Certificate of Compliance Renewal Application for the HI-STAR 100 Dry Storage System

Certificate of Compliance No. 1008, Docket Number 72-1008

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CHAPTER 1: GENERAL INFORMATION

1.0 Introduction

The HI-STAR 100 System Certificate of Compliance (CoC) No. 72-1008 was first approved for storage of spent nuclear fuel by the NRC on October 4, 1999, under the provisions of 10CFR 72 for use by general licensees, and therefore expires October 4, 2019. In accordance with 10 CFR 72.240(a) and as the certificate holder of CoC 1008, Holtec International is applying for a renewal of CoC 1008 for an additional term of 40 years.

This renewal application includes the Safety Analysis Report (SAR) information required by 10 CFR 72.240(c). The content of this application is based on the guidance provided in NUREG-1927 [1.0.1]. Additional guidance on content and format of this application is also provided in NEI-14-03 [1.0.2].

In accordance with the guidance in NUREG-1927, this renewal application is based on the continuation of the existing licensing basis throughout the period of extended operation and is based on maintaining the intended safety function of the structures, systems, and components (SSCs) important to safety. The existing licensing basis for the HI-STAR 100 system, consists primarily of:

a. CoC 1008 including appendices for each approved amendment
b. Safety Evaluation Reports (SERs) issued for each approved amendment
c. The Final Safety Analysis Reports corresponding to each approved amendment
d. Any other Docketed Licensing Correspondence, as applicable

Exemption Requests granted to individual sites should be considered part of that specific site's licensing basis.

This renewal application also includes appendices summarizing the aging management programs (AMPs), time-limited aging analyses (TLAA), as well as the changes needed to the HI-STAR 100 FSAR and CoC to address the aging management of the system.

1.1 HI-STAR 100 System Description

This section provides a brief description of the HI-STAR 100 storage system. Full details of the system are contained in the FSAR [1.1.1] referenced herein.

1.2.1 General System Description

The HI-STAR 100 system is a canister based system for the storage of spent nuclear fuel comprised of two discrete components: the multi-purpose canister (MPC), and the storage/transport overpack. Other auxiliaries including lifting and handling systems, welding equipment, drying system, and transporter are required to deploy the HI-STAR 100 system for storage.

1.2.2 Principle Components of the HI-STAR 100 System

1.2.2.1 Multi-Purpose Canister (MPC)

The HI-STAR 100 MPCs are welded cylindrical structures with flat ends. Each MPC is an assembly consisting of a honeycombed fuel basket, a baseplate, canister shell, a lid, and a closure ring. The outer diameter and cylindrical height of each MPC is fixed. However, the number of spent nuclear fuel storage locations in each of the MPCs depends on the fuel assembly characteristics.

The MPC provides the confinement boundary for the stored fuel. The confinement boundary is a seal-welded enclosure constructed entirely of stainless steel.

The construction features of the PWR MPC-24, PWR MPC-32, and the BWR MPC-68 are similar. However, the PWR MPC-24 canister, which is designed for highly enriched PWR fuel without credit for soluble boron, differs in construction from the MPC-32 or MPC-68 in one important aspect. The fuel storage cells are physically separated from one another by a “flux trap” between each storage cell for criticality control. All MPC baskets are formed from an array of plates welded to each other, such that a honey comb structure is created which resembles a multiflanged, closed-section beam in its structural characteristics. MPC-32 contains a non-flux trap (NFT) fuel basket for PWR fuel.

The MPC Fuel basket is positioned and supported within the MPC shell by “basket shims” located in the space between the inside of the MPC shell and the Fuel Basket. Between the periphery of the basket, the MPC shell, and the basket supports, heat conduction elements are optionally installed. The heat conduction elements are installed along the full length of the MPC basket, except at the drain pipe location, to create a nonstructural thermal connection which facilitates heat transfer from the basket to shell. In their operating condition, the heat conduction elements will conform to and contact the MPC shell and basket walls.

Lifting lugs attached to the inside surface of the MPC canister shell serve to permit lifting and placement of the empty MPC into the overpack. The lifting lugs also serve to axially locate the lid prior to welding. These internal lifting lugs are not used to handle a loaded MPC. Since the MPC lid is installed prior to any handling of the loaded MPC, there is no access to the lifting lugs once the MPC is loaded.

The top end of the HI-STAR 100 MPC incorporates a redundant closure system. The MPC lid is a circular plate edge-welded to the MPC outer shell. This lid is equipped with vent and drain ports which are utilized to remove moisture and air from the MPC, and backfill the MPC with a specified pressure of inert gas (helium). The vent and drain ports are covered and welded before the closure ring is installed. The closure ring is a circular ring edge-welded to the MPC shell and lid. The MPC lid provides sufficient rigidity to allow the entire MPC loaded with SNF to be lifted by threaded holes in the MPC lid.

For fuel assemblies that are shorter than the design basis length, upper and lower fuel spacers (as appropriate) maintain the axial position of the fuel assembly within the MPC basket.

The MPC is constructed entirely from stainless steel alloy materials (except for the neutron absorber and aluminum heat conduction elements). No carbon steel parts are permitted to be in contact with the pool water in the MPC. All structural components in an MPC shall be made of Alloy X, a full description of Alloy X is contained in the HI-STAR 100 FSAR [1.1.1].

1.2.2.2 HI-STAR 100 Overpack

The HI-STAR 100 overpack is a heavy-walled steel cylindrical vessel. The overpack helium retention boundary is formed by an inner shell welded at the bottom to a cylindrical forging and, at the top, to a heavy main flange with a bolted closure plate. Two concentric grooves are machined into the closure plate for self-energizing seals. The closure plate is recessed into the top flange and the bolted joint is configured to provide maximum protection to the closure bolts and seals in the event of a drop accident. The closure plate has a vent port which is sealed by a threaded port plug with a seal. The bottom plate has a drain port which is sealed by a threaded port plug with a seal. The inner surfaces of the HI-STAR overpack form an internal cylindrical cavity for housing the MPC.

The outer surface of the overpack inner shell is buttressed with intermediate shells of gamma shielding which are installed in a manner to ensure a permanent state of contact between adjacent layers. Besides serving as an effective gamma shield, these layers provide additional strength to the overpack to resist potential punctures or penetrations from external missiles. Radial channels are vertically welded to the outside surface of the outermost intermediate shell at nominally equal intervals around the circumference. These radial channels act as fins for improved heat conduction to the overpack outer enclosure shell surface and as cavities for retaining and protecting the neutron shielding. The enclosure shell is formed by welding enclosure shell panels between each of the channels to form additional cavities. Neutron shielding material is placed into each of the radial cavity segments formed by the radial channels, the outermost intermediate shell, and the enclosure shell panels. The exterior flats of the radial channels and the enclosure shell panels form the overpack outer enclosure shell. Atop the outer enclosure shell, rupture disks are positioned in a recessed area. The rupture disks relieve internal pressure which may develop as a result of the fire accident and subsequent off-gassing of the neutron shield material. Within each radial channel, a layer of silicone sponge is positioned, if required, to alleviate the thermal stresses from differential expansion.

The exposed steel surfaces of the overpack are coated with paint to prevent corrosion. The paint is described in detail in the HI-STAR 100 FSAR [1.1.1]. The inner cavity of the overpack is coated with a paint appropriate to its higher temperatures and the exterior of the overpack is coated with a paint appropriate for fuel pool operations and environmental exposure.

Lifting trunnions are attached to the overpack top flange forging for lifting and for roating the cask body between vertical and horizontal positions. The lifting trunnions are located 180^o apart in the sides of the top flange. Pocket trunnions, if used, are welded to the lower side of the overpack to provide a pivoting axis for rotation. The pocket trunnions are located slightly off-center to ensure the proper rotation direction of the overpack. The lifting trunnions do not protrude beyond the cylindrical envelope of the overpack enclosure shell. This feature reduces the potential for a direct impact on a trunnion in the event of an overpack side impact.

1.2.2.3 Other Structures, Systems, and Components

Fuel Assemblies

The HI-STAR 100 system is designed to store spent fuel assemblies as described in Chapter 2 of the HI-STAR 100 FSAR [1.1.1], and authorized in Appendix B of the CoC.

Fuel Transfer and Auxiliary Equipment

Auxiliary equipment used for loading of MPCs and cask movement (e.g., drying system, cask transporter, welding equipment, etc.) are not included as part of the HI-STAR 100 CoC, and as such are not described in detail in the FSAR, nor are they within scope for aging management.

ISFSI Pad

The pad is a reinforced concrete structure where the HI-STAR 100 casks are stored. Beginning with Amendment 2 of the HI-STAR 100 CoC, the ISFSI Pad is not a "licensed component," of the HI-STAR 100 System. The CoC requirement is that the cask storage pad be verified by analysis to limit cask deceleration during both the design basis drop and non-mechanistic tipover event to ≤60 g's at the top of the MPC fuel basket. These analyses shall be performed using methodologies consistent with those described in the HI-STAR 100 FSAR. Previous amendments of the CoC required specific pad properties in the CoC to be met by the users to ensure that the cask deceleration was within limits.

1.3 Background

The HI-STAR 100 System was originally approved by the NRC on October 4, 1999. Subsequently amendments 1 and 2 were approved by the NRC, with a 3rd amendment currently under NRC review. These amendments were requested by Holtec International to address continuing needs of utilities to store different types of PWR or BWR fuel, with revised heat loads, enrichments, or other parameters. The HI-STAR 100 cask is also approved for transportation under 10 CFR Part 71, but that CoC is not part of this storage renewal application.

Table 1.3-1 lists each of the approved HI-STAR 100 storage amendments. The table provides a description of the scope of the amendment, its approval time, identification of the FSAR which provides the licensing basis, and a pointer to where the AMPs for different amendments are located in this application. Note, that because the FSAR is updated for each amendment, the latest FSAR contains the full licensing basis for all previous amendments.

Table 1.3-1: HI-STAR 100 CoC Amendments

Amendment Number	Description of Changes	Approval Date	Original FSAR Basis	Location of Aging Management Program (AMP)
0	Initial Issue	10/4/1999	HI-2012610, Rev 0	Appendix A
1	• Revisions to limits for existing fuel array/classes • Addition of PWR Burnable Poison Rod Assemblies (BPRAs) and Thimble Plug Devices (TPDs) • Addition of two new fuel assembly array/classes • Addition of a new damaged fuel container (DFC) • Addition of thoria rods in canisters • Addition of antimony-beryllium neutron sources	12/26/2000	HI-2012610, Rev 0	Appendix A
2	Modification to the specifications for the cask pad and foundation.	5/29/2001	HI-2012610, Rev 3	Appendix A
3	• Addition of MPC-32 • Addition of Metamic neutron absorber • Revision of confinement boundary leak tight criterion • Addition of soluble boron credit • Pocket trunnions revised as optional • Addition of Forced Helium Dehydration (FHD) option • Allow horizontal storage of the HI-STAR 100 casks • Align fuel cladding temperature limits with ISG-11 Rev 3			Appendix A

1.3 References

[1.0.1] NUREG-1927, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel," Revision 1. US NRC, June 2016.

[1.0.2] NEI 14-03, "Format, Content and Implementation Guidance for Dry Cask Storage Operations-Based Aging Management," Revision 2, December 2016

[1.1.1] HI-2012610, "HI-STAR 100 FSAR," Revision 3, October 2013

CHAPTER 2: SCOPING EVALUATION

2.0 Introduction

Chapter 2 describes the evaluation process and methodology used to identify the structures, systems, and components (SSCs) of the HI-STAR 100 System and the subcomponents thereof that are within the scope of the license renewal.

2.1 Scoping Evaluation Process and Methodology

The scoping evaluation of the HI-STAR 100 System is performed based on the two-step process described in NUREG-1927 [1.0.1]. The first step in the process is a screening evaluation to determine which systems, structures, and component (SSC) are within the scope of the license renewal, and then the in scope components are reviewed to determine the need for aging management activities. Per NUREG-1927, Section 2.4.2, structures, systems, and components (SSC) are considered to be within the scope of the renewal if they satisfy either of the following criteria:

1) They are classified as Important-To-Safety (ITS), as they are relied on to do one of the following functions:

i. Maintain the conditions required by the regulation or CoC to store spent fuel safely;

ii. Prevent damage to the spent fuel during handling and storage; or

iii. Provide reasonable assurance that spent fuel can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public.

These SSCs ensure that important safety functions are met for (1) confinement, (2) radiation shielding, (3) sub-criticality control, (4) heat-removal capability, (5) structural integrity, and (6) retrievability

2) They are classified as Not-Important-To-Safety (NITS), but, according to the design bases, their failure could prevent fulfillment of a function that is ITS.

Any SSC that meets either Scoping Criterion 1 or 2 above is considered within the scope of license renewal (in-scope), and the function(s) it is required to perform during the extended term is identified. The results of the scoping evaluation are presented in Section 2.2.

As stated above, the HI-STAR 100 renewal is based on the continuation of the existing Current Licensing Basis (CLB) throughout the period of extended operation and maintenance of the intended safety functions of the SSC ITS. Accordingly, the sources of information reviewed in the scoping evaluation that describe the CLB and the intended safety functions of the SSC ITS are the HI-STAR 100 FSAR ([2.1.1]) and CoC ([2.1.2], [2.1.3], and [2.1.5]).

2.2 Results of Scoping Evaluation

As discussed in Section 1.2, the HI-STAR 100 system includes the following major components:

- MPC

- HI-STAR 100 Overpack
- Fuel Assembly
- ISFSI Pad
- Fuel Transfer and Auxiliary Equipment

The following sections include brief descriptions of the components, detailed descriptions can be found in Reference [2.1.1]. Table 2.1-1 summarizes the results of the scoping evaluation, listing the SSC that are identified as within scope and the criteria upon which they are determined to be within scope. There are no other components identified as part of the generically licensed HI-STAR 100 system.

2.2.1 Description of SSC

2.2.1.1 MPC

The MPC (including fuel basket) is constructed primarily of stainless steel, with supplemented Metamic® or Boral™ neutron absorbers (Metamic was added as an option in the submittal of Amendment 3, and is therefore included in this license renewal). The primary functions of the MPC (including fuel basket) are confinement, criticality control, heat transfer, and shielding. The MPC is classified as ITS-A.

2.2.1.2 HI-STAR 100 Overpack

The HI-STAR 100 overpack provides helium retention for heat rejection and gamma and neutron shielding for the HI-STAR 100 system. The overpack consists primarily of a welded carbon steel cavity with a bolted carbon steel closure lid. Intermediate and enclosure carbon steel shells and Holtite-A comprise the majority of the overpack body. The primary functions of the overpack are structural integrity and shielding. The overpack is classified as ITS-A.

2.2.1.3 Fuel Assembly

The HI-STAR 100 system is designed to store spent fuel assemblies as described in Chapter 2 of the HI-STAR 100 FSAR [2.1.1]. Parts of the fuel assembly have the functions of criticality control, radiation shielding, confinement, and structural integrity.

2.2.1.4 ISFSI Pad

The ISFSI Pad is a facility within the perimeter fence, designed for the storage of loaded HI-STAR 100 overpacks. Though not described in detail in the FSAR, basic requirements for the storage pad are defined to ensure there is no adverse impact to the overpacks or spent fuel contained within under the conditions analyzed in the FSAR.

2.2.1.5 Fuel Transfer and Auxiliary Equipment

Auxiliary equipment used for loading of MPCs and cask movement (e.g., drying system, cask transporter, welding equipment, etc.) are not included as part of the HI-STAR 100 CoC, and as such are not described in detail in the FSAR, nor are they within scope for aging management.

2.2.2 SSC's Within the Scope of CoC Renewal

The SSCs determined to be within the scope of the license renewal are the MPC, Overpack, Fuel Assembly, and the ISFSI Pad as shown in Table 2.1-1. Note that the fuel assembly hardware and cladding which supports the retrievability of the spent fuel are considered in scope.

2.2.3 SSC's Not Within the Scope of CoC Renewal

As shown in Table 2.1-1, the Fuel Transfer and Auxiliary Equipment do not meet the criteria for being within scope of the license renewal. Note that the fuel pellets within the assemblies are not relied on to meet retrievability or confinement functions and are therefore not considered in this renewal application.

Sites that have site specific equipment should utilize the same scoping criteria and document the components in their 72.212 report. Note that components that are considered replaceable may be out of scope for aging management.

Table 2.1-1 – Summary of Scoping Evaluation Results			
Structure, System, or Component (SSC)	Scoping Results		In-Scope SSC
	Criterion 1[1]	Criterion 2[2]	
MPC	Yes	N/A	Yes
HI-STAR 100 Overpack	Yes	N/A	Yes
Fuel Assembly[3]	Yes	N/A	Yes
ISFSI Pad	No[4]	Yes	Yes
Fuel Transfer and Auxiliary Equipment	No	No	No

Notes:

1. SSC is Important-to-Safety (ITS)
2. SSC is Not Important-to-Safety (NITS), but its failure could prevent an ITS function from being fulfilled
3. Fuel pellets not included
4. According to the CoC and FSAR, the ISFSI Pad is NITS, some individual sites may have chosen to upgrade the safety class, but this application is for renewal of the generic CoC and FSAR.

Table 2.1-2 – MPC Enclosure Vessel Subcomponents			
Subcomponent	**Safety Class**	**Intended Function**	**Licensing Drawing Number**
Shell	ITS	Confinement	PROPRIETARY INFORMATION WITHHELD
Baseplate	ITS	Confinement	
Lid (one-piece design or top portion of two-piece design)	ITS	Confinement	
Closure Ring	ITS	Confinement	
Vent/Drain Port Cover Plate	ITS	Confinement	
Vent/Drain Shield Block	ITS	Shielding	
Plugs for Drilled Holes	NITS	Shielding	
Bottom Portion of Two-Piece Lid (if applicable)	ITS	Shielding	
Lift Lug	ITS	Structural Integrity	
Lift Lug Baseplate	ITS	Structural Integrity	
Upper Fuel Spacer Column	ITS	Structural Integrity	
Upper Fuel Spacer Bolt	NITS	Structural Integrity	
Upper Fuel Spacer End Plate	ITS	Structural Integrity	
Lower Fuel Spacer Column	ITS	Structural Integrity	
Lower Fuel Spacer End Plate	ITS	Structural Integrity	
Vent Shield Block Spacer	ITS	Structural Integrity	
Vent/Drain Tube	ITS	Operations	
Vent/Drain Port Cap	ITS	Operations	
Vent/Drain Cap Seal Washer	NITS	Operations	
Vent/Drain Cap Seal Washer Bolt	NITS	Operations	
Reducer	NITS	Operations	
Drain Line	NITS	Operations	
Drain Line Guide Tube	NITS	Operations	
Support Plate (for Drain Line)	NITS	Operations	

Table 2.1-3 – MPC Basket Subcomponents

Subcomponent	**Safety Class**	**Intended Function**	**Licensing Drawing Number**
Basket Cell Plate	ITS	Criticality Control	PROPRIETARY INFORMATION WITHHELD
Neutron Absorber	ITS	Criticality Control	
Sheathing	ITS	Structural Integrity	
Shim	NITS	Structural Integrity	
Basket Support (Angled Plate)	ITS	Structural Integrity	
Basket Support (Flat Plate)	NITS	Structural Integrity	

Table 2.1-4 – HI-STAR 100 Overpack Subcomponents			
Subcomponent	**Safety Class**	**Intended Function**	**Licensing Drawing Number**
Inner Shell	ITS	Helium Retention	PROPRIETARY INFORMATION WITHHELD
Bottom Plate	ITS	Helium Retention	
Top Flange	ITS	Helium Retention	
Closure Plate	ITS	Helium Retention	
Closure Plate Bolt	ITS	Helium Retention	
Port Plug	ITS	Helium Retention	
Port Plug Seal	ITS	Helium Retention	
Closure Plate Seal	ITS	Helium Retention	
Port Cover Seal	ITS	Helium Retention	
Intermediate Shell	ITS	Shielding	
Neutron Shield	ITS	Shielding	
Plugs for Drilled Holes	NITS	Shielding	
Removable Shear Ring	ITS	Shielding	
Radial Channel	ITS	Heat Transfer	
Lifting Trunnion	ITS	Structural Integrity	
Relief Device	ITS	Structural Integrity	
Relief Device Plate	ITS	Structural Integrity	
Removable Shear Ring Bolt	ITS	Structural Integrity	
Thermal Expansion Foam	NITS	Structural Integrity	
Closure Bolt Washer	NITS	Structural Integrity	
Enclosure Shell Panel	ITS	Structural Integrity	
Enclosure Shell Return	ITS	Structural Integrity	
Port Cover	ITS	Structural Integrity	
Port Cover Bolt	ITS	Structural Integrity	
Trunnion End Cap	ITS	Operations	
Trunnion End Cap Bolt	ITS	Operations	

Table 2.1-4 – HI-STAR 100 Overpack Subcomponents			
Subcomponent	**Safety Class**	**Intended Function**	**Licensing Drawing Number**
Lifting Trunnion Locking Pad	ITS	Operations	PROPRIETARY INFORMATION WITHHELD
Trunnion Locking Pad Bolt	ITS	Operations	
Nameplate	NITS	Operations	

Table 2.1-5 – Fuel Assembly Subcomponents			
Subcomponent	**Safety Class**	**Intended Function**	**Licensing Drawing Number**
Fuel Pellets	ITS	N/A	N/A
Fuel Cladding	ITS	Criticality Control, Radiation Shielding, Confinement Structural Integrity, Retreivability	N/A
Spacer Grid Assemblies	ITS	Criticality Control, Structural Integrity	N/A
Upper End Fitting	ITS	Structural Integrity	N/A
Lower End Fitting	ITS	Structural Integrity	N/A
Guide Tubes	ITS	Structural Integrity	N/A
Hold-Down Spring & Upper End Plugs	ITS	N/A	N/A
Control Components	ITS	N/A	N/A

Table 2.1-6 – ISFSI Pad Subcomponents			
Subcomponent	**Safety Class**	**Intended Function**	**Licensing Drawing Number**
ISFSI Pad	NITS	Structural Integrity	N/A

2.3 References

[2.1.1] HI-STAR 100 Final Safety Analysis Report, Holtec Report No.HI-2012610, Rev 3

[2.1.2] HI-STAR 100 Certificate of Compliance 72-1008, Amendment 0

[2.1.3] HI-STAR 100 Certificate of Compliance 72-1008, Amendment 1

[2.1.4] HI-STAR 100 Certificate of Compliance 72-1008, Amendment 2

CHAPTER 3: AGING MANAGEMENT REVIEW

3.0 Introduction

The HI-STAR 100 dry storage system, US NRC Certificate of Compliance (CoC) 1008, has a life that is broken down into three classifications. The first classification, the license life of the system, is the amount of time that the system has been licensed by the NRC for use in dry storage. The second classification, a design life of 50 years is the length of time for which the storage system has been engineered to perform all of its design functions. The final classification is the minimum service life of 100 years, which is contingent upon at least two license renewals beyond the original license life.

Because the HI-STAR 100 dry storage system is nearing the end of its initial 20 year license life and the US NRC requires an aging management program be put in place in order to complete the license renewal for the next 40 year license life, this chapter presents the Aging Management Review (AMR) for the HI-STAR 100 system. The purpose of the AMR is to assess the aging effects and mechanisms that could adversely affect the ability of the system, structures, or components (SSC), determined to be within the scope of the license renewal, to perform their intended functions during the period of extended storage. The aging management program must take into account the intended function of each SSC, its material, and the environment in which it was used to determine what activities are needed. The US NRC guidance for the aging management program is contained in NUREG-1927 [1.0.1].

3.1 Operating Experience Review

3.1.1 Engineering Changes

HI-STAR 100 change documents (ECOs) were reviewed to determine if any changes impact the need for aging management activities for the HI-STAR 100 system. This review [3.1.1] demonstrated that no additional aging management activities are required based on these change documents. Additionally, no design changes were made (other than those in the Amendment 3 application, which are considered in this renewal) since the previous biennial submittal of the FSAR [3.1.2].

3.1.2 User Operating Experience

Site operating experience (OE) was reviewed to determine if there is any impact to the aging management activities of the HI-STAR 100 system. Sites performed annual external inspections in accordance with the requirements of the HI-STAR 100 FSAR. These inspections showed minor external corrosion due to general outdoor exposure, which some sites have addressed by performing repainting on the system. The aging management program for the overpack includes checking the external of the overpack for corrosion, which aligns with what the sites have experienced.

3.2 Aging Management Review Methodology

As described in NUREG-1927 [1.0.1], the aging management review process is broken down into a number of steps. The first step is determining the in-scope SSC subcomponents that require aging management review, followed by identification of the aging effects requiring management, and finally identification of the necessary management activities for each affected subcomponent. Aging management activities can either be Time Limited Aging Analyses (TLAAs) or Aging Management Programs (AMPs) depending on the component material, service environment, and existing licensing basis calculations.

3.2.1 Identification of In-Scope SSC's Requiring Aging Management Review

As discussed in Chapter 2, all SSC subcomponents that perform or support any of the identified, intended functions in a passive manner are in-scope for license renewal and are therefore, in-scope for aging management review. These subcomponents are presented in Table 3.3-1 through Table 3.3-5.

Any SSC subcomponents that do not perform or support an intended function or already have their condition monitored at some established frequency are excluded from further evaluation in the aging management review.

3.2.2 Identification of Materials and Environments

A detailed description of the HI-STAR 100 system and the materials used in the SSC's are described in the HI-STAR 100 FSAR [2.1.1]. A breakdown of each SSC subcomponent in-scope for aging management, with its intended function, material, and service environment is contained in Table 3.3-1 through Table 3.3-5. Note that subcomponents which do not have a safety function or support a safety function are not required to undergo aging management. A summary of the main environments is shown below. The materials used in the system are the same as those described in the draft MAPS report [3.2.1].

3.2.2.1 Helium

The helium environment refers to the inside of the MPC and overpack cavity space, which are backfilled with inert helium gas. Based on the vacuum drying process, the environment has negligible amounts of oxygen or moisture. The inert environment is exposed to the range of temperatures calculated for the MPC and overpack as well as significant radiation impacts from the stored fuel.

3.2.2.2 Sheltered Environment

The term sheltered environment refers to environments that may include ambient air, but are shielded from sunlight, rain, or wind exposure. One sheltered environment would be inside a building that may not have HVAC controlled settings. The ambient air contains moisture, salinity, or other contaminants typical for the site. The temperature of the sheltered environment is within the limits of the air temperature passing through the annular space. This environment is not present in the HI-STAR 100 system.

3.2.2.3 Embedded Environment

The embedded environment applies to materials that in contact with another material. Items in this environment include the internal shells of the overpack and reinforcing bars embedded in the ISFSI pad. The embedded items are exposed to the temperatures of the components in which they are embedded.

3.2.2.4 Air-Outdoor Environment

The term “air-outdoor” environment is used for exterior surfaces that are exposed to direct sunlight, wind, rain, and other weather aspects. Items in an “air-outdoor” environment in the HI-STAR 100 include the outer surface of the overpack. The “air-outdoor,” environment has temperature ranges equivalent to the site ambient temperature ranges.

A description of the subcomponent material of construction and environmental information is given in the following sections and summarized in Tables 3-1 through 3-5.

3.2.3 Identification of Aging Effects Requiring Management

After the materials and environments have been identified, the next step involves determining the aging effects requiring management. Aging effects requiring management during the renewed license period are those that could cause a loss of SSC intended function. If degradation of a subcomponent would be insufficient to cause a loss of function or the relevant conditions do not exist for the aging effect to occur and propagate, then no aging management is required. These aging effects were determined based on the combination of materials and environments and a review of known literature, industry operating experience, and maintenance and inspection records. Both potential aging effects that could theoretically occur, as well as aging effects that have actually occurred based upon industry operating experience were considered.

Aging effects occur due to aging mechanisms. In order to manage aging effects, the aging mechanism that could be at work based on material and environment, must be determined. Therefore, the AMR process identifies both aging effects and the aging mechanism causing that effect. The aging effects and mechanisms for each SSC are broken down by subcomponent in Table 3.3-1 through Table 3.3-5.

3.2.4 Determination of Aging Management Activity Required

The final step in the AMR process is to determine the aging management activity or program to manage the effect of aging. As much as possible, existing ISFSI programs and activities were credited to manage aging effects that could cause a loss of intended function during the renewed license period.

As described in NUREG-1927 [Ref. 1.0.1], there are two options for managing aging effects on components; a time-limited aging analysis (TLAA) or an aging management program (AMP).

3.2.4.1 Time-Limited Aging Analysis (TLAA)

A Time-Limited Aging Analysis (TLAA) is a licensee or CoC holder calculation or analysis that meets all of the following attributes, as defined in 10CFR72.3:

- Involves SSCs important to safety within the scope of license or CoC renewal,
- Considers the effects of aging,
- Involves time-limited assumptions defined by the current operating term
- Was determined to be relevant by the licensee or CoC holder in making a safety determination
- Involves conclusions or provides the basis for conclusions related to the capability of the SSCs to perform their intended safety functions, and
- Is contained or incorporated by reference in the design bases.

3.2.4.2 Aging Management Program (AMP)

An Aging Management Program (AMP) is a program conducted by the licensee or Certificate of Compliance (CoC) user for the purposes of addressing the aging effects in accordance with NUREG-1927. The program may include prevention, mitigation, condition monitoring, and/or performance monitoring. These AMPs are to be started as the HI-STAR 100 systems reach the end of their initial license life and intended to support the HI-STAR 100 systems during their renewed license periods.

3.3 Aging Management Review Results

3.3.1 Aging Management Review Results – MPC

Table 3.3-1 and Table 3.3-2 summarize the results of the aging management review for the MPC subcomponents previously determined to be in the scope of the license renewal.

Additional description of the MPC subcomponents is provided in Section 3.3.1.1, while Sections 3.3.1.2 and 3.3.1.3 present the materials and environments for the specified subcomponents. The aging effects requiring management and the proposed activities required to manage these effects are discussed in Sections 3.3.1.4 and 3.3.1.5, respectively.

3.3.1.1 Description of MPC

MPC Enclosure Vessel

The MPC enclosure vessel is a welded cylindrical structure with flat ends that provides confinement of the spent nuclear fuel during storage operations. The confinement boundary, comprised of a baseplate, shell, lid, port covers, and a closure ring, is constructed entirely of stainless steel. The MPC lid is a circular plate edge-welded to the MPC shell. Access to the MPC cavity for the purposes of moisture/air removal and subsequent backfilling with a specified amount of inert gas (helium) is achieved via two penetrations (i.e., vent and drain ports) in the MPC lid. Circular cover plates are seal welded over the vent and drain ports, completing the primary closure system. A circular closure ring is welded to the MPC shell and lid, providing a redundant closure system at the top end of the MPC.

Lifting lugs attached to the inside surface of the enclosure vessel serve to permit lifting and placement of the empty MPC into the overpack. The lifting lugs also serve to axially locate the lid prior to welding. These internal lifting lugs are not used to handle a loaded MPC. Since the MPC lid is installed prior to any handling of the loaded MPC, there is no access to the lifting lugs once the MPC is loaded. The MPC lid is sufficiently rigid to permit the entire MPC loaded with spent nuclear fuel to be lifted via threaded holes in the top of the lid.

MPC Fuel Basket

Within each MPC enclosure vessel is a honeycombed fuel basket responsible for maintaining the spent nuclear fuel in a subcritical condition. Though the number of fuel storage cells will vary depending on the type of fuel to be stored, all fuel baskets are formed from an array of stainless steel plates welded to each other such that the final assembly resembles a multi-flanged, closed-section beam. The location of neutron absorber panels against the walls of the fuel storage cells is fixed via enveloping stainless steel sheathings welded to the basket panels. In addition, “flux traps” physically separate adjacent fuel storage cells in the MPC-24 fuel baskets.

The fuel basket is positioned and supported within the enclosure vessel by “basket shims” located in the space between the inside of the shell and the basket. Thin aluminum heat conduction elements are optionally installed between the fuel basket and the support structure and MPC shell to ensure conformal contact. Though all MPC models have identical overall dimensions (e.g., MPC cavity height and fuel basket height), the fuel assemblies stored within may be shorter than the design basis length. As such, upper and lower fuel spacers, as appropriate, are utilized to maintain the axial position of the fuel assembly within the MPC basket.

3.3.1.2 MPC Materials

With the exception of the neutron absorbers which are constructed of either Boral™ or Metamic®, and the aluminum heat conduction elements (only utilized in some MPCs) all other MPC subcomponents in the scope of the license renewal are constructed of stainless steel. Additional material details for the MPC subcomponents are provided in Table 3.3-1 and 3.3-2.

3.3.1.3 MPC Environments

Because the MPC and the HI-STAR 100 overpack cavities are both sealed, dried, and backfilled with helium prior to entering storage, both the internal and external MPC subcomponents are maintained in a very low moisture, helium environment. The temperature ranges from the highest value at the maximum canister head load to the minimum ambient air temperature as the heat load reduces over time. MPC subcomponents are also exposed to significant gamma and neutron radiation.

3.3.1.4 Aging Effects Requiring Management (MPC)

Based on the aging management review of the MPC materials and the environments experienced during long-term storage, the aging effects requiring management are limited to the loss of material properties of the neutron absorber due to radiation.

3.3.1.5 Aging Management Activities (MPC)

Based on the aging management review of the MPC during long-term storage, it has been determined that a time-limited aging analysis (TLAA) for the effects of radiation on the material properties of the neutron absorber. This aging management activity is discussed in Section 3.4.

3.3.2 Aging Management Review Results – HI-STAR 100 Overpack

Table 3.3-3 summarizes the results of the aging management review for the HI-STAR 100 overpack subcomponents previously determined to be in the scope of the license renewal.

Additional description of the Overpack subcomponents is provided in Section 3.3.2.1, while Sections 3.3.2.2 and 3.3.2.3 present the materials and environments for the specified subcomponents. The aging effects requiring management and the proposed activities required to manage these effects are discussed in Sections 3.3.2.4 and 3.3.2.5, respectively.

3.3.2.1 Description of Overpack

The HI-STAR 100 overpack is a heavy-walled steel cylindrical vessel that provides the helium retention boundary during storage operations. The helium retention boundary is comprised of the overpack inner shell welded to a cylindrical forging at its bottom and a heavy flange with a bolted closure plate at its top. The closure plate is equipped with two concentric grooves for self-energizing seals. Access to the overpack's internal cavity for the purposes of moisture/air removal and subsequent backfilling with a specified amount of inert gas (helium) is achieved via a vent port in the closure plate and a drain port in the bottom forging. Both ports are sealed by threaded port plugs with seals.

Intermediate shells installed against the outer surface of the inner shell (i.e., helium retention boundary) provide additional structural strength to resist puncture or penetration, as well as provide gamma shielding from the spent fuel contained within. Radial channels welded to the outermost intermediate shell create vertical cavities for retaining and protecting neutron shielding material, as well as acting as fins for improved heat conduction away from the intermediate shell. Additional neutron shielding material cavities are formed by welding enclosure shell panels between the radial channels. To relieve internal pressure that could develop in the neutron shielding cavities, rupture disks are installed atop the outer enclosure shell.

Lifting and rotating the loaded/unloaded overpack between the vertical and horizontal orientations is achieved via a pair of trunnions attached to the heavy top flange. The top pair of trunnions are located 180° apart, while the pocket trunnions, if used, are attached to the lower side of the overpack and located slightly off-center to ensure proper rotation of the overpack.

3.3.2.2 Overpack Materials

The majority of the HI-STAR 100 overpack is constructed of carbon steel, with exposed surfaces coated to protect against corrosion. Other materials included in the construction are Holtite for the purposes of neutron shielding and non-ferrous alloys for lifting appurtenances and seals. Additional material details for the HI-STAR 100 overpack subcomponents are provided in Table 3.3-3.

3.3.2.3 Overpack Environments

During fuel loading operations, the exterior surface of the overpack is exposed to borated water, while the annulus between the MPC and the inner cavity wall of the overpack is exposed to demineralized water. Prior to entering storage, the annulus water is purged and the overpack cavity is sealed, dried and backfilled with helium creating a very low moisture, helium environment for the inner surface of the overpack helium rentention boundary. Intermediate overpack components such as the intermediate shells or the inner surfaces of the radial channels and enclosure shell panels are considered to be in embedded environments where potential chemical reactions between adjacent materials are the primary concerns. The outer surfaces of the overpack, including the enclosure shell, radial channels, bottom forging, top flange, and closure plate, are exposed to all weather-related effects, including insolation, wind, rain, snow, ice, and ambient air. Overpack subcomponents are also exposed to gamma and neutron radiation.

3.3.2.4 Aging Effects Requiring Management (Overpack)

Based on the aging management review of the HI-STAR 100 overpack materials and the environments experienced during long-term storage, the aging effects requiring management are loss of material due to corrosion.

3.3.2.5 Aging Management Activities (Overpack)

Based on the aging management review of the HI-STAR 100 overpack during long-term storage, it has been determined that an AMP the exterior surfaces of the overpack is required. This aging management activity is discussed in Section 3.5.

3.3.3 Aging Management Review Results – Fuel Assembly

Table 3.3-4 summarizes the results of the aging management review for the Fuel Assembly subcomponents previously determined to be in the scope of the license renewal.

Additional description of the fuel assembly subcomponents is provided in Section 3.3.3.1, while Sections 3.3.3.2 and 3.3.3.3 present the materials and environments for the specified subcomponents. The aging effects requiring management and the proposed activities required to manage these effects are discussed in Sections 3.3.3.4 and 3.3.3.5, respectively.

3.3.3.1 Description of Fuel Assembly

Depending on the MPC model being used, the fuel contained within consists of either 24 PWR fuel assemblies, 32 PWR fuel assemblies, or 68 BWR fuel assemblies. For an MPC containing 24 PWR fuel assemblies, the maximum MPC heat load at the time of loading is 19 kW if the MPC is to be stored in the vertical orientation and 20 kW if the MPC is to be stored in the horizontal orientation. The maximum burnup of the fuel assemblies is 42,100 MWd/MTU with a minimum cooling time of 5 years. For an MPC containing 32 PWR fuel assemblies, the maximum MPC heat load at the time of loading is 18.5 kW if the MPC is to be stored in the vertical orientation and 20 kW if the MPC is to be stored in the horizontal orientation. The maximum burnup of the fuel assemblies is 44,500 MWd/MTU with a minimum cooling time of 8 years. For an MPC containing 68 BWR fuel assemblies, the maximum MPC heat load at the time of loading is 18.5 kW regardless of storage orientation. The maximum burnup of the fuel assemblies is 37,600 MWd/MTU with a minimum cooling time of 5 years. No high burnup fuel is allowed for storage in the HI-STAR 100 system.

The cladding of the fuel assembly provides the primary confinement barrier, while the physical structure of the fuel assembly maintains the axial distribution of the radiological source and its position within the gridwork of the fuel basket. The fuel pellets, hold-down springs and upper end plugs, and control components were excluded from further aging management review because they do not support or impact the intended function of the fuel assemblies during the extended storage period.

3.3.3.2 Fuel Assembly Materials

The fuel assembly subcomponents included in the aging management review are made from zircaloy, stainless steel, and/or Inconel. Additional material details for the Fuel Assembly subcomponents are provided in Table 3.3-4.

3.3.3.3 Fuel Assembly Environments

Because the MPC is sealed, dried, and backfilled with helium prior to entering storage, the fuel assemblies are maintained in a very low moisture, helium environment. The temperature ranges from the maximum value corresponding to the short term limit for a maximum canister head load to the minimum ambient air temperature as the heat load reduces over time.

3.3.3.4 Aging Effects Requiring Management (Fuel Assembly)

The fuel assemblies stored in the HI-STAR 100 system are not classified as high-burnup fuel and as such, cladding embrittlement due to irradiation damage or hydride formation is not a concern. A report prepared by Pacific Northwest National Laboratory (PNNL-14390 [3.3.1]), documenting research conducted by EPRI and the US Department of Energy, confirms that similar, non-high-burnup fuel assemblies stored in an inert environment, like the one present inside the MPC, do not exhibit detectable degradation of the cladding or more than negligible release of gaseous fission products during storage. Therefore, no aging effects requiring management are identified for the fuel assemblies.

3.3.3.5 Aging Management Activities (Fuel Assembly)

Because no aging effects requiring management are identified for the fuel assemblies, no aging management activities are required for the renewed license period.

3.3.4 Aging Management Review Results – ISFSI Pad

Table 3.3-5 summarizes the results of the aging management review for the ISFSI Pad, previously determined to be in the scope of the license renewal.

Additional description of the ISFSI Pad is provided in Section 3.3.4.1, while Sections 3.3.4.2 and 3.3.4.3 present the materials and environments. The aging effects requiring management and the proposed activities required to manage these effects are discussed in Sections 3.3.4.4 and 3.3.4.5, respectively.

3.3.4.1 Description of ISFSI Pad

The ISFSI Pad is a reinforced concrete slab founded on a soil-like subgrade where the loaded HI-STAR 100 overpack will be staged for storage. The ISFSI Pad is designed to limit cask deceleration values at the top of the fuel basket to less than or equal to 60 g's during all design basis drop and tip-over events. To ensure this limit is met, the key parameters that must be taken into consideration and balanced for satisfactory performance are the thickness of the concrete slab, the compressive strength of the concrete, and the equivalent Young's Modulus of the subgrade. In addition to satisfying this g-load limit requirement, the ISFSI Pad must also possess sufficient flexural and shear stiffness to meet ACI 318.

3.3.4.2 ISFSI Pad Materials

The ISFSI Pad is constructed of concrete with embedded ASTM reinforcing bar. Additional material detail for the ISFSI Pad is provided in Table 3.3-5.

3.3.4.3 ISFSI Pad Environments

During construction of the ISFSI Pad, the reinforcing bars are passively embedded in the concrete before the concrete sets, thereby protecting the rebar from direct exposure to the ambient environment. The concrete itself is exposed to all weather-related effects, including insolation, wind, rain, snow, ice, and ambient air as discussed in the HI-STAR FSAR Section 2.2.1. The reinforced concrete of the ISFSI Pad is in contact with a soil-like subgrade as discussed in Section 3.3.4.1.

3.3.4.4 Aging Effects Requiring Management (ISFSI Pad)

This section describes the aging effects/mechanisms that could, if left unmanaged, cause degradation of the ISFSI pad and result in a loss of intended function(s) during the period of extended operation. The potential aging effects/mechanisms that were considered for the ISFSI pad were based on the NRC's draft MAPS report [3.2.1]. The AMR results for the ISFSI pad are listed in Table 3.3-5.

3.3.4.5 Aging Management Activities (ISFSI Pad)

The ISFSI Pad Aging Management Program manages the aging effects for the ISFSI pad.

A description of this aging management program is provided in Appendix C along with the demonstration that the identified aging effects will be effectively managed for the period of extended operation.

3.4 Time-Limited Aging Analyses (TLAA)

Using the TLAA-identification criteria discussed in Section 3.2.4.1, the CoC, SER, Technical Specifications were reviewed and the following TLAA's were identified for further evaluation and disposition, and are described in Appendix B:

1. Neutron Absorber Depletion

3.5 Aging Management Programs (AMP)

Based on the results of the aging management reviews for systems, structures, and components (SSC) previously determined to be within the scope of the license renewal, presented above, the following AMP's are required:

1. Overpack AMP
2. ISFSI Pad AMP

The full details of these AMP's are presented in Appendix A.

3.6 References

[3.1.1] HI-2188307 “ECO Review in Support of HI-STAR 100 Renewal Application,” Holtec International, latest revision

[3.1.2] Holtec Letter 5014828, “HI-STAR 100 Final Safety Analysis Report Update per 10CFR72.248(c)(6), dated October 20, 2017

[3.2.1] Draft NUREG-2214, “Managing Aging Processes in Storage (MAPS) Report, US NRC, October2017

[3.3.1] PNNL-14390, “Dry Storage Demonstration for High-Burnup Spent Nuclear Fuel – Feasibility Study, August 2003

Table 3.3-1: Aging Management Review of MPC Enclosure Vessel Subcomponents

Subcomponent	Primary Function	Material	Environment[1]	Aging Effects Requiring Management	Aging Mechanism	Aging Management Activity
Shell	Confinement	SA-240 TYPE 316/316L	Helium	None identified	None identified	None Required
Baseplate	Confinement	SA-240 TYPE 316/316L	Helium	None identified	None identified	None Required
Lid (one-piece design or top portion of two-piece design)	Confinement	Alloy X	Helium	None identified	None identified	None Required
Closure Ring	Confinement	Alloy X	Helium	None identified	None identified	None Required
Vent/Drain Port Cover Plate	Confinement	SA-240 TYPE 316/316L	Helium	None identified	None identified	None Required
Vent/Drain Shield Block	Shielding	Alloy X	Helium	None identified	None identified	None Required
Plugs for Drilled Holes	Shielding	Alloy X	Helium	None identified	None identified	None Required
Bottom Portion of Two-Piece Lid (if applicable)	Shielding	Alloy X	Helium	None identified	None identified	None Required
Lift Lug	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Lift Lug Baseplate	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Upper Fuel Spacer Column	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Upper Fuel Spacer Bolt	Structural Integrity	A193-B8	Helium	None identified	None identified	None Required
Upper Fuel Spacer End Plate	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Lower Fuel Spacer Column	Structural Integrity	Stainless Steel	Helium	None identified	None identified	None Required

Table 3.3-1: Aging Management Review of MPC Enclosure Vessel Subcomponents						
Subcomponent	**Primary Function**	**Material**	**Environment[1]**	**Aging Effects Requiring Management**	**Aging Mechanism**	**Aging Management Activity**
Lower Fuel Spacer End Plate	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Vent Shield Block Spacer	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Vent/Drain Tube	Operations	SA-479 TYPE 304	Helium	None identified	None identified	None Required
Vent/Drain Port Cap	Operations	Stainless Steel	Helium	None identified	None identified	None Required
Vent/Drain Cap Seal Washer	Operations	Aluminum	Helium	None identified	None identified	None Required
Vent/Drain Cap Seal Washer Bolt	Operations	Aluminum	Helium	None identified	None identified	None Required
Reducer	Operations	Alloy X	Helium	None identified	None identified	None Required
Drain Line	Operations	Alloy X	Helium	None identified	None identified	None Required
Drain Line Guide Tube	Operations	Stainless Steel	Helium	None identified	None identified	None Required
Support Plate (for Drain Line)	Operations	Alloy X	Helium	None identified	None identified	None Required

Notes:

1) Unlike ventilated casks, the HI-STAR 100 is sealed and filled with helium, so both the inner and outer surfaces of the MPC are contained within an inert helium environment.

Table 3.3-2: Aging Management Review of MPC Fuel Basket Subcomponents

Subcomponent	Primary Function	Material	Environment[1]	Aging Effects Requiring Management	Aging Mechanism	Aging Management Activity
Basket Cell Plate	Criticality Control	Alloy X	Helium	None identified	None identified	None Required
Neutron Absorber	Criticality Control	Metamic® or Boral™	Helium	Loss of material properties	Radiation	TLAA – See Appendix B
Sheathing	Structural Integrity	Alloy X	Helium	None identified	None identified	None Required
Shim	Structural Integrity	SA-479 TYPE 316/316L	Helium	None identified	None identified	None Required
Basket Support (Angled Plate)	Structural Integrity	SA-240 TYPE 316/316L	Helium	None identified	None identified	None Required
Basket Support (Flat Plate)	Structural Integrity	SA-240 TYPE 316/316L	Helium	None identified	None identified	None Required
Optional Aluminum Heat Conduction Elements	Heat Transfer	Aluminum; Alloy 1100	Helium	None identified	None identified	None Required

Notes:

1) Unlike ventilated casks, the HI-STAR 100 is sealed and filled with helium, so both the inner and outer surfaces of the MPC are contained within an inert helium environment.

Table 3.3-3: Aging Management Review of HI-STAR 100 Overpack Subcomponents						
Subcomponent	**Primary Function**	**Material**	**Environment[1,2]**	**Aging Effects Requiring Management**	**Aging Mechanism[3]**	**Aging Management Activity**
Inner Shell	Helium Retention	SA-203 Gr. E or SA-350 LF3	Helium	None identified	None identified	None Required
Bottom Plate	Helium Retention	SA-350 LF3	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Top Flange	Helium Retention	SA-350 LF3	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Closure Plate	Helium Retention	SA-350 LF3	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Closure Plate Bolt	Helium Retention	SB-637 N07718	Air-Outdoor	None identified	None identified	None required
Port Plug	Helium Retention	SA-193 B8	Embedded	None identified	None identified	None Required
Port Plug Seal	Helium Retention	Alloy X750	Air-Outdoor	None identified	None identified	None Required
Closure Plate Seal	Helium Retention	Alloy X750	Air-Outdoor	None identified	None identified	None Required
Port Cover Seal	Helium Retention	Alloy X750	Air-Outdoor	None identified	None identified	None Required
Intermediate Shell	Shielding	SA-516 Gr. 70	Embedded	None identified	None identified	None Required
Neutron Shield	Shielding	Holtite-A	Embedded	Radiation Embrittlement	Cracking	Overpack Aging Management Program – Shielding Effectiveness Test

Table 3.3-3: Aging Management Review of HI-STAR 100 Overpack Subcomponents						
Subcomponent	**Primary Function**	**Material**	**Environment[1,2]**	**Aging Effects Requiring Management**	**Aging Mechanism[3]**	**Aging Management Activity**
				Thermal Aging	Loss of fracture toughness and loss of ductility	Overpack Aging Management Program – Shielding Effectiveness Test
				Boron Depletion	Loss of shielding	Overpack Aging Management Program – Shielding Effectiveness Test
Plugs for Drilled Holes	Shielding	SA-193 B7	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Removable Shear Ring	Shielding	Carbon Steel	Embedded	None identified	None identified	None Required
Radial Channel	Heat Transfer	SA-515 Gr. 70	Embedded / Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program (for non-embedded portions)
Lifting Trunnion	Structural Integrity	SB-637 N07718	Air-Outdoor	None identified	None identified	None required
Relief Device	Structural Integrity	Commercial	Air-Outdoor	Loss of Material	General Corrosion	Routine Maintenance
Relief Device Plate	Structural Integrity	SA-516 Gr. 70 or A569	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Removable Shear Ring Bolt	Structural Integrity	SA-193 B7	Embedded	None identified	None identified	None Required
Thermal Expansion Foam	Structural Integrity	Silicone Foam	Embedded	None identified	None identified	None Required
Closure Bolt Washer	Structural Integrity	A564, 17-7 PH	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program

Table 3.3-3: Aging Management Review of HI-STAR 100 Overpack Subcomponents						
Subcomponent	**Primary Function**	**Material**	**Environment[1,2]**	**Aging Effects Requiring Management**	**Aging Mechanism[3]**	**Aging Management Activity**
Enclosure Shell Panel	Structural Integrity	SA-515 Gr. 70	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Enclosure Shell Return	Structural Integrity	SA-515 Gr. 70	Embedded	None identified	None identified	None Required
Port Cover	Structural Integrity	SA-203 Gr. E or SA-350 LF3	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Port Cover Bolt	Structural Integrity	SA-193 B7	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Trunnion End Cap	Operations	SA-516 Gr. 70 or SA-515 Gr. 70	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Trunnion End Cap Bolt	Operations	SA-193 B7	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Lifting Trunnion Locking Pad	Operations	SA-516 Gr. 70	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Trunnion Locking Pad Bolt	Operations	SA-193 B7	Air-Outdoor	Loss of Material	General Corrosion	Overpack Aging Management Program
Nameplate	Operations	Stainless Steel	Air-Outdoor	None identified	None identified	None Required

Notes:

1) Unlike ventilated casks, the HI-STAR 100 is sealed and filled with helium, so the inner surfaces of the overpack are contained within an inert helium environment.

2) The term “embedded” refers to the fact that the individual component is mechanically sealed and is not exposed to any environment.

3) The term “general corrosion” refers to loss of material due to corrosion, proceeding at approximately the same rate over a metal surface, also referred to as “uniform corrosion.”

Table 3.3-4: Aging Management Review of Fuel Assembly Subcomponents

Subcomponent	Primary Function	Material	Environment	Aging Effects Requiring Management	Aging Mechanism	Aging Management Activity
Fuel Pellets	N/A	N/A	N/A	N/A	N/A	None Required
Fuel Cladding	Criticality Control, Radiation Shielding, Confinement Structural Integrity	Zircaloy	Helium	None identified	None identified	None Required
Spacer Grid Assemblies	Criticality Control, Structural Integrity	Zircaloy	Helium	None identified	None identified	None Required
Upper End Fitting	Structural Integrity	Stainless Steel Inconel	Helium	None identified	None identified	None Required
Lower End Fitting	Structural Integrity	Stainless Steel Inconel	Helium	None identified	None identified	None Required
Guide Tubes	Structural Integrity	Zircaloy / Stainless Steel	Helium	None identified	None identified	None Required
Hold-Down Spring & Upper End Plugs	N/A	N/A	N/A	N/A	N/A	None Required
Control Components	N/A	N/A	N/A	N/A	N/A	None Required

Table 3.3-5: Aging Management Review of ISFSI Pad						
Subcomponent	**Primary Function**	**Material**	**Environment**	**Aging Effects Requiring Management**	**Aging Mechanism**	**Aging Management Activity**
ISFSI Pad	Structural Integrity	Concrete (Reinforced)	"Air-Outdoor"	Change in Material Properties	Leaching of $Ca(OH)_2$ (1,2,3)	ISFSI Pad Aging Management Program
					Aggressive chemical attack (1,2)	ISFSI Pad Aging Management Program
				Cracking	Freeze-thaw	ISFSI Pad Aging Management Program
					Aggressive chemical attack	ISFSI Pad Aging Management Program
					Differential settlement	ISFSI Pad Aging Management Program
					Reaction with Aggregates	ISFSI Pad Aging Management Program
				Loss of material properties (spalling, scaling)	Aggressive chemical attack	ISFSI Pad Aging Management Program
					Freeze and thaw	ISFSI Pad Aging Management Program
					Salt scaling	ISFSI Pad Aging Management Program

Table 3.3-5: Aging Management Review of ISFSI Pad						
Subcomponent	**Primary Function**	**Material**	**Environment**	**Aging Effects Requiring Management**	**Aging Mechanism**	**Aging Management Activity**
			Embedded (in soil)	Loss of Material	Freeze-thaw	ISFSI Pad Aging Management Program
					Aggressive chemical attack	ISFSI Pad Aging Management Program
					Salt scaling	ISFSI Pad Aging Management Program
					Microbiological degradation	ISFSI Pad Aging Management Program
					Corrosion of reinforced steel	ISFSI Pad Aging Management Program
				Cracking	Aggressive chemical attack	ISFSI Pad Aging Management Program
					Differential settlement	ISFSI Pad Aging Management Program
					Freeze and thaw	ISFSI Pad Aging Management Program
					Reaction to aggregates	ISFSI Pad Aging Management Program
					Corrosion of reinforced steel	ISFSI Pad Aging Management Program

Table 3.3-5: Aging Management Review of ISFSI Pad						
Subcomponent	**Primary Function**	**Material**	**Environment**	**Aging Effects Requiring Management**	**Aging Mechanism**	**Aging Management Activity**
				Change in Material Properties Cracking	Leaching of $Ca(OH)_2$ (1,2,3)	ISFSI Pad Aging Management Program
					Aggressive chemical attack (1,2)	ISFSI Pad Aging Management Program
					Microbiological degradation (1,2,3)	ISFSI Pad Aging Management Program
					Corrosion of reinforced steel (1,4)	ISFSI Pad Aging Management Program
					Reaction with Aggregates (1)	ISFSI Pad Aging Management Program

Note- The changes in material properties for every aging mechanism are indicated in the table above. Change in material properties includes –

(1) Loss of strength

(2) Reduction of concrete pH

(3) Increase in porosity and permeability.

(4) Loss of concrete steel bond

CHAPTER 4: AGING MANAGEMENT TOLLGATES

4.0 Introduction

NEI 14-03 (Ref [1.0.2]) introduced the concept of tollgates to be included as part of an operations-based aging management program. The tollgate concept provides a structured way for licensees to pause and formally assess aggregated feedback at specific points in time during the period of extended storage.

Tollgates are established as requirements in the generic CoC renewed application, and implemented by ISFSI generic licensees to evaluate aging management feedback and perform a safety assessment that confirms the safe storage of spent nuclear fuel. The impact of the aggregate feedback will be assessed by the site as it pertains to components at the site's ISFSI and actions taken as necessary, such as:

- Adjustment of aging-related degradation monitoring and inspection programs in AMPs described in Appendix A (e.g. scope, frequency)
- Modification of TLAAs described in Appendix B
- Performance of mitigation activities

Each tollgate assessment will address the following elements as applicable:

- Summary of research findings, operating experience, monitoring data, and inspection results made available since last assessment
- Aggregate impact of findings, including any trends
- Consistency of data with the assumptions and inputs in the TLAAs
- Effectiveness of AMPs
- Corrective actions, including any changes to AMPs
- Summary and conclusions

Sites will have access to the ISFSI Aging Management INPO Database to facilitate the aggregation and dissemination of aging-related information for the completion of these tollgate assessments. Generic tollgates are shown in Table 4-1. Note that the implementation of these tollgates does not infer that generic licensees will wait until one of these designated times to evaluate information. Sites will continue to follow existing processes for addressing emergent issues, including the use of the corrective action program on site. These tollgates are specific times where an aggregate of information will be evaluated as a whole.

Table 4-1: Tollgate Assessments for General Licensees

Tollgate	Year	Assessment
1	Year of first canister loading + 25 years	Evaluate information from the following sources (as available) and perform a written assessment of the aggregate impact of the information, including but not limited to trends, corrective actions required, and the effectiveness of the AMPs with which they are associated: • Results, if any, of research and development programs focused specifically on aging-related degradation mechanisms identified as potentially affecting the storage system and ISFSI site. One example of such research and development would be EPRI Chloride-Induced Stress Corrosion Cracking (CISCC) research. • Relevant results of other domestic and international research, which may include non-nuclear research • Relevant domestic and international operating experience, which may include non-nuclear operating experience • Relevant results of domestic and international ISFSI and dry storage system performance monitoring
2	Maximum interval of 5 years since last tollgate	Evaluate additional information gained from the sources listed in Tollgate 1 along with any new relevant sources and perform a written assessment of the aggregate impact of the information. This evaluation should be informed by the results of Tollgate 1. The aging effects and mechanisms evaluated at this tollgate and the time at which it is conducted may be adjusted based on the results of the Tollgate 1 assessment.
3	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1 and 2
4	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, and 3
5	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, and 4
6	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, 4, and 5
7	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, 4, 5, and 6
8	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, 4, 5, 6, and 7

APPENDIX A: HI-STAR 100 AMPs

A.0 Introduction

Section 3.5 identifies the following needed AMPs:

1. Overpack AMP
2. ISFSI Pad AMP

This appendix contains the 10 elements of the AMPs, following the guidance of NUREG-1927 Revision 1.

Overpack Exterior AMP

Element	**Description**
1. Scope of Program	The program covers the subcomponents of the HI-STAR 100 Overpack identified in Table 3.3-3 which require the HI-STAR 100 Overpack AMP, to operate into the extended storage period.
2. Preventative Actions	This AMP uses condition monitoring to manage aging effects. The design of the system is intended to minimize aging effects on the system, but this AMP focuses on condition monitoring. No new preventative actions are included in this AMP.
3. Parameters Monitored / Inspected	The condition of the exterior of each in-service cask is inspected visually to ensure the intended functions of the cask exterior are not compromised. Visual inspections will look for: • Visual evidence of discontinuities, imperfections, and rust staining indicative of corrosion, SCC, and wear • Visual evidence of loose or missing bolts, physical displacement, and other conditions indicative of loss of preload • Visual evidence of coating degradation (e.g., blisters, cracking, flacking, delamination) indicative of corrosion of the base metal
4. Detection of Aging Effects	<u>Readily Accessible Surfaces</u> *Annual Examination* A visual inspection of the exterior surface of the overpack provides a means to detect degradation of these components due to a potential loss of material and confirm that the intended functions are not compromised. This visual inspection shall be performed on all HI-STAR 100 casks annually. This inspection was required for the initial license period, per FSAR Table 9.2.1, so it is recommended that users follow their existing inspection procedures for these annual inspections. *5 Year Code Inspection* Once every 5 years, visual inspections are performed in accordance with ASME Code Section XI, Article IWA-2213, for VT-3 examinations, and cover all normally accessible surfaces on all casks. This visual inspection is conducted by a qualified individual. <u>Shielding Effectiveness</u> A shielding effectiveness test shall be performed every five years on each overpack. Calibrated neutron and gamma dose meters shall be used to measure the actual neutron and gamma dose rates at the surface of the HI-STAR overpack. Measurements will be taken at three cross-sectional planes and at four points along each plane’s circumference. Additionally, four measurements shall be taken at the top of the overpack closure plate. The average results from each sectional plane shall be compared to the design basis limits for surface dose rates established in the HI-STAR 100 FSAR Chapter 5. This test was required for the initial license period, per FSAR Table 9.1.2 (although the frequency may have been different), so it is recommended that users follow their existing test procedures.

	<u>Data Collection</u> Data from the visual examinations and shielding effectiveness test shall be documented on a checklist or inspection form. The results of the inspection shall be documented, including descriptions of observed aging effects and supporting sketches, photographs, or video. Corrective actions resulting from each AMP inspection shall also be documented. <u>Timing</u> Annual external examinations and shielding effectiveness tests are continued from the initial period of operation. The first 5 year code inspection should be performed when the cask enters its period of extended operation. If the cask is already in its period of extended operation (due to timely renewal) or within 365 days of entering its period of extended operation when the renewed license is issued, the site has 365 days to complete the first 5 year code inspection from the issuance of the renewed license.
5. Monitoring and Trending	The inspections and tests described for external subcomponents of the HI-STAR 100 are performed periodically in order to identify areas of degradation. The visual inspection results will be evaluated by a qualified individual, and areas of degradation not meeting established criteria will be entered into the site Corrective Action Program (CAP) for resolution or more detailed evaluation. The shielding test results shall be compared to the acceptance criteria (described below), and results not meeting these criteria will be entered into the site CAP for resolution or more detailed evaluation. The results from both the visual inspection and shielding tests will be compared against previous inspections in order to monitor and trend the progression of the aging effects over time.
6. Acceptance Criteria	<u>External Visual Inspection</u> The acceptance criteria for the visual inspections are: • No detectable loss of material from the base metal, including uniform wall thinning, localized corrosion pits, and crevice corrosion • No red-orange-colored corrosion products on the base metal or coatings • No coating defects (e.g., blisters, cracking, flaking, delamination) • No indications of loose bolts or hardware, displaced parts If evidence of corrosion, wear, or coating degradation is identified, then the severity of the degradation must be determined using approved site-specific procedures. These may include additional visual, surface, or volumetric non destructive examination methods to determine the loss of material. <u>Shielding Effectiveness Test</u> The dose rate measurements described above shall be compared to the design basis limits for surface dose rates from the HI-STAR 100 FSAR Chapter 5. The test results are considered acceptable if the actual dose readings are lower or equal to the acceptance criteria in the Technical Specifications. If dose rates are higher than the Technical Specification limits, the required actions of the Technical Specifications shall be completed.

7. Corrective Actions	The corrective actions performed based on any detected aging effects are in accordance with the site's Quality Assurance (QA) program. The QA Program ensures that corrective actions are completed within the site's Corrective Action Program (CAP). As applicable, the CAP program will perform cause evaluations, address the extent of condition, determine any necessary actions to prevent recurrence, identify any changes to the existing AMP, and determine if the condition is reportable. The CAP program corrective actions will also identify the actions needing to be taken for increased scope or frequency of inspections, as necessary, based on any detected aging effects.
8. Confirmation Process	The confirmation process will be commensurate with the site QA Program. The QA program ensures that inspections, evaluations, and corrective actions are completed in accordance with the site CAP.
9. Administrative Controls	The site QA program and implementing procedures for this AMP will address instrument calibration and maintenance, inspector requirements, record retention requirements, and document control. This AMP will be updated periodically, as necessary, based on the toll gate assessments described in Chapter 4 of this application. Inspection results will be documented and made available for NRC inspectors to view upon request.
10. Operating Experience	<u>Previous Operating Experience</u> The sites have utilized the same HI-STAR 100 casks since they were initially loaded. Both the periodic visual inspections and periodic shielding effectiveness tests have not shown any aging related degradation of the system. <u>Future Operating Experience</u> As the inspections are performed, sites will upload information into the INPO AMID database to be shared with other users.

ISFSI Pad AMP

Element	**Description**
1. Scope of Program	The program covers the subcomponents of the ISFSI Pad identified in Table 3.3.5 which require the ISFSI Pad AMP, to operate into the extended storage period.
2. Preventative Actions	This AMP uses condition monitoring to manage aging effects. The design of the ISFSI Pad is intended to minimize aging effects on the system, but this AMP focuses on condition monitoring. No new preventative actions are included in this AMP.
3. Parameters Monitored / Inspected	The ISFSI Pad exposed surfaces are visually examined for cracking, loss of material (spalling, scaling), loss of bond, and increased porosity/permeability. Degradation could affect the ability of the concrete pad to provide support to the casks over the period of extended storage. The pad itself does not have any safety function, but may impact the storage of the casks.
4. Detection of Aging Effects	The ISFSI Pad AMP is a visual inspection in order to detect any aging effects. The visual survey in accordance with ACI-349, should identify the source of any staining or corrosion-related activity and the degree of damage. This visual inspection identifies the current condition of the pad and can identify the extent and cause of any aging effect noted. This visual inspection is conducted every 5 years by a qualified individual. Timing The first ISFSI pad inspection should be performed when the first cask on the pad enters its period of extended operation. If the cask is already in its period of extended operation (due to timely renewal) or within 365 days of entering its period of extended operation when the renewed license is issued, the site has 365 days to complete the first 5 year code inspection from the issuance of the renewed license.
5. Monitoring and Trending	The inspection described for the ISFSI pad is performed periodically in order to identify areas of degradation. The results will be evaluated by a qualified individual, and areas of degradation not meeting established criteria will be entered into the site CAP for resolution or more detailed evaluation. The results will be compared against previous inspections in order to monitor and trend the progression of the aging effects over time.
6. Acceptance Criteria	American Concrete Institute Standard 349.3R-02 includes quantitative three-tier acceptance criteria for visual inspections of concrete surfaces, namely (1) acceptance without further evaluation, (2) acceptance after review, (3) acceptance requiring further evaluation. Acceptable signifies that a component is free of significant deficiencies or degradation that could lead to the loss of structural integrity. Acceptable after review signifies that a component contains deficiencies or degradation but will

	remain able to perform its design basis function until the next inspection or repair. Acceptance requiring further evaluation signifies that a component contains deficiencies or degradation that could prevent (or could prevent prior to the next inspection) the ability to perform their design basis function. Degradations or conditions meeting the ACI349.3R-02 Tier 2 and 3 criteria will be entered into the site's CAP for evaluation and resolution. Should the site determine there is a need to deviate from the ACI394.3R-02 acceptance criteria; a technical justification will be fully documented.
7. Corrective Actions	The corrective actions performed based on any detected aging effects are in accordance with the site's Quality Assurance (QA) program. The QA Program ensures that corrective actions are completed within the site's Corrective Action Program (CAP). As applicable, the CAP program will perform cause evaluations, address the extent of condition, determine any necessary actions to prevent recurrence, identify any changes to the existing AMP, and determine if the condition is reportable. The CAP program corrective actions will also identify the actions needing to be taken for increased scope or frequency of inspections, as necessary, based on any detected aging effects.
8. Confirmation Process	The confirmation process will be commensurate with the site QA Program. The QA program ensures that inspections, evaluations, and corrective actions are completed in accordance with the site CAP.
9. Administrative Controls	The site QA program and implementing procedures for this AMP will address instrument calibration and maintenance, inspector requirements, record retention requirements, and document control. This AMP will be updated periodically, as necessary, based on the toll gate assessments described in Chapter 4 of this application. Inspection results will be documented and made available for NRC inspectors to view upon request.
10. Operating Experience	<u>Future Operating Experience</u> As the ISFSI Pad inspections are performed, sites will upload information into the INPO AMID database to be shared with other users.

APPENDIX B: HI-STAR 100 TLAAs

B.0 Introduction

This appendix contains a summary of the Time Limited Aging Analyses (TLAAs) performed in support of the HI-STAR 100 license renewal, which meet the definition in 10CFR72.3.

B.1 Identification of HI-STAR 100 TLAAs

Using the TLAA-identification criteria discussed in Section 3.2.4.1 of this report, the CoC, SER, Technical Specifications were reviewed and the following TLAA's were identified for further evaluation and disposition:

1. Neutron Absorber Depletion

B.2 Neutron Absorber Depletion

Section 6.3.2 of the HI-STAR 100 FSAR describes the boron depletion of the fixed neutron absorber within the MPC. The original analysis demonstrated that the boron depletion of the neutron absorbing material is negligible over a 50 year duration. [PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390]. The same analysis was re-performed in support of this license renewal request, as documented in Ref. [B.2.1].

The analysis concludes that the total depletion of B-10 in Boral over a 500 year period is negligible (less than 1 ppm of total B-10 atoms depleted). Therefore, the TLAA for neutron absorber depletion shows that the neutron absorber will perform its intended function well into the extended storage period and that no aging management program is needed to manage the neutron absorber aging.

B.3 References

[B.2.1] HI-951322R24, “HI-STAR 100 Shielding Design and Analysis for Transport and Storage,” Appendix 3

APPENDIX C: SYSTEM INSPECTIONS

C.0 Introduction

There are two types of initial storage system inspections related to the HI-STAR 100 CoC renewal applications and initial AMP implementation, respectively. The first type, known as a pre-application inspection is intended to gather information to inform the development of the renewal application in general, and AMPs for specific SSCs in particular. The second, known as a baseline inspection, is essentially the first AMP inspection of the SSC, which is performed at a particular ISFSI at approximately the time when the storage system enters the period of extended storage.

C.1 Pre-application Inspections

Although a pre-application inspection is not a regulatory requirement, the HI-STAR 100 System has undergone a number of pre-application inspections which have informed the AMPs included in this application.

C.1.1 Overpack External

The HI-STAR 100 system FSAR already required an annual visual external examination, in Table 9.2.1. This inspection is continued as one part of the overpack AMP. These previous inspections lessons learned have been incorporated into the acceptance criteria in the AMP in this application.

C.1.2 ISFSI Pad

ISFSI Pads in use at existing sites have been examined over the course of their use. Lessons learned from these previous inspections have been incorporated into the acceptance criteria in the AMP in this application.

C.2 Baseline Inspections

Baseline inspections are the first AMP inspections conducted at an ISFSI site at the approximate time the ISFSI enters the period of extended storage (i.e., 20 years after the first HI-STAR 100 system was placed in service). The baseline inspection for the ISFSI meets the criteria defined in the AMPs in Appendix A. Note that sites that have entered the period of extended operation prior to issuance of the renewed license or are near the period of extended operation when the renewal is issued have a grace period from the issuance of the renewed license. Table C.2-1 describes the schedule for baseline and subsequent inspections. This schedule applies to both the Overpack External Code Inspection and the ISFSI Pad Inspection.

Table C.2-1 Aging Management Program Schedule

Date of First Canister Loading	Period of Extended Storage Date	Baseline Inspection Date	Subsequent Inspection Date
Date x, 1999	Date x, 2019	By Date of Renewed License Approval + 365 Days	5 years after the baseline inspection ± 1 year
Date x, 2000	Date x, 2020	By Date of Renewed License Approval + 365 Days	5 years after the baseline inspection ± 1 year
Date x, 2001	Date x, 2021	By Date of Renewed License Approval + 365 Days	5 years after the baseline inspection ± 1 year
Date x, 2002 and later	Date x, 2022 and later	Inspection prior to Period of Extended Storage Date	5 years after the baseline inspection ± 1 year

APPENDIX D: AGING MANAGEMENT FSAR CHANGES

is the only mechanism for fatigue. These low stress, high-cycle conditions cannot lead to a fatigue failure of the MPC which is made from stainless alloy stock (endurance limit well in excess of 20,000 psi). All other off-normal or postulated accident conditions are infrequent or one-time occurrences which cannot produce fatigue failures. Finally, the MPC uses materials that are not susceptible to brittle fracture.

Maintenance of Helium Atmosphere

The inert helium atmosphere in the MPC provides a non-oxidizing environment for the SNF cladding to assure its integrity during long-term storage. The preservation of the helium atmosphere in the MPC is assured by the robust design of the MPC confinement boundary described in Section 7.1. Maintaining an inert environment in the MPC mitigates conditions that might otherwise lead to SNF cladding failures. The required mass quantity of helium backfilled into the canister at the time of closure as defined in the Technical Specification contained in Chapter 12, and the associated leak tightness requirements for the canister defined in the Technical Specification contained in Chapter 12, are specifically set down to assure that an inert helium atmosphere is maintained in the canister throughout a 40-year service life.

Allowable Fuel Cladding Temperatures

The helium atmosphere in the MPC promotes heat removal and thus reduces SNF cladding temperatures during dry storage. In addition, the SNF decay heat will substantially attenuate over a 40-year dry storage period. Maintaining the fuel cladding temperatures below allowable levels during long-term dry storage mitigates the damage mechanism that might otherwise lead to SNF cladding failures. The allowable long-term SNF cladding temperatures used for thermal acceptance of the MPC design are conservatively determined, as discussed in Section 4.3.

Neutron Absorber Boron Depletion

The effectiveness of the fixed borated neutron absorbing material used in the MPC fuel basket design requires that sufficient concentrations of boron be present to assure criticality safety during worst case design basis conditions over the 40-year service life of the MPC. Information on the characteristics of the borated neutron absorbing material used in the MPC fuel basket is provided in Section 1.2.1.3.1. The low neutron flux, which will continue to decay over time, to which this borated material is subjected, does not result in depletion of the material's available boron to prevent performing its intended safety function. In addition, the boron content of the material used in the criticality safety analysis is conservatively based on the minimum specified boron areal density (rather than the nominal), which is further reduced by 25% for analysis purposes, as described in Section 6.1. Analysis discussed in Section 6.3.2 demonstrates that the boron depletion in the Boral is negligible over a 6~~5~~0-year duration. Thus, sufficient levels of boron are present in the fuel basket neutron absorbing material to maintain criticality safety functions over the 40-year service life of the MPC.

The above findings are consistent with those of the NRC's Waste Confidence Decision Review, which concluded that dry storage systems designed, fabricated, inspected, and operated in the manner

9.1.5.3, to validate the ^{10}B (poison) concentration in the Boral. To demonstrate that the neutron flux from the irradiated fuel results in a negligible depletion of the poison material over the storage period, an MCNP4a calculation of the number of neutrons absorbed in the ^{10}B was performed. The calculation conservatively assumed a constant neutron source for 6~~5~~0 years equal to the initial source for the design basis fuel, as determined in Section 5.2, and shows that the fraction of ^{10}B atoms destroyed is only 3.2~~2.6~~E-09 in 6~~5~~0 years. Thus, the reduction in ^{10}B concentration in the Boral by neutron absorption is negligible. In addition, analysis in Appendix 3.M.1 demonstrates that the sheathing, which affixes the Boral panel, remains in place during all credible accident conditions, and thus, the Boral panel remains permanently fixed. Therefore, in accordance with NUREG-1536, there is no need to provide a surveillance or monitoring program to verify the continued efficacy of the neutron absorber, as required by 10CFR72.124(b).

Prior to transport of the HI-STAR 100 System following completion of the storage period, a Containment Periodic Verification leakage test shall be performed in accordance with ANSI N14.5 [9.1.9] and the HI-STAR 100 Safety Analysis Report [9.1.4] to verify the continued integrity of the containment boundary metallic seals.

9.2.3 Subsystem Maintenance

The HI-STAR 100 System does not include any subsystems which provide auxiliary cooling. Normal maintenance and calibration testing will be required on the vacuum drying, helium backfill, and leakage testing systems. Rigging, remote welders, cranes, and lifting beams shall also be inspected *prior to each loading campaign* to ensure proper maintenance and continued performance is achieved. Auxiliary shielding provided during on-site transfer operations or installed with the HI-STAR 100 at the storage pad requires no maintenance.

9.2.4 Rupture disks

The rupture disks shall be replaced *as described in Table 9.2.1* with approved spares per written and approved procedures.

9.2.5 Shielding

The gamma and neutron shielding materials in the overpack and MPC degrade negligibly over time or as a result of usage. To ensure continuing compliance of the HI-STAR 100 System to the design basis dose rate values, the Shielding Effectiveness Test shall be reperformed *as described in Table 9.2.1* after placement into service. ~~After the first 20 years of service~~When the site implements an aging management program, this inspection is replaced by the Overpack Aging Management Program.

Radiation monitoring of the ISFSI by the licensee *in accordance with 10CFR72.104(c)* provides ongoing evidence and confirmation of the shielding integrity and performance. If increased radiation doses are indicated by the facility monitoring program, additional surveys of overpacks *shall* be performed to determine the cause of the increased dose rates.

The *neutron absorber* panels installed in the MPC baskets are not expected to degrade under normal long-term dry storage conditions. The use of Boral in similar nuclear applications is discussed in Chapter 1, and the long-term performance in a dry, inert gas atmosphere is evaluated in Chapter 3. *A similar discussion is provided for METAMIC ® neutron absorber material.* Therefore, no periodic verification testing of neutron poison material is required on the HI-STAR 100 System.

9.2.6 Thermal

There are no active cooling systems required for the long-term thermal performance of the HI-STAR 100 System. Therefore, no periodic thermal testing is required for the HI-STAR 100 System.

9.2.7 Aging Management Program

An aging management assessment of the components of the HI-STAR 100 system was performed. This review identified inspection and monitoring activities necessary to provide reasonable assurance that system components within the scope of license renewal continue to perform their intended functions consistent with the current licensing basis for the renewed operating period. This section describes these aging management programs.

9.2.7.1 Overpack Aging Management Program

The Overpack Aging Management Program involves monitoring the exterior surface of each of the HI-STAR 100 overpacks for signs of degradation. A visual examination in accordance with the maintenance program described in Section 9.2.2 is performed annually. Additionally, a VT-3 inspection in accordance with ASME Code, Section XI, Article IWA-2213 is performed every 5 years.

Visual inspections will look for:

- Visual evidence of discontinuities, imperfections, and rust staining indicative of corrosion, SCC, and wear
- Visual evidence of loose or missing bolts, physical displacement, and other conditions indicative of loss of preload
- Visual evidence of coating degradation (e.g., blisters, cracking, flacking, delamination) indicative of corrosion of the base metal

Additionally, the Overpack Aging Management Program involves a shielding effectiveness test, following the same procedure as the test described in Table 9.2.1~~2~~, performed every 5 years.

The full description of the Overpack Aging Management Program is contained in Table 9.2.2.

9.2.7.2 ISFSI Pad Aging Management Program

The ISFSI Pad Aging Management Program involves monitoring the condition of the ISFSI pad. An annual inspection is performed in accordance with ACI-349. This visual inspection identifies the current condition of the pad and can identify the extent and cause of any aging effect noted. The acceptance criteria for this program are defined in ACI-349.3R-02.

The full description of the ISFSI Pad Aging Management Program is contained in Table 9.2.3.

9.2.7.3 Tollgates

Tollgates are established as requirements in the renewed CoC, and implemented by ISFSI generic licensees to evaluate aging management feedback and perform a safety assessment that confirms the safe storage of spent nuclear fuel. The impact of the aggregate feedback will be assessed by the site as it pertains to components at the site's ISFSI and actions taken as necessary, such as:

- Adjustment of aging-related degradation monitoring and inspection programs in AMPs
- Modification of TLAAs
- Performance of mitigation activities

Each tollgate assessment will address the following elements as applicable:

- Summary of research findings, operating experience, monitoring data, and inspection results made available since last assessment
- Aggregate impact of findings, including any trends
- Consistency of data with the assumptions and inputs in the TLAAs
- Effectiveness of AMPs
- Corrective actions, including any changes to AMPs
- Summary and conclusions

A schedule for these tollgate assessments is shown in Table 9.2.4.

Table 9.2.2

OVERPACK AGING MANAGEMENT PROGRAM

Element	**Description**
1. Scope of Program	The program covers the subcomponents of the HI-STAR 100 Overpack identified in Table 3.3-3 which require the HI-STAR 100 Overpack AMP, to operate into the extended storage period.
2. Preventative Actions	This AMP uses condition monitoring to manage aging effects. The design of the system is intended to minimize aging effects on the system, but this AMP focuses on condition monitoring. No new preventative actions are included in this AMP.
3. Parameters Monitored / Inspected	The condition of the exterior of each in-service cask is inspected visually to ensure the intended functions of the cask exterior are not compromised. Visual inspections will look for: • Visual evidence of discontinuities, imperfections, and rust staining indicative of corrosion, SCC, and wear • Visual evidence of loose or missing bolts, physical displacement, and other conditions indicative of loss of preload • Visual evidence of coating degradation (e.g., blisters, cracking, flacking, delamination) indicative of corrosion of the base metal
4. Detection of Aging Effects	<u>Readily Accessible Surfaces</u> *Annual Examination* A visual inspection of the exterior surface of the overpack provides a means to detect degradation of these components due to a potential loss of material and confirm that the intended functions are not compromised. This visual inspection shall be performed on all HI-STAR 100 casks annually. This inspection was required for the initial license period, per FSAR Table 9.2.1, so it is recommended that users follow their existing inspection procedures for these annual inspections. *5 Year Code Inspection* Once every 5 years, visual inspections are performed in accordance with ASME Code Section XI, Article IWA-2213, for VT-3 examinations, and cover all normally accessible surfaces on all casks. This visual inspection is conducted by a qualified individual. <u>Shielding Effectiveness</u> A shielding effectiveness test shall be performed every five years on each overpack. Calibrated neutron and gamma dose meters shall be used to measure the actual neutron and gamma dose rates at the surface of the HI-STAR overpack. Measurements will be taken at three cross-sectional planes and at four points along each plane's circumference. Additionally, four measurements shall be taken at the top of the overpack closure plate. The average results from each sectional plane shall be compared to the design basis limits for surface dose rates established in the HI-STAR 100 FSAR Chapter 5. This test was required for the initial license period, per FSAR Table 9.1.2 (although the frequency may have been different), so it is recommended that users follow their existing test

	procedures. Data Collection Data from the visual examinations and shielding effectiveness test shall be documented on a checklist or inspection form. The results of the inspection shall be documented, including descriptions of observed aging effects and supporting sketches, photographs, or video. Corrective actions resulting from each AMP inspection shall also be documented. Timing Annual external examinations and shielding effectiveness tests are continued from the initial period of operation. The first 5 year code inspection should be performed when the cask enters its period of extended operation. If the cask is already in its period of extended operation (due to timely renewal) or within 365 days of entering its period of extended operation when the renewed license is issued, the site has 365 days to complete the first 5 year code inspection from the issuance of the renewed license.
5. Monitoring and Trending	The inspections and tests described for external subcomponents of the HI-STAR 100 are performed periodically in order to identify areas of degradation. The visual inspection results will be evaluated by a qualified individual, and areas of degradation not meeting established criteria will be entered into the site Corrective Action Program (CAP) for resolution or more detailed evaluation. The shielding test results shall be compared to the acceptance criteria (described below), and results not meeting these criteria will be entered into the site CAP for resolution or more detailed evaluation. The results from both the visual inspection and shielding tests will be compared against previous inspections in order to monitor and trend the progression of the aging effects over time.
6. Acceptance Criteria	External Visual Inspection The acceptance criteria for the visual inspections are: • No detectable loss of material from the base metal, including uniform wall thinning, localized corrosion pits, and crevice corrosion • No red-orange-colored corrosion products on the base metal or coatings • No coating defects (e.g., blisters, cracking, flaking, delamination) • No indications of loose bolts or hardware, displaced parts If evidence of corrosion, wear, or coating degradation is identified, then the severity of the degradation must be determined using approved site-specific procedures. These may include additional visual, surface, or volumetric non destructive examination methods to determine the loss of material. Shielding Effectiveness Test The dose rate measurements described above shall be compared to the design basis limits for surface dose rates from the HI-STAR 100 FSAR Chapter 5. The test results are considered acceptable if the actual dose readings are lower or equal to the acceptance criteria in the Technical Specifications. If dose rates are higher than the Technical Specification limits, the required actions of the Technical Specifications shall be completed.

7. Corrective Actions	The corrective actions performed based on any detected aging effects are in accordance with the site's Quality Assurance (QA) program. The QA Program ensures that corrective actions are completed within the site's Corrective Action Program (CAP). As applicable, the CAP program will perform cause evaluations, address the extent of condition, determine any necessary actions to prevent recurrence, identify any changes to the existing AMP, and determine if the condition is reportable. The CAP program corrective actions will also identify the actions needing to be taken for increased scope or frequency of inspections, as necessary, based on any detected aging effects.
8. Confirmation Process	The confirmation process will be commensurate with the site QA Program. The QA program ensures that inspections, evaluations, and corrective actions are completed in accordance with the site CAP.
9. Administrative Controls	The site QA program and implementing procedures for this AMP will address instrument calibration and maintenance, inspector requirements, record retention requirements, and document control. This AMP will be updated periodically, as necessary, based on the toll gate assessments described in Chapter 4 of this application. Inspection results will be documented and made available for NRC inspectors to view upon request.
10. Operating Experience	<u>Previous Operating Experience</u> The sites have utilized the same HI-STAR 100 casks since they were initially loaded. Both the periodic visual inspections and periodic shielding effectiveness tests have not shown any aging related degradation of the system. <u>Future Operating Experience</u> As the inspections are performed, sites will upload information into the INPO AMID database to be shared with other users.

Table 9.2.3

ISFSI PAD AGING MANAGEMENT PROGRAM

Element	Description
1. Scope of Program	The program covers the subcomponents of the ISFSI Pad identified in Table 3.3.5 which require the ISFSI Pad AMP, to operate into the extended storage period.
2. Preventative Actions	This AMP uses condition monitoring to manage aging effects. The design of the ISFSI Pad is intended to minimize aging effects on the system, but this AMP focuses on condition monitoring. No new preventative actions are included in this AMP.
3. Parameters Monitored / Inspected	The ISFSI Pad exposed surfaces are visually examined for cracking, loss of material (spalling, scaling), loss of bond, and increased porosity/permeability. Degradation could affect the ability of the concrete pad to provide support to the casks over the period of extended storage. The pad itself does not have any safety function, but may impact the storage of the casks.
4. Detection of Aging Effects	The ISFSI Pad AMP is a visual inspection in order to detect any aging effects. The visual survey in accordance with ACI-349, should identify the source of any staining or corrosion-related activity and the degree of damage. This visual inspection identifies the current condition of the pad and can identify the extent and cause of any aging effect noted. This visual inspection is conducted every 5 years by a qualified individual. Timing The first ISFSI pad inspection should be performed when the first cask on the pad enters its period of extended operation. If the cask is already in its period of extended operation (due to timely renewal) or within 365 days of entering its period of extended operation when the renewed license is issued, the site has 365 days to complete the first 5 year code inspection from the issuance of the renewed license.
5. Monitoring and Trending	The inspection described for the ISFSI pad is performed periodically in order to identify areas of degradation. The results will be evaluated by a qualified individual, and areas of degradation not meeting established criteria will be entered into the site CAP for resolution or more detailed evaluation. The results will be compared against previous inspections in order to monitor and trend the progression of the aging effects over time.
6. Acceptance Criteria	American Concrete Institute Standard 349.3R-02 includes quantitative three-tier acceptance criteria for visual inspections of concrete surfaces, namely (1) acceptance without further evaluation, (2) acceptance after review, (3) acceptance requiring further evaluation. Acceptable signifies that a component is free of significant deficiencies or degradation that could lead to the loss of structural integrity. Acceptable after review signifies that a component contains deficiencies or degradation but will

	remain able to perform its design basis function until the next inspection or repair. Acceptance requiring further evaluation signifies that a component contains deficiencies or degradation that could prevent (or could prevent prior to the next inspection) the ability to perform their design basis function. Degradations or conditions meeting the ACI349.3R-02 Tier 2 and 3 criteria will be entered into the site's CAP for evaluation and resolution. Should the site determine there is a need to deviate from the ACI394.3R-02 acceptance criteria; a technical justification will be fully documented.
7. Corrective Actions	The corrective actions performed based on any detected aging effects are in accordance with the site's Quality Assurance (QA) program. The QA Program ensures that corrective actions are completed within the site's Corrective Action Program (CAP). As applicable, the CAP program will perform cause evaluations, address the extent of condition, determine any necessary actions to prevent recurrence, identify any changes to the existing AMP, and determine if the condition is reportable. The CAP program corrective actions will also identify the actions needing to be taken for increased scope or frequency of inspections, as necessary, based on any detected aging effects.
8. Confirmation Process	The confirmation process will be commensurate with the site QA Program. The QA program ensures that inspections, evaluations, and corrective actions are completed in accordance with the site CAP.
9. Administrative Controls	The site QA program and implementing procedures for this AMP will address instrument calibration and maintenance, inspector requirements, record retention requirements, and document control. This AMP will be updated periodically, as necessary, based on the toll gate assessments described in Chapter 4 of this application. Inspection results will be documented and made available for NRC inspectors to view upon request.
10. Operating Experience	<u>Future Operating Experience</u> As the ISFSI Pad inspections are performed, sites will upload information into the INPO AMID database to be shared with other users.

Table 9.2.4

TOLLGATES

Tollgate	Year	Assessment
1	Year of first canister loading + 25 years	Evaluate information from the following sources (as available) and perform a written assessment of the aggregate impact of the information, including but not limited to trends, corrective actions required, and the effectiveness of the AMPs with which they are associated: • Results, if any, of research and development programs focused specifically on aging-related degradation mechanisms identified as potentially affecting the storage system and ISFSI site. One example of such research and development would be EPRI Chloride-Induced Stress Corrosion Cracking (CISCC) research. • Relevant results of other domestic and international research, which may include non-nuclear research • Relevant domestic and international operating experience, which may include non-nuclear operating experience • Relevant results of domestic and international ISFSI and dry storage system performance monitoring
2	Maximum interval of 5 years since last tollgate	Evaluate additional information gained from the sources listed in Tollgate 1 along with any new relevant sources and perform a written assessment of the aggregate impact of the information. This evaluation should be informed by the results of Tollgate 1. The aging effects and mechanisms evaluated at this tollgate and the time at which it is conducted may be adjusted based on the results of the Tollgate 1 assessment.
3	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1 and 2
4	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, and 3
5	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, and 4
6	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, 4, and 5
7	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, 4, 5, and 6
8	Maximum interval of 5 years since last tollgate	Same as Tollgate 2 as informed by the results of Tollgates 1, 2, 3, 4, 5, 6, and 7

APPENDIX E: AGING MANAGEMENT CoC CHANGES

Note that these CoC changes are shown on only Amendment 3 as an example. The same wording will need to be added to each renewed certificate amendment.

NRC FORM 651
(3-1999)
10 CFR 72

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE FOR SPENT FUEL STORAGE CASKS

The U.S. Nuclear Regulatory Commission is issuing this Certificate of Compliance pursuant to Title 10 of the Code of Federal Regulations, Part 72, "Licensing Requirements for Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (10 CFR Part 72). This certificate is issued in accordance with 10 CFR 72.238, certifying that the storage design and contents described below meet the applicable safety standards set forth in 10 CFR Part 72, Subpart L, and on the basis of the Final Safety Analysis Report (FSAR) of the cask design. This certificate is conditional upon fulfilling the requirements of 10 CFR Part 72, as applicable, and the conditions specified below.

Certificate No.	Effective Date	Expiration Date	Docket No.	Amendment No.	Amendment Effective Date	Package Identification No.
1008	10/04/99	10/04/19	72-1008	3	TBD	USA/72-1008
	Renewed Effective Date	Renewed Expiration Date		Revision No.	Revision Effective Date	
	TBD	10/4/59		0	NA	

Issued To: (Name/Address)

Holtec International
Holtec Center
One Holtec ~~Drive~~Boulevard
~~Marlton~~Camden, NJ 08014~~53~~

Safety Analysis Report Title

Holtec International Inc., Final Safety Analysis Report for the HI-STAR 100 Cask System
Docket No. 72-1008

CONDITIONS

This certificate is conditioned upon fulfilling the requirements of 10 CFR Part 72, as applicable, the attached Appendix A (Technical Specifications) and Appendix B (Approved Contents and Design Features), and the conditions specified below:

1. CASK

   The HI-STAR 100 Cask System is certified as described in the Final Safety Analysis Report (FSAR) and in NRC's Safety Evaluation Report (SER) accompanying the Certificate of Compliance. It is designed for both storage and transfer of irradiated nuclear fuel.

   a. Model No.: HI-STAR 100 (MPC-24, MPC-32, MPC-68, MPC-68F)

      The HI-STAR 100 Cask System is comprised of the multi-purpose canister (MPC), which contains the fuel, and the overpack, which contains the MPC. The two digits after the MPC designate the number of reactor fuel assemblies for which the respective MPCs are designed. The MPC-24 is designed to contain up to 24 Pressurized Water Reactor (PWR) fuel assemblies. The MPC-32 is designed to contain up to 32 PWR fuel assemblies. The MPC-68 is designed to contain up to 68 Boiling Water Reactor (BWR) fuel assemblies. Any MPC-68 containing fuel assemblies with known or suspected defects, such as ruptured fuel rods, severed rods, loose fuel pellets, or which cannot be handled by normal means due to fuel cladding damage, is designated as MPC-68F. The MPC-24, the MPC-32, and the MPC-68 (including the MPC-68F) are identical in external dimensions and will fit into the same overpack design.

NRC FORM 651A (3-1999) 10 CFR 72

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE FOR SPENT FUEL STORAGE CASKS

Supplemental Sheet

Certificate No. 1008
Amendment No. 3

1. b. Description

The complete HI-STAR 100 Cask System for storage of spent nuclear fuel is comprised of two discrete components: the MPC and the storage/transport overpack. The HI-STAR 100 CASK System consists of interchangeable MPCs which constitute the confinement boundary for BWR or PWR spent nuclear fuel and an overpack which provides the helium retention boundary, gamma and neutron radiation shielding, and heat rejection capability. All MPCs have identical exterior dimensions which render them interchangeable. A single overpack design is provided which is capable of storing each type of MPC.

The HI-STAR 100 MPCs are welded cylindrical structures with flat ends. Each MPC is an assembly consisting of a honeycombed fuel basket, a baseplate, canister shell, a lid, and a closure ring. The outer diameter and cylindrical height of each MPC is fixed. However, the number of spent nuclear fuel storage locations in each of the MPCs depends on the fuel assembly characteristics. The MPC provides the confinement boundary for the stored fuel. The confinement boundary is a seal-welded enclosure constructed entirely of a stainless steel alloy. The inner surfaces of the HI-STAR 100 overpack form an internal cylindrical cavity for housing the MPC. The outer surface of the overpack inner shell is buttressed with intermediate shells of gamma shielding.

The fuel transfer and auxiliary equipment necessary for Independent Spent Fuel Storage Installation operation are not included as part of the HI-STAR 100 Cask System reviewed for a Certificate of Compliance under 10 CFR Part 72, Subpart L. Such equipment may include, but is not limited to, special lifting devices, transfer trailers or equipment, and vacuum drying/helium leak test equipment.

2. OPERATING PROCEDURES

Written operating procedures shall be prepared for cask handling, loading, movement, surveillance, and maintenance. The user's site-specific written operating procedures shall be consistent with the technical basis described in Chapter 8 of the SAR.

3. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Written cask acceptance tests and maintenance program shall be prepared consistent with the technical basis described in Chapter 9 of the SAR.

4. QUALITY ASSURANCE

Activities in the areas of design, procurement, fabrication, assembly, inspection, testing, operation, maintenance, repair, modification of structures, systems and components, and decommissioning that are important to safety shall be conducted in accordance with a Commission-approved quality assurance program which satisfies the applicable requirements of 10 CFR Part 72, Subpart G, and which is established, maintained, and executed with regard to the cask system.

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CERTIFICATE OF COMPLIANCE FOR SPENT FUEL STORAGE CASKS
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5. HEAVY LOADS REQUIREMENTS

Each lift of a HI-STAR 100 spent fuel cask must be made in accordance with the existing heavy loads requirements and procedures of the licensed facility in which the lift is made. A plant-specific safety review (in accordance with 10 CFR 50.59 or 10 CFR 72.48, if applicable) is required to show operational compliance with existing plant-specific heavy loads requirements.

6. APPROVED CONTENTS

Contents of the HI-STAR 100 Cask System must meet the fuel specifications given in Appendix B to this certificate.

7. APPROVED DESIGN FEATURES

Features or characteristics for the site or cask must be in accordance with Appendix B to this certificate.

8. CHANGES TO THE CERTIFICATE OF COMPLIANCE

The holder of this certificate who desires to make changes to the certificate, which includes Appendix A (Technical Specifications) and Appendix B (Approved Contents and Design Features), shall submit an application for amendment of the certificate.

9. AUTHORIZATION

The HI-STAR 100 Cask System, which is authorized by this certificate, is hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to 10 CFR 72.210, subject to the conditions specified by 10 CFR 72.212, and the attached Appendix A and Appendix B.

10. FSAR UPDATE FOR RENEWED COC

The CoC holder shall submit an updated FSAR to the Commission, in accordance with 10 CFR 72.4, within 90 days of the effective date of the renewal. The updated FSAR shall reflect the changes and CoC holder commitments resulting from the review and approval of the renewal of the CoC. The CoC holder shall continue to update the FSAR pursuant to the requirements of 10 CFR 72.248.

11. 72.212 EVALUATIONS FOR RENEWED COC USE

Any general licensee that initiates spent fuel dry storage operations with the HI-STAR 100 system after the effective date of the renewal of the CoC and any general licensee operating a HI-STAR 100 system as of the effective date of the renewal of the CoC, including those that put additional storage systems into service after that date, shall:

a. as part of the evaluations required by 10CFR72.212(b)(5), include the evaluations related to the terms, conditions, and specifications of this CoC amendment as modified (i.e., changed or added) as a result of the renewal of the CoC;

b. as part of the document review required by 10CFR72.212(b)(6), include a review of the FSAR changes resulting from the renewal of the CoC; and

c. ensure that the evaluations required by 10CFR72.212(b)(7) and (8) capture the evaluations and review described in (a.) and (b.) of this CoC condition.

12. AMENDMENTS AND REVISIONS FOR RENEWED COC

All future amendments and revisions to this CoC shall include evaluations of the impacts to aging management activities (i.e. time-limited aging analyses and aging management programs) to assure they remain adequate for any changes to SSCs within the scope of renewal.

FOR THE U. S. NUCLEAR REGULATORY COMMISSION

Division of Spent Fuel Management
Office of Nuclear Material Safety and Safeguards

Attachments:
1. Appendix A
2. Appendix B

3.0 ADMINISTRATIVE CONTROLS AND PROGRAMS

The following programs shall be established, implemented, and maintained.

3.1 Deleted

3.2 Deleted

3.3 Deleted

3.4. Radioactive Effluent Control Program

This program implements the requirements of 10 CFR 72.44(d).

a. The HI-STAR 100 Cask System does not create any radioactive materials or have any radioactive waste treatment systems. Therefore, specific operating procedures for the control of radioactive effluents are not required. Specification 2.1.1, Multi-Purpose Canister (MPC), provides assurance that there are no radioactive effluents from the SFSC.

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

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

3.5 Aging Management Program Procedures ~~and Reporting~~

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

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

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