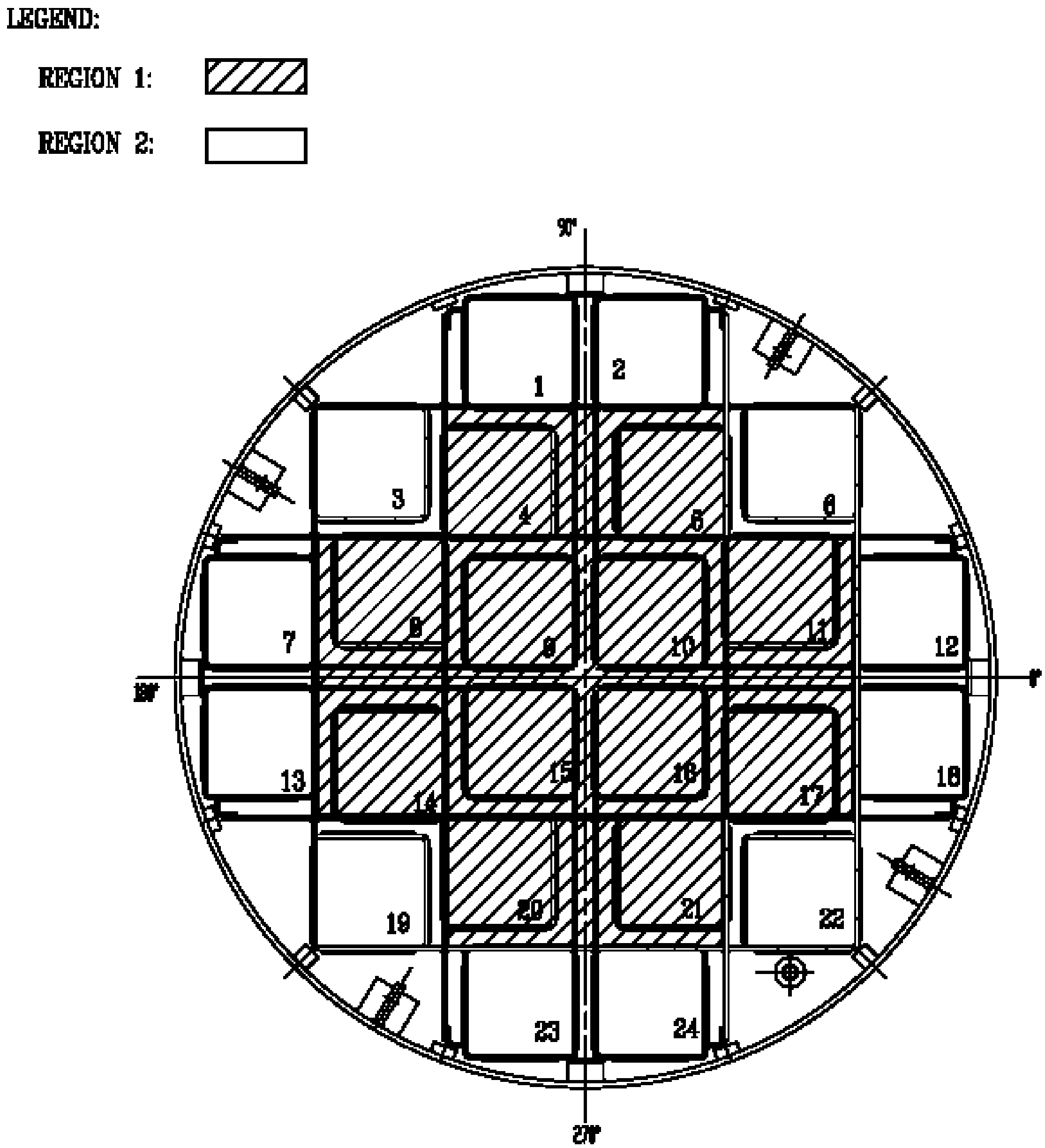

Figure 2-2: Fuel Loading Regions – MPC-24E/24EF

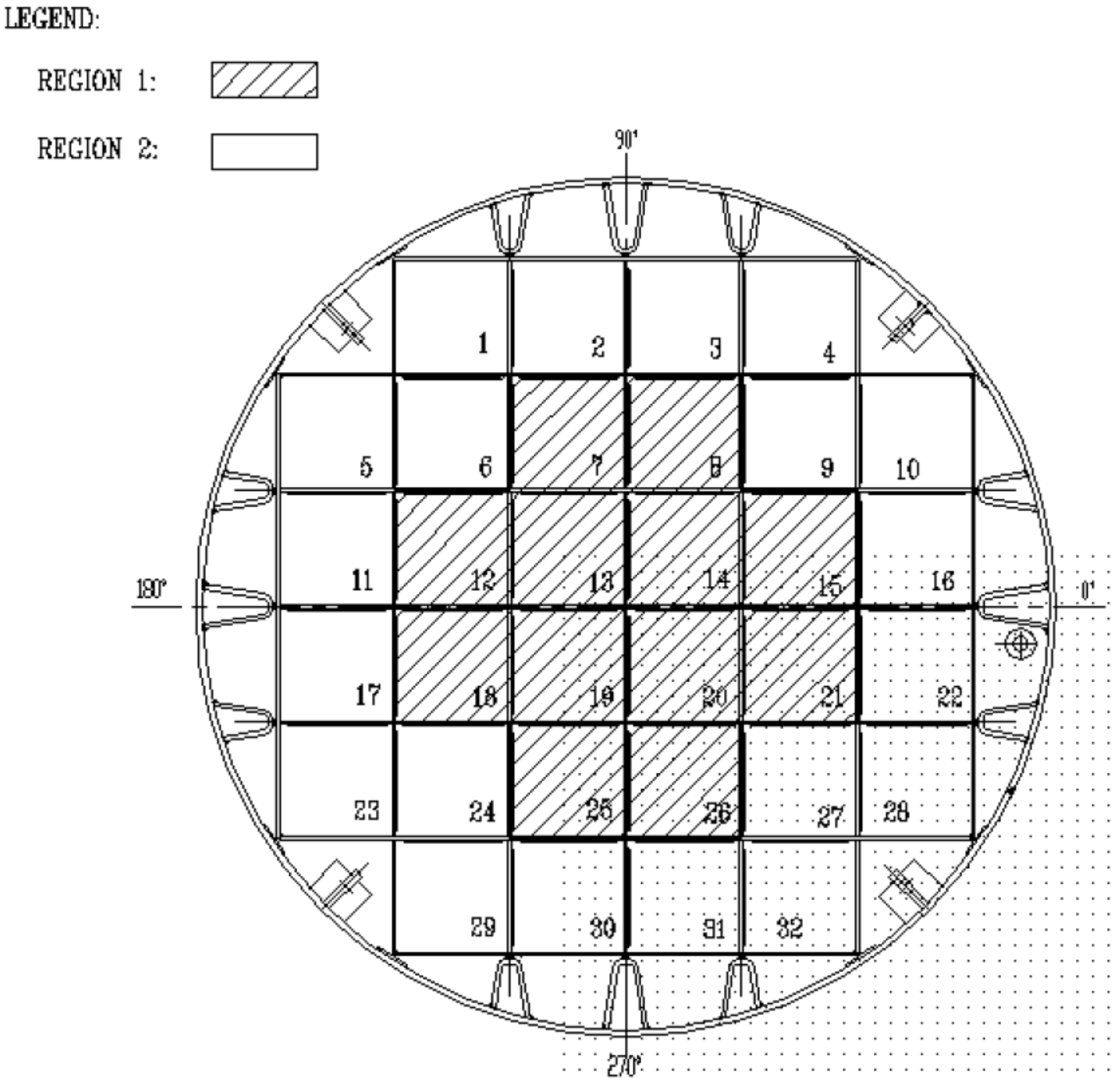

Figure 2-3: Fuel Loading Regions – MPC32/32F

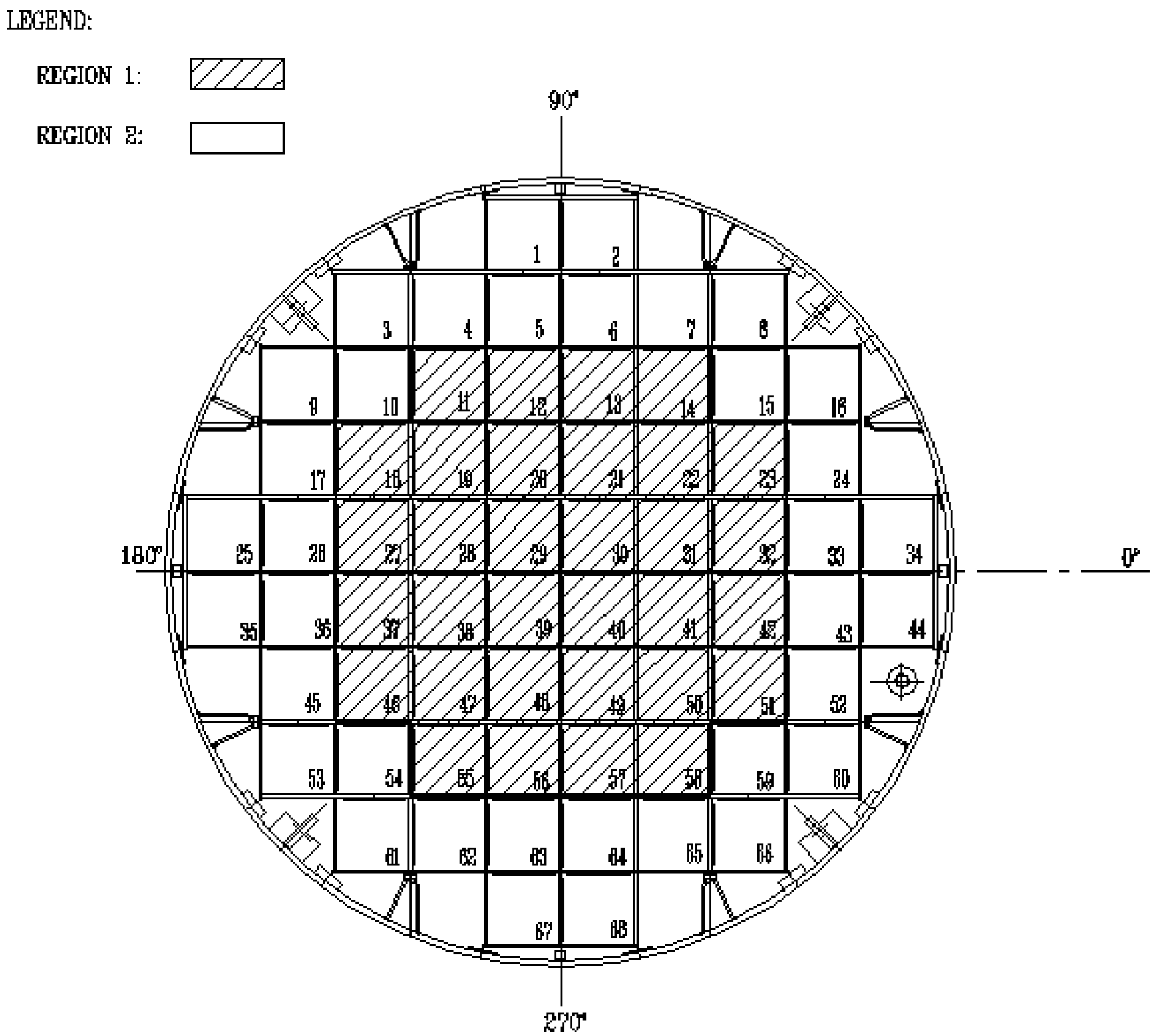

Figure 2-4: Fuel Loading Regions - MPC-68/68FF/68M

Table 2-1 (page 1 of 30)

Fuel Assembly Limits

I. MPC MODEL: MPC-24

A. Allowable Contents

1. Uranium oxide, PWR INTACT FUEL ASSEMBLIES listed in Table 2-2, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR or Stainless Steel (SS) as specified in Table 2-2 for the applicable fuel assembly array/class.
b. Initial Enrichment:	As specified in Table 2-2 for the applicable fuel assembly array/class.
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Classes 14x14D,14x14E, and 15x15G	Cooling time ≥ 8 years and an average burnup ≤ 40,000 MWD/MTU.
ii. All Other Array/Classes	Cooling time and average burnup as specified in Section 2.2.
ii. NON-FUEL HARDWARE	As specified in Table 2-4.

Table 2-1 (page 2 of 30)

Fuel Assembly Limits

I. MPC MODEL: MPC-24 (continued)

A. Allowable Contents (continued)

d. Decay Heat Per Fuel Storage Location:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	≤ 710 Watts
ii. All Other Array/Classes	As specified in Section 2.2.
e. Fuel Assembly Length:	≤ 176.8 inches (nominal design)
f. Fuel Assembly Width:	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	≤ 1720 lbs (including NON-FUEL HARDWARE) for assemblies that do not require fuel spacers, otherwise ≤ 1680 lbs (including NON-FUEL HARDWARE)

B. Quantity per MPC: Up to 24 fuel assemblies.

C. Deleted.

D. DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS are not authorized for loading into the MPC-24.

E. One NSA is authorized for loading into the MPC-24.

Note 1: Fuel assemblies containing BPRAs, TPDs, WABAs, water displacement guide tube plugs, orifice rod assemblies, or vibration suppressor inserts with or without ITTRs, may be stored in any fuel storage location. Fuel assemblies containing APSRs or NSAs may only be loaded in fuel storage locations 9, 10, 15, and/or 16. Fuel assemblies containing CRAs, RCCAs, CEAs may only be stored in fuel storage locations 4, 5, 8 - 11, 14 - 17, 20 and/or 21 (see Figure 2-1). These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

Table 2-1 (page 3 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F

A. Allowable Contents

1. Uranium oxide, BWR INTACT FUEL ASSEMBLIES, with or without ZR channels. Uranium oxide BWR INTACT FUEL ASSEMBLIES shall meet the criteria specified in Table 2-3 for fuel assembly array class 6x6A, 6x6C, 7x7A or 8x8A, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table 2-3 for the applicable fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTU.
e. Decay Heat Per Assembly	≤ 115 Watts
f. Fuel Assembly Length:	≤ 135.0 inches (nominal design)
g. Fuel Assembly Width:	≤ 4.70 inches (nominal design)
h. Fuel Assembly Weight:	≤ 400 lbs, including channels

Table 2-1 (page 4 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR DAMAGED FUEL ASSEMBLIES, with or without ZR channels, placed in DAMAGED FUEL CONTAINERS. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES shall meet the criteria specified in Table 2-3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table 2-3 for the applicable fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTU.
e. Decay Heat Per Assembly:	≤ 115 Watts
f. Fuel Assembly Length:	≤ 135.0 inches (nominal design)
g. Fuel Assembly Width:	≤ 4.70 inches (nominal design)
h. Fuel Assembly Weight:	≤ 550 lbs, including channels and DFC

Table 2-1 (page 5 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

3. Uranium oxide, BWR FUEL DEBRIS, with or without ZR channels, placed in DAMAGED FUEL CONTAINERS. The original fuel assemblies for the uranium oxide BWR FUEL DEBRIS shall meet the criteria specified in Table 2-3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for the applicable original fuel assembly array/class.
c. Initial Maximum Rod Enrichment:	As specified in Table 2-3 for the applicable original fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTU for the original fuel assembly.
e. Decay Heat Per Assembly	≤ 115 Watts
f. Original Fuel Assembly Length	≤ 135.0 inches (nominal design)
g. Original Fuel Assembly Width	≤ 4.70 inches (nominal design)
h. Fuel Debris Weight	≤ 550 lbs, including channels and DFC

Table 2-1 (page 6 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

4. Mixed oxide (MOX), BWR INTACT FUEL ASSEMBLIES, with or without ZR channels. MOX BWR INTACT FUEL ASSEMBLIES shall meet the criteria specified in Table 2-3 for fuel assembly array/class 6x6B, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for fuel assembly array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table 2-3 for fuel assembly array/class 6x6B.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTIHM.
e. Decay Heat Per Assembly	≤ 115 Watts
f. Fuel Assembly Length:	≤ 135.0 inches (nominal design)
g. Fuel Assembly Width:	≤ 4.70 inches (nominal design)
h. Fuel Assembly Weight:	≤ 400 lbs, including channels

Table 2-1 (page 7 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

5. Mixed oxide (MOX), BWR DAMAGED FUEL ASSEMBLIES, with or without ZR channels, placed in DAMAGED FUEL CONTAINERS. MOX BWR DAMAGED FUEL ASSEMBLIES shall meet the criteria specified in Table 2-3 for fuel assembly array/class 6x6B, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for fuel assembly array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table 2-3 for fuel assembly array/class 6x6B.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTIHM.
e. Decay Heat Per Assembly	≤ 115 Watts
f. Fuel Assembly Length:	≤ 135.0 inches (nominal design)
g. Fuel Assembly Width:	≤ 4.70 inches (nominal design)
h. Fuel Assembly Weight:	≤ 550 lbs, including channels and DFC

Table 2-1 (page 8 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

6. Mixed Oxide (MOX), BWR FUEL DEBRIS, with or without ZR channels, placed in DAMAGED FUEL CONTAINERS. The original fuel assemblies for the MOX BWR FUEL DEBRIS shall meet the criteria specified in Table 2-3 for fuel assembly array/class 6x6B, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for original fuel assembly array/class 6x6B.
c. Initial Maximum Rod Enrichment:	As specified in Table 2-3 for original fuel assembly array/class 6x6B.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTIHM for the original fuel assembly.
e. Decay Heat Per Assembly	≤ 115 Watts
f. Original Fuel Assembly Length:	≤ 135.0 inches (nominal design)
g. Original Fuel Assembly Width:	≤ 4.70 inches (nominal design)
h. Fuel Debris Weight:	≤ 550 lbs, including channels and DFC

Table 2-1 (page 9 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

7. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters and meeting the following specifications:

a. Cladding Type:	ZR
b. Composition:	98.2 wt.% ThO_2, 1.8 wt. % UO_2 with an enrichment of 93.5 wt. % ^{235}U. OR 98.5 wt.% ThO2, 1.5 wt.% UO2 with an enrichment of 93.5 wt.% ^{235}U
c. Number of Rods Per Thoria Rod Canister:	≤ 18
d. Decay Heat Per Thoria Rod Canister:	≤ 115 Watts
e. Post-irradiation Fuel Cooling Time and Average Burnup Per Thoria Rod Canister:	A fuel post-irradiation cooling time ≥ 18 years and an average burnup ≤ 16,000 MWD/MTIHM.
f. Initial Heavy Metal Weight:	≤ 27 kg/canister
g. Fuel Cladding O.D.:	≥ 0.412 inches
h. Fuel Cladding I.D.:	≤ 0.362 inches
i. Fuel Pellet O.D.:	≤ 0.358 inches
j. Active Fuel Length:	≤ 111 inches
k. Canister Weight:	≤ 550 lbs, including fuel

Table 2-1 (page 10 of 30)

Fuel Assembly Limits

II. MPC MODEL: MPC-68F (continued)

B. Quantity per MPC (up to a total of 68 assemblies):
(All fuel assemblies must be array/class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A):

Up to four (4) DFCs containing uranium oxide BWR FUEL DEBRIS or MOX BWR FUEL DEBRIS. The remaining MPC-68F fuel storage locations may be filled with fuel assemblies of the following type, as applicable:

1. Uranium oxide BWR INTACT FUEL ASSEMBLIES;
2. MOX BWR INTACT FUEL ASSEMBLIES;
3. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES placed in DFCs;
4. MOX BWR DAMAGED FUEL ASSEMBLIES placed in DFCs; or
5. Up to one (1) Dresden Unit 1 Thoria Rod Canister.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68F.

D. Dresden Unit 1 fuel assemblies with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68F. The Antimony-Beryllium source material shall be in a water rod location.

Table 2-1 (page 11 of 30)

Fuel Assembly Limits

III. MPC MODEL: MPC-68 and MPC-68FF

A. Allowable Contents

1. Uranium oxide or MOX BWR INTACT FUEL ASSEMBLIES listed in Table 2-3, with or without channels and meeting the following specifications:

a. Cladding Type:	ZR or Stainless Steel (SS) as specified in Table 2-3 for the applicable fuel assembly array/class
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment	As specified in Table 2-3 for the applicable fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly	
i. Array/Classes 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTU (or MWD/MTIHM).
ii. Array/Class 8x8F	Cooling time ≥ 10 years and an average burnup ≤ 27,500 MWD/MTU.
iii. Array/Classes 10x10D and 10x10E	Cooling time ≥ 10 years and an average burnup ≤ 22,500 MWD/MTU.
iv. All Other Array/Classes	As specified in Section 2.2.

Table 2-1 (page 12 of 30)

Fuel Assembly Limits

III. MPC MODEL: MPC-68 and MPC-68FF (continued)

A. Allowable Contents (continued)

e. Decay Heat Per Assembly

i. Array/Classes 6x6A, 6X6B, 6x6C, 7x7A, and 8x8A	≤ 115 Watts
ii. Array/Class 8x8F	≤ 183.5 Watts
iii. Array/Classes 10x10D and 10x10E	≤ 95 Watts
iv. All Other Array/Classes	As specified in Section 2.2.

f. Fuel Assembly Length

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 135.0 inches (nominal design)
ii. All Other Array/Classes	≤ 176.5 inches (nominal design)

g. Fuel Assembly Width

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 4.70 inches (nominal design)
ii. All Other Array/Classes	≤ 5.85 inches (nominal design)

h. Fuel Assembly Weight

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 400 lbs, including channels
ii. All Other Array/Classes	≤ 730 lbs, including channels

Table 2-1 (page 13 of 30)

Fuel Assembly Limits

III. MPC MODEL: MPC-68 and MPC-68FF (continued)

A. Allowable Contents (continued)

2. Uranium oxide or MOX BWR DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, with or without channels, placed in DAMAGED FUEL CONTAINERS. Uranium oxide and MOX BWR DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS shall meet the criteria specified in Table 2-3, and meet the following specifications:

a. Cladding Type:	ZR or Stainless Steel (SS) in accordance with Table 2-3 for the applicable fuel assembly array/class.
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	
i. Array/Classes 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A.	As specified in Table 2-3 for the applicable fuel assembly array/class.
ii. All Other Array Classes	≤ 4.0 wt.% ^{235}U.
c. Initial Maximum Rod Enrichment	As specified in Table 2-3 for the applicable fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	Cooling time ≥ 18 years and an average burnup ≤ 30,000 MWD/MTU (or MWD/MTIHM).
ii. Array/Class 8x8F	Cooling time ≥ 10 years and an average burnup ≤ 27,500 MWD/MTU.
iii. Array/Class 10x10D and 10x10E	Cooling time ≥ 10 years and an average burnup ≤ 22,500 MWD/MTU.
iv. All Other Array/Classes	As specified in Section 2.2.

Table 2-1 (page 14 of 30)

Fuel Assembly Limits

III. MPC MODEL: MPC-68 and MPC-68FF (continued)

A. Allowable Contents (continued)

e. Decay Heat Per Assembly

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 115 Watts
ii. Array/Class 8x8F	≤ 183.5 Watts
iii. Array/Classes 10x10D and 10x10E	≤ 95 Watts
iv. All Other Array/Classes	As specified in Section 2.2.

f. Fuel Assembly Length

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 135.0 inches (nominal design)
ii. All Other Array/Classes	≤ 176.5 inches (nominal design)

g. Fuel Assembly Width

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 4.70 inches (nominal design)
ii. All Other Array/Classes	≤ 5.85 inches (nominal design)

h. Fuel Assembly Weight

i. Array/Class 6x6A, 6x6B, 6x6C, 7x7A, or 8x8A	≤ 550 lbs, including channels and DFC
ii. All Other Array/Classes	≤ 830 lbs, including channels and DFC

Table 2-1 (page 15 of 30)

Fuel Assembly limits

III. MPC MODEL: MPC-68 and MPC-68FF (continued)

A. Allowable Contents (continued)

3. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters and meeting the following specifications:

a. Cladding type	ZR
b. Composition	98.2 wt.% ThO_2, 1.8 wt.% UO_2 with an enrichment of 93.5 wt.% ^{235}U. OR 98.5 wt.% ThO2, 1.5 wt.% UO2 with an enrichment of 93.5% wt.% ^{235}U
c. Number of Rods per Thoria Rod Canister:	≤ 18
d. Decay Heat Per Thoria Rod Canister:	≤ 115 Watts
e. Post-irradiation Fuel Cooling Time and Average Burnup per Thoria Rod Canister:	A fuel post-irradiation cooling time ≥ 18 years and an average burnup ≤16,000 MWD/MTIHM
f. Initial Heavy Metal Weight:	≤ 27 kg/canister
g. Fuel Cladding O.D.:	≥ 0.412 inches
h. Fuel Cladding I.D.:	≤ 0.362 inches
i. Fuel Pellet O.D.:	≤ 0.358 inches
j. Active Fuel Length:	≤ 111 inches
k. Canister Weight:	≤ 550 lbs, including fuel

Table 2-1 (page 16 of 30)

Fuel Assembly Limits

III. MPC MODEL: MPC-68 and MPC-68FF (continued)

B. Quantity per MPC (up to a total of 68 assemblies)

1. For fuel assembly array/classes 6x6A, 6X6B, 6x6C, 7x7A, or 8x8A, up to 68 BWR INTACT FUEL ASSEMBLIES and/or DAMAGED FUEL ASSEMBLIES. Up to eight (8) DFCs containing FUEL DEBRIS from these array/classes may be stored.

2. For all other array/classes, up to sixteen (16) DFCs containing BWR DAMAGED FUEL ASSEMBLIES and/or up to eight (8) DFCs containing FUEL DEBRIS. DFCs shall be located only in fuel storage locations 1, 2, 3, 8, 9, 16, 25, 34, 35, 44, 53, 60, 61, 66, 67, and/or 68. The remaining fuel storage locations may be filled with fuel assemblies of the following type:

   i. Uranium Oxide BWR INTACT FUEL ASSEMBLIES; or

   ii. MOX BWR INTACT FUEL ASSEMBLIES.

3. Up to one (1) Dresden Unit 1 Thoria Rod Canister

C. Dresden Unit 1 fuel assemblies with one Antimony-Beryllium neutron source are authorized for loading. The Antimony-Beryllium source material shall be in a water rod location.

D. Array/Class 10x10D and 10x10E fuel assemblies in stainless steel channels must be stored in fuel storage locations 19 - 22, 28 - 31, 38 -41, and/or 47 - 50 (see Figure 2-4).

Table 2-1 (page 17 of 30)

Fuel Assembly Limits

IV. MPC MODEL: MPC-24E and MPC-24EF

A. Allowable Contents

1. Uranium oxide, PWR INTACT FUEL ASSEMBLIES listed in Table 2-2, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR or Stainless Steel (SS) as specified in Table 2-2 for the applicable fuel assembly array/class
b. Initial Enrichment:	As specified in Table 2-2 for the applicable fuel assembly array/class.
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	Cooling time ≥ 8 years and an average burnup ≤ 40,000 MWD/MTU.
ii. All Other Array/Classes	As specified in Section 2.2.
iii. NON-FUEL HARDWARE	As specified in Table 2-4.

Table 2-1 (page 18 of 30)

Fuel Assembly Limits

IV. MPC MODEL: MPC-24E and MPC-24EF (continued)

A. Allowable Contents (continued)

d. Decay Heat Per Fuel Storage Location:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	≤ 710 Watts.
ii. All other Array/Classes	As specified in Section 2.2.
e. Fuel Assembly Length:	≤ 176.8 inches (nominal design)
f. Fuel Assembly Width:	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	≤ 1,720 lbs (including NON-FUEL HARDWARE) for assemblies that do not require fuel spacers, otherwise, ≤ 1,680 lbs (including NON-FUEL HARDWARE)

Table 2-1 (page 19 of 30)

Fuel Assembly Limits

IV. MPC MODEL: MPC-24E and MPC-24EF (continued)

A. Allowable Contents (continued)

2. Uranium oxide, PWR DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS, with or without NON-FUEL HARDWARE, placed in DAMAGED FUEL CONTAINERS. Uranium oxide PWR DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS shall meet the criteria specified in Table 2-2 and meet the following specifications (Note 1):

a. Cladding Type:	ZR or Stainless Steel (SS) as specified in Table 2-2 for the applicable fuel assembly array/class
b. Initial Enrichment:	As specified in Table 2-2 for the applicable fuel assembly array/class.
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	Cooling time ≥ 8 years and an average burnup ≤ 40,000 MWD/MTU.
ii. All Other Array/Classes	As specified in Section 2.2.
iii. NON-FUEL HARDWARE	As specified in Table 2-4.

Table 2-1 (page 20 of 30)

Fuel Assembly Limits

IV. MPC MODEL: MPC-24E and MPC-24EF (continued)

A. Allowable Contents (continued)

d. Decay Heat Per Fuel Storage Location:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	≤ 710 Watts.
ii. All Other Array/Classes	As specified in Section 2.2.
e. Fuel Assembly Length	≤ 176.8 inches (nominal design)
f. Fuel Assembly Width	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight	≤ 1,720 lbs (including NON-FUEL HARDWARE and DFC) for assemblies that do not require fuel spacers, otherwise, ≤ 1,680 lbs (including NON-FUEL HARDWARE and DFC)

B. Quantity per MPC: Up to four (4) DAMAGED FUEL ASSEMBLIES and/or FUEL DEBRIS in DAMAGED FUEL CONTAINERS, stored in fuel storage locations 3, 6, 19 and/or 22. The remaining fuel storage locations may be filled with PWR INTACT FUEL ASSEMBLIES meeting the applicable specifications.

C. One NSA is permitted for loading.

Note 1: Fuel assemblies containing BPRAs, TPDs, WABAs, water displacement guide tube plugs, orifice rod assemblies, or vibration suppressor inserts, with or without ITTRs, may be stored in any fuel storage location. Fuel assemblies containing APSRs or NSAs may only be loaded in fuel storage locations 9, 10, 15, and/or 16 (see Figure 2-2). Fuel assemblies containing CRAs, RCCAs, or CEAs may only be stored in fuel storage locations 4, 5, 8 - 11, 14 - 17, 20 and/or 21 (see Figure 2-2). These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

Table 2-1 (page 21 of 30)

Fuel Assembly Limits

V. MPC MODEL: MPC-32 and MPC-32F

A. Allowable Contents

1. Uranium oxide, PWR INTACT FUEL ASSEMBLIES listed in Table 2-2, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR or Stainless Steel (SS) as specified in Table 2-2 for the applicable fuel assembly array/class
b. Initial Enrichment:	As specified in Table 2-2 for the applicable fuel assembly array/class.
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	Cooling time ≥ 9 years and an average burnup ≤ 30,000 MWD/MTU or cooling time ≥ 20 years and an average burnup ≤ 40,000 MWD/MTU.
ii. All Other Array/Classes	As specified in Section 2.2.
iii. NON-FUEL HARDWARE	As specified in Table 2-4.

Table 2-1 (page 22 of 30)

Fuel Assembly Limits

V. MPC MODEL: MPC-32 and MPC-32F (cont'd)

A. Allowable Contents (cont'd)

d. Decay Heat Per Fuel Storage Location:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	≤ 500 Watts.
ii. All Other Array/Classes	As specified in Section 2.2.
e. Fuel Assembly Length	≤ 176.8 inches (nominal design)
f. Fuel Assembly Width	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight	≤ 1,720 lbs (including NON-FUEL HARDWARE) for assemblies that do not require fuel spacers, otherwise, ≤ 1,680 lbs (including NON-FUEL HARDWARE)

Table 2-1 (page 23 of 30)

Fuel Assembly Limits

V. MPC MODEL: MPC-32 and MPC-32F (cont'd)

A. Allowable Contents (cont'd)

2. Uranium oxide, PWR DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS, with or without NON-FUEL HARDWARE, placed in DAMAGED FUEL CONTAINERS. Uranium oxide PWR DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS shall meet the criteria specified in Table 2-2 and meet the following specifications (Note 1):

a. Cladding Type:	ZR or Stainless Steel (SS) as specified in Table 2-2 for the applicable fuel assembly array/class
b. Initial Enrichment:	As specified in Table 2-2 for the applicable fuel assembly array/class.
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	Cooling time ≥ 9 years and an average burnup ≤ 30,000 MWD/MTU or cooling time ≥ 20 years and an average burnup ≤ 40,000 MWD/MTU.
ii. All Other Array/Classes	As specified in Section 2.2.
iii. NON-FUEL HARDWARE	As specified in Table 2-4.

Table 2-1 (page 24 of 30)

Fuel Assembly Limits

V. MPC MODEL: MPC-32 and MPC-32F (cont'd)

A. Allowable Contents (cont'd)

d. Decay Heat Per Fuel Storage Location:	
i. Array/Classes 14x14D, 14x14E, and 15x15G	≤ 500 Watts.
ii. All Other Array/Classes	As specified in Section 2.2.
e. Fuel Assembly Length	≤ 176.8 inches (nominal design)
f. Fuel Assembly Width	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight	≤ 1,720 lbs (including NON-FUEL HARDWARE and DFC) for assemblies that do not require fuel spacers, otherwise, ≤ 1,680 lbs (including NON-FUEL HARDWARE and DFC)

B. Quantity per MPC: Up to eight (8) DAMAGED FUEL ASSEMBLIES and/or FUEL DEBRIS in DAMAGED FUEL CONTAINERS, stored in fuel storage locations 1, 4, 5, 10, 23, 28, 29, and/or 32. The remaining fuel storage locations may be filled with PWR INTACT FUEL ASSEMBLIES meeting the applicable specifications.

C. One NSA is permitted for loading.

Note 1: Fuel assemblies containing BPRAs, TPDs, WABAs, water displacement guide tube plugs, orifice rod assemblies, or vibration suppressor inserts, with or without ITTRs, may be stored in any fuel storage location. Fuel assemblies containing NSAs may only be loaded in fuel storage locations 13, 14, 19 and/or 20 (see Figure 2-3). Fuel assemblies containing CRAs, RCCAs, CEAs or APSRs may only be loaded in fuel storage locations 7, 8, 12-15, 18-21, 25 and/or 26 (see Figure 2-3). These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

Table 2-1 (page 25 of 30)

Fuel Assembly Limits

VI. MPC MODEL: MPC-68M

A. Allowable Contents

1. Uranium oxide BWR UNDAMAGED FUEL ASSEMBLIES listed in Table 2-3, with or without channels and meeting the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment	As specified in Table 2-3 for the applicable fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly	
i. Array/Class 8x8F	Cooling time ≥ 10 years and an average burnup ≤ 27,500 MWD/MTU.
ii. All Other Array/Classes	As specified in Section 2.2.

Table 2-1 (page 26 of 30)

Fuel Assembly Limits

VI. MPC MODEL: MPC-68M (continued)

A. Allowable Contents (continued)

e. Decay Heat Per Assembly

i. Array/Class 8x8F	≤ 183.5 Watts
ii. All Other Array/Classes	As specified in Section 2.2.

f. Fuel Assembly Length	≤ 176.5 inches (nominal design)
g. Fuel Assembly Width	≤ 5.85 inches (nominal design)
h. Fuel Assembly Weight	≤ 730 lbs, including channels

Table 2-1 (page 27 of 30)

Fuel Assembly Limits

VI. MPC MODEL: MPC-68M (continued)

A. Allowable Contents (continued)

2. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, with or without channels, placed in DAMAGED FUEL CONTAINERS. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES whose damage is limited such that the fuel assembly is able to be handled by normal means and whose structural integrity remains intact to the extent that geometric rearrangement of fuel is not expected, with or without channels, placed in basket cell locations containing top and bottom DAMAGED FUEL ISOLATORS. BWR DAMAGED FUEL ASSEMBLIES used with DFIs may contain missing or partial fuel rods and/or fuel rods with known or suspected cladding defects greater than hairline cracks or pinhole leaks. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS shall meet the criteria specified in Table 2-3, and meet the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT:	As specified in Table 2-3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment	As specified in Table 2-3 for the applicable fuel assembly array/class.
d. Post-irradiation Cooling Time and Average Burnup Per Assembly:	
i. Array/Class 8x8F	Cooling time ≥ 10 years and an average burnup ≤ 27,500 MWD/MTU.
ii. All Other Array/Classes	Cooling time ≥ 1 year and an average burnup ≤ 65,000 MWD/MTU.

Table 2-1 (page 28 of 30)

Fuel Assembly Limits

VI. MPC MODEL: MPC-68M (continued)

A. Allowable Contents (continued)

e. Decay Heat Per Assembly

i. Array/Class 8x8F	≤ 183.5 Watts
ii. All Other Array/Classes	As specified in Section 2.2.
f. Fuel Assembly Length	≤ 176.5 inches (nominal design)
g. Fuel Assembly Width	≤ 5.85 inches (nominal design)
h. Fuel Assembly Weight	≤ 830 lbs, including channels and DFC/DFIs

Table 2-1 (page 29 of 30)

Fuel Assembly Limits

VI. MPC MODEL: MPC-68M (continued)

A. Allowable Contents (continued)

3. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters and meeting the following specifications:

a. Cladding Type:	ZR
b. Composition	98.2 wt.% ThO_2, 1.8 wt.% UO_2 with an enrichment of 93.5 wt.% ^{235}U OR 98.5 wt.% ThO_2, 1.5 wt.% UO_2 with an enrichment of 93.5% wt.% ^{235}U
c. Number of Rods per Thoria Rod Canister:	≤ 18
d. Decay Heat Per Thoria Rod Canister:	≤ 115 Watts
e. Post-irradiation Fuel Cooling Time and Average Burnup per Thoria Rod Canister:	A fuel post-irradiation cooling time ≥ 18 years and an average burnup ≤ 16,000 MWD/MTIHM
f. Initial Heavy Metal Weight:	≤ 27 kg/canister
g. Fuel Cladding O.D.:	≥ 0.412 inches
h. Fuel Cladding I.D.:	≤ 0.362 inches
i. Fuel Pellet O.D.:	≤ 0.358 inches
j. Active Fuel Length:	≤ 111 inches
k. Canister Weight:	≤ 550 lbs, including fuel

Table 2-1 (page 30 of 30)

Fuel Assembly Limits

VI. MPC MODEL: MPC-68M (continued)

B. Quantity per MPC (up to a total of 68 assemblies)

1. Up to sixteen (16) DFCs or DFIs containing BWR DAMAGED FUEL ASSEMBLIES and/or up to eight (8) DFCs containing FUEL DEBRIS. DFCs/DFIs shall be located only in fuel storage locations 1, 2, 3, 8, 9, 16, 25, 34, 35, 44, 53, 60, 61, 66, 67, and/or 68. Alternatively BWR DAMAGED FUEL ASSEMBLIES using DFCs/DFIs may be stored in inner locations when using the loading pattern in Figure 2-4. The remaining fuel storage locations may be filled with Uranium Oxide BWR UNDAMAGED FUEL ASSEMBLIES.

2. Up to one (1) Dresden Unit 1 Thoria Rod Canister.

Table 2-2 (page 1 of 5)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**14x14A**	**14x14B**	**14x14C**	**14x14D**	**14x14E**
Clad Material	ZR	ZR	ZR	SS	SS
Design Initial U (kg/assy.) (Note 3)	≤ 365	≤ 412	≤ 438	≤ 400	≤ 206
Initial Enrichment (MPC-24, 24E and 24EF without soluble boron credit) (wt % ^{235}U) (Note 7)	≤ 4.6 (24) ≤ 5.0 (24E/24EF)	≤ 4.6 (24) ≤ 5.0 (24E/24EF)	≤ 4.6 (24) ≤ 5.0 (24E/24EF)	≤ 4.0 (24) ≤ 5.0 (24E/24EF)	≤ 5.0 (24) ≤ 5.0 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, 32, or 32F with soluble boron credit - see Note 5) (wt % ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 11)	179	179	176	180	173
Fuel Rod Clad O.D. (in.)	≥ 0.400	≥ 0.417	≥ 0.440	≥ 0.422	≥ 0.3415
Fuel Rod Clad I.D. (in.)	≤ 0.3514	≤ 0.3734	≤ 0.3880	≤ 0.3890	≤ 0.3175
Fuel Pellet Dia. (in.)(Note 8)	≤ 0.3444	≤ 0.3659	≤ 0.3805	≤ 0.3835	≤ 0.3130
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.556	≤ 0.580	≤ 0.556	Note 6
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 144	≤ 102
No. of Guide and/or Instrument Tubes	17	17	5 (Note 4)	16	0
Guide/Instrument Tube Thickness (in.)	≥ 0.017	≥ 0.017	≥ 0.038	≥ 0.0145	N/A

Table 2-2 (page 2 of 5)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**15x15A**	**15x15B**	**15x15C**	**15x15D**	**15x15E**	**15x15F**
Clad Material	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 473	≤ 473	≤ 473	≤ 495	≤ 495	≤ 495
Initial Enrichment (MPC-24, 24E and 24EF without soluble boron credit) (wt % ^{235}U) (Note 7)	≤ 4.1 (24) ≤ 4.5 (24E/24EF)	≤ 4.1 (24) ≤ 4.5 (24E/24EF)	≤ 4.1 (24) ≤ 4.5 (24E/24EF)	≤ 4.1 (24) ≤ 4.5 (24E/24EF)	≤ 4.1 (24) ≤ 4.5 (24E/24EF)	≤ 4.1 (24) ≤ 4.5 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, 32, or 32F with soluble boron credit - see Note 5)(wt % ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 11)	204	204	204	208	208	208
Fuel Rod Clad O.D. (in.)	≥ 0.418	≥ 0.420	≥ 0.417	≥ 0.430	≥ 0.428	≥ 0.428
Fuel Rod Clad I.D. (in.)	≤ 0.3660	≤ 0.3736	≤ 0.3640	≤ 0.3800	≤ 0.3790	≤ 0.3820
Fuel Pellet Dia. (in.) (Note 8)	≤ 0.3580	≤ 0.3671	≤ 0.3570	≤ 0.3735	≤ 0.3707	≤ 0.3742
Fuel Rod Pitch (in.)	≤ 0.550	≤ 0.563	≤ 0.563	≤ 0.568	≤ 0.568	≤ 0.568
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	21	21	21	17	17	17
Guide/Instrument Tube Thickness (in.)	≥ 0.0165	≥ 0.015	≥ 0.0165	≥ 0.0150	≥ 0.0140	≥ 0.0140

Table 2-2 (page 3 of 5)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/ Class	**15x15G**	**15x15H**	**15x15I**	**16x16A**	**16x16B**	**16x16C**
Clad Material	SS	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.)(Note 3)	≤ 420	≤ 495	≤ 495	≤ 448	≤ 448	≤ 448
Initial Enrichment (MPC-24, 24E, and 24EF without soluble boron credit)(wt % ^{235}U) (Note 7)	≤ 4.0 (24) ≤ 4.5 (24E/24EF)	≤ 3.8 (24) ≤ 4.2 (24E/24EF)	N/A (Note 9)	≤ 4.6 (24) ≤ 5.0 (24E/24EF)	≤ 4.6 (24) ≤ 5.0 (24E/24EF)	≤ 4.6 (24) ≤ 5.0 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, 32, or 32F with soluble boron credit - see Note 5) (wt % ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0 (Note 9)	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 11)	204	208	216	236	236	235
Fuel Rod Clad O.D. (in.)	≥ 0.422	≥ 0.414	≥ 0.413	≥ 0.382	≥ 0.374	≥ 0.374
Fuel Rod Clad I.D. (in.)	≤ 0.3890	≤ 0.3700	≤ 0.367	≤ 0.3350	≤ 0.3290	≤ 0.3290
Fuel Pellet Dia. (in.) (Note 8)	≤ 0.3825	≤ 0.3622	≤ 0.360	≤ 0.3255	≤ 0.3225	≤ 0.3225
Fuel Rod Pitch (in.)	≤ 0.563	≤ 0.568	≤ 0.550	≤ 0.506	≤ 0.506	≤ 0.485
Active Fuel Length (in.)	≤ 144	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	21	17	9 (Note 10)	5 (Note 4)	5 (Note 4)	21
Guide/Instrument Tube Thickness (in.)	≥ 0.0145	≥ 0.0140	≥ 0.0140	≥ 0.0350	≥ 0.0400	≥ 0.0157

Table 2-2 (page 4 of 5)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/ Class	**17x17A**	**17x17B**	**17x17C**
Clad Material	ZR	ZR	ZR
Design Initial U (kg/assy.)(Note 3)	< 433	< 474	< 480
Initial Enrichment (MPC-24, 24E, and 24EF without soluble boron credit)(wt % ^{235}U) (Note 7)	< 4.0 (24) < 4.4 (24E/24EF)	< 4.0 (24) < 4.4 (24E/24EF)	< 4.0 (24) < 4.4 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, 32, or 32F with soluble boron credit - see Note 5) (wt % ^{235}U)	< 5.0	< 5.0	< 5.0
No. of Fuel Rod Locations (Note 11)	264	264	264
Fuel Rod Clad O.D. (in.)	> 0.360	> 0.372	> 0.377
Fuel Rod Clad I.D. (in.)	< 0.3150	< 0.3310	< 0.3330
Fuel Pellet Dia. (in.) (Note 8)	< 0.3088	< 0.3232	< 0.3252
Fuel Rod Pitch (in.)	< 0.496	< 0.496	< 0.502
Active Fuel Length (in.)	< 150	< 150	< 150
No. of Guide and/or Instrument Tubes	25	25	25
Guide/Instrument Tube Thickness (in.)	> 0.016	> 0.014	> 0.020

Table 2-2 (page 5 of 5)

PWR FUEL ASSEMBLY CHARACTERISTICS

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.

2. Deleted.

3. Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each PWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with users' fuel records.

4. Each guide tube replaces four fuel rods.

5. Soluble boron concentration per LCO 3.3.1.

6. This fuel assembly array/class includes only the Indian Point Unit 1 fuel assembly. This fuel assembly has two pitches in different sectors of the assembly. These pitches are 0.441 inches and 0.453 inches.

7. For those MPCs loaded with both INTACT FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, the maximum initial enrichment of the INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS is 4.0 wt.% ^{235}U.

8. Annular fuel pellets are allowed in the top and bottom 12" of the active fuel length.

9. This fuel assembly array/class can only be loaded in MPC-32.

10. One Instrument Tube and eight Guide Bars (Solid ZR).

11. Any number of fuel rods in an assembly can be replaced by irradiated or unirradiated Steel or Zirconia rods. If the rods are irradiated, the site specific dose and dose rate analyses performed under 10 CFR 72.212 should include considerations for the presence of such rods.

Table 2-3 (page 1 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**6x6A**	**6x6B**	**6x6C**	**7x7A**	**7x7B**	**8x8A**
Clad Material	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 110	≤ 110	≤ 110	≤ 100	≤ 198	≤ 120
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68, 68F, and 68FF) (wt.% ^{235}U) (Note 14)	≤ 2.7	≤ 2.7 for the UO_2 rods. See Note 4 for MOX rods	≤ 2.7	≤ 2.7	≤ 4.2	≤ 2.7
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68M) (wt.% ^{235}U) (Note 16, 19)	Note 18	Note 18	Note 18	Note 18	≤ 4.8	Note 18
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 4.0	≤ 4.0	≤ 4.0	≤ 5.5	≤ 5.0	≤ 4.0
No. of Fuel Rod Locations (Note 20)	35 or 36	35 or 36 (up to 9 MOX rods)	36	49	49	63 or 64
Fuel Rod Clad O.D. (in.)	≥ 0.5550	≥ 0.5625	≥ 0.5630	≥ 0.4860	≥ 0.5630	≥ 0.4120
Fuel Rod Clad I.D. (in.)	≤ 0.5105	≤ 0.4945	≤ 0.4990	≤ 0.4204	≤ 0.4990	≤ 0.3620
Fuel Pellet Dia. (in.)	≤ 0.4980	≤ 0.4820	≤ 0.4880	≤ 0.4110	≤ 0.4910	≤ 0.3580
Fuel Rod Pitch (in.)	≤ 0.710	≤ 0.710	≤ 0.740	≤ 0.631	≤ 0.738	≤ 0.523
Active Fuel Length (in.)	≤ 120	≤ 120	≤ 77.5	≤ 80	≤ 150	≤ 120
No. of Water Rods (Note 11)	1 or 0	1 or 0	0	0	0	1 or 0
Water Rod Thickness (in.)	> 0	> 0	N/A	N/A	N/A	≥ 0
Channel Thickness (in.)	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.120	≤ 0.100

Table 2-3 (2 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**8x8B**	**8x8C**	**8x8D**	**8x8E**	**8x8F**	**9x9A**
Clad Material	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 192	≤ 190	≤ 190	< 190	≤ 191	≤ 180
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68, 68F, and 68FF) (wt.% ^{235}U) (Note 14)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.2
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68M) (wt.% ^{235}U) (Note 16, 19)	≤ 4.8	≤ 4.8	≤ 4.8	≤ 4.8	≤ 4.5 (Note 15)	≤ 4.8
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 20)	63 or 64	62	60 or 61	59	64	74/66 (Note 5)
Fuel Rod Clad O.D. (in.)	≥ 0.4840	≥ 0.4830	≥ 0.4830	≥ 0.4930	≥ 0.4576	≥ 0.4400
Fuel Rod Clad I.D. (in.)	≤ 0.4295	≤ 0.4250	≤ 0.4230	≤ 0.4250	≤ 0.3996	≤ 0.3840
Fuel Pellet Dia. (in.)	≤ 0.4195	≤ 0.4160	≤ 0.4140	≤ 0.4160	≤ 0.3913	≤ 0.3760
Fuel Rod Pitch (in.)	≤ 0.642	≤ 0.641	≤ 0.640	≤ 0.640	≤ 0.609	≤ 0.566
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 or 0	2	1 - 4 (Note 7)	5	N/A (Note 12)	2
Water Rod Thickness (in.)	≥ 0.034	> 0.00	> 0.00	≥ 0.034	≥ 0.0315	> 0.00
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.100	≤ 0.055	≤ 0.120

Table 2-3 (page 3 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**9x9B**	**9x9C**	**9x9D**	**9x9E (Note 13)**	**9x9F (Note 13)**	**9x9G**
Clad Material	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.)(Note 3)	≤ 180	≤ 182	≤ 182	≤ 183	≤ 183	≤ 164
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68, 68F, and 68FF) (wt.% ^{235}U) (Note 14)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0	≤ 4.2
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68M) (wt.% ^{235}U) (Note 16, 19)	≤ 4.8	≤ 4.8	≤ 4.8	≤ 4.5 (Note 15)	≤ 4.5 (Note 15)	≤ 4.8
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 20)	72	80	79	76	76	72
Fuel Rod Clad O.D. (in.)	≥ 0.4330	≥ 0.4230	≥ 0.4240	≥ 0.4170	≥ 0.4430	≥ 0.4240
Fuel Rod Clad I.D. (in.)	≤ 0.3810	≤ 0.3640	≤ 0.3640	≤ 0.3640	≤ 0.3860	≤ 0.3640
Fuel Pellet Dia. (in.)	≤ 0.3740	≤ 0.3565	≤ 0.3565	≤ 0.3530	≤ 0.3745	≤ 0.3565
Fuel Rod Pitch (in.)	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 (Note 6)	1	2	5	5	1 (Note 6)
Water Rod Thickness (in.)	> 0.00	≥ 0.020	≥ 0.0300	≥ 0.0120	≥ 0.0120	≥ 0.0320
Channel Thickness (in.)	≤ 0.120	≤ 0.100	≤ 0.100	≤ 0.120	≤ 0.120	≤ 0.120

Table 2-3 (page 4 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	**10x10A**	**10x10B**	**10x10C**	**10x10D**	**10x10E**	**10x10F**	**10x10G**
Clad Material	ZR	ZR	ZR	SS	SS	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 188	≤ 188	≤ 179	≤ 125	≤ 125	≤ 192	≤ 188
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT(MPC-68, 68F, and 68FF) (wt.% ^{235}U) (Note 14)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0	Note 17	Note 17
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (MPC-68M) (wt.% ^{235}U) (Note 16, 19)	≤ 4.8	≤ 4.8	≤ 4.8	Note 18	Note 18	≤ 4.7 (Note 15) ≤ 5.0 (Note 26)	≤ 4.75 (Note 21) ≤ 5.0 (Note 26)
Initial Maximum Rod Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 20)	92/78 (Note 8)	91/83 (Note 9)	96	100	96	92/78 (Note 8)	96/84
Fuel Rod Clad O.D. (in.)	≥ 0.4040	≥ 0.3957	≥ 0.3780	≥ 0.3960	≥ 0.3940	≥ 0.4035	≥ 0.387
Fuel Rod Clad I.D. (in.)	≤ 0.3520	≤ 0.3480	≤ 0.3294	≤ 0.3560	≤ 0.3500	≤ 0.3570	≤ 0.340
Fuel Pellet Dia. (in.)	≤ 0.3455	≤ 0.3420	≤ 0.3224	≤ 0.3500	≤ 0.3430	≤ 0.3500	≤ 0.334
Fuel Rod Pitch (in.)	≤ 0.510	≤ 0.510	≤ 0.488	≤ 0.565	≤ 0.557	≤ 0.510	≤ 0.512
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 83	≤ 83	≤ 150	≤ 150
No. of Water Rods (Note 11)	2	1 (Note 6)	5 (Note 10)	0	4	2	5 (Note 10)
Water Rod Thickness (in.)	≥ 0.030	> 0.00	≥ 0.031	N/A	≥ 0.022	≥ 0.030	≥ 0.031
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.055	≤ 0.080	≤ 0.080	≤ 0.120	≤ 0.060

Table 2-3 (page 5 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array and Class	**10x10I** (Note 17, 22)	**10x10J** (Note 17, 23)	**11x11A** (Note 17, 24)
Clad Material	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 194	≤ 194	≤ 194
Maximum Planar-Average Initial Enrichment (wt.% ^{235}U) (Note 16, 19)	4.8	4.8	4.8
Maximum Planar-Average Initial Enrichment with Partial Gadolinium Credit (wt.%235U) (Note 26)	5.0	5.0	5.0
Initial Rod Maximum Enrichment (wt.% ^{235}U)	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations (Note 20)	91/79	96/80	112/92
Fuel Clad O.D. (in.)	≥ 0.4047	≥0.3999	≥0.3701
Fuel Clad I.D. (in.)	≤ 0.3559	≤ 0.3603	≤ 0.3252
Fuel Pellet Dia. (in.)	≤ 0.3492	≤ 0.3531	≤ 0.3193
Fuel Rod Pitch (in.)	≤ 0.5100	≤ 0.5149	≤ 0.4705
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 25)	1	1	1
Water Rod Thickness (in.)	≥ 0.0315	≥ 0.0297	≥ 0.0340
Channel Thickness (in.)	≤ 0.100	≤ 0.0938	≤ 0.100

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.
2. Deleted.
3. Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each BWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 1.5 percent for comparison with users' fuel records.
4. ≤ 0.635 wt. % 235U and ≤ 1.578 wt. % total fissile plutonium (239Pu and 241Pu), (wt. % of total fuel weight, i.e., UO2 plus PuO2).
5. This assembly class contains 74 total rods; 66 full length rods and 8 partial length rods.
6. Square, replacing nine fuel rods.
7. Variable.

8. This assembly contains 92 total fuel rods; 78 full length rods and 14 partial length rods.
9. This assembly class contains 91 total fuel rods; 83 full length rods and 8 partial length rods.
10. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.
11. These rods may also be sealed at both ends and contain Zr material in lieu of water.
12. This assembly is known as “QUAD+.” It has four rectangular water cross segments dividing the assembly into four quadrants.
13. For the SPC 9x9-5 fuel assembly, each fuel rod must meet either the 9x9E or the 9x9F set of limits for clad O.D., clad I.D., and pellet diameter.
14. For MPC-68, 68F, and 68FF loaded with both INTACT FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, the maximum PLANAR AVERAGE INITIAL ENRICHMENT for the INTACT FUEL ASSEMBLIES is limited to 3.7 wt.% ^{235}U, as applicable.
15. Fuel assemblies classified as damaged fuel assemblies are limited to 4.6 wt.% ^{235}U for the 10x10F arrays/classes. Fuel assemblies classified as damaged fuel assemblies are limited to 4.0 wt.% ^{235}U for the 8x8F, 9x9E and 9x9F arrays/classes except when loaded to Figure 2-4. Fuel assemblies classified as damaged fuel assemblies are limited to 4.5 wt.% ^{235}U for the 8x8F, 9x9E and 9x9F when loaded to Figure 2-4.
16. For MPC-68M loaded with both UNDAMAGED FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, the maximum PLANAR AVERAGE INITIAL ENRICHMENT for the UNDAMAGED FUEL ASSEMBLIES is limited to the enrichment limit of the damaged assembly.
17. This fuel assembly array/class is not allowable contents in MPC-68, 68F, or 68FF.
18. This fuel assembly array/class is not allowable contents in MPC-68M.
19. In accordance with the definition of UNDAMAGED FUEL ASSEMBLY, certain assemblies may be limited to up to 3.3 wt.% U-235. When loading these fuel assemblies, all other undamaged fuel assemblies in the MPC are limited to enrichments as specified in this table.
20. Any number of fuel rods in an assembly can be replaced by irradiated or unirradiated Steel or Zirconia rods. If the rods are irradiated, the site specific dose and dose rate analyses performed under 10 CFR 72.212 should include considerations for the presence of such rods.
21. Fuel assemblies classified as damaged fuel assemblies are limited to 4.6 wt.% 235U for the 10x10G array/class escept when loaded to Figure 2-4. Fuel assemblies classified as damaged fuel assemblies are limited to 4.5 wt.% 235U for the 10x10G array/class when loaded to Figure 2-4.
22. Contains in total 91 fuel rods; 79 full length rods, 12 partial length rods, and one square water rod, replacing 9 fuel rods.
23. Contains in total 96 fuel rods; 80 full length rods, 8 long partial length rods, 8 short partial length rods and one water rod replacing 4 fuel rods.
24. Contains in total 112 fuel rods; 92 full length rods, 8 long partial length rods, 12 short partial length rods, and one square water rod replacing 9 fuel rods.
25. These rods may also be sealed at both ends and contain Zr material in lieu of water.
26. The restrictions in Table 2-5 apply.

Table 2-4

NON-FUEL HARDWARE COOLING AND AVERAGE BURNUP (Notes 1, 2, 3, and 7)

Post-irradiation Cooling Time (years)	**NSA with NFH** **INSERTS** (Note 4) **BURNUP (MWD/MTU)**	**NSA without NFH, GUIDE TUBE HARDWARE, or CONTROL COMPONENT** (Note 5) **BURNUP (MWD/MTU)**	**APSR BURNUP (MWD/MTU)**
≥ 3	≤ 24,635	NA (Note 6)	NA
≥ 4	≤ 30,000	NA	NA
≥ 5	≤ 36,748	≤ 630,000	≤ 45,000
≥ 6	≤ 44,102	-	≤ 54,500
≥ 7	≤ 52,900	-	≤ 68,000
≥ 8	≤ 60,000	-	≤ 83,000
≥ 9	≤ 79,784	-	≤ 111,000
≥ 10	≤ 101,826	-	≤ 180,000
≥ 11	≤ 141,982	-	≤ 630,000
≥ 12	≤ 360,000	-	-

Notes:
1. Burnups for NON-FUEL HARDWARE are to be determined based on the burnup and uranium mass of the fuel assemblies in which the component was inserted during reactor operation.
2. Linear interpolation between points is permitted, except that APSR burnups > 180,000 MWD/MTU and ≤ 630,000 MWD/MTU must be cooled ≥ 11 years.
3. Applicable to uniform loading and regionalized loading.
4. Includes Burnable Poison Rod Assemblies (BPRAs), Wet Annular Burnable Absorbers (WABAs), vibration suppressor inserts and Neutron Source Assemblies (NSAs) in combination with other control components (i.e. BPRAs, TPDs, and/or RCCAs).
5. Includes Thimble Plug Devices (TPDs), water displacement guide tube plugs, orifice rod assemblies, Control Rod Assemblies (CRAs), Control Element Assemblies (CEAs), Rod Cluster Control Assemblies (RCCAs) and NSAs without other forms of control components.
6. NA means not authorized for loading at this cooling time.
7. Non-fuel hardware burnup and cooling times are not applicable to ITTRs since they are installed post irradiation.

Table 2-5
RESTRICTIONS FOR PARTIAL GADOLINIUM CREDIT IN MPC-68M

FUEL ASSEMBLY ARRAY AND CLASS	RESTRICTION
All 10x10 and 11x11	The gadolinium rod loading is not less than 3.0 wt% Gd_2O_3
All 10x10 and 11x11	The gadolinium rods located in the peripheral row of the fuel lattice cannot be credited
All 10x10 and 11x11	Gadolinium rods are NOT required to be present in damaged fuel in DFIs or damaged fuel/fuel debris in DFCs
10x10A, 10x10B, 10x10F, 10x10I, 10x10J, and 11x11A	At least one gadolinium rod must be present.
10x10C and 10x10G	At least two gadolinium rods must be present

2.2 Decay Heat Limits for ZR-Clad Fuel

This section provides the limits on ZR-clad fuel assembly decay heat, burnup, and cooling time for storage in the HI-STORM 100 System. The method to calculate the limits and verify compliance, including examples, is provided in Chapter 12 of the HI-STORM 100 FSAR.

2.2.1 Uniform Fuel Loading Decay Heat Limits for ZR-clad Fuel for VENTILATED OVERPACK

Table 2-6 provides the maximum allowable decay heat per fuel storage location for ZR-clad fuel in uniform fuel loading for each MPC model.

Table 2-6: Maximum Allowable Decay Heat per Fuel Storage Location (Uniform Loading, ZR-Clad)

MPC Model	Decay Heat per Fuel Storage Location (kW)	
	Intact or Undamaged Fuel Assemblies	Damaged Fuel Assemblies and Fuel Debris
MPC-24	$\leq$ 1.416	Not Permitted
MPC-24E/24EF	$\leq$ 1.416	$\leq$ 1.114
MPC-32/32F	$\leq$ 1.062	$\leq$ 0.718
MPC-68/68FF/68M	$\leq$ 0.500	$\leq$ 0.393

2.2.2 Regionalized Fuel Loading Decay Heat Limits for ZR-Clad Fuel for VENTILATED OVERPACK

The maximum allowable decay heat per fuel storage location for intact or undamaged fuel assemblies in regionalized loading is determined using the following equations:

$Q(X) = 2 \times Q_0 / (1 + X^y)$

$y = 0.23 / X^{0.1}$

$q_2 = Q(X) / (n_1 \times X + n_2)$

$q_1 = q_2 \times X$

Where:

Q_0 = Maximum uniform storage MPC decay heat (34 kW)

X = Inner region to outer region assembly decay heat ratio

$(0.5 \leq X \leq 3)$

n_1 = Number of storage locations in inner region from Table 2-7.

n_2 = Number of storage locations in outer region from Table 2-7.

Allowable heat loads for Damaged Fuel and Fuel Debris in regionalized loading are shown in Table 2-8.

Optional loading patterns for MPC-68M are shown in Figures 2-5 through 2-8.

Table 2-7: Fuel Storage Regions per MPC

MPC Model	Number of Storage Locations in Inner Region (Region 1)	Number of Storage Locations in Outer Region (Region 2)
MPC-24 and MPC-24E/EF	12	12
MPC- 32/32F	12	20
MPC-68/68FF/68M[Note1]	32	36

Note 1: For an optional regionalized loading pattern for MPC-68M, see Figures 2-5 through 2-8.

Table 2-8: Allowable Heat Load for Damaged Fuel Assemblies and Fuel Debris under Regionalized Loading

MPC Model	Maximum Per Cell Allowable Heat Load for Damaged Fuel Assemblies and Fuel Debris in DFCs [Note 1,3]
MPC-24E/24EF	$0.75*q_2$
MPC- 32/32F	$0.65*q_2$
MPC-68/68FF/68M[Note 2]	$0.75*q_2$

Note 1: q_2 is the maximum permissible heat load in Region 2 for intact fuel assemblies.

Note 2: Optional QSHL loading patterns for MPC-68M including Damaged Fuel and Fuel Debris are shown in Figures 2-5 through 2-8.

Note 3: Damaged fuel stored with DFIs can be stored up to q_2 limits.

2.2.3 Burnup Limits as a Function of Cooling Time for ZR-Clad Fuel for VENTILATED OVERPACK

The maximum allowable ZR-clad fuel assembly average burnup varies with the minimum required fuel assembly cooling time. Tables 2-9 and 2-10 provide for each MPC the allowable maximum burnup based on the assembly's particular cooling time.

2.2.3.1 Linear interpolation of burnups between cooling times is permitted. For example, the allowable burnup for a cooling time of 4.5 years may be interpolated between those burnups calculated for 4 year and 5 years.

2.2.3.2 Calculated burnup limits shall be rounded down to the nearest integer.

2.2.3.3 Calculated burnup limits greater than 68,200 MWD/MTU for PWR fuel and 65,000 MWD/MTU for BWR must be reduced to be equal to these values.

2.2.4 Compliance with Maximum Fuel Storage Location Decay Heat Limits

When complying with the maximum fuel storage location decay heat limits, users must account for the decay heat from both the fuel assembly and any NON-FUEL HARDWARE, as applicable for the particular fuel storage location, to ensure the decay heat emitted by all contents in a storage location does not exceed the limit.

2.2.5 Fuel Loading Decay Heat Limits for UNVENTILATED OVERPACK

Tables 2-11 and 2-12 provide the maximum allowable decay heat per fuel storage location for MPC-68M in an UNVENTILATED OVERPACK.

A minor deviation from the prescribed loading pattern in an MPC's permissible contents to allow one slightly thermally-discrepant fuel assembly per quadrant to be loaded as long as the peak cladding temperature for the MPC remains below the ISG-11 Rev 3 requirements is permitted for essential dry storage campaigns to support decommissioning.

2.2.6 Burnup and Cooling Time Qualifications for the MPC-68M for UNVENTILATED OVERPACK

The burnup and cooling time for every fuel loaded into the MPC-68M must satisfy the following equation:

$$Ct = A \cdot Bu^3 + B \cdot Bu^2 + C \cdot Bu + D$$

where,

Ct = Minimum cooling time (years),

Bu = Assembly-average burnup (MWd/mtU),

A, B, C, D = Polynomial coefficients listed in Table 2-15

Table 2-9: PWR Fuel Assembly Burnup and Cooling Time Limits for VENTILATED OVERPACK (ZR-Clad Fuel)

Minimum Cooling Time (years)	Maximum Allowable Burnup, MWd/mtU
MPC-24/24E/24EF	
1.0	5,000
1.4	15,000
1.8	25,000
2.0	35,000
2.2	40,000
2.4	45,000
2.6	50,000
2.8	55,000
3.0	60,000
4.0	69,000
5.0	75,000
MPC-32/32F	
1.0	5,000
1.4	10,000
1.8	20,000
2.0	25,000
2.2	30,000
2.4	35,000
2.6	40,000
3.0	45,000
4.0	60,000
5.0	69,000

Table 2-10: BWR Fuel Assembly Burnup and Cooling Time Limits for VENTILATED OVERPACK (ZR-Clad Fuel)

Minimum Cooling Time (years)	Maximum Allowable Burnup, MWd/mtU
MPC-68/68FF/68M	
1.0	10,000
1.2	15,000
1.4	20,000
2.0	25,000
2.2	30,000
2.4	35,000
2.6	40,000
3.0	50,000
4.0	62,000
5.0	65,000
6.0	70,000

Table 2-11: MPC-68M Heat Load Data for UNVENTILATED OVERPACK

Number of Regions: 2			
Number of Storage Cells: 68			
Maximum Total Heat Load (kW): 25			
Maximum Section Heat Load (kW): 3.125 (Note 1)			
Region No.	Decay Heat Limit per Cell, kW	Number of Cells per Region	Decay Heat Limit per Region, kW
1 (Inner)	0.368	32	11.765
2 (Outer)	0.368	36	13.325
Note 1: Figure 2-4 identifies the MPC basket regions and cell locations, and Table 2-13 identifies the cells included in each Heat Load for each section.			

Table 2-12: MPC-68M Requirements on Developing Regionalized Heat Load Patterns for UNVENTILATED OVERPACK

(See Figure 2-4)

1. Total MPC aggregate Heat Load must be equal to 25 kW
2. Maximum Section Heat Load must be equal to 3.125 kW, calculated per Table 2-13, and pattern must be 1/8th symmetric
3. Maximum Heat Load per Cell in Region 1 is 0.368 kW
4. Maximum Heat Load per Cell in Region 2 is 0.735 kW
5. Pattern-specific Decay Heat in a storage cell may need to be adjusted to meet items 1 and 2
6. Pattern-specific Heat Load for storage cells may be determined by reducing the allowable heat load in any Region 1 cell in Table 2-11 by a certain amount (Δ) and adding the same Δ to a single cell or distributed amongst multiple cells in Region 2. i.e. Any reduction of total allowable heat load in Region 1 must be compensated by an equivalent addition in Region 2.

General Notes –

1. Any assembly with a Heat Load less than the limits defined above can be loaded in the applicable cell, provided it meets all other CoC requirements.
2. DFCs/DFIs are permitted in locations denoted in Table 2-14 with the applicable Heat Load penalties identified therein.

Table 2-13: Section Heat Load Calculations for MPC=68M for UNVENTILATED OVERPACK

Section	Equation for Section Heat Load[1]
Section 1	$Q_{21} + Q_{13} + Q_{14} + Q_6 + Q_7 + Q_8 + Q_2 + ½Q_{30} + ½Q_{22} + ½Q_{15}$
Section 2	$Q_{31} + Q_{32} + Q_{23} + Q_{33} + Q_{24} + Q_{16} + Q_{34} + ½Q_{30} + ½Q_{22} + ½Q_{15}$
Section 3	$Q_{41} + Q_{42} + Q_{51} + Q_{43} + Q_{52} + Q_{60} + Q_{44} + ½Q_{40} + ½Q_{50} + ½Q_{59}$
Section 4	$Q_{49} + Q_{58} + Q_{57} + Q_{64} + Q_{65} + Q_{66} + Q_{68} + ½Q_{40} + ½Q_{50} + ½Q_{59}$
Section 5	$Q_{48} + Q_{56} + Q_{55} + Q_{61} + Q_{62} + Q_{63} + Q_{67} + ½Q_{39} + ½Q_{47} + ½Q_{54}$
Section 6	$Q_{38} + Q_{46} + Q_{37} + Q_{36} + Q_{45} + Q_{53} + Q_{35} + ½Q_{39} + ½Q_{47} + ½Q_{54}$
Section 7	$Q_{28} + Q_{27} + Q_{18} + Q_9 + Q_{17} + Q_{26} + Q_{25} + ½Q_{29} + ½Q_{19} + ½Q_{10}$
Section 8	$Q_{20} + Q_{11} + Q_{12} + Q_3 + Q_4 + Q_5 + Q_1 + ½Q_{29} + ½Q_{19} + ½Q_{10}$

Note:

1. Q_{X-Y} is the heat load in kW in cell ID (X-Y), identified in Figure 2-4

Table 2-14: DFC and DFI Storage Locations with Heat Load penalties for MPC-68M for UNVENTILATED OVERPACK

MPC Type	DFC/DFI (Note 1)	Locations/Storage Cell Numbers (Note 2)	Heat Load Penalty (Note 3)	Min. Soluble Boron Content
MPC-68M	DFI	1, 2, 3, 8, 9, 16, 25, 34, 35, 44, 53, 60, 61, 66, 67, 68	25%	N/A
	DFC		25%	
	DFC or DFI		DFCs – 25% DFIs – 25%	

Notes

1: Damaged fuel assemblies or fuel debris can be loaded in DFCs while only damaged fuel assemblies that can be handled by normal means can be loaded in DFIs.

2: DFCs/DFIs are allowed for storage in certain basket peripheral locations as defined herein. Basket storage cell numbers are identified in Figure 2-4 for the MPC-68M.

3: Heat load penalties are applicable to ONLY those cells where DFCs/DFIs are located and are applied to the allowable undamaged fuel assembly decay heat limit in that storage cell location. The penalties remain the same for all regionalized patterns and discrete loading patterns.

Table 2-15: Burnup and Cooling Time Fuel Qualification Requirements for MPC-68M for UNVENTILATED OVERPACK

Cell Decay Heat Load Limit (kW)	Polynomial Coefficients, see Subsection 2.2.3			
	A	B	C	D
≤ 0.382	9.44656e-14	-8.01992e-09	2.79524e-04	-4.10441e-01
0.382 < decay heat ≤ 1.625	8.59250e-15	-1.40950e-09	9.57523e-05	-1.02585e+00

Table 2-16: Regionalized Storage Cell Heat Load Limits

(Note 2)

<table>
<tr><th>MPC Type</th><th>Number of Cells in Inner Region[Note 1]</th><th>Storage Cell Heat Load (Inner Region) (kW)</th><th>Number of Cells in Outer Region[Note 1]</th><th>Storage Cell Heat Load (Outer Region) (kW)</th></tr>
<tr><td>MPC-24</td><td>4</td><td>1.470</td><td>20</td><td>0.900</td></tr>
<tr><td>MPC-24E/EF</td><td>4</td><td>1.540</td><td>20</td><td>0.900</td></tr>
<tr><td>MPC-32/32F</td><td>12</td><td>1.131</td><td>20</td><td>0.600</td></tr>
<tr><td>MPC-68/68F/68FF/68M</td><td>32</td><td>0.500</td><td>36</td><td>0.275</td></tr>
<tr><td colspan="5">Note 1: The location of MPC-32 and MPC-68 inner and outer region cells are defined in Figures 2-3 and 2-4 respectively.
The MPC-24 and MPC-24E/EF cell locations are defined below:
Inner Region Cell numbers 9, 10, 15, 16 in Figures 2-1 and 2-2 respectively.
Outer Region Cell numbers 1-8, 11-14, 17-24 in Figures 2-1 and 2-2 respectively.

Note 2: The storage cell regionalization is defined in Note 1 in accordance with safety analyses under the heat load limits of this Table.</td></tr>
</table>

Table 2-17: Uniform Storage Cell Heat Load Limits

MPC Type	Heat Load (kW)
MPC-24	1.157
MPC-24E/EF	1.173
MPC-68/68F/68FF/68M	0.414
MPC-32	0.898

				1 0.5*	2 0.5*				
		3 0.5*	4 0.5	5 1.2	6 1.2	7 0.5	8 0.5*		
	9 0.5*	10 0.5	11 1.2	12 0.4	13 0.4	14 1.2	15 0.5	16 0.5*	
	17 0.5	18 1.2	19 0.4	20 0.4	21 0.4	22 0.4	23 1.2	24 0.5	
25 0.5*	26 1.2	27 0.4	28 0.4	29 0.4	30 0.4	31 0.4	32 0.4	33 1.2	34 0.5*
35 0.5*	36 1.2	37 0.4	38 0.4	39 0.4	40 0.4	41 0.4	42 0.4	43 1.2	44 0.5*
	45 0.5	46 1.2	47 0.4	48 0.4	49 0.4	50 0.4	51 1.2	52 0.5	
	53 0.5*	54 0.5	55 1.2	56 0.4	57 0.4	58 1.2	59 0.5	60 0.5*	
		61 0.5*	62 0.5	63 1.2	64 1.2	65 0.5	66 0.5*		
Cell ID **Heat Load (kW)**				67 0.5*	68 0.5*				

Figure 2-5: QSHL Pattern Per Cell Allowable Heat Loads (kW) - MPC-68M

* When DAMAGED FUEL or FUEL DEBRIS is stored in this location (in a DFC), the allowable heat load of the cell is limited to 0.35 kW. When DFIs are utilized for DAMAGED FUEL, the value in the figure applies.

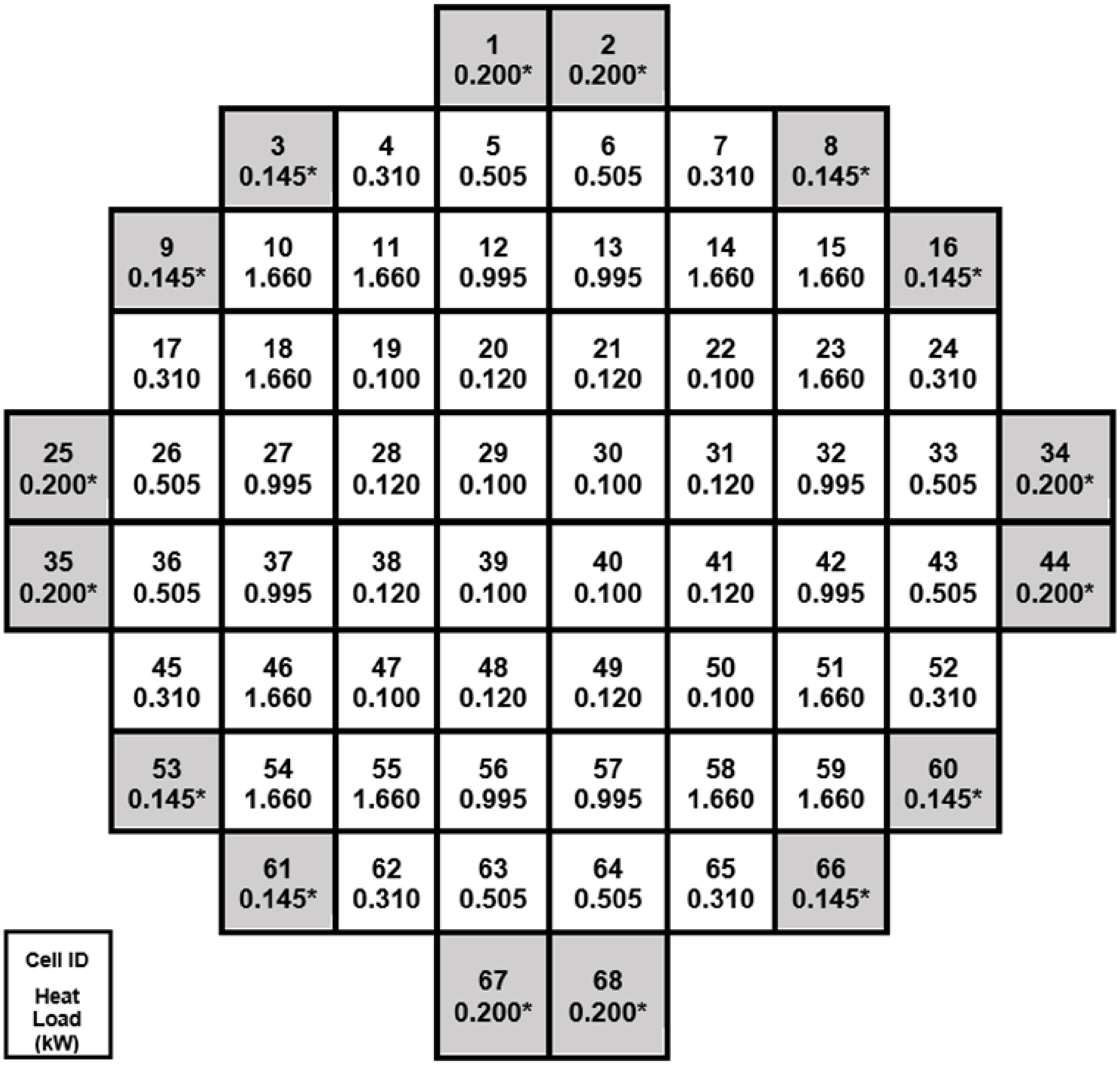

Figure 2-6: QSHL-2 Pattern, Per Cell Allowable Heat Loads (kW) - MPC-68M

* DFCs/DFIs are allowed in shaded cells. When DAMAGED FUEL or FUEL DEBRIS (in a DFC) is stored in this location, the allowable heat load of the cell is reduced by 25%. When DFIs are utilized for DAMAGED FUEL, the value in the figure applies.

				1 0.505*	2 0.505*				
		3 0.145*	4 0.310	5 0.200	6 0.200	7 0.310	8 0.145*		
	9 0.145*	10 1.660	11 1.660	12 0.995	13 0.995	14 1.660	15 1.660	16 0.145*	
	17 0.310	18 1.660	19 0.100	20 0.120	21 0.120	22 0.100	23 1.660	24 0.310	
25 0.505*	26 0.200	27 0.995	28 0.120	29 0.100	30 0.100	31 0.120	32 0.995	33 0.200	34 0.505*
35 0.505*	36 0.200	37 0.995	38 0.120	39 0.100	40 0.100	41 0.120	42 0.995	43 0.200	44 0.505*
	45 0.310	46 1.660	47 0.100	48 0.120	49 0.120	50 0.100	51 1.660	52 0.310	
	53 0.145*	54 1.660	55 1.660	56 0.995	57 0.995	58 1.660	59 1.660	60 0.145*	
		61 0.145*	62 0.310	63 0.200	64 0.200	65 0.310	66 0.145*		
Cell ID Heat Load (kW)				67 0.505*	68 0.505*				

Figure 2-7: QSHL-3 Pattern, Per Cell Allowable Heat Loads (kW) - MPC-68M

* DFCs/DFIs are allowed in shaded cells. When DAMAGED FUEL or FUEL DEBRIS (in a DFC) is stored in this location, the allowable heat load of the cell is reduced by 25%. When DFIs are utilized for DAMAGED FUEL, the value in the figure applies.

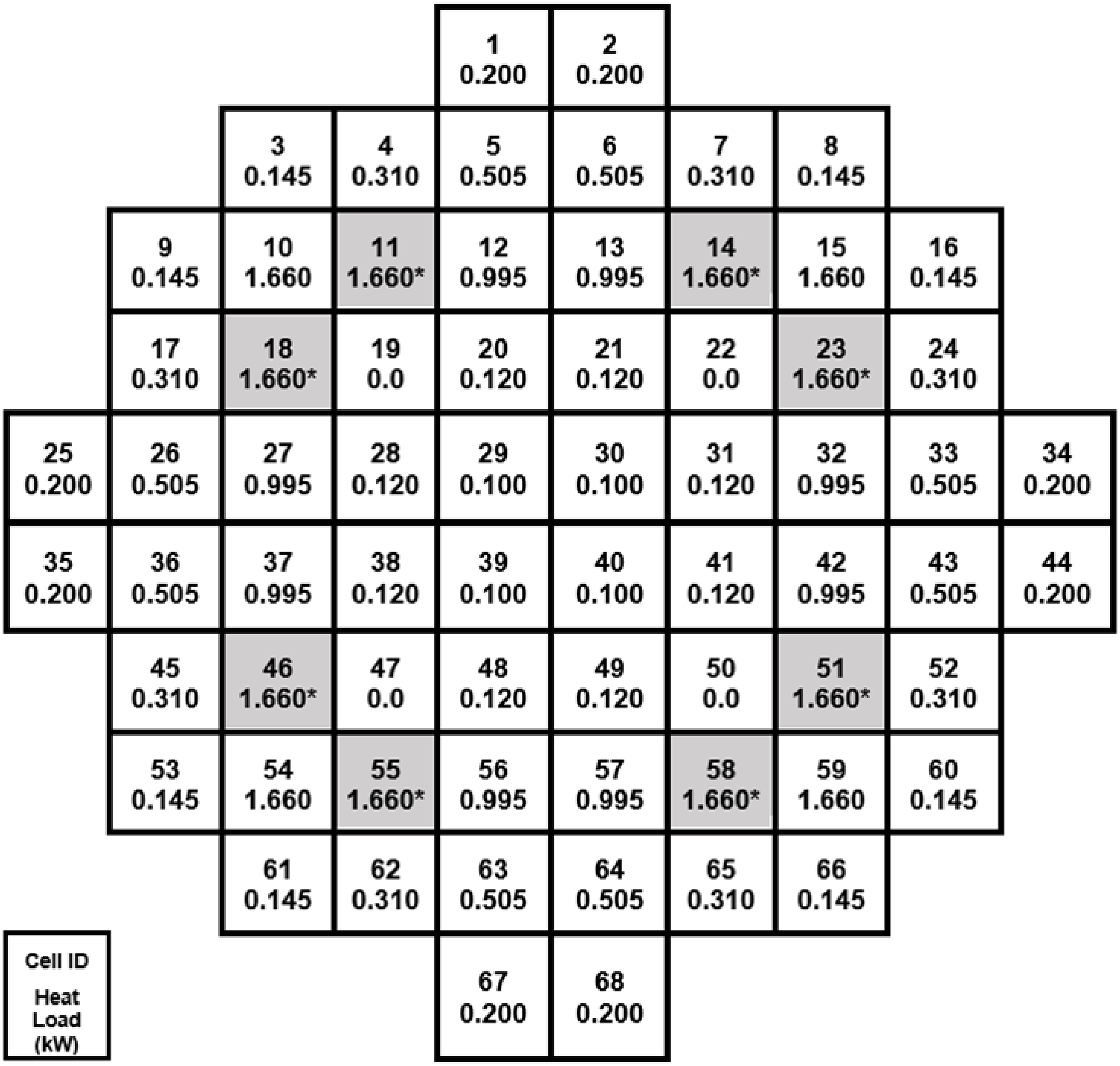

Figure 2-8: QSHL-4 Pattern, Per Cell Allowable Heat Loads (kW) - MPC-68M

* DFCs/DFIs are allowed in shaded cells. Cell IDs 19, 22, 47 and 50 must remain empty.

3 LIMITING CONDITIONS FOR OPERATION (LCOS) AND SURVEILLANCE REQUIREMENTS (SRS)

3.0 Applicability

Limiting Conditions for Operation (LCO) Applicability

LCO 3.0.1	LCOs shall be met during specified conditions in the Applicability, except as provided in LCO 3.0.2.
LCO 3.0.2	Upon 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. If the LCO is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated.
LCO 3.0.3	Not applicable.
LCO 3.0.4	When an LCO is not met, entry into a specified condition in the Applicability shall not be made except when the associated ACTIONS to be entered permit continued operation in the specified condition in the Applicability for an unlimited period of time. This Specification shall not prevent changes in specified conditions in the Applicability that are required to comply with ACTIONS or that are related to the unloading of an SFSC.
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.

Surveillance Requirement (SR) Applicability

SR 3.0.1	SRs shall be met during the specified conditions in the Applicability for individual LCOs, unless otherwise stated in the SR. Failure to meet 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.
SR 3.0.3 (continued)	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 an SFSC.

3.1 SFSC INTEGRITY

3.1.1 Multi-Purpose Canister (MPC)

LCO 3.1.1 The MPC shall be dry and helium filled.

Tables 3-1 and 3-2 provide decay heat and burnup limits for forced helium dehydration (FHD) and vacuum drying. FHD is not subject to time limits. Vacuum drying of MPCs may be subject to time limits, from the end of bulk water removal until the start of helium backfill, as shown in Tables 3-1 and 3-2.

APPLICABILITY: During TRANSPORT OPERATIONS and STORAGE OPERATIONS.

ACTIONS

--NOTES--

1. Separate Condition entry is allowed for each MPC.
2. MPC helium leak rate limit for cover plate base metal listed in Condition D and SR 3.1.1.3, is not applicable to casks that were initially loaded to Amendments 2 through 7.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MPC cavity vacuum drying pressure or demoisturizer exit gas temperature limit not met.	A.1 Perform an engineering evaluation to determine the quantity of moisture left in the MPC.	7 days
	AND	
	A.2 Develop and initiate corrective actions necessary to return the MPC to compliance with Tables 3-1 and 3-2.	30 days

ACTIONS (continued)

B. MPC cavity vacuum drying acceptance criteria not met during allowable time.	B.1 Backfill the MPC cavity with helium to a pressure of at least 0.5 atm.	6 hours
C. MPC helium backfill limit not met.	C.1 Perform an engineering evaluation to determine the impact of helium differential.	72 hours
	<u>AND</u>	
	C.2.1 Develop and initiate corrective actions necessary to return the MPC to an analyzed condition by adding helium to or removing helium from the MPC. <u>OR</u> C.2.2 Develop and initiate corrective actions necessary to demonstrate through analysis, using the models and methods from the HI-STORM FSAR, that all limits for cask components and contents will be met.	14 days
D. MPC helium leak rate limit for vent and drain port cover plate welds or cover plate base metal not met.	D.1 Perform an engineering evaluation to determine the impact of increased helium leak rate on heat removal capability and offsite dose.	24 hours
	<u>AND</u>	
	D.2 Develop and initiate corrective actions necessary to return the MPC to compliance with SR 3.1.1.3.	7 days

E. Required Actions and associated Completion Times not met.	E.1 Remove all fuel assemblies from the SFSC.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1.1	Verify that the MPC cavity has been dried in accordance with the applicable limits in Tables 3-1 and 3-2, within the specified vacuum drying time limits as applicable.	Once, prior to TRANSPORT OPERATIONS
SR 3.1.1.2	Verify MPC helium backfill quantity is within the limit specified in Tables 3-3 and 3-4 for the applicable MPC model. Re-performance of this surveillance is not required upon successful completion of Action C.2.2.	Once, prior to TRANSPORT OPERATIONS
SR 3.1.1.3	Verify that the helium leak rate through the MPC vent and drain port cover plates (confinement welds and the base metal) meets the leaktight criteria of ANSI N14.5-1997. This surveillance does not need to be performed in the MPC utilizing the REDUNDANT PORT COVER DESIGN.	Once, prior to TRANSPORT OPERATIONS

3.1.2 SFSC Heat Removal System

LCO 3.1.2 The SFSC Heat Removal System shall be operable

---NOTE--

The SFSC Heat Removal System is operable when 50% or more of the inlet and outlet vent areas are unblocked and available for flow or when air temperature requirements are met. This LCO only applies to the VENTILATED OVERPACKs.

APPLICABILITY: During STORAGE OPERATIONS.

ACTIONS

---NOTE--

Separate Condition entry is allowed for each SFSC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. SFSC Heat Removal System operable, but partially (<50%) blocked.	A.1 Remove blockage.	N/A

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. SFSC Heat Removal System inoperable.	B.1 Restore SFSC Heat Removal System to operable status.	Table 3-5
C. Required Action B.1 and associated Completion Time not met.	C.1 Measure SFSC dose rates in accordance with the Radiation Protection Program.	Immediately and once per 12 hours thereafter
	<u>AND</u>	
	C.2.1 Restore SFSC Heat Removal System to operable status.	Table 3-5
	<u>OR</u>	
	C.2.2 Transfer the MPC into a TRANSFER CASK.	Table 3-5

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.1.2	Verify all OVERPACK inlets and outlets are free of blockage from solid debris or floodwater.	Table 3-5
	<u>OR</u>	
	For OVERPACKS with installed temperature monitoring equipment, verify that the difference between the average OVERPACK air outlet temperature and ISFSI ambient temperature is $\leq$ 155°F for OVERPACKS containing PWR MPCs, $\leq$ 137°F for OVERPACKS containing BWR MPCs (except MPC-68M) and ≤ 164°F for OVERPACKS containing MPC-68M.	Table 3-5

3.1.3 MPC Cavity Reflooding

LCO 3.1.3 The MPC cavity pressure shall be < 100 psig

--NOTE--

The LCO is only applicable to wet UNLOADING OPERATIONS.

APPLICABILITY: UNLOADING OPERATIONS prior to and during re-flooding.

ACTIONS

--NOTE--

Separate Condition entry is allowed for each MPC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MPC cavity pressure not within limit.	A.1 Stop re-flooding operations until MPC cavity pressure is within limit.	Immediately
	AND	
	A.2 Ensure MPC vent port is not closed or blocked.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY

SR 3.1.3.1	Ensure via analysis or direct measurement that MPC cavity pressure is within limit.	Once, prior to MPC re-flooding operations. <u>AND</u> Once every 1 hour thereafter when using direct measurement.

3.1.4 Supplemental Cooling System

LCO 3.1.4 A supplemental cooling system (SCS) shall be operable

--NOTE---

Upon reaching steady state operation, the SCS may be temporarily disabled for a short duration (≤ 7 hours) to facilitate necessary operational evolutions, such as movement of the TRANSFER CASK through a door way, or other similar operation.

APPLICABILITY: This LCO is not applicable to the MPC-68M. For all other MPCs this LCO is applicable when the loaded MPC is in the TRANSFER CASK and:

a. Within 4 hours of the completion of MPC drying operations in accordance with LCO 3.1.1 or within 4 hours of transferring the MPC into the TRANSFER CASK if the MPC is to be unloaded

AND

b. The MPC contains one or more fuel assemblies with an average burnup > 45,000 MWD/MTU

AND

c1. MPC backfilled to higher helium backfill limits in Tables 3-3 and 3-4 AND any storage cell decay heat load exceeds 90% of maximum allowable storage cell heat load defined in Section 2.2.1 or 2.2.2 and FSAR Section 2.1.9.1 procedures.

OR

c2. MPC backfilled to lower helium backfill limits in Tables 3-3 and 3-4 AND any storage cell heat load exceeds 90% of storage cell heat load limits defined in Tables 2-16 or 2-17.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. SFSC Supplemental Cooling System inoperable.	A.1 Restore SFSC Supplemental Cooling System to operable status.	7 days
B. Required Action A.1 and associated Completion Time not met.	B.1 Remove all fuel assemblies from the SFSC.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	Verify SCS is operable.	2 hours

3.2 SFSC RADIATION PROTECTION.

3.2.1 Deleted.

LCO 3.2.1 Deleted.

3.2.2 TRANSFER CASK Surface Contamination.

LCO 3.2.2 Removable contamination on the exterior surfaces of the TRANSFER CASK and accessible portions of the MPC shall each not exceed:

a. 1000 dpm/100 cm^2 from beta and gamma sources

b. 20 dpm/100 cm^2 from alpha sources.

---NOTE---

This LCO is not applicable to the TRANSFER CASK if MPC TRANSFER operations occur inside the FUEL BUILDING.

APPLICABILITY: During TRANSPORT OPERATIONS.

ACTIONS

---NOTE---

Separate Condition entry is allowed for each TRANSFER CASK.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. TRANSFER CASK or MPC removable surface contamination limits not met.	A.1 Restore removable surface contamination to within limits.	7 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.2.1	Verify that the removable contamination on the exterior surfaces of the TRANSFER CASK and accessible portions of the MPC containing fuel is within limits.	Once, prior to TRANSPORT OPERATIONS

3.3 SFSC CRITICALITY CONTROL

3.3.1 Boron Concentration

LCO 3.3.1

As required by Table 2-2, the concentration of boron in the water in the MPC shall meet the following limits for the applicable MPC model and the most limiting fuel assembly array/class and classification to be stored in the MPC:

a. MPC-24 with one or more fuel assemblies having an initial enrichment greater than the value in Table 2-2 for no soluble boron credit and $\leq$ 5.0 wt% ^{235}U: $\geq$ 400 ppmb

b. MPC-24E or MPC-24EF (all INTACT FUEL ASSEMBLIES) with one or more fuel assemblies having an initial enrichment greater than the value in Table 2-2 for no soluble boron credit and $\leq$ 5.0 wt% ^{235}U: $\geq$ 300 ppmb

c. MPC-24E or MPC-24EF (one or more DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS) with one or more fuel assemblies having an initial enrichment > 4.0 wt% ^{235}U and $\leq$ 5.0 wt% ^{235}U: $\geq$ 600 ppmb

d. MPC-32/32F: Minimum soluble boron concentration as required by the table below†.

Array/Class	All INTACT FUEL ASSEMBLIES		One or more DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS	
	Maximum Initial Enrichment $\leq$ 4.1 wt% ^{235}U (ppmb)	Maximum Initial Enrichment 5.0 wt% ^{235}U (ppmb)	Maximum Initial Enrichment $\leq$ 4.1 wt% ^{235}U (ppmb)	Maximum Initial Enrichment 5.0 wt% ^{235}U (ppmb)
14x14A/B/C/D/E	1,300	1,900	1,500	2,300
15x15A/B/C/G/I	1,800	2,500	1,900	2,700
15x15D/E/F/H	1,900	2,600	2,100	2,900
16x16A/B/C	1,400	2,000	1,500	2,300
17x17A	1,600	2,200	1,800	2,600
17x17B/C	1,900	2,600	2,100	2,900

† For maximum initial enrichments between 4.1 wt% and 5.0 wt% ^{235}U, the minimum soluble boron concentration may be determined by linear interpolation between the minimum soluble boron concentrations at 4.1 wt% and 5.0 wt%.

APPLICABILITY: During PWR fuel LOADING OPERATIONS with fuel and water in the MPC

AND

During PWR fuel UNLOADING OPERATIONS with fuel and water in the MPC.

ACTIONS

--NOTE--

Separate Condition entry is allowed for each MPC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Boron concentration not within limit.	A.1 Suspend LOADING OPERATIONS or UNLOADING OPERATIONS.	Immediately
	AND	
	A.2 Suspend positive reactivity additions.	Immediately
	AND	
	A.3 Initiate action to restore boron concentration to within limit.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
--NOTE---------------------------------- This surveillance is only required to be performed if the MPC is submerged in water or if water is to be added to, or recirculated through the MPC. --- SR 3.3.1.1 Verify boron concentration is within the applicable limit using two independent measurements.	Once, within 4 hours prior to entering the Applicability of this LCO. <u>AND</u> Once per 48 hours thereafter.

Table 3-1: MPC Cavity Drying Limits for all MPC Types for Ventilated Overpack

Fuel Burnup (MWD/MTU)	MPC Heat Load (kW)	Method of Moisture Removal (Notes 1 and 2)
All Assemblies ≤ 45,000	≤ 26 (MPC-24/24E/24EF, MPC-32/32F, MPC-68/68F/68FF)	VDS Note 5 or FHD Note 6
	≤ 36.9 (MPC-68M) Note 6	VDS or FHD
	≤ 42.8 (MPC-68M) Note 7	VDS or FHD
All Assemblies ≤ 45,000	≤ 36.9 (MPC-24/24E/24EF, MPC-32/32F, MPC-68/68F/68FF) Note 6	VDS Note 8 or FHD
One or more assemblies > 45,000	≤ 29 (MPC-68M)	VDS Note 4
One or more assemblies > 45,000	≤ 36.9 (MPC-24/24E/24EF/MPC-32/32F/MPC-68/68F/68FF) Note6	VDS Note8 or FHD
	≤ 36.9 (MPC-68M) Note6	VDS Note8 or FHD
	≤ 42.8 (MPC-68M) Note 7	VDS Note8 or FHD

Notes:

1. VDS means a vacuum drying system. The acceptance criterion when using a VDS is MPC cavity pressure shall be ≤ 3 torr for ≥ 30 minutes.
2. FHD means a forced helium dehydration system. The acceptance criterion when using an FHD system is the gas temperature exiting the demoisturizer shall be

   ≤ 21°F for ≥ 30 minutes or the gas dew point exiting the MPC shall be ≤ 22.9°F for ≥ 30 minutes.
3. Vacuum drying of the system must be performed with the annular gap between the MPC and the TRANSFER CASK filled with water.
4. The maximum allowable decay heat per fuel storage location is 0.426 kW.
5. Maximum allowable storage cell heat load is 1.083 kW (MPC-24/24E/24EF), 0.812 kW (MPC-32/32F) and 0.382 kW (MPC-68/68F/68FF).
6. Maximum per assembly allowable heat loads under uniform or regionalized storage defined in Section 2.2.1 or 2.2.2.
7. Maximum per assembly allowable heat loads defined in Figures 2-5 through 2-8.

8. Vacuum drying of the MPC must be performed using cycles of the drying system, according to the guidance contained in ISG-11 Revision 3. The time limit for these cycles shall be determined based on site specific conditions. Applies when any one assembly heat load is greater than 0.426 kW.

Table 3-2: MPC Cavity Drying Limits for all MPC Types for Unventilated Overpack

Fuel Burnup (MWD/MTU)	MPC Heat Load (kW)	Method of Moisture Removal (Notes 1 and 2)
All burnups	≤ 25 (MPC-68M)[Note 4]	VDS or FHD

Notes:

1. VDS means a vacuum drying system. The acceptance criterion when using a VDS is MPC cavity pressure shall be ≤ 3 torr for ≥ 30 minutes.
2. FHD means a forced helium dehydration system. The acceptance criterion when using an FHD system is the gas temperature exiting the demoisturizer shall be

   ≤ 21°F for ≥ 30 minutes or the gas dew point exiting the MPC shall be ≤ 22.9°F for ≥ 30 minutes.
3. Vacuum drying of the system must be performed with the annular gap between the MPC and the TRANSFER CASK filled with water.
4. Maximum per assembly allowable heat loads under uniform or regionalized storage defined in Section 2.2.5.

Table 3-3: MPC Helium Backfill Limits for Ventilated Overpack (Note 1)

MPC MODEL	LIMIT
MPC-24/24E/24EF	
i. Cask Heat Load ≤ 27.77 kW (MPC-24) or ≤ 28.17 kW (MPC-24E/EF) - uniformly distributed per Table 2-17 or regionalized loading per Table 2-16	0.1212 +/-10% g-moles/l OR ≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load >27.77 kW (MPC-24) or > 28.17 kW (MPC-24E/EF) - uniformly distributed or greater than regionalized heat load limits per Table 2-16	≥ 45.5 psig and ≤ 48.5 psig
MPC-68/68F/68FF	
i. Cask Heat Load ≤ 28.19 kW - uniformly distributed per Table 2-17 or regionalized loading per Table 2-16	0.1218 +/-10% g-moles/l OR ≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load > 28.19 kW - uniformly distributed or greater than regionalized heat load limits per Table 2-16	≥ 45.5 psig and ≤ 48.5 psig
MPC-32/32F	
i. Cask Heat Load ≤ 28.74 kW - uniformly distributed per Table 2-17 or regionalized loading per Table 2-16	≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load >28.74 kW - uniformly distributed or greater than regionalized heat load limits per Table 2-16	≥ 45.5 psig and≤ 48.5 psig

MPC-68M	
i. Cask Heat Load ≤ 28.19 kW - uniformly distributed per Table 2-17 or regionalized loading per Table 2-16	0.1218 +/-10% g-moles/l OR ≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load > 28.19 kW - uniformly distributed or greater than regionalized heat load limits per Table 2-16	≥ 45.5 psig and ≤ 48.5 psig
iii. Cask Heat Load ≤ 42.8 kW QSHL Loading Pattern shown in Figure 2-5	≥ 43.5 psig and ≤ 46.5 psig
QSHL patterns shown in Figures 2-6 through 2-8	≥ 45.5 psig and ≤ 48.5 psig

Note:

1. Helium used for backfill of MPC shall have a purity of ≥ 99.995%. Pressure range is at a reference temperature of 70°F

Table 3-4: MPC Helium Backfill Limits for Unventilated Overpack

MPC MODEL	LIMIT
MPC-68M	
i. Cask Heat Load ≤ 25 kW - uniformly distributed per Section 2.2.5 or regionalized loading per Section 2.2.5	0.1218 +/-10% g-moles/l OR ≥ 42.0 psig and ≤ 45.0 psig

Note:

1. Helium used for backfill of MPC shall have a purity of ≥ 99.995%. Pressure range is at a reference temperature of 70°F

Table 3-5: Completion Time for Actions to Restore SFSC Heat Removal System Operable

MPC Material	MPC Type	Decay Heat Limits per Storage Location	Condition B Completion Time	Condition C Completion Time	Surveillance Frequency
Alloy X Except Duplex[1]	MPC-24/24E/24EF	Section 2.2	8 hrs	24 hrs	24 hrs
	MPC-32/32F				
	MPC-68/68F/68FF/68M				
	MPC-68M	Figures 2-5 through 2-8			
Alloy X	MPC-24/24E/24EF	Section 2.2	8 hrs	16 hrs	16 hrs
	MPC-32/32F				
	MPC-68/68F/68FF/68M				
Alloy X	MPC-68M	Figures 2-5 through 2-8	4 hrs	12 hrs	12 hrs
Alloy X Except Duplex[1]	MPC-24	Table 2-16 (Regionalized) OR Table 2-17 (Uniform)	8 hrs	64 hrs	24 hrs
	MPC-24E/EF				
	MPC-32/32F				
	MPC-68/68F/68FF/68M				
	MPC-24	Table 2-16	8 hrs	24 hrs	24 hrs
	MPC-24E/EF				

	MPC-32/32F	(Regionalized) OR Table 2-17 (Uniform)			
	MPC-68/68F/68FF/68M				
Alloy X	MPC-24/24E/24EF	0.75 kW	24 hrs	64 hrs	30 days
	MPC-32/32F	0.5 kW			
	MPC-68/68F/68FF/68M	0.264 kW			

Note:

1. If any component of the MPC is made of duplex, these completion times are not applicable.

4 ADMINISTRATIVE CONTROLS

4.1 Radioactive Effluent Control Program

a. The HI-STORM 100 Cask System does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Specification 3.1.1, Multi-Purpose Canister (MPC), provides assurance that there are not radioactive effluents from the SFSC.

b. This program includes an environmental monitoring program. Each general license user may incorporate SFSC operations into their environmental monitoring programs for 10 CFR Part 50 operations.

c. An annual report shall be submitted pursuant to 10 CFR 72.44(d)(3).

4.2 Cask Transport Evaluation Program

This program provides a means for evaluating various transport configurations and transport route conditions to ensure that the design basis drop limits are met. For lifting of the loaded TRANSFER CASK or OVERPACK using devices which are integral to a structure governed by 10 CFR Part 50 regulations, 10 CFR 50 requirements apply. This program is not applicable when the TRANSFER CASK or OVERPACK is in the FUEL BUILDING or is being handled by a device providing support from underneath (i.e., on a rail car, heavy haul trailer, air pads, etc...) or is being handled by a device designed in accordance with the increased safety factors of ANSI N14.6 and having redundant drop protection.

Pursuant to 10 CFR 72.212, this program shall evaluate the site-specific transport route conditions.

4.2.1 Freestanding Overpacks and the Transfer Cask

For free-standing OVERPACKS and the TRANSFER CASK, the following requirements apply:

4.2.1.1 The lift height above the transport route surface(s) shall not exceed the limits in Table 4-1 except as provided for in Specification 4.2.1.2. Also, if applying the limits in Table 4-1, the program shall ensure that the transport route conditions (i.e., surface hardness and pad thickness) are equivalent to or less limiting than either Set A or Set B in HI-STORM FSAR Table 2.2.9.

4.2.1.2 The program may determine lift heights by analysis based on the site-specific conditions to ensure that the impact loading due to design basis drop events does not exceed 45 g's at the top of the MPC fuel basket. These alternative analyses shall be commensurate with the drop analyses described in the Final Safety Analysis Report for the HI-STORM 100 Cask System. The program shall ensure that these alternative analyses are documented and controlled.

4.2.1.3 The TRANSFER CASK or OVERPACK, when loaded with spent fuel, may be lifted to any height necessary during TRANSPORT OPERATIONS, provided the lifting device is designed in accordance with applicable stress limits from ANSI N14.6, and/or NUREG-0612, and has redundant drop protection features.

4.2.1.4 The TRANSFER CASK and MPC, when loaded with spent fuel, may be lifted to those heights necessary to perform cask handling operations, including MPC TRANSFER, provided the lifts are made with structures and components designed in accordance with the criteria specified in Section 2.3 of Appendix A to Certificate of Compliance No. 1014, as applicable.

4.2.2 Anchored Overpacks

For the transport of OVERPACKS to be anchored to the ISFSI pad, the following requirements apply:

4.2.2.1 Except as provided in 4.2.2.2, user shall determine allowable OVERPACK lift height limit(s) above the transport route surface(s) based on site-specific transport route conditions. The lift heights shall be determined by evaluation or analysis, based on limiting the design basis cask deceleration during a postulated drop event to ≤ 45 g's at the top of the MPC fuel basket. Evaluations and/or analyses shall be performed using methodologies consistent with those in the HI-STORM 100 FSAR.

4.2.2.2 The OVERPACK, when loaded with spent fuel, may be lifted to any height necessary during TRANSPORT OPERATIONS provided the lifting device is designed in accordance with applicable stress limits from ANSI N14.6, and/or NUREG-0612, and has redundant drop protection features.

Table 4-1: Transfer Cask and Free-Standing Overpack Lifting Requirements

ITEM	ORIENTATION	LIFTING HEIGHT LIMIT (in.)
TRANSFER CASK	Horizontal	42 Notes 1 and 2
TRANSFER CASK	Vertical	None Established Note 2
OVERPACK	Horizontal	Not Permitted
OVERPACK	Vertical	11 Note 3

Notes:
1. To be measured from the lowest point on the TRANSFER CASK (i.e., the bottom edge of the cask/lid assemblage)
2. See Technical Specification 4.2.1.3 and 4.2.1.4
3. See Technical Specification 4.2.1.3.

4.3 Radiation Protection Program

4.3.1.1 Each cask user shall ensure that the Part 50 radiation protection program appropriately addresses dry storage cask loading and unloading, as well as ISFSI operations, including transport of the loaded OVERPACK or TRANSFER CASK outside of facilities governed by 10 CFR Part 50. The radiation protection program shall include appropriate controls for direct radiation and contamination, ensuring compliance with applicable regulations, and implementing actions to maintain personnel occupational exposures As Low As Reasonably Achievable (ALARA). The actions and criteria to be included in the program are provided below.

4.3.1.2 Based on the analysis performed pursuant to 10 CFR 72.212(b)(5)(iii), the licensee shall establish individual cask surface dose rate limits for the HI-TRAC TRANSFER CASK and the HI-STORM OVERPACK to be used at the site. Total (neutron plus gamma) dose rate limits shall be established at the following locations:

a. The top of the TRANSFER CASK and the OVERPACK.

b. The side of the TRANSFER CASK and OVERPACK

c. The inlet and outlet ducts on the OVERPACK (applicable only for VENTILATED OVERPACKS)

4.3.1.3 Notwithstanding the limits established in Section 4.3.1.2, the measured dose rates on a loaded OVERPACK shall not exceed the following values:

a. 30 mrem/hr (gamma + neutron) on the top of the OVERPACK

b. 300 mrem/hr (gamma + neutron) on the side of the OVERPACK, excluding inlet and outlet ducts

c. 4000 mrem/hr (gamma + neutron) on the side of the TRANSFER CASK

4.3.1.4 The licensee shall measure the TRANSFER CASK and OVERPACK surface neutron and gamma dose rates as described in Section 4.3.1.7 for comparison against the limits established in Section 4.3.1.2 or Section 4.3.1.3, whichever are lower.

4.3.1.5 If the measured surface dose rates exceed the lower of the two limits established in Section 4.3.1.2 or Section 4.3.1.3, the licensee shall:

a. Administratively verify that the correct contents were loaded in the correct fuel storage cell locations.

b. Perform a written evaluation to verify whether an OVERPACK at the ISFSI containing the as-loaded MPC will cause the dose limits of 10 CFR 72.104 to be exceeded.

c. Perform a written evaluation within 30 days to determine why the surface dose rate limits were exceeded.

4.3.1.6 If the evaluation performed pursuant to Section 4.3.1.5 shows that the dose limits of 10 CFR 72.104 will be exceeded, the MPC shall not be placed into storage or, in the case of the OVERPACK loaded at the ISFSI, the MPC shall be removed from storage until appropriate corrective action is taken to ensure the dose limits are not exceeded.

4.3.1.7 TRANSFER CASK and OVERPACK surface dose rates shall be measured at approximately the following locations:

a. A minimum of four (4) dose rate measurements shall be taken on the side of the TRANSFER CASK approximately at the cask mid-height plane. The measurement locations shall be approximately 90 degrees apart around the circumference of the cask. Dose rates shall be measured between the radial ribs of the water jacket.

b. A minimum of four (4) TRANSFER CASK top lid dose rates shall be measured at locations approximately half way between the edge of the hole in the top lid and the outer edge of the top lid, 90 degrees apart around the circumference of the top lid.

c. A minimum of twelve (12) dose rate measurements shall be taken on the side of the OVERPACK in three sets of four measurements. One measurement set shall be taken approximately at the cask mid-height plane, 90 degrees apart around the circumference of the cask. The second and third measurement sets shall be taken approximately 60 inches above and below the mid-height plane, respectively, also 90 degrees apart around the circumference of the cask.

d. A minimum of five (5) dose rate measurements shall be taken on the top of the OVERPACK. One dose rate measurement shall be taken at approximately the center of the lid and four measurements shall be taken at locations on the top concrete shield, approximately half way between the center and the edge of the top concrete shield, 90 degrees apart around the circumference of the lid.

e. A dose rate measurement shall be taken on contact at the surface of each inlet and outlet vent duct screen of the OVERPACK (applicable only for VENTILATED OVERPACK).

4.4 Fabrication Helium Leak Test

At completion of welding the MPC shell to baseplate, an MPC confinement weld helium leak test shall be performed using a helium mass spectrometer. This test shall include the base metals of the MPC shell and baseplate. A helium leak test shall also be performed on the base metal of the fabricated MPC lid. The confinement boundary leakage rate tests shall be performed in accordance with ANSI N14.5 to “leaktight” criteria. If a leakage rate exceeding the acceptance criteria is detected, then the area of leakage shall be determined and the area repaired per ASME Code Section III, Subsection NB requirements. Re-testing shall be performed until the leakage rate acceptance criterion is met.

Casks initially loaded to Amendments No. 2 through 7 must meet the following:

- Casks fabricated on or after July 1, 2009 a fabrication helium leak test at completion of the welding of the MPC shell to baseplate must be performed in accordance with the above requirements.
- Casks loaded before July 1, 2009 must meet the fabrication helium leak test requirements of the lid base metal of the amendment to which they were originally loaded.
- Casks loaded before July 1, 2009 do not meet the above fabrication helium leak test requirements after MPC shell to baseplate welding. These casks may be upgraded to Amendment 15.

4.5 Violations of Fuel Specifications or Loading Conditions

If any Fuel Specifications or Loading Conditions of 2.1 are violated, the following actions shall be completed:

a. The affected fuel assemblies shall be placed in a safe condition.

b. Within 24 hours, notify the NRC Operations Center.

c. Within 30 days, submit a special report which describes the cause of the violation, and actions taken to restore compliance and prevent recurrence.

4.6 Heavy Loads Requirements

Each lift of an MPC, a HI-TRAC transfer cask, or any HI-STORM overpack must be made in accordance to the existing heavy loads requirements and procedures of the licensed facility at which the lift is made. A plant specific review (under 10 CFR 50.59 or 10 CFR 72.48, if applicable) is required to show operational compliance with existing plant specific heavy loads requirements. Lifting operations outside of structures governed by 10 CFR Part 50 must be in accordance with Section 4.2 and Sections 2.1.6 and 2.3 (if applicable) of Appendix A.

4.7 Aging Management Program

Each general licensee shall have a program to establish, implement, and maintain written procedures for each AMP described in the FSAR. The program shall include provisions for changing AMP elements, as necessary, and within the limitations of the approved licensing bases to address new information on aging effects based on inspection findings and/or industry operating experience provided to the general licensee during the renewal period.

The general licensee shall establish and implement these written procedures within 365 days after the effective date of the renewal of the CoC or 365 days of the 20th anniversary of the loading of the first dry storage system at its site, whichever is later.

Each general licensee shall perform tollgate assessments as described in Chapter 9 of the FSAR.