PROPOSED CERTIFICATE OF COMPLIANCE NO. 1032

APPENDIX B

TECHNICAL SPECIFICATIONS

FOR THE HI-STORM FW MPC STORAGE 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.
BLEU FUEL	Blended Low Enriched Uranium (BLEU) fuel is the same as a commercial spent fuel but with a higher cobalt impurity.
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.
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 FW System are as follows: 1. Holtec Generic BWR design 2. Holtec Generic PWR design

Term	Definition
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.
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.
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.

Term	Definition
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.
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 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.

Term	Definition
REPAIRED/RECONSTITUTED FUEL ASSEMBLY	Spent nuclear fuel assembly which contains dummy fuel rods that displaces an amount of water greater than or equal to the original fuel rods and/or which contains structural repairs so it can be handled by normal means. If irradiated dummy stainless steel rods are present in the fuel assembly, the dummy/replacement rods will be considered in the site specific dose calculations.
SPENT FUEL STORAGE CASKS (SFSCs)	SFSCs are containers approved for the storage of spent fuel assemblies at the ISFSI. The HI-STORM FW SFSC System consists of the OVERPACK 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 prior to and during unloading and to transfer the MPC to or from the OVERPACK.
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 ASSEMBLIES are: a) fuel assemblies 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 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 UNVERNTILATED 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.
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 <u>AND</u> and <u>OR</u>. 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 FW MPC Storage System

a. UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, FUEL DEBRIS, and NON-FUEL HARDWARE meeting the limits specified in Table 2.1-1 and other referenced tables may be stored in the HI-STORM FW MPC Storage System.
b. All BWR fuel assemblies may be stored with or without ZR channels.

2.1.2 Fuel Loading

Figures 2.1-1 and 2.1-2 define the regions for the MPC-37 and MPC-89 models, respectively. Figures 2.1-3 defines the cell identifications for the MPC-32ML. Figures 2.1-4 and 2.1-5 defines the cell identifications for the MPC-37P and MPC-44 models, respectively. Fuel assembly decay heat limits are specified in Section 2.2.1. Fuel assemblies shall meet all other applicable limits specified in Tables 2.1-1 through 2.1-3.

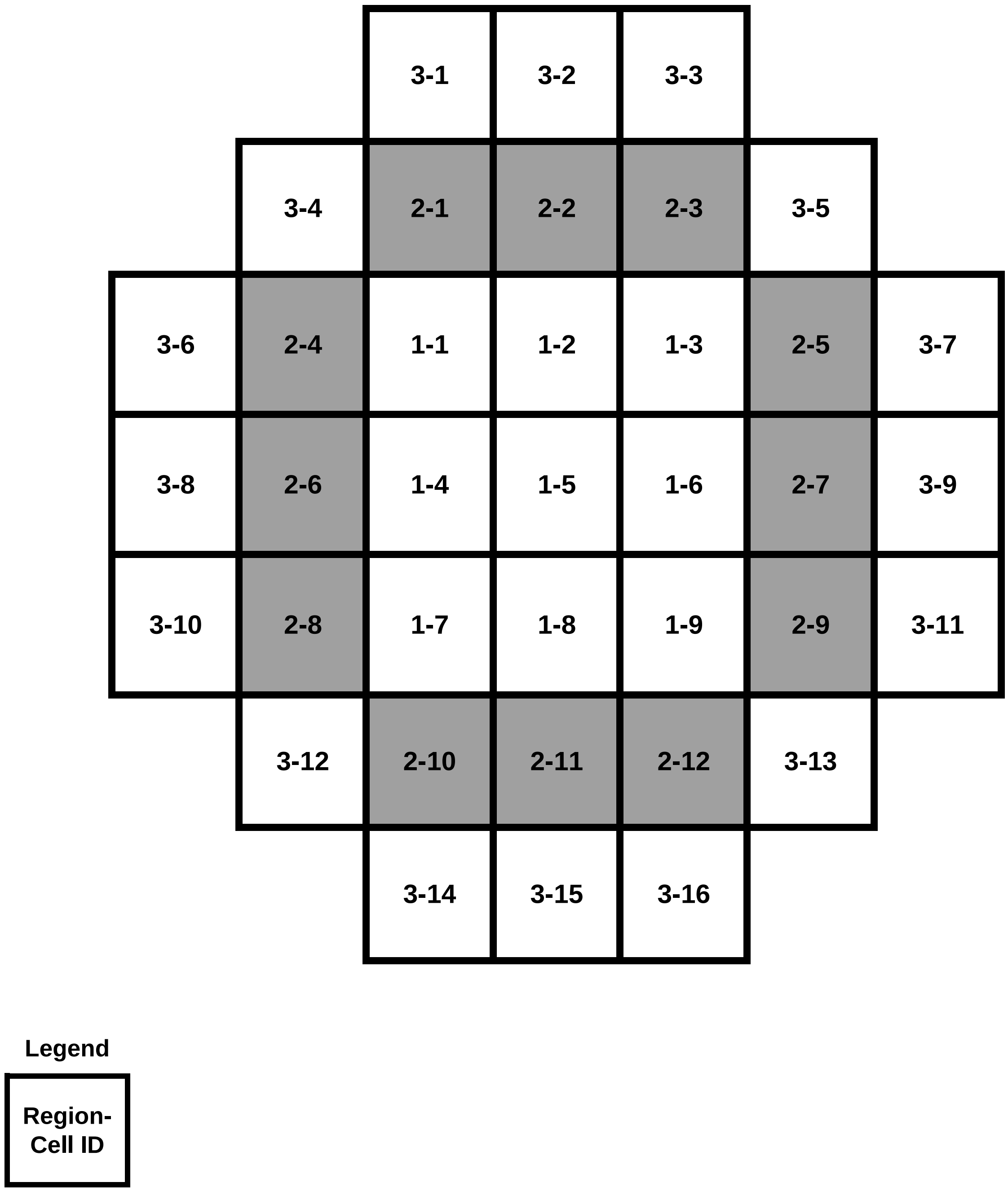

Figure 2.1-1: MPC-37 Region-Cell Identification

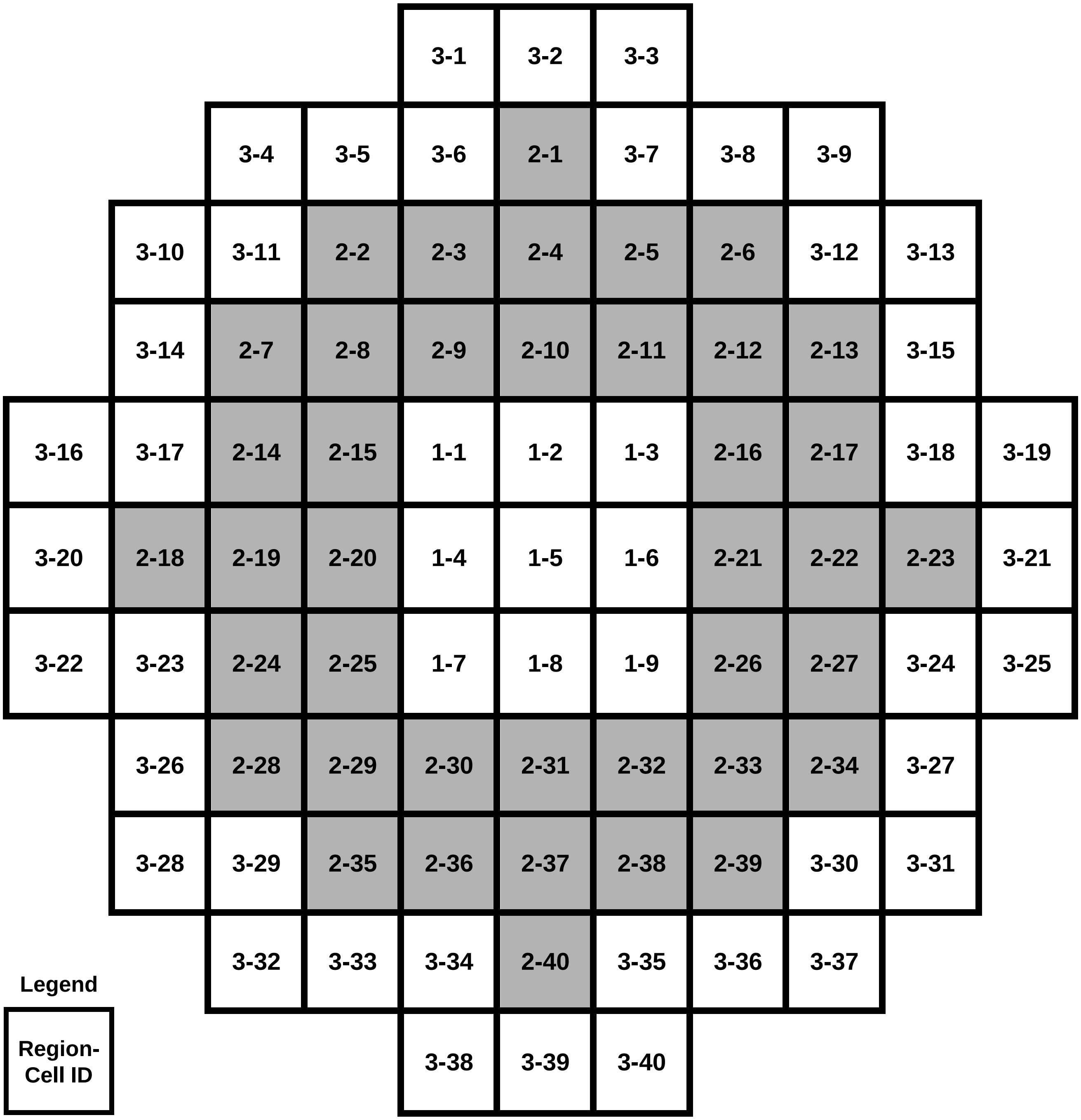

Figure 2.1-2: MPC-89 Region-Cell Identification

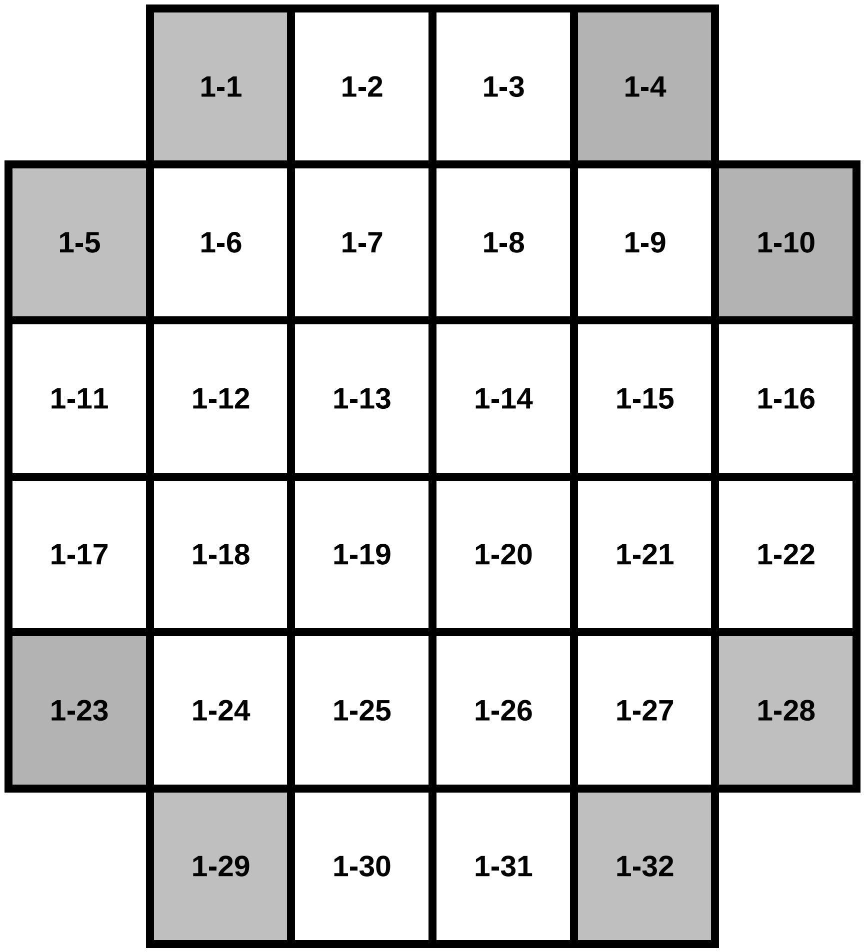

Figure 2.1-3: MPC-32ML Cell Identification

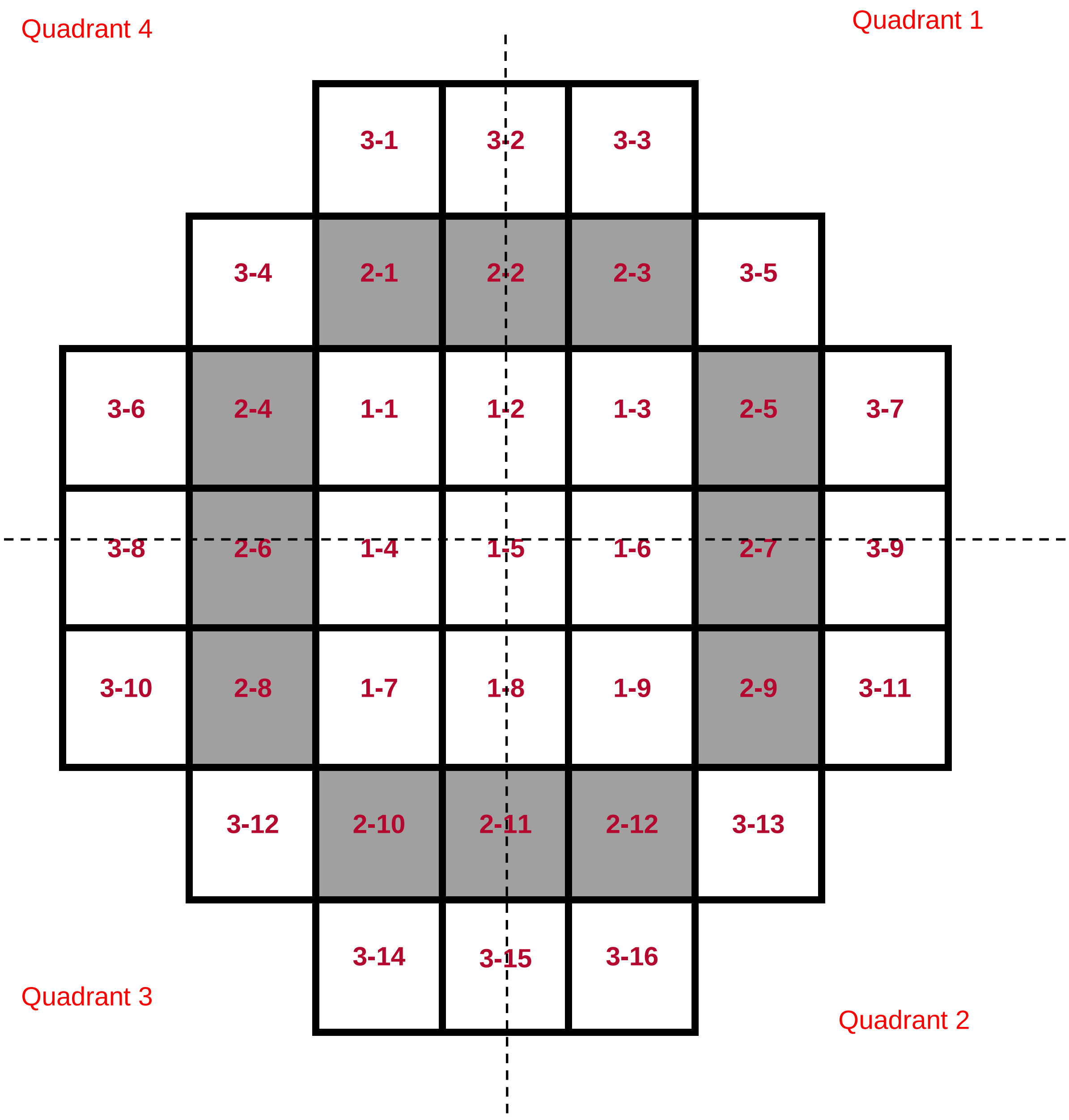

Figure 2.1-4: MPC-37P Cell Identification

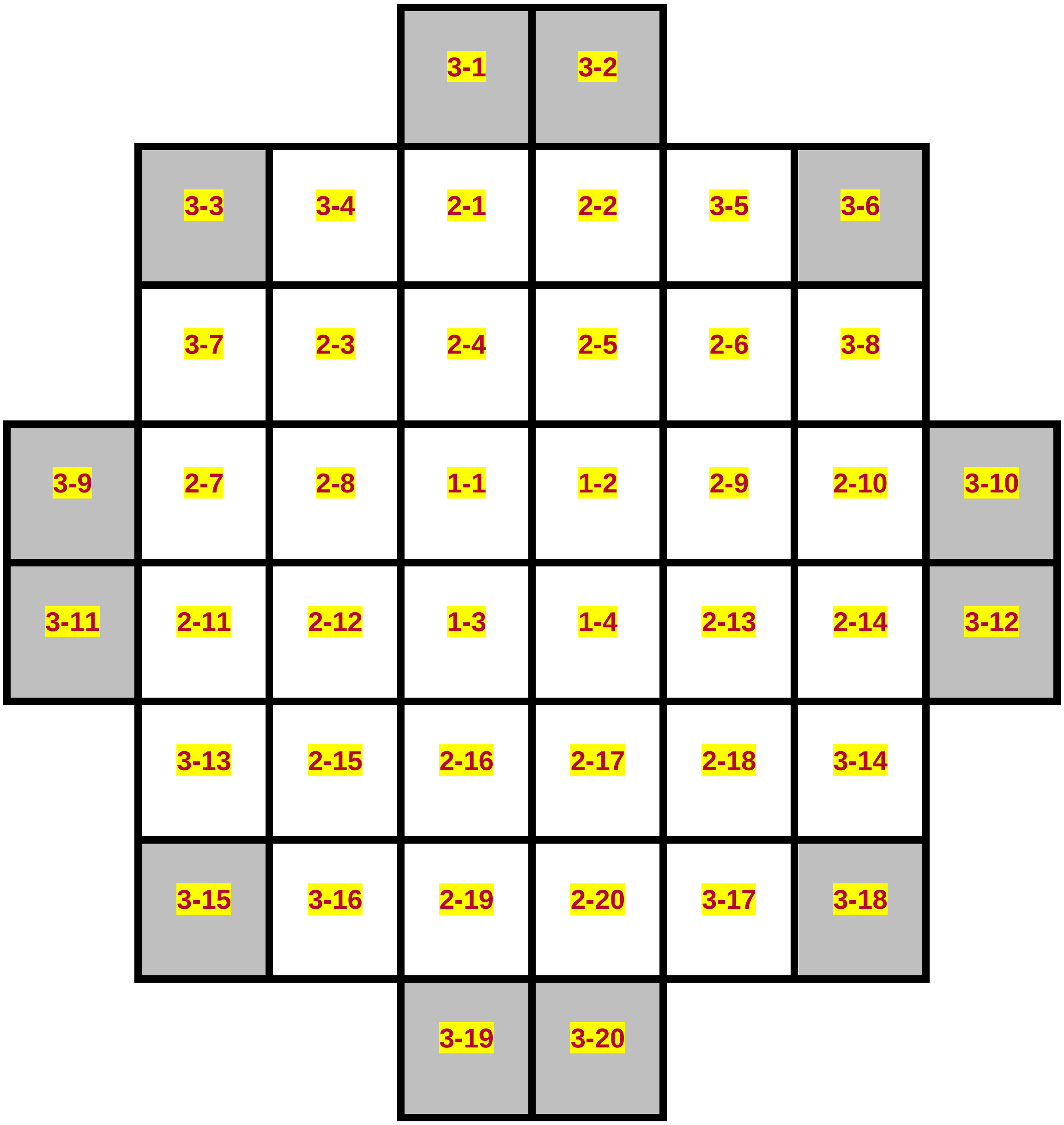

Figure 2.1-4: MPC-44 Cell Identification

Table 2.1-1 (page 1 of 10~~6~~)

Fuel Assembly Limits

I. MPC MODEL: MPC-37

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES meeting the criteria in Table 2.1-2 and/or FUEL DEBRIS, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR
b. Maximum Initial Enrichment:	5.0 wt. % U-235 with soluble boron credit per LCO 3.3.1 OR burnup credit per Section 2.3
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling Time ≥ 1 years and meeting the equation in Section 2.4 Assembly Average Burnup ≤ 68.2 GWD/MTU
d. Decay Heat Per Fuel Storage Location:	As specified in Section 2.2
e. Fuel Assembly Weight:	≤ 2050 lbs (including NON-FUEL HARDWARE and DFC)

Fuel Assembly Limits

I. MPC MODEL: MPC-37 (continued)

B. Quantity per MPC: 37 FUEL ASSEMBLIES with up to twelve (12) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 3-1, 3-3 through 3-7, 3-10 through 3-14, and 3-16 (see Figure 2.1-1), OR in fuel storage locations 2-1, 2-3, 2-4, 2-5, 2-8, 2-9, 2-10, and 2-12 (see Figure 2.1-1), depending on heat load pattern, see Section 2.2.1. The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications. For MPCs utilizing burnup credit, the MPC and DFC loading configuration must also meet the additional requirements of Section 2.3.

C. One (1) Neutron Source Assembly (NSA) is authorized for loading in the MPC-37.

D. Up to thirty (30) ~~BRPAs~~ BPRAs are authorized for loading in the MPC-37.

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, RCCAs, CEAs, CRAs (including, but not limited to those with hafnium), or NSAs may only be loaded in fuel storage Regions 1 and 2 (see Figure 2.1-1).

Note 2: DAMAGED FUEL ASSEMBLIES which can be handled by normal means and whose structural integrity is such that geometric rearrangement of fuel is not expected, may be stored in storage locations designated for DFCs using DFIs or DFCs. 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.

Table 2.1-1 (page 3 of 10~~6~~)

Fuel Assembly Limits

II. MPC MODEL: MPC-89

A. Allowable Contents

1. Uranium oxide BWR UNDAMAGED FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES meeting the criteria in Table 2.1-3 and/or FUEL DEBRIS, with or without channels and meeting the following specifications:

a. Cladding Type:	ZR
b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (Note 1):	As specified in Table 2.1-3 for the applicable fuel assembly array/class.
c. Initial Maximum Rod Enrichment	5.0 wt. % U-235
d. Post-irradiation Cooling Time and Average Burnup Per Assembly	
i. Array/Class 8x8F	Cooling time ≥ 10 years and an assembly average burnup ≤ 27.5 GWD/MTU.
ii. All Other Array Classes	Cooling Time ≥ 1 years and meeting the equation in Section 2.4 and an assembly average burnup ≤ 65 GWD/MTU
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 Weight	≤ 850 lbs, including a DFC as well as a channel

Table 2.1-1 (page 4 of 10~~6~~)

Fuel Assembly Limits

II. MPC MODEL: MPC-89 (continued)

B. Quantity per MPC: 89 FUEL ASSEMBLIES with up to sixteen (16) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 3-1, 3-3, 3-4, 3-9, 3-10, 3-13, 3-16, 3-19, 3-22, 3-25, 3-28, 3-31, 3-32, 3-37, 3-38, and 3-40 (see Figure 2.1-2), OR in fuel storage locations 2-1, 2-2, 2-6, 2-7, 2-13, 2-18, 2-23, 2-28, 2-34, 2-35, 2-39, and 2-40 (see Figure 2.1-2), depending on heat load pattern, see Section 2.2.1. The remaining fuel storage locations may be filled with BWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

Note 1: The lowest maximum allowable enrichment of any fuel assembly loaded in an MPC-89, based on fuel array class and fuel classification, is the maximum allowable enrichment for the remainder of the assemblies loaded in that MPC.

Note 2: DAMAGED FUEL ASSEMBLIES which can be handled by normal means and whose structural integrity is such that geometric rearrangement of fuel is not expected, may be stored in storage locations designated for DFCs using DFIs or DFCs. 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 Assembly Limits

III. MPC MODEL: MPC-32ML

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES meeting the criteria for array/class 16x16D in Table 2.1-2 and/or FUEL DEBRIS, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR
b. Maximum Initial Enrichment:	5.0 wt. % U-235 with soluble boron credit per LCO 3.3.1
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling Time ≥ 1 years and meeting the equation in Section 2.4 Assembly Average Burnup ≤ 68.2 GWD/MTU
d. Decay Heat Per Fuel Storage Location:	As specified in Section 2.2
e. Fuel Assembly Weight:	≤ 1858 lbs (including NON-FUEL HARDWARE and DFC)

Fuel Assembly Limits

III. MPC MODEL: MPC-32ML (continued)

B. Quantity per MPC: 32 FUEL ASSEMBLIES with up to eight (8) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 1-1, 1-4, 1-5, 1-10, 1-23, 1-28, 1-29, and 1-32 (see Figure 2.1-3). The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

C. One (1) Neutron Source Assembly (NSA) is authorized for loading in the MPC-32ML.

D. Up to thirty-two (32) ~~BRPAs~~ BPRAs are authorized for loading in the MPC-32ML.

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, RCCAs, CEAs, CRAs, or NSAs may only be loaded in fuel cells 1-6 through 1-9, 1-12 through 1-15, 1-18 through 1-21, and 1-24 through 1-27.

Note 2: DAMAGED FUEL ASSEMBLIES which can be handled by normal means and whose structural integrity is such that geometric rearrangement of fuel is not expected, may be stored in storage locations designated for DFCs using DFIs or DFCs. 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.

Table 2.1-1 (page 7 of 10)

Fuel Assembly Limits

IV. MPC MODEL: MPC-37P

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES meeting the criteria for array/class 15x15I in Table 2.1-2 and/or FUEL DEBRIS, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR
b. Maximum Initial Enrichment:	5.0 wt. % U-235 with soluble boron credit per LCO 3.3.1
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling Time ≥ 1.6 years and meeting the equation in Section 2.4 Assembly Average Burnup ≤ 68.2 GWD/MTU
d. Decay Heat Per Fuel Storage Location:	As specified in Section 2.2
e. Fuel Assembly Weight:	≤ 1610 lbs (including NON-FUEL HARDWARE and DFC)

Table 2.1-1 (page 8 of 10)

Fuel Assembly Limits

III. MPC MODEL: MPC-37P (continued)

B. Quantity per MPC: 37 FUEL ASSEMBLIES with up to twelve (12) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 3-1, 3-3 through 3-7, 3-10 through 3-14, and 3-16, OR DFCs may be stored in fuel storage locations 2-1, 2-3, 2-10, and 2-12 (see Figure 2.1-4). The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

Note 1: Fuel assemblies containing 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, RCCAs, CEAs, CRAs (including, but not limited to those with hafnium), or NSAs may only be loaded in fuel storage Regions 1 and 2 (see Figure 2.1-4).

Note 2: DAMAGED FUEL ASSEMBLIES which can be handled by normal means and whose structural integrity is such that geometric rearrangement of fuel is not expected, may be stored in storage locations designated for DFCs using DFIs or DFCs. 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.

Table 2.1-1 (page 9 of 10)

Fuel Assembly Limits

V. MPC MODEL: MPC-44

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES and DAMAGED FUEL ASSEMBLIES meeting the criteria for array/class 14x14A and 14x14B in Table 2.1-2 and/or FUEL DEBRIS, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR
b. Maximum Initial Enrichment:	5.0 wt. % U-235
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling Time ≥ 3 years and meeting the equation in Section 2.4 Assembly Average Burnup ≤ 60.0 GWD/MTU
d. Decay Heat Per Fuel Storage Location:	As specified in Section 2.2
g. Fuel Assembly Weight:	≤ 1250 lbs (including and DFC)

Fuel Assembly Limits

V. MPC MODEL: MPC-44 (continued)

B. Quantity per MPC: 44 FUEL ASSEMBLIES with up to twelve (12) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 3-1 through 3-3, 3-6, 3-9 through 3-12, 3-15, and 3-18 through 3-20 (see Figure 2.1-5). The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

C. Up to twenty-two (22) BPRAs and/or WABAs are authorized for loading in the MPC-44.

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.

Note 2: DAMAGED FUEL ASSEMBLIES which can be handled by normal means and whose structural integrity is such that geometric rearrangement of fuel is not expected, may be stored in storage locations designated for DFCs using DFIs or DFCs. 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.

Table 2.1-1: PWR Fuel Assembly Characteristics
(Note 5)

Fuel Assembly Array/ Class	No. of Fuel Rod Locations (Note 4)	No. of Guide and/or Instrument Tubes
14x14 A	179	17
14x14 B	179	17
14x14 C	176	5 (Note 1)
15x15 B	204	21
15x15 C	204	21
15x15 D	208	17
15x15 E	208	17
15x15 F	208	17
15x15 H	208	17
15x15 I	216 (Note 2)	9 (Note 2)
16x16 A	236	5 (Note 1)
16x16 B	236	5 (Note 1)
16x16 C	235	21
16x16 D (Note 3)	236	20
17x17A	264	25
17x17 B	264	25
17x17 C	264	25
17x17 D	264	25
17x17 E	265	24

Notes:

1. Each guide tube replaces four fuel rods.
2. Assemblies have one Instrument Tube and eight Guide Bars (Solid ZR). Some assemblies have up to 16 fuel rods removed or replaced by Guide Tubes
3. This fuel array/class only allowable for loading in the MPC-32ML.
4. 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.
5. Any number of fuel rods in an assembly can contain BLEU fuel. If the BLEU rods are present, the site specific dose and dose rate analyses performed under 10 CFR 72.212 should include considerations for the presence of such rods.

Table 2.1-2: BWR Fuel Assembly Characteristics
(Note 14)

Fuel Assembly Array and Class	Maximum Planar-Average Initial Enrichment (wt.% ^{235}U) (Note 11)	No. of Fuel Rod Locations (Full Length or Total/Full Length) (Note 13)	No. of Water Rods (Note 8)
7x7 B	≤ 4.8	49	0
7x7 C	≤ 4.8	48	1 (Note 12)
8x8 B	≤ 4.8	63 or 64	1 or 0
8x8 C	≤ 4.8	62	2
8x8 D	≤ 4.8	60 or 61	1 - 4 (Note 4)
8x8 E	≤ 4.8	59	5
8x8 F	≤ 4.5 (Note 9)	64	N/A (Note 1)
8x8 G	≤ 4.8	60	4 (Note 12)
9x9 A	≤ 4.8	74/66 (Note 2)	2
9x9 B	≤ 4.8	72	1 (Note 3)
9x9 C	≤ 4.8	80	1
9x9 D	≤ 4.8	79	2
9x9 E (Note 1)	≤ 4.5 (Note 9)	76	5
9x9 F (Note 1)	≤ 4.5 (Note 9)	76	5
9x9 G	≤ 4.8	72	1 (Note 3)
10x10 A	≤ 4.8	92/78 (Note 5)	2
10x10 B	≤ 4.8	91/83 (Note 6)	1 (Note 3)
10x10 C	≤ 4.8	96	5 (Note 7)
10x10 F	≤ 4.7 (Note 10)	92/78 (Note 5)	2
10x10 G	≤ 4.6	96/84	5

	(Note 9)		(Note 7)
10x10 I	≤ 4.8	91/79 (Note 15)	1 (Note 3)
10x10 J	≤ 4.8	96/80 (Note 16)	1
11x11 A	≤ 4.8	112/92 (Note 17)	1 (Note 3)

Notes:

1. This assembly is known as “QUAD+.” It has four rectangular water cross segments dividing the assembly into four quadrants.
2. This assembly class contains 74 total rods; 66 full length rods and 8 partial length rods.
3. Square, replacing nine fuel rods.
4. Variable.
5. This assembly contains 92 total fuel rods; 78 full length rods and 14 partial length rods.
6. This assembly class contains 91 total fuel rods; 83 full length rods and 8 partial length rods.
7. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.
8. These rods may also be sealed at both ends and contain ZR material in lieu of water.
9. When loading fuel assemblies classified as DAMAGED FUEL, all assemblies in the MPC are limited to 4.0 wt.% U-235.
10. When loading fuel assemblies classified as DAMAGED FUEL, all assemblies in the MPC are limited to 4.6 wt.% U-235.
11. In accordance with the definition of UNDAMAGED FUEL, certain assemblies may be limited to 3.3 wt.% U-235. When loading these fuel assemblies, all assemblies in the MPC are limited to 3.3 wt.% U-235.
12. These fuel designs do not have water rods, but instead contain solid zirc rods.
13. 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.
14. Any number of fuel rods in an assembly can be contain BLEU fuel. If the BLEU rods are present, the site specific dose and dose rate analyses performed under 10 CFR 72.212 should include considerations for the presence of such rods.
15. Contains in total 91 fuel rods; 79 full length rods, 12 long partial length rods, and one square water rod replacing 9 fuel rods.
16. 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 or 12 fuel rods.
17. ~~14.~~ 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.

2.2 Decay Heat Limits

This section provides the limits on fuel assembly decay heat for storage in the HI-STORM FW System. The method to verify compliance, including examples, is provided in Chapter 13 of the HI-STORM FW FSAR.

2.2.1 Fuel Loading Decay Heat Limits for VENTILATED OVERPACK

Tables 2.3-1A, 2.3-1B, and 2.3-1C provide the maximum allowable decay heat per fuel storage location for MPC-37. Tables 2.3-2A and 2.3-2B provide the maximum allowable decay heat per fuel storage location for MPC-89. Tables 2.3-1A and 2.3-7A provide the maximum allowable decay heat per fuel storage location for MPC-37P. Table 2.3-8A provides the maximum allowable decay heat per fuel storage location for MPC-44. No drying time limits are required for decay heat values meeting the limits in these tables when using FHD to dry moderate or high burnup fuel and when using VDS to dry moderate burnup fuel. Drying time limits apply when using VDS to dry high burnup fuel with decay heat values meeting the limits in these tables. Tables 2.3-3 and 2.3-4 provide the maximum allowable decay heat per fuel storage location for MPC-37 and MPC-89, respectively, with no drying time limits imposed, when using VDS to dry high burnup fuel. Table 2.3-5 provides the maximum allowable decay heat per fuel storage location for the MPC-32ML for both FHD and VDS drying. Tables 2.3-7B and 2.3-8B provide the maximum allowable decay heat per fuel storage location for the MPC-37P and MPC-44, respectively, with no drying time limits imposed, when using VDS to dry high burnup fuel. The per cell limits in these tables apply to cells containing undamaged fuel or damaged fuel in DFCs/DFIs or fuel debris in DFCs.

Figures 2.3-1 through 2.3-15 provide alternative loading patterns for the MPC-37 and MPC-89, with undamaged fuel and a combination of undamaged fuel and damaged fuel in DFCs/DFIs and fuel debris in DFCs. The per cell limits in these figures are applicable when using vacuum drying or FHD to dry moderate or high burnup fuel in accordance with Table 3.3-1. The MPC-37 patterns are based on the fuel length to be stored in the MPC, see Table 2.3-6.

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.

2.2.2 Fuel Loading Decay Heat Limits for UNVENTILATED OVERPACK

Tables 2.3-9A and 2.3-9B provide the maximum allowable decay heat per fuel storage location for MPC-37. Tables 2.3-10A and 2.3-10B provide the maximum allowable decay heat per fuel storage location for MPC-89. Table 2.3-13 provides the maximum allowable decay heat per fuel storage location for MPC-44. The per cell limits in these tables apply to cells containing undamaged fuel or damaged fuel in DFCs/DFIs or fuel debris in DFCs.

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.

2.2.3 Variable Fuel Height for MPC-37 and MPC-44

2.2.3.1 For fuel with a longer active fuel length than the reference fuel (144 inches), the maximum total heat load, maximum quadrant heat load limits and specific heat load limits in each cell, may be increased by the ratio SQRT(L/144), where L is the active length of the fuel in inches.

2.2.3.2 For fuel with a shorter active fuel length than the reference fuel (144 inches), the maximum total heat load, maximum quadrant heat load limits and specific heat load limits in each cell, shall be reduced linearly by the ratio L/144, where L is the active fuel length of the fuel in inches.

2.2.4 Variable Fuel Height for MPC-89

2.2.4.1 For fuel with a longer active fuel length than the reference fuel (150 inches), the maximum total heat load, maximum quadrant heat load limits and specific heat load limits in each cell, may be increased by the ratio SQRT(L/150), where L is the active length of the fuel in inches.

~~2.2.1.1~~2.2.4.2 For fuel with a shorter active fuel length than the reference fuel (150 inches), the total heat load, quadrant heat load limits and specific heat load limits in each cell, shall be reduced linearly by the ratio L/150, where L is the active fuel length of the fuel in inches.

~~2.2.2~~2.2.5 Decay Heat Limit Compliance

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.

Table 2.3-1A: MPC-37 and MPC-37P Heat Load Data
(See Figure 2.1-1)

Number of Regions: 3					
Number of Storage Cells: 37					
Maximum Design Basis Heat Load (kW): 44.09 (Pattern A); 45.0 (Pattern B)					
Region No.	Decay Heat Limit per Cell, kW		Number of Cells per Region	Decay Heat Limit per Region, kW	
	Pattern A	Pattern B		Pattern A	Pattern B
1	1.05	1.0	9	9.45	9.0
2	1.70	1.2	12	20.4	14.4
3	0.89	1.35	16	14.24	21.6

Table 2.3-1B: MPC-37 Heat Load Data
(See Figure 2.1-1)

Number of Regions: 3			
Number of Storage Cells: 37			
90% of Pattern A - Sub-design Heat Load (kW): 39.68			
Region No.	Decay Heat Limit per Cell, kW	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.945	9	8.505
2	1.530	12	18.36
3	0.801	16	12.816

Table 2-.3-1C: MPC-37 Heat Load Data
(See Figure 2.1-1)

Number of Regions: 3			
Number of Storage Cells: 37			
80% of Pattern A - Sub-design Heat Load (kW): 35.27			
Region No.	Decay Heat Limit per Cell, kW	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.84	9	7.56
2	1.36	12	16.32
3	0.712	16	11.392

Table 2.3-2A: MPC-89 Heat Load Data
(See Figure 2.1-2)

Number of Regions: 3			
Number of Storage Cells: 89			
Maximum Design Basis Heat Load: 46.36 kW			
Region No.	Decay Heat Limit per Cell, kW	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.44	9	3.96
2	0.62	40	24.80
3	0.44	40	17.60

Table 2.3-2B: MPC-89 Heat Load Data
(See Figure 2.1-2)

Number of Regions: 3			
Number of Storage Cells: 89			
80% Sub-design Heat Load (kW): 37.1			
Region No.	Decay Heat Limit per Cell, kW	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.352	9	3.168
2	0.496	40	19.84
3	0.352	40	14.08

Table 2.3-3: MPC-37 Heat Load Data
(See Figure 2.1-1)

Number of Regions: 3			
Number of Storage Cells: 37			
Maximum Heat Load: 29.6			
Region No.	Decay Heat Limit per Cell, W	Number of Cells per Region	Decay Heat Limit per Region, kW
1	800	9	7.2
2	800	12	9.6
3	800	16	12.8

Table 2.3-4: MPC-89 Heat Load Data
(See Figure 2.1-2)

Number of Regions: 3			
Number of Storage Cells: 89			
Maximum Heat Load: 30.0kW			
Region No.	Decay Heat Limit per Cell, W	Number of Cells per Region	Decay Heat Limit per Region, kW
1	337	9	3.03
2	337	40	13.48
3	337	40	13.48

Table 2.3-5: MPC-32ML Heat Load Data

Number of Regions: 1		
Number of Storage Cells: 32		
Pattern	Maximum Heat Load, kW	Decay Heat Limit per Cell, kW
Pattern A	44.16	1.380
Pattern B	28.70	0.897

Table 2.3-6: PWR Fuel Length Categories

Category	Length Range
Short Fuel	128 inches ≤ L < 144 inches
Standard Fuel	144 inches ≤ L < 168 inches
Long Fuel	L ≥ 168 inches

Notes:

1. “L” means "nominal active fuel length". The nominal, unirradiated active fuel length of the PWR fuel assembly is used to designate it as “short”, “standard” and “long”.

Table 2.3-7A: MPC-37P Heat Load Data for Ventilated Overpack
(see Figure 2.1-4)

Number of Storage Cells:	37
Maximum Design Basis Heat Load (kW):	45
Maximum Quadrant Heat Load (kW):	11.25
Decay Heat Limit per Cell (kW):	See Figures 2-19 and 2-20

Note:

1. Decay heat limit per cell for cells containing damaged fuel or fuel debris is equal to the decay heat limit per cell of the region where the damaged fuel or fuel debris is permitted to be stored.

Table 2.3-7B: MPC-37P Heat Load Data for Ventilated Overpack
(see Figure 2.1-4)

Number of Regions: 3			
Number of Storage Cells: 37			
Maximum Heat Load: 33.3			
Region No.	Decay Heat Limit per Cell, W	Number of Cells per Region	Decay Heat Limit per Region, kW
1	900	9	8.1
2	900	12	10.8
3	900	16	14.4

Table 2.3-8A: MPC-44 Heat Load Data for Ventilated Overpack
(See Figure 2.1-5)

Number of Regions: 1
Number of Storage Cells: 44
Maximum Total Heat Load (kW): 44
Maximum Decay Heat Limit per Cell (kW): 1.0

Note:

1. There is a 5% decay heat penalty per cell for cells containing DFCs and/or DFIs.

Table 2.3-8B: MPC-44 Heat Load Data for Ventilated Overpack
(See Figure 2.1-5)

Number of Regions: 1
Number of Storage Cells: 44
Maximum Total Heat Load (kW): 30
Maximum Decay Heat Limit per Cell (kW): 0.682

Table 2.3-9A: MPC-37 Heat load Data for Unventilated Overpack
(See Figure 2.1-1)

Number of Regions: 3			
Number of Storage Cells: 37			
Maximum Total Heat Load (kW): 29			
Maximum Section Heat Load (kW): 3.625 (Note 1)			
Region No.	Decay Heat Limit per Cell, kW (Note 2)	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.784	9	7.054
2	0.784	12	9.405
3	0.784	16	12.541
Note 1: Figure 2.1-1 identifies the cell locations, and Table 2.3-11 identifies the cells included in the heat load for each section Note 2: Maximum total heat load, maximum section heat load and specific cell heat load limits may need to be adjusted in accordance with Section 2.2.3. Note 3: This pattern can be modified to develop regionalized patterns in accordance with the requirements in Table 2.3-9B.			

Table 2.3-9B: MPC-37 Requirements on Developing Regionalized Heat Load Patterns for Unventilated Overpack
(See Figure 2.1-1)

1. Pattern-specific total heat load must be equal to 29 kW
2. Section Heat Load must be equal to 3.625 kW, calculated per Table 2.3-11, and pattern must be 1/8th symmetric
3. Maximum Allowable Decay Heat per Cell in Region 1 is 0.784 kW
4. Maximum Allowable Decay Heat per Cell in Region 2 is 1.568 kW
5. Maximum Allowable Decay Heat per Cell in Region 3 is 1.568 kW
6. Pattern-specific Decay Heat in a storage cell may need to be adjusted to meet items 1 and 2
7. Pattern-specific decay heat for any storage cell in Region 1 may be determined by reducing the allowable in Region 1 of Table 2.3-9A by Δ and pattern-specific decay heat for any storage cell in Regions 2 and 3 may be determined by increasing the allowable in Region 2 and/or Region 3 of Table 2.3-9A by the same Δ.
8. Pattern-specific decay heat for any storage cell in Region 2 may be determined by reducing the allowable in Region 2 of Table 2.3-9A by θ and pattern-specific decay heat for any storage cell in Region 3 may be determined by increasing the allowable in Region 3 of Table 2.3-9A by the same θ. This θ may not be added to other cells in

Region 2.
9. Items 1 through 8 need to be scaled in accordance with Section 2.2.4 for non-standard active fuel lengths.

General Note – The limits developed for the patterns are maximums, and any assembly with a heat load less than those limits can be loaded in the applicable cell, provided it meets all other CoC requirements.

Table 2.3-10A: MPC-89 Heat load Data for Unventilated Overpack
(See Figure 2.1-2)

Number of Regions: 3			
Number of Storage Cells: 89			
Maximum Total Heat Load (kW): 29			
Maximum Section Heat Load (kW): 3.625 (Note 1)			
Region No.	Decay Heat Limit per Cell, kW (Note 2)	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.326	9	2.932
2	0.326	40	13.034
3	0.326	40	13.034

Note 1: Figure 2.1-2 identifies the cell locations, and Table 2.3-12 identifies the cells included in the heat load for each section.
Note 2: Maximum total heat load, maximum section heat load and specific cell heat load limits may need to be adjusted in accordance with Section 2.2.4.
Note 3: This pattern can be modified to develop regionalized patterns in accordance with the requirements in Table 2.3-10B.

Table 2.3-10B: MPC-89 Requirements on Developing Regionalized Heat Load Patterns for Unventilated Overpack
(See Figure 2.1-2)

1. Pattern-specific total heat load must be equal to 29 kW
2. Section Heat Load must be equal to 3.625 kW, calculated per Table 2.3-12, and pattern must be 1/8th symmetric
3. Maximum Allowable Decay Heat per Cell in Region 1 is 0.326 kW
4. Maximum Allowable Decay Heat per Cell in Region 2 is 0.652 kW
5. Maximum Allowable Decay Heat per Cell in Region 3 is 0.652 kW
6. Pattern-specific Decay Heat in a storage cell may need to be adjusted to meet items 1 and 2
7. Pattern-specific decay heat for any storage cell in Region 1 may be determined by reducing the allowable in Region 1 of Table 2.3-10A by Δ and pattern-specific decay heat for any storage cell in Regions 2 and 3 may be determined by increasing the allowable in Region 2 and/or Region 3 of Table 2.3-10A by the same Δ.
8. Pattern-specific decay heat for any storage cell in Region 2 may be determined by

reducing the allowable in Region 2 of Table 2.3-10A by θ and pattern-specific decay heat for any storage cell in Region 3 may be determined by increasing the allowable in Region 3 of Table 2.3-10A by the same θ. This θ may not be added to other cells in Region 2.

9. Items 1 through 8 need to be scaled in accordance with Section 2.2.4 for non-standard active fuel lengths.

General Note – The limits developed for the patterns are maximums, and any assembly with a heat load less than those limits can be loaded in the applicable cell, provided it meets all other CoC requirements.

Table 2.3-11: Section Heat Load Calculations for MPC-37

Section	**Equation for Section Heat Load (Note 1)**
Section 1	$Q_{3\text{-}1} + Q_{2\text{-}1} + ½Q_{3\text{-}2} + ½Q_{3\text{-}4} + ½Q_{2\text{-}2} + ½Q_{1\text{-}1} + ½Q_{1\text{-}2} + 1/8Q_{1\text{-}5}$
Section 2	$Q_{3\text{-}3} + Q_{2\text{-}3} + ½Q_{3\text{-}2} + ½Q_{3\text{-}5} + ½Q_{2\text{-}2} + ½Q_{1\text{-}3} + ½Q_{1\text{-}2} + 1/8Q_{1\text{-}5}$
Section 3	$Q_{2\text{-}5} + Q_{3\text{-}7} + ½Q_{1\text{-}6} + ½Q_{3\text{-}5} + ½Q_{2\text{-}7} + ½Q_{1\text{-}3} + ½Q_{3\text{-}9} + 1/8Q_{1\text{-}5}$
Section 4	$Q_{2\text{-}9} + Q_{3\text{-}11} + ½Q_{1\text{-}6} + ½Q_{1\text{-}9} + ½Q_{2\text{-}7} + ½Q_{3\text{-}13} + ½Q_{3\text{-}9} + 1/8Q_{1\text{-}5}$
Section 5	$Q_{2\text{-}12} + Q_{3\text{-}16} + ½Q_{1\text{-}8} + ½Q_{1\text{-}9} + ½Q_{2\text{-}11} + ½Q_{3\text{-}13} + ½Q_{3\text{-}15} + 1/8Q_{1\text{-}5}$
Section 6	$Q_{2\text{-}10} + Q_{3\text{-}14} + ½Q_{1\text{-}8} + ½Q_{1\text{-}7} + ½Q_{2\text{-}11} + ½Q_{3\text{-}12} + ½Q_{3\text{-}15} + 1/8Q_{1\text{-}5}$
Section 7	$Q_{2\text{-}8} + Q_{3\text{-}10} + ½Q_{1\text{-}4} + ½Q_{1\text{-}7} + ½Q_{2\text{-}6} + ½Q_{3\text{-}12} + ½Q_{3\text{-}8} + 1/8Q_{1\text{-}5}$
Section 8	$Q_{2\text{-}4} + Q_{3\text{-}6} + ½Q_{1\text{-}4} + ½Q_{1\text{-}1} + ½Q_{2\text{-}6} + ½Q_{3\text{-}4} + ½Q_{3\text{-}8} + 1/8Q_{1\text{-}5}$

Note:

1. $Q_{X\text{-}Y}$ is the heat load in kW in cell ID (X-Y), identified in Figure 2.1-1

Table 2.3-12: Section Heat Load Calculations for MPC-89

Section	Equation for Section Heat Load[1]
Section 1	$Q_{3-1} + Q_{3-4} + Q_{3-5} + Q_{3-6} + Q_{2-2} + Q_{2-3} + Q_{2-9} + \frac{1}{2}Q_{3-2} + \frac{1}{2}Q_{2-1} + \frac{1}{2}Q_{2-4} + \frac{1}{2}Q_{2-10} + \frac{1}{2}Q_{1-2} + \frac{1}{2}Q$ $\frac{1}{2}Q_{2-8} + \frac{1}{2}Q_{2-11} + 1/8Q_{1-5}$
Section 2	$Q_{3-3} + Q_{3-7} + Q_{3-8} + Q_{3-9} + Q_{2-5} + Q_{2-6} + Q_{2-11} + \frac{1}{2}Q_{3-2} + \frac{1}{2}Q_{2-1} + \frac{1}{2}Q_{2-4} + \frac{1}{2}Q_{2-10} + \frac{1}{2}Q_{1-2} + \frac{1}{2}Q_{1-3} + \frac{1}{2}Q_{2-12} + \frac{1}{2}Q_{3-12} + 1/8Q_{1-5}$
Section 3	$Q_{3-13} + Q_{2-13} + Q_{3-15} + Q_{2-16} + Q_{2-17} + Q_{3-18} + Q_{3-19} + \frac{1}{2}Q_{1-6} + \frac{1}{2}Q_{2-21} + \frac{1}{2}Q_{2-22} + \frac{1}{2}Q_{2-23} + \frac{1}{2}Q_{3-21} + \frac{1}{2}Q_{1-3} + \frac{1}{2}Q_{2-12} + \frac{1}{2}Q_{3-12} + 1/8Q_{1-5}$
Section 4	$Q_{2-26} + Q_{2-27} + Q_{3-24} + Q_{3-25} + Q_{2-34} + Q_{3-27} + Q_{3-31} + \frac{1}{2}Q_{1-6} + \frac{1}{2}Q_{2-21} + \frac{1}{2}Q_{2-22} + \frac{1}{2}Q_{2-23} + \frac{1}{2}Q_{3-21} + \frac{1}{2}Q_{1-9} + \frac{1}{2}Q_{2-33} + \frac{1}{2}Q_{3-30} + 1/8Q_{1-5}$
Section 5	$Q_{2-32} + Q_{2-38} + Q_{2-39} + Q_{3-35} + Q_{2-36} + Q_{3-37} + Q_{3-40} + \frac{1}{2}Q_{1-8} + \frac{1}{2}Q_{2-31} + \frac{1}{2}Q_{2-37} + \frac{1}{2}Q_{2-40} + \frac{1}{2}Q_{3-39} + \frac{1}{2}Q_{1-9} + \frac{1}{2}Q_{2-33} + \frac{1}{2}Q_{3-30} + 1/8Q_{1-5}$
Section 6	$Q_{2-30} + Q_{2-35} + Q_{2-36} + Q_{3-32} + Q_{2-33} + Q_{3-34} + Q_{3-38} + \frac{1}{2}Q_{1-8} + \frac{1}{2}Q_{2-31} + \frac{1}{2}Q_{2-37} + \frac{1}{2}Q_{2-40} + \frac{1}{2}Q_{3-39} + \frac{1}{2}Q_{1-7} + \frac{1}{2}Q_{2-29} + \frac{1}{2}Q_{3-29} + 1/8Q_{1-5}$
Section 7	$Q_{2-25} + Q_{2-24} + Q_{3-23} + Q_{3-22} + Q_{2-28} + Q_{3-26} + Q_{3-28} + \frac{1}{2}Q_{1-4} + \frac{1}{2}Q_{2-20} + \frac{1}{2}Q_{2-19} + \frac{1}{2}Q_{2-18} + \frac{1}{2}Q_{3-20} + \frac{1}{2}Q_{1-7} + \frac{1}{2}Q_{2-29} + \frac{1}{2}Q_{3-29} + 1/8Q_{1-5}$
Section 8	$Q_{2-15} + Q_{2-14} + Q_{3-17} + Q_{3-16} + Q_{2-7} + Q_{3-14} + Q_{3-10} + \frac{1}{2}Q_{1-4} + \frac{1}{2}Q_{2-20} + \frac{1}{2}Q_{2-19} + \frac{1}{2}Q_{2-18} + \frac{1}{2}Q_{3-20} + \frac{1}{2}Q_{1-1} + \frac{1}{2}Q_{2-8} + \frac{1}{2}Q_{3-11} + 1/8Q_{1-5}$

Note:

1. Q_{X-Y} is the heat load in kW in cell ID (X-Y), identified in Figure 2.1-2

Table 2.3-13: MPC-44 Heat Load Data for Unventilated Overpack (See Figure 2.1-5)

Number of Regions: 1
Number of Storage Cells: 44
Maximum Total Heat Load (kW): 28
Maximum Decay Heat Limit per Cell (kW): 0.636

		0.45 (D/F)	0.45	0.45 (D/F)		
	0.45 (D/F)	3.2	0.5	3.2	0.45 (D/F)	
0.6 (D/F)	2.4	0.5	0.6	0.5	2.4	0.6 (D/F)
0.6	0.5	0.6	0.5	0.6	0.5	0.6
0.6 (D/F)	2.4	0.5	0.6	0.5	2.4	0.6 (D/F)
	0.45 (D/F)	3.2	0.5	3.2	0.45 (D/F)	
		0.45 (D/F)	0.45	0.45 (D/F)		

Figure 2.3-1: Loading Pattern 37C1 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC “Short” Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F”.)

		0.45	0.45	0.45		
	0.45	3.2 (D)	Empty	3.2 (D)	0.45	
0.6	2.4 (D)	Empty	0.6	Empty	2.4 (D)	0.6
0.6	0.5	0.6	0.5	0.6	0.5	0.6
0.6	2.4 (D)	Empty	0.6	Empty	2.4 (D)	0.6
	0.45	3.2 (D)	Empty	3.2 (D)	0.45	
		0.45	0.45	0.45		

Figure 2.3-2: Loading Pattern 37C2 for MPC-37 Containing Undamaged and Damaged Fuel in DFC/DFI/, "Short" Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, Undamaged Fuel or Damaged Fuel in a DFC and/or using DFIs may be stored in cells denoted by "D." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell.)

		0.45	0.45	0.45		
	0.45	3.2 (D/F)	Empty	3.2 (D/F)	0.45	
0.6	2.4	Empty	0.6	Empty	2.4	0.6
0.6	0.5	0.6	0.5	0.6	0.5	0.6
0.6	2.4	Empty	0.6	Empty	2.4	0.6
	0.45	3.2 (D/F)	Empty	3.2 (D/F)	0.45	
		0.45	0.45	0.45		

Figure 2.3-3: Loading Pattern 37C3 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC, "Short" Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by "D/F." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell.)

		0.55 (D/F)	0.55	0.55 (D/F)		
	0.55 (D/F)	3.2	0.55	3.2	0.55 (D/F)	
0.75 (D/F)	2.4	0.55	0.65	0.55	2.4	0.75 (D/F)
0.75	0.55	0.65	0.55	0.65	0.55	0.75
0.75 (D/F)	2.4	0.55	0.65	0.55	2.4	0.75 (D/F)
	0.55 (D/F)	3.2	0.55	3.2	0.55 (D/F)	
		0.55 (D/F)	0.55	0.55 (D/F)		

Figure 2.3-4: Loading Pattern 37D1 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFCs, “Standard” Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F.)

		0.55	0.55	0.55		
	0.55	3.2 (D)	Empty	3.2 (D)	0.55	
0.75	2.4 (D)	Empty	0.65	Empty	2.4 (D)	0.75
0.75	0.55	0.65	0.55	0.65	0.55	0.75
0.75	2.4 (D)	Empty	0.65	Empty	2.4 (D)	0.75
	0.55	3.2 (D)	Empty	3.2 (D)	0.55	
		0.55	0.55	0.55		

Figure 2.3-5: Loading Pattern 37D2 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, "Standard" Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, "D" Undamaged Fuel or Damaged Fuel in a DFC and/or using DFIs may be stored in cells denoted by "D." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell)

		0.55	0.55	0.55		
	0.55	3.2 (D/F)	Empty	3.2 (D/F)	0.55	
0.75	2.4	Empty	0.65	Empty	2.4	0.75
0.75	0.55	0.65	0.55	0.65	0.55	0.75
0.75	2.4	Empty	0.65	Empty	2.4	0.75
	0.55	3.2 (D/F)	Empty	3.2 (D/F)	0.55	
		0.55	0.55	0.55		

Figure 2.3-6: Loading Pattern 37D3 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC, “Standard” Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F.” Cells denoted as “Empty” must remain empty regardless of the contents of the adjacent cell.)

		0.65 (D/F)	**0.65**	**0.65 (D/F)**		
	0.65 (D/F)	**3.5**	**0.65**	**3.5**	**0.65 (D/F)**	
0.85 (D/F)	**2.6**	**0.65**	**0.75**	**0.65**	**2.6**	**0.85 (D/F)**
0.85	**0.65**	**0.75**	**0.65**	**0.75**	**0.65**	**0.85**
0.85 (D/F)	**2.6**	**0.65**	**0.75**	**0.65**	**2.6**	**0.85 (D/F)**
	0.65 (D/F)	**3.5**	**0.65**	**3.5**	**0.65 (D/F)**	
		0.65 (D/F)	**0.65**	**0.65 (D/F)**		

Figure 2.3-7: Loading Pattern 37E1 for MPC-37 Loading Pattern for MPCs Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFCs, "Long" Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by "D/F.")

		0.65	0.65	0.65		
	0.65	3.5 (D)	Empty	3.5 (D)	0.65	
0.85	2.6 (D)	Empty	0.75	Empty	2.6 (D)	0.85
0.85	0.65	0.75	0.65	0.75	0.65	0.85
0.85	2.6 (D)	Empty	0.75	Empty	2.6 (D)	0.85
	0.65	3.5 (D)	Empty	3.5 (D)	0.65	
		0.65	0.65	0.65		

Figure 2.3-8: Loading Pattern 37E2 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, "Long" Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, "D" means Undamaged Fuel or Damaged Fuel in a DFC and/or using DFIs may be stored in cells denoted by "D." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell)

		0.65	0.65	0.65		
	0.65	3.5 (D/F)	Empty	3.5 (D/F)	0.65	
0.85	2.6	Empty	0.75	Empty	2.6	0.85
0.85	0.65	0.75	0.65	0.75	0.65	0.85
0.85	2.6	Empty	0.75	Empty	2.6	0.85
	0.65	3.5 (D/F)	Empty	3.5 (D/F)	0.65	
		0.65	0.65	0.65		

Figure 2.3-9: Loading Pattern 37E3 for MPC-37 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC, "Long" Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by "D/F." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell)

				0.25 (D/F)	0.25	0.25 (D/F)				
		0.25 (D/F)	0.25	0.25	1.45	0.25	0.25	0.25 (D/F)		
	0.25 (D/F)	0.25	1.45	0.9	0.9	0.9	1.45	0.25	0.25 (D/F)	
	0.25	1.45	0.32	0.32	0.32	0.32	0.32	1.45	0.25	
0.25 (D/F)	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25 (D/F)
0.25	1.45	0.9	0.32	0.32	0.32	0.32	0.32	0.9	1.45	0.25
0.25 (D/F)	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25 (D/F)
	0.25	1.45	0.32	0.32	0.32	0.32	0.32	1.45	0.25	
	0.25 (D/F)	0.25	1.45	0.9	0.9	0.9	1.45	0.25	0.25 (D/F)	
		0.25 (D/F)	0.25	0.25	1.45	0.25	0.25	0.25 (D/F)		
				0.25 (D/F)	0.25	0.25 (D/F)				

Figure 2.3-10: Loading Pattern 89A1 for MPC-89 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC, per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F.”)

				0.25	0.25	0.25				
		0.25	0.25	0.25	1.45 (D/F)	0.25	0.25	0.25		
	0.25	0.25	1.45 (D/F)	0.9	0.9	0.9	1.45 (D/F)	0.25	0.25	
	0.25	1.45 (D/F)	Empty	0.32	0.32	0.32	Empty	1.45 (D/F)	0.25	
0.25	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25
0.25	1.45 (D/F)	0.9	0.32	0.32	0.32	0.32	0.32	0.9	1.45 (D/F)	0.25
0.25	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25
	0.25	1.45 (D/F)	Empty	0.32	0.32	0.32	Empty	1.45 (D/F)	0.25	
	0.25	0.25	1.45 (D/F)	0.9	0.9	0.9	1.45 (D/F)	0.25	0.25	
		0.25	0.25	0.25	1.45 (D/F)	0.25	0.25	0.25		
				0.25	0.25	0.25				

Figure 2.3-11: Loading Pattern 89A2 for MPC-89 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFCs, per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by "D/F." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell.)

				0.11 (D/F)	0.47	0.11 (D/F)				
		0.19 (D/F)	0.23	0.68	1.46	0.68	0.23	0.19 (D/F)		
	0.25 (D/F)	0.27	1.42	1.05	0.40	1.05	1.42	0.27	0.25 (D/F)	
	0.23	1.44	0.29	0.31	0.33	0.31	0.29	1.44	0.23	
0.10 (D/F)	0.71	0.72	0.36	0.28	0.21	0.28	0.36	0.72	0.71	0.10 (D/F)
0.40	1.46	0.47	0.33	0.21	0.10	0.21	0.33	0.47	1.46	0.40
0.10 (D/F)	0.71	0.72	0.36	0.28	0.21	0.28	0.36	0.72	0.71	0.10 (D/F)
	0.23	1.44	0.29	0.31	0.33	0.31	0.29	1.44	0.23	
	0.25 (D/F)	0.27	1.42	1.05	0.40	1.05	1.42	0.27	0.25 (D/F)	
		0.19 (D/F)	0.23	0.68	1.46	0.68	0.23	0.19 (D/F)		
				0.11 (D/F)	0.47	0.11 (D/F)				

Figure 2.3-12: Loading Pattern 89B1 for MPC-89 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC, per cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F.”)

				0.11	0.47	0.11				
		0.19	0.23	0.68	1.46 (D/F)	0.68	0.23	0.19		
	0.25	0.27	1.42 (D/F)	1.05	0.40	1.05	1.42 (D/F)	0.27	0.25	
	0.23	1.44 (D/F)	Empty	0.31	0.33	0.31	Empty	1.44 (D/F)	0.23	
0.10	0.71	0.72	0.36	0.28	0.21	0.28	0.36	0.72	0.71	0.10
0.40	1.46 (D/F)	0.47	0.33	0.21	0.10	0.21	0.33	0.47	1.46 (D/F)	0.40
0.10	0.71	0.72	0.36	0.28	0.21	0.28	0.36	0.72	0.71	0.10
	0.23	1.44 (D/F)	Empty	0.31	0.33	0.31	Empty	1.44 (D/F)	0.23	
	0.25	0.27	1.42 (D/F)	1.05	0.40	1.05	1.42 (D/F)	0.27	0.25	
		0.19	0.23	0.68	1.46 (D/F)	0.68	0.23	0.19		
				0.11	0.47	0.11				

Figure 2.3-13: Loading Pattern 89B2 for MPC-89 Containing Undamaged and Damaged Fuel in DFCs/DFIs, and/or Fuel Debris in DFC, per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by "D/F." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell.)

		0.64 (D/F)	0.95	0.64 (D/F)		
	1.37 (D/F)	3.03	1.7	3.03	1.37 (D/F)	
0.86 (D/F)	2.64	Empty	0.73	Empty	2.64	0.86 (D/F)
0.95	2.43	0.79	0.22	0.79	2.43	0.95
0.86 (D/F)	2.64	Empty	0.73	Empty	2.64	0.86 (D/F)
	1.37 (D/F)	3.03	1.7	3.03	1.37 (D/F)	
		0.64 (D/F)	0.95	0.64 (D/F)		

Figure 2.3-14: Loading Pattern 1 for MPC-37P

(All Storage cell heat loads are in kW. Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F.” Cells denoted as “Empty” must remain empty regardless of the contents of the adjacent cell.)

		0.64	0.95	0.64		
	1.37	3.03 (D/F)	1.7	3.03 (D/F)	1.37	
0.86	2.64	Empty	0.73	Empty	2.64	0.86
0.95	2.43	0.79	0.22	0.79	2.43	0.95
0.86	2.64	Empty	0.73	Empty	2.64	0.86
	1.37	3.03 (D/F)	1.7	3.03 (D/F)	1.37	
		0.64	0.95	0.64		

Figure 2.3-15: Loading Pattern 2 for MPC-37P

(All Storage cell heat loads are in kW. Undamaged Fuel, or Damaged Fuel in DFCs and/or using DFIs, and/or Fuel Debris in a DFC may be stored in cells denoted by “D/F.” Cells denoted as “Empty” must remain empty regardless of the contents of the adjacent cell.)

2.3 Burnup Credit

Criticality control during loading of the MPC-37 and MPC-37P is achieved through either meeting the soluble boron limits in LCO 3.3.1 OR verifying that the assemblies meet the minimum burnup requirements in Table 2.4-1.

For those spent fuel assemblies that need to meet the burnup requirements specified in Table 2.4-1, a burnup verification shall be performed in accordance with either Method A OR Method B described below.

2.3.1 Method A: Burnup Verification Through Quantitative Burnup Measurement

For each assembly in the MPC-37 and MPC-37P where burnup credit is required, the minimum burnup is determined from the burnup requirement applicable to the loading configuration chosen for the cask (see Table 2.4-1). A measurement is then performed that confirms that the fuel assembly burnup exceeds this minimum burnup. The measurement technique may be calibrated to the reactor records for a representative set of assemblies. The assembly burnup value to be compared with the minimum required burnup should be the measured burnup value as adjusted by reducing the value by a combination of the uncertainties in the calibration method and the measurement itself.

2.3.2 Method B: Burnup Verification Through an Administrative Procedure and Qualitative Measurements

Depending on the location in the basket, assemblies loaded into a specific MPC-37 and MPC-37P can either be fresh, or have to meet a single minimum burnup value. The assembly burnup value to be compared with the minimum required burnup should be the reactor record burnup value as adjusted by reducing the value by the uncertainties in the reactor record value. An administrative procedure shall be established that prescribes the following steps, which shall be performed for each cask loading:

a. Based on a review of the reactor records, all assemblies in the spent fuel pool that have a burnup that is below the minimum required burnup of the loading curve for the cask to be loaded are identified.
b. After the cask loading, but before the release for shipment of the cask, the presence and location of all those identified assemblies is verified, except for those assemblies that have been loaded as fresh assemblies into the cask.
c. An independent, third-party verification of the loading process, including the fuel selection process and generation of the fuel move instructions

Additionally, for all assemblies to be loaded that are required to meet a minimum burnup, a qualitative verification shall be performed that verifies that the assembly is not a fresh assembly.

Table 2.4-1: Polynomial Functions for the Minimum Burnup as a Function of Initial Enrichment

Assembly Classes	Configuration (Note 1)	Cooling Time, years	Minimum Burnup (GWd/mtU) as a Function of the Initial Enrichment (wt% ^{235}U)
15x15B, C, D, E, F, H, I and 17x17A, B, C, D, E	Uniform	≥3.0 and <7.0	f(x) = -7.9224e-02 * x^3 -7.6419e-01 * x^2 +2.2411e+01 * x^1 -4.1183e+01
		≥7.0	f(x) = +1.3212e-02 * x^3 -1.6850e+00 * x^2 +2.4595e+01 * x^1 -4.2603e+01
	Regionalized	≥3.0 and <7.0	f(x) = +3.6976e-01 * x^3 -5.8233e+00 * x^2 +4.0599e+01 * x^1 -5.8346e+01
		≥7.0	f(x) = +3.3423e-01 * x^3 -5.1647e+00 * x^2 +3.6549e+01 * x^1 -5.2348e+01
16x16A, B, C	Uniform	≥3.0 and <7.0	f(x) = -1.0361e+00 * x^3 +1.1386e+01 * x^2 -2.9174e+01 * x^1 +2.0850e+01
		≥7.0	f(x) = -9.6572e-01 * x^3 +1.0484e+01 * x^2 -2.5982e+01 * x^1 +1.7515e+01
	Regionalized	≥3.0 and <7.0	f(x) = -2.1456e-01 * x^3 +2.4668e+00 * x^2 +2.1381e+00 * x^1 -1.2560e+01
		≥7.0	f(x) = -5.9154e-01 * x^3 +5.8403e+00 * x^2 -6.9339e+00 * x^1 -4.7951e+00
		Combined (Note 2) (>3.0)	f(x) = -4.9680e-01 * x^3 +4.9471e+00 * x^2 -4.2373e+00 * x^1 -7.3936e+00

Notes:

1. Uniform configuration refers to Configuration 1 in Table 2.4-2. Regionalized configuration refers to Configuration 2, 3, or 4 in Table 2.4-2.
2. The combined cooling time loading curve is applicable for fuel with above 3 years cooling time.

Table 2.4-2: Burnup Credit Configurations

Configuration	Description
Configuration 1	Spent UNDAMAGED fuel assemblies are placed in all positions of the basket
Configuration 2	Fresh UNDAMAGED fuel assemblies are placed in locations 3-4, 3-5, 3-12, and 3-13 (see Figure 2.1-1); spent UNDAMAGED fuel assemblies are placed in the remaining positions
Configuration 3	Damaged Fuel Containers (DFCs) and/or Damaged Fuel Isolators (DFIs) with spent DAMAGED fuel assemblies are placed in locations 3-1, 3-3, 3-4, 3-5, 3-6, 3-7, 3-10, 3-11, 3-12, 3-13, 3-14, and 3-16 (see Figure 2.1-1); spent UNDAMAGED fuel assemblies are placed in the remaining positions
Configuration 4	DFCs with Damaged Fuel and/or fresh FUEL DEBRIS are placed in locations 3-1, 3-7, 3-10, and 3-16 with locations 2-1, 2-5, 2-8, and 2-12 (see Figure 2.1-1) empty; spent UNDAMAGED fuel assemblies are placed in the remaining positions

Table 2.4-3: In-Core Operating Requirements

Assembly Type	Specific Power (MW/mtU)	Moderator Temperature (K)	Fuel Temperature (K)	Soluble Boron (ppm)
Bounding Values (for Design Basis Calculations)				
15x15D, E, F, H	≤ 47.36	≤ 604	≤ 1169	≤ 1000
15x15B, C (Note 1)	≤ 52.33	≤ 620	≤ 1219	≤ 1000
16x16A, B	≤ 51.90	≤ 608	≤ 1113	≤ 1000
17x17A, B, C, D, E	≤ 61.61	≤ 620	≤ 1181	≤1000

Note:

1. The same core operating parameters are assumed for the 15x15I and 16x16C fuel assembly types.

2.4 Burnup and Cooling Time Qualification Requirements

2.4.1 Burnup and Cooling Time for MPC-32ML

Burnup and cooling time limits for fuel assemblies authorized for loading into the MPC-32ML are provided in Table 2.5-1. Burnup and cooling time limits for fuel assemblies authorized for loading according to only the alternative loading patterns shown in Figures 2.3-1 through 2.3-9 (MPC-37) and Figures 2.3-10 through 2.3-13 (MPC-89) are provided in Table 2.5-2.

The burnup and cooling time for every fuel loaded into the MPC-32 ML must satisfy the following equation:

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

where,

Ct = Minimum cooling time (years)

Bu = Assembly-average burnup (MWd/mtU)

A,B,C,D =Polynomial coefficients listed in ~~the below t~~Tables 2.5-1 and 2.5-2

Minimum cooling time must also meet limits specified in Table 2.1-1. If the calculated Ct is less than the cooling time limit in Table 2.1-1, the minimum cooling time in Table 2.1-1 is used.

2.4.2 Burnup and Cooling Time for MPC-37P and MPC-44

Burnup and cooling time limits for fuel assemblies authorized for loading into the MPC-37P and MPC-44 are provided in Table 2.5-3.

The burnup and cooling time for every fuel loaded into the MPC-37P and MPC-44 must satisfy the following equation:

$$Ct = A \bullet Bu^4 + B \bullet Bu^3 + C \bullet Bu^2 + D \bullet Bu + E$$

where,

Ct = Minimum cooling time (years)

Bu = Assembly-average burnup (MWd/mtU)

A,B,C,D,E =Polynomial coefficients listed in Tables 2.5-3

Table 2.5-1: Burnup and Cooling Time Fuel Qualification Requirements for MPC-32ML

A	B	C	D
6.7667E-14	-36736E-09	8.1319E-05	2.7951E+00

Table 2.5-2: Burnup and Cooling Time Fuel Qualification Requirements for MPC-37 and MPC-89

Cell Decay Heat Load Limit (kW)	Polynomial Coefficients			
	A	B	C	D (Note 1)
MPC-37				
≤ 0.85	1.68353E-13	-9.65193E-09	2.69692E-04	2.95915E-01
0.85 < decay heat ≤ 3.5	1.19409E-14	-1.53990E-09	9.56825E-05	-3.98326E-01
MPC-89				
≤ 0.32	1.65723E-13	-9.28339E-09	2.57533E-04	3.25897E-01
0.32 < decay heat ≤ 0.5	3.97779E-14	-2.80193E-09	1.36784E-04	3.04895E-01
0.5 < decay heat ≤ 0.75	1.44353E-14	-1.21525E-09	8.14851E-05	3.31914E-01
0.75 < decay heat ≤ 1.1	-7.45921E-15	1.09091E-09	-1.14219E-05	9.76224E-01
1.1 < decay heat ≤ 1.45	3.10800E-15	-7.92541E-11	1.56566E-05	6.47040E-01
1.45 < decay heat ≤ 1.6	-8.08081E-15	1.23810E-09	-3.48196E-05	1.11818E+00

Note:

1. For BLEU fuel, coefficient D is increased by 1.

Table 2.5-3: Burnup and Cooling Time Fuel Qualification Requirements for MPC-37P and MPC-44

Cell Decay Heat Load Limit (kW)	Polynomial Coefficients				
	A	B	C	D	E
MPC-37P					
≤ 0.79	-7.95196E-18	1.45069E-12	-7.94501E-08	1.81131E-03	-1.09897E+01
0.79 < decay heat ≤ 0.95	-1.25365E-19	2.60073E-13	-2.20748E-08	7.29884E-04	-4.89153E+00
0.95 < decay heat ≤ 1.37	-5.32045E-18	1.07046E-12	-7.62281E-08	2.40535E-03	-2.51659E+01
1.37 < decay heat ≤ 2.64	-1.78154E-21	1.30015E-15	1.74063E-10	1.65882E-05	1.36110E+00
2.64 < decay heat ≤ 3.03	3.36123E-20	2.18480E-15	1.42012E-10	9.23077E-06	6.00000E-01
MPC-44					
≤ 1.0	2.30737E-18	-1.72421E-13	3.59688E-09	9.41169E-05	6.41653E-01

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.

Table 3.3-1 provides decay heat and burnup limits for forced helium dehydration (FHD) and vacuum drying.

APPLICABILITY: Prior to TRANSPORT OPERATIONS.

ACTIONS

--NOTES--

Separate Condition entry is allowed for each MPC.

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 Table 3.3-1.	30 days

ACTIONS (continued)

B. MPC helium backfill limit not met.	B.1 Perform an engineering evaluation to determine the impact of helium differential. AND B.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. OR B.2.2 Develop and initiate corrective actions necessary to demonstrate through analysis, using the models and methods from the HI-STORM FW FSAR, that all limits for cask components and contents will be met.	72 hours 14 days
C. MPC helium leak rate limit for vent and drain port cover plate welds or cover plate base metal not met.	C.1 Perform an engineering evaluation to determine the impact of increased helium leak rate on heat removal capability and offsite dose. AND C.2 Develop and initiate corrective actions necessary to return the MPC to compliance with SR 3.1.1.3.	24 hours 7 days

D. Required Actions and associated Completion Times not met.	D.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 Table 3.3-1.	Once, prior to TRANSPORT OPERATIONS
SR 3.1.1.2	Verify MPC helium backfill quantity is within the limit specified in Table 3.3-2 for the applicable MPC model. Re-performance of this surveillance is not required upon successful completion of Action B.2.2.	Once, prior to TRANSPORT OPERATIONS
SR 3.1.1.3	Verify that the helium leak rate through the MPC vent port confinement weld meets the leaktight criteria of ANSI N14.5-1997 and verify that the helium leak rate through the MPC drain port confinement weld 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 each 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
B. SFSC Heat Removal System inoperable.	B.1 Restore SFSC Heat Removal System to operable status.	8 hours

(continued)

ACTIONS (continued)

C. Required Action B.1 and associated Completion Time not met.	C.1 Measure SFSC dose rates in accordance with the Radiation Protection Program. AND C.2.1 Restore SFSC Heat Removal System to operable status. OR C.2.2 Transfer the MPC into a TRANSFER CASK. OR C.2.3 Perform an engineering evaluation to demonstrate through analysis, using the models and methods from the HI-STORM FW FSAR, that all components and contents remain below allowable temperature limits.	Immediately and once per 12 hours thereafter 24 hours 24 hours 24 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.1.2	Verify all OVERPACK inlets and outlets are free of blockage from solid debris or floodwater.	24 hours
	<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: • ≤ 137°F for OVERPACKS containing MPC-37s, • ≤ 152°F for OVERPACKS containing BWR MPCs, • ≤ 130 °F for OVERPACKS containing MPC-32MLs • ≤ 116 °F for OVERPACKS containing MPC-37Ps • ≤ 144 °F for OVERPACKS containing MPC-44s	24 hours

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. <u>AND</u> A.2 Ensure MPC vent port is not closed or blocked.	Immediately 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 TRANSFER CASK Heat Removal System

LCO 3.1.4 The HI-TRAC VW Version V or V2 Heat Removal System shall be operable

---NOTE---

The HI-TRAC Version V or V2 Heat Removal System is operable when 100% of the inlet and outlet vent areas are unblocked and available for flow. If surveillance shows partial blockage (≤ 100%) of the duct areas, the blockage shall be removed.

APPLICABILITY: This LCO is applicable when a loaded MPC is in the HI-TRAC VW Version V or V2 TRANSFER CASK AND completion of MPC drying operations in accordance with LCO 3.1.1.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. HI-TRAC VW Version V or V2 Heat Removal System inoperable.	A.1 Restore HI-TRAC VW Version V or V2 Heat Removal System to operable status	8 hours
B. Required Action A.1 and associated Completion Time not met	B.1 Continue to restore HI-TRAC VW Version V or V2 Heat Removal System to operable status	64 hours for Version V 8 hours for Version V2
C. Required Action B.1 and associated Completion Time not met.	C.1 Provide supplemental cooling OR C.2 Remove MPC from HI-TRAC	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4	Verify all HI-TRAC VW Version V or V2 inlets and outlets are free of blockage from debris.	Immediately and once every 8 hours

3.2 SFSC RADIATION PROTECTION.

3.2.1 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 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 to be stored in the MPC:

MPC-37, MPC-32ML, MPC-37P, or MPC-44~~32ML~~: Minimum soluble boron concentration as required by the table below†.

MPC	Array/Class	All Undamaged Fuel Assemblies		One or more Damaged Fuel Assemblies or Fuel Debris	
		Maximum Initial Enrichment ≤ 4.0 wt% ^{235}U (ppmb)	Maximum Initial Enrichment 5.0 wt% ^{235}U (ppmb)	Maximum Initial Enrichment ≤ 4.0 wt% ^{235}U (ppmb)	Maximum Initial Enrichment 5.0 wt% ^{235}U (ppmb)
MPC-37	All 14x14 and 16x16A, B, C	1000	1600	1300	1800
	All 15x15 and 17x17	1500	2000	1800	2300
MPC-32ML	16x16D	1500	2000	1600	2100
MPC-37P	15x15I	1500	2000	1800	2300
MPC-44	14x14A, B	1400	1900	1500	2000

† For maximum initial enrichments between 4.0 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 4.0 wt% and 5.0 wt%.

---NOTE---

This LCO does not apply if burnup credit as described in Section 2.3 is utilized in selecting assemblies prior to loading.

14x14 classes must use soluble boron as described in this LCO.

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. AND Once per 48 hours thereafter.

Table 3.3-1: MPC Cavity Drying Limits

Fuel Burnup (MWD/MTU)	MPC Type	MPC Heat Load (kW)	Method of Moisture Removal (Notes 1 and 2)
All Assemblies ≤ 45,000	MPC-37	≤ 29 (Table 2.3-9A or pattern developed in accordance with Table 2.3-9B) ≤ 44.09 (Pattern A in Tables 2.3-1A, 2.3-1B, and 2.3-1C) ≤ 45.00 (Pattern B in Table 2.3-1A) ≤ 37.4 (Figures 2.3-1 through 2.3-3) ≤ 39.95 (Figures 2.3-4 through 2.3-6) ≤ 44.85 (Figures 2.3-7 through 2.3-9)	VDS (Notes 3 and 4) or FHD (Note 4)
	MPC-32ML	≤ 44.16 (Pattern A in Table 2.3-5)	
	MPC-37P	≤ 44.09 (Pattern A in Tables 2.3-1A) ≤ 45.00 (Pattern B in Table 2.3-1A) ≤ 45.00 (Table 2.3-7A)	
	MPC-44	≤ 28 (Table 2.3-13) ≤ 44 (Table 2.3-8A)	
	MPC-89	≤ 29 (Table 2.3-10A or pattern developed in accordance with Table 2.3-10B) ≤ 46.36 (Table 2.3-2A) ≤ 46.2 (Figures 2.3-10 and 2.3-11) ≤ 46.14 (Figures 2.3-12 and 2.3-13)	
One or more assemblies > 45,000	MPC-37	≤ 29 (Table 2.3-9A or pattern developed in accordance with Table 2.3-9B) ≤ 29.6 (Table 2.3-3)	VDS (Notes 3 and 4) or FHD (Note 4)
	MPC-32ML	≤ 28.70 (Pattern B in Table 2.3-5)	
	MPC-37P	≤ 33.3 (Table 2.3-7B)	
	MPC-44	≤ 28 (Table 2.3-13) ≤ 30 (Table 2.3-8B)	
	MPC-89	≤ 29 (Table 2.3-10A or pattern developed in accordance with Table 2.3-10B ≤ 30.0 (Table 2.3-4)	

Fuel Burnup (MWD/MTU)	MPC Type	MPC Heat Load (kW)	Method of Moisture Removal (Notes 1 and 2)
One or more assemblies > 45,000	MPC-37	≤ 44.09 (Pattern A in Tables 2.3-1A, 2.3-1B, and 2.3-1C) ≤ 45.00 (Pattern B in Table 2.3-1A) ≤ 37.4 (Figures 2.3-1 through 2.3-3) ≤ 39.95 (Figures 2.3-4 through 2.3-6) ≤ 44.85 (Figures 2.3-7 through 2.3-9)	VDS (Notes 3, 4, and 5) or FHD (Note 4)
	MPC-32ML	≤ 44.16 (Pattern A in Table 2.3-5)	
	MPC-37P	≤ 44.09 (Pattern A in Tables 2.3-1A, 2.3-1B, and 2.3-1C) ≤ 45.00 (Pattern B in Table 2.3-1A) ≤ 45.00 (Table 2.3-7A)	
	MPC-44	≤ 44 (Table 2.3-8A)	
	MPC-89	≤ 46.36 (Table 2.3-2A) ≤ 46.2 (Figures 2.3-10 and 2.3-11) ≤ 46.14 (Figures 2.3-12 and 2.3-13)	

Notes:

1. VDS means a vacuum drying system. The acceptance criterion when using a VDS is the MPC cavity pressure shall be ≤ 3 torr for ≥ 30 minutes while the MPC is isolated from the vacuum pump.
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 MPC must be performed with the annular gap between the MPC and the TRANSFER CASK filled with water.
4. Heat load limits are set for each cell; see Section 2.2.
5. 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.

Table 3.3-1: MPC Helium Backfill Limits
(Note 1)

MPC Model	Decay Heat Limits Applied (per Section 2.2)	Pressure range (psig)
MPC-37	Table 2.3-1C Table 2.3-3	≥ 42.0 and ≤ 50.0
	Table 2.3-1B	≥ 42.0 and ≤ 47.8
	Table 2.3-1A, Pattern A	≥ 42.0 and ≤ 45.5
	Table 2.3-1A, Pattern B	≥ 41.0 and ≤ 46.0
	Figure 2.3-1 Figure 2.3-2 Figure 2.3-3	≥ 45.5 and ≤ 49.0
	Figure 2.3-4 Figure 2.3-5 Figure 2.3-6	≥ 44.0 and ≤ 47.5
	Figure 2.3-7 Figure 2.3-8 Figure 2.3-9	≥ 44.5 and ≤ 48.0
	Table 2.3-9A Table 2.3-9B	≥ 41.0 and ≤ 44.0
MPC-89	Table 2.3-2B Table 2.3-4	≥ 42.0 and ≤ 50.0
	Table 2.3-2A	≥ 42.5 and ≤ 47.5
	Figure 2.3-10 Figure 2.3-11 Figure 2.3-12 Figure 2.3-13	≥ 42.0 and ≤ 47.0
	Table 2.3-10A Table 2.3-10B	≥ 42.5 and ≤ 45.5
MPC-32ML	Table 2.3-5, All Patterns	≥ 41.5 and ≤ 45.5
MPC-37P	Table 2.3-1A, Pattern A	≥ 42.0 and ≤ 45.5
	Table 2.3-1A, Pattern B	≥ 41.0 and ≤ 46.0
	Table 2.3-7A Table 2.3-7B	≥ 44.0 and ≤ 47.0
MPC-44	Table 2.3-8A Table 2.3-8B Table 2.3-13	≥ 41.0 and ≤ 44.0

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.

4 ADMINISTRATIVE CONTROLS

4.1 Radioactive Effluent Control Program

a. The HI-STORM FW MPC Storage System does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents and annual reporting in accordance with 10 CFR 72.44(d)(3) are not required.

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.

4.2 Transport Evaluation Program

a. For lifting of the loaded MPC, TRANSFER CASK, or OVERPACK using equipment which is integral to a structure governed by 10 CFR Part 50 regulations, 10 CFR 50 requirements apply.

b. This program is not applicable when the TRANSFER CASK or OVERPACK is in the FUEL BUILDING or is being handled by equipment providing support from underneath (i.e., on a rail car, heavy haul trailer, air pads, etc...).

c. The TRANSFER CASK or OVERPACK, when loaded with spent fuel, may be lifted to and carried at any height necessary during TRANSPORT OPERATIONS and MPC TRANSFER, provided the lifting equipment is designed in accordance with items 1, 2, and 3 below.

   1. The metal body and any vertical columns of the lifting equipment shall be designed to comply with stress limits of ASME Section III, Subsection NF, Class 3 for linear structures. All vertical compression loaded primary members shall satisfy the buckling criteria of ASME Section III, Subsection NF.

   2. The horizontal cross beam and any lifting attachments used to connect the load to the lifting equipment shall be designed, fabricated, operated, tested, inspected, and maintained in accordance with applicable sections and guidance of NUREG-0612, Section 5.1. For lifting attachments, ~~T~~this includes applicable stress limits from ANSI N14.6.

   3. The lifting equipment shall have redundant drop protection features which prevent uncontrolled lowering of the load.

   4. For existing handling equipment which does not meet the above criteria, a site-specific drop analysis shall be performed as part of the 10 CFR 72.212 report to demonstrate that the acceptance criteria set forth in the HI-STORM FW FSAR are met. The analysis shall be performed using methodologies consistent with those described in the HI-STORM FW FSAR.

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 OVERPACK.

b. The side OVERPACK

c. The side of the TRANSFER CASK

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

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

a. 15 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. 3500 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 OVERPACK shall not be moved to the ISFSI or, in the case of the OVERPACK loaded at the ISFSI, the MPC shall be removed from the ISFSI 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 dose rate measurement shall be taken on the top of the OVERPACK at approximately the center of the lid.

b. 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.

c. 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. For a TRANSFER CASK with a neutron shield cylinder, dose rates shall be measured between the radial ribs of the neutron shield cylinder.

d. 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 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.

4.5 Heavy Loads Requirements

Each lift of an MPC, a HI-TRAC VW transfer cask, or any HI-STORM FW 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 of the heavy load handling procedures (under 10 CFR 50.59 or 10 CFR 72.48, as 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.

4.6 Combustible Gas Monitoring During MPC Lid Welding and Cutting

During MPC lid-to-shell welding and cutting operations, combustible gas monitoring of the space under the MPC lid is required, to ensure that there is no combustible mixture present.

4.7 Pre-Operational Testing and Training

4.7.1 Dry Run Training Exercise

A dry run training exercise of the loading, closure, handling, unloading, and transfer of the HI-STORM FW MPC Storage System shall be conducted by the licensee prior to the first use of the system to load spent fuel assemblies. The training exercise shall not be conducted with spent fuel in the MPC. The dry run may be performed in an alternate step sequence from the actual procedures, but all steps must be performed. The dry run shall include, but is not limited to the following:

a. Moving the MPC and the transfer cask into the spent fuel pool or cask loading pool.

b. Preparation of the HI-STORM FW MPC Storage System for fuel loading.

c. Selection and verification of specific fuel assemblies to ensure type conformance.

d. Loading specific assemblies and placing assemblies into the MPC (using a dummy fuel assembly), including appropriate independent verification.

e. Remote installation of the MPC lid and removal of the MPC and transfer cask from the spent fuel pool or cask loading pool.

f. MPC welding, NDE inspections, pressure testing, draining, moisture removal (by vacuum drying or forced helium dehydration, as applicable), and helium backfilling. (A mockup may be used for this dry-run exercise.)

g. Transfer of the MPC from the transfer cask to the overpack.

h. Placement of the HI-STORM FW MPC Storage System at the ISFSI.

i. HI-STORM FW MPC Storage System unloading, including flooding MPC cavity and removing MPC lid welds. (A mockup may be used for this dry-run exercise.)

Any of the above steps can be omitted if they have already been successfully carried out at a site to load a HI-STORM 100 System (USNRC Docket 72-1014).