Enclosure 3 to E-39887

Certificate of Compliance Renewal Application for the Standardized NUHOMS® System, Certificate of Compliance No. 1004 (Docket No. 72-1004), Revision 0 (Public Version)

NON-PROPRIETARY

Certificate of Compliance Renewal Application for the Standardized NUHOMS® System

Certificate of Compliance No. 1004

(Docket No. 72-1004)

Prepared by:

AREVA TN Americas, an operating division of AREVA Inc.
Columbia, Maryland

Revision 0

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Contents

Acronym List
(4 pages)

Acronym	Definition
ACI	American Concrete Institute
AH	Absolute Humidity
AHSM	Advanced Horizontal Storage Module
AMA	Aging Management Activity
AMP	Aging Management Program
AMR	Aging Management Review
ANSI	American National Standards Institute
APSRA	Axial Power Shaping Rod Assembly
AR	Action Report
ASME	American Society of Mechanical Engineers
ASR	Alkali-Silica Reaction
ASSO	Alternate Shifted Shielding Option
ASTM	American Society for Testing and Materials
B&W	Babcock and Wilcox
BLEU	Blended Low-Enriched Uranium
BPRA	Burnable Poison Rod Assembly
BSPA	Bottom Shield Plug Assembly
BWR	Boiling Water Reactor
CAD	Computer-Aided Design
CAR	Corrective Action Report
CASTNET	Clean Air Status and Trends Network
CDP	Cask Demonstration Project
CE	Combustion Engineering
CFD	Computational Fluid Dynamics
CGR	Crack Growth Rate
CISCC	Chloride-Induced Stress Corrosion Cracking
CMTR	Certified Material Test Report
CoC	Certificate of Compliance
CR	Condition Report
CRA	Control Rod Assembly
CRIEPI	Central Research Institute of Electric Power Industry
CSAR	Certified Safety Analysis Report
DBTT	Ductile-to-Brittle Transition Temperature
DBT	Design Basis Tornado

Acronym List
(4 pages)

Acronym	Definition
DCS	Dry Cask Storage
DFI	Demand for Information
DWH	Dead Weight
DRH	Deliquescence Relative Humidity
DO	Discrete Ordinates
DOE	Department of Energy
DOT	Department of Transportation
DSC	Dry Shielded Canister
ECCS	Emergency Core Cooling System
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
FA	Fuel Assembly
FEM	Finite Element Model
GE	General Electric
HAZ	Heat Affected Zone
HBU	High Burnup
HDRP	High Burnup Dry Storage Cask Research and Development Project
HLZC	Heat Load Zone Configuration
HSM	Horizontal Storage Module
ID	Inner Diameter
IFA	Irradiated Fuel Assembly
IFI	Inspector Follow-up Item
IGSCC	Intergranular Stress Corrosion Cracking
IN	Information Notice
INL	Idaho National Laboratory
INPO	The Institute of Nuclear Power Operations
IR	Inspection Report
ISFSI	Independent Spent Fuel Storage Installation
ISG	Interim Staff Guidance
ITS	Important-to-Safety
KSC	Kennedy Space Center
LPI	Liquid Penetrant Inspection
LR	Licensing Review
MCNP	Monte Carlo N-Particle

Acronym List
(4 pages)

Acronym	Definition
MMC	Metal Matrix Composite
MT	Magnetic Particle Examination
NAP	Neutron Absorbing Plates
NCR	Non-Conformances Report
NDE	Non-Destructive Examination
NITS	Not Important-to-Safety
NOAA	National Oceanic and Atmospheric Administration
NPP	Nuclear Power Plant
NRC	U.S. Nuclear Regulatory Commission
NSA	Neutron Source Assembly
NSP	Neutron Shield Panels
OD	Outer Diameter
ODSCC	Outer Diameter Stress Corrosion Cracking
OE	Operating Experience
ORA	Orifice Rod Assembly
OTCP	Outer Top Cover Plate
PCI	Precast/Prestressed Concrete Institute
PLSA	Partial Length Shield Assembly
PNFS	Pacific Nuclear Fuel Services, Inc.
ppm	Parts Per Million
PRA	Poison Rod Assembly
psu	Practical Salinity Units
PT	Penetrant Testing
PTZ	Pan Tilt Zoom
PWR	Pressurized Water Reactor
RCCA	Rod Cluster Control Assembly
RG	Regulatory Guide
RH	Relative Humidity
RP	Radiation Protection
SAR	Safety Analysis Report
SCC	Stress Corrosion Cracking
SE	Safety Evaluation
SER	Safety Evaluation Report
SFA	Spent Fuel Assembly

Acronym List
(4 pages)

Acronym	Definition
SI	International System of Units
SIF	Stress Intensity Factor
SONGS	San Onofre Nuclear Generating Station
SRP	Standard Review Plan
SRS	Safety Review Screening
SSC	Structure, System, and Component
SST	Shear Stress Transport
TAD	Transportation Aging and Disposal Project
TC	Transfer Cask
TEDE	Total Effective Dose Equivalent
TGA	Top Grid Assembly
TGSCC	Transgranular Stress Corrosion Cracking
TLAA	Time-Limited Aging Analysis
TMI-2	Three Mile Island, Unit 2
TN	Transnuclear Inc.
TNW	Transnuclear West, Inc.
TPA	Thimble Plug Assembly
TS	Technical Specifications
TWC	Through-Wall Cracking
UDF	User-Defined Functions
UFSAR	Updated Final Safety Analysis Report
UT	Ultrasonic Testing
UTS	Ultimate Tensile Stress
VSI	Vibration Suppression Insert
VT	Visual Testing
WE	Westinghouse
ZPA	Zero Period Acceleration

CHAPTER 1
General Information

CONTENTS

LIST OF TABLES

1.1 Introduction

The Standardized NUHOMS® System Certificate of Compliance (CoC) No. 1004, Revision 0 [1.5.3] was approved by the NRC on January 23, 1995, for storage of spent nuclear fuel by general licensees. The expiration date for CoC 1004 is January 23, 2015. As the certificate holder of CoC 1004, AREVA Inc., is applying for a renewal of CoC 1004 for a term of 40 years, in accordance with 10 CFR 72.240(a) [1.5.1].

This application for CoC 1004 renewal includes the Safety Analysis Report (SAR) information required by 10 CFR 72.240(c). The SAR content of this application is based on the guidance provided in NUREG-1927 [1.5.2].

In accordance with NUREG-1927 [1.5.2], this renewal application is based "on the continuation of the existing licensing basis throughout the period of extended operation and on the maintenance of the intended safety functions of the structures, systems, and components (SSCs) important to safety." The existing licensing basis consists primarily of the following:

a. The Updated Final (or as named for a particular amendment) Safety Analysis Reports corresponding to each approved amendment—See References section in Appendices 1A through 1J,

b. The CoC 1004 and Technical Specifications (TS) for each approved amendment— See References section in Appendices 1A through 1J,

c. Safety Evaluation Reports (SERs) issued for each approved amendment—See References section in Appendices 1A through 1J,

d. Docketed Licensing Correspondence, as applicable—See References section in Appendices 1A through 1J.

1.2 Standardized NUHOMS® System Description

1.2.1 General System Description

The Standardized NUHOMS® System is a modular canister-based system for the dry storage of irradiated spent fuel assemblies (SFAs) consisting of a dry shielded canister (DSC) and a reinforced concrete horizontal storage module (HSM). Additional SSCs include an onsite transfer cask (TC) and other fuel transfer and auxiliary equipment used to support DSC loading and transfer operations.

The following paragraphs provide an overview of the Standardized NUHOMS® System. A more complete system description, including supporting design basis, is contained in the Updated Final Safety Analysis Report (UFSAR), Revision 14 [1.5.7].

1.2.2 Principal Components of the Standardized NUHOMS® System

1.2.2.1 Dry Shielded Canister

The DSC consists of the shell assembly and the internal basket assembly. The shell assembly is a high integrity stainless steel welded pressure vessel that provides confinement of radioactive materials, encapsulates the fuel in an inert atmosphere (the canister is back-filled with helium before being seal-welded closed), and provides radiological shielding (in the axial direction). The shell assembly consists of a cylindrical shell and the top and bottom end assemblies, which form the pressure retaining confinement boundary for the spent fuel.

The DSC has double, redundant seal welds that join the shell and the top and bottom end assemblies to form the confinement boundary. The bottom end assembly confinement boundary welds are made during fabrication of the DSC. The top end assembly confinement boundary welds are made after fuel loading. Both top plug penetrations (siphon and vent ports) are redundantly sealed after DSC drying operations are complete. The DSC shell assembly also includes a shield plug at both top and bottom ends to minimize occupational doses during drying, sealing, and handling operations.

The internal basket assembly contains a storage position for each fuel assembly. The basket assembly may consist of an assemblage of spacer discs supported on vertical rods (spacer disc design) or an assemblage of individual tubes or a grid of plates (tube or plate grid design).

The 24P, 24PT2, 24PHB, and 52B DSCs use the spacer disc basket design. In this design, structural support for the fuel assemblies in the lateral direction is provided by circular spacer disc plates. Axial support of the basket assembly is provided by support rods that are either welded to the spacer discs or preloaded to maintain each spacer disc in place using spacer sleeves in between spacer discs. The support rods extend over the full length of the DSC cavity and bear on the canister top and bottom end assemblies. Subcriticality is maintained through the geometric separation of the fuel assemblies by the DSC basket assembly and the neutron absorbing capability of the DSC materials of construction. The 52B DSC contains fixed neutron absorber material for additional criticality control.

The 61BT, 32PT, 24PTH, 61BTH, 32PTH1, 69BTH, and 37PTH DSCs use the tube or plate grid basket design. The basket structures for these DSCs consist of assemblies of stainless steel fuel compartments made up of individual tubes or plates welded to form a grid-like structure. Fixed neutron absorber material provides the necessary criticality control. Aluminum sheets/plates are used to provide the heat conduction paths from the fuel assemblies to the canister shell. Transition rails, consisting of welded stainless steel plates or aluminum parts, form the transition between the box like fuel compartment structure and the cylindrical DSC shell.

The DSC shell assembly is designed and fabricated in accordance with the provisions of the ASME Code, Section III, Division 1, Subsection NB [1.5.10, 1.5.11, 1.5.12], with certain code alternatives as described in the UFSAR [1.5.7]. The basket assembly is designed and fabricated in accordance with the provisions of ASME Code, Section III, Division 1, Subsections NF and/or NG (depending on the specific basket design) [1.5.10, 1.5.11, 1.5.12], with certain code alternatives as described in the UFSAR [1.5.7].

1.2.2.2 Horizontal Storage Module

The HSM is a low profile, modular, reinforced concrete structure whose primary functions are to provide a means for passively removing spent fuel decay heat, provide structural support and environmental protection to the loaded DSC, and provide radiation shielding protection. Heat removal is achieved by a combination of radiation, conduction, and convection. Ambient air enters the HSM through ventilation inlet openings located in the lower region of the front or side walls and circulates around the DSC. Air exits through outlet openings in the top regions of the HSM walls. Thermal monitoring or visual inspections are used to provide indication of HSM performance or a blocked vent condition. Structural support of the loaded DSC is provided by a structural steel frame structure (HSM model 80 and model 102) anchored to the floor slab and walls of the HSM, or a structural steel rail assembly (HSM models HSM-H, -152, -202, and HSM-HS). Environmental protection and radiation shielding is provided by massive thick side walls and roof of the HSM, supplemented by thick wall units attached at the ends of the array and at the rear walls of the HSM if the array is of single row configuration.

The HSM is designed in accordance with the rules of ACI-349 [1.5.13] and constructed in accordance with ACI-318 [1.5.8].

1.2.2.3 Onsite Transfer Cask

The onsite TC is a non-pressure retaining cylindrical vessel with a welded bottom assembly and a bolted lid. The TC is designed for onsite transfer of the DSC to and from the plant's spent fuel pool and the independent spent fuel storage installation (ISFSI). The TC provides the shielding and heat rejection mechanism for the DSC and SFAs during handling in the fuel or reactor building, DSC closure operations, transfer to the ISFSI, and insertion into the HSM. The TC also provides primary protection for the loaded DSC during off-normal and drop accident events postulated to occur during the transfer operations.

There are five alternate configurations of the TC. The first configuration, where the TC is provided with a solid neutron shield, is denoted as the "Standardized Cask." The second configuration, where a liquid neutron shield is provided instead, is designated as the OS197 TC and OS197H TC. The third configuration, designated as OS197FC/OS197H FC, or OS197FC-B/OS197HFC-B, is a modified version of the OS197/OS197H, equipped with a modified top lid to allow air circulation through the TC/DSC annulus. This option is required for high heat loads when established time limits to complete the transfer operations are not met. The fourth configuration, designated as OS197L TC, is a reduced weight version of the OS197 TC. Because of its reduced shielding capability, the OS197L TC relies on the use of supplemental shielding to provide radiological shielding in conjunction with remote operations during handling in the fuel or reactor building, transfer to the ISFSI, and insertion into the HSM operations. The fifth configuration is designated as OS200/OS200FC TC. This is a larger diameter TC designed to accommodate the larger diameter 32PTH1, 69BTH, and 37PTH DSCs. The OS200/OS200FC TC, when provided with an aluminum internal sleeve, may also be used for onsite transfer of the smaller diameter 61BT, 32PT, 24PTH, and 61BTH DSCs.

The Standardized TC, OS197, OS197H, OS197FC, OS197FC-B, and OS200/OS200FC TCs are constructed from three concentric cylindrical shells to form an inner and outer annulus. The inner annulus is filled with cast lead to provide gamma shielding. The outer annulus forms a steel jacket that is filled with a hydrogen rich solid material or water for neutron shielding. The two inner shells are welded to heavy forged ring assemblies at the top and bottom ends of the TC. Rails fabricated from a non-galling, wear resistant material coated with a high contact pressure dry film lubricant are provided to facilitate DSC transfer.

The OS197L TC is constructed from a single, thicker structural shell in lieu of the concentric inner liner and outer structural shell with lead shielding in the annular space in the OS197 TC. To compensate for the lack of lead shielding, the OS197L TC requires the use of supplemental shielding in conjunction with remote operations and use of optical targets. The supplemental shielding consists of a thick carbon steel upper shielding bell and a lower shielding sleeve that enclose the TC in the decontamination area, and thick carbon steel plates/covers, which are attached to or supported by the transfer trailer skid and, which enclose the TC while on the transfer trailer.

Two trunnion assemblies are provided in the upper region of the TC for lifting of the TC inside the plant's fuel or reactor building, and for supporting the TC on the skid for transfer to and from the ISFSI. An additional pair of trunnions in the lower region of the TC is used to position the TC on the support skid, serve as the rotation axis during down-ending of the TC, and provide support for the bottom end of the TC during transfer operations. Neither the TC nor the trunnions are special lifting devices per ANSI N14.6 [1.5.9]. Nonetheless, a one-time pre-service load test of the trunnions is performed at a load equal to 150% of the design load, followed by an examination of all accessible trunnion welds. The upper lifting trunnions and trunnion sleeves are conservatively designed in accordance with the ANSI N14.6 stress allowables for a non-redundant lifting device.

The TC is designed and fabricated in accordance with the applicable portions of the ASME Code, Section III, Division 1, Subsection NC [1.5.10, 1.5.11, 1.5.12] for Class 2 vessels.

1.2.2.4 Other Structures, Systems, and Components

Spent Fuel Assemblies

The Standardized NUHOMS® System is designed to store pressurized water reactor (PWR) and boiling water reactor (BWR) spent fuel assembly (SFA) types as authorized contents per the TS [1.5.5].

Fuel Transfer and Auxiliary Equipment

The Standardized NUHOMS® System is provided with the following auxiliary equipment for fuel handling and transfer inside the reactor/fuel building and at the ISFSI:

- TC lifting yoke
- DSC automatic welding machine to enable sealing the DSC top end
- Vacuum drying system to drain and vacuum dry the DSC cavity following loading of SFAs into the DSC
- Transfer trailer equipped with a TC skid to support the TC during transfer and a skid positioning system

- Hydraulic ram system for insertion and withdrawal of a loaded DSC into and from an HSM

The yoke design used for TC handling is a non-redundant, two-point lifting device with a single pinned connection to the crane hook. Thus, the yoke balances the TC weight between the two trunnions and has sufficient margin for any minor eccentricities in the TC vertical center of gravity that may occur. The yoke and other lifting devices are designed and fabricated to meet the requirements of ANSI N14.6 [1.5.9]. The test load for the yoke and other lifting devices is 300% of the design load, with annual dimensional and liquid penetrant or magnetic particle inspection, to meet ANSI N14.6 requirements.

ISFSI Basemat and Approach Slab

The HSM is installed on a load-bearing foundation, which consists of a reinforced concrete pad on a subgrade suitable to support the loads. There are no structural connections or means to transfer shear between the HSM base unit module and the concrete basemat. The approach slab is a reinforced concrete slab that provides access and support to the DSC transfer system. The concrete basemat and the approach slab are classified as not important-to-safety as they are not relied upon to provide safety functions.

1.3 Background

The Standardized NUHOMS® System, originally approved in January 1995, has evolved with time via approval of 12 amendments to the original CoC 1004. Each of these amendments has been designed to accommodate the evolving needs of the industry to store spent PWR or BWR fuel that is intact or damaged, or in a failed condition while having characteristics such as high decay heat loads, high U-235 enrichments, and high burnup levels.

A listing of the approved CoC 1004 Amendments is provided in Table 1-1. This table provides (a) a brief description of the scope of each amendment and an overview of the timeline when each amendment was approved, (b) a listing of the Final Safety Analysis Report (FSAR) appendix or chapter where the licensing basis of a specific amendment is located, and (c) a cross-reference to the FSAR revision that incorporated that amendment. Table 1-1 also provides a mapping between the various amendments and Appendices 1A through 1J.

1.4 Application Format and Content

This application includes SAR information required by 10 CFR 72.240 (c) [1.5.1]. The format and content of this SAR information is consistent with the guidance contained in NUREG-1927 [1.5.2]. In addition, consistent with Appendix A of the proposed NEI supplemental guidance [1.5.6], a new Chapter 4, as described below, is included with this application.

General Information: Chapter 1 provides (1) a general description of the Standardized NUHOMS® System, (2) a discussion of CoC 1004 Amendments, and (3) information on the format and content of this application.

Scoping Evaluation: Chapter 2 provides a description of the methodology used to identify the SSCs of the Standardized NUHOMS® System that are within the scope of the renewal. This methodology is based on the two-step process described in NUREG-1927 [1.5.2]. Chapter 2 also provides a summary of the results of the scoping evaluation based on Revision 14 of the UFSAR [1.5.7], which incorporates the most recently approved Amendment 13.

Aging Management Review: Chapter 3 provides the methodology used for the aging management review (AMR) of the Standardized NUHOMS® System, based on the guidance provided in NUREG-1927 [1.5.2]. The AMR documented in Chapter 3 identifies the materials and environment for those SSCs and associated subcomponents determined to be within the renewal scope in Chapter 2. This is accomplished by reviewing the drawings and the design basis included in the current UFSAR [1.5.7], CoC Amendment 13 [1.5.4], and associated TS [1.5.5]. Once the component material/environment combinations are determined, potential aging effects requiring management are identified and evaluated based on engineering literature, related industry research information, and existing operating experience (OE). Chapter 3 also provides a summary of the OE accumulated over the last 20 years for the Standardized NUHOMS® System. The information gleaned from this OE is used to identify potential aging effects that require management.

Aging Management Tollgates: As described in [1.5.6], tollgates are requirements included in the renewed CoC and associated UFSAR for the general licensee to perform and document an assessment of the aggregate impact of aging-related OE, research, monitoring, and inspections at specific points in time during the period of extended operation. Chapter 4 described the proposed tollgates for CoC 1004.

After potential effects are identified, it is determined whether they can be addressed by analysis (TLAA), or will require an AMP. Appendix 3 provides a description and results of the TLAAs and other supplemental evaluations prepared for the in-scope SSCs. If a TLAA does not adequately manage the identified aging effect on an in-scope SSC for the period of extended operation, the affected SSC is included in an aging management program (AMP) described in Appendix 6 of this application. The AMP is designed to ensure that no identified aging effect results in a loss of intended design function of the in-scope SSCs for the term of the renewal.

Chapter 1, Appendices 1A through 1J: Appendix 1A through 1J represents a "mini-SAR" application for the renewal of CoC 1004, Amendment 0 through Amendment 11, and Amendment 13. Each Appendix addresses all the information required by 10 CFR 72.240 (c) for the subject Amendment. This includes (a) a brief description of the SSCs approved by each Amendment, (b) scoping evaluation of SSCs and associated subcomponents to determine in-scope SSCs, (c) AMR results of in-scope SSCs (including TLAA results and a listing of applicable AMPs), and (d) fuel retrievability.

The results of the scoping evaluation and AMR are summarized in a Table for each SSC and its associated subcomponents in Chapter 1, Appendix 1A through 1J.

In accordance with the guidance provided in Section 1.4.4 of NUREG-1927 [1.5.2], all significant changes implemented to the Standardized NUHOMS® System under the provision of 10 CFR 72 (or Condition 9 of CoC 1004 prior to approval of the 10 CFR 72.48 rule) have been listed in each Chapter 1 appendix, along with a listing of the updated UFSAR drawings applicable to each amendment.

Each Chapter 1 appendix also provides an overview of the DSCs loaded under each amendment, along with pertinent information of the contents of each DSC such as the highest fuel assembly burnup, highest fuel assembly enrichment, minimum cooling time, maximum calculated heat load of the loaded DSC and the date when the DSC was loaded.

Chapter 2, Appendices 2A through 2E: Based on a review of Revision 14 of the UFSAR [1.5.7], detailed scoping evaluation results at the subcomponent and subcomponent part level are presented in Appendix 2A (for DSCs), Appendix 2B (for HSMs), Appendix 2C (for TCs), and Appendix 2D (for SFAs). The scoping results as presented in Appendices 2A, 2B, and 2C represent a consolidated scoping evaluation of the storage system as currently configured and also identify the current revision of the source drawings as contained in the current revision of the UFSAR. The source drawings upon which these detailed scoping tables are based are summarized in Appendix 2E.

Chapter 3, Appendices 3A through 3N: As discussed above, Appendix 3A through 3N provide a summary of the various TLAAs and other supplemental evaluations prepared for the SSCs of the Standardized NUHOMS® System.

Appendix 4: This appendix summarizes the AREVA approach to meet the intent of the NUREG-1927 Appendix E guidance on lead canister inspections. AREVA did not perform a lead canister inspection prior to the renewal submittal. Instead, credit is taken from previous NUHOMS®-based lead canister and baseline inspections of systems approved under site-specific licenses. These systems are similar to those approved in CoC 1004.

Appendix 5: This appendix presents the results of the chloride-induced stress corrosion cracking (CISCC) on the DSC exterior surfaces fabricated from austenitic stainless steel.

Appendix 6: This appendix presents the AMP in support of CoC 1004 renewal.

Attachment A: This attachment provides the recommended changes to the UFSAR for CoC 1004 renewal.

Attachment B: This attachment provides the recommended changes to the CoC 1004 TS for CoC 1004 renewal.

1.5 References (Chapter 1, General Information)

1.5.1 U.S. Nuclear Regulatory Commission, 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste," Code of Federal Regulations.

1.5.2 U.S. Nuclear Regulatory Commission, NUREG-1927, Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance, Final Report, March 2011.

1.5.3 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks," Certificate No. 1004, Revision 0, January 23, 1995, Docket No. 72-1004.

1.5.4 U.S. Nuclear Regulatory Commission," Certificate of Compliance for Spent Fuel Storage Casks," Certificate No. 1004, Amendment No. 13, Effective May 24, 2014, Docket No. 72-1004.

1.5.5 Technical Specifications for the Standardized NUHOMS® Horizontal Storage System, Certificate of Compliance No. 1004, Amendment No. 13, May 24, 2014, Docket No. 72-1004.

1.5.6 NEI 14-03, "Guidance for Operations-Based Aging Management for Dry Cask Storage," Nuclear Energy Institute, September 2014.

1.5.7 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

1.5.8 American Concrete Institute, "Building Code Requirement for Reinforced Concrete," ACI-318, 1983.

1.5.9 ANSI N14.6-1993, "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More for Nuclear Materials," American National Standards Institute, Inc., New York, New York.

1.5.10 ASME B&PV Code, Section III, Division 1, 1983 Edition with Winter 1985 Addenda.

1.5.11 ASME B&PV Code, Section III, Division 1, 1998 Edition Addenda through 2000.

1.5.12 ASME B&PV Code, Section III, Division 1, 2004 Edition with Addenda through 2006.

1.5.13 American Concrete Institute, "Code Requirements for Nuclear Safety Related Concrete Structures and Commentary," ACI-349, 1985 and ACI-349, 1997 Editions.

Table 1-1
Listing of CoC 1004 Amendments
(3 pages)

Amendment No.	Amendment Approval Date	Description	Location of Supporting Licensing Basis within the FSAR	FSAR Revision	CoC 1004 Renewal Appendix
0	1/23/1995	Initial approval to store spent fuel in the Standardized NUHOMS® System.	Main FSAR Body and Appendices A through G	3A and 4A	1A
1	4/27/2000	Transfer of CoC from VECTRA Technologies, Inc., to Transnuclear West Inc.	-	5	1B
2	9/5/2000	Addition of fuel qualification tables for authorized PWR and BWR fuel. Addition of burnable poison rod assemblies (BPRAs) to the authorized content of 24P DSCs.	Chapter 3, Appendix H, and Appendix J	5	1B
3	9/12/2001	Addition of the NUHOMS®-61BT DSC to the contents of the Standardized NUHOMS® System.	Appendix K	6	1C
N/A[(1)]	N/A	Addition of the NUHOMS®-24PT2 DSC to the contents of the Standardized NUHOMS® System.	Appendix L	6	1C
4	2/12/2002	Addition of low burnup fuel to the contents of the NUHOMS®-24P DSC.	Chapter 3	7	1D
5	1/7/2004	Addition of the NUHOMS®-32PT DSC to the Standardized NUHOMS® System.	Appendix M	8	1E
6	12/22/2003	Addition of the NUHOMS®-24PHB DSC to the Standardized NUHOMS® System.	Appendix N	8	1E
7	3/2/2004	Addition of damaged fuel to the contents of the NUHOMS®-61BT DSC.	Appendix K	8	1E

Table 1-1
Listing of CoC 1004 Amendments
(3 pages)

Amendment No.	Amendment Approval Date	Description	Location of Supporting Licensing Basis within the FSAR	FSAR Revision	CoC 1004 Renewal Appendix
8	12/5/2005	Addition of the NUHOMS®-24PTH System to the Standardized NUHOMS® System. Revision of the authorized contents of the 32PT DSC to include low enrichment and reconstituted fuel. Revision of the authorized contents of the 24PHB DSC to include additional fuel types.	Appendix P Appendix M Appendix N	9 9 9	1F
N/A(1)	N/A	Addition of an alternate version of the HSM, designated as HSM Model 152, to the Standardized NUHOMS® System.	Appendix R	9	1F
9	4/17/2007	Addition of FANP9 fuel to the contents of the 61BT DSC.	Appendix K	10	1G
N/A(1)	N/A	Addition of HSM Model 202 to the Standardized NUHOMS® System.	Appendix V	10	1G
10	8/24/2009	Addition of Control Components to the contents of the 32PT DSC. Addition of WE 15x15 partial length shield assemblies to the contents of the 24PTH DSC. Addition of 61BTH System to the Standardized NUHOMS® System. Addition of 32PTH1 System to the Standardized NUHOMS® System.	Appendix M Appendix P Appendix T Appendix U	11, 12	1H
11	1/7/2014	Addition of the OS197L TC to the Standardized NUHOMS® System.	Appendix W	13	1I
12	N/A	An application for Amendment 12 was submitted on September 11, 2009, associated with the U.S. Department of Energy Transportation Aging and Disposal (TAD) project. The amendment application was docketed, but was returned un-reviewed due to a lack of funding.	N/A	N/A	N/A

Table 1-1
Listing of CoC 1004 Amendments
(3 pages)

Amendment No.	Amendment Approval Date	Description	Location of Supporting Licensing Basis within the FSAR	FSAR Revision	CoC 1004 Renewal Appendix
13	5/24/14	Addition of the 69BTH System to the Standardized NUHOMS® System. Addition of the 37PTH System to the Standardized NUHOMS® System.	Appendix Y Appendix Z	14	IJ

Note:

(1) Added pursuant to 10 CFR 72.48

CHAPTER 2
SCOPING EVALUATION

CONTENTS

LIST OF TABLES

2.1 Introduction

Chapter 2 describes the evaluation process and methodology used to identify the structures, system, and components (SSCs) of the Standardized NUHOMS® System that are within the scope of renewal.

In accordance with the guidance contained in NUREG-1927, “Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance” [2.4.1], the first step of the renewal process is the performance of a scoping evaluation. The objective of the scoping evaluation is to identify the SSCs of the Standardized NUHOMS® System that are within the scope of renewal. The second step is the aging management review (AMR) whereby the SSCs that are identified to be within the scope of renewal are subsequently subjected to evaluation for potential degradation due to aging effects.

A description of the scoping process and methodology is provided in Section 2.2. The results of the scoping evaluation are provided in Section 2.3.

2.2 Scoping Evaluation Process and Methodology

This section describes the scoping evaluation process and methodology used to determine the SSCs and associated subcomponents and subcomponents parts that are within the scope of renewal. The scoping evaluation is performed based on the two-step process described in NUREG-1927 [2.4.1]. The first step is a screening evaluation to determine which SSCs are within the scope of the renewal. In accordance with the NUREG-1927 [2.4.1] guidance, SSCs are considered to be within the scope of the renewal, if they satisfy either of the following criteria:

Criterion 1: The SSC is classified as important-to-safety (ITS) as it is relied on to perform one of the following functions (10 CFR 72.3):

a. Maintain the conditions required by the regulations and CoC to store spent fuel safely.

b. Prevent damage to the spent fuel during handling and storage.

c. 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) criticality, (2) shielding, (3) confinement, (4) heat transfer, (5) structural integrity, and (6) retrievability.

Criterion 2: The SSC is classified as not important-to-safety (NITS), but according to the licensing basis, their failure could prevent fulfillment of a function that is ITS, or their failure as support SSCs could prevent fulfillment of a function that is ITS.

The second step involves further review of the SSCs that are determined to be within the scope of the renewal to identify and describe the subcomponents and subcomponents parts that support the intended function or functions of the SSCs. The intended functions of the SSCs subcomponents may include:

- Providing criticality control of the spent fuel
- Providing heat transfer
- Directly or indirectly maintaining a pressure boundary
- Providing radiation shielding
- Providing structural support, functional support, or both, to SSCs that are ITS

The scope of the CoC 1004 renewal encompasses the initial approved application (Amendment 0) and twelve subsequently approved amendments (Amendment 1 through Amendment 11, and Amendment 13), excluding Amendment 12 for the Department of Energy's Transportation and Disposal canister system, which was docketed, but not reviewed. A summary description of the contents of each amendment is provided in Appendices 1A through 1J. Therefore, the scoping evaluation process described above is performed individually for each amendment in order to identify the SSCs within scope of renewal, corresponding to each amendment.

In accordance with NUREG-1927 [2.4.1], the renewal is based "on the continuation of the existing licensing basis throughout the period of extended operation and on the maintenance of the intended safety functions of the SSCs important to safety." Accordingly, the sources of information reviewed in the scoping evaluation are those that describe the licensing basis and the intended safety functions of the ITS SSCs and consist primarily of the following:

- The Updated Final (or as named for a particular amendment) Safety Analysis Reports corresponding to each approved amendment—See References section in Appendices 1A through 1J,
- The CoC 1004 and Technical Specifications (TS) for each approved amendment— See References section in Appendices 1A through 1J,
- Safety Evaluation Reports (SERs) issued for each approved amendment—See References section in Appendices 1A through 1J,
- Docketed Licensing Correspondence, as applicable—See References section in Appendices 1A through 1J.

These documents are reviewed to determine those SSCs with safety functions that meet either Scoping Criterion 1 or 2, as defined above. Based on this review, those subcomponents that perform or support any of the identified intended functions are determined to require an AMR. Those subcomponents that do not perform or support a safety function are excluded from further evaluation in the AMR with supporting justification provided in Appendices 2A (for DSCs), 2B (for HSMs), and 2C (for TCs).

The CoC 1004 Standardized NUHOMS® System Updated Final Safety Analysis (UFSAR) is updated every 24 months in accordance with 10 CFR Part 72.248, and incorporates any amendments that were approved and became effective during the previous 24 months. The updated UFSAR incorporates the amendment, as approved, and the conditions of the approved amendment as may be contained in the applicable SER. Thus, the UFSAR revision issued following approval of a given amendment provides a description of the components of the dry storage system and documents the safety analysis of the system. The revision levels of the UFSAR corresponding to each incorporated amendment are provided in Appendices 1A through 1J. These versions (revision levels) of the UFSAR, which incorporated each approved amendment, are the primary sources used in the scoping evaluation.

The SSCs of the Standardized NUHOMS® System under the scope of renewal, corresponding to the approved initial submittal and each approved subsequent amendment, are also described in Appendices 1A through 1J. The scoping process as described above was followed to determine the SSCs within scope of renewal applicable to each amendment. In determining the in-scope SSCs for renewal under each amendment, the versions of the UFSAR and TS that incorporated each approved amendment and the associated SER, and other docketed information were reviewed and are the basis for the in-scope determinations.

2.3 Results of Scoping Evaluation

Section 2.3 discusses the renewal scoping results. Table 2-1 summarizes the results of the scoping evaluation, listing the SSCs that are identified within the scope of renewal and the criteria upon which they are determined to be within the scope of renewal.

The SSCs within scope of renewal are described Appendices 1A through 1J for each amendment. Section 1X.2 of each appendix (where X is A through J) identifies, for each amendment, the SSCs within the scope of renewal, as well as the SSCs excluded from the scope of renewal. Detailed scoping results for each Standardized NUHOMS® System component, evaluated to the subcomponent and subcomponent parts level, including the determination of their associated intended safety function, are provided in tables in Section 1X.3 of Appendices 1A through 1J.

Detailed scoping results have also been generated, based on the current revision of the UFSAR [2.4.2], which incorporates the most recently approved amendment, Amendment 13. These detailed scoping results are presented for each component and are shown in Appendix 2A (for DSCs), Appendix 2B (for horizontal storage modules (HSMs)), Appendix 2C (for transfer casks (TCs)), and Appendix 2D (for the spent fuel assemblies (SFAs). The scoping results as presented in Appendices 2A, 2B, and 2C represent a consolidated scoping evaluation of the storage system as currently designed and licensed, and also identify the current revision of the source drawings as contained in the current revision of the UFSAR. The source drawings upon which these detailed scoping tables are based are summarized in Appendix 2E.

2.3.1 Structures, Systems, and Components within Scope of CoC Renewal

In general, the SSCs determined to be within the scope of renewal are the DSC, HSM, and TC. These principal components are the only ITS SSCs approved by CoC 1004 under 10 CFR Part 72, Subpart L. The DSC, HSM, and TC satisfy Criteria 1 of the scoping evaluation process. The subcomponents of the in-scope SSCs and their intended safety functions are identified on an amendment-by-amendment basis in Appendices 1A thorough 1J and on a consolidated component-by-component basis in Appendix 2A (DSCs), Appendix 2B (HSMs), and Appendix 2C (TCs).

The SFAs, which are stored in an inert and sealed environment, and are supported inside the DSC basket assembly, are also determined to be within the scope of renewal. Table 2-2 provides a summary of the characteristics of the SFAs allowed for storage. As noted in NUREG-1927 [2.4.1], the fuel pellets are not within the scope of renewal. The intended safety functions of the SFAs subcomponents are identified in Appendix 2D.

NITS items that meet Criterion 2 are within scope of renewal. For these NITS items, the intended ITS function that could be prevented from being fulfilled is identified. These NITS items are then evaluated for potential aging effects.

2.3.2 SSCs not within the Scope of CoC Renewal

The SSCs that are not in the scope of renewal include the fuel transfer and auxiliary equipment. These components are classified as NITS and do not meet scoping Criteria 2. Also not within scope are those NITS items of the DSC/HSM and TC that did not meet Criterion 2 because their failure does not prevent fulfillment of an ITS function; explanation/justification for these are provided in Appendix 2A, 2B and 2C for the DSCs, HSMs, and TCs, respectively. The independent spent fuel storage installation (ISFSI) storage pad (except as noted in Section 2.3.1), and other ISFSI miscellaneous equipment (e.g., lightning protection, security, etc.) are plant-specific and not within scope of the renewal.

Fuel Transfer and Auxiliary Equipment

As stated in 3(b) of the CoC [2.4.3] and in Section 1.3.5 of the initial SER [2.4.4], with the exception of the TC, fuel transfer and auxiliary equipment necessary for ISFSI operations are not included as part of the Standardized NUHOMS® System CoC approved under 10 CFR72, Subpart L. Fuel transfer equipment necessary for ISFSI operations include the lifting yoke, transfer trailer, skid positioning system, hydraulic ram system, ram support assembly, and the cask support skid. Auxiliary equipment used to facilitate canister loading, draining, drying, inerting, and sealing operations include, but is not limited to, the vacuum drying system, automatic welding equipment, cask and canister annulus seal. Fuel transfer and auxiliary equipment are not included as part of the Standardized NUHOMS® System approved by the CoC [2.4.3].

UFSAR [2.4.2] Table 3.4-1 summarizes the safety classification of the Standardized NUHOMS® System components. As discussed in the UFSAR [2.4.2], the DSC and the TC are designed to withstand potential failure of the fuel transfer equipment and would not prevent the DSC or the TC from fulfilling their intended safety functions. Auxiliary equipment is not relied on to perform any of the functions outlined above for Criterion 1, and its failure would not prevent fulfilment of an ITS function. The fuel transfer and auxiliary equipment do not meet scoping Criteria 2 and, therefore, are not in the scope of renewal.

Because the TC lifting yoke, including the rigid extension or sling lifting members, is a special lifting device that provides the means for performing cask handling operations within the plant's fuel or auxiliary building, it is subject to 10 CFR Part 50 license site-specific evaluations. It is classified as "Safety-Related" in accordance with 10 CFR 50, and is designed according to the same criteria as the TC.

Approach Slab

The approach slab is a NITS, reinforced concrete structure, designed and constructed to plant-specific site conditions. The approach slab provides access to the HSM and supports the DSC transfer system. It does not provide a safety function, and its failure would not prevent fulfillment of a safety function of the HSM loaded with a DSC.

Miscellaneous Equipment

ISFSI miscellaneous equipment (e.g., ISFSI security fences and gates, lighting, lightning protection, communications, and monitoring equipment) are not part of the CoC 1004 storage system approved in accordance with 10 CFR Part 72, Subpart L.

2.4 References

2.4.1 NUREG-1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," March 2011.

2.4.2 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

2.4.3 AREVA Inc., "Certificate of Compliance for Spent Fuel Storage Casks," Certificate No. 1004, Amendment 13.

2.4.4 Safety Evaluation Report of the Safety Analysis Report for the Standardized NUHOMS® Horizontal Storage System for Irradiated Nuclear Fuel, December 1994.

Table 2-1
Scoping Evaluation of Standardized NUHOMS® System SSCs

SSC	Criterion 1	Criterion 2	In-Scope
Dry Shielded Canister (DSC)[1]	Yes	N/A	Yes
HSM[2]	Yes	N/A	Yes
Transfer Cask (TC)[3]	Yes	N/A	Yes
Transfer Cask Lifting Yoke[4]	No	N/A	No
Spent Fuel Assemblies[5]	Yes	N/A	Yes
ISFSI Basemat[6]	No	Yes	Yes
ISFSI Approach Slab	No	No	No
Other Transfer Equipment[7]	No	No	No
Auxiliary Equipment[8]	No	No	No
Miscellaneous Equipment[9]	No	No	No

Table 2-2
Summary of SFA Characteristics Allowed for Storage in Each DSC Type

DSC System	Sub Types	DSC Design Basis Heat Load (kW)	Average Assembly Initial Enrichment (wt % U-235)	Burnup (GWd/MTU)	Cladding Type	Damaged Fuel
24P	24P Standard 24P Long Cavity	24.0	4	40	Zircaloy	No
24PT2	24PT2S 24PT2L	24.0	4	40	Zircaloy	No
52B		19.2	4	35	Zircaloy	No
24PHB	24PHBS 24PHBL	24.0	4.5	55	Zirconium Alloy	Yes
61BT		18.3	4.4	40	Zircaloy	Yes
32PT	32PTS-100 32PTS-125 32PTL-100 32PTL-125	24.0	5	55	Zircaloy	No
24PTH(1)	24PTHS 24PTHL	40.8	5	62	Zircaloy	Yes
	24PTH-S-LC	24	5	62	Zircaloy	Yes
	24PTHF	40.8	5	62	Zircaloy	Yes
61BTH Type 1		22.0	5	62	Zircaloy	Yes
61BTH(2) Type 2		31.2	5	62	Zircaloy	Yes
	61BTHF	31.2	5	62	Zircaloy	Yes
32PTH1	32PTH1-S 32PTH1-M 32PTH1-L	40.8	5	62	Zircaloy	Yes
69BTH		35.0	5	62	Zircaloy	Yes
37PTH	37PTH-S 37PTH-M	30.0	5	62	Zircaloy	Yes

CHAPTER 3
AGING MANAGEMENT REVIEW

CONTENTS

LIST OF TABLES

3.1 Introduction

This chapter describes the aging management review (AMR) of the Certificate of Compliance (CoC) 1004 NUHOMS® dry storage system. The purpose of the AMR is to assess the structures, systems, and components (SSCs) determined to be within the scope of renewal. The AMR addresses aging effects and mechanisms that could adversely affect the ability of the SSCs to perform their intended functions during the period of extended operation.

Section 3.2 presents a summary of the NUHOMS® dry storage system operating experience (OE), representing about 20 years of fabrication, installation, and available OE of the storage system deployed across seventeen sites in the United States. Section 3.3 provides an overview of AMR-relevant design, fabrication, and maintenance (if applicable) aspects for each of the storage system components (dry shielded canister (DSC), horizontal storage module (HSM), and transfer cask (TC)). Sections 3.2 and 3.3 provide valuable input to the AMR process.

Section 3.4 describes the AMR methodology, which follows the guidance and the processes of NUREG-1927 [3.11.1]. This section addresses each of the major steps of the AMR: Section 3.4.1 (Identification of Materials and Environment), Section 3.4.2 (Identification of Aging Effects Requiring Management), and Section 3.4.3 (Identification of the Activities Required to Manage the Effects of Aging).

Sections 3.5, 3.6, 3.7, and 3.8 provide the AMR results of the DSC, HSM, TC and spent fuel assemblies (SFAs), respectively. Each of these sections provides a description of the component, the materials of construction, the environment(s), and the evaluation of the potential aging effects and the associated aging mechanisms. The aging effects and associated aging mechanisms that could cause degradation resulting in loss of intended function are evaluated for each component. These evaluations result in the final aging effects requiring management, and the required aging management activities (AMAs) (time-limited aging analyses (TLAAs) or aging management programs (AMPs)).

The identified TLAAs and other supplemental/support evaluations are presented in Appendix 3. These TLAAs are prepared to assess SSCs that have a time-dependent operating life to demonstrate that the existing licensing basis remains valid and that the intended functions of the SSCs in scope of renewal are maintained during the period of extended operation. Time dependency may entail fatigue life (cycles), change in a mechanical property such as fracture toughness or strength of materials due to irradiation, or time-limited operation of a subcomponent.

Given the large number of DSC, HSM, and TC types, and their applicability to multiple amendments, bounding evaluations are generally performed to bound all the different types of a given component (e.g., all DSC types). The evaluations employ bounding parameters, bounding analysis models, or both. As an example of the former, temperatures and pressures that bound all DSC types are used for the fatigue evaluation of the DSCs and TCs. As an example of the latter, an MCNP model of an HSM loaded with bounding DSC sources is used for the evaluation of neutron and gamma exposure of component materials. In some cases, the evaluations are based on a particular DSC type that is identified as a bounding DSC for that particular purpose. For example, the 32PTH1 DSC inside the HSM- H is selected to determine maximum DSC shell and concrete temperatures because the 32PTH1 DSC has the highest design basis heat load of 40.8 kW.

As appropriate, an AMP is created to summarize the activities or procedures implemented to monitor and manage the aging effects. The AMPs credited for managing the effects of aging degradation are presented in Appendix 6A.

3.2 Operating Experience Review

3.2.1 Operating Experience Review Process

This section summarizes OE information for the Standardized NUHOMS® System. This information was obtained from documented internal (i.e., AREVA INC.) corrective action reports (CARs) and non-conformance reports (NCRs) generated during storage system components fabrication or installation, or from licensee condition reports (CRs) or action reports (ARs) generated during in-service operations. The internal CAR and NCR databases comprise about 20 years of storage system fabrication and installation experience, and document the identification and resolution of relevant issues encountered during fabrication and installation of the Standardized NUHOMS® System components. Licensee-provided CRs and ARs that resulted from findings during installation or walkdown inspections performed as part of Maintenance Rule activities or other independent spent fuel storage installation (ISFSI) inspection programs were also reviewed and summarized. Review and evaluation of these sources of information provided insights on the various forms of potential degradation that could affect the ability of the system components to perform their intended function. Furthermore, they are specific to the Standardized NUHOMS® System and used in the formulation of aging management programs (AMPs). This OE is summarized in Section 3.2.2 and discussed in Table 3.2-1.

In addition to Standardized NUHOMS® System -specific information, relevant general industry information was reviewed. This includes the Institute of Nuclear Power Operations (INPO) database, which was queried for relevant industry OE of dry cask storage systems, and relevant U.S. Nuclear Regulatory Commission (NRC) Information Notices, NRC Inspection Reports, and NRC Bulletins. These reports were reviewed for any conditions that could affect the aging of the Standardized NUHOMS® System and its components. This OE is discussed in Section 3.2.3.

Finally, information from the lead canister inspection reports from similar NUHOMS®-based site-specific ISFSI renewal applications were reviewed as part of the aging management review (AMR) process to identify applicable actual or potential aging effects and associated aging mechanisms specific to the Standardized NUHOMS® System components. These include the site-specific renewal application inspection reports for Calvert Cliffs Nuclear Power Plant ISFSI [3.11.2, 3.11.44, 3.11.46], Oconee Nuclear Station ISFSI [3.11.3], and H.B. Robinson Steam Electric Plant ISFSI [3.11.4, 3.11.5]. These inspections reports are considered relevant because their ISFSIs are based on similar NUHOMS®-based storage system design. A summary discussion of these lead canister inspections is provided in Appendix 4A.

Proprietary Information on Pages 3-4 through 3-10
Withheld Pursuant to 10 CFR 2.390

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

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Table 3.2-1
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(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance
4	NRC IN 2011-20 addresses the occurrence of ASR-induced concrete degradation on seismic Category 1 structures at Seabrook Station. ASR is one type of alkali-aggregate reaction that can degrade concrete structures. ASR is a slow chemical process in which alkalis, usually predominantly from the cement, react with certain types of silica (e.g., chert, quartzite, opal and strained quartz crystals) in the aggregate, when moisture is present. This reaction produces an alkali-silica gel that can absorb water and expand to cause micro-cracking of the concrete. In order for ASR to occur, three conditions must be present: a sufficient amount of reactive silica in the aggregate, adequate alkali content in the concrete and sufficient moisture. To prevent ASR, the American Society for Testing and Materials (ASTM) has issued standards for testing concrete aggregate during construction to verify that only non-reactive aggregates are used. Seabrook used these standards (ASTM C289 and ASTM C295); however, ASR degradation still occurred.	[ ]	[ ] [ ]

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

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(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance
16	At an operating ISFSI, HSM roof has surface cracking, which appears to align with the underlying reinforcing steel. Other roof modules also have similar surface cracking. See INPO OE27586. Cause: Conditioning of the concrete surface during fabrication	[ ]	[ ] well above the design requirement of 5,000 psi. The evaluations concluded that the type of crack observed is not structural and is limited to the outer layer of the concrete cover. The overall HSM and HSM array continues to be capable of fully performing the intended function/performance requirements, both structurally and radiologically. As a mitigating measure, TN recommended sealing the concrete surface with concrete sealant to prevent moisture intrusion. Relevance to CoC renewal: Applicable aging effect included in the HSM AMP for external and internal surfaces.

Table 3.2-1
Operating Experience Documentation of Potential Age-Related Degradation
(12 Pages)

OE ID Number	Brief Description/Cause	Potential Aging Effect & Mechanism	Disposition/CoC Renewal Relevance

Proprietary Information on Pages 3-23 through 3-120
Withheld Pursuant to 10 CFR 2.390

3.11 References

3.11.1 NUREG-1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," U.S. Nuclear Regulatory Commission, March 2011.

3.11.2 Calvert Cliffs Nuclear Power Plant, Independent Spent Fuel Storage Installation, Material License No. SNM-2505, Docket No. 72-8, Response to Request for Supplemental Information, RE: Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal Application (TAC No. L24475), ADAMS ML12212A216, July 27, 2012.

3.11.3 Duke Energy Carolinas, LLC, Oconee Nuclear Station, Docket No. 72-4, License No. SNM-2503, License Renewal Application for the Site-Specific Independent Spent Fuel Storage Installation (ISFSI) - Response to Requests for Additional Information, License Amendment Request No. 2007-06, ADAMS ML090370066, January 30, 2009.

3.11.4 H.B. Robinson Steam Electric Plant, Unit No. 2, Independent Spent Fuel Storage Installation, Docket No. 72-3/License No. SNM-2502, Independent Spent Fuel Storage Installation (ISFSI) Inspection Report, January 31, 1994.

3.11.5 H.B. Robinson Steam Electric Plant, Unit No. 2, Independent Spent Fuel Storage Installation, Docket No. 72-3/License No. SNM-2502, Independent Spent Fuel Storage Installation (ISFSI) Inspection Report, May 5, 2000.

3.11.6 NUREG/CR-7116, "Materials Aging Issues and Aging Management for Extended Storage and Transportation of Spent Nuclear Fuel," U.S. Nuclear Regulatory Commission, November 2011.

3.11.7 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3.11.8 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment 10.

3.11.9 NRC Information Notice 2011-20, "Concrete Degradation by Alkali-Silica Reaction," U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, November 18, 2011.

3.11.10 NRC Information Notice 2012-20, "Potential Chloride-Induced Stress Corrosion Cracking of Austenitic Stainless Steel and Maintenance of Dry Cask Storage System Canister," U.S. Nuclear Regulatory Commission, November 14, 2012.

3.11.11 NRC Information Notice 2013-07, "Premature Degradation of Spent Fuel Storage Cask Structures and Components from Environmental Moisture," U.S. Nuclear Regulatory Commission, April 16, 2013.

3.11.12 NUREG-1801, Revision 2, "Final Report – Generic Aging Lessons Learned (GALL) Report," U.S. Nuclear Regulatory Commission, December 2010.

3.11.13 NUREG-1536, Revision 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility – Final Report," U.S. Nuclear Regulatory Commission, July 2010.

3.11.14 ASME B&PV Code, Section III, Division 1, 1983 Edition, with Winter 1985 Addenda.

3.11.15 ASME B&PV Code, Section III, Division 1, 1998 Edition with 1999 Addenda.

3.11.16 ASME B&PV Code, Section III, Division 1, 1998 Edition with Addenda through 2000.

3.11.17 ASME B&PV Code Section III, Division 1, 2004 Edition through 2006.

3.11.18 AREVA TN Technical Report No. E-25768, Revision 0, "Evaluation of Creep of NUHOMS® Basket Aluminum Components under Long Term Storage Conditions," (Proprietary Report), November 01, 2007.

3.11.19 AREVA TN Letter E-25506, "Revision 1 to Transnuclear, Inc. (TN) Application for Amendment 10 to the Standardized NUHOMS® System (Docket No. 72-1004; TAC No. L24052)," November 7, 2007.

3.11.20 ACI 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures."

3.11.21 ACI 318-83 or ACI 318-95, "Building Code Requirements for Reinforced Concrete."

3.11.22 ACI 201.1, "Guide for Conducting a Visual Inspection of Concrete in Service."

3.11.23 ACI 201.2, "Guide to Durable Concrete."

3.11.24 ACI 209-82, "Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures."

3.11.25 ACI 215R-74, "Considerations for Design of Concrete Structures Subjected to Fatigue Loading," Revised 1992, Reapproved 1997.

3.11.26 ACI 221.1R-98, "State-of-the-Art Report on Alkali-Aggregate Reactivity."

3.11.27 ACI 349-85 or ACI 349-97, "Nuclear Safety Related Concrete Structures."

3.11.28 ASTM A123/A123M-13, "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products" ASTM International, 2013.

3.11.29 ASTM C33/C33M-13, "Standard Specification for Concrete Aggregates," ASTM International, 2013.

3.11.30 ASTM C150/C150M-12, "Standard Specification for Portland Cement," ASTM International, 2012.

3.11.31 ASTM C227-10, "Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)," ASTM International, 2010.

3.11.32 ASTM C289-07, "Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)," ASTM International, 2007.

3.11.33 ASTM C295/C295M-12,"Standard Guide for Petrographic Examination of Aggregates for Concrete," ASTM International, 2012.

3.11.34 ASTM C1562-10, "Standard Guide for Evaluation of Materials Used in Extended Service of Interim Spent Nuclear Fuel Dry Storage Systems," ASTM International, 2010.

3.11.35 EPRI Report 1015078, Plant Support Engineering: Aging Effects for Structures and Structural Components (Structural Tools), December 2007.

3.11.36 "Managing Aging Effects on Dry Cask Storage Systems for Extended Long-Term Storage and Transportation of Used Fuel," Rev. 1, Argonne National Laboratory, September 30, 2013.

3.11.37 Metals Handbook, Volume 13, "Corrosion," Ninth Edition, ASM International.

3.11.38 EPRI Report 1002882, "Dry Cask Storage Characterization Project, Final Report, Electric Power Research Institute," September 2002.

3.11.39 EPRI Report 3002000815, "Failure Modes and Effects Analysis (FMEA) of Welded Stainless Steel Canisters for Dry Cask Storage Systems," December 2013.

3.11.40 EPRI Report TR-108757, R. E. Einziger, D. L. Baldwin, and S. G. Pitman, "Data Needs for Long-Term Dry Storage of LWR Fuel," Electric Power Research Institute, 1998.

3.11.41 EPRI Report 1003416, J. Kessler and R. Einziger, "Technical Bases for Extended Dry Storage of Spent Nuclear Fuel," Electric Power Research Institute, , December 2002.

3.11.42 Interim Staff Guidance, SFST-ISG- 11, Rev. 2, "Cladding Considerations for the Transportation and Storage of Spent Fuel," U.S. Nuclear Regulatory Commission, Spent Fuel Project Office.

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CHAPTER 4
AGING MANAGEMENT TOLLGATES

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LIST OF TABLES

4.1 Introduction

Aging management programs (AMPs) are defined in Appendix 6A for the horizontal storage module (HSM) concrete and steel, for the dry shielded canister (DSC) external surfaces, for the transfer cask (TC), for atmospheric chloride-induced stress corrosion cracking (CISCC) of the DSC, and for the integrity of high burnup (HBU) fuel cladding. These AMPs are subject to modification under 10 CFR 72.48 as new operating experience (OE) accumulates.

For two of these AMPs, the present state of knowledge and the difficulty of directly inspecting for the aging effects requires that the process of periodic assessment and, if necessary, revision of the AMPs, be formalized by a tollgate process:

a. DSC AMP for the Effects of CISCC (Appendix 6A.4)

b. HBU Fuel AMP (Appendix 6A.8)

4.2 Generic Tollgate Process

This application adopts these definitions from the draft NEI 14-03 [4.5.1]:

Tollgate A requirement included in a renewed certificate of compliance (CoC) and associated Updated Final Safety Analysis Report (UFSAR) for the licensee to perform and document an assessment of the aggregate impact of aging-related dry cask storage (DCS) OE, research, monitoring, and inspections at specific points in time during the renewed operating period.

Tollgate Assessment A written evaluation, performed by licensees at each tollgate, of the aggregate impact of aging-related DCS OE, research, monitoring, and inspections on the intended functions of in-scope DCS structures, systems, and components (SSCs). Tollgate assessments are intended to include non-nuclear and international operating information on a best-effort basis. Corrective or mitigative actions arising from tollgate assessments are managed through the corrective action programs of the licensee, the certificate holder, or both.

Corrective actions may include

- Modification of time-limited aging analyses (TLAAs)
- Adjustment of the scope, frequency, or both of AMPs
- Repair or replacement of SSCs

Licensees and AREVA Inc. assess new information relevant to aging management, as it becomes available, in accordance with normal corrective action and OE programs. Tollgates are an opportunity to seek out other information that may be available and perform an aggregate assessment.

Assessments are not stopping points. No action other than performing an assessment is required to continue NUHOMS® dry storage system operation.

The tollgate process applies only to those licensees for whom the corresponding AMP applies.

Tollgate assessment reports are not required to be submitted to the NRC, but are available for inspection.

Proprietary Information on Pages 4-3 and 4-4
Withheld Pursuant to 10 CFR 2.390

4.5 References

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4.5.2 DOE EPRI, "High Burnup Dry Storage Cask Research and Development Project - Final Test Plan," Electric Power Research Institute, February 27, 2014.

4.5.3 NRC Interim Staff Guidance 24, "The Use of a Demonstration Program as a Surveillance Tool for Confirmation of Integrity for Continued Storage of High Burnup Fuel Beyond 20 Years," Revision 0, July 11, 2014.

APPENDIX 1:

NUHOMS® CoC 1004 Amendment Renewals

APPENDIX 1A
Renewal of the Standardized NUHOMS® System Approved under Amendment 0 to the NUHOMS® CoC No. 1004

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1A.1 Introduction

VECTRA Technologies, Inc. (VECTRA), formerly Pacific Nuclear Fuel Services, Inc. (PNFS), submitted a Safety Analysis Report (SAR) and supplementary docketed material [1A.5.1] for storage of spent nuclear fuel in the Standardized NUHOMS® System. This application was approved by the U.S. Nuclear Regulatory Commission (NRC) effective January 23, 1995, with the initial issuance of Certificate of Compliance (CoC) 1004 [1A.5.2]. This initial CoC 1004 issuance is referred to in this Appendix as Amendment 0.

1A.1.1 Brief Description of Amendment 0

The Standardized NUHOMS® System is a modular canister-based system consisting of a dry shielded canister (DSC) fabricated from steel, a reinforced concrete horizontal storage module (HSM) and an onsite transfer cask (TC).

The Standardized NUHOMS® System is designed to store up to 24 intact pressurized water reactor (PWR) spent fuel assemblies (SFAs) in the NUHOMS®-24P DSC with a maximum initial enrichment of 4.0 wt.% irradiated to a maximum burnup of 40 GWd/MTU, a maximum decay heat load of 1.0 kW per SFA, and a minimum cooling time of five years. The maximum initial uranium content per SFA is limited to 472 kg.

The Standardized NUHOMS® System is also designed to store up to 52 intact boiling water reactor (BWR) SFAs in the NUHOMS®-52B DSC with a maximum initial enrichment of 4.0 wt. % irradiated to a maximum burnup of 35 GWd/MTU, a maximum decay heat load of 0.37 kW per SFA, and a minimum cooling time of five years. The maximum initial uranium content per SFA is limited to 198 kg.

The following paragraphs provide a brief description of the components of the Standardized NUHOMS® System. A more detailed description of the Standardized NUHOMS® System is provided in Section 4.2 of the SAR of the Standardized NUHOMS® System Revision 3A [1A.5.4], which incorporated the license commitments from CoC 1004 and the associated Safety Evaluation Report (SER) [1A.5.6] issued by the NRC.

Description of the NUHOMS®-24P and 52B DSCs

The DSC is a high integrity stainless steel welded pressure vessel that provides confinement of radioactive materials, encapsulates the fuel in a helium atmosphere, and, when placed in the TC, provides biological shielding during DSC closure and transfer operations.

The DSC cylindrical shell is fabricated from rolled and butt-welded stainless steel plate material. Stainless steel cover plates and thick carbon steel or lead encased in steel shielding material form the DSC top and bottom end assemblies. The cover plates are double-seal welded to the DSC shell to form the containment pressure boundary.

The DSC shell and top and bottom end assemblies enclose a non-pressure retaining basket assembly, which serves as the structural support for the SFAs. The primary components of the basket assembly are the spacer discs, which maintain cross-sectional spacing of (and provide lateral support to) the fuel assemblies (FAs) within the DSC, and the support rods, which hold the spacer discs in place and maintain longitudinal separation of the spacer discs during a postulated cask drop accident.

The 24P DSC basket assembly consists of 24 stainless steel guidesleeves, eight carbon steel spacer discs, and four Type XM-19 stainless steel support rods. The inner guidesleeves in the assembly are equipped with stainless steel oversleeves placed at both ends of the basket assembly between the two top and bottom spacer discs. Criticality control is achieved by use of water with dissolved boron in the DSC cavity.

The 52B DSC basket assembly uses nine spacer discs to maintain fuel position within the DSC. Axial position of the discs is maintained by preloaded spacer sleeves. The basket includes fixed neutron absorbing plates ("poison sheets") to provide criticality control for BWR FAs in non-borated water. The spacer discs are constructed of carbon steel. The spacer sleeves and support rods are constructed of SA-564, Type 630 precipitation hardened steel. The poison plates are constructed of A-887, Type 304B3 borated stainless steel.

The shield plugs at each end of the DSC provide biological shielding when the DSC is in the TC or in the HSM. The design of the DSC is intended to allow for differential thermal expansion between the DSC shell assembly and basket assembly components.

The inner top cover plate is welded to the DSC shell to form the inner pressure boundary at the top end of the DSC. The outer pressure boundary is provided by the outer top cover plate that is also welded to the DSC shell. All closure welds are multiple-layer welds. This effectively eliminates any pinhole leak, which might occur in a single-layer weld, since the chance of pinholes being in alignment on successive weld layers is negligibly small. The circumferential and longitudinal shell plate weld seams are fabricated using multi-layer full penetration butt welds. The butt weld joints are fully radiographed and inspected according to the requirements of Section V of the ASME Boiler and Pressure Vessel Code [1A.5.3] to ensure that the integrity of the welded joint is as sound as the parent metal itself.

The 24P and 52B DSC design incorporates a siphon and a vent port for draining and filling operations. Both ports are used to remove water from the DSC during the drying and sealing operations. Four lifting lug plates are provided on the interior of the DSC shell to facilitate placement of the empty DSC into the TC prior to fuel loading.

Description of the Standardized HSM

The Standardized HSM is a massive reinforced concrete structure that provides protection for the DSC against tornado missiles and other potentially adverse natural phenomena. The HSM also serves as the principal biological shield for the spent fuel during storage. Drawings for the HSM are contained in Appendix E of the SAR Revision 3A [1A.5.4].

The HSM contains four shielded air inlet openings in the lower side walls of the structure to admit ambient ventilation air into the HSM. The cooling ventilation air flows around the DSC to the top of the HSM. Air warmed by the DSC is exhausted through four shielded vent openings near the HSM roof slab. Adjacent modules are spaced to provide adequate ventilation flow and shielding. This passive system provides an effective means for spent fuel decay heat removal. A heat shield is provided between the DSC and HSM concrete to mitigate concrete temperatures.

The DSC rests on a frame structure with support rails in the cavity of the HSM, which is anchored to the HSM floor slab, side wall, and front wall opening. The support structure is leveled and bolted to the HSM floor slab and side wall during module assembly. The support rails extend into the HSM front wall access opening, which is slightly larger in diameter than the DSC. The HSM access opening has a stepped flange sized to facilitate docking of the TC. This configuration minimizes streaming of radiation through the HSM opening during DSC transfer.

The top surfaces of the rails, on which the DSC slides, are coated with a dry film lubricant that is suitable for a radiation environment. The support rail sliding surfaces consist of hardened stainless steel cover plates for corrosion protection and added lubricity. Inside the HSM, the heat rejected from the DSC has a drying effect. Thus, the HSM atmosphere is benign in terms of corrosion; decay heat warms the air, which prevents the accumulation or condensation of moisture inside the HSM.

The DSC is prevented from sliding along the support rails during a postulated seismic event by rail stops attached to the back ends of the DSC support rails and a DSC axial retainer located in the front access door of the HSM.

The HSM wall and roof thicknesses are primarily dictated by shielding requirements. The massive HSM walls, together with the end shield walls, adequately protect the DSC against tornado missiles and other adverse natural phenomena. The tornado-generated missile effects are considered to bound any other reasonable impact-type accident. The HSM wall thickness for individual modules and HSM arrays is specified on the Appendix E drawings of the SAR [1A.5.4].

The entrance to the HSM is covered by a thick steel door that provides shielding and protection against tornado missiles. The door assembly includes a solid concrete core that acts as a combined gamma and neutron shield. The door is attached to the front wall using four bolted clamps.

The HSM gap between modules is covered with stainless steel wire bird screen to prevent pests or foreign material from entering the HSM. A daily visual inspection of the HSM inlets and outlets is a required surveillance activity per CoC 1004 Technical Specifications (TS) [1A.5.11].

The reinforced concrete components of the HSM are constructed of 5,000 psi compressive strength, normal weight concrete.

Description of the TC

The TC is a non-pressure-retaining cylindrical vessel with a welded bottom assembly and bolted top cover plate. The TC is designed for onsite transfer of the DSC to and from the plant's spent fuel pool and the independent spent fuel storage installation (ISFSI). The TC provides the principal biological shielding and heat rejection mechanism for the DSC and SFAs during handling in the fuel/reactor building, DSC closure operations, and transfer to the ISFSI/HSM. The TC also provides primary protection for the loaded DSC during off-normal and drop accident events postulated to occur during the transfer operations.

The TC is constructed from three concentric, cylindrical shells to form an inner and outer annulus. The inner and outer annulus is filled with lead and a neutron absorbing material, respectively. The two inner shells are welded to heavy forged ring assemblies at the top and bottom ends of the cask. Rails fabricated from a hardened, non-galling, wear resistant material coated with a high contact pressure dry film lubricant are provided to facilitate DSC transfer. The surfaces that are exposed to fuel pool water are stainless steel. The TC structural shell and the bolted top cover plate may be fabricated from carbon or stainless steel.

The TC neutron shield cavity is fabricated as a pressure vessel since it is intended that this cavity remain leak tight to prevent intrusion of contaminated spent fuel pool water. Solid neutron shielding materials are also incorporated into the top and bottom end closures to provide effective radiological protection.

Two trunnion assemblies are provided in the upper region of the cask for lifting the TC and DSC inside the plant's fuel/reactor building, and for supporting the cask on the skid for transfer to and from the ISFSI. An additional pair of trunnions, provided in the lower region of the cask, used to position the cask on the support skid, also serve as the rotation axis during down-ending of the cask, and provide support for the bottom end of the cask during transfer operations. Neither the TC nor the trunnions are special lifting devices per ANSI N.14.6 [1A.5.8].

The cask bottom ram penetration cover plate is a watertight closure used during fuel loading in the fuel pool, during DSC closure operations in the cask decon area, and during cask handling operations in the fuel/reactor building.

The cask upper flange is designed to allow an inflatable seal to be inserted between the cask liner and the DSC. The seal is fabricated from reinforced elastomeric material rated for temperatures well above boiling. The seal is placed after the DSC is located in the cask and serves to isolate the clean water in the annulus from the contaminated water in the spent fuel pool. After installation, the seal is inflated to prevent contamination of the DSC exterior surfaces by waterborne particulates.

The structural materials and licensing requirements for the NUHOMS® TC are delineated on the Appendix E drawings of the SAR Revision 3A [1A.5.4]. The cask is designated as an atmospheric pressure vessel and, therefore, a pressure test is not required. The cask is not N-stamped. The upper lifting trunnions and trunnion sleeves are conservatively designed in accordance with the ANSI N14.6 stress allowable requirements for a non-redundant lifting device. All structural welds are ultrasonically or radiographically examined, or tested by the dye penetrant method as appropriate for the weld joint configuration. These stringent design and fabrication requirements ensure the structural integrity of the TC and performance of its intended safety function.

<u>Description of Fuel Transfer and Auxiliary Equipment</u>

The Standardized NUHOMS® System is provided with the following auxiliary equipment for fuel handling and transfer inside the Auxiliary Building and at the ISFSI:

- TC lifting yoke (including the rigid extension or sling lifting members)
- DSC automatic welding equipment to enable sealing the DSC top end
- Vacuum drying system to drain and vacuum dry the DSC cavity following loading of SFAs into the DSC
- Transfer trailer equipped with a TC skid to support the TC during transfer and a skid positioning system
- Hydraulic ram system for insertion or withdrawal of a loaded DSC into or from an HSM

The yoke design used for cask handling is a non-redundant two-point lifting device with a single pinned connection to the crane hook. Thus, the yoke balances the cask weight between the two trunnions and has sufficient margin for any minor eccentricities in the cask vertical center of gravity that may occur. The yoke and other lifting devices are designed and fabricated to meet the requirements of ANSI N14.6 [1A.5.8]. The test load for the yoke and other lifting devices is 300% of the design load, with annual dimensional and liquid penetrant or magnetic particle inspection, to meet ANSI N14.6 requirements.

As stated in 3(b) of CoC 1004 [1A.5.2] and in Section 1.3.5 of the SER [1A.5.6], with the exception of the TC, fuel transfer and auxiliary equipment necessary for ISFSI operations are not included as part of the Standardized NUHOMS® System CoC approved under 10 CFR 72, Subpart L.

A detailed description of the fuel transfer and auxiliary equipment is provided in Section 4.7.3 of the SAR Revision 3A [1A.5.4].

1A.1.2 Design Drawings Certified in Amendment 0

The January 1, 1995 Edition of 10 CFR Part 72 was in effect at the time of approval for Amendment No. 0 to CoC No. 1004.

The design configuration of the Standardized NUHOMS® System, including critical dimensions and materials of construction, is shown on drawings listed in Appendix E of the SAR Revision 3A [1A.5.4].

Tables 1A-1, 1A-2, 1A-3, 1A-4, and 1A-5 provide a listing of all the drawings contained in SAR Revision 3A [1A.5.4] following the approval of Amendment 0. These SAR drawings reflect the certified Standardized NUHOMS® System configuration along with additional changes implemented under Standardized NUHOMS® CoC Condition 9.

Additional design changes to the Standardized NUHOMS® System configuration were implemented under CoC Condition 9 as reflected in the updated SAR drawings contained in SAR Revision 4A [1A.5.5]. The major design changes implemented under CoC Condition 9 in SAR Revision 3A and SAR Revision 4A are described in Sections 1A.1.3 and 1A.1.4, respectively.

1A.1.3 Changes to the Standardized NUHOMS® System Implemented in SAR Revision 3A

Revision 3A of the SAR [1A.5.4] incorporated the conditions of use and the final TS specified by CoC 1004 [1A.5.2]and the U.S. NRC's SER [1A.5.6].

SAR Revision 3A [1A.5.4] also incorporated changes to the Standardized NUHOMS® System that were implemented under the provisions of Condition 9 of CoC 1004 [1A.5.2]. A listing of these changes, along with the supporting Safety Review Screenings (SRSs) and Safety Evaluations (SEs) for each change are provided in Appendix I of SAR Revision 4A [1A.5.5]. The referenced Safety Evaluation (SE) in the list for each change provides justification that the change did not require an amendment to CoC 1004.

The following sections provide a brief description of the significant design changes implemented in SAR Revision 3A.

1A.1.3.1 24P and 52B DSC Design Changes

No major design changes were implemented to the 24P and 52B DSC configuration.

1A.1.3.2 TC Design Changes

The following design changes were implemented into the onsite TC configuration as listed on Page I.25, Appendix I, of SAR Revision 4A [1A.5.5]:

Description of Change	Associated SRS/SE
Allow Alternate TC Configuration with Liquid Neutron Shield: This design change implements an alternate TC configuration, which allows the use of water as a neutron shield in lieu of the original castable neutron shield. As noted in the SE, the use of a liquid neutron shield has been described in the NUHOMS®-24P Topical Report, previously approved by the NRC.	95-003, DC-NSHIELD
Allow Punch-through Detail for TC Trunnions: This design change allows an alternate punch through weld detail for attachment of the trunnions to the TC shell. The original configuration is a surface welded attachment of the trunnions. This change minimizes weld distortion issues and addresses concerns associated with the laminar tearing of the structural shell during attachment of the trunnions.	95-003, DC-TRUN
Eliminate Ram Access Temporary Shield: This design change eliminates the temporary shield ring and plug from the bottom of the TC. The revised configuration for the ram access cover plate consists of only a machined plate. The use of an integral ram eliminates the need for a ram access temporary shield.	95-003, DC-TMPSHLD

1A.1.3.3 HSM Design Changes

The following design changes were implemented to the HSM configuration as listed on Page I.26, Appendix I, of SAR Revision 4A [1A.5.5]:

Description of Change	Associated SRS/SE
HSM Base Unit and Roof Slab Connection Detail Modification: This modification replaces the original complex connection detail between the HSM roof slab and base unit, which required welding a number of embedded parts and specified that the assembled HSM (base unit and roof) be lifted by connecting a lifting eye to the embedded assembly in the roof. The modified connection detail consists of a # 11 embedded Richmond Dowel and a 1 ⅝″ diameter roof bolt that extends through a grouted sleeve in the roof slab. Four of these dowel splices will be installed in each base unit, one in each corner. Each dowel splice has a female threaded connection in its end that connects with the roof bolt. The roof slab is connected to the HSM base unit with these four roof bolts. Each bolt is placed through a sleeve in the roof slab and the sleeves are fully grouted after the bolt is installed. This change was implemented to simplify fabrication and utilize a design with a more direct load path.	95-009, DC1

Description of Change	Associated SRS/SE
Cask Docking Ring Design Modification: The cask docking ring assembly is embedded in the front wall of the HSM. The method of attaching the HSM shielded door assembly to the cask docking ring assembly is changed from structural stitch welding to bolted clamps. The welded attachment of the embedded rail plates is now made prior to casting (the rail plates are now components of the cask docking ring assembly). The inner and outer ring dimensions are also modified. This design change is made to improve HSM fabrication and assembly. The change to a bolted door connection eliminates field welding and provides a faster method of securing the door to the docking ring.	95-009, DC5
DSC Support Structure Design Modification: The DSC support rails are replaced with standard W8x40 wide flange support rails with stiffeners at the support connections and the W8x35 crossbeams are replaced with W8x40 wide flanges. The welded rail to cross beam connections are replaced with bolted connections. The rail to the extension plate weld is revised from a single to a double V-groove. Also, minor changes were made to the length of the cross beam and the extension plate. The changes were made for ease of fabrication, assembly, assure proper fit-up and to allow the use of standard materials.	95-009, DC14

1A.1.4 Changes to the Standardized NUHOMS® System Implemented in SAR Revision 4A

Following issuance of SAR Revision 3A, additional changes to the Standardized NUHOMS® System were implemented under Condition 9 of CoC 1004 and are incorporated in SAR Revision 4A [1A.5.5].

A listing of the changes incorporated in SAR Revision 4A [1A.5.5], along with the supporting SRS/SE number for each change is provided in Pages iv through xvii of the SAR. The referenced SE in the list provides justification that the change did not require an amendment to CoC 1004.

The following subsections provide a brief description of the significant design changes implemented in SAR Revision 4A.

1A.1.4.1 Changes to the 24P DSC and 52B

Two major design changes were implemented to the DSC configuration as described below:

Description of Change	Associated SRS/SE
Allow Reduction in the DSC Shell Wall Thickness: SAR Revision 4A drawings NUH-03-1021 (24P-DSC) and NUH-03-1029 (52B-DSC) are revised to indicate the minimum acceptable thickness of 0.563″ for the DSC shell and the shell circumferential and longitudinal weld seams. The drawings are included in Appendix E of the SAR. The nominal thickness of 0.625″ is not affected by this change. The SAR drawings listed above are revised to indicate the minimum acceptable thickness for the shell welds.	95-037 and 96-193
Add Long Cavity PWR DSC Capable of Storing Longer PWR FAs: This design change provides an option to use the long cavity 24P DSC, which is capable of storing PWR FAs longer than those acceptable for storage in the standard 24P DSC (with lengths up to 171.75″). The long cavity DSC has an external length and diameter identical to the 24P DSC. To obtain a longer cavity length, the carbon steel shield plugs used in both ends of the 24P DSC are replaced with composite lead/steel shield plugs. The shield plug lead thickness has been selected to provide equivalent shielding while reducing the overall plug thickness. The 24P Long Cavity DSC is incorporated into the SAR via addition of Appendix H and new SAR drawings NUH-03-1050, NUH-03-1051, NUH-03-1052, and NUH-03-1053. To stay within the constraints of CoC 1004 TS, this design change does not authorize storage of longer FAs or FAs with burnable poison rod assemblies (BPRAs) within the long cavity DSC. It merely provides a DSC, which is capable of storing such FAs. VECTRA submitted a separate CoC Amendment application for storage of such FAs in the long cavity DSC that was approved by the NRC as described in Appendix 1B of this application.	95-121

1A.1.4.2 TC Design Changes

No major design changes were implemented to the onsite TC configuration in SAR Revision 4A.

1A.1.4.3 HSM Design Changes

One major design change was implemented into the Standardized HSM configuration in SAR Revision 4A as described below:

Description of Change	Associated SRS/SE
Revise the connection between the HSM base unit and the roof slab: This modification deletes the not important-to-safety (NITS) Roof attachment bolt detail including the Richmond Dowel embedments in the base unit, and replaces it with a simpler bolted bracket attachment between the underside of the roof and the interior side of the front and back walls. The roof attachment detail has no safety functions. The new detail consists of a steel angle (6x6x3/4) at four corners of the roof that attach the roof to the front and rear walls of the base unit using two 1 ¼″Ø bolts into the roof and another two 1 ¼″Ø bolts into the base unit walls. This method of attachment between the roof and the base unit facilitates fabrication of the roof slab since the four corner sleeves are no longer required. It also facilitates fabrication of the base units by eliminating the four Richmond Dowels. In addition, the 39″ long roof bolt is eliminated, and there is no need to grout the roof sleeves during the HSM installation in the field.	96-195

1A.1.5 Amendment 0 Loading Overview

Tables 1A-6, 1A-7, and 1A-8 provide an overview of the FAs loaded under CoC 1004 Amendment 0 at Oconee Nuclear Station, Davis Besse Nuclear Power Station, and Susquehanna Steam Electric Station sites, respectively. The data contained in these tables is for general information and is current as of the time of the compilation of the data for this application.

These tables list the pertinent FA parameters such as the maximum fuel enrichment, maximum burnup, minimum cooling time, total DSC heat load, and the model numbers of the DSC and HSM into which these FAs are stored.

1A.2 Scoping Evaluation of CoC 1004 Amendment 0 SSCs

Chapter 2 provides a description of the two-step scoping evaluation process used to determine the structures, systems, and components (SSCs) and associated subcomponents that are within the scope of CoC 1004 renewal. This process is consistent with the methodology of NUREG 1927 [1A.5.7]. This two-step process, described in Chapter 2, was applied to the SSCs authorized under CoC 1004 Amendment 0.

In accordance with NUREG-1927 [1A.5.7], the renewal is based on “the continuation of the existing licensing basis throughout the period of extended operation and on the maintenance of the intended safety functions of the SSC ITS.” Accordingly, the primary source documents reviewed in the scoping evaluation are CoC 1004, Revision 0 [1A.5.2], CoC 1004 TS [1A.5.11], CoC 1004 SER [1A.5.6], and the Safety Analysis Report (SAR) [1A.5.4, 1A.5.5].

The results of this scoping evaluation for Amendment 0 renewal are presented in the following sections.

1A.2.1 Standardized NUHOMS® System SSCs Included within the Scope of CoC 1004 Amendment 0 Renewal

The Standardized NUHOMS® System SSCs determined to be within the scope of CoC 1004 Amendment 0 renewal are:

- 24P DSC
- 24P Long Cavity DSC
- 52B DSC
- HSM (Model 80)
- Onsite TC (Standardized TC and OS197 TC)
- SFAs

The ISFSI storage pad for the HSM, a NITS item, is included in the scope of renewal for CoC 1004 renewal (Amendments 0 through 11 and Amendment 13) as discussed in Chapter 2, Section 2.3.1.

1A.2.2 Standardized NUHOMS® System SSCs Excluded from the Scope of CoC 1004 Amendment 0 Renewal

As stated in Section 1.3.5 of the SER [1A.5.6], “With the exception of the TC, fuel transfer and auxiliary equipment necessary for ISFSI operations are not included as part of the Standardized NUHOMS® System to be reviewed for a CoC under 10 CFR 72, Subpart L.” Hence, the SSCs listed below are excluded from the scope of CoC 1004 renewal (Amendments 0 through 11 and Amendment 13):

- TC lifting yoke (including the rigid extension or sling lifting members)

- DSC automatic welding machine
- Vacuum drying system
- TC transfer trailer (including the TC support skid and the skid positioning system)
- Cask support skid
- Hydraulic ram system
- Other miscellaneous independent spent fuel storage installation hardware (e.g., lightning, lighting protection, monitoring equipment, and security equipment)

1A.3 Aging Management Review of Amendment 0 SSCs

An overview of the aging management review (AMR) methodology is provided in NUREG 1927 [1A.5.7] and in Section 3.4, Chapter 3. The AMR process involves the following steps:

- Identification of materials and environments for those SSCs and associated subcomponents determined to be within the scope
- Identification of aging effects requiring management
- Identification of time-limited aging analyses (TLAAs)
- Identification of aging management programs (AMPs) required to manage the effects of aging

Chapter 3 documents the AMR of the Standardized NUHOMS System SSCs. Sections 3.5, 3.6, 3.7 and 3.8 describe the AMR results for the DSCs, HSMs, and TCs, respectively, for the Standardized NUHOMS® System. The Amendment 0 AMR presented herein is based on the Chapter 3 AMR.

SAR drawings listed in Tables 1A-1, 1A-2, 1A-3, 1A-4, and 1A-5 were reviewed to identify the subcomponents and the materials of construction for each of the in-scope SSCs (24P DSC, 24P Long Cavity DSC, 52B DSC, HSM, and onsite TC) for Amendment 0.

Tables 1A-9, 1A-10, 1A-11, 1A-12, and 1A-13 summarize the results of this review and list the subcomponents associated with the SSCs. Also listed are the materials of construction, Safety Classification and the intended function of each of the subcomponents of these SSCs.

1A.3.1 Materials of Construction of Subcomponents:

A review of Tables 1A-9, 1A-10, 1A-11, 1A-12, and 1A-13 shows that the following materials of construction have been used for Amendment 0 subcomponents:

- 24P DSC, 52B DSC, and 24P Long Cavity DSC Materials Evaluated: carbon steel, carbon steel coated with aluminum thermal spray, carbon steel coated with electroless nickel, stainless steel, borated stainless steel, and chemical copper lead.
- HSM Materials Evaluated: reinforced concrete, carbon steel, carbon steel rebar, and stainless steel.
- Standardized TC and OS197 TC Materials Evaluated: carbon steel, stainless steel, chemical copper lead, and NS-3.
- Spent Fuel Assemblies: Zircaloy

1A.3.2 Environments Experienced by the Subcomponents

Sections 3.5.3, 3.6.3, 3.7.3 and 3.8.3 of Chapter 3 provide a discussion of the limiting external and internal environments experienced by the in-scope SSCs. Tables 1A-9, 1A-10, 1A-11, 1A-12, and 1A-13 provide a listing of the environment to which these in-scope subcomponents are exposed.

1A.3.3 Identification of Aging Effects Requiring Management

Sections 3.5.4, 3.6.4, 3.7.4 and 3.8.4 of Chapter 3 provide a detailed discussion of the process of identifying potential aging effects associated with the Standardized NUHOMS® System SSCs. These potential and actual aging effects were extracted from a review of the following sources:

- Industry experience published in literature including Electric Power Research Institute (EPRI) Reports, ASTM Standards, NUREGs/CRs, NRC Information Notices, NRC Bulletins, Interim Staff Guidance (ISG), the Institute of Nuclear Power Operations (INPO) Operating Experience (OE), etc.
- Available OE as described in Section 3.2 of Chapter 3.

The AMR process identifies both the aging effects and the associated aging mechanism that causes them. Each identified mechanism requires a certain set of specific conditions to be met for the mechanism to occur, such as a certain high temperature limit, or a minimum moisture concentration, or a combination of several other specific conditions.

As discussed in Chapter 3, the aging effects that could potentially cause a loss of intended function are:

For Metals:

- Loss of material due to general corrosion – affects carbon steel
- Loss of material due to crevice and pitting corrosion – affects carbon steel, stainless steel and aluminum
- Loss of material (wear) of the TC rail surface from galling, scratching or gouging against the DSC surface during insertion/extraction of a DSC into or out of an HSM
- Cracking due to stress corrosion cracking – affects stainless steel
- Chloride-induced stress corrosion cracking (CISCC) – affects austenitic stainless steel
- Cracking due to thermal fatigue – affects carbon steel, stainless steel and aluminum
- Change in material properties due to elevated temperature - affects carbon steel, stainless steel and aluminum

- Change in material properties due to irradiation – affects carbon steel, stainless steel and aluminum
- Change in material properties due to creep – affects aluminum

For Concrete:

- Loss of material (mechanisms include freeze-thaw, elevated temperature, aggressive chemical attack, corrosion of embedments and rebar)
- Cracking (mechanisms include freeze-thaw, reactions with aggregates, shrinkage, settlement, elevated temperature, fatigue, irradiation embrittlement)
- Change in material properties (leaching of calcium hydroxide, elevated temperature, aggressive chemical attack, irradiation embrittlement, creep and fatigue)

Sections 3.5.4, 3.6.4, 3.7.4 and 3.8.4 of Chapter 3 documents the evaluation of the above listed potential aging effects on the subcomponents of the DSC, HSM, TC and SFAs, respectively. This review results in elimination of some of the aging mechanisms from further consideration based on the justification provided therein.

1A.3.4 Identification of TLAAs

Aging effects that were not eliminated from a review of published literature or OE are further subjected to TLAAs.

A TLAA is a process to assess SSCs that have a time dependent operating life. AREVA Inc. has performed TLAA evaluations for the NUHOMS® SSCs as documented in Appendix 3 of this application. Unless specifically mentioned otherwise, each of the TLAAs described in the following sections is performed by selecting bounding evaluation parameters for the SSC under consideration, so that the results of the TLAA are applicable to all the SSCs certified in CoC 1004 (Amendments 0 through 11 and Amendment 13). A summary of these TLAA evaluations is provided in the next section.

1A.3.4.1 DSC TLAAs

- Fatigue Evaluation of DSCs: Appendix 3A presents an evaluation of the effects of cyclical loading (fatigue) on the mechanical properties of the following DSCs: 24P, 52B, 24P Long Cavity, 24PT2, 61BT, 32PT, 24PHB, 24PTH, 61BTH, 32PTH1, 37PTH, and 69BTH. The evaluation demonstrates that the six fatigue exemption criteria given in the applicable edition of the ASME Code Section NB-3222.4(d) [1A.5.3, 1A.5.13, 1A.5.14, or 1A.5.15] are met for a 100-year service life for each of these DSCs. Hence, DSC cracking due to fatigue is not an aging effect requiring management during the period of extended operation.

- DSC Poison Plate Boron Depletion: Appendix 3D performs an evaluation to determine the amount of B-10 depleted in the DSC poison plates due to neutron irradiation during 100 years of storage. The analysis selects a bounding FA with the maximum neutron source (B&W 15x15) to envelop all the NUHOMS® DSC certified for storage in CoC 1004 (Amendments 0 through 11 and Amendment 13). It demonstrates that 99.9% of B-10 remains in the poison plates after 100 years of service life for this bounding configuration. Hence, B-10 depletion in DSC poison plates is not an aging effect requiring management during the period of extended operation.
- Evaluation of Neutron Fluence and Gamma Radiation on Materials: Appendix 3E evaluates the effects of neutron fluence and gamma radiation on the mechanical properties of DSC and HSM materials. The evaluation develops two Monte Carlo N-Particle (MCNP) models to envelop all possible geometry configurations of a DSC stored inside an HSM. The two bounding MCNP models incorporate the 32PTH1 DSC and the 69BTH DSC, respectively, since the FAs stored in these two DSCs have the maximum neutron and gamma source strength per FA. The calculated neutron and gamma exposures obtained for the 32PTH1 DSC are scaled by 37/32 to account for the fact that the 37PTH DSC holds the most fuel assemblies. This bounding evaluation demonstrates that the neutron fluence and gamma energy levels, after 100 years of service, are below the threshold levels of concern for the DSC and HSM materials and, therefore, no degradation due to radiation effects is expected. Hence, change in material properties due to irradiation is not an aging effect requiring management.
- Confinement Evaluation of 24P and 52B DSCs: Appendix 3F presents the confinement evaluation of the following DSCs: 24P, 24P Long Cavity, 52B and 24PT2. Per CoC 1004 TS, these DSCs are not required to be tested to the 10^{-7} ref cm^3/sec “leaktight” requirement of ANSI N14.5-1997 [1A.5.12]. This TLAA presents the total dose commitments from a single DSC at a distance of 100 meters and 500 meters from the DSC after 20 years of storage. The TLAA results demonstrate that these DSCs meet the 10 CFR 72.104 and 10 CFR 72.106 requirements at the start of the period of extended operation.
- CISCC of Austenitic Stainless Steel DSC External Surfaces: Appendix 3G evaluates the temperatures on the external surface of the DSCs stored in each of the HSM types: Standardized HSM (HSM Model 80 or Model 102), HSM-H (the HSM Model 202 and the HSM-HS are thermally the same as the HSM-H), and HSM Model 152. The evaluation determines that the minimum confinement weld temperatures, depending on the DSC decay heat load, fall below the minimum criterion of 80 °C and are therefore within the susceptible range for CISCC. As discussed in Appendix 5A and 5B, there are numerous uncertainties in the parameters and correlations, which predict the initiation of CISCC on austenitic stainless steel. Also, the relevant field test data for evaluating CISCC of the DSC in dry storage are very scarce. Hence, CISCC is an aging effect requiring management and is included in the AMP described in Appendix 6A.

Results of DSC TLAAs:

The above listed TLAAs for Amendment 0 DSCs eliminate several aging effects from further consideration. However, the following aging effects cannot be eliminated and are therefore included in the AMP described in Appendix 6A:

- Loss of material due to crevice and pitting corrosion – affects stainless steel
- Cracking due to CISCC – affects stainless steel

Results of DSC AMR

Tables 1A-9, 1A-10, 1A-11 summarize the results of the AMR for Amendment 0 DSCs.

1A.3.4.2 Horizontal Storage Modules Time-Limited Aging Analyses

Appendix 3C evaluates the effects of temperature, thermal cycling fatigue and corrosion on the components of each of the following HSM types authorized in CoC 1004: Standardized HSM (HSM Model 80 and Model 102), HSM Model 152, and HSM-H (HSM-HS and HSM Model 202). The evaluation presented in Appendix 3C envelops all HSM types and, therefore, is bounding for the Amendment 0 HSMs. The results of Appendix 3C evaluation are as follows:

- Degradation due to elevated temperature is not an aging effect requiring management for the HSM concrete. The long-term temperatures corresponding to maximum design basis heat loads trend toward the allowed long-term temperature limits of the ACI 349 Code.
- Thermal cycling fatigue is not an aging effect requiring management for the HSM concrete. A fatigue usage factor of 0.25 due to daily and seasonal temperature fluctuations is conservatively calculated.
- Even though environmental degradation of the HSM concrete due to rebar corrosion is not expected to occur, corrosion of rebar reinforcing is considered an aging effect requiring management for the HSM concrete.
- Loss of material due to general corrosion of carbon steel and crevice and pitting corrosion of stainless steel DSC steel support structure is considered an aging effect requiring management for the HSM DSC steel support structure.
- Loss of material due to general corrosion of the carbon steel heat shield and crevice and pitting corrosion of stainless steel and aluminum heat shields is an aging effect requiring management.

Evaluation of Neutron Fluence and Gamma Radiation on Materials: The evaluation presented in Section 1A.3.4.1 included HSM materials. Therefore, as concluded in 1A.3.4.1, change in material properties due to irradiation is not an aging effect requiring management.

Results of HSM TLAAs:

The following aging affects require management for the HSM components:

- Loss of material due to corrosion of reinforcing rebar
- Loss of material due to general corrosion of carbon steel and crevice and pitting corrosion of stainless steel DSC steel support structure
- Loss of material due to general corrosion of the carbon steel heat shield and crevice and pitting corrosion of stainless steel and aluminum heat shields

Results of HSMs AMR

Table 1A-12 summarizes the results of the AMR for Amendment 0 HSMs.

1A.3.4.3 Transfer Cask TLAAs

- Fatigue Evaluation of TCs: Appendix 3B performs an evaluation of the effects of cyclical loading (fatigue) on the mechanical properties of all the TCs approved in CoC 1004 (Amendments 0 through Amendment 11, and Amendment 13). The evaluation includes the Standardized TC, the OS197 Type TCs (OS197, OS197H, OS197FC, OS197HFC, OS197FC-B, OS197HFC-B and OS197L TC) and OS200 TCs. Appendix 3B performs an evaluation for the TC based on a conservative average of 24 uses per year of a TC, for a service life of 60 years, or 1440 uses per loaded DSC. The evaluation demonstrates that the six criteria contained in the applicable edition of the ASME Code Section NC-3219.2 [1A.5.3, or 1A.5.14] are satisfied for all the components of the TCs for an extended service life of 60 years. Hence, TC fatigue is not an aging effect requiring management during the period of extended operations.

Results of TC TLAAs:

- The above-listed TLAA eliminates fatigue of the components of the Standardized TC, OS197 family of TCs, and the OS200 TC as an aging effect requiring management.
- The lead shielding and the solid neutron shielding of the Standardized TC are completely encased and are therefore not wetted by the borated water of the spent fuel pool water. Hence, the aging effect of corrosion on these two TC subcomponents is eliminated.
- Because carbon steel subcomponents of the TC are subject to general corrosion effects as discussed in Section 3.7.4.2 of Chapter 3, they have been included in the NUHOMS® AMP discussed in Appendix 6A.

- As discussed in Section 3.7.4.2 of Chapter 3, because stainless steel and carbon steel subcomponents of the TC are subject to pitting and crevice aging effects, they have been included in the NUHOMS® AMP discussed in Appendix 6A.

Results of TCs AMR

Table 1A-13 summarizes the results of the AMR for Amendment 0 TCs.

1A.3.4.4 SFA TLAAs

The spent fuel authorized for storage in 24P, 52B and 24P Long Cavity, 24PT2, and 52B DSCs is low burnup fuel with assembly average burnup of less than 45 GWd/MTU. As noted in ISG-11, Revision 3 [1A.5.9], and supported by the results from Dry Cask Storage Characterization Project [1A.5.10], FAs with burnups less than 45 GWd/MTU are unlikely to have a significant radial hydride reorientation due to limited hydride content. See Chapter 3, Section 3.8.5.1 for additional justification.

Therefore, because the condition of the SFAs stored in Amendment 0 DSCs with burnup less than 45 GWd/MTU are not expected to degrade during the period of extended operation, no AMP is required for Amendment 0 SFAs.

1A.3.5 Identification of AMPs

For SSCs within the scope of CoC 1004 renewal, aging effects that cannot be satisfactorily addressed with TLAAs described in Appendix 3, AREVA Inc. has developed an AMP, which is consistent with NUREG 1927 [1A.5.7] requirements. This AMP is described in Appendix 6A.

DSC AMPs:

Based on the AMR for the DSCs presented in Section 3.5, and as discussed in Section 3.5.5.2, the following implementing AMPs have been developed to manage the aging effects for the DSCs and associated subcomponents included in CoC 1004 Amendment 0 through 11 and Amendment 13:

- DSC External Surfaces AMP (see Section 6A.3 of Appendix 6A)
- DSC AMP for the Effects of CISCC (see Section 6A.4 of Appendix 6A)

Sections 6A.3 and 6A.4 of Appendix 6A provide a description of the 10 program elements of these two AMPs, including a graduated schedule for the baseline inspections and subsequent inspections. It should be noted that the proposed schedule for the baseline and subsequent inspections by the general licensees for the DSCs loaded under Amendment 0 have a grace period described in Sections 6A.3 and 6A.4 of Appendix 6A.

HSM AMPs:

Based on the AMR for the HSMs presented in Section 3.6, and as discussed in Section 3.6.5.2, the following implementing AMPs have been developed to manage the aging effects for the HSMs and associated subcomponents included in CoC 1004 Amendment 0 through 11 and Amendment 13:

- HSM AMP for External and Internal Surfaces - applicable to HSM, DSC support structures (See Section 6A.5 of Appendix 6A)
- HSM Inlets and Outlets Ventilation AMP - applicable to HSM (See Section 6A.6 of Appendix 6A)

Section 6A.5 of Appendix 6A provides a description of the ten program elements of the HSM AMP, including a graduated schedule for the baseline inspections and subsequent inspections. It should be noted that the proposed schedule for the baseline and subsequent inspections by the general licensees for the HSMs loaded under Amendment 0 have a grace period described in Sections 6A.5 of Appendix 6A.

The HSM Inlet and Outlet Ventilation AMP described in Section 6A.6 of Appendix 6A is performed daily.

TC AMP:

Based on the AMR for the TCs presented in Section 3.7, and as discussed in Section 3.7.5.2, the TC AMP manages the aging effects for the TCs and associated subcomponents included in CoC 1004 Amendment 0 through 11 and Amendment 13. This AMP is described in Section 6A.7 of Appendix 6A.

SFA AMP

Based on the AMR for SFAs presented in Section 3.8 and as discussed in Section 3.8.5.1 and Section 1.A.3.4.4, low burnup fuel with assembly average burnup of less than 45 GWd/MTU will not degrade during the period of extended operation and thus no AMP is required for low burnup fuel.

1A.4 Fuel Retrievability

The retrievability evaluation presented in Section 3.9 is a generic evaluation that is applicable to Amendment 0 SSCs. Based on the AMR results of the SFAs in Amendment 0, and the AMPs of the DSCs and HSMs, as discussed in this appendix, there is reasonable assurance that the Amendment 0 SFAs will be retrievable by normal means during the period of extended operation.

1A.5 References (Appendix 1A)

1A.5.1 Pacific Nuclear Fuel Services, Inc., "Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Docket No. 72-1004.

a. NUH-003, Revision 0, 12/20/1990.

b. NUH-003, Revision 1, 9/25/1991.

c. NUH-003, Revision 3, 11/5/1993.

1A.5.2 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004," Revision 0, January 23, 1995, Docket No. 72-1004.

1A.5.3 American Society of Mechanical Engineers, "ASME Boiler and Pressure Vessel Code," Section III, 1983 Edition, with Winter 1995 Addenda.

1A.5.4 Vectra Technologies, Inc., "NUH-003, Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 3A," Docket No. 72-1004, June 1995.

1A.5.5 Vectra Technologies, Inc., "NUH-003, Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 4A," Docket No. 72-1004, June 1996.

1A.5.6 U.S. Nuclear Regulatory Commission, Office of Nuclear Materials Safety and Safeguards, "Safety Evaluation Report of VECTRA Technologies, Inc., a.k.a Pacific Nuclear Fuel Services, Inc., Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Docket No. 72-1004, December 1994.

1A.5.7 U.S. Nuclear Regulatory Commission, NUREG-1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance, Revision 0," March 2011.

1A.5.8 American National Standards Institute, Inc., "American National Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials," ANSI N14.6-1993.

1A.5.9 Interim Staff Guidance No. 11, Revision 3, "Cladding Considerations for the Transportation and Storage of Spent Fuel," NRC Spent Fuel Project Office, November 2003.

1A.5.10 EPRI TR-1002882, "Dry Cask Storage Characterization Project, Final Report", Electric Power Research Institute, Palo Alto, CA, 1998.

1A.5.11 Technical Specifications for the Standardized NUHOMS® Horizontal Storage System, Certificate of Compliance No. 1004, Amendment 0, Docket 72-1004.

1A.5.12 American National Standards Institute, Inc., "Standard for Radioactive Materials – Leakage Tests on Packages for Shipments," ANSI N14.5-1997.

1A.5.13 American Society of Mechanical Engineers, "ASME Boiler and Pressure Vessel Code," Section III, 1998 Edition, with 1999 Addenda.

1A.5.14 American Society of Mechanical Engineers, "ASME Boiler and Pressure Vessel Code," Section III, 1998 Edition, with Addenda through 2000.

1A.5.15 American Society of Mechanical Engineers, "ASME Boiler and Pressure Vessel Code," Section III, 2004 Edition, with Addenda through 2006.

Table 1A-1
NUHOMS®-24P DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (SAR Rev. 3A)	Drawing Revision Level (SAR Rev. 4A)
NUH-03-1020-SAR	General License NUHOMS® DSC for PWR Fuel – Basket Assembly	2	2
NUH-03-1021-SAR	General License NUHOMS® DSC for PWR Fuel – Shell Assembly	2	3
NUH-03-1022-SAR	General License NUHOMS® DSC for PWR Fuel Basket – Shell Assembly	1	1
NUH-03-1023-SAR	General License NUHOMS® DSC for PWR Fuel – Main Assembly	2	3

Table 1A-2
NUHOMS®-52B DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (SAR Rev. 3A)	Drawing Revision Level (SAR Rev. 4A)
NUH-03-1029-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Shell Assembly	2	3
NUH-03-1030-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket-Shell Assembly	1	1
NUH-03-1031-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Main Assembly	2	3
NUH-03-1032-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket Assembly	3	3

Table 1A-3
NUHOMS®-24P Long Cavity DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (SAR Rev. 3A)	Drawing Revision Level (SAR Rev. 4A)
NUH-03-1050-SAR	General License NUHOMS®-24P Long Cavity DSC Basket Assembly	NA(1)	0
NUH-03-1051-SAR	General License NUHOMS®-24P Long Cavity DSC Shell Assembly	NA(1)	0
NUH-03-1052-SAR	General License NUHOMS®-24P Long Cavity DSC Basket – Shell Assembly	NA(1)	0
NUH-03-1053-SAR	General License NUHOMS®-24P Long Cavity DSC – Main Assembly	NA(1)	0

Note:

(1) NUHOMS®-24P Long Cavity DSC was added in SAR Revision 4A under CoC Condition 9.

Table 1A-4
NUHOMS® HSM Design Drawings

Design Drawing No.	Description	Drawing Revision Level (SAR Rev. 3A)	Drawing Revision Level (SAR Rev. 4A)
NUH-03-6008-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – ISFSI General Arrangement	4	5
NUH-03-6009-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Main Assembly	3	4
NUH-03-6010-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit Assembly	0	1
NUH-03-6014-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit	4	5
NUH-03-6015-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Roof Slab Assembly	3	4
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	2	3
NUH-03-6017-01-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Accessories	3	4
NUH-03-6018-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Shield Wall Plan and Details	4	5
NUH-03-6024-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Erection Hardware	0	1

Table 1A-5
NUHOMS® Onsite TC Design Drawings

Design Drawing Number	Description	Drawing Revision Level (SAR Rev. 3A)	Drawing Revision Level (SAR Rev. 4A)
NUH-03-8001-SAR	General License NUHOMS® ISFSI Onsite TC – Structural Assembly	3	4
NUH-03-8002-SAR	General License NUHOMS® ISFSI Onsite TC – Inner and Outer Shell Assembly	3	4
NUH-03-8003-SAR	General License NUHOMS® ISFSI Onsite TC – Main Assembly	3	4

Proprietary Information on Pages 1A-28 through 1A-49
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1B
Renewal of the Standardized NUHOMS® System Approved under Amendments 1 and 2 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1B.1 Introduction

Amendment 1 to Certificate of Compliance (CoC) 1004 [1B.5.3] was issued by the U.S. Nuclear Regulatory Commission (NRC) to reflect the transfer of CoC from VECTRA Technologies, Inc., to Transnuclear West, Inc. (TNW), effective April 27, 2000. This CoC 1004 transfer was driven by the purchase by TNW of VECTRA's intellectual properties and assets associated with the NUHOMS® technology. There was no change in the authorized contents of CoC 1004 or the associated Technical Specifications (TS) or the technical content of the NUHOMS® Final Safety Analysis Report (FSAR). This transfer of CoC 1004 to TNW is reflected in NUHOMS® FSAR Revision 5 [1B.5.5].

Due to the administrative nature of the change authorized under Amendment 1, with no change in the technical content of the NUHOMS® CoC, Amendment 1 has been grouped together with Amendment 2 to CoC 1004 [1B.5.4] under this Appendix B for CoC 1004 renewal application. No additional discussion has been included in this Appendix for Amendment 1 renewal.

VECTRA Inc. had previously submitted an application for CoC 1004 Amendment 2 to the NRC on February 16, 1996 [1B.5.1], as supplemented, to update the fuel specification tables. These updated fuel specification tables provide a simplified method to the general licensees for determining acceptable spent fuel to be stored in the NUHOMS®-24P (24P) and NUHOMS®-52B (52B) Systems.

Following purchase of VECTRA's intellectual assets, TNW submitted an application for CoC 1004 Amendment 3 to the NRC on July 26, 1999 [1B.5.2], as supplemented, to allow licensees to store burnable poison rod assemblies (BPRAs) with Babcock and Wilcox (B&W) 15x15 and WE 17x17 spent fuel assemblies (SFA) in the NUHOMS®-24P Long Cavity DSC.

The two separate applications described above were consolidated and approved by the NRC as Amendment 2 to CoC 1004 [1B.5.4], effective September 5, 2000.

1B.1.1 Brief Description of Amendment 2

Change 1 (Original Amendment 2 Submittal):

Change 1 incorporated new fuel qualification tables for the pressurized water reactor (PWR) and boiling water reactor (BWR) fuels authorized for storage in the Standardized NUHOMS® System. These tables present the minimum required cooling time for fuel as a function of initial enrichment and fuel burnup. The use of these tables provides a simplified approach for users of the Standardized NUHOMS® System to select acceptable fuel for storage without calculating specific fuel assembly (FA) decay heat and radiation source terms. The supporting structural analysis showed that the maximum dry shielded canister (DSC) pressure under accident conditions increases to 60 psig from 50 psig. NUHOMS® FSAR Revision 5 [1B.5.5] has been updated to incorporate supporting structural, thermal, criticality, and shielding analysis. This change did not result in any physical change to the configuration of the Standardized NUHOMS® System.

Change 2 (Original Amendment 3 Submittal):

Change 2 authorized the addition of burnable poison rod assemblies (BPRAs) for the B&W 15x15 and Westinghouse (WE) 17x17 FA types to the authorized contents of the long cavity 24P DSC described in Appendix H of the Certified Safety Analysis Report (CSAR) [1B.5.10]. NUHOMS® FSAR Revision 5 [1B.5.5] has been updated to incorporate supporting structural, thermal, criticality, and shielding analysis. This change did not result in any physical change to the configuration of the Standardized NUHOMS® System.

1B.1.2 Design Drawings Certified in Amendment 2

The January 1, 2000 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendments 1 and 2 to CoC No. 1004.

Amendments 1 and 2 to CoC 1004 did not involve any change to the design drawings of the Standardized NUHOMS® System included in Appendix E of NUHOMS® FSAR Revision 5 [1B.5.5].

Tables 1B-1, 1B-2, 1B-3, 1B-4, and 1B-5 provide a list of the drawings for the 24P DSC, 52B DSC, 24P Long Cavity DSC, horizontal storage module (HSM) and onsite transfer cask (TC) that are contained in NUHOMS® FSAR Revision 5 [1B.5.5], which was docketed following the approval of Amendments 1 and 2. These Safety Analysis Report (SAR) drawings reflect the certified Standardized NUHOMS® System configuration along with additional changes implemented under the provisions of CoC Condition 9.

1B.1.3 Changes to the Standardized NUHOMS® System Implemented in FSAR Revision 5

FSAR Revision 5 [1B.5.5] incorporated changes due to the approval of Amendments 1 and 2 to CoC 1004. FSAR Revision 5 also incorporated design modifications and supporting analysis implemented under Condition 9 of CoC 1004 subsequent to the issuance of CSAR Revision 4A. A brief summary of the changes made to the Standardized NUHOMS® System configuration, along with a brief justification, is included in the biannual report submitted to the NRC [1B.5.6].

As noted in the biannual report [1B.5.6], a large majority of the changes implemented into FSAR Revision 5 under CoC Condition 9 resulted from the corrective actions implemented by VECTRA in response to the NRC's "Demand for Information (DFI)" [1B.5.8].

As a result of the DFI, a comprehensive license review of the Standardized NUHOMS® System was performed initially by VECTRA, and completed by TNW following its purchase of VECTRA's intellectual assets. This review identified deficiencies with the 24P and 52B DSC structural evaluations. In addition, TNW implemented independent reviews of the HSM and TC calculations. The deficiencies identified by the reviews were corrected by performing a reanalysis of the affected evaluations. All of the reanalysis changes were evaluated in accordance with CoC Condition 9, and determined not to require an amendment to CoC 1004.

Upon completion of the required remedial activities resulting from the DFI, the NRC authorized full resumption of fabrication activities of the NUHOMS® cask per IR 72-1004/98-209 [1B.5.9]. This Inspection Report (IR) specifically concluded that "TN West's reevaluation of the DSC calculations sufficiently demonstrated that the proposed design changes identified by the reevaluation were bounded by the NUHOMS® FSAR [1B.5.5] and that no amendments to CoC 1004 were necessary."

A list of the significant changes incorporated into FSAR Revision 5 under CoC Condition 9 is provided in Sections 1B.1.3.1 through 1B.1.3.8.

1B.1.3.1 24P DSC Changes

The 24P DSC shell and basket configuration as described in FSAR Revision 5 [1B.5.5] drawings, located in FSAR Appendix E.1.1, has been modified as listed below. The text, tables, and figures shown in FSAR Chapters 1.2, 1.3, 3.2, 3.3, 3.4, 4.2, 8.1, and 8.2 were updated accordingly to agree with the revised configuration, and reflect the revised results from the supporting structural and criticality calculations.

Description of Change	Associated SRS/SE
• For each DSC guidesleeve, the four guidesleeve clips located at the bottom surface of the bottom spacer disc were removed and replaced with two new	72-1013 and 72-1018

Description of Change	Associated SRS/SE
stainless steel extraction stops per guidesleeve located between the second and third spacer disc. • Increased the length of the guidesleeves by 0.5″ and added scallops to the bottom of guidesleeves. • Revised the DSC guidesleeve corner weld from an intermittent weld to a continuous weld. • Revised the DSC support rod diameter from 3.00″ to 3.25″. Revised the support rod material from SA-36 carbon steel or SA-479 Type 304 stainless steel to SA-479 Type XM-19 stainless steel. • Separated the DSC Level D internal pressure loading into a Level C and a Level D load case with pressure magnitudes specified for each case. The Level C pressure of 41 psig is to be applied to the DSC inner top and bottom cover plates. The Level D pressure of 50.3 psig remains unchanged and is to be applied to the inner and outer top and bottom cover plates. This change revises the FSAR Load Combination Table 3.2-6. • Redefined the DSC Level A/B/C/D loads for insertion into the HSM as 80 kips, and redefined the Level A/B/C/D loads for extraction from the HSM as 60/60/80/80 kips. This represents an increase to the Level A, B, and C loads. However, the maximum load of 80 kips is unchanged. • Clarified seismic loadings for the DSC shell and basket assemblies. Specifically, the acceleration values required are noted to be very conservative and the more accurate values from Reg. Guide 1.60 are stated. However, evaluations are still performed using the previous conservative accelerations. • Revised the acceptance criteria for weldment of the support rod to the spacer disks to utilize the ASME Subsection NF stress acceptance criteria, including weld and base metal checks. • Augmented the stability criteria for the support rods to include the ASME Code Subsection NF and Appendix F interaction criteria and the use of a factored (2/3) analytically calculated failure load.	
• Revised the callout of welds for the lifting lug to add a requirement for a fillet weld at the lower end of the lifting lug. Also, revised the weld of the top shield plug support ring to the DSC shell to require a continuous length of fillet weld on the bottom of the support ring to the shell, centered under each lug. • Revised the weld details of the DSC inner top cover plate to DSC shell weld from a ¼″ minimum throat groove weld to a 3/16″ minimum throat groove weld. • Reduced the minimum combined thickness of the top closure plates from 10.16″ to 10.04″ to allow for a recess of the top outer cover plate to improve closure welding.	96-437, 96-361, and 96-315
• Provided flexibility in acceptance criteria for the radial gaps between the DSC shell and the top shield plug gap for the 24P DSC shell given in Appendix E.1.1 drawings.	72-1344 and 72-1315
• Performed an evaluation of the DSC components for a 20 psig load associated with DSC blowdown during fuel loading. The load combination results for the	72-1327

Description of Change	Associated SRS/SE
DSC inner top cover plate are reported in FSAR Tables 8.1-10 and 8.2-11. • Corrected an omission in FSAR Tables 8.1-1 and 8.1-2 to reflect the applicability of external pressure loads due to flooding. Also, added the results of DSC flood load evaluations to the FSAR. Stresses resulting from DSC reflood operations were addressed as being bounded by the 20 psig blowdown discussed in the above change. • Reformatted the DSC load combination table (FSAR Table 3.2-6) and added a new table (FSAR Table 8.2-24 to the FSAR to provide a detailed description of all the applicable loads to be considered for the DSC analysis.	

1B.1.3.2 52B DSC Changes

The 52B DSC shell and basket configuration as described in FSAR Revision 5 [1B.5.5] drawings, located in FSAR Appendix E.1.2, has been modified as listed below. The text, tables, and figures shown in FSAR Chapters 1.2, 1.3, 3.2, 3.3, 3.4, 4.2, 8.1, and 8.2 were revised accordingly to agree with the revised configuration, and reflect the revised results from the supporting structural and criticality calculations.

Description of Change	Associated SRS/SE
• Replaced the existing four (4) SA-479 Type 304 stainless steel or SA-36 carbon steel 3.00″ ∅ support rods with six (6) support assemblies consisting of a series of sleeves (3.25″ ∅ OD, 1.33″ ∅ ID, SA-564, Type 630) and a rod (1.25″ ∅ OD, SA-564, Type 630). The purpose of this change is to increase the strength of the support assemblies. The overall length of the support rod assemblies is unchanged from that of the support rods. The location of the two new assemblies is at the 0 and 180 azimuths. The rod and sleeve assemblies will be preloaded to “lock” the basket together during fabrication and installation. The maintenance of this preload is not a design requirement • Increased the thickness of the top spacer disk from 2.50″ to 3.00″ and changed the material from SA-516 Gr. 70 to SA-537, Class 2 carbon steel. The impact requirements for the spacer disk material remain unchanged. The fuel cell openings in the top spacer disk contain no neutron absorber plate slots, only a square hole with the same 6.00″ width dimension. The top spacer disk has also been relocated 2″ higher in the basket. • Changed the connection of the neutron absorber plates to the top spacer disk. The neutron absorber plates are now connected to the bottom of the top spacer disk and do not pass through the top spacer disk. • Reduced the length of the neutron absorber plate slots in the bottom 8 spacer disks designed to restrain the neutron absorber plate. The extension of the slot beyond the edge of the fuel cell opening is reduced from 0.28″ to 0.20″. This increases the ligament width at the cross location. • Relocated the two keyways in the top spacer disk. They are shifted clockwise 7° ± 1° from the 0° and 180° positions to avoid the two new support assemblies	72-1033, 72-1026, 96-315, 96-361, and 96-437

Description of Change	Associated SRS/SE
now at 0° and 180°. The width and depth of the keyway in the top spacer disk remain unchanged. • Replaced the coating on the basket from a thermal spray aluminum to an electroless nickel coating for the spacer disks and top shield plug. The coating has been revised in accordance with IEB 96-04 requirements for control of hydrogen gas generation during loading/unloading operations. The selection of the nickel coating was submitted and accepted by the NRC for the 52B design. • Separated the DSC Level D internal pressure loading into a Level C and a Level D load case with correct pressure magnitudes for each case. The Level C pressure of 41 psig is to be applied to the DSC inner top and bottom cover plates. The Level D pressure of 50.3 psig remains unchanged and is to be applied to the inner and outer top and bottom cover plates. This change revises the FSAR Load Combination Table 3.2-6. • Redefined the DSC Level A/B/C/D loads for insertion into the HSM as 80 kips, and the Level A/B/C/D loads for extraction from the HSM have been redefined as 60/60/80/80 kips. This represents an increase to the Level A, B, and C loads. However, the maximum load of 80 kips is unchanged. • Clarified seismic loadings for the DSC shell and basket assemblies in FSAR section 8.2.3. Specifically, the acceleration values required are noted to be very conservative and the more accurate values from Reg. Guide 1.60 are stated. However, evaluations are still performed using the previous conservative acceleration values. • Augmented the stability criteria for the support rods to address the ASME Code Subsection NF and Appendix F interaction criteria and the use of a factored (2/3) analytically calculated failure load. • Provided flexibility in acceptance criteria for the radial gaps between the DSC shell and the top shield plug. • Reduced the minimum required combined thickness of the top closure plates from 9.91″ to 9.79″ to allow for a recess of the top outer cover plate to improve closure welding. • Revised the callout of welds for the lifting lug to add a requirement for a fillet weld at the lower end of the lifting lug to bring the design configuration into compliance with the structural analysis of the lug. • Revised the weld details of the DSC inner top cover plate to DSC shell weld from a ¼″ minimum throat groove weld to a 3/16″ minimum throat groove weld. • Revised the weld of the DSC top shield plug support ring to the DSC shell to require a continuous length of fillet weld on the bottom of the support ring to the shell, centered under each lug.	
• Performed an evaluation of the DSC components for a 20 psig load associated with DSC blowdown during fuel loading. The load combination results for the DSC inner top cover plate are reported in FSAR Tables 8.1-11, and 8.2-12. • Corrected an omission in FSAR Tables 8.1-1 and 8.1-2 to reflect the applicability of external pressure loads due to flooding. This change also adds the results of flood load evaluations to the FSAR. Stresses resulting from DSC reflood operations are addressed as being bounded by the 20 psig blowdown discussed above.	72-1327

Description of Change	Associated SRS/SE
• Reformatted the DSC load combination table (FSAR Table 3.2-6) and added a new table (FSAR Table 8.2-24) to the FSAR to provide a detailed description of all the applicable loads to be considered for the DSC analysis.	

1B.1.3.3 24P Long Cavity Dry Shielded Canister Changes

All of the modifications described in B.1.3.1 for the 24P DSC have also been implemented for the 24P Long Cavity DSC with an additional change. This change revised the top and bottom shield plug from a solid lead plug configuration to an encased shield plug assembly with stiffeners to bring the configuration into compliance with the results of the revised structural analysis (Reference SE 72-1175).

1B.1.3.4 Horizontal Storage Module Changes

Minor changes to the HSM configuration as described in Appendix E.2 drawings are implemented to improve fabricability, provide tolerance clarifications, and fix drafting errors.

In addition, the HSM structural analysis has been revised to resolve deficiencies identified in an audit. The text, tables, and figures shown in Revision 5 of the NUHOMS® FSAR Chapters 3.2, 4.2, 8.1 and 8.2 were revised accordingly to agree with the new HSM structural and thermal calculations.

Description of Change	Associated SRS/SE
• Removed the painting requirement for the inside surface of the HSM heat shields. The HSM thermal calculation was revised to address this issue. • Revised the HSM structural calculation with an updated ANSYS model to reflect the latest HSM geometry and design parameters. The revised calculation corrected errors identified in the audit, provided clarification of the methodology and assumptions used. The revised DSC weights and the updated HSM thermal analysis results were also incorporated into the revised HSM structural calculation. The HSM design as described in the FSAR Revision 5 [1B.5.5] remains qualified by the HSM reanalysis.	72-1327, 96-399 and 96-410

1B.1.3.5 Transfer Cask Changes

The TC configuration as described in Appendix E.3 drawings has been modified as listed. NUHOMS® FSAR Revision 5 Table 8.1.3 has been revised accordingly to agree with the alternative materials allowed for the configuration.

In addition, the OS197 and Standardized TCs have been reanalyzed to resolve deficiencies and to incorporate updated DSC weight data. This reanalysis did not result in any physical change to the TC configuration. The text, tables, and figures shown in NUHOMS® FSAR Revision 5 Chapters 3.2, 8.1, 8.2 and Appendix C have been revised accordingly to add OS197 TC analysis results and to update the Standardized TC results, based on the new or revised structural and thermal calculations.

Description of Change	Associated SRS/SE
• Allowed the use of alternative materials for the TC trunnion sleeves (SA-240 Type 304N or SA-182 Type F304N) and the 3″ thick TC top cover plate (SA-516 Grade 70 or SA-240Type 304). • Limited the use of the single leg neutron shield panel support angle for use only with solid neutron shielding (i.e., Standardized TC). • Permitted the use of alternate lifting hardware.	72-1317
• Evaluated the Standardized TC, including the BWR cask collar to determine the impact of updated DSC weight data. The combined stresses for each TC component remain within ASME Code [1B.5.15] allowable stresses. • Reanalyzed the OS197 TC to address issues identified in an independent assessment review. The revision added a tornado load analysis and addressed revised thermal and DSC weight data. Combined stresses for each TC component remain within ASME Code [1B.5.15] allowable stresses.. • Reanalyzed the OS197 TC liquid neutron shield to address issues identified in an independent assessment review. The revised analysis considered additional load conditions and limited OS197 TC evaluation with only the double-sided support angle design. Combined stresses for each TC component remain within ASME Code [1B.5.15] allowable stresses. • Analyzed the OS197 TC lifting trunnions to address issues identified in an independent assessment review. The new analysis evaluated loads due to critical lifting, transfer, HSM loading/unloading and seismic. Combined stresses for the trunnions, sleeves, shell, and connecting welds remain within the allowable stresses defined by NUREG 0612 [1B.5.11] and ANSI N14.6 [1B.5.12] for the critical lift conditions and ASME Code [1B.5.15] allowables for all other load conditions.	72-1327

1B.1.3.6 Procedure Changes

The following changes were made to the procedures given in Chapter 5 of FSAR Revision 5 [1B.5.5]:

Description of Change	Associated SRS/SE
• Revised the helium test pressure to be consistent with values recommended in the detailed operations procedures for the Standardized NUHOMS® System. • Added a note to FSAR to limit the DSC pressure during reflood operations. • Clarified the DSC vacuum drying procedures for consistency with CoC 1004 TS 1.2.2 limits. Added details for releasing and re-evacuating helium from the DSC after leak testing in accordance with CoC TS 1.2.2 limits. • Made minor changes to the sequence of steps related to the installation/removal of the axial retainer.	72-1327

1B.1.3.7 Addition of ASME Code Exceptions for NUHOMS® Components

FSAR Sections 4.8 and 4.9 have been added to provide a list of alternatives to the ASME Code for the DSC and TC and to provide a justification for these alternatives. The details of the code alternatives do not constitute a change from the intent of the code criteria described in the FSAR (Reference SE 72-1327).

1B.1.3.8 Miscellaneous Changes

In addition to the above-described changes, several miscellaneous modifications as listed below were also implemented into FSAR Revision 5:

Description of Change	Associated SRS/SE
• Developed a new calculation, in response to a non-conforming condition of "as-built" cavity length for a canister, to determine the allowed irradiation growth versus the minimum cold cavity length. The text in FSAR Chapter 8.1 was revised accordingly to reflect the methodology and results of the supporting calculation.	72-1233
• Addressed an inconsistency between FSAR safety classification listings and the DSC drawings in Appendix E of the FSAR. The result was to revise Table 3.3-1 and Table 3.4-1 in FSAR Chapter 3 to clarify that the important-to-safety (ITS) classification applies only to lead shield plugs associated with the 24P Long Cavity DSC.	72-1248
• Addressed a revision to the shielding analysis to include dose rate calculations for the BWR canister system. The text and tables in FSAR Chapter 7.3 are revised accordingly to reflect the revised results from the shielding calculation.	72-1514
• Addressed a revision to FSAR Chapter 4.2 to clarify the requirements for, and qualification of, the aggregates used in the HSM concrete mix.	96-450

Description of Change	Associated SRS/SE
• Addressed a revision to FSAR Table 7.2-3 to modify the gamma energy spectrum for PWR fuel by doubling the group fractions for the 9.5 MeV, 7 MeV and 5 MeV energy groups. The effect of the changes is evaluated in the shielding calculation.	97-482

1B.1.4 Amendments 1 and 2 Loading Overview

Table 1B-6 provides an overview of the FAs loaded under CoC 1004 Amendments 1 and 2 at the Oconee Nuclear Station site. The data contained in this table is for general information and is current as of the time this data was compiled for this application.

1B.2 Scoping Evaluation of CoC 1004 Amendment 1 and Amendment 2 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 1 [1B.5.3], CoC 1004 Amendment 2 [1B.5.4], CoC 1004 Amendment 2 TS [1B.5.7], CoC 1004 Amendment 2 SER [1B.5.13] and 1B.5.14], and the NUHOMS® FSAR Revision 5 [1B.5.5].

The SSCs determined to be within the scope of CoC 1004 Amendment 1 and Amendment 2 renewal are identical to those listed in Section 1A.2, Appendix 1A for Amendment 0.

1B.3 Aging Management Review of Amendment 1 and Amendment 2 SSCs

The structures, systems, and components (SSCs) determined to be within the scope of CoC 1004 Amendment 1 and Amendment 2 renewal are unchanged relative to those listed in Appendix 1A for Amendment 0.

The 72.48 changes in the subcomponents, including the materials of construction of the 24P DSC, 24P Long Cavity DSC, 52B DSC, HSM, and onsite TC are identified in Tables 1B-7, 1B-8, 1B-9, 1B-10, and 1B-11, respectively.

There is no change in the environment to which these in-scope subcomponents are exposed on a recurring basis relative to the environment listed in Appendix 1A.

The discussion provided in Appendix 1A, Section 1A.3 for Amendment 0 SSCs is also applicable to Amendment 1 and 2 SSCs regarding the following:

- Identification of aging effects requiring management
- Identification of time-limited aging analysis (TLAAs)
- Identification of aging management programs (AMPs)

The 72.48 changes implemented in the material of construction of the subcomponents of the 24P DSC, 24P Long Cavity DSC, 52B DSC, HSM and onsite TC did not alter the results of the AMR as documented in Tables 1B-7, 1B-8, 1B-9, 1B-10, and 1B-11, respectively.

1B.4 Fuel Retrievability

The spent fuel authorized for storage in CoC 1004 Amendments 1 and 2 is low burnup fuel with assembly average burnup of less than 45 GWd/MTU.

CoC 1004 Amendments 1 and 2 modifications, as well as the 10 CFR 72.48 changes described in Section 1B.1.3 do not alter the justification provided in Section 1A.4, Appendix 1A regarding fuel retrievability. Therefore, retrievability of fuel stored in Amendments 1 and 2 SSCs remains assured.

1B.5 References (Appendix 1B)

1B.5.1 VECTRA Inc., "Application for Amendment No. 2 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks," February 16, 1996.

1B.5.2 Transnuclear West, Inc., "Application for Amendment No. 3 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks," July 26, 1999.

1B.5.3 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 1," April 27, 2000, Docket No. 72-1004.

1B.5.4 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 2," September 2000, Docket No. 72-1004.

1B.5.5 Transnuclear West, Inc., "NUH-003, Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 5," Docket No. 72-1004, September 2000.

1B.5.6 Transnuclear West, Inc., Letter to the U.S. Nuclear Regulatory Commission, NUH03-00-1657, "Summary Report of CoC Condition 9 Changes Implemented in NUHOMS® FSAR Revision 5 and Associated Safety Evaluations," dated September 15, 2000, Docket No. 72-1004.

1B.5.7 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment No. 2," Docket No. 72-1004, September 2000.

1B.5.8 U.S. Nuclear Regulatory Commission (NRC) Letter to VECTRA Technologies, Inc., "Demand for Information," dated January 13, 1997 (Docket 72-1004).

1B.5.9 U.S. NRC Inspection Report 72-1004/98-209 dated October 30, 1998.

1B.5.10 Vectra Technologies, Inc., "NUH-003, Certified Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 4A," Docket No. 72-1004, June 1996.

1B.5.11 U.S. Nuclear Regulatory Commission, "Control of Heavy Loads at Nuclear Power Plants," NUREG-0612 (July 1980).

1B.5.12 American National Standards Institute, Inc., "American National Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials," ANSI N14.6-1993.

1B.5.13 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report to Allow the Addition of Burnable Poison Rod Assemblies, Model Nos. NUHOMS®-24P and -52B, Transnuclear West, Inc., Certificate of Compliance No. 1004," Docket No. 72-1004, September 2000.

1B.5.14 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report to Include a New Fuel Specification, Standardized NUHOMS® Horizontal Modular Storage System, Transnuclear West, Inc., Certificate of Compliance No. 1004," Docket No. 72-1004, September 2000.

1B.5.15 American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code, Section III, 1983 Edition, with Winter 1995 Addenda.

Table 1B-1
NUHOMS®-24P DSC Design Drawings

Design Drawing No.	Description	FSAR Rev. 5
NUH-03-1020-SAR	General License NUHOMS® DSC for PWR Fuel – Basket Assembly	3
NUH-03-1021-SAR	General License NUHOMS® DSC for PWR Fuel – Shell Assembly	4
NUH-03-1022-SAR	General License NUHOMS® DSC for PWR Fuel Basket – Shell Assembly	2
NUH-03-1023-SAR	General License NUHOMS® DSC for PWR Fuel – Main Assembly	4

Table 1B-2
NUHOMS®-52B DSC Design Drawings

Design Drawing No.	Description	FSAR Rev. 5
NUH-03-1029-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Shell Assembly	4
NUH-03-1030-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket-Shell Assembly	2
NUH-03-1031-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Main Assembly	4
NUH-03-1032-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket Assembly	4

Table 1B-3
NUHOMS®-24P Long Cavity DSC Design Drawings

Design Drawing No.	Description	FSAR Rev. 5
NUH-03-1050-SAR	General License NUHOMS®-24P Long Cavity DSC - Basket Assembly	1
NUH-03-1051-SAR	General License NUHOMS®-24P Long Cavity DSC - Shell Assembly	1
NUH-03-1052-SAR	General License NUHOMS®-24P Long Cavity DSC- Basket – Shell Assembly	1
NUH-03-1053-SAR	General License NUHOMS®-24P Long Cavity DSC – Main Assembly	1

Table 1B-4
NUHOMS® HSM Design Drawings

Design Drawing No.	Description	FSAR Rev. 5
NUH-03-6008-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – ISFSI General Arrangement	6
NUH-03-6009-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Main Assembly	5
NUH-03-6010-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit Assembly	2
NUH-03-6014-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit	6
NUH-03-6015-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Roof Slab Assembly	5
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	4
NUH-03-6017-01-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Accessories	5
NUH-03-6018-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Shield Wall Plan and Details	6
NUH-03-6024-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Erection Hardware	2

Table 1B-5
NUHOMS® Onsite Transfer Cask Design Drawings

Design Drawing No.	Description	FSAR Rev. 5
NUH-03-8000-SAR	General License NUHOMS® ISFSI Onsite TC – Overview(1)	0
NUH-03-8001-SAR	General License NUHOMS® ISFSI Onsite TC – Structural Assembly	5
NUH-03-8002-SAR	General License NUHOMS® ISFSI Onsite TC – Inner and Outer Shell Assembly	5
NUH-03-8003-SAR	General License NUHOMS® ISFSI Onsite TC – Main Assembly	5

Note:

(1) This was a new drawing created in FSAR Rev. 5 to provide an overview of the various TC configurations.

Proprietary Information on Pages 1B-21 through 1B-26
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1C
Renewal of the Standardized NUHOMS® System Approved under Amendment 3 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1C.1 Introduction

Transnuclear West, Inc. (TNW) submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 3 to the U.S. Nuclear Regulatory Commission (NRC) on July 15, 2000 [1C.5.1], as supplemented, to add the NUHOMS®-61BT System to the Standardized NUHOMS® System. CoC 1004 Amendment 3 was approved by the NRC effective September 12, 2001 [1C.5.2].

1C.1.1 Brief Description of Amendment 3

The NUHOMS®-61BT System consists of a NUHOMS®-61BT dry shielded canister (DSC) stored in a NUHOMS® horizontal storage module (HSM) and transferred in an OS197 transfer cask (TC). A description of the NUHOMS®-61BT System and the associated safety analysis is provided in Appendix K of the Final Safety Analysis Report (FSAR) Revision 6 [1C.5.3].

Amendment 3 does not make any changes to the HSM or the OS197 TC configuration that is described in Appendix 1B of this application.

The NUHOMS®-61BT DSC is designed to store 61 intact standard boiling water reactor (BWR) fuel assemblies (FAs) with or without fuel channels, with a maximum decay heat of 300 watts/assembly, or a total of 18.3 kW. The maximum fuel assembly weight with channel is 705 lb.

Intact BWR FAs with various combinations of burnup, enrichment, and cooling time can be stored in the NUHOMS®-61BT DSC provided the fuel assembly parameters fall within the design limits specified in Table K.2-1 and Table K.2-4 of Appendix K2, FSAR Revision 6 [1C.5.3].

The maximum design basis internal pressures for the NUHOMS®-61BT DSC are 10, 20 and 65 psig for normal, off-normal and accident conditions of storage, respectively.

1C.1.2 Description of the NUHOMS®-61BT DSCs

Each NUHOMS®-61BT DSC consists of a fuel basket and a canister body (shell, canister inner bottom and top cover plates and shield plugs). The NUHOMS®-61BT DSC shell thickness is 0.50" instead of 0.625" as used for the NUHOMS®-24P or -52B DSC designs. The bottom and top shield plugs are 5.0" and 7.0", respectively, as compared to the 5.75" and 8.0" used for the NUHOMS®-52B DSC design.

The confinement vessel for the NUHOMS®-61BT DSC consists of a shell, which is a welded, stainless steel cylinder with an integrally-welded, stainless steel bottom closure assembly; and a stainless steel top closure assembly, which includes the vent and drain system.

There are no penetrations through the confinement vessel. The draining and venting systems are covered by the seal-welded, outer top closure plate and vent port plug. To preclude air in-leakage, the canister cavity is pressurized above atmospheric pressure with helium. The NUHOMS®-61BT DSC is designed and tested to meet the leaktight criteria of ANSI N14.5-1997 [1C.5.9].

The basket structure consists of assemblies of stainless steel fuel compartments held in place by basket rails and a hold-down ring. The four and nine fuel compartment assemblies are held together by welded stainless steel boxes wrapped around the fuel compartments, which also retain the neutron poison plates between the compartments in the assemblies. The borated aluminum or boron carbide/aluminum metal matrix composite plates or Boral® (neutron poison plates) provide the necessary criticality control and provide the heat conduction paths from the FAs to the cask cavity wall. This method of construction forms a very strong structure of compartment assemblies that provide for storage of 61 FAs. The minimum open dimension of each fuel compartment is 5.8" x 5.8", which provides clearance around the FAs.

There are three 61BT DSC basket types designated as Types A, B, and C. The three basket types are identical with the exception of the minimum B-10 content of the poison plates as specified in Table K.2-4 of Appendix K2, FSAR Revision 6 [1C.5.3]. The maximum lattice average enrichment authorized for Type A, B, and C 61BT DSCs is 3.7, 4.1 and 4.4 weight percent (wt. %) U-235, respectively.

1C.1.3 Design Drawings Certified in Amendment 3

The January 1, 2001 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 3 to CoC No. 1004 [1C.5.2].

The design configuration of the NUHOMS®-61BT System, including critical dimensions and materials of construction, is shown on drawings listed in Section K.1.5, Appendix K, FSAR Revision 6 [1C.5.3].

Tables 1C-1, 1C-2, 1C-3, 1C-4, 1C-5, 1C-6, and 1C-7 provide a list of the drawings for the 24P DSC, 52B DSC, 24P Long Cavity DSC, 24PT2 DSC, 61BT DSC, HSM, and onsite TC contained in FSAR Revision 6 [1C.5.3] that was docketed following the approval of Amendment 3. These FSAR drawings reflect the certified Standardized NUHOMS® System configuration along with additional changes implemented under the provisions of 10 CFR 72.48.

1C.1.4 Changes to the Standardized NUHOMS® System Implemented in FSAR Revision 6

FSAR Revision 6 [1C.5.3] added Appendix K to the FSAR due to the approval of Amendment 3 to CoC 1004.

Sections 1C.1.4.1 through 1C.1.4.4 list the changes implemented to the Standardized NUHOMS® System and incorporated into FSAR Revision 6 [1C.5.3]. Also listed is the corresponding safety evaluation (SE), which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biannual report submitted to the NRC [1C.5.4].

1C.1.4.1 Addition of 24PT2 DSC to the Standardized NUHOMS® System

A new DSC, designated as the 24PT2 DSC, was added to the Standardized NUHOMS® System under the provisions of 10 CFR 72.48. A description of the NUHOMS®-24PT2 System and the associated safety analysis is provided in Appendix L of the FSAR, Revision 6 [1C.5.3].

The NUHOMS®-24PT2 DSC consists of the 24PT2S DSC and 24PT2L DSC. The 24PT2S DSC is a transportable DSC with a cavity length identical to the Standardized NUHOMS®-24P DSC and is designed to store 24 pressurized water reactor (PWR) FAs without burnable poison rod assemblies (BPRAs). The 24PT2L DSC has a cavity length identical to the long cavity 24P DSC and is designed to store 24 PWR FAs with or without BPRAs. The 24PT2S and 24PT2L DSCs have been analyzed to demonstrate that they can handle the payload requirements specified in Technical Specification (TS) 1.2.1 of NUHOMS® CoC 1004 (PWR fuel with or without BPRAs), while meeting the requirements of 10 CFR 72.236.

The 24PT2 DSC utilizes a NUHOMS® TC for transfer operations and the NUHOMS® HSM for storage, with no changes to the HSM or TC as described in CoC 1004.

The 24PT2S and 24PT2L are based upon the original FO and FC DSCs, respectively, which have been previously certified by the NRC per CoC 9255 [1C.5.6] for transportation of spent fuel in the NUHOMS® MP 187 Package.

The NUHOMS®-24PT2S and -24PT2L DSC shell assemblies are similar to the existing DSCs; however, the basket assembly has the following design enhancements implemented to meet the 10 CFR 71 requirements:

- Increased number of spacer discs (26 for the 24PT2 versus eight for the 24P),
- Spacer disc thickness changed to 1.25" from 2.00" thick for the 24P,
- Spacer disc material changed to SA 533 Grade B, Class 1 instead of SA 516 Grade 70 to accommodate the higher basket temperatures. The spacer discs are coated with electroless nickel versus thermal sprayed aluminum,
- The support rod assemblies design consist of pretensioned 2" diameter high strength stainless steel rods and 3" diameter spacer sleeves versus welded rod to spacer disc design in the 24P,

- The support rods are high strength stainless steel (SA 564 TP 630, H1100 versus SA 479, XM-19 for the 24P), and
- Guidesleeves and oversleeves that support borated neutron absorber sheets (no neutron absorber used in 24P).

SE 72-1023 evaluated the addition of the 24PT2 DSC to the Standardized NUHOMS® System under the criteria of 10 CFR 72.48 and determined the change may be implemented without a CoC Amendment.

1C.1.4.2 24P DSC, 52B DSC, and 24P Long Cavity DSC Changes

Description of Change	Associated SRS/SE
Revised the end detail of the rod and sleeve assembly of the 52B DSC to allow the ends of the support rod to be slightly recessed. Added the use of a thread locking material to the small screws that restrain the neutron absorber plates. Revised the end sleeve of the rod and sleeve configuration (top and bottom) of the 52B DSC to allow these end sleeves to be made up of two pieces, and the lengths of the sleeve pieces may be varied to obtain the necessary spacer disk spacing. The location tolerances of the spacer disk are unchanged. Also, a requirement for mating the two pieces is added to ensure necessary load transfer, and the orientation of the anti-rotation pin is specified to allow potential future removal. For the 52B DSC, added a flag note to the weld callout for the support bar to the top spacer disk to allow for substitute weld configuration and weld prep details. No change to materials is permitted. Also, added the use of magnetic particle inspection (MPI) to examine the carbon steel to carbon steel weldment (support bar to top spacer disk).	72-1150
Added a NUREG-0612-compliant optional lifting lug configuration to the 52B DSC basket-shell assembly for vertical lifts of an empty DSC. This change does not affect any component analyzed in other calculations because weld sizes and plate thicknesses in the 52B DSC either increase or remain unchanged.	72-1218
This modification limits the interfacing internal dimension of the oversleeve and the corresponding external dimension of the guidesleeve components in the “C”-shaped configuration for the 24P DSC. It also specifies a weld reinforcement of 0.03" for the welding. To ensure that there is no interference, changed the design to limit the maximum guidesleeve outside dimension to 9.17" and require that the guide sleeve and over sleeve installation be such that the C-Section welds are not in the same azimuth. The oversleeve inside dimension is also revised to preclude interference with the guidesleeve.	72-1280
This modification implements changes to the top and bottom shield plugs of the 24P Long Cavity DSC. These changes enhance fabricability of the shield plug assemblies. In addition, an alternate option for a different physical configuration of the radial and center stiffeners, curved instead of straight, is provided to address concerns relative to potential radiation streaming.	72-1426

Description of Change	Associated SRS/SE
This modification increases the maximum length of the DSC shell from 186.29" to 186.55" to allow flexibility in fabrication of the long cavity PWR DSCs, relative to meeting the DSC top and bottom shield plug thickness, shell recess and DSC shell length requirements.	72-1493
This modification enhances DSC fabrication flexibility by allowing alternate materials as listed below: • Add alternative materials for fabrication of Siphon and Vent Blocks (ASME SA-182, Grade F304N and ASME SA-479, Type 304); applies to 24P Standard and Long Cavity DSCs (PWR and BWR) to allow DSC fabricator flexibility in material selection for the blocks. • Add alternative materials for fabrication of Siphon and Vent Port Cover Plates (ASME SA-479, Type 304); applies to 24P Standard and Long Cavity DSCs (PWR and BWR) to allow DSC fabricator flexibility in material section. • 24P Long Cavity PWR Shell Assembly drawing, allows the bottom shield plug assembly (BSPA) inner ring plate to be fabricated from pipe section or rolled ring, similar to fabrication methods allowed for the grapple ring support. • Add alternative materials for fabrication of support ring (ASME SA-479, Type 304); applies to 24P Standard and Long Cavity DSCs (PWR and BWR) to allow DSC fabricator flexibility in material selection for the support ring. Also specifies maximum edge dimension. • All materials remain 304 stainless steel. The material properties (Sy, Su, density, and thermal expansion) are unchanged. There is no change to the weight of the DSC or the TC.	72-1513
This modification addresses deficiencies associated with the NUHOMS®-24P Long Cavity DSC shield plug structural calculations. These changes result in a revision to FSAR Tables H-3, H-4, and H-5 (associated with revisions to the 24P Long Cavity DSC shield plug structural analysis calculations) and a revision to FSAR Table 8.2-7 (associated with the revision to the 24P Standardized DSC shell structural analysis). All of the reported stress values remain below the allowable values.	72-1544

Description of Change	Associated SRS/SE
This modification enhances DSC fabrication flexibility by allowing alternate materials as described below: • Add alternative materials for fabrication of Siphon and Vent Blocks (ASME SA-182, Grade F304); applies to 24P Standard and Long-Cavity DSCs (PWR and BWR) to allow DSC fabricator flexibility in material selection for the blocks. • The alternate siphon tube (not important-to-safety (NITS) component) material is added at the request of a new DSC fabricator to allow flexibility of material selection for the tubing. The only major difference between the existing ASTM A249 (welded) material and the new alternative ASTM A213 (seamless) material is the method of tube fabrication. • Add alternative materials for fabrication of DSC basket-shell assembly's key (ASME SA-479, Type 304); applies to 24P Standard and Long-Cavity DSCs (PWR and BWR) to allow DSC fabricator flexibility in material selection.	72-1559
An internal Transnuclear (TN) review identified errors in an existing thermal calculation. Specifically, an incorrect heat transfer correlation was used in the calculation to model convection heat transfer from the DSC surface (cylindrical geometry) to the bulk air for all the cases analyzed for the 24P and 52B DSCs. In addition, for the -40 °F ambient storage case in the HSM, a heat load of 19.2 kW was used in the analysis of the 24P DSC instead of the licensed 24 kW. SE 72-1589 determines the impact of corrective actions performed to address the deficiencies noted above. Maximum temperatures presented in Revision 5 of the NUHOMS® FSAR [1C.5.5] for the DSC shell are affected. The HSM temperatures reported in Revision 5 of the FSAR [1C.5.5] are not significantly affected by the changes. DSC revised stress values are less than those reported in Sections 8.1 and 8.2 of Revision 5 of the NUHOMS® FSAR [1C.5.5]. DSC support structure revised stresses are also below allowables. The calculated fuel cladding temperatures reported in the FSAR Table 8.1-26 and Table 8.1-27 are also not affected by this change.	72-1589

1C.1.4.3 HSM Changes

Description of Change	Associated SRS/SE
This modification evaluates the following changes to the HSM design configuration: Cask Docking Surface: The steel cask docking ring embedment is eliminated and the recessed cask docking flange is formed in concrete during casting of the base unit. The recessed flange and door dimensions are based on the larger MP-187 Cask diameter, to provide flexibility to allow the use of MP-187 or the OS-197 Cask. DSC Support Rail Extension Anchorage: A baseplate is added under the rail extension plate, which is bolted and grouted to the front opening, thereby eliminating field welding. DSC Axial Retainer: A drop-in tube steel is used as a post to axially restrain the DSC, analogous to a removable parking bollard. Less door clamps are required since the door is no longer in the load path for axial restraint of the DSC. Four door clamps are bolted	72-1434

Description of Change	Associated SRS/SE
to threaded embedments around the formed opening.	
This modification addresses a set of changes to the Standardized HSMs to enhance the shielding capacity of the HSMs. The revised modules are designated as HSM Model 102, to distinguish them from the original modules, designated as HSM Model 80. The optional set of changes include: • The standardized design composite door with steel liners on all faces is replaced by a reinforced concrete shield door (with steel liner on the inside only), which is 24.5" thick. The door is square at the front of the wall and circular on the inside. A 0.5" thick steel liner is provided on the inside surface of the door. • A 1 ½" thick concrete layer around the perimeter of each air vent (on the side walls) is replaced with steel plates.	72-1616

1C.1.4.4 TC Changes

Description of Change	Associated SRS/SE
This modification deletes the bottom support ring holes that are primarily used for the attachment of a nonintegral ram. The elimination of these holes will also eliminate the localized stress concentrations due to the holes. Also, the description of "Chemical Lead" is revised to "Chemical-Copper Lead" to reflect the new grade name that is used in the 1992 revision of ASTM Specification B29 for the corresponding lead.	72-1545
This modification implements the following changes to the OS197 TC to create a modified version of the TC, designated as OS97H TC: • Relocated the TC trunnion inner plate towards the outboard side, so that the necessary lead thickness will be achieved by placing lead only on one side of the inner plate to enhance the fabricability of the trunnion assemblies. • Allowed an optional continuous weld for the welding of the rails to the TC to eliminate potential of the rail being out of tolerance due to stitch welding, to avoid crud traps, and to enhance fabricability. • Increased the effective throat for the groove weld between the TC upper trunnion and the upper trunnion sleeve rom 1-⅜" to 1-½" in order to increase the stress margin on the weld. As a result of the increase in weld size, the upper trunnion overlay size had to be increased. In addition, revised the weld filler material and added optional weld filler materials to the cask fabrication specification. • Increased TC upper trunnion wall thickness by reducing the inboard inner diameter from 9.0" to 8.0". • Revised the minimum thickness requirement of the cask inner liner from 0.38" to 0.45".	72-1601
This modification evaluates the reanalysis performed for the required design changes to the OS197 TC to create the modified TC, designated as OS197H. The reanalysis demonstrates that the maximum on-the-hook weight capacity of the OS197H TC is	72-1610

Description of Change	Associated SRS/SE
250,000 lb (OS197 was originally qualified for 200,000 lb), and the maximum payload weight is 116,000 lb (OS197 was originally qualified for 80,000 lb). In addition, the reanalysis documents that with no design changes to the OS197 TC, the maximum on-the-hook weight capacity of the cask is increased from 200,000 to 208,500 lb, and the maximum payload weight is increased from 80,000 to 90,000 lb.	

1C.1.5 Amendment 3 Loading Overview

Table 1C-8 provides an overview of the FAs loaded under CoC 1004 Amendment 3 at the Oconee Nuclear Station site. The data contained in this table is for general information and is current as of the time this data was compiled for this application.

1C.2 Scoping Evaluation of CoC 1004 Amendment 3 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 3 [1C.5.2], CoC 1004 Amendment 3 TS [1C.5.7], CoC 1004 Amendment 3 SER [1C.5.8], and the NUHOMS® FSAR [1C.5.3].

Using the methodology described in Chapter 2, in addition to the Standardized NUHOMS® System structures, systems, and components (SSCs) listed in Appendix 1A, Section 1A.2.1, the following SSCs were determined to be within the scope of CoC 1004 Amendment 3 renewal:

- 24PT2 DSC
- 61BT DSC
- HSM Model 102
- OS197H TC

1C.3 Aging Management Review of CoC 1004 Amendment 3 SSCs

Approval of Amendment 3 did not result in any change in the design configuration of the 24P DSC, 24P Long Cavity DSC, 52B DSC, HSM Model 80, Standardized TC and OS197 TC. Hence, the aging management review (AMR) results listed in Appendix 1A, Section 1A.3, remain applicable for these SSCs.

There is a minimal change in the configuration of the 24P DSC, 24P Long Cavity DSC and 52B DSC, HSM Model 80, and onsite TC following incorporation of 10 CFR 72.48 changes in the FSAR [1C.5.3]. These modifications are described in Section 1C.1.4.2 through 1C.1.4.4 and the affected subcomponents are listed Tables 1C-9, 1C-10, and 1C-11. A review of these tables shows that the AMR results presented in Appendix 1A, Section 1.A.3 remain applicable for these SSCs.

1C.3.1 Aging Management Review of HSM (Model 102)

A new HSM, designated as HSM Model 102, has been added to the Standardized NUHOMS® System under the criteria of 10 CFR 72.48. These changes are described in Section 1C.1.4.3.

The changed subcomponents of the HSM Model 102, relative to the HSM Model 80 configuration described in Appendix 1A, are listed in Table 1C-14. A review of Table 1C-14 shows that the AMR results presented previously in Appendix 1A, Section 1A.3.4.2 for the HSM Model 80 remain applicable for HSM Model 102.

1C.3.2 Aging Management Review of OS197H TC

The addition of the OS197H TC design to the Standardized NUHOMS® System provides a more robust upper trunnion design configuration and, thus, increases the lifting capacity of the onsite TC. There was no change in the subcomponents of the onsite TC due to the addition of OS197H TC as noted in Table 1C-15. Hence, the AMR results presented previously in Appendix 1A, Section 1A.3.4.3 for the onsite TC remain applicable to OS197H TC.

1C.3.3 Aging Management Review of 24PT2 DSC

Table 1C-12 lists the subcomponents of the 24PT2 DSC and the material of construction of each subcomponent. Also listed are the environment, the Safety Classification and the intended function of each of the subcomponent of the 24PT2 DSC.

The 24PT2 DSC basket is of similar design as the 24P basket, but uses additional spacer discs and higher strength materials. The 24PT2 DSC shell assembly design is almost identical to the 24P DSC. Also, the materials of construction of the 24PT2 DSC shell assembly, the environment to which the subcomponents are exposed to, the decay heat load, payload authorized are identical to the 24P DSC. Hence, the AMR results for the DSCs described in Appendix 1A, Section 1A.3.4 are also applicable to the 24PT2 DSC.

1C.3.4 Aging Management Review of 61BT DSC

Table 1C-13 lists the subcomponents of the 61BT DSC and the material of construction of each subcomponent. Also listed are the environment, the Safety Classification and the intended function of each of the subcomponent of the 61BT DSC.

The NUHOMS®-61BT DSC shell thickness is 0.50" versus 0.625" for the NUHOMS®-52B DSC shell design. In addition, the 61BT DSC is designed with a “leaktight” confinement boundary. Except for these differences, the 61BT DSC shell assembly design is essentially the same to that of the 52B DSC. The 61BT DSC basket is a more robust “fuel compartment”-type design as opposed to a basket design consisting of “support rods and spacer discs” used in 24P and 52B DSCs. Finally, the materials of construction of the 61BT DSC shell assembly and the environment to which the subcomponents are exposed, are essentially the same to the 52B DSC.

Based on this discussion, the AMR results for the DSCs described in Appendix A, Section 1A.3.4 are also applicable to the 61BT DSC.

1C.3.5 Aging Management Review of SFAs Authorized in Amendment 3

The spent fuel authorized for storage in CoC 1004 Amendment 3 is low burnup fuel with assembly average burnup of less than 45 GWd/MTU. Therefore, based on the justification provided in Section 1A.3.4.4, Appendix 1A, no TLAAs or AMP is required for the spent fuel assemblies (SFAs) authorized for storage in CoC 1004 Amendment 3.

1C.4 Fuel Retrievability

The spent fuel authorized for storage in CoC 1004 Amendment 3 is low burnup fuel with assembly average burnup of less than 45 GWd/MTU.

CoC 1004 Amendment 3 modifications, as well as the 10 CFR 72.48 changes described in Section 1C.1.4, do not alter the justification provided in Section 1A.4, Appendix 1A regarding fuel retrievability. Therefore, retrievability of fuel stored in Amendments 3 SSCs remains ensured.

1C.5 References (Appendix 1C)

1C.5.1 Transnuclear West, Inc., Application for Amendment No. 3 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks, July 26, 1999.

1C.5.2 U.S. Nuclear Regulatory Commission, Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 3, September 12, 2001, Docket No. 72-1004.

1C.5.3 Transnuclear West, Inc., "NUH-003, Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 6," Docket No. 72-1004, October 2001.

1C.5.4 Transnuclear Inc. Letter to the U.S. Nuclear Regulatory Commission, NUH03-02-1680, dated September 16, 2002, "Summary Report of 72.48 Evaluations Implemented in NUHOMS® FSAR Revision 6," Docket No. 72-1004.

1C.5.5 Transnuclear West, Inc., "NUH-003, Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 5," Docket No. 72-1004, August 2000.

1C.5.6 Certificate No. 9255 for Model No. NUHOMS® MP187 Multipurpose Cask (Docket No. 71-9255).

1C.5.7 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment No. 3," Docket No. 72-1004, September 2001.

1C.5.8 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Addition of NUHOMS®-61BT Dry Shielded Canister and Additional Fuel Types, Transnuclear West, Inc., Certificate of Compliance No. 1004," Docket No. 72-1004, September 2001.

1C.5.9 American National Standards Institute, Inc., "Standard for Radioactive Materials – Leakage Tests on Packages for Shipments," ANSI N14.5-1997.

Table 1C-1
NUHOMS®-24P DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-03-1020-SAR	General License NUHOMS® DSC for PWR Fuel – Basket Assembly	4
NUH-03-1021-SAR	General License NUHOMS® DSC for PWR Fuel – Shell Assembly	4
NUH-03-1022-SAR	General License NUHOMS® DSC for PWR Fuel Basket – Shell Assembly	3
NUH-03-1023-SAR	General License NUHOMS® DSC for PWR Fuel – Main Assembly	5

Table 1C-2
NUHOMS®-52B DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-03-1029-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Shell Assembly	4
NUH-03-1030-SAR	General License NUHOMS® DSC for Channeled BWR Fuel Basket – Shell Assembly	3
NUH-03-1031-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Main Assembly	5
NUH-03-1032-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket Assembly	5

Table 1C-3
NUHOMS®-24P Long Cavity DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-03-1050-SAR	General License NUHOMS®-24P Long Cavity DSC – Basket Assembly	2
NUH-03-1051-SAR	General License NUHOMS®-24P Long Cavity DSC – Shell Assembly	2
NUH-03-1052-SAR	General License NUHOMS®-24P Long Cavity DSC Basket – Shell Assembly	2
NUH-03-1053-SAR	General License NUHOMS®-24P Long Cavity DSC – Main Assembly	2

Table 1C-4
NUHOMS®-24PT2 DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-03-1070-SAR	General License NUHOMS®-24PT2S – DSC Main Assembly	0
NUH-03-1071-SAR	General License NUHOMS®-24PT2L – DSC Main Assembly	0

Table 1C-5
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-61B-1060-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel General Arrangement	1
NUH-61B-1061-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Shell Assembly	1
NUH-61B-1062-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Canister Details	1
NUH-61B-1063-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Basket Assembly	1
NUH-61B-1064-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Basket Details	1
NUH-61B-1065-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Parts List	1

Table 1C-6
NUHOMS® HSM Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-03-6008-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – ISFSI General Arrangement	7
NUH-03-6009-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Main Assembly	6
NUH-03-6010-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit Assembly	3
NUH-03-6014-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit	7
NUH-03-6015-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Roof Slab Assembly	6
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	5
NUH-03-6017-01-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Accessories	6
NUH-03-6018-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Shield Wall Plan and Details	6
NUH-03-6024-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Erection Hardware	3

Table 1C-7
NUHOMS® Onsite Transfer Cask Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 6)
NUH-03-8000-SAR	General License NUHOMS® ISFSI Onsite TC – Overview	1
NUH-03-8001-SAR	General License NUHOMS® ISFSI Onsite TC – Structural Assembly	6
NUH-03-8002-SAR	General License NUHOMS® ISFSI Onsite TC – Inner and Outer Shell Assembly	6
NUH-03-8003-SAR	General License NUHOMS® ISFSI Onsite TC – Main Assembly	6

Proprietary Information on Pages 1C-21 through 1C-32
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1D
Renewal of the Standardized NUHOMS® System Approved under Amendment 4 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1D.1 Introduction

Transnuclear West, Inc. (TNW) submitted an application for CoC No. 1004 Amendment 4 to the U.S. Nuclear Regulatory Commission (NRC) on February 23, 2001 [1D.5.1], as supplemented, to allow storage of pressurized water reactor (PWR) fuel assemblies (with or without Burnable Poison Rod Assemblies (BPRAs)) that have an equivalent unirradiated enrichment of greater than 1.45 wt. % U-235 in NUHOMS®-24P dry shielded canister (DSC). It also requested an increase of 0.25" in the maximum fuel assembly (FA) length of the authorized contents of the NUHOMS®-24P Long Cavity DSC when storing low burnup fuel with BPRAs.

CoC 1004 Amendment 4 was approved by the NRC effective February 12, 2002 [1D.5.2].

1D.1.1 Brief Description of Amendment 4

CoC 1004 Amendment 4 authorizes storage of low burnup PWR FAs (with or without BPRAs) that have an equivalent unirradiated enrichment of greater than 1.45 wt. % U-235 in NUHOMS®-24P DSC. There is no change in the configuration of the 24P DSC, HSM, or TC. The supporting criticality analyses for the 24P DSC presented in Final Safety Analysis Report (FSAR) Chapter 3 was updated in Revision 7 [1D.5.3]. The amendment did not affect the structural, thermal, shielding or confinement analysis presented in the FSAR.

Table 1-1a of Technical Specification (TS) [1D.5.5] 1.2.1 has been revised to specify an increased maximum FA length of 171.93 inches for fuel with burnup ≤ 32,000 MWd/MTU.

To accommodate the storage of low burnup fuel, TS [1D.5.5] 1.2-1, 1.2.15, TS Tables 1-1a, 1-1b, 1-1c, 1-1d, 1-2a, and 1-2c and Figure 1-1 have been revised.

Finally, Amendment 4 reflects the transfer of CoC holder from TNW to Transnuclear Inc.

1D.1.2 Design Drawings Certified in Amendment 4

The January 1, 2002 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 4 to CoC No. 1004 [1D.5.2].

Amendment 4 [1D.5.2] modified the contents authorized for storage in 24P DSC. It did not result in any change in the design configuration of the Standardized NUHOMS® System. This amendment did not result in any change in the FSAR design drawings.

However, additional changes were implemented to the Standardized NUHOMS® System configuration under the provisions of 10 CFR 72.48. Tables 1D-1, 1D-2, 1D-3, 1D-4, 1D-5, 1D-6, and 1D-7 provide a list of the drawings for the 24P DSC, 52B DSC, 24P Long Cavity DSC, 24PT2 DSC, 61BT DSC, HSM, and onsite TC contained in FSAR Revision 7 [1D.5.3] that were docketed following the approval of Amendment 4.

1D.1.3 Changes to the Standardized NUHOMS® System Implemented in FSAR Revision 7

Sections 1D.1.3.1 through 1D.1.3.3 describe the changes implemented to the Standardized NUHOMS® System and incorporated into FSAR Revision 7 [1D.5.3]. Also listed for each change is the corresponding safety evaluation (SE), which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the FSAR Revision 7 biannual report of 72.48 Changes submitted to the NRC [1D.5.4].

1D.1.3.1 24P DSC, 52B DSC, and 24P Long Cavity DSC Changes

Description of Change	**Associated SRS/SE**
This change adds a more detailed description of the methodology used in the generation of Fuel Qualification Tables 3.1-8a and 3.1-8b to FSAR Section 7. This methodology was the basis for a previously approved CoC 1004 Amendment 2, but was not detailed in the FSAR. This change was requested by the NRC staff during the review of another Transnuclear (TN) application. This change reflects the analysis of a previously approved amendment and represents an enhancement in documentation. This change does not impact the licensing basis.	721004-016
This change reduces the length of the weld addressed in the FSAR analysis (Appendix K, sections K.3.6, K.3.7, and K.3.4) from 4″ to 3″, thereby increasing the stresses in the weld. Therefore, in all the evaluated load cases in the FSAR Appendix K analysis, the shear stress in the weld will increase by the factor 4/3.	72-1704
This modification adds a note to 61BT DSC FSAR drawing to ensure that the test port plug sits flat against the outer top cover plate (OTCP) counter bore and does not protrude above the OTCP. This is a fabricability change to ensure proper interface between components.	72-1765

Description of Change	Associated SRS/SE
This modification adds B9 and B10D versions of the Babcock and Wilcox (B&W) 15 x 15 Mark B Fuel Assemblies (FAs) into the 24P and 24PT2 DSC's. This is not an addition of a new FA type; rather it is the evaluation of a continued modification of currently acceptable B&W 15x15 fuel assemblies. The B9 and B10D versions contain B9 rods (Zircaloy cladding and fuel pellets), which are different than that evaluated in the FSAR. The fuel pellet diameter for the B9 rod is 0.370″, as opposed to 0.369″ described in the FSAR. In addition, the B10D FA has a different upper end holddown spring configuration. The B9 and prior versions utilize a helical spring, while the B10D uses a cruciform spring. That includes the 24P and the 24PT2. The evaluation considers both the original boron loading (2000 ppm) for FA's with and without BPRA's, and the low burnup boron loading of 2350 ppm.	72-1793

1D.1.3.2 Horizontal Storage Module Changes

Description of Change	Associated SRS/SE
This modification revises the configuration of the air vents on the side walls of horizontal storage module (HSM) Model 102 from straight to a tapered configuration. It also addresses the weight increase of HSM Model 102 due to incorporation of a reinforced concrete shielded door and replacement of 1.5″ concrete layer in the HSM vents with steel liners.	721004-014

1D.1.3.3 Transfer Cask Changes

Description of Change	Associated SRS/SE
This modification addresses a change to revise an assumption that states that the neutron shield water will be drained prior to in-pool lifting operations. To achieve reduced dose rates during loading operations, the neutron shield is filled with water and only 800 gallons is drained instead of 1100 gallons (as specified in FSAR Section K.8.1.2). This change is specific to Oyster Creek Nuclear Generating Station site and is supported by Oyster Creek Generating Station's lift crane of 105 tons (instead of 100 tons crane capacity in Appendix K of the FSAR).	72-1697

• The weld size for welding the neutron shield panels (NSP) top and bottom support rings to the OS197 Cask structural shell (Refer FSAR Drawing NUH-06-8002) is reduced to eliminate potential distortion of the NSP top and bottom support ring plates during welding of the plates to the cask shell. • The non-destructive examination (NDE) requirements for the NSP angle to the structural shell intermittent weld is revised from penetrant testing (PT) to visual testing (VT) to reduce fabrication time cleaning the liquid penetrant and eliminate the potential for liquid penetrant remaining in the weld interface and degrading weld performance.	72-1751

1D.1.4 Amendment 4 Loading Overview

Tables 1D-8, 1D-9, 1D-10, and 1D-11 provide an overview of the fuel assemblies loaded under CoC 1004 Amendment 4 at the Susquehanna Steam Electric Station, Oconee Nuclear Station, Oyster Creek Nuclear Generating Station, and Duane Arnold Energy Center sites, respectively. The data contained in these tables is for general information and is current as of the time this data was compiled for this application.

1D.2 Scoping Evaluation of CoC 1004 Amendment 4 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 4 [1D.5.2], CoC 1004 Amendment 4 TS [1D.5.5], CoC 1004 Amendment 4 SER [1D.5.6], and NUHOMS® FSAR Revision 7 [1D.5.3].

There is no change in the design configuration of the Standardized NUHOMS® System due to approval of CoC 1004 Amendment 4. Hence, the Standardized NUHOMS® System structures, systems, and components (SSCs) determined to be within the scope of CoC 1004 Amendment 4 renewal are identical to those described in Appendix 1C, Section 1C.2.

1D.3 Aging Management Review of Amendment 4 SSCs

Incorporation of CoC 1004 Amendment 4 and the 72.48 changes described in Section 1D.1.3 did not result in any change to the subcomponents of the Standardized NUHOMS® System listed in Appendix 1C, Tables 1C-9 through 1C-15. There is no change in the environment to which these in-scope subcomponents are exposed on a recurring basis, relative to the environment listed in Appendix 1C, Tables 1C-9 through 1C-15.

Hence, the results of the aging management review (AMR) as documented in Appendix 1C, Tables 1C-9 through 1C-15 are also applicable to Amendment 4 SSCs.

The spent fuel authorized for storage in CoC 1004 Amendment 4 is low burnup fuel with assembly average burnup of less than 45 GWd/MTU. Therefore, based on the justification provided in Section 1A.3.4.4, Appendix 1A, there is no time-limited aging analysis (TLAA) or aging management program (AMP) required for the spent fuel assemblies (SFAs) authorized for storage in CoC 1004 Amendment 4.

1D.4 Fuel Retrievability

The spent fuel authorized for storage in CoC 1004 Amendment 4 is low burnup fuel with assembly average burnup of less than 45 GWd/MTU.

CoC 1004 Amendment 4 modifications, as well as the 10 CFR 72.48 changes described in Section 1D.1.3, do not alter the justification provided in Section 1A.4, Appendix 1A regarding fuel retrievability. Therefore, retrievability of fuel stored in Amendments 4 SSCs remains ensured.

1D.5 References (Appendix 1D)

1D.5.1 Transnuclear West, Inc., "NUH03-01-1681, Application for Amendment No. 4 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks, Revision 0," February 23, 2001.

1D.5.2 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 4," February 12, 2002, Docket No. 72-1004.

1D.5.3 Transnuclear Inc., "NUH-003, Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 7," Docket No. 72-1004, November 28, 2003.

1D.5.4 Transnuclear, Letter to the U.S. Nuclear Regulatory Commission, NUH03-04-58, "Bi-annual Report of 72.48 Evaluations performed for the Standardized NUHOMS® System for the Period 10/31/01 to 10/31/03 Docket No. 72-1004, May 28, 2004.

1D.5.5 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment No. 4, Docket No. 72-1004, March 2002.

1D.5.6 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Storage of Spent Fuel with a Burnup less than 32 GWd/MTU and an Unirradiated Enrichment in excess of 1.45%, Transnuclear Inc., Certificate of Compliance No. 1004," Docket No. 72-1004, March 2002.

Table 1D-1
NUHOMS®-24P DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-03-1020-SAR	General License NUHOMS® DSC for PWR Fuel – Basket Assembly	5
NUH-03-1021-SAR	General License NUHOMS® DSC for PWR Fuel – Shell Assembly	5
NUH-03-1022-SAR	General License NUHOMS® DSC for PWR Fuel Basket – Shell Assembly	4
NUH-03-1023-SAR	General License NUHOMS® DSC for PWR Fuel – Main Assembly	6

Table 1D-2
NUHOMS®-52B DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-03-1029-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Shell Assembly	5
NUH-03-1030-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket-Shell Assembly	4
NUH-03-1031-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Main Assembly	6
NUH-03-1032-SAR	General License NUHOMS® DSC for Channeled BWR Fuel – Basket Assembly	6

Table 1D-3
NUHOMS®-24P Long Cavity DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-03-1050-SAR	General License NUHOMS®-24P Long Cavity DSC Basket Assembly	3
NUH-03-1051-SAR	General License NUHOMS®-24P Long Cavity DSC Shell Assembly	3
NUH-03-1052-SAR	General License NUHOMS®-24P Long Cavity DSC Basket – Shell Assembly	3
NUH-03-1053-SAR	General License NUHOMS®-24P Long Cavity DSC – Main Assembly	3

Table 1D-4
NUHOMS®-24PT2 DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-03-1070-SAR	General License NUHOMS®-24PT2S – DSC Main Assembly	1
NUH-03-1071-SAR	General License NUHOMS®-24PT2L – DSC Main Assembly	1

Table 1D-5
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-61B-1060-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel General Arrangement	2
NUH-61B-1061-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Shell Assembly	2
NUH-61B-1062-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Canister Details	2
NUH-61B-1063-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Basket Assembly	2
NUH-61B-1064-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Basket Details	2
NUH-61B-1065-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Parts List	2

Table 1D-6
NUHOMS® HSM Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-03-6008-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – ISFSI General Arrangement	8
NUH-03-6009-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Main Assembly	7
NUH-03-6010-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module –Base Unit Assembly	4
NUH-03-6014-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Base Unit	8
NUH-03-6015-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Roof Slab Assembly	7
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	6
NUH-03-6017-01-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Accessories	7
NUH-03-6018-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Shield Wall Plan and Details	7
NUH-03-6024-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Erection Hardware	4

Table 1D-7
NUHOMS® Onsite Transfer Cask Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 7)
NUH-03-8000-SAR	General License NUHOMS® ISFSI Onsite TC – Overview	2
NUH-03-8001-SAR	General License NUHOMS® ISFSI Onsite TC – Structural Assembly	7
NUH-03-8002-SAR	General License NUHOMS® ISFSI Onsite TC – Inner and Outer Shell Assembly	7
NUH-03-8003-SAR	General License NUHOMS® ISFSI Onsite TC – Main Assembly	7

Proprietary Information on Pages 1D-16 through 1D-19
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1E
Renewal of the Standardized NUHOMS® System Approved under Amendments 5, 6, and 7 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1E.1 Introduction

Transnuclear Inc. (TN) submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 5 to the U.S. Nuclear Regulatory Commission (NRC) on June 29, 2001 [1E.5.1], as supplemented, to add the NUHOMS®-32PT System to the Standardized NUHOMS® System. CoC 1004 Amendment 5 was approved by the NRC effective January 7, 2004 [1E.5.2].

TN submitted an application for CoC 1004 Amendment 6 to the NRC on August 31, 2001 [1E.5.3], as supplemented, to add the NUHOMS®-24PHB system to the Standardized NUHOMS® System. CoC 1004 Amendment 6 was approved by the NRC effective December 22, 2003 [1E.5.4].

TN submitted an application for CoC No. 1004 Amendment 7 to the NRC on March 29, 2002 [1E.5.5], as supplemented, to add damaged fuel to the authorized contents of the NUHOMS®-61BT DSC. CoC 1004 Amendment 7 was approved by the NRC effective March 2, 2004 [1E.5.6].

The above-listed three amendments to CoC 1004 were approved almost concurrently within a short timeframe of three months of each other and were all incorporated into NUHOMS® Final Safety Analysis Report (FSAR) Revision 8 [1E.5.7]. The renewal application of these three amendments has therefore been grouped together in this appendix.

1E.1.1 Brief Description of Amendment 5

The NUHOMS®-32PT System consists of a NUHOMS®-32PT dry shielded canister (DSC) stored in a NUHOMS® horizontal storage module (HSM) and transferred in an OS197 transfer cask (TC). A description of the NUHOMS®-32PT System and the associated safety analysis is provided in Appendix M of the NUHOMS® FSAR [1E.5.7].

Amendment 5 does not make any changes to the HSM or the OS197 TC configuration.

The NUHOMS®-32PT DSC is designed to store 32 intact standard pressurized water reactor (PWR) fuel assemblies (FAs) with or without burnable poison rod assemblies (BPRAs) in any of the three alternate heat-zoning configurations, with a maximum decay heat of 1.2 kW per assembly and a maximum heat load of 24 kW per DSC. The maximum fuel assembly weight is 1682 lbs, which is the same as the NUHOMS®-24P DSC design. The fuel that is authorized to be stored in the NUHOMS®-32PT DSC is described in Section M.2.1 of Appendix M of FSAR Revision 8 [1E.5.7].

The maximum design basis internal pressures for the NUHOMS®-32PT DSC are 15, 20, and 105 psig for normal, off-normal, and accident conditions of storage, respectively.

Description of the NUHOMS®-32PT DSCs

Each NUHOMS®-32PT DSC consists of a fuel basket and a canister body (shell, canister inner and outer bottom and top cover plates and shield plugs). The 32PT DSC System consists of four design configurations or types as follows:

- 32PT-S100, Short Canister (186.2" length)
- 32PT-L100, Long Canister (192.2" length)
- 32PT-S125, Short Canister (186.2" length)
- 32PT-L125, Long Canister (192.2" length)

These four design configurations allow for flexibility to accommodate the various payload fuel types with and without BPRAs.

The thickness for the individual plate components of the top and bottom end cover plates has been increased to accommodate the higher internal pressure, while the top and bottom end shield plug thickness has been reduced relative to the 24P DSC configuration. The NUHOMS®-32PT DSC shell thickness is 0.50" instead of 0.625" as used for the NUHOMS®-24P or -52B DSC designs.

The confinement vessel for the NUHOMS®-32PT DSC consists of a shell, which is a welded stainless steel cylinder with an integrally-welded, stainless steel bottom closure assembly, and a stainless steel top closure assembly, which includes the vent and drain system.

There are no penetrations through the confinement vessel. The draining and venting systems are covered by the seal welded outer top closure plate and vent and siphon port plugs. To preclude air in-leakage, the canister cavity is inerted and pressurized above atmospheric pressure with helium. The NUHOMS®-32PT DSCs are designed and tested to meet the leak tight criteria of ANSI N14.5-1997 [1E.5.8].

The basket structure consists of a grid assembly of welded stainless steel plates or tubes that make up a grid of 32 fuel compartments. Each fuel compartment accommodates aluminum and/or neutron absorbing plates (NAPs) (which are made of either borated aluminum or metal matrix composites such as Boralyn®, Metamic®, or equivalent) that provide the necessary criticality control and heat conduction paths from the fuel assemblies to the canister shell. The space between the fuel compartment grid assembly and the perimeter of the DSC shell is bridged by transition rail structures. The transition rails are solid aluminum segments that support the fuel compartment grid assembly and transfer mechanical loads to the DSC shell. They also provide the thermal conduction path from the basket assembly to the canister shell wall, making it efficient in rejecting heat from its payload. This method of construction forms a robust structure of compartment assemblies which provides for storage of 32 fuel assemblies. The nominal clear dimension of each fuel compartment opening is 8.7" x 8.7", which provides clearance around the FAs.

During dry storage of the spent fuel in the NUHOMS®-32PT System, no active systems are required for the removal and dissipation of the decay heat from the fuel. The NUHOMS®-32PT DSC is designed to transfer the decay heat from the fuel to the basket, from the basket to the canister body and ultimately to the ambient via the HSM or TC.

The four NUHOMS®-32PT DSC design configurations have the same minimum boron content of 0.0070g/cm^2 for the poison neutron plates. The criticality analysis is based on 90% credit or 0.0063 g/cm^2 of B10. A 32PT basket may contain 0, 4, 8, or 16 poison rod assemblies (PRAs) and is designated a Type A, Type B, Type C or Type D basket, respectively.

1E.1.2 Brief Description of Amendment 6

The NUHOMS®-24PHB System consists of a NUHOMS®-24PHB DSC stored in a NUHOMS® HSM Model 102 and transferred in a Standard, OS197, or OS197H TC. A description of the NUHOMS®-24PHB System and the associated safety analysis is contained in Appendix N of the NUHOMS® FSAR Revision 8 [1E.5.7].

Amendment 6 does not implement any changes to the HSM or the TC as described in the NUHOMS® FSAR.

There are two design configurations for the NUHOMS®-24PHB DSC: the 24PHBS and 24PHBL. The 24PHBS and the 24PHBL DSC design configurations are essentially the same as the 24P DSC and 24P Long Cavity DSCs, respectively, except that the 24PHB DSC outer top cover plate is provided with a test port/plug to allow testing of the DSC confinement boundary for leaktightness.

Each DSC configuration is designed to store 24 intact Babcock and Wilcox (B&W) 15x15 Class pressurized water reactor (PWR) FAs (with or without BPRAs), including reconstituted assemblies, with a maximum burnup of 55,000 Mwd/MTU (high burnup fuel). The design characteristics of the spent FAs are described in Table N.2-1, Section N.2, Appendix N of the FSAR [1E.5.7].

The NUHOMS®-24PHB DSC may store PWR FAs arranged in one of two alternate heat load zoning configurations, with a maximum decay heat of 1.3 kW per assembly and a maximum heat load of 24 kW per DSC. The heat load zoning configurations are shown in Figure N.2-1 and Figure N.2-2, Section N.2, Appendix N of the FSAR [1E.5.7]. The NUHOMS®-24PHB DSC is vacuum-dried and backfilled with helium at the time of loading. The maximum (bounding) FA weight of 1682 lbs with a BPRA is identical to the NUHOMS®-24P DSC design.

Description of the NUHOMS®-24PHB DSCs

The 24PHB DSC design configuration is nearly identical to the 24P DSC described in Appendix 1A of this application. The only change to the 24PHB DSC relative to the 24P DSC design is the addition of a test port and plug to the outer top cover plate to allow for testing to a condition of "leaktight" per ANSI N14.5 criteria [1E.5.8].

1E.1.3 Brief Description of Amendment 7

The NUHOMS®-61BT System, described in Appendix 1C of this application, was originally approved for storing intact 61 boiling water reactor (BWR) assemblies. CoC 1004 Amendment 7 authorizes the storage of up to 16 damaged BWR assemblies and balance intact, for a total of 61 standard BWR assemblies with or without fuel channels. It also adds additional fuel types to the authorized content of the NUHOMS®-61BT System.

Intact and damaged BWR fuel assemblies with various combinations of burnup, enrichment, and cooling time can be stored in the NUHOMS®-61BT DSC, provided the FA parameters fall within the design limits specified in Table K.2-1, Table K.2-2, and Table K.2-4 of Appendix K, FSAR Revision 8 [1E.5.7]. Amendment 7 also provided a simplified approach for determination of FAs qualified for storage in the NUHOMS®-61BT System.

Description of the NUHOMS®-61BT DSC Basket for Storing Damaged Fuel

Amendment 7 added a modified basket to the NUHOMS®-61BT DSC to handle the storage of damaged fuel. The modified basket configuration and the supporting safety analysis are provided in Appendix K, FSAR Revision 8 [1E.5.7].

Damaged BWR fuel is to be stored only in the outer four 2x2 compartments of a Type C 61BT basket. A top and bottom end cap is to be installed in each fuel compartment where a damaged fuel assembly is stored. The top end cap is attached to the fuel compartment through a compartment extension, which ensures that the fuel assembly is fully enclosed within the fuel compartment. Also, each 61BT DSC that stores damaged fuel assemblies must use an alternate holddown ring. This alternate holddown ring is designed to provide clearance for the top end cap and extension hardware.

1E.1.4 Design Drawings Certified in Amendments 5, 6, and 7

The January 1, 2004 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 5 [1E.5.2] and Amendment 7 to CoC No. 1004 [1E.5.6]. The January 1, 2003 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 6 to CoC No. 1004 [1E.5.4].

Tables 1E-1, 1E-2, and 1E-3 provide a listing of the FSAR drawings for the NUHOMS®-61BT, -32PT, and -24PHB DSC, respectively, contained in FSAR Revision 8 [1E.5.7], which was docketed following the approval of Amendments 5, 6, and 7.

There were no 72.48 changes implemented to the configuration of 24P DSC, 24P Long Cavity DSC, 24PT2 DSC, or 52B DSC. One HSM drawing was updated to reflect a minor revision as listed in Table 1E-4.

These FSAR drawings reflect the certified Standardized NUHOMS® System configuration along with additional changes implemented under the provisions of 10 CFR 72.48.

1E.1.5 Changes to the Standardized NUHOMS® System Implemented in FSAR Revision 8

FSAR Revision 8 [1E.5.7] added Appendix M and Appendix N to the FSAR due to the approval of Amendments 5 and 6, respectively. FSAR Appendix K was also updated to reflect the addition of damaged fuel to the authorized contents of 61BT DSC due to the approval of Amendment 7 to CoC 1004.

Sections 1E.1.5.1 through E.1.5.4 list the more significant changes implemented to the Standardized NUHOMS® System and incorporated into FSAR Revision 8 [1E.5.7]. Also listed is the corresponding safety evaluation (SE) which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biannual report submitted to the NRC [1E.5.9].

1E.1.5.1 32PT DSC Changes

Description of Change	Associated SE
The 32PT DSC Main Assembly procurement drawings have been revised to : • Allow for the 32PT DSC siphon and vent block to be positioned below the top of the support ring to ensure that the top shield plug rests only on the support ring. • Add notches to the support ring to facilitate loading and unloading of the fuel assemblies into and from the outermost fuel compartments of the DSC basket. • Clarify nomenclature for stamping serial numbers on 32PT DSCs.	721004-029
The 32PT DSC Shell Assembly procurement drawings have been revised to: • Add an alternate option for the 32PT DSC bottom end closure. This option replaces the inner and outer bottom cover plates plus the bottom shield plug with a single solid forging welded to the DSC shell. This alternate configuration of the DSC bottom closure is ASME NB compliant and subject to full volumetric examination. • Add details for a basket shear key to prevent basket rotation.	721004-037

Description of Change	Associated SE
The 32PT DSC Basket Assembly procurement drawings have been revised to: • Add two alternative basket configurations, designated as Alternate 1 (Type A Basket only) and Alternate 2 (Type A/B/C/D Basket), to the 32PT DSC design. Alternate 1 basket consists of 16 NAPs and 16 aluminum compartment plates, with all the L-shaped chevron plates being oriented in such a way that one of its legs is at the bottom and the other vertical within each basket cell, when the DSC is in a storage configuration (horizontal). Included in this change is the reduced minimum emissivity requirement of 0.8 for the NAP and compartment plates. Alternate 2 basket is similar to the Alternate 1 basket with regards to plate orientation and emissivity specification but has 24 NAPs and 8 aluminum plates instead. • Add an alternate basket configuration, which deletes the retention plates at the bottom of the basket. This alternate option requires the NAP and aluminum compartment plates to be extended to the bottom of the basket grid. • Add four lifting cutouts in the bottom end of the basket plates. These lifting cutouts are used to place the empty DSC basket into the canister during fabrication. • Add an alternative for the R90 transition rail, which utilizes a three-piece, radially split, configuration. This change is only applicable to the 2 Alternative basket configurations listed in the first bullet above for this SE. • Add acceptance criteria for scratches and local thinning on the NAP and compartment plates. This is done as a contingency to address potential fabrication non-conformances. This change is only applicable to the 2 Alternative basket configurations listed in the first bullet above for this SE. • Allow the use of lifting lugs to restrain the basket against rotation. This utilizes shimming plates attached to the transition rails. • Revise the non-destructive examination (NDE) requirements for the R45 and R90 transition rail attachment stud weldments and allow an alternative attachment stud configuration with different NDE requirement.	721004-038
The 32PT DSC structural analysis is updated to accommodate a change in ASME service level criteria from Level A to Level B for uplifting and uprighting an empty 32PT DSC. These are non-operational load cases as shown in FSAR Table M.2-15.	721004-124

1E.1.5.2 24PHBL DSC Changes

Description of Change	Associated SRS/SE
Revised the 24PHBL DSC procurement documentation to reflect the addition of an alternate design configuration for the top and bottom DSC shield plugs (designated herein as "shifted shielding" option). This "shifted shielding" shield plug design configuration is added as an alternate option to the "ribbed shield plug" design of the 24PHBL DSC design described in the FSAR. This alternate option differs from the original "ribbed shield plug" design configuration in the following aspects: • A portion of the lead shielding is shifted from the bottom shield plug to the top	721004-044

Description of Change	Associated SRS/SE
shield plug. • The bottom lead shielding is encased within the outer bottom cover plate and the inner grapple ring support (at the bottom), and the bottom forging (at the top and at the sides). • The top lead shielding is encased within the inner top forging (at the bottom and side) and the lead plug top cover plate (at the top). • No stiffeners (i.e., ribs) are used in the top and bottom lead shielding for this added option. • The grapple ring support (in one piece) is welded to the bottom forging, which forms part of the pressure boundary. The bottom forging is designed to take the pressure, ram push, and grapple pull loads. • An inner grapple ring is welded to the grapple ring support, and is designed to take a ram push load of up to 80 kips. • The 24PHBL DSC cavity length has been increased by ¼". Correspondingly, the length of the support rods for the basket assembly has also been increased by ¼". In addition, this change allows electroless nickel coating in lieu of aluminum thermal spray for the 24PHBL DSC spacer discs.	

1E.1.5.3 61BT DSC Changes

Description of Change	Associated SRS/SE
Revised the 61BT DSC procurement drawing to chamfer the bottom of the holddown. The ⅜" plate is chamfered 1/16" on each side to facilitate placement of the holddown ring into the DSC.	721004-090

1E.1.5.4 TC Changes

Description of Change	Associated SRS/SE
The structural evaluation of the OS197 TC has been revised to allow an increase in the maximum (dry) payload and wet payloads to 97,250 lbs and 102,410 lbs respectively. This makes this analysis consistent with the TC trunnion lifting capacity of 208,500 lbs. The maximum (dry) payload is based on the OS197 TC trunnion lift capacity of 208,500 lb less the cask weight of 111,250 lbs (TC neutron shield full, with top lid), or 97,250 lbs. Similarly, the maximum (wet) payload is calculated as 208,500 lbs less 106,090 lbs (TC neutron shield full, without top lid), or 102,410 lb. These payload limits assume that the TC neutron shield is full (4,580 lbs). The maximum allowed loaded TC weight as described in the FSAR remains unchanged (i.e., 208,500 lbs).	721004-076

Description of Change	Associated SRS/SE
As a consequence of this change, any references to 100 ton (32PT-S100 and 32PT-L100 DSC) or 125-ton (32PT-S125 and 32PT-L125 DSC) capacity crane have been deleted from Appendix M. The 32PT DSC 100-ton configuration is now designated as 32PT-S100/32PT-L100, and the 32PT DSC 125-ton configuration is designated as 32PT-S125/32PT-L125 in Appendix M. This is a nomenclature change only.	

1E.1.6 Amendment 5, 6, and 7 Loading Overview

Table 1E-5 provides an overview of the fuel loaded under Amendments 6 and 7 at the Oconee Nuclear Station site. Tables 1E-6, 1E-7, and 1E-8 provide an overview of the FAs loaded under Amendment 7 at the Millstone Power Station, Oyster Creek Nuclear Generating Station, and Point Beach Nuclear Plant sites, respectively. No fuel loads were accomplished under Amendment 5. The data contained in these tables is for general information and is current as of the time the data was compiled for this application.

1E.2 Scoping Evaluation of CoC 1004 Amendments 5, 6, and 7 SSCs

For CoC 1004 Amendment 5, the primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 5 [1E.5.2], CoC 1004 Amendment 5 Technical Specifications (TS) [1E.5.13], CoC 1004 Amendment 5 SER [1E.5.14], and the FSAR [1E.5.7].

For CoC 1004 Amendment 6, the primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 6 [1E.5.4], CoC 1004 Amendment 6 TS [1E.5.15], CoC 1004 Amendment 6 SER [1E.5.16], and the FSAR [1E.5.7].

For CoC 1004 Amendment 7, the primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 7 [1E.5.6], CoC 1004 Amendment 7 TS [1E.5.17], CoC 1004 Amendment 7 SER [1E.5.18], and the FSAR [1E.5.7].

Using the methodology described in Chapter 2, in addition to the Standardized NUHOMS® System structures, systems, and components (SSCs) described in Appendix 1C, Section 1C.2, the following SSCs were determined to be within the scope of CoC 1004 Amendments 5, 6, and 7 renewal:

- 32PT DSC
- 24PHB DSC
- 61BT DSC (updated to include storage of damaged fuel)

1E.3 Aging Management Review of Amendments 5, 6, and 7 SSCs

The aging management review (AMR) of Amendments 5, 6, and 7 SSCs is based on the AMR presented in Chapter 3, Sections 3.5, 3.6, 3.7, and 3.8 for DSCs, HSMs, TCs, and spent fuel assemblies (SFAs), respectively. Incorporation of CoC 1004 Amendment 5, 6 and 7 changes described in Section 1E.1 and the 72.48 changes described in Section 1E.1.5 did not result in any change to the subcomponents of the Standardized NUHOMS® System listed in Appendix 1C, Tables 1C-9 through 1C-15. There is no change in the environment to which these in-scope subcomponents are exposed to relative to the environment listed in Appendix 1C, Tables 1C-9 through 1C-15. Hence, as documented in Table 1E-12, there is no change in the results of the AMR presented Appendix 1C, Tables 1C-9 through 1C-15 for the following SSCs:

- 24P DSC,
- 24P Long cavity DSC,
- 52B DSC,
- 24PT2 DSC,
- 61BT DSC (Intact Fuel Only),
- HSM (Model 80 and Model 102) and
- Onsite TC (Standardized, OS197 and OS197H TC).

1E.3.1 Aging Management Review of the NUHOMS®-32PT DSC

Table 1E-10 lists the subcomponents of the 32PT DSC and the material of construction of each subcomponent. Also listed are the environment, the Safety Classification and the intended function of each of the subcomponent of the 32PT DSC.

The NUHOMS®-32PT DSC shell thickness is 0.50" versus 0.625" for the NUHOMS®-24P DSC shell design. In addition, the 32PT DSC is designed with a "leaktight" confinement boundary. Except for these differences, the 32PT DSC shell design is essentially the same as the 24P DSC. Finally, the materials of construction of the 32PT DSC shell assembly, the environment to which the subcomponents are exposed to, are similar to the 24P DSC. Hence, AMR results described in Appendix A, Section 1A.3.3 and 1A.3.4.1, respectively, for the 24P DSC are also applicable to the 32PT DSC.

1E.3.2 Aging Management Review of the NUHOMS®-24PHB DSC

Table 1E-11 lists the subcomponents of the 24PHB DSC and the material of construction of each subcomponent. Also listed are the environment, the Safety Classification and the intended function of each of the subcomponent of the 24PHB DSC.

The 24PHBS DSC design configuration is essentially similar to the 24P DSC described in Appendix 1A of this application. The 24PHBL DSC design configuration is similar to the 24P Long Cavity DSC described in Appendix 1A except for the “shifted shielding” modification described in Section 1E.1.5.2. The only other change to the 24PHBS and 24PHBL DSC, relative to the 24P DSC design, is the addition of a test port and plug to the outer top cover plate to allow for testing to a condition of “leaktight” per ANSI N14.5 criteria [1E.5.8]. Also, the materials of construction of the 24PHB DSC shell assembly, the environment to which the subcomponents are exposed to, the decay heat load, payload authorized are similar to the 24P DSC. Hence, the AMR results described in Appendix A, Section 1A.3.3 and 1A.3.4.1, respectively, for the 24P DSC are also applicable to the 24PHB DSC.

1E.3.3 Aging Management Review of the NUHOMS®-61BT DSC (With Damaged Fuel)

Amendment 7 added a modified basket to the 61BT DSC to allow storage of damaged FAs. The subcomponents of the modified 61BT DSC basket and the materials of construction of each subcomponent are listed in Table 1E-9. Also listed are the environment, the Safety Classification and the intended function of each of the subcomponent. There is no change in 61BT DSC shell assembly. Hence, the AMR results described in Appendix C, Section 1C.3.4 for the 61BT DSC, which stores only intact FAs, are also applicable to the 61BT DSC, which stores intact and damaged FAs.

1E.3.4 Spent Fuel Assembly AMR

1E.3.4.1 Low Burnup Fuel

The 32PT DSC and 61BT DSC are authorized to store low burnup fuel (≤ 45,000 MWd/MTU). Hence, based on the justification provided in Appendix 1A, Section 1A.3.4.4, no aging management program (AMP) is required for fuel stored in 32PT and 61BT DSCs.

1E.3.4.2 High Burnup Fuel

The 24PHB DSC is authorized to store high burnup fuel (>45,000 MWd/MTU). The basis for storage of high burnup fuel during the period of extended operation is provided in Chapter 3, Section 3.8.5.2. The following is a summary of the evaluation presented in Section 3.8.5.2.

Acceptability of storage of high burnup fuel (>45,000 MWd/MTU) for the initial 20 years is based on ISG-11, Revision 3 [1E.5.10]. This basis may not be applicable for high burnup fuel storage beyond 20 years, due to the potential for further cooldown in the high burnup fuel cladding temperature during the extended 60-year renewal period. As the high burnup fuel cools down below the ductile-to-brittle transition temperature (DBTT), the formation of radial hydrides may provide an additional embrittlement mechanism to alter the acceptance criteria of ISG-11 for storage of high burnup fuel.

TN has performed the following TLAA evaluations to demonstrate the acceptability of storage of high burnup fuel during the period of extended operation:

- Appendix 3H evaluates the potential effects of additional cladding oxidation and concurrent hydride formation on the cladding integrity when the DSC confinement is hypothetically breached after 40 and 60 years of storage due to chloride-induced stress corrosion cracking (CISCC) of the stainless steel DSC shell. The evaluation is performed on the limiting 32PTH1 DSC with an initial heat load of 40.8 kW. The evaluation shows that the additional cladding thinning of 0.125 μm during extended operation is bounded by the cladding thinning of 68.6 μm assumed in the 32PTH1 DSC drop accident scenarios in the UFSAR [1E.5.19]. Also, for irradiated high burnup fuel rods including Zircaloy-4 and ZIRLO™, the amount of additional radial hydride as a result of cladding oxidation during air exposure after 40 years of storage will be less than 1 wppm. Thus, the postulated air exposure will not have any practical impact on the cladding degradation due to radial hydride formation.
- Appendix 3I determines the incubation time that the fuel cladding remains undamaged when exposed to an oxidizing atmosphere following a breach of the DSC confinement boundary. This evaluation is based on the limiting high burnup fuel stored in the 32PTH1 DSC, which has the highest heat load. The evaluation shows that it takes 14 years for conversion of UO_2 pellets to U_3O_8 to affect the fuel cladding and potentially release the fissile material into the DSC. During the incubation time of 14 years, the fuel cladding temperature will drop below 369 ºF, which further increases the incubation time to 225 years. The evaluation concludes that the development of a gross rupture due to a hypothetical breach of the DSC confinement after 20 years of dry storage is an unlikely event.
- Appendix 3J evaluates the structural adequacy of high burnup FAs during the renewal period by selecting the limiting 69BTH and 32PTH1 FAs. The evaluation shows that the decreasing temperature of the fuel could result in a ductile-to-brittle transition but any reduction in ductility due to radial hydride formation is not a concern due to the low fuel cladding stress levels. The expected stress values do not approach the yield strength of the cladding materials. Therefore, any possible ductile-to-brittle transition of the cladding does not affect the ability to safely retrieve the high burnup FAs after 60 years of storage.

<u>Results of the High Burnup Fuel TLAAs:</u>

- The above listed high burnup fuel TLAAs demonstrate that in the event of a hypothetical breach of the DSC confinement: (a) the high burnup fuel cladding oxidation effects are minimal (b) the development of a gross rupture is an unlikely event and (c) any possible ductile-to-brittle transition does not affect the ability to safely retrieve high burnup FAs after 60 years of storage.
- The TLAA evaluations discussed above envelop the evaluations of all the high burnup fuel authorized for storage in CoC 1004.

- Due to limited high burnup fuel test data currently available, the TLAA results are to be supplemented by an AMP described in the next section.

1E.3.5 Aging Management Program for High Burnup Fuel

NRC Interim Staff Guidance (ISG)-24 [1E.5.11] provides guidance for the storage of high burnup fuel for periods greater than 20 years, and specifies that the applicant may use the results of a completed or an ongoing demonstration, in conjunction with an actively updated aging management program (AMP), as an acceptable means for confirming that the canister contents satisfy the applicable regulations. ISG-24 further specifies that the high burnup fuel TLAAs and AMP should be periodically reevaluated and updated whenever new data from the demonstration program or other short term tests or modeling indicate potential degradation of the fuel or deviation from the assumptions of the TLAA or AMP.

Accordingly, AREVA has developed an AMP for the high burnup fuel as described in Appendix 6A, Section 6A.8. The high burnup fuel AMP is a generic program that is applicable to all licensees storing high burnup fuel assemblies. Consistent with the guidance provided in ISG-24, AREVA will take credit for the DOE/EPRI High Burnup Dry Storage Cask Research and Development Project (HDRP) [1E.5.12].

Data collected from periodic monitoring of the HDRP over the length of the program will be used to update or refine the analysis models used in the above listed high burnup fuel TLAAs Also, the test data collected from the HDRP will be used to validate the mechanical properties of the high burnup fuel cladding used in the TLAAs listed above.

The high burnup AMP is a “learning” AMP subject to the tollgates assessments as described in Chapter 4.

1E.4 Fuel Retrievability

In addition to the DSCs addressed in Appendix 1C, the 61BT DSC (authorized to store damaged and intact fuel) and the 32PT DSC also store low burnup fuel (≤45,000 MWd/MTU). Hence, as stated in Section 1A.4, Appendix 1A, the low burnup fuel retrievability is ensured even when the CISCC aging affects compromise the DSC confinement boundary during the period of extended operation of 60 years.

To ensure retrievability of high burnup fuel (> 45,000 MWd/MTU) during the period of extended operation, in addition to the justification provided in Section 1A.4 of Appendix 1A, the evaluation presented in 1E.3.4.2 and the implementation of the high burnup fuel AMP, as described in Appendix 6A, Section 6A.8, provide reasonable assurance that the high burnup SFAs will be retrievable during the period of extended operation.

1E.5 References (Appendix 1E)

1E.5.1 Transnuclear Inc., "Application for Amendment No. 5 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks," June 29, 2001.

1E.5.2 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 5," January 7, 2004, Docket No. 72-1004.

1E.5.3 Transnuclear Inc., "Application for Amendment No. 6 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks," August 31, 2001.

1E.5.4 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 6," December 22, 2003, Docket No. 72-1004.

1E.5.5 Transnuclear Inc., "Application for Amendment No.7 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks," March 29, 2002.

1E.5.6 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 7," March 2, 2004, Docket No. 72-1004.

1E.5.7 Transnuclear Inc., "NUH-003, Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 8," Docket No. 72-1004, June 2004.

1E.5.8 ANSI N14.5-1997, "Leakage Tests on Packages for Shipment," February 1998.

1E.5.9 Transnuclear Inc. Letter to the U.S. Nuclear Regulatory Commission, NUH03-04-67, dated July 27, 2004, "Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System for the Period 11/1/03 – 6/30/2004," Docket No. 72-1004.

1E.5.10 Interim Staff Guidance No. 11, Revision 3, "Cladding Considerations for the Transportation and Storage of Spent Fuel," NRC Spent Fuel Project Office, November 2003.

1E.5.11 Interim Staff Guidance No. 24, Revision 0, "The Use of a Demonstration Program as a Surveillance Tool for Confirmation of Integrity for Continued Storage of High Burnup Fuel Beyond 20 Years."

1E.5.12 "High Burnup Dry Storage Cask Research and Development Project, Final Test Plan," Electric Power Research Institute, February 27, 2014.

1E.5.13 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment No. 5, Docket No. 72-1004, January 2004.

1E.5.14 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 5" Docket No. 72-1004, January 2004.

1E.5.15 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment No. 6," Docket No. 72-1004, December 2003.

1E.5.16 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Addition of NUHOMS®-24PHB System, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 6," Docket No. 72-1004, December 2003.

1E.5.17 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Certificate of Compliance No. 1004, Amendment No. 7," Docket No. 72-1004, March 2004.

1E.5.18 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Standardized NUHOMS® Horizontal Modular Storage System, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 7," Docket No. 72-1004, March 2004.

1E.5.19 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

Table 1E-1
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 8)
NUH-61B-1060-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel General Arrangement	3
NUH-61B-1061-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Shell Assembly	3
NUH-61B-1062-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Canister Details	3
NUH-61B-1063-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Basket Assembly	3
NUH-61B-1064-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Basket Details	3
NUH-61B-1065-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Parts List	3
NUH-61B-1066-SAR	NUHOMS®-61BT Transportable Canister – Basket Details for Damaged Fuel	4

Table 1E-2
NUHOMS®-32PT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 8)
NUH-32PT-1001-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Main Assembly	2
NUH-32PT-1002-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Shell Assembly	2
NUH-32PT-1003-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly, Plate Options	3
NUH-32PT-1004-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly, Tube Options	3
NUH-32PT-1006-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Aluminum Transition Rails	2

Table 1E-3
NUHOMS®-24PHB DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 8)
NUH-HBU-1000-SAR	24PHBS and 24PHBL DSC	1

Table 1E-4
NUHOMS® HSM Design Drawings

Design Drawing No.	Description	Drawing Revision Level (FSAR Rev. 8)
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	7

Proprietary Information on Pages 1E-20 through 1E-31
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1F
Renewal of the Standardized NUHOMS® System Approved under Amendment 8 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1F.1 Introduction

Transnuclear Inc. (TN) submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 8 to the U.S. Nuclear Regulatory Commission (NRC) on September 19, 2003 [1F.5.1], as supplemented, to add the NUHOMS®-24PTH System to the Standardized NUHOMS® System.

Amendment 8 application also requested three additional changes:

- Revise 32PT DSC Technical Specifications (TS) to allow storage of low enrichment and reconstituted fuel,
- Revise 24PHB DSC TS to allow storage of additional fuel types including CE 14x14, WE 14x14, WE 15x15 and WE 17x17 class pressurized water reactor (PWR) fuel assemblies (FAs), and
- Revise the transfer cask (TC)/dry shielded canister (DSC) handling and lifting height TS.

CoC 1004 Amendment 8 was approved by the NRC effective December 5, 2005 [1F.5.2].

1F.1.1 Brief Description of Amendment 8

The NUHOMS®-24PTH System is a modular canister-based spent fuel storage and transfer system, similar to the Standardized NUHOMS®-24P System described in Appendix 1A of this application. The NUHOMS®-24PTH System consists of the following new or modified components:

- A new dual purpose (Storage and Transportation) DSC, with three alternate configurations, designated as DSC Type NUHOMS®-24PTH-S, -24PTH-L, and -24PTH-S-LC,
- A new 24PTH DSC basket design, which is provided with two alternate options: with aluminum inserts (Type 1) or without aluminum inserts (Type 2). In addition, depending on the boron content in the basket poison plates, each basket type is designated as Type A (low B-10), Type B (moderate B-10) or Type C (high B-10), which results in six different basket types (Type 1A, 1B, 1C, 2A, 2B, or 2C),
- A modified version of the standardized horizontal storage module (HSM) Model 102 described in the Updated Final Safety Analysis Report (UFSAR) [1F.5.3], designated as HSM-H, has been equipped with special design features that provide enhanced shielding and heat rejection capabilities, and
- A modified version of the OS197/OS197H TC described in Revision 9 of the UFSAR [1F.5.3], designated as OS197FC TC, has been provided with an optional modified top lid to allow air circulation through the TC/DSC annulus during transfer operations at certain heat loads.

A detailed description of the NUHOMS®-24PTH System, including drawings, authorized payload contents and supporting safety analyses for this system are provided in Appendix P of the UFSAR [1F.5.3].

The 24PTH DSC is designed to accommodate up to 24 intact (or up to 12 damaged and balance intact) PWR FAs, with characteristics as described in Section P.2.1, Appendix P.2 of the UFSAR [1F.5.3].

The 24PTH-S and 24PTH-L are the short and long cavity configurations of the 24PTH DSC designed for a maximum heat load of 40.8 kW. They are transferred to the independent spent fuel storage installation (ISFSI) for storage in the HSM-H in either the OS197/OS197H or OS197FC TC depending upon the heat load.

The 24PTH-S-LC DSC is a modified version of 24PTH-S DSC, provided with thinner top and bottom lead shield plugs instead of steel, resulting in a longer cavity length. This DSC type is designed for a maximum heat load of 24 kW per DSC and may be stored in either the currently licensed Standardized HSM Model 102, or in the new HSM-H, while the currently licensed Standardized TC (with a solid neutron shield) is used for onsite transfer.

FAs with control components are to be stored only in 24PTH-L and 24PTH-S-LC DSC Types, due to their longer cavity length.

The maximum internal pressures for the 24PTH-S DSC and 24PTH-L DSC are 15, 20, and 120 psig for normal, off-normal, and accident conditions, respectively. The maximum internal pressures for the 24PTH-S-LC are 15, 20, and 90 psig for normal, off-normal, and accident conditions, respectively.

Description of the NUHOMS®-24PTH DSC

Each NUHOMS®-24PTH DSC consists of a DSC shell assembly (cylindrical shell, canister bottom and top cover plates and shield plugs or shield plug assemblies) and a basket assembly. The 24PTH DSC is provided with three alternate configurations depending on the DSC shell assembly length and DSC cavity length to allow flexibility to accommodate the various payload fuel types and control components described in Section P.2.1, Appendix P of UFSAR Revision 9[1F.5.3].

The primary confinement boundary for the NUHOMS®-24PTH DSC consists of the DSC shell, the top and bottom inner cover plates, (or the top and bottom inner cover plates of the shield plug assemblies for the 24PTH-S-LC), the siphon and vent block, the siphon and vent port cover plates, and the associated welds. The outer top cover plate and associated welds form the redundant confinement boundary.

The cylindrical shell and the inner bottom cover plate boundary welds are fully compliant to Subsection NB of the ASME Code [1F.5.5] and are made during fabrication. The top closure confinement welds are multi-layer welds applied after fuel loading and comply with the requirements of the alternative ASME Code Case N-595-2. The outer top cover plate is welded to the shell subsequent to the leak testing of the confinement boundary to the leaktight criteria of ANSI N14.5-1997 [1F.5.6].

The 24PTH DSC basket structure consists of 24 stainless steel fuel tubes with the space between adjacent tubes sandwiched by aluminum and neutron poison plates. The poison plates are made of either borated aluminum, metal matrix composites (MMCs) or Boral® that provide the necessary criticality control. The aluminum plates, together with the poison plates, provide a heat conduction path from the FAs to the canister shell. Each fuel tube is welded together at selected elevations along the axial length of the basket through stainless steel insert plates, which separate the aluminum and poison plates arranged in an egg crate configuration. The transition rails provide the transition between the rectangular basket structure and the cylindrical DSC shell. There are two types of transition rails: four R90 solid aluminum rails located at 0°, 90°, 180°, and 270° and eight R45 steel transition rails located on both sides of 45°, 135°, 225°, and 275° locations inside the DSC cavity. The transition rails support the fuel tubes and transfer mechanical loads to the DSC shell. They also provide the thermal conduction path from the basket assembly to the canister shell wall, making the basket assembly efficient in rejecting heat from its payload. The nominal clear dimension of each fuel tube opening is sized to accommodate the limiting assembly with sufficient clearance around the FA.

During dry storage of the spent fuel in the NUHOMS®-24PTH System, no active systems are required for the removal and dissipation of the decay heat from the fuel. The NUHOMS®-24PTH DSC is designed to transfer the decay heat from the fuel to the canister body via the basket and ultimately to the ambient via either the HSM-H in storage mode or the TCs in the transfer mode.

<u>Description of the NUHOMS® HSM-H Module</u>

The HSM-H module design is similar to the design of HSM Model 102 described in Revision 9 of the the UFSAR [1F.5.3] with the following features provided to improve the heat rejection and shielding capabilities:

- Use of a thicker roof with no uniform gap between the adjacent modules,
- Use of slotted plates and holes in the DSC support rails to increase airflow at the bottom portion of canister,
- Increased height of the module to increase module cavity and stack height and to minimize air flow resistance in the module cavity,
- Optimized DSC support structure to minimum airflow resistance,
- Use of finned side heat shields option for high heat loads to improve convection heat transfer by increasing surface area of heat shield, and

- Use of alternate louvered top heat shield design to minimize airflow resistance.

The key design parameters and estimated weights of the HSM-H module are shown in Table P.1-1, Appendix P.1 of the UFSAR Revision 9 [1F.5.3].

Description of the NUHOMS® OS197FC TC

The OS197FC TC is a modified version of the OS 197/OS197H TC described in Chapter 1 of UFSAR Revision 9 [1F.5.3].

The top lid of the OS197/OS197H TC is scalloped out at sixteen locations on the lid underside to provide slots that provide an exit path for air circulation through the TC/DSC annulus. This external air circulation feature is needed during the transfer mode if decay heat is greater than 31.2 kW and basket type used in the DSC is 1A, 1B, or 1C and specific time limits for transfer are not met, or if the decay heat is greater than 24.0 kW (but not greater than 31.2 kW) and basket type used is 2A, 2B, 2C, and specific time limits for transfer are not met.

To achieve this air circulation, the NUHOMS® TC support skid is modified by the addition of two motor-driven redundant industrial grade blowers and associated hoses that are connected via a cone adapter to the ram access opening. The TC spacer inside the TC cavity also requires minor modifications to ensure distribution of the airflow to the perimeter region of the TC. The air circulation system is sized to provide a minimum capacity of 450 cfm.

1F.1.2 Design Drawings Certified in Amendment 8

The January 1, 2005 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 8 [1F.5.2].

Tables 1F-1, 1F-2, and 1F-3 provide a listing of the UFSAR drawings for the NUHOMS®-24PTH DSC, HSM-H and OS197-FC TC, respectively, contained in UFSAR Revision 9 [1F.5.3], which was docketed following the approval of Amendment 8. These 24PTH System drawings reflect the configuration approved by the NRC plus the modifications implemented under the provisions of 10 CFR 72.48 as described in Subsection 1F.1.3 below.

The 61BTH DSC, 32PT DSC, and HSM configurations were modified as shown in the UFSAR drawings listed in Tables 1F-4, 1F-5, and 1F-6, respectively, under 10 CFR 72.48 criteria. There were no 72.48 changes implemented to the configuration of 24P DSC, 24P Long Cavity DSC, 24PT2 DSC, 52B DSC, or 24PHB DSC.

1F.1.3 Changes to the Standardized NUHOMS® System Implemented in UFSAR Revision 9

Section 1F.1.3.1 provides a description of the HSM Model 152 added to the Standardized NUHOMS® System.

Sections 1F.1.3.2 through 1F.1.3.5 list the more significant changes implemented to the Standardized NUHOMS® System and incorporated into UFSAR Revision 9 [1F.5.3]. Also listed is the corresponding safety evaluation (SE), which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biannual report submitted to the NRC [1F.5.4].

1F.1.3.1 Addition of HSM Model 152 to the Standardized NUHOMS® System

A new HSM, designated as HSM Model 152, which provides considerably more shielding than either the HSM Model 80 or HSM Model 102, has been added to the Standardized NUHOMS® System under the provisions of 10 CFR 72.48. A description of HSM Model 152 and the associated safety analyses is presented in Appendix R of the UFSAR Revision 9 [1F.5.3].

In general, the HSM Model 152 is similar to the existing HSM Model 80 and Model 102. The material and physical properties for all three HSM models are basically the same. The major differences between the HSM Model 152 and the existing Model 80 and Model 102 are listed in Table R.1-1, Appendix R of the UFSAR [1F.5.3] and highlighted below:

The HSM Model 152 has the roof thickness increased to 5'-8" to improve shielding performance.

The thickness of the end shield wall and rear shield wall in the HSM Model 152 is increased to 3'-0" to improve shielding performance and provide additional protection from external hazards.

The thickness of the HSM Model 152 base unit side wall is decreased to 1'-0" in recognition of the self-shielding of adjacent HSMs and the removal of the 6" side gap.

The HSM Model 152 does not have a floor slab. The door of the HSM Model 152 is similar to the one for the HSM Model 102 in that it is a 24" thick door constructed of reinforced concrete.

The HSM Model 152 has a single inlet vent located along the bottom front wall and a single outlet vent located at the back of the roof.

All three HSM designs consist of massive reinforced concrete structures that are capable of withstanding all normal condition loads as well as the abnormal condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena hazards. Also, they remove decay heat by natural circulation convection and by conduction through the HSM walls and roof.

The HSM Model 152 is evaluated in Appendix R for all the same requirements as the original HSM Model 80 and Model 102, which have been previously reviewed, approved and licensed by the NRC in Certificate of Compliance (CoC) 1004.

1F.1.3.2 24PTH DSC Changes

Description of Change	Associated SE
The 24PTH DSC licensing drawings were modified as listed below to allow additional fabrication flexibility: Change Description • Slightly increased the maximum length of the 24PTH-S-LC. • Changed the description of the diametrical gap that is required between the DSC shell inner diameter (ID) and the outer diameter (OD) of the basket assembly to specify the gap as a range instead of a single nominal value. • Added alternate configurations for attaching the R45 transition rails to the basket structure, which allows fabrication flexibility for mounting the transition rails to the basket assembly, that is, the R45 transition rails are mounted separately from the aluminum inserts. • Added flexibility in fabrication of the R90 transition rails as either single or three longitudinal segments. • Added details for the alternate design configurations for attaching the optional aluminum inserts separate from the R45 transition rails.	LR 721004-294
• Added a supplementary thermal evaluation for the 24PTH DSC during storage and transfer conditions to Appendix P of the UFSAR. Also, changed the steel emissivity of the transfer cask and DSC stainless steel shells from 0.46 to 0.587 to be consistent with the property values reported in UFSAR.	LR 721004-301

1F.1.3.3 32PT DSC and 61BT DSC Changes

Description of Change	Associated SRS/SE
• This 72.48 evaluation addresses the differences in the length of the neutron absorbing plates (NAPs), aluminum compartment plates, and the height of the retention plates as shown on the 32PT DSC procurement drawings relative to the 32PT DSC licensing drawings. Specifically, the length of the NAPs and aluminum compartment plates is shorter on the procurement drawings (164.1" versus 166.1"). The height of the retention plate is also different, that is, 2.5" on the procurement drawing and 0.75" on the licensing drawing.	LR 721004-093
• Table K.3.1-2, Appendix K of the UFSAR, which lists the ASME Code Exceptions for the NUHOMS®-61BT DSC confinement boundary, has been revised to add a statement that clarifies that the inner top cover weld around the vent and siphon block is per Code Case N-595. Also, added a statement to clarify that the weld between the shell and the vent and siphon block of the 61BT DSC is a code alternative.	LR 71004-250
• This 72.48 evaluation addresses the addition of a 1” spacer pad to the 61BT DSC	LR 721004-345

Description of Change	Associated SRS/SE
shell and removal of the spacer pads from the 61BT DSC holddown ring plates. In addition, a chamfer is added to the step of the 61BT DSC siphon/vent block.	

1F.1.3.4 HSM and TC Changes

Description of Change	Associated SRS/SE
• This 72.48 evaluation addresses an increase in the maximum (wet) payload from 90,000 lb to 97,950 lb, and in the maximum (dry) payload from 80,000 to 93,300 lb for the Standardized TC. The maximum allowed TC weight of 200,000 lbs remains unchanged.	SE 721004-172
• This change addresses the fabrication of HSM important-to-safety (ITS) welds in accordance with AWS D1.1-96, instead of AWS D1.1-98.	LR 721004-313

1F.1.3.5 HSM-H Changes

Description of Change	Associated SRS/SE
Several changes to the HSM-H design were implemented to incorporate fabricator's input, operational experience, past practices, ease of fabrication, etc. and are listed below: <u>Shield Wall Configuration</u> The end shield wall design has been changed from a horizontal lap joint with horizontal primary reinforcement to a vertical lap joint with vertical primary reinforcement. The Type A rear wall is deleted and replaced by a 3' square corner piece. The 1" diameter through-bolt connections that connect the shield walls to the base unit have been replaced with 1.5" diameter bolts. The material specification of the bolts/nuts has been revised to ASTM A193 Gr B7/ASTM A194. <u>Outlet Vent Cover</u> The outlet vent cover clear span length and total length have been changed to 12'-10" and 14'-10", respectively. Two through-bolts are used to attach the vent cover to the roof instead of four bolts. <u>DSC Support Structure</u> The ASTM A572, GR 50 material specification for the DSC stop plate assembly has been changed to ASTM A36. The thickness of the rail extension baseplate has been changed from 1.25" to 1" thick. <u>DSC Support Structure Connections</u>	LR 721004-206

Description of Change	Associated SRS/SE
• The front wall bolted connections have been changed to two 1.5" diameter ASTM A325 bolts (without washers) for each rail, bolted to individual threaded embedments. • The rear wall bolted connections have been redesigned. • The attachment of the leveling nuts and rear connection plates to the lower flanges have been replaced with ⅛" fillet welds for attaching the leveling nuts and 5/16" fillet welds for attaching the rear connection plates to the lower flanges. • One inch nominal grout layer thickness has been changed to ¾" nominal grout layer thickness. Roof Louvered Heat Shield and Fasteners • The mounting bar material has been changed from A240, Type 304 stainless steel to aluminum Type 1100. • The dimensions of the louvered panels have been changed for ease of fabrication. • The cross section dimension of each louver plate of 2" x ⅛" and the distance separating each louver plate of 1" have been added to the drawings. • The connection detail of the heat shields to the roof has been changed from a stainless steel bracket type connection to a ¾" diameter schedule 40 aluminum pipe welded to the mounting bar. Side Heat Shield This change implements a side heat shield design without fins for heat loads up to 31.2 kW. Bird Screens The inlet and outlet vent screen open area has been changed from 80% to 70%. Concrete Components The "min" designation for the door opening and the inside diameter of the cask docking flange have been deleted. Door Type A (square) and Type B (round) Minor dimensional changes have been implemented. Errors, Omissions, Clarification Minor dimensional corrections, clarifications have been implemented.	

1F.1.4 Amendment 8 Loading Overview

Tables 1F-7, 1F-8, 1F-9, 1F-10, 1F-11, and 1F-12 provide an overview of the fuel loaded under Amendment 8 at the Oconee Nuclear Station, Millstone Power Station, Fort Calhoun Station, H.B. Robinson Steam Electric Plant, Susquehanna Steam Electric Station, and Point Beach Nuclear Plant sites, respectively. The data contained in these tables is for general information and is current as of the time this data was compiled for this application.

1F.2 Scoping Evaluation of CoC 1004 Amendment 8 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 8 [1F.5.2], CoC 1004 Amendment 8 TS [1F.5.7], CoC 1004 Amendment 8 Safety Evaluation Report (SER) [1F.5.8], and the UFSAR [1F.5.3].

Using the methodology described in Chapter 2, in addition to all the Standardized NUHOMS® System structures, systems, and components (SSCs) described in Appendix 1E, Section 1E.2.0, the following SSCs are also included within the scope of CoC 1004 Amendment 8 renewal:

- 24PTH DSC
- HSM-H Module
- HSM (Model 152)
- OS197FC TC

1F.3 Aging Management Review of Amendment 8 SSCs

The AMR of Amendment 8 SSCs is based on the AMR presented in Chapter 3, Sections 3.5, 3.6, 3.7, and 3.8 for DSCs, HSMs, TCs, and SFAs, respectively. Approval of Amendment 8 did not result in any change in the design configuration of the 24P DSC, 24P Long Cavity DSC, 52B DSC, 24PT2 DSC, Standardized HSM (Model 80 and Model 102), Standardized TC, OS197 TC, and OS197H TC. Hence, the aging management review (AMR) results listed in Appendix 1A, Section 1A.3, remain applicable for these SSCs.

There is a minimal change in the design configuration of the 61BT DSC, 32PT DSC and 24PHB DSC following incorporation of 10 CFR 72.48 changes in the UFSAR [1F.5.3]. Hence, the AMR results listed in Appendix 1E, Section 1E.3 remain applicable for these SSCs.

The above results are documented in Table 1F-17.

1F.3.1 Aging Management Review of the NUHOMS® 24PTH DSC

Table 1F-13 lists the subcomponents of the 24PTH DSC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the 24PTH DSC subcomponents.

Appendix 3A, 3D, 3E and 3G provide a discussion of the DSC time-limited aging analyses (TLAAs) methodology and the DSC TLAA results. As noted in these Appendices, each of the TLAA is performed by selecting bounding evaluation parameters for the DSC under consideration so that the TLAA results are applicable to all the DSCs certified in CoC 1004 (Amendment 1 through 11 and Amendment 13). A summary of these limiting DSC TLAA results is provided in Appendix 1A, Section 1A.3.4.1. These TLAA results are also applicable to the 24PTH DSC.

Table 1F-13 presents the results of the AMR for the 24PTH DSC subcomponents.

1F.3.2 Aging Management Review of HSM-H and HSM Model 152

Table 1F-14 and Table 1F-15 list the subcomponents of the HSM-H and HSM Model 152, respectively. These tables also list the material of construction of each subcomponent, the environment, the safety classification and the intended function of the subcomponents of the HSM-H and HSM Model 152.

Appendix 3C and 3E provide a discussion of the HSM TLAAs methodology and the HSM TLAA results. As noted in these Appendices, each of the TLAA is performed by selecting bounding evaluation parameters for the HSM Model under consideration so that the TLAA results are applicable to all the HSM Models certified in CoC 1004 (Amendment 1 through 11 and Amendment 13). A summary of these limiting HSM TLAA results is provided in Appendix 1A, Section 1A.3.4.2. These TLAA results are also applicable to HSM-H and HSM Model 152.

Table 1F-14 and Table 1F-15 present the results of the AMR for HSM-H and HSM Model 152 subcomponents.

1F.3.3 Aging Management Review of the OS197FC TC

Table 1F-16 lists the subcomponents of the OS197FC TC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the OS197FC TC subcomponents.

Appendix 3B presents the results of fatigue evaluation for the OS197FC TC. As determined in Appendix 3B, fatigue of OS197FC TC is not an aging effect requiring management during extended operations. The TLAA results for the Onsite TC presented in Section 1A.3.4.3 of Appendix 1A are also applicable to the OS197FC TC.

Table 1F-16 presents the results of the AMR for the OS197FC TC subcomponents.

1F.3.4 Aging Management Review of the Spent Fuel Assemblies

There is no change in the AMR results for the low burnup fuel discussed in Appendix 1E, Section 1E.3.4.1.

The AMR results for the high burnup fuel presented in Appendix 1E, Section 1E.3.4.2 are also applicable to the high burnup fuel authorized for storage in the 24PTH DSC. The aging management program (AMP) for the high burnup fuel is discussed in Appendix 1E, Section 1E.3.5.

1F.4 Fuel Retrievability

The retrievability of low burnup and high burnup FAs is ensured as discussed in Section 1E.4, Appendix 1E.

1F.5 References (Appendix 1F)

1F.5.1 Transnuclear Inc., "Application for Amendment No. 8 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks", September 19, 2003.

1F.5.2 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004," Amendment 8, December 5, 2005, Docket No. 72-1004.

1F.5.3 Transnuclear Inc., "NUH-003, Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 9," Docket No. 72-1004, January 2006.

1F.5.4 Transnuclear Inc. Letter to the U.S. Nuclear Regulatory Commission, NUH03-06-87, dated July 26, 2006, "Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System for the Period 7/1/04 – 2/3/2006," Docket No. 72-1004.

1F.5.5 American Society of Mechanical Engineers, ASME Boiler And Pressure Vessel Code, Section III, Division 1 - Subsections NB, NG and NF, 1998 edition including 2000 Addenda.

1F.5.6 ANSI N14.5-1997, "Leakage Tests on Packages for Shipment," February 1998.

1F.5.7 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 8," Docket No. 72-1004, December 2005.

1F.5.8 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 8" Docket No. 72-1004, December 2005.

Table 1F-1
NUHOMS®-24PTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 9)
NUH-24PTH-1001-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel, Main Assembly	2
NUH-24PTH-1002-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel, Shell Assembly	2
NUH-24PTH-1003-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel Basket Assembly	1
NUH-24PTH-1004-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel, Transition Rails	2

Table 1F-2
NUHOMS® HSM-H Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 9)
NUH-03-7001-SAR	Standardized NUHOMS® ISFSI HSM-H, Main Assembly	2

Table 1F-3
NUHOMS® Onsite Transfer Cask Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 9)
NUH-03-8006-SAR	General License NUHOMS® ISFSI OS197FC Onsite Transfer Cask Main Assembly	0
NUH-03-8000-SAR	General License NUHOMS® ISFSI Onsite TC – Overview	3

Table 1F-4
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 9)
NUH-61B-1062-SAR	NUHOMS®-61BT Transportable Canister for BWR Fuel Canister Details	4
NUH-61B-1066-SAR	NUHOMS®-61BT Transportable Canister – Basket Details for Damaged Fuel	5

Table 1F-5
NUHOMS®-32PT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 9)
NUH-32PT-1001-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Main Assembly	3
NUH-32PT-1002-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Shell Assembly	3
NUH-32PT-1003-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly, Plate Options	4
NUH-32PT-1004-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly, Tube Options	4
NUH-32PT-1006-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Aluminum Transition Rails	3

Table 1F-6
NUHOMS® HSM (Model 80, Model 102, and Model 152) Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 9)
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	8
NUH-03-6400-SAR	General License NUHOMS® Model 152 Main Assembly	0

Proprietary Information on Pages 1F-19 through 1F-37
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1G
Renewal of the Standardized NUHOMS® System Approved under Amendment 9 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1G.1 Introduction

Transnuclear Inc. (TN), submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 9 to the NRC on April 18, 2006 [1G.5.1], as supplemented, to revise the authorized contents of the NUHOMS®-61BT DSC to include the Framatome-ANP, Version 9x9-2 (FANP9 9x9-2) fuel assemblies (FAs).

CoC 1004 Amendment 9 was approved by the U.S. Nuclear Regulatory Commission (NRC) effective April 17, 2007 [1G.5.2].

1G.1.1 Brief Description of Amendment 9

The addition of the FANP9 9x9-2 FAs to the NUHOMS®-61BT DSC did not result in any changes to the physical configuration of the 61BT DSC. This new payload is bounded by the other fuel types currently authorized for storage in the 61BT DSC. The supporting structural, thermal, shielding and criticality analysis have been added to Appendix K of the UFSAR Revision 10 [1G.5.3].

1G.1.2 Design Drawings certified in Amendment 9

The January 1, 2007 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 9 [1G.5.2].

There were no changes to the UFSAR drawings for the NUHOMS®-61BT contained in UFSAR Revision 10 [1G.5.3] due to the approval of Amendment 9.

TN implemented changes to the 61BT DSC, 32PT DSC, HSM-H, and onsite transfer cask (TC) configurations and added HSM Model 202 under the 10 CFR 72.48 criteria. These changes were incorporated in the drawings included in UFSAR Revision 10 [1G.5.3] listed in Tables 1G-1, 1G-2, 1G-3, 1G-4, and 1G-5.

There were no 72.48 changes implemented to the configuration of the NUHOMS®-24P DSC, -24P Long Cavity DSC, -24PT2 DSC,- 52B DSC, -24PHB DSC, or -24PTH DSC.

1G.1.3 Changes to the Standardized NUHOMS® System implemented in UFSAR Revision 10

Section 1G.1.3.1 provides a description of the HSM Model 202 added to the Standardized NUHOMS® System.

Section 1G.1.3.2 provides a discussion of the addition of the OS197L TC to the Standardized NUHOMS® System.

Sections 1G.1.3.3 through 1G.1.3.5 list the more significant changes implemented to the Standardized NUHOMS® System and incorporated into UFSAR Revision 10 [1G.5.3]. Also listed is the corresponding licensing review (LR), which evaluated each change under the criteria of 10 CFR 72.48, and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biennial report submitted to the NRC [1G.5.4].

1G.1.3.1 Addition of HSM Model 202 to the Standardized NUHOMS® System

A new HSM, designated as HSM Model 202, has been added to the Standardized NUHOMS® System as an alternative to the existing Standardized HSM Model 80 and Model 102 under the provisions of 10 CFR 72.48.

The HSM Model 202 is qualified to store the 24P, 52B, 61BT, 24PT2, 32PT, 24PHB, and 24PTH-S-LC DSCs, which are currently licensed under CoC 1004. These DSCs store spent fuel with a maximum heat load of 24.0 kW.

The geometry and configuration of the HSM Model 202 is the same as the HSM-H. The HSM Model 202 offers greater biological shielding and heat rejection capabilities compared to Models 80 and 102.

The HSM Model 202 can store both pressurized water reactor (PWR) and boiling water reactor (BWR) dry shielded canisters (DSCs) of varying lengths. The varying lengths of the DSCs are accommodated through the use of rail spacers. Similar to the design basis, function, and operation of the HSM Model 80 and Model 102, the Model 202 provides a passive cooling system involving air circulation by natural convection to ensure that peak cladding temperatures during long-term storage of spent fuel assemblies (SFAs) remain below acceptable limits to assure fuel cladding integrity.

The HSM Model 202 is evaluated in Appendix V of the UFSAR [1G.5.3] for all the same requirements as the original HSM Model 80 and Model 102, which have been previously reviewed, approved and licensed by the NRC in CoC 1004.

1G.1.3.2 Addition of OS197L TC

TN has developed a lightweight configuration of the OS197 TC, designated as OS197L TC. The design intent of this cask is to allow for loading/unloading and transfer of licensed DSCs 24P, 52B, 61BT, 24PT2, 32PT and 24PHB and maintain the bounding crane load to less than 75 tons. However, this change was subsequently determined to require a change to the CoC 1004 Technical Specifications, and thus, according to 10 CFR 72.48 criteria, an Amendment to CoC 1004 is required for implementing this change. Accordingly, the OS197L TC has not been included in the scope of UFSAR Revision 10.

1G.1.3.3 HSM-H Changes

Description of Change	Associated LR
The HSM-H design configuration was modified to simplify fabrication and installation of the modules as listed below: • Provide an option to eliminate the 2" x ½" slots on the DSC support structure extension plate. • Provide for optional (flat) anodized aluminum side heat shield with (flat) stainless steel side heat shields. • Provide for optional louvered aluminum roof heat shield with flat stainless steel heat shield.	721004-352

1G.1.3.4 24PHB DSC Changes

Description of Change	Associated LR
• This LR addresses qualification of Babcock and Wilcox (B&W) 15x15 burnable poison rod assemblies (BPRAs) with a different material composition (Mark-B BPRAs) for storage in the NUHOMS®-24PHB System.	721004-401

1G.1.3.5 TC Changes

Description of Change	Associated LR
• This 72.48 clarifies the transfer cask external contamination criteria during cask handling operations outside the spent fuel pool for existing NUHOMS® transfer casks. The UFSAR is revised to state that the limits are those imposed by the specific plant radiation protection (RP) program.	721004-406
• This change implements solid upper and lower trunnions as an alternate configuration to the multi-piece trunnion design for the OS197 and OS197H onsite TCs. This alternate design enhances structural strength of the cask, simplifies fabricability, and results in reduced maintenance costs during the life of the cask.	721004-410

1G.1.4 Amendment 9 Loading Overview

Tables 1G-6 through 1G-17 provide an overview of the fuel loaded under Amendment 9 at Oconee Nuclear Station, Millstone Power Station, Kewaunee Power Station, Fort Calhoun Station, H. B. Robinson Steam Electric Plant, Susquehanna Steam Electric Station, Point Beach Nuclear Plant, Duane Arnold Energy Center, Monticello Nuclear Generating Plant, Oyster Creek Nuclear Generating Station, Limerick Generating Station, and Cooper Nuclear Station sites.

These tables list the pertinent FA parameters such as the maximum fuel enrichment, maximum burnup, minimum cooling time, total DSC heat load, and the Model Numbers of the DSC and HSM into which these FAs are stored.

These loading tables are provided for general information and are current as of the time this data was compiled for this application.

1G.2 Scoping Evaluation of CoC 1004 Amendment 9 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 9 [1G.5.2], CoC 1004 Amendment 9 Technical Specifications [1G.5.5], CoC 1004 Amendment 9 SER [1G.5.6], and the UFSAR [1G.5.3].

Using the methodology described in Chapter 2, in addition to all the Standardized NUHOMS® System SSCs described in Appendix 1F, Section 1F.2, the following SSC is also included within the scope of CoC 1004 Amendment 9 renewal:

- HSM Model 202

1G.3 Aging Management Review of Amendment 9 SSCs

The AMR of Amendment 9 SSCs is based on the AMR presented in Chapter 3, Sections 3.5, 3.6, 3.7, and 3.8 for DSCs, HSMs, TCs, and SFAs, respectively. Approval of Amendment 9 did not result in any change in the design configuration of the SSCs previously addressed in Appendix 1F. Hence, the aging management review (AMR) results listed in Appendix 1F, Section 1F.3, remain applicable for these SSCs as documented in Table 1G-21.

There is a minimal change in the design configuration of the HSM-H and OS197 TC following incorporation of 10 CFR 72.48 changes in the UFSAR [1G.5.3] as listed in Tables 1G-18 and 1G-20. Hence, the AMR results listed in Appendix 1F, Section 1F.3 remain applicable for HSM-H and OS197 TC also.

1G.3.1 Aging Management Review of the HSM Model 202

The design configuration of HSM Model 202 is based on HSM-H with deviations as listed in drawing NUH03-7002-SAR in Appendix V or UFSAR Revision 10 [1G.5.3]. As noted in Table 1G-19, the intended functions and AMR results for HSM Model 202 are identical to those listed for HSM-H in Table 1F-14 of Appendix 1F.

1G.3.2 Aging Management Review of SFAs

There is no change in the AMR results of low burnup and high burnup fuel discussed in Appendix 1E, Section 1E.3.4.1 and 1E.3.4.2 respectively.

The AMP for the high burnup fuel is discussed in Appendix 1E, Section 1E.3.5.

1G.4 Fuel Retrievability

The retrievability of low burnup and high burnup FAs is ensured as discussed in Section 1E.4, Appendix 1E.

1G.5 References (Appendix 1G)

1G.5.1 Transnuclear Inc., "Application for Amendment No. 9 of NUHOMS® CoC No. 1004 for Dry Spent Fuel Storage Casks," April 18, 2006.

1G.5.2 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment 9," April 17, 2007, Docket No. 72-1004.

1G.5.3 Transnuclear Inc., "NUH-003, Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 10," Docket No. 72-1004, February 2008.

1G.5.4 Transnuclear Inc. Letter to the U.S. Nuclear Regulatory Commission, E-26771, dated July 25, 2008, "Submittal of Biennial Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System, CoC 1004, for the Period 2/4/2006 – 7/25/20008," Docket No. 72-1004.

1G.5.5 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Transnuclear Inc., "Certificate of Compliance No. 1004, Amendment No. 9," Docket No. 72-1004, April 2007.

1G.5.6 U.S. Nuclear Regulatory Commission, "Safety Evaluation Report, Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 9," Docket No. 72-1004, April 2007.

Table 1G-1
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 10)
NUH-61B-1060-SAR	NUHOMS® - 61BT Transportable Canister for BWR Fuel General Arrangement	4
NUH-61B-1062-SAR	NUHOMS® - 61BT Transportable Canister for BWR Fuel Canister Details	5

Table 1G-2
NUHOMS®-32PT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 10)
NUH-32PT-1001-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Main Assembly	4

Table 1G-3
NUHOMS® HSM-H Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 10)
NUH-03-7001-SAR	Standardized NUHOMS® ISFSI HSM-H, Main Assembly	3

Table 1G-4
NUHOMS® HSM (Model 80, Model 102, and Model 202) Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 10)
NUH-03-7002	Standardized NUHOMS® ISFSI HSM Model 202 – Main Assembly	0
NUH-03-6016-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – DSC Support Structure	9

Table 1G-5
NUHOMS® Onsite Transfer Cask Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 10)
NUH-03-8000-SAR	General License NUHOMS® ISFSI Onsite TC – Overview	4
NUH-03-8001-SAR	General License NUHOMS® ISFSI Onsite TC – Structural Assembly	8
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Withheld Pursuant to 10 CFR 2.390

APPENDIX 1H
Renewal of the Standardized NUHOMS® System Approved under Amendment 10 to the NUHOMS® CoC No. 1004

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1H.1 Introduction

Transnuclear Inc. (TN) submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 10 to the U.S. Nuclear Regulatory Commission (NRC) on January 12, 2007 [1H.5.1], as supplemented, to (a) add the NUHOMS®-61BTH System and the -32PTH1 System to the Standardized NUHOMS® System and (b) amend the authorized contents of the NUHOMS®-24PTH and -32PT Systems. Amendment 10 was approved by the NRC effective August 24, 2009 [1H.5.2].

1H.1.1 Brief Description of Amendment 10

Amendment 10 to CoC 1004 implemented four separate changes to the Standardized NUHOMS® System as described in the following paragraphs:

Change No. 1:

A new NUHOMS®-61BTH System was added to the Standardized NUHOMS® System described in Revision 11 of the Updated Final Safety Analysis Report (UFSAR) [1H.5.3]. The NUHOMS®-61BTH System is a modular canister-based system, similar to the Standardized NUHOMS®-61BT System described in Appendix K of the UFSAR. The NUHOMS®-61BTH System consists of the following new or modified components:

- A new dual purpose (storage and transportation) dry shielded canister (DSC), with two alternate configurations, designated as NUHOMS®-61BTH Type 1 or Type 2 DSC. The 61BTH Type 1 DSC is very similar to the previously approved 61BT DSC described in Appendix K of the UFSAR, but is designed to accommodate a maximum heat load of 22.0 kW. The 61BTH Type 2 DSC is designed with thicker cover plates and aluminum basket rails to accommodate a maximum heat load of 31.2 kW.
- The 61BTH DSC basket is designed with three alternate neutron absorber materials, with each material analyzed for six different B-10 loadings to accommodate the various fuel enrichment levels. The six alternate 61BTH basket configurations are designated as Type “A” for the lowest B-10 loading to Type “F” for the basket with the highest B-10 loading.
- The 61BTH Type 1 DSC is stored in either the previously approved Standardized Horizontal Storage Module (HSM) described in the UFSAR, or in a modified version of the previously approved HSM-H module described in Appendix P of the UFSAR. The HSM-H module for the 61BTH is the same as the HSM-H described in Appendix P except for a thinner door to accommodate the longer 61BTH DSC. The 61BTH DSC Type 2 must be stored in the HSM-H module only.

- The 61BTH Type 1 DSC is transferred to the independent spent fuel storage installation (ISFSI) in either the previously approved OS197/OS197H Transfer Cask (TC) described in the UFSAR, or in a slightly modified version of the previously approved OS197FC TC described in Appendix P of the UFSAR. This modified version of the TC is designated as OS197FC-B TC. The 61BTH Type 2 is transferred to the ISFSI in OS197FC-B TC only.

The NUHOMS®-61BTH System is designed to store up to 61 intact (or up to 16 damaged and balance intact) boiling water reactor (BWR) fuel assemblies (FAs). The fuel to be stored is limited to a maximum assembly average initial enrichment of 5.0 wt. %, a maximum assembly average burnup of 62 GWd/MTU, and a minimum cooling time of 3.0 years.

A detailed description of the 61BTH System including authorized payload contents and supporting safety analyses are incorporated in Appendix T of UFSAR in Revision 11 [1H.5.3].

Change No. 2:

A new NUHOMS®-32PTH1 System was added to the Standardized NUHOMS® System in Revision 11 of the UFSAR. The NUHOMS®-32PTH1 System is a modular canister-based system, similar to the Standardized NUHOMS®-24PTH System described in Appendix P of the UFSAR.

The NUHOMS®-32PTH1 System consists of the following new or modified components:

- A new dual-purpose (storage and transportation) DSC, with three alternate length configurations, designated as Type 32PTH1-S DSC for short length, Type32PTH1-M DSC for medium length and Type 32PTH1-L DSC for a long DSC. The 32PTH1 DSC is designed with a slightly larger diameter than the previously licensed NUHOMS® DSCs to increase the system capacity. In addition, it accommodates a maximum heat load of 40.8 kW/DSC.
- The 32PTH1 DSC basket is designed with two alternate basket types: solid aluminum rails, designated as Type 1 basket or with steel rails (with aluminum inserts), designated as Type 2 basket. In addition, each basket type is provided with three alternate neutron absorber materials, with each material analyzed for five different B-10 loadings to accommodate the various fuel enrichment levels. The five alternate 32PTH1 basket configurations are designated as Type "A" for the lowest B-10 loading to Type "E" for the basket with the highest B-10 loading.

- The 32PTH1 DSC is stored in a modified version of the previously approved HSM-H module described in Appendix P of the UFSAR. The diameter of the HSM-H access door is increased to accommodate the larger diameter of the 32PTH1 DSC, with spacers provided to accommodate the various DSC lengths of the 32PTH1 DSC. In addition, an alternate “high-seismic” option of the HSM-H, designated as HSM-HS, has been added to the UFSAR for storing the 32PTH1 DSC. The HSM-HS module is qualified for 1.0g horizontal and 1.0g vertical zero period acceleration (ZPA) levels.
- The 32PTH1 DSC is transferred to the ISFSI in OS200 TC, which is a modified version of the previously approved OS197 TC described in the UFSAR. The OS200 TC has a slightly larger TC cavity diameter and length relative to OS197 TC to accommodate the larger dimensions of the 32PTH1 DSC. An alternate TC design is also provided, with an optional modified top to allow air circulation through the TC/DSC annulus at certain heat loads, designated as OS200 FC TC.

The NUHOMS®-32PTH1 System is designed to store up to 32 intact (or up to 16 damaged and balance intact) pressurized water reactor (PWR) FAs with or without control components. The fuel to be stored is limited to a maximum assembly average initial enrichment of 5.0 wt. %, a maximum assembly average burnup of 62 GWd/MTU, and a minimum cooling time of 3.0 years.

A detailed description of the 32PTH1 DSC, including authorized payload contents and supporting safety analyses are provided in Appendix U of the UFSAR [1H.5.3].

<u>Change No. 3:</u>

The purpose of this change is to expand the authorized content of the NUHOMS®-32PT DSC to include PWR FAs with control components, such as burnable poison rod assemblies (BPRAs), thimble plug assemblies (TPAs), control rod assemblies (CRAs), rod cluster control assemblies (RCCAs), vibration suppression inserts (VSIs), axial power shaping rod assemblies (APSRAs), orifice rod assemblies (ORAs), neutron source assemblies (NSAs), and neutron sources. The PWR FAs currently authorized for storage in 32PT DSC may include control components except for the CE 15x15 FAs.

A brief description of the modified payload contents of the NUHOMS®-32PT System and supporting safety analyses are provided in Appendix M of the UFSAR [1H.5.3].

<u>Change No. 4:</u>

The purpose of this change is to add WE 15x15 FAs with partial length shield assemblies (PLSAs) to the authorized content of the NUHOMS®-24PTH DSC described in Appendix P of the UFSAR.

A brief description of the modified payload contents of the NUHOMS®-24PTH System and supporting safety analyses are provided in Appendix P of UFSAR Revision 11 [1H.5.3].

1H.1.2 Design Drawings Certified in Amendment 10

The January 1, 2009 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment 10 to CoC No. 1004. None of the changes in Amendment 10 were the result of any differences between this edition of the 10 CFR Part 72 and the effective edition of 10 CFR 72 for the initial CoC, and prior CoC Amendments.

Tables 1H-1, 1H-2, 1H-3, 1H-4, 1H-5, 1H-6,1H-7, 1H-8, 1H-9, 1H-10, 1H-11 and 1H-12 provide a listing of the UFSAR drawings for the NUHOMS®-61BTH DSC, -32PTH1 DSC, -32PT DSC, -61BT DSC, -24PHB DSC, -24PTH DSC, HSM-H, HSM-HS, HSM Model 80 and Model 102, HSM Model 152, Onsite TC, and OS200 TC, respectively, contained in UFSAR Revision 11 [1H.5.3]. These tables also show the revision levels of these drawings as shown in Revision 12 of the UFSAR [1H.5.4].

1H.1.3 Changes to the Standardized NUHOMS® System Following Amendment 10 Approval

Additional changes to the Standardized NUHOMS® System following approval of Amendment 10 have been implemented pursuant to the requirements of 10 CFR 72.48.

Section 1H.1.3.1 lists the more significant changes implemented and incorporated into UFSAR Revision 11 [1H.5.3]. Also listed is the corresponding licensing review (LR), which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biennial report submitted to the NRC [1H.5.5].

Following the docketing of UFSAR Revision 11 [1H.5.3], TN implemented additional 72.48 changes to the Standardized NUHOMS® System, which were incorporated in UFSAR Revision 12 [1H.5.4]. During this 24-month window, no new amendments to CoC 1004 were approved. Hence, these additional 72.48 changes implemented in UFSAR Revision 12 also have been included in this appendix.

Section 1H.1.3.2 lists the more significant changes implemented and incorporated into UFSAR Revision 12 [1H.5.4]. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biennial report submitted to the NRC [1H.5.6].

1H.1.3.1 Significant Changes Implemented in UFSAR Revision 11

Description of Change	Associated LR
• Evaluated the effects of partial zero gaps between the DSC shell and basket. Evaluated the effects of a zero basket to DSC shell gap in the design basis analytical model for the 24PTH, 61BT, 32PT, 24PHB, 61BTH, and 32PTH1 DSCs. The results demonstrated that ASME Code stress allowable values were met so that design basis compliance for the DSC confinement boundary is maintained.	LR 721004-558
• Evaluated the use of a new Type B HSM Model 202 door, which has a minimum of 25 ⅜"-thick reinforced concrete attached to a 3″-thick steel plate vs. the existing HSM Model 202 door, which has a minimum of 18 ½″-thick reinforced concrete attached to a 7 ⅞"-thick steel plate.	LR 721004-614
• Evaluated the effects of the design basis tornado (DBT) on the Standardized TC and OS197 TC using the DBT and missile spectrum for which the HSM has been evaluated. The DBT and missile spectrum for HSMs are higher than those used previously for the evaluation of the TCs. Using the same DBT and missile spectrum for HSMs and TCs ensures consistency in the design of the Standardized NUHOMS® System.	LR 721004-632
Modified the OS197FC TC as listed below in order to render its configuration the same as the OS197FC-B TC. • Attach ½"-thick plate wedge segments arranged around the circumference of the cask bottom plate. The size and distribution of the wedge segments is the same as those in the OS197FC-B TC. • To maintain the same cask cavity length, remove ½"-thick material from the underside of the top cover lid and add it to the outer side of the lid (to maintain the same 3" nominal thickness of the top cover). The net effect of this change is a lid that protrudes ½" instead of 1" into the cask cavity, and an overall increase in cask length of ½″. • Because of Change 2, the length of the top lid bolts is increased by ½" and the length of the taper pins is adjusted.	LR 721004-649 Rev. 1
Modified the 32PTH1 DSC as listed below with five design changes that improve fabricability: • Change to the weld preparations of the outer top cover plate • Change to the weld preparations of the inner top cover plate • Permit chamfers to the middle basket plate • Change from a chamfer to a notch at the bottom corners of eight corner fuel compartments • Permit blending of the subsections of the transition rails.	LR 721004-664

Description of Change	Associated LR
Modified the 61BTH Type 2 DSC as listed below for fabricability and clarification purposes: • Allow the use of alternate design for the top grid assembly ((TGA) Alternate 3) with associated configuration changes necessary for its assembly. • Allow use of an alternate configuration for the inner bottom cover plate to shell connection. • Allow chamfering the bottom of the aluminum plates to accommodate weld shrinkage and potential distortion of the shell near the weld with the inner bottom cover plate. • Allow chamfering the bottom outside corner of the four, 4-compartment assemblies to accommodate weld shrinkage and potential distortion of the shell near the weld with the inner bottom cover plate. • Allow chamfering the aluminum plate on the R90 rail to accommodate weld shrinkage and potential distortion of the shell near the weld with the inner bottom cover plate. • Allow the aluminum plates to be made from multiple pieces and using them as shims to meet basket to shell gap requirements. • Editorial changes to drawings to improve the section views and make them clearer. • Allow the use of nuts to fasten screws to the R45 rails in lieu of threading the R45 rails.	LR 721004-665
• This change involved the use of a low density grout material to perform specified repairs (limited to smaller surface areas) on the concrete surfaces of the HSMs. Also, the use of the low density grout is allowed to perform cosmetic rework on the entire surface of the HSM (no limit on the surface area) provided the rework is not performed over surfaces with exposed rebar.	LR 721004-688 Rev. 2
• This change explicitly required that the R45 and R90 rail centerlines shown on the UFSAR drawing NUH-61B-1064-SAR for the 61BT DSC be coincident with the neutron absorber/insert plate centerlines and deletes the web locating dimensions shown on the UFSAR drawing. It also required that the end plate centerlines on the R90 rails be coincident with the nine compartment wrap plate centerlines.	LR 721004-707
• This change evaluated the reduction in the open area of the bird screens located at the inlet and outlet vents of the HSM Model 80/102 from 83% considered in the thermal evaluation analysis to 70.5% as shown on UFSAR drawing NUH-03-6024-SAR, Rev. 4 and the corresponding design drawing.	LR 721004-715

Description of Change	Associated LR
• Evaluated the impact of using irradiated UO_2 pellet conductivity on the thermal performance of the Standardized NUHOMS® System. The evaluation concluded that no change to the existing thermal analysis is required. See NRC Information Notice 2009-23, "Nuclear Fuel Thermal Conductivity Degradation."	LR 721004-786
• This change involved the use of shims to make the adjustment of the inserts possible to meet the specified basket to shell gap requirement during fabrication of the 24PTH DSC, based on fabricator feedback.	LR 721004-828

1H.1.3.2 Significant Changes Implemented in UFSAR Revision 12

Description of Change	Associated LR
• Added an optional door design for HSMs, Model HSM-H. The optional door has a thinner steel section than the standard door, but is 2" thicker overall. The optional door has 3" of steel and 29.375" of concrete (overall 32.375"), whereas the standard door has 7.875" of steel and 22.5" of concrete (overall 30.375").	LR 721004-802, Rev. 1
• Evaluated the use of NUHOMS® HSM Model 102, on an inclined ISFSI pad at a general licensee site. Evaluated the stability of the Model 102 loaded with a 61BT DSC on an incline of 2" over 10', from side to side, for seismic, flood, tornado, and missile loads.	LR 721004-813
• Added an alternative 61BTH DSC transition rail configuration, which will improve the fabricability of these transition rails. The alternate configuration involves a one-piece, bent plate for the "R45" transition rail plate, in lieu of a two-welded-plate configuration.	LR 721004-923, Rev. 1

1H.1.4 Amendment 10 Loading Overview

Tables 1H-13 through 1H-19 provide an overview of the FAs loaded under CoC 1004 Amendment 10 at Brunswick Steam Electric Plant, H.B. Robinson Steam Electric Plant, Kewaunee Power Station, Nine Mile Point Nuclear Station, Oyster Creek Nuclear Generating Station, Point Beach Nuclear Plant, and R.E. Ginna Nuclear Power Plant, respectively.

These tables list the pertinent FA parameters such as the maximum fuel enrichment, maximum burnup, minimum cooling time, total DSC heat load, the DSC and HSM model numbers into which these FAs are stored. These loading tables are provided for general information and are current as of the time this data was compiled for this application.

1H.2 Scoping Evaluation of CoC 1004 Amendment 10 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 10 [1H.5.2], CoC 1004 Amendment 10 TS [1H.5.7], CoC 1004 Amendment 10 SER [1H.5.8], and UFSAR Revision 11 [1H.5.3].

Using the methodology described in Chapter 2, in addition to all the Standardized NUHOMS® System structures, systems, and components (SSCs) described in Section 1G.2, Appendix 1G, the following SSCs are included within the scope of CoC 1004 Amendment 10 renewal:

1H.2.1 NUHOMS®-61BTH System SSCs

The addition of the NUHOMS®-61BTH System to the Standardized NUHOMS® System results in the addition of the following SSCs to the scope of renewal:

- Type 1 61BTH DSC
- Type 2 61BTH DSC
- OS197FC-B TC

The OS197FC-B TC authorized in Amendment 10 added a modified top lid and bottom lid to the OS197 TC subcomponents previously listed in Table 1A-13, Appendix 1A. The modified subcomponents are listed in Table 1H-31.

1H.2.2 NUHOMS®-32PTH1 System SSCs

The addition of the NUHOMS®-32PTH1 System to the Standardized NUHOMS® System results in the addition of the following SSCs to the scope of renewal:

- 32PTH1 DSC
- HSM-H/HSM-HS Modules
- OS200 TC

CoC 1004 Amendment 10 implemented minor modifications to the HSM-H configuration to accommodate the storage of 32PTH1 DSC.

1H.2.3 NUHOMS®-32PT System SSCs

CoC 1004 Amendment 10 did not implement any physical changes to the NUHOMS®-32PT System design configuration described previously in Appendix 1E of this application. CoC 1004 Amendment 10 expanded the previously authorized contents of the 32PT System to include control components.

1H.2.4 NUHOMS®-24PTH System SSCs

CoC 1004 Amendment 10 did not implement any physical changes to the NUHOMS®-24PTH System design configuration described previously in Appendix 1F of this application. CoC 1004 Amendment 10 added WE 15x15 with PLSAs to the previously authorized contents of the 24PTH System.

1H.2.5 10 CFR 72.48 Changes Incorporated in the UFSAR

In addition to the changes authorized under Amendment 10, additional changes were incorporated into the UFSAR in Revision 11 and Revision 12 [1H.5.3, 1H.5.4] under the provisions of 10 CFR 72.48 and are described in Section 1H.1.3. Additional changes not listed in Section 1H.1.3 reflecting the modified subcomponents of the 32PT DSC, 61BT DSC, 24PHB DSC, 24PTH DSC, HSM Model 80, HSM Model 102, HSM Model 152, and HSM-H are listed in Table 1H-24 through Table 1H-30.

1H.3 Aging Management Review of Amendment 10 SSCs

The AMR of Amendment 10 SSCs is based on the AMR presented in Chapter 3, Sections 3.5, 3.6, 3.7, and 3.8 for DSCs, HSM, TCs, and SFAs, respectively. Approval of Amendment 10 did not result in any change in the design configuration of the 24P DSC, 24P Long Cavity DSC, 52B DSC, 24PT2 DSC, Standardized TC and OS197 TC. Hence, the aging management review (AMR) results listed in Appendix 1C, Section 1C.3 remain applicable for these SSCs.

There is a minimal change in the design configuration of 32PT DSC, 61BT DSC, 24PHB DSC, 24PTH DSC, HSM (Model 80 and Model 102), HSM Model 152 and HSM-H following incorporation of 10 CFR 72.48 changes into the UFSAR in Revision 11 and Revision 12 [1H.5.3, 1H.5.4]. The affected subcomponents and the changed configuration of these subcomponents are listed in Table 1H-24 through Table 1H-30. A review of these tables shows that the AMR results presented in previous appendices for these SSCs and associated subcomponents remains unchanged.

1H.3.1 Aging Management Review of the NUHOMS®-61BTH DSC

Table 1H-20 lists the subcomponents of the 61BTH DSC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the 61BTH DSC subcomponents.

Appendix 3A, 3D, 3E and 3G provide a discussion of the DSC time-limited aging analyses (TLAAs) methodology and the DSC TLAA results. As noted in these appendices, each of the TLAA is performed by selecting bounding evaluation parameters for the DSC under consideration so that the TLAA results are applicable to all the DSCs certified in CoC 1004 (Amendments 1 through 11 and Amendment 13). A summary of these limiting DSC TLAA results is provided in Appendix 1A, Section 1A.3.4.1. These TLAA results are also applicable to the 61BTH DSC.

Table 1H-20 presents the results of the AMR for the 61BTH DSC subcomponents.

1H.3.2 Aging Management Review of the NUHOMS®-32PTH1 DSC

Table 1H-21 lists the subcomponents of the 32PTH1 DSC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the 32PTH1 DSC subcomponents.

The discussion provided in Section 1H.3.1, above, regarding DSC TLAA results is also applicable to 32PTH1 DSC.

Table 1H-21 presents the results of the AMR for the 32PTH1 DSC subcomponents.

1H.3.3 Aging Management Review of the HSM-HS

Table 1H-22 lists the subcomponents of the HSM-HS. This table also lists the material of construction of each subcomponent, the environment, the safety classification and the intended function of the subcomponents of the HSM-HS.

Appendices 3C and 3E provide a discussion of the HSM TLAAs methodology and the HSM TLAA results. As noted in these Appendices, each of the TLAAs is performed by selecting bounding evaluation parameters for the HSM Model under consideration so that the TLAA results are applicable to all the HSM Models certified in CoC 1004 (Amendment 1 through 11 and Amendment 13). A summary of these limiting HSM TLAA results is provided in Appendix 1A, Section 1A.3.4.2.

Table 1H-22 presents the results of the AMR for HSM-HS subcomponents.

1H.3.4 Aging Management Review of the OS200 TC

Table 1H-23 lists the subcomponents of the OS200 TC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the OS200 TC subcomponents.

Cyclical loading or fatigue evaluation of OS200 class TCs is presented in Appendix 3B. As determined in Appendix 3B, fatigue is not an aging effect requiring management during extended operations. The TLAA results for Onsite TC presented in Section 1A.3.4.3 of Appendix 1A are also applicable to OS200 TC.

Table 1H-23 presents the results of the AMR for the OS200 TC subcomponents.

1H.3.5 Aging Management Review of the OS197FC-B TC

Table 1H-31 lists the modified subcomponents of the OS197FC-B TC (modified relative to the OS197 TC configuration) and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the OS197FC-B TC subcomponents.

Appendix 3B lists presents the results of fatigue evaluation for the OS197FC-B TC. As determined in Appendix 3B, fatigue is not an aging effect requiring management during extended operations. The TLAA results for Onsite TC presented in Section 1A.3.4.3 of Appendix 1A are also applicable to OS197FC-B TC.

Table 1H-31 presents the results of the AMR for the OS197FC-B TC subcomponents.

1H.3.6 Aging Management Review of the Irradiated Fuel Assemblies

There is no change in the AMR of low burnup fuel discussed in Appendix 1E, Section 1E.3.4.1.

The AMR and the supporting TLAAs of the high burnup fuel discussed in Appendix 1E, Section 1E.3.4.2 are also applicable to the high burnup fuel authorized for storage in the 61BTH and 32PTH1 DSCs.

The AMP for the high burnup fuel is discussed in Appendix 1E, Section 1E.3.5.

1H.4 Fuel Retrievability

The retrievability of low burnup and high burnup FAs is ensured as discussed in Section 1E.4, Appendix 1E.

1H.5 References (Appendix 1H)

1H.5.1 Transnuclear Inc., "Application for Amendment 10 of the NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0," Docket No. 72-1004, January 12, 2007.

1H.5.2 U.S. Nuclear Regulatory Commission, Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment No. 10, Docket No. 72-1004, Effective August 24, 2009.

1H.5.3 Transnuclear Inc., "NUH-003, Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 11," Docket No. 72-1004, February 2010.

1H.5.4 Transnuclear Inc., "NUH-003, Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 12," Docket No. 72-1004, February 2012.

1H.5.5 Transnuclear Letter to the U.S. Nuclear Regulatory Commission, E-29629, dated July 23, 2010, "Biennial Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System, CoC 1004, for the Period 07/26/08 to 07/23/10," Docket No. 72-1004.

1H.5.6 Transnuclear Letter to the U.S. Nuclear Regulatory Commission, E-32971, dated July 23, 2012, "Biennial Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System, CoC 1004, for the Period 07/24/10 to 07/23/12," Docket No. 72-1004.

1H.5.7 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 10, Docket No. 72-1004, August 2009.

1H.5.8 U.S. Nuclear Regulatory Commission, "Final Safety Evaluation Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Transnuclear Inc., Certificate of Compliance No. 1004, Amendment No. 10," Docket No. 72-1004, August 2009.

Table 1H-1
NUHOMS®-61BTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH61BTH-1000-SAR	NUHOMS®-61BTH DSC Type 1 Main Assembly	0	1
NUH61BTH-2000-SAR	NUHOMS®-61BTH DSC Type 2 Main Assembly	0	1
NUH61BTH-2001-SAR	NUHOMS®-61BTH DSC Type 2 Shell Assembly	0	1
NUH61BTH-2002-SAR	NUHOMS®-61BTH DSC Type 2 Basket Assembly	0	1
NUH61BTH-2003-SAR	NUHOMS®-61BTH DSC Type 2 Transition Rails	0	1
NUH61BTH-2004-SAR	NUHOMS®-61BTH DSC Type 2 Damaged Fuel End Caps	0	0

Table 1H-2
NUHOMS®-32PTH1 DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-32PTH1-1001-SAR	NUHOMS®-32PTH1 Transportable Canister, for PWR Fuel, Main Assembly	0	1
NUH-32PTH1-1002-SAR	NUHOMS®-32PTH1 Transportable Canister, for PWR Fuel, Shell Assembly	0	0
NUH-32PTH1-1003-SAR	NUHOMS®-32PTH1 Transportable Canister, for PWR Fuel, Basket Assembly	0	1
NUH-32PTH1-1004-SAR	NUHOMS®-32PTH1 Transportable Canister, for PWR Fuel, Transition Rails	0	0
NUH-32PTH1-1005-SAR	NUHOMS®-32PTH1 Transportable Canister, for PWR Fuel, Alternate Top Closure	0	0

Table 1H-3
NUHOMS®-32PT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-32PT-1001-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Main Assembly	5	6
NUH-32PT-1002-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Shell Assembly	4	4
NUH-32PT-1003-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly Option 1	4	5
NUH-32PT-1004-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly Option 2	4	4
NUH-32PT-1006-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Aluminum Transition Rails	3	3

Table 1H-4
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-61B-1060-SAR	NUHOMS®-61B Transportable Canister for BWR Fuel General Arrangement	5	5
NUH-61B-1065-SAR	NUHOMS®-61B Transportable Canister for BWR Fuel Parts Lists	4	5

Table 1H-5
NUHOMS®-24PHB DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-HBU-1000-SAR	24PHBS and 24PHBL DSC	2	2

Table 1H-6
NUHOMS®-24PTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-24PTH-1001-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel, Main Assembly	3	4
NUH-24PTH-1002-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel, Shell Assembly	2	2
NUH-24PTH-1003-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel Basket Assembly	2	3
NUH-24PTH-1004-SAR	NUHOMS®-24PTH Transportable Storage DSC, for PWR Fuel, Transition Rails	2	3

Table 1H-7
NUHOMS® HSM-H Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-03-7001-SAR	Standardized NUHOMS® ISFSI HSM-H, Main Assembly	4	4

Table 1H-8
NUHOMS® HSM-HS Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-03-7003-SAR	Standardized NUHOMS® ISFSI HSM-HS, Main Assembly	0	0

Table 1H-9
NUHOMS® HSM (Model 80 and Model 102) Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-03-6024-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Erection Hardware	5	5

Table 1H-10
NUHOMS® HSM Model 152 Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-03-6400-SAR	General License NUHOMS® Model 152 Main Assembly	1	1

Table 1H-11
NUHOMS® Onsite Transfer Cask Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-03-8000-SAR	General License NUHOMS® ISFSI Onsite TC – Overview	5	5
NUH-03-8007-SAR(1)	General License NUHOMS® ISFSI OS197FC-B Onsite Transfer Cask Main Assembly	0	0

Note:

(1) NUH-03-8007-SAR adds a new OS197FC-B TC.

Table 1H-12
NUHOMS® OS200 TC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 11)	Drawing Revision Level (UFSAR Rev. 12)
NUH-08-8001-SAR	NUHOMS® OS200 Onsite Transfer Cask, Structural Shell Assembly	0	1
NUH-08-8002-SAR	NUHOMS® OS200 Onsite Transfer Cask, Inner and Outer Shell Assembly	0	0
NUH-08-8003-SAR	NUHOMS® OS200 Onsite Transfer Cask, Main Assembly	0	1

Proprietary Information on Pages 1H-21 through 1H-49
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1I
Renewal of the Standardized NUHOMS® System Approved under Amendment 11 to the NUHOMS® CoC No. 1004

CONTENTS

LIST OF TABLES

1I.1 Introduction

By application dated April 10, 2007 [1I.5.1], and as supplemented, Transnuclear Inc. (TN) submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 11 to the NRC. Amendment 11 implements two primary changes: (a) add a lightweight transfer cask (TC), designated as OS197L TC, for use with the NUHOMS® -61BT and NUHOMS® -32PT dry shielded canisters (DSCs) under specific loading conditions and (b) convert the existing CoC 1004 Technical Specifications (TS) to a format and content consistent with the U.S. Nuclear Regulatory Commission (NRC) guidance provided in NUREG-1745 [1I.5.5].

CoC 1004 Amendment 11 was approved by the NRC effective January 7, 2014 [1I.5.2].

1I.1.1 Brief Description of Amendment 11

Amendment 11 to CoC 1004 implemented two separate changes to the Standardized NUHOMS® system as described in the following paragraphs.

Change No. 1:

A new lightweight TC, designated as NUHOMS®-OS197L TC, has been added to the four onsite transfer casks types (Standardized Cask, NUHOMS®-OS197, NUHOMS®-OS197H and OS200 TCs) previously authorized for use with the Standardized NUHOMS® System, described in Revision 12 of the Updated Final Safety Analysis Report (UFSAR) [1I.5.8].

The OS197L TC is designed to accommodate fuel transfer needs of plants where the payload is limited to a maximum of 13.0 kW. The design and configuration of the OS197L TC is a modified version of the OS197 and OS197H TCs described in Section 1.3.2.1 of the UFSAR and is limited to onsite use under 10 CFR 72. The major differences between the OS197L TC System relative to the OS197 TC design are:

- Reduced cask weight:
  - The nominal loaded weight in the "dry" configuration (water in the DSC and DSC/TC annulus drained and the top cask lid installed) is approximately 82 tons.;
- Authorized for the transfer of the NUHOMS®-61BT and 32PT DSCs with a maximum heat load of 13.0 kW;
- one-piece solid trunnion configuration for the upper and lower cask trunnions;
- two-piece neutron shield (inner and outer shell of 1/4" nominal thickness provided in OS197L TC versus an outer shell of 3/16" nominal thickness provided in OS197 TC);

- a 6” nominal thickness steel decontamination area supplemental shield within which the OS197L TC is placed for personnel shielding during fuel loading operations;
- a cask support skid supplemental shielding described in Section W.1.2.1.1, to be used for personnel shielding during OS197L TC transfer operations;
- remote crane operations in conjunction with laser/optical targeting and cameras are to be used for handling the OS197L TC when it is not within the decontamination area shielding.

The OS197L TC, when used in conjunction with the supplemental shielding and the remote cask handling procedures described in Chapter W.8 of UFSAR Revision 13 [1I.5.3], provides shielding and protection from potential hazards during the DSC fuel loading and unloading operations and transfer to the horizontal storage module (HSM).

A detailed description of the OS197L TC System, including limitations of the authorized payload contents, operating procedures and supporting safety analyses are incorporated in Appendix W of the UFSAR, Revision 13 [1I.5.3].

Change No. 2:

The existing CoC 1004 TS have been converted to a format and content consistent with the NRC guidance provided in NUREG-1745 [1I.5.5]. The previously approved payloads and the corresponding TS, including tables and figures, have been retained “as-is” in the new format of the TS. In addition, this change removes the bases from the TS and relocates them to Chapter 10 of UFSAR Revision 13 [1I.5.3].

Additional specific TS changes due to the addition of the OS197L TC are listed in Section 12.2.2 of the NRC SER [1I.5.6].

1I.1.2 Design Drawings Certified in Amendment 11

The January 1, 2014 Edition of 10 CFR Part 72 was in effect at the time of approval Amendment No. 11 to CoC No. 1004. None of the changes in Amendment No. 11 was the result of any differences between this edition of the 10 CFR 72 and the effective edition of 10 CFR 72 for the initial CoC and prior CoC Amendments.

Tables 1I-2, 1I-3, 1I-4, 1I-5, 1I-6, 1I-7, 1I-8 and 1I-9 provide a list of the UFSAR drawings for the NUHOMS®-61BT DSC, -32PT DSC, -61BTH DSC, HSM (Model 80 and Model 102), HSM Model 152, HSM-H, HSM-HS and OS197L TC, respectively, which were updated for incorporation into UFSAR Revision 13 [1I.5.3]. Some of these drawings were revised to reflect Amendment 11 changes while the remaining were revised to reflect the 10 CFR 72.48 changes, the more significant of which are discussed in Section 1I.3.

Table 1I-1 provides a listing of the structures, systems, and components (SSCs) where the drawings were revised to reflect a generic editorial change but did not involve any design configuration changes. Hence, the modified drawings for these SSCs have not been listed here.

1I.1.3 Changes to the Standardized NUHOMS® System Following Amendment 11 Approval

Additional changes to the Standardized NUHOMS® System following approval of Amendment 11 have been implemented pursuant to the requirements of 10 CFR 72.48.

Section 1I1.3.1 lists the more significant changes incorporated into UFSAR Revision 13 [1I.5.3]. Also listed is the corresponding licensing review (LR), which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along, with a brief justification, is included in the biennial report submitted to the NRC [1I.5.4].

Significant changes are defined as those changes that were screened in and resulted in a 72.48 evaluation.

1I.1.3.1 Significant Changes Implemented in UFSAR Revision 13

Description of Change	**Associated LR**
This change provides an additional R45 transition rail configuration for the NUHOMS®-61BTH DSC basket, which will reduce the time required for the R45 rail fitup and welding. The alternate configuration comprises of providing a one piece bent plate for the R45 transition rail web/rib plate in lieu of implementing a two-welded plate configuration in accordance with safety analysis report (SAR) drawing NUH-61B-1064-SAR, Rev 4, Sheet 2 of 2, Basket Rail Type 1.	LR 721004-1005
Corrective Action Report (CAR) 2012-088 documents the fabrication of the R45 transition rails of the 61BTH Type 1 DSC from multiple suppliers by removing material from the inner support webbing to assist in providing access to the weld stud access ports. The material removal is not addressed on any TN fabrication or license drawings. Non-Conformance Report (NCR) 2012-084 was generated to document the nonconformance for current and previous projects which contain this non-conformance. Revision 1 of this LR includes the analysis for the NUHOMS®-61BT design since the 61BTH Type 1 DSC design bounds the 61BT DSC design. This LR demonstrated the acceptability of "use-as-is" disposition of this NCR by evaluating the impact of this deviation on the structural and thermal functions of the R45 rail. In addition, the supporting evaluation from this LR has been incorporated into the UFSAR and the 61BT DSC SAR drawing has been updated to allow	LR 721004-1075, Revision 1

Description of Change	Associated LR
removal of material from the R45 transition rails of the 61BT DSC.	
The change involves an alternate design option to reduce the maximum length of the spent fuel assembly from 171.76 inches to 171.23 inches. This change provides an alternate option of the 24PHBL DSC configuration, designated as “24PHBL DSC with Alternate Shifted Shielding Option” (ASSO) or 24PHBL DSC (ASSO). This alternate configuration includes a modified top shield plug assembly design with a thicker top shield plug (the minimum lead thickness increased from 4.3 to 4.7 inches) and a thicker top shield plug cover plate (thickness increased from 0.3 to 0.4 inches). To accommodate the changes in the DSC top shield plug assembly, the dimensions of the DSC siphon and vent block assembly shelf are also increased by 0.5 inches. The 24PHBL DSC (ASSO) shell length is maintained constant by reducing the DSC cavity length by 0.5 inches (from 173.28 to 172.78 inches). Likewise, the DSC basket length is also reduced accordingly by reducing the DSC support rod length by 0.5 inches (from 172.75 to 172.25 inches). This design change option takes advantage of the reduced FA length by providing additional shielding at the DSC top end to reduce personnel dose exposure from gamma radiation during DSC top end closure operations.	LR 721004-1067
This modification introduces a number of changes to the HSM model 152 loaded with a 32PT-L125 DSC. The design changes for the HSM include: (1) adding a rail spacer to accommodate all DSC length configurations for new and existing models, (2) an increase in the concrete clear cover to the top shield block of the HSM, and (3) reducing the weld between the rear baseplate to the rail. In addition, a design option has been added for a stainless steel DSC axial retainer, and alternate welding design options in two locations for the DSC support structure. The changes also incorporate new lifting embedments design to improve the alignment of attachment hardware and to meet code requirements.	LR 721004-1112
This change involves an option to grout the through-hole penetrations in the roof of the HSM Model 152. This change will prevent water accumulation in the through-holes, which can freeze and cause cracking damage to the HSM roof. The filling of the through-holes has been implemented at previous or existing HSM sites utilizing a design with a through-hole in the roofs. The NRC had expressed a concern about cracking in the HSM roof that was observed in a short period of time at the TMI-2 ISFSI at Idaho National Laboratory (INL). AREVA addressed NRC concerns/issues and provided recommendations to users related to the HSMs through-hole penetrations for the sites using this HSM.	LR 721004-1198

1I.1.4 Amendment 11 Loading Overview

As of the time of preparation of this application, no fuel assemblies (FAs) have been loaded under CoC 1004 Amendment 11 at any site.

1I.2 Scoping Evaluation of CoC 1004 Amendment 11 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 11 [1I.5.2], CoC 1004 Amendment 11 TS [1I.5.7], CoC 1004 Amendment 11 SER [1I.5.6], and UFSAR Revision 13 [1I.5.3].

Using the methodology described in Chapter 2, in addition to the Standardized NUHOMS® System SSCs listed in Appendix 1H, Section 1H.2.0, the following SSCs are included within the scope of CoC 1004 Amendment 11 renewal:

1I.2.1 NUHOMS® OS197L TC SSCs within the Scope of CoC 1004 Amendment 11 Renewal

The NUHOMS® OS197L TC SSCs determined to be within the scope of renewal are:

- OS197L TC (Bare Cask)
- Decontamination Area Shield
- Cask Support Skid Supplemental Shielding

1I.2.2 NUHOMS®-61BT System SSCs within the Scope of CoC 1004 Amendment 11 Renewal

CoC 1004 Amendment 11 did not implement any design configuration changes to the NUHOMS®-61BT System described previously in Appendix 1C. However, to minimize the dose consequences when using the OS197L TC for the loading and transfer of the 61BT DSC, the contents allowed were limited to meet the updated heat load zoning configuration requirements and the 61BT DSC heat load is limited to 12.0 kW.

1I.2.3 NUHOMS®-32PT System SSCs within the Scope of CoC 1004 Amendment 11 Renewal

CoC 1004 Amendment 11 did not implement any design configuration changes to the NUHOMS®-32PT System described previously in Appendix 1E. However, to minimize the dose consequences when using the OS197L TC for the loading and transfer of the 32PT DSC, the contents allowed were limited to meet the updated heat load zoning configuration requirements and the 32PT DSC heat load is limited to 13.0 kW.

1I.2.4 Remaining NUHOMS® System SSCs within the Scope of CoC 1004 Amendment 11 Renewal

CoC 1004 Amendment 11 did not implement any additional changes to the design configuration of the other Standardized NUHOMS® System SSCs described previously in Appendix 1H of this application. Following approval of Amendment 11, additional 72.48 changes described in Section 1I.1.3 above were implemented and are included in the renewal scope.

1I.3 Aging Management Review of Amendment 11 SSCs

The AMR of Amendment 11 SSCs is based on the AMR presented in Chapter 3, Sections 3.5, 3.6, 3.7, and 3.8 for DSCs, HSMs, TCs, and SFAs, respectively. Approval of CoC 1004 Amendment 11 did not result in any change in the design configuration of the SSCs previously addressed in Appendix 1H. Hence, the aging management review (AMR) results listed in Appendix 1H, Section 1H.3 remain applicable for these SSCs.

There is a minimal change in the design configuration of HSM-HS and onsite TC following incorporation of 10 CFR 72.48 changes into the UFSAR Revision 13 [1I.5.3]. The affected subcomponents and the changed configuration of HSM-HS and onsite TC are listed in Table 1I-11 and Table 1I-12, respectively. A review of these tables shows that the AMR results presented in the previous Appendices for these SSCs and associated subcomponents remain unchanged.

1I.3.1 Aging Management Review of the OS197L TC

Table 1I-10 lists the subcomponents of the OS197L TC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the OS197L TC subcomponents.

Cyclical loading or fatigue evaluation of OS197L TC is performed in Appendix 3B. As determined in Appendix 3B, fatigue is not an aging effect requiring management during extended operations. The time-limited aging analysis (TLAA) results for the onsite TC presented in Section 1A.3.4.3 of Appendix 1A are also applicable to the OS197L TC.

Table 1I-10 presents the results of the AMR for the OS197L TC subcomponents.

1I.3.2 Aging Management Review of the Spent Fuel Assemblies

OS197L TC is used only for loading and unloading and transfer of DSCs. There is no change in the AMR results either of low burnup fuel or high burnup fuel discussed in Appendix 1E, Sections 1E.3.4.1 and 1E.3.4.2, respectively.

1I.4 Fuel Retrievability

The retrievability of low burnup and high burnup FAs is ensured as discussed in Section 1E.4, Appendix 1E.

1I.5 References (Appendix 1I)

1I.5.1 Transnuclear Inc., "Application for Amendment 11 of the NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0," Docket No. 72-1004, April 10, 2007.

1I.5.2 U.S. Nuclear Regulatory Commission, "Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment No. 11," Docket No. 72-1004, Effective January 7, 2014.

1I.5.3 Transnuclear Inc., "NUH-003, Updated Final Safety Analysis Report for the Standardized NUHOMS Horizontal Modular Storage System for Irradiated Fuel, Revision 13," Docket No. 72-1004, January 2014.

1I.5.4 Transnuclear Letter to the U.S. Nuclear Regulatory Commission, E-39211, dated July 23, 2014, "Biennial Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System, CoC 1004, for the Period 07/24/12 to 07/23/14," Docket No. 72-1004.

1I.5.5 U.S. Nuclear Regulatory Commission, NUREG-1745, "Standard Format and Content for Technical Specifications for 10 CFR Part 72 Cask Certificates of Compliance," 2001.

1I.5.6 Final Safety Evaluation Report, "Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Certificate of Compliance No. 1004, Conversion of Technical Specifications to Standard Form and Addition of Light Weight Transfer Cask (OS197L), Amendment No. 11 (Docket 72-1004)," January 2014.

1I.5.7 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, Transnuclear Inc., "Certificate of Compliance No. 1004, Amendment No. 11," Docket No. 72-1004, January 2014.

1I.5.8 Transnuclear Inc., "NUH-003, Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel, Revision 12," Docket No. 72-1004, February 2012.

Table 1I-1
Design Drawings of SSCs Affected by an Editorial Change

The drawing revision level of the following SSCs has increased due to the implementation of a generic editorial change (Reference LR 721004-1063). There was no change in the design configuration of each of the affected SSCs.

- NUHOMS® -24P DSC
- NUHOMS® -52B DSC
- NUHOMS® -24P Long Cavity DSC
- NUHOMS® -24PT2L DSC
- NUHOMS® -24PHB DSC
- NUHOMS® -24PTH DSC
- NUHOMS® -32PTH1 DSC
- HSM Model 202
- NUHOMS® Standardized TC, OS197 TC, OS197H TC, OS197FC TC, OS197FC-B TC and OS200 TC

Table 1I-2
NUHOMS®-61BT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-61B-1062-SAR	NUHOMS®-61B Transportable Canister for BWR Fuel Canister Details	6
NUH-61B-1064-SAR	NUHOMS®-61B Transportable Canister for BWR Fuel Basket Details	6

Table 1I-3
NUHOMS®-32PT DSC Design Drawings [(1)]

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-32PT-1004-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly Option 2	5

Note 1: Drawings modified by an editorial change are not listed here.

Table 1I-4
NUHOMS®-61BTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH61BTH-1000-SAR	NUHOMS®-61BTH DSC Type 1 Main Assembly	2
NUH61BTH-2001-SAR	NUHOMS®-61BTH DSC Type 2 Shell Assembly	2
NUH61BTH-2006-SAR	NUHOMS®-61BTH DSC Type 2 Top Grid Assembly Alternate 3	1

Note 1: Drawings modified by an editorial change are not listed here.

Table 1I-5
NUHOMS® HSM (Model 80, Model 102) Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-03-6008-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – ISFSI General Arrangement	10
NUH-03-6024-SAR	Standardized NUHOMS® ISFSI Horizontal Storage Module – Module Erection Hardware	5

Table 1I-6
NUHOMS® HSM Model 152 Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-03-6400-SAR	General License NUHOMS® Model 152 Main Assembly	2

Note: Drawings modified by an editorial change are not listed here.

Table 1I-7
NUHOMS® HSM-H Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-03-7001-SAR	Standardized NUHOMS® ISFSI HSM-H, Main Assembly	5

Table 1I-8
NUHOMS® HSM-HS Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-03-7003-SAR	Standardized NUHOMS® ISFSI HSM-HS, Main Assembly	1
NUH-03-7004-SAR	Standardized NUHOMS® ISFSI HSM-H/HSM-HS Dose Reduction Hardware	0

Note 1: Drawings modified by an editorial change are not listed here.

Table 1I-9
NUHOMS® OS197L TC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 13)
NUH-03-8008-SAR	NUHOMS® OS197L Onsite Transfer Cask, Cask Body Assembly	1
NUH-03-8009-SAR	NUHOMS® OS197L Onsite Transfer Cask, Light Neutron Shield Assembly	1
NUH-03-8010-SAR	NUHOMS® OS197L Onsite Transfer Cask, OS197L Main Assembly	1
NUH-03-8011-SAR	NUHOMS® OS197L Onsite Transfer Cask Support Skid Supplemental Shielding	0
NUH-03-8012-SAR	NUHOMS® OS197L Onsite Transfer Cask Decon Area Cask Shielding Assemblies	0

Proprietary Information on Pages 1I-16 through 1I-22
Withheld Pursuant to 10 CFR 2.390

APPENDIX 1J
Renewal of the Standardized NUHOMS® System Approved under Amendment 13 to the NUHOMS® CoC No. 1004

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LIST OF TABLES

1J.1 Introduction

By application dated February 9, 2011 [1J.5.1], and as supplemented, Transnuclear Inc. (TN) submitted an application for Certificate of Compliance (CoC) No. 1004 Amendment 13 to the NRC.

Amendment 13 implemented six separate changes as listed below:

- Added a new NUHOMS®-69BTH System to the Standardized NUHOMS® System.
- Added a new NUHOMS®-37PTH System to the Standardized NUHOMS® System.
- Added damaged fuel assemblies (FAs) and control components other than burnable poison rod assemblies (BPRAs) to the authorized contents of the NUHOMS®-24PHB DSC.
- Added high burnup (HBU) FAs, with and without control components, to the authorized contents of the NUHOMS®-32PT DSC.
- Added failed FAs to the authorized contents of the NUHOMS®-24PTH and NUHOMS®-61BTH DSCs for storage of failed fuel.
- Incorporated additional changes, as follows:
  - Extended the use of the Model HSM-HS for the storage of NUHOMS®-61BT, -32PT, -24PTH, -61BTH, -69BTH, and -37PTH DSCs,
  - Extended the use of metal matrix composites (MMC) as a neutron absorber material in the 61BTH Type 1 and Type 2 DSCs for higher heat loads,
  - Added blended low-enriched uranium (BLEU) fuel material as authorized contents,
  - Modified the HSM-H/HSM-HS inlet vent shielding design to achieve dose reductions,
  - Extended the OS200 transfer cask (TC) to allow transfer of the NUHOMS®-61BT, -32PT, -24PTH, and -61BTH DSCs,
  - Allowed the use of Type III cement as an alternate equivalent to the Type II cement use in horizontal storage module (HSM) construction,
  - Modified the neutron absorber testing and acceptance requirements in the Technical Specifications (TS) in order to remain consistent with similar requirements in other ongoing licensing actions, plus certain new changes in this area, and
  - Implemented certain additional changes for consistency within the TS and the Updated Final Safety Analysis Report (UFSAR).

CoC 1004 Amendment 13 was approved by the U.S. Nuclear Regulatory Commission (NRC) effective May 24, 2014 [1J.5.2].

1J.1.1 Brief Description of Amendment 13

Amendment 13 to CoC 1004 implemented six separate changes to the Standardized NUHOMS® System, which were incorporated into Revision 14 of the NUHOMS® UFSAR as described in the following paragraphs:

Change 1 - Addition of a new NUHOMS®-69BTH System

The NUHOMS®-69BTH System is a modular canister-based spent fuel storage and transfer system, similar to the NUHOMS®-61BTH System described in Appendix T, Section T.1.2.1 of the UFSAR [1J.5.4]. The NUHOMS®-69BTH System consists of the following components:

- The 69BTH dry shielded canister (DSC) physical dimensions are increased (the outside diameter and outside length are increased to 69.75 inches and 197.0 inches, respectively) to accommodate up to 69 intact (or up to 24 damaged and balance intact) boiling water reactor (BWR) FAs. The NUHOMS®-69BTH DSC is a dual purpose (storage/transportation) DSC provided with aluminum rails to accommodate a maximum heat load of up to 35.0 kW.
- The NUHOMS®-69BTH DSC basket is designed with three alternate neutron absorber plate materials: (1) borated aluminum alloy, (2) boron carbide/aluminum MMC and (3) Boral®. For each neutron absorber material, the NUHOMS®-69BTH DSC basket is analyzed for six alternate basket configurations, depending on the boron loadings analyzed to accommodate the various fuel enrichment levels (designated "A" for the lowest B-10 loading to "F" for the highest B-10 loading).
- The 69BTH DSC is stored in the HSM-H with a larger door opening as described in Appendix U.1, Section U.1.2.1.2 [1J.5.4]. For site locations where higher seismic levels exist, an upgraded version of the HSM-H, designated as HSM-HS, is used.
- A loaded 69BTH DSC with a heat load of up to 24.0 kW is transferred from a plant's fuel or reactor building in the OS200 TC, which is described in Appendix U, Section U.1.2.1.3 [1J.5.4]. An alternate TC option, designated as OS200FC TC and described in Appendix U, Section U.1.2.1.3, is also provided to accommodate transfer of a loaded 69BTH DSC with heat loads up to 35.0 kW.

The NUHOMS®-69BTH System is designed to store up to 69 intact (including reconstituted) or up to 24 damaged and balance intact BWR FAs with uranium dioxide (UO_2). The fuel to be stored is limited to a maximum initial lattice average initial enrichment of 5.0 wt%, a maximum assembly average burnup of 62 GWd/MTU, and a minimum cooling time of 3.0 years.

A detailed description of the 69BTH System including authorized payload contents and supporting safety analyses is incorporated in Appendix Y of the UFSAR [1J.5.4].

Change 2 - Addition of a new NUHOMS®-37PTH System

The NUHOMS®-37PTH System is a modular canister-based spent fuel storage and transfer system. The NUHOMS®-37PTH System consists of the following components:

- A 37PTH DSC, with two alternate configurations, depending on the canister length: a short length (182.00 in.) DSC designated as type 37PTH-S DSC and a medium length (189.25 in.) DSC designated as type 37PTH-M DSC. The 37PTH DSC is designed for a maximum heat load of 30.0 kW.
- The NUHOMS®-37PTH DSC basket is provided with solid aluminum rails for support, and to facilitate heat transfer. For criticality control, the 37PTH basket is provided with three alternate neutron absorber plate materials: (1) borated aluminum alloy, (2) boron carbide/aluminum MMC, and (3) Boral®.
- The NUHOMS®-37PTH DSC is stored in the HSM-H with a larger door opening as described in Appendix U.1, Section U.1.2.1.2 [1J.5.4]. For site locations where higher seismic levels exist, an upgraded version of the HSM-H, designated as HSM-HS, is used.
- A loaded 37PTH DSC with a heat load of up to 22.0 kW is transferred from a plant's fuel or reactor building in the OS200 TC, which is described in Appendix U, Section U.1.2.1.3 [1J.5.4]. An alternate TC option, designated as OS200FC TC and described in Appendix U, Section U.1.2.1.3 [1J.5.4], is also provided to accommodate the transfer of a loaded 37PTH DSC with heat loads up to 30.0 kW.

The NUHOMS®-37PTH System is designed to store up to 37 intact (including reconstituted) or up to four damaged and balance intact pressurized water reactor (PWR) FAs with uranium dioxide (UO_2). The fuel to be stored is limited to a maximum assembly average initial enrichment of 5.0 wt% U-235, a maximum assembly average burnup of 62 GWd/MTU, and a minimum cooling time of 3.0 years.

A detailed description of the 37PTH System including authorized payload contents and supporting safety analyses is incorporated in Appendix Z of the UFSAR [1J.5.4].

Change 3 - Modification to the NUHOMS®-24PHB DSC Authorized Contents

Amendment 13 added control components other than BPRAs to the authorized contents of the NUHOMS®-24PHB DSC. It also authorizes storage of damaged fuel assemblies with up to four missing fuel rods, and allows non-zircaloy cladding/ guide tubes to the authorized content of the NUHOMS®-24PHB DSC as described in Appendix N of the UFSAR.

Change 4 -Modification to the NUHOMS®-32PT DSC Authorized Contents

The authorized payload of the NUHOMS®-32PT DSC described in Appendix M of the UFSAR is expanded to include 32 intact HBU FAs with or without control components. The fuel to be stored is limited to a maximum assembly average enrichment of 5.0 wt. % U-235. The maximum allowable assembly average burnup is limited to 55 GWd/MTU and the minimum cooling time is five years.

Amendment 13 also added two additional 32PT basket types, designated as Type A1 and A2, which have poison plates with a higher minimum B-10 content of 0.015 and 0.020 gm/cm^2, respectively. Type A1 and A2 basket configurations are qualified for the 24-plate basket design only.

Change 5 - Modification to the NUHOMS®-61BTH DSC and 24PTH DSC Authorized Contents

The authorized contents of the NUHOMS®-61BTH DSC described in Appendix T of the UFSAR [1J.5.4] are expanded to include up to four failed fuel cans loaded with failed fuel as part of the up to 16 damaged FAs, with the remainder intact BWR FAs. The 61BTH basket design is modified to reflect the addition of failed fuel cans.

The authorized content of the NUHOMS®-24PTH DSC described in Appendix P of the UFSAR [1J.5.4] are expanded to add up to eight failed fuel cans loaded with failed fuel as part of the up to 12 damaged FAs, with the remainder intact PWR FAs, with or without control components. The 24PTH basket design is modified to reflect the addition of failed fuel cans.

Change 6 - Additional Changes

Several additional changes listed below have also been authorized in CoC 1004 Amendment No. 13:

- Amendment No. 13 to CoC No. 1004 expands the authorized contents of the 24PHB, 24PTH, 32PTH1, 61BT, and the 61BTH to allow storage of BLEU fuel material. Fuel pellets containing BLEU fuel are generally similar to UO_2 fuel pellets, except that they contain a larger quantity of cobalt. This cobalt impurity affects the gamma source term for fuel assemblies located on the periphery of the DSC. These FAs require additional cooling time to ensure that the source terms calculated for UO_2 are bounding.
- The HSM-HS is an upgraded version of the NUHOMS® HSM-H designed for use in higher seismic areas. The NUHOMS® HSM-HS has been previously approved for use with the 32PTH1 DSC (with a heat load up to 40.8 kW) as described in Appendix U of the UFSAR [1J.5.4]. Amendment 13 modifies the HSM-HS door dimensions to accommodate the storage of the smaller diameter NUHOMS®-61BT, -32PT, -24PTH, and -61BTH DSCs in the HSM-HS module. It also evaluates the storage of these smaller diameter DSCs, as well as the new 69BTH and 37PTH DSCs

- The OS200 TC has been previously approved for onsite transfer of the NUHOMS®-32PTH1 DSC as described in Appendix U of the UFSAR. Amendment 13 evaluates the transfer of the 61BT, 32PT, 24PTH and 61BTH with the addition of an inner sleeve to accommodate these smaller diameter DSCs. A modified OS200 TC (OS200FC TC) is used to allow air circulation through the TC/DSC annulus, if required for the transfer of the 37PTH DSC and 69BTH DSC.
- The use of Type III cement as an alternate equivalent to the Type II cement in HSM construction is allowed.
- The use of MMC as a neutron absorber material in the 61BTH Type 1 and Type 2 DSCs for higher heat loads.
- Added dose reduction hardware to the HSM-H/HSM-HS inlets vent design to achieve enhanced shielding performance.
- Neutron absorber material testing and acceptance requirements in UFSAR Appendices K.9, M.9, P.9, T.9, U.9, Y.9 and Z.9 have been updated to reflect these most current expectations. Much of this information is incorporated by reference into the technical specifications.

1J.1.2 Design Drawings Certified in Amendment 13

The January 1, 2014 Edition of 10 CFR Part 72 was in effect at the time of approval of Amendment No. 13 to CoC No. 1004. None of the changes in Amendment No. 13 was the result of any differences between this edition of the 10 CFR Part 72 and the effective edition of 10 CFR Part 72 for the initial CoC and prior CoC Amendments.

Tables 1J-2, 1J-3, 1J-4, 1J-5, 1J-6, 1J-7, 1J-8, 1J-9 and 1J-10 provide a list of the UFSAR drawings for the 32PT DSC, 24PHB DSC, 24PTH DSC, 61BTH DSC, 69BTH DSC, 37PTH DSC, HSM-H, HSM-HS and OS200 TC, respectively, which were updated for incorporation into UFSAR Revision 14 [1J.5.4]. Some of these drawings were revised to reflect Amendment 13 changes while the remaining were revised to reflect the 10 CFR 72.48 changes discussed in Section 1J.1.3.

Table 1J-1 provides a listing of the SSCs that were not affected by CoC 1004 Amendment 13 changes.

1J.1.3 Changes to the Standardized NUHOMS® System Following Amendment 13 Approval

Additional changes to the Standardized NUHOMS® System following approval of Amendment 13 have been implemented pursuant to the requirements of 10 CFR 72.48.

Section 1J.1.3.1 lists the more significant changes implemented and incorporated into UFSAR Revision 14 [1J.5.4]. Also listed is the corresponding licensing review (LR), which evaluated each change under the criteria of 10 CFR 72.48 and determined that the change did not require an amendment to CoC 1004. A summary of the changes made to the Standardized NUHOMS® System configuration along with a brief justification is included in the biennial report submitted to the NRC [1J.5.5].

1J.1.3.1 Significant Changes Implemented in UFSAR Revision 14

Description of Change	Associated LR
This change involves the introduction of a new Basket Option 3 for the 37PTH DSC. The new basket option consists of a reduction in poison plate thickness and the thickness of the center section basket plates, intended to accommodate the fabrication of a larger cell size with a corresponding larger fuel gauge size. The changes include: (1) using only full thickness MMC poison plate for Basket Option 3 with no option for pairing aluminum plate with poison plate, (2) reducing the poison plate thickness, and (3) reducing the thermal conductivity requirement of the poison plates (neutron absorber), (4) revising the basket to shell diametrical gap range resulting in a change to the nominal basket OD associated with the maximum gap, (5) revising the center basket plates dimensions and materials, and (6) provide for a split poison plate option that replaces the chevron "L" shape with two discrete plates, which requires additional poison plate mounting attachments in the center section of the plates.	LR 721004-1079, Rev. 1
This modification introduces a number of changes to the HSM model 152. The design changes for the HSM include: (1) adding a rail spacer to accommodate all DSC length configurations for new and existing models, (2) an increase in the concrete clear cover to the top shield block of the HSM, and (3) reducing the weld between the rear baseplate to the rail. In addition, a design option has been added for a stainless steel DSC axial retainer, and alternate welding design options in two locations for the DSC support structure. The changes also incorporate new lifting embedments design to improve the alignment of attachment hardware and to meet code requirements.	LR 721004-1112, Rev. 1
This change involves an option to grout the through-hole penetrations in the roof of the HSM Model 152. The physical change will prevent water accumulation in the through-holes, which can freeze and cause cracking damage to the HSM Roof. The filling of the through-holes has been implemented at previous/existing HSM sites utilizing a design with a through-hole in the roofs. The NRC had expressed a concern about cracking in the HSM roof that was observed in a short period of time at the TMI-2 ISFSI at Idaho National Laboratory (INL). The NRC requested that AREVA provide a list of sites utilizing CoC No. 1004	LR 721004-1198 Rev. 1

Description of Change	Associated LR
in conjunction with through-hole penetration via letter dated 02-02-2012. AREVA notified NRC by AREVA Letter # E-32270, dated March 1, 2012, from Jayant Bondre to the NRC-Document Control Desk, which addressed the Identification of Sites Using Horizontal Storage Modules with Through-Hole Penetrations for all sites utilizing the NUHOMS® design. AREVA addressed NRC concerns and issues, and provided recommendations to users related to the HSMs through-hole penetrations for the sites using this HSM.	

1J.1.4 Amendment 13 Loading Overview

As of the time of preparation of this application, no FAs have been loaded under CoC 1004 Amendment 13 at any site.

1J.2 Scoping Evaluation of CoC 1004 Amendment 13 SSCs

The primary source documents reviewed in this scoping evaluation are CoC 1004 Amendment 13 [1J.5.2], CoC 1004 Amendment 13 TS [1J.5.3], CoC 1004 Amendment 13 SER [1J.5.6], and the UFSAR [1J.5.4].

Using the methodology described in Chapter 2, in addition to the Standardized NUHOMS® System structures, systems and components (SSCs) described in Appendix 1I, Section 1I.2, the following SSCs are also included within the scope of CoC 1004 Amendment 13 renewal:

1J.2.1 NUHOMS®-69BTH System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

The NUHOMS®-69BTH System SSCs determined to be within the scope of renewal are:

- 69BTH DSC
- HSM-H/HSM-HS modules
- OS200 TC/OS200FC TC

Amendment 13 modified the HSM-HS design configuration to add an alternate door design to allow storage of the smaller diameter DSCs. Also, the HSM-HS UFSAR drawings were modified to depict storage of 69BTH DSC.

The design configuration of OS200 TC/OS200FC TC has been modified by the addition of an internal sleeve to allow transfer of smaller diameter DSCs.

1J.2.2 NUHOMS®-37PTH System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

The NUHOMS®-37PTH System SSCs determined to be within the scope of renewal are:

- 37PTH DSC
- HSM-H/HSM-HS modules
- OS200 TC/OS200FC TC

In addition to the changes described in Section 1J.2.1 above, Amendment 13 modified the HSM-HS UFSAR drawings to depict storage of 37PTH DSC.

1J.2.3 NUHOMS®-32PT System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

The design configuration of the 32PT DSC basket has been modified to add two additional basket types, Type A1 and A2.

There are no other changes to the design configuration of the NUHOMS®-32PT System SSCs described previously in Appendix E.

1J.2.4 NUHOMS®-24PHB System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

The 24PHBL DSC and 24PHBS DSC baskets have been modified to accommodate storage of damaged fuel.

There are no other changes to the design configuration of the NUHOMS®-24PHB System SSCs described previously in Appendix 1E.

1J.2.5 NUHOMS®-24PTH System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

The 24PTHF basket has been added to the 24PTH System to accommodate storage of failed fuel.

There are no other changes to the design configuration of the NUHOMS®-24PTH System SSCs described previously in Appendix 1F.

1J.2.6 NUHOMS®-61BTH System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

The 61BTHF DSC basket has been added to the 61BTH System to accommodate storage of failed fuel.

There are no other changes to the design configuration of the NUHOMS®-61BTH System SSCs, previously described in Appendix 1H.

1J.2.7 Remaining Standardized NUHOMS® System SSCs within the Scope of CoC 1004 Amendment 13 Renewal

CoC 1004 Amendment 13 did not implement any additional changes to the design configuration of the other NUHOMS® System SSCs described previously in Appendices 1A through 1J except for the 10 CFR 72.48 changes described in Section 1J.1.3.

1J.3 Aging Management Review of Amendment 13 SSCs

The AMR of Amendment 13 SSCs is based on the AMR presented in Chapter 3, Sections 3.5, 3.6, 3.7 and 3.8 for DSCs, HSMs, TCs and SFAs.

As listed in Table 1J-1, approval of Amendment 13 did not result in any change in the design configuration of the 24P DSC, 24P Long Cavity DSC, 52B DSC, 24PT2 DSC, 61BT DSC, 32PTH1 DSC, HSM (Model 80, Model 102, Model 152 and Model 202), Standardized TC and OS197 TCs. Hence, the aging management review (AMR) results listed in previous appendices remain applicable for these SSCs.

1J.3.1 Aging Management Review of the NUHOMS®-69BTH DSC

Table 1J-15 lists the subcomponents of the 69BTH DSC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the 61BTH DSC subcomponents.

Appendix 3A, 3D, 3E and 3G provide a discussion of the DSC time-limited aging analyses (TLAAs) methodology and the DSC TLAA results. As noted in these Appendices, each of the TLAA is performed by selecting bounding evaluation parameters for the DSC under consideration, so that the TLAA results are applicable to all the DSCs certified in CoC 1004 (Amendment 1 through 11 and Amendment 13). A summary of these limiting DSC TLAA results is provided in Appendix 1A, Section 1A.3.4.1. These TLAA results are also applicable to the 69BTH DSC

Table 1J-15 presents the results of the AMR for the 69BTH DSC subcomponents.

1J.3.2 Aging Management Review of the NUHOMS®-37PTH DSC

Table 1J-16 lists the subcomponents of the 37PTH DSC and the material of construction of each subcomponent. Also listed are the environment, the safety classification, and the intended function of the 37PTH DSC subcomponents.

The discussion provided in Section 1J.3.1, above, regarding DSC TLAA results is also applicable to 37PTH DSC.

Table 1J-16 presents the results of the AMR for the 37PTH DSC subcomponents.

1J.3.3 Aging Management Review of the NUHOMS®-32PT, -24PHB, -24PTH and -61BTH DSC

Approval of Amendment 13 changes resulted in the addition of two new 32PT basket types. Table 1J-11 presents the results of the 32PT DSC AMR due to these incremental changes. As shown in Table 1J-11, there is no change in the 32PT DSC AMR results presented previously in Appendix 1E.

Amendment 13 added control components other than BPRAs to the authorized contents of the 24PHB DSC. It also authorized storage of up to four damaged FAs. Table 1J-12 presents the results of the 24PHB DSC AMR due to these incremental changes. As shown therein, there is no change in the 24PHB DSC AMR results presented previously in Appendix 1E.

Approval of Amendment 13 changes resulted in the addition of failed fuel cans to the 24PTH and 61BTH DSC baskets. Tables 1J-13 and 1J-14 present the AMR results for the 24PTH and 61BTH DSC, respectively, due to these incremental changes. As shown in these tables, there is no change in the AMR results presented previously in Appendix 1F and Appendix 1H for the 24PTH DSC and 61BTH DSC, respectively.

1J.3.4 Aging Management Review of the HSM-H/HSM-HS

Amendment 13 added dose reduction hardware to the HSM-H/HSM-HS inlet vent design to achieve enhanced shielding performance. It also modified the HSM-HS door dimensions to accommodate the storage of smaller diameter DSCs. Table 1J-17 presents the AMR results for the HSM-H/HSM-HS due to these incremental changes. As shown in Table 1J-17, these incremental changes do not alter the AMR results presented in Appendix 1F and Appendix 1H for HSM-H and HSM-HS, respectively.

1J.3.5 Aging Management Review of the OS200FC TC

Table 1J-18 lists the subcomponents of the OS200FC TC and the material of construction of each subcomponent. Also listed are the environment, the safety classification and the intended function of the OS200 TC subcomponents.

Cyclical loading or fatigue evaluation of OS200 class TCs is performed in Appendix 3B. As determined in Appendix 3B, fatigue is not an aging effect requiring management during extended operations.

Table 1J-18 presents the results of the AMR for the OS200FC TC subcomponents

1J.3.6 Aging Management Review of the Irradiated Fuel Assemblies

There is no change in the AMR of low burnup fuel discussed in Appendix 1E, Section 1E.3.4.1.

The AMR and the supporting TLAAs of the HBU FAs discussed in Appendix 1E, Section 1E.3.4.2 is also applicable to the HBU FAs authorized for storage in the 32PT, 69BTH and 37PTH DSCs. The AMP for the HBU FAs is discussed in Appendix 1E, Section 1E.3.5.

1J.4 Fuel Retrievability

The retrievability of low and HBU FAs is ensured as discussed in Section 1E.4, Appendix 1E.

1J.5 References (Appendix J)

1J.5.1 Transnuclear Inc., “Application for Amendment 13 of the NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0,” Docket No. 72-1004, February 9, 2011.

1J.5.2 U.S. Nuclear Regulatory Commission, “Certificate of Compliance for Spent Fuel Storage Casks, Certificate No. 1004, Amendment No. 13,” Docket No. 72-1004, Effective May 24, 2014.

1J.5.3 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System, AREVA, Inc., “Certificate of Compliance No. 1004, Amendment No. 13, May 2014,” Docket No. 72-1004.

1J.5.4 AREVA Inc. Document NUH003.0103, “Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Fuel,” Revision 14, September 2014.

1J.5.5 Transnuclear Letter to the U.S. Nuclear Regulatory Commission, E-39211, dated July 23, 2014, “Biennial Report of 72.48 Evaluations Performed for the Standardized NUHOMS® System, CoC 1004, for the Period 07/24/12 to 07/23/14,” Docket No. 72-1004.

1J.5.6 Final Safety Evaluation Report, “Standardized NUHOMS® Modular Storage System for Irradiated Nuclear Fuel, Certificate of Compliance No. 1004, Amendment No. 13, May 2014, Docket 72-1004.

Table 1J-1
Design Drawings of SSCs Not Affected by CoC 1004 Amendment 13

- NUHOMS®-24P DSC
- NUHOMS®-52B DSC
- NUHOMS®-24P Long Cavity DSC
- NUHOMS®-24PT2 DSC
- NUHOMS®-61BT DSC
- NUHOMS®-32PTH1 DSC
- Standardized HSM (Model 80, Model 102, Model 152 and Model 202)
- NUHOMS® Standardized TC, OS197 TC, OS197H TC, OS197FC TC and OS197FC-B TC

Table 1J-2
NUHOMS®-32PT DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH-32PT-1002-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Shell Assembly	5
NUH-32PT-1003-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly - Plate Options	7
NUH-32PT-1004-SAR	NUHOMS®-32PT Transportable Storage Canister for PWR Fuel, Basket Assembly – Tube Options	6

Table 1J-3
NUHOMS®-24PHB DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH-HBU-1001-SAR	General License NUHOMS 24PHBS and 24PHBL DSC, Modifications for Damaged Fuel	0

Table 1J-4
NUHOMS®-24PTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH-24PTH-1003-SAR	NUHOMS®-24PTH Transportable Storage DSC for PWR Fuel, Basket Assembly	5
NUH-24PTH-1004-SAR	NUHOMS®-24PTH Transportable Storage DSC for PWR Fuel, Transition Rails	5
NUH24PTH-72-1008	NUHOMS®-24PTHF Transportable Canister for PWR Fuel, Failed Fuel Can	0
NUH24PTH-72-1009	NUHOMS®-24PTHF Transportable Canister for PWR Fuel, Basket Assembly	0

Table 1J-5
NUHOMS®-61BTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH61BTH-1000-SAR	NUHOMS®-61BTH DSC Type 1 Main Assembly	3
NUH61BTH-2001-SAR	NUHOMS®-61BTH DSC Type 2 Shell Assembly	3
NUH61BTH-72-1105	NUHOMS®-61BTHF Type 2 Transportable Canister for BWR Fuel, Failed Fuel Can	0

Table 1J-6
NUHOMS®-69BTH DSC Design Drawings

Design Drawing No	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH69BTH-72-1001	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Main Assembly	0
NUH69BTH-72-1002	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Basket-Shell Assembly	0
NUH69BTH-72-1003	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Shell Assembly	0
NUH69BTH-72-1004	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Alternate Top Closure	0
NUH69BTH-72-1011	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Basket Assembly	0
NUH69BTH-72-1012	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Transition Rail Assembly and Details	0
NUH69BTH-72-1013	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Holddown Ring Assembly	0
NUH69BTH-72-1014	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Damaged Fuel Modification	0
NUH69BTH-72-1015	NUHOMS®-69BTH DSC Transportable Canister for BWR Fuel, Damaged Fuel End Caps	0

Table 1J-7
NUHOMS®-37PTH DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH37PTH-72-1001	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Main Assembly	0
NUH37PTH-72-1002	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Basket Shell Assembly	0
NUH37PTH-72-1003	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Shell Assembly	0
NUH37PTH-72-1004	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Alternate Top Closure	0
NUH37PTH-72-1011	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Basket Assembly	0
NUH37PTH-72-1012	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Transition Rails	0
NUH37PTH-72-1015	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Damaged Fuel End Caps	0
NUH37PTH-72-1016	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Basket Assembly (Option 3)	0
NUH37PTH-72-1017	NUHOMS®-37PTH Transportable Canister for PWR Fuel, Transition Rails (Basket Option 3)	0

Table 1J-8
NUHOMS®-HSM-H DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH-03-7001-SAR	Standardized NUHOMS® ISFSI HSM-H, Main Assembly	6

Table 1J-9
NUHOMS®-HSM-HS DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH-03-7003-SAR	Standardized NUHOMS® ISFSI HSM-HS, Main Assembly	2
NUH-03-7004-SAR	Standardized NUHOMS® ISFSI HSM-H/HSM-HS, Dose Reduction Hardware	1

Table 1J-10
NUHOMS®-OS200 TC DSC Design Drawings

Design Drawing No.	Description	Drawing Revision Level (UFSAR Rev. 14)
NUH-08-8001-SAR	NUHOMS® OS200 Onsite Transfer Cask, Structural Shell Assembly	2
NUH-08-8004-SAR	NUHOMS® OS200 Onsite Transfer Cask, Internal Sleeve Design	0
NUH-08-8005-SAR	NUHOMS® OS200 Onsite Transfer Cask, Spacer Design	0

Proprietary Information on Pages 1J-23 through 1J-43
Withheld Pursuant to 10 CFR 2.390

APPENDIX 2:

Scoping Evaluation on a Component-by-Component Basis Based on UFSAR Revision 14

Proprietary Information on Pages 2A-i and 2A-1 through 2A-35
Withheld Pursuant to 10 CFR 2.390

Proprietary Information on Pages 2B-i and 2B-1 through 2B-17
Withheld Pursuant to 10 CFR 2.390

Proprietary Information on Pages 2C-i and 2C-1 through 2C-9
Withheld Pursuant to 10 CFR 2.390

Proprietary Information on Pages 2D-i and 2D-1
Withheld Pursuant to 10 CFR 2.390

APPENDIX 2E
List of UFSAR Revision 14 Drawings Used in the Scoping Evaluations

LIST OF TABLES

Table 2E-1
List of Drawings for the NUHOMS Storage System - DSCs
(3 Pages)

Component	Drawing No.	Subcomponent	Location in the UFSAR
24P DSC	NUH-03-1020-SAR	Basket Assembly	Appendix E
24P DSC	NUH-03-1021-SAR	Shell Assembly	Appendix E
24P DSC	NUH-03-1022-SAR	Basket-Shell Assembly	Appendix E
24P DSC	NUH-03-1023-SAR	Main Assembly	Appendix E
52B DSC	NUH-03-1029-SAR	Shell Assembly	Appendix E
52B DSC	NUH-03-1030-SAR	Basket-Shell Assembly	Appendix E
52B DSC	NUH-03-1031-SAR	Main Assembly	Appendix E
52B DSC	NUH-03-1032-SAR	Basket Assembly	Appendix E
24P Long Cavity	NUH-03-1050-SAR	Basket Assembly	Appendix E
24P Long Cavity	NUH-03-1051-SAR	Shell Assembly	Appendix E
24P Long Cavity	NUH-03-1052-SAR	Basket-Shell Assembly	Appendix E
24P Long Cavity	NUH-03-1053-SAR	Main Assembly	Appendix E
61BT	NUH-61B-1061-SAR	Shell Assembly	Appendix K
61BT	NUH-61B-1062-SAR	Canister Details	Appendix K
61BT	NUH-61B-1063-SAR	Basket Assembly	Appendix K
61BT	NUH-61B-1065-SAR	Parts List	Appendix K
61BT	NUH-61B-1066-SAR	Basket Details for Damaged BWR Fuel	Appendix K
24PT2S	NUH-03-1070	Main Assembly	Appendix L
24PT2L	NUH-03-1071	Main Assembly	Appendix L
32PT	NUH-32PT-1001-SAR	Main Assembly	Appendix M
32PT	NUH-32PT-1002-SAR	Shell Assembly	Appendix M
32PT	NUH-32PT-1003-SAR	Basket Assembly	Appendix M
32PT	NUH-32PT-1004-SAR	Basket Assembly	Appendix M
32PT	NUH-32PT-1006-SAR	PWR Fuel Aluminum Transition Rails	Appendix M
24PHB	NUH-HBU-1000-SAR	24PHBS AND 24PHBL DSC	Appendix N
24PHB	NUH-HBU-1001-SAR	24PHBS AND 24PHBL DSC MOD FOR DAMAGED FUEL	Appendix N
24 PTH	NUH24PTH-1001-SAR	Main Assembly	Appendix P
24 PTH	NUH24PTH-1002-SAR	Shell Assembly	Appendix P
24 PTH	NUH24PTH-1003-SAR	Basket Assembly	Appendix P

Table 2E-1
List of Drawings for the NUHOMS Storage System - DSCs
(3 Pages)

Component	Drawing No.	Subcomponent	Location in the UFSAR
24 PTH	NUH24PTH-1004-SAR	Transition Rails	Appendix P
24PTHF	NUH24PTH-72-1008	PWR Fuel Failed Fuel Can	Appendix P
24PTHF	NUH24PTH-72-1009	Basket Assembly Failed Fuel Can	Appendix P
61BTH	NUH61BTH-1000-SAR	Type 1 Main Assembly	Appendix T
61BTH	NUH61BTH-2000-SAR	Type 2 Main Assembly	Appendix T
61BTH	NUH61BTH-2001-SAR	Type 2 Shell Assembly	Appendix T
61BTH	NUH61BTH-2002-SAR	Type 2 Basket Assembly	Appendix T
61BTH	NUH61BTH-2003-SAR	Type 2 Transition Rails	Appendix T
61BTH	NUH61BTH-2004-SAR	Type 2 Damaged Fuel End Caps	Appendix T
			Appendix T
61BTH	NUH61BTH-2006-SAR	Type 2 Top Grid Assembly	Appendix T
61BTHF	NUH61BTH-72-1105	Type 2 Fuel Failed Fuel Can	Appendix T
32PTH1	NUH-32PTH1-1001-SAR	Main Assembly	Appendix U
32PTH1	NUH-32PTH1-1002-SAR	Shell Assembly	Appendix U
32PTH1	NUH-32PTH1-1003-SAR	Basket Assembly	Appendix U
32PTH1	NUH-32PTH1-1004-SAR	Transition Rails	Appendix U
32PTH1	NUH-32PTH1-1005-SAR	Alternate Top Closure	Appendix U
69BTH	NUH69BTH-72-1001	Main Assembly	Appendix Y
69BTH	NUH69BTH-72-1002	Basket Shell Assembly	Appendix Y
69BTH	NUH69BTH-72-1003	Shell Assembly	Appendix Y
69BTH	NUH69BTH-72-1004	Alternate Top Closure	Appendix Y
69BTH	NUH69BTH-72-1011	Basket Assembly	Appendix Y
69BTH	NUH69BTH-72-1012	Transition Rail Assembly and Details	Appendix Y
69BTH	NUH69BTH-72-1013	Holddown Ring Assembly	Appendix Y
69BTH	NUH69BTH-72-1014	Damaged Fuel Modification	Appendix Y
69BTH	NUH69BTH-72-1015	Damaged Fuel End Caps	Appendix Y
37PTH	NUH-37PTH-72-1001	Main Assembly	Appendix Z
37PTH	NUH-37PTH-72-1002	Basket Shell Assembly	Appendix Z

Table 2E-1
List of Drawings for the NUHOMS Storage System - DSCs
(3 Pages)

Component	Drawing No.	Subcomponent	Location in the UFSAR
37PTH	NUH-37PTH-72-1003	Shell Assembly	Appendix Z
37PTH	NUH-37PTH-72-1004	Alternate Top Closure	Appendix Z
37PTH	NUH-37PTH-72-1011	Basket Assembly	Appendix Z
37PTH	NUH-37PTH-72-1012	Transition Rails	Appendix Z
37PTH	NUH-37PTH-72-1015	Damaged Fuel end Caps	Appendix Z
37PTH	NUH-37PTH-72-1016	Basket Assembly (Option 3)	Appendix Z
37PTH	NUH-37PTH-72-1017	Transition Rails (Basket Option 3)	Appendix Z

Table 2E-2
List of Drawings for the NUHOMS Storage System - HSMs

Component	Drawing No.	Subcomponent	Location in the UFSAR
HSM-102, HSM-80	NUH-03-6008-SAR	General Arrangement	Appendix E
HSM-102, HSM-80	NUH-03-6009-SAR	Main Assembly	Appendix E
HSM-102, HSM-80	NUH-03-6010-SAR	Base Unit Assembly	Appendix E
HSM-102, HSM-80	NUH-03-6014-SAR	Base Unit	Appendix E
HSM-102, HSM-80	NUH-03-6015-SAR	Roof Slab Assembly	Appendix E
HSM-102, HSM-80	NUH-03-6016-SAR	DSC Support Structure	Appendix E
HSM-102, HSM-80	NUH-03-6017-01-SAR	Module Accessories	Appendix E
HSM-102, HSM-80	NUH-03-6018-SAR	Shield Walls Plans & Details	Appendix E
HSM-102, HSM-80	NUH-03-6024-SAR	Module Erection Hardware	Appendix E
HSM-H	NUH-03-7001-SAR	Main Assembly	Appendix P
HSM-152	NUH-03-6400-SAR	Main Assembly	Appendix R
HSM-202	NUH-03-7002-SAR	Main Assembly	Appendix V
HSM-HS	NUH-03-7003-SAR	Main Assembly	Appendix U
HSM-H/HSM-HS	NUH-03-7004-SAR	Dose Reduction Hardware	Appendix P

Table 2E-3
List Of Drawings for the NUHOMS Storage System - TCs

Component	Drawing No.	Subcomponent	Location in the UFSAR
Onsite TC	NUH-03-8000-SAR	Onsite Transfer Cask Overview	Appendix E
Onsite TC	NUH-03-8001-SAR	Structural Shell Assembly	Appendix E
Onsite TC	NUH-03-8002-SAR	Inner & Outer Shell Assembly	Appendix E
Onsite TC	NUH-03-8003-SAR	Main Assembly	Appendix E
OS197-FC TC	NUH-03-8006-SAR	Main Assembly	Appendix P
OS197FC-B TC	NUH-03-8007-SAR	Main Assembly	Appendix T
OS197L TC	NUH-03-8008-SAR	Cask Body Assembly	Appendix W
OS197L TC	NUH-03-8009-SAR	Light Neutron Shield Assembly	Appendix W
OS197L TC	NUH-03-8010-SAR	Main Assembly	Appendix W
OS197L TC	NUH-03-8011-SAR	Support Skid Supp. Shielding	Appendix W
OS197L TC	NUH-03-8012-SAR	Decon Area Cask Shielding Assemblies	Appendix W
OS200 TC	NUH-08-8001-SAR	Structural Shell Assembly	Appendix U
OS200 TC	NUH-08-8002-SAR	Inner and Outer Shell Assembly	Appendix U
OS200 TC	NUH-08-8003-SAR	Main Assembly	Appendix U
OS200TC	NUH-08-8004-SAR	Internal Sleeve Design	Appendix U
OS 200TC	NUH-08-8005-SAR	OS 200TC Spacer	Appendix U

NOTES:

1. Onsite TC refers to the Standardized TC and the OS197 TC.

APPENDIX 3:

Time-Limited Aging Analyses and Other Supplemental Evaluations

APPENDIX 3A
Fatigue Evaluation of the Dry Shielded Canisters

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LIST OF FIGURES

3A.1 Summary Description

This time-limited aging analysis (TLAA) evaluates the effects of cyclic loading (fatigue) on the mechanical properties of dry shielded canister (DSC) materials of the Standardized NUHOMS® System.

The evaluation is performed in accordance with the provisions of NB 3222.4(d) of the applicable ASME Code: "Rules to Determine Need for Fatigue Analysis of Integral Parts of Vessels." As provided by the American Society of Mechanical Engineers (ASME) Code, fatigue effects need not be specifically evaluated provided the six criteria contained in NB 3222.4(d) are met. An evaluation using these six criteria is performed to show that the ASME Code fatigue exemption requirements are satisfied for the DSCs. The following DSCs are included: 24P, 24PTH, 24PT2, 24PHB, 32PT, 32PTH1, 37PTH, 52B, 61BT, 61BTH, and 69BTH.

3A.2 Analysis

Table 3A-1 gives maximum normal and off-normal temperatures and design pressures [3A.4.1] for use in the fatigue exemption evaluation.

For all designs, the pressure-retaining DSC shell and cover plate components are made of stainless steel material, SA 240 Type 304 or SA-182 Type F304 (for forgings). Both of these materials have the same mechanical and structural properties.

The evaluation uses bounding S_m, E, and α values to cover the ASME Code editions applicable to the DSCs shown in Table 3A-2. Based on the temperatures in Table 3A-1, and considering the full range of applicable ASME Code years, the following bounding values are used:

Proprietary Information on Pages 3A-3 through 3A-8
Withheld Pursuant to 10 CFR 2.390

3A.3 Conclusions

The evaluation for the NUHOMS® DSCs shows that fatigue analysis exemption criteria given in ASME Code Section NB 3222.4(d) are met for a 100-year service life for the following NUHOMS® DSCs: 24P, 24PTH, 24PT2, 24PHB, 32PT, 32PTH1, 37PTH, 52B, 61BT, 61BTH, and 69BTH. No additional fatigue evaluations are required for the DSCs.

3A.4 References

3A.4.1 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3A.4.2 ASME Boiler and Pressure Vessel Code, Section II, Part D (Applicable Code Years shown in Table 3A-2).

3A.4.3 ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NB (Applicable Code Years shown in Table 3A-2).

3A.4.4 ASME Boiler and Pressure Vessel Code, Section III, Division 1, Appendix I (Applicable Code Years shown in Table 3A-2).

Table 3A-1
DSC Design Data Used in Fatigue Exemption Evaluations

DSC Type	Max. Normal/ Off-Normal Temperature (°F)	Normal Design Pressure (psig)	Off-Normal Design Pressure (psig)	Source References (All table numbers refer to [3A.4.1])
24P	399	10	10	Temperature: Table 8.1-26, App. H and J Pressure: Table 8.1-6, Section H.3.1.1, Table J.4-2
24PT2	491	10	10	Temperature: Figure L.4-14 Pressure: Same as 24P
24PHB	399	15	20	Temperature: Tables N.4-1 and N.4-3 Pressure: Table N.4-7
24PTH	461	15	20	Temperature: Tables P.4-15 through P.4-17 and P.4-21 through P.4-23 Pressure: Tables P.4-19 and P.4-24
32PT	382	15	20	Temperature: Tables M.4-3 through M.4-5 and M.4-9 through M.4-11 Pressure: Tables M.4-7 and M.4-12
32PTH1	491	15	20	Temperature: Table U.4-2 Pressure: Tables U.4-19 and U.4-23
37PTH	427	15	20	Temperature: Table Z.4-4 Pressure: Table Z.4-7
52B	352	10	10	Temperature: Table 8.1-27 Pressure: Table 8.1-7
61BT	345	10	20	Temperature: Table K.4-1 Pressure: Table K.4-5
61BTH Type 1	399	10	20	Temperature: Tables T.4-13 and T.4-18 Pressure: Table T.4-16 andT.4-20
61BTH Type 2	438	15	20	Temperature: Tables T.4-14 and T.4-19 Pressure: Table T.4-16 andT.4-20
69BTH	455	15	20	Temperature: Table Y.4-10 Pressure: Table Y.4-13

Table 3A-2
Applicable Codes

DSC Type	Applicable Code	Edition/Year
24P/52B/ 24PHB	ASME B&PV Code, Section Ill, Division 1, Subsections NB and NF	1983 Edition with Winter 1985 Addenda
61BT	ASME B&PV Code, Section Ill, Division 1, Subsections NB, NG and NF, including Code Case N-595-1	1998 Edition with 1999 Addenda
32PT, 24PTH	ASME B&PV Code, Section Ill, Division 1, Subsections NB, NG and NF, including Code Case N-595-2	1998 Edition with Addenda through 2000
61BTH, 32PTH1	ASME B&PV Code, Section Ill, Division 1, Subsections NB, NG and NF	1998 Edition with Addenda through 2000
69BTH, 37PTH	ASME B&PV Code, Section Ill, Division 1, Subsection NB, NG, and NF	2004 Edition with Addenda through 2006

Notes:

1. Note the 24PT2 DSC is a modified version of the 24P DSC and therefore, the same Code and year apply.
2. ASME Code Section II Part D [3A.4.2] and Section III Appendices [3A.4.3, 3A.4.4] are used to determine bounding material properties.

Table 3A-3
DSC Heat Load Conditions, Temperatures, ΔT and Changes in ΔT

Figure 3A-1
61BTH Type 2 DSC Temperature Distribution in HSM (31.2 kW, -40 °F Ambient)

Figure 3A-2
61BTH Type 2 DSC Temperature Distribution in HSM (31.2 kW, 0 °F Ambient)

Figure 3A-3
61BTH Type 2 DSC Temperature Distribution in HSM (31.2 kW, 100 °F Ambient)

Figure 3A-4
61BTH Type 2 DSC Temperature Distribution in HSM (31.2 kW, 117 °F Ambient)

Figure 3A-5
24PTH DSC Temperature Distribution in HSM-H (40.8 kW, -40 °F Ambient)

(from Figure P.4-16 of [3A.4.1])

Figure 3A-6
24PTH-S or 24PTH-L DSC Temperature Distribution in HSM-H (40.8 kW, 117 °F Ambient)

(from Figure P.4-11 of [3A.4.1])

APPENDIX 3B
Fatigue Evaluation of the Transfer Casks

CONTENTS

LIST OF TABLES

3B.1 Summary Description

This time-limited aging analysis (TLAA) evaluates the effects of cyclic loading (fatigue) on the mechanical properties of transfer cask (TC) materials of the Standardized NUHOMS® System.

The evaluation is performed in accordance with the provisions of NC-3219.2 of the applicable American Society of Mechanical Engineers (ASME) Code: "Rules to Determine Need for Fatigue Analysis of Integral Parts of Vessels." The evaluation includes the OS197 Type and OS200 TCs, as well as the Standardized TC. Throughout this evaluation, the OS197 Type TC is used to refer to all of the variations of the OS197 TC design. The OS197 Type TCs include the following: OS197, OS197H, OS197FC, OS197H FC, OS197FC-B, OS197HFC-B, and OS197L.

[ ]

Material properties used in determining the need for a fatigue evaluation are based on a maximum temperature of [ ] anywhere in the TC. A review of all of the structural calculations associated with any of the TCs shows that this is a bounding temperature for TC operational temperatures of the TC. In addition, the controlling (or largest) product of E times α (product of modulus of elasticity times instantaneous coefficient of thermal expansion taken at the mean temperature of the adjacent points) is taken at this temperature, and is conservative because it gives a larger resulting product of E times α than that at lower temperatures. Therefore, bounding conservative products of E and α are used in the evaluation. The material properties are based on ASME Code 1998 through 2000 Addenda [3B.4.2] for the OS200 TC and on ASME Code 1983 through 1985 Addenda [3B.4.3] for the Standardized TC and OS197 Type TCs.

3B.2 Analysis

The materials and associated bounding mechanical properties used in the evaluation of the TC steel components, at [ ] , are summarized in Table 3B-1 through Table 3B-4.

For all evaluations related to thermal gradients, the Subsection NC-3219.2 definitions of adjacent points are used. From [3B.4.2] and [3B.4.3], adjacent points are defined in (a) and (b) below.

a. For surface temperature differences:

   1. on surfaces of revolution, in the meridional direction, adjacent points are defined as points which are less than the distance 2 $(Rt)^{1/2}$, where R is the radius measured normal to the surface from the axis of rotation to the midjoint wall, and t is the thickness of the part at the point under consideration: if the product of Rt varies, the average value of the points shall be used;
   2. on surfaces of revolution, in the circumferential direction and on flat parts (such as flanges and flat heads) adjacent points are defined as any two points on the same surface.

b. For through-thickness temperature differences, adjacent points are defined as any two points on a line normal to any surface.

This evaluation to demonstrate that fatigue analysis is not required for the TCs is based on a review of all referenced structural and thermal stress calculations and associated temperature distributions and gradients. The Standardized TC is evaluated separately from the OS197 Type and OS200 TCs. For the latter two, the OS197 Type TCs are bounding for temperature gradients and the OS200 TC is bounding for mechanical load fluctuations (lift and transfer conditions).

The following six criteria (criterion (a) through criterion (f) below), from NC-3219.2, are evaluated for the OS197 Type and OS200 TCs and the Standardized TC. All six criteria shall be met to exempt the TCs from a detailed fatigue analysis.

a. Expected Design Number of Full Range Pressure Cycles

   The TC is not a pressure-retaining boundary; therefore, the first criterion is not applicable.

b. Expected Design Range of Pressure Cycles During Normal Service

   The TC is not a pressure-retaining boundary; therefore, the second criterion is not applicable.

c. Temperature Difference in °F between Any Two Adjacent Points

The temperature difference in °F between any two adjacent points of the TC during normal service and during startup and shutdown does not exceed:

$$\Delta T \leq S_a / (2\ E\ \alpha)$$

where

S_a is the value obtained from the applicable fatigue curve for the specified number of startup and shutdown cycles (which is [ ] cycles),

α is the instantaneous coefficient of thermal expansion at the mean value of the temperatures at the two points, and

E is the modulus of elasticity taken at the mean value of the temperatures at the two points.

The following interpolation equation [3B.4.2] and [3B.4.3] is used for calculating the S value corresponding to [ ] cycles:

$$\frac{N}{N_i} = \frac{N_j}{N_i}^{[\log(S_i/S)]/\log(S_i/S_j)}$$

where

N is the number of cycles [ ] and S_a is the associated stress value for interpolation,

N_i and S_i are the number of cycles (and associated S_a value) below N, and

N_j and S_j are the number of cycles (and associated S_a value) above N.

<u>OS197 Type and OS200 TCs</u>

From Figure I-9.2.1 and Table I-9.1 of Appendix I of [3B.4.2 and 3B.4.3]:

Subscript	N (cycles)	S (ksi)
i	1000	119
x	[	]
j	2000	97

The TCs have meridional (longitudinal), circumferential, flat surface and through-wall temperature gradients. The gradients in the trunnions are not as severe as the worst-case gradients due to the heat load from the spent fuel assembly (SFA) in the active fuel region (i.e., on the inner liner and cask structural shell).

Existing analyses were used to extract the temperatures using ANSYS post-processing for the OS197 Type and OS200 TCs. The post-processed values were pulled into EXCEL for additional calculations to obtain the bounding maximum temperature gradients between adjacent points, including meridional (longitudinal), circumferential, along flat surfaces, and through-wall directions.

Therefore, the third criterion is satisfied for the OS197 Type and OS200 TCs.

<u>Standardized Transfer Cask</u>

The combination of material properties for SA-533 Gr. B, Cl. 2 gives the most limiting requirement for temperature difference between adjacent points. Because the ultimate tensile stress (UTS) of this material is 90 ksi, and per the note on Figure I-9.1 of Appendix I of [3B.4.3], interpolation of the Sa value between the two fatigue curves on Figure I-9.1 is required.

From Figure I-9.1 (UTS < 80 ksi) and Table I-9.1 of Appendix I of [3B.4.2 and 3B.4.3]:

Subscript	**N (cycles)**	**S (ksi)**
i	1000	83
x	[	]
j	2000	64

From Figure I-9.1 (UTS = 115 ksi to 130 ksi) and Table I-9.1 of Appendix I of [3B.4.3]:

Subscript	**N (cycles)**	**S (ksi)**
i	1000	78
x	[	]
j	2000	62

Interpolating for 90 ksi steel gives Sa = 71.5 ksi for 1,440 cycles. Using 71.5 ksi and a conservative set of E and α values, a bounding ΔT is calculated:

[ ]

Existing analyses were reviewed for maximum temperatures and gradients for the Standardized TC.

[ ]

Therefore, the third criterion is satisfied for the Standardized TC.

d. Range of Temperature Difference in °F Between Any Two Adjacent Points

The range of temperature difference in °F between any two adjacent points on the TC does not change during normal service by more than the quantity

$$\Delta T \leq S_a / (2\ E\ \alpha)$$

where S_a is the value obtained from the applicable design fatigue curve for the total specified number of significant temperature difference fluctuations, and E and α are as defined before (see criterion c above).

A temperature difference fluctuation is considered to be significant if its total algebraic range exceeds the quantity:

$$S / (2\ E\ \alpha)$$

where S equals the value of S_a for 10^6 cycles in case of total number of service cycles is 10^6 or less and E and α are as defined before.

Depending on the material, the level of significance for a change in temperature between adjacent points ranges from about 30 °F (for carbon steel, Standardized TC only) to 52 °F (for stainless steel for all TCs).

During a normal use cycle, the TC is subjected to temperature fluctuations relative to the prevailing ambient temperature at the start of a use cycle. A normal TC thermal use cycle for DSC loading and transfer to the horizontal storage module (HSM) would result in a temperature fluctuation from the following operational conditions:

The only significant change in temperature differences between adjacent points due to the above fluctuations is the gradual heating of the TC as the SFAs transfer their heat to the TC components. All other fluctuations due to changes in ambient conditions are less than 30° F. This was calculated by taking the differences in temperature between adjacent points going from a cold condition to a hot condition.

The only significant cycle is when the adjacent points are at the same temperature at ambient conditions and heat up to the maximum temperature difference identified in the third criterion (c) check above. This happens only once per loading cycle and, therefore, reduces to the same limit as that in the third criterion (c) above. In other words, the evaluation for the third criterion (c) above is bounding and further evaluation of the fourth criterion (d) is not required.

The fourth criterion, therefore, is satisfied for the TCs.

e. Temperature Difference –Dissimilar Materials

For components fabricated from materials of differing moduli of elasticity or coefficients of thermal expansion, the total algebraic range of temperature fluctuation in °F experienced by the TC during normal service does not exceed the magnitude

$$\Delta T = S_a / (2\,(E_1\,\alpha_1 - E_2\,\alpha_2))$$

where

S_a is the value obtained from the applicable fatigue curve for the total specified number of significant temperature fluctuations,

E_1 and E_2 are the moduli of elasticity, and α_1 and α_2 are the values of the instantaneous coefficients of thermal expansion at the mean temperature value involved for the two materials of construction.

A temperature fluctuation is considered to be significant if its total excursion exceeds the quantity $S / (2\,(E_1\alpha_1 - E_2\alpha_2))$, where S is the value of S_a obtained from the applicable fatigue curve for 10^6 cycles. If the two materials used have different applicable design fatigue curves, the lower value of S_a shall be used.

<u>OS197 Type and OS200 TCs</u>

There are no excursions that have the possibility of exceeding this temperature range.

Standardized Transfer Cask

The only excursion that has the possibility of exceeding this temperature range is from an unloaded condition to a loaded condition. As discussed earlier, the associated number of cycles is [ ].

From Figure I-9.1 (for UTS 115 ksi to 130 ksi) and Table I-9.1 of Appendix I of [3B.4.3]:

Subscript	N (cycles)	S (ksi)
i	1000	78
x		
j	2000	62

[ ]. Therefore, the criterion is met for this location.

Consider an interior location of the SA-516 Gr. 70 welded to SA-240 Type 304 and where temperatures may reach a maximum.

From Figure I-9.1 (for UTS ≤ 80 ksi) and Table I-9.1 of Appendix I of [3B.4.3]:

Subscript	N (cycles)	S (ksi)
i	1000	83
x	[	]
j	2000	64

[ ]

This limit applies where temperatures are a maximum but they are well below the value shown above. Therefore, the criterion is met for this location.

Therefore, the fifth criterion is satisfied for the TCs.

f. Mechanical Loads

The sixth criterion states that the TC is adequate for fatigue effects provided that the specified full range of mechanical loads do not result in stress ranges which exceed the S_a value obtained from the applicable fatigue curve for the total specified number of significant load fluctuations. If the total specified number of significant load fluctuations does not exceed 10^6, S is the value of S_a at $N = 10^6$ cycles.

A mechanical load fluctuation is only considered significant if the total excursion of load stress intensity exceeds the S_a value for 10^6 cycles.

[ ].

Structural evaluations were reviewed to determine the maximum stresses associated with these normal operating loads.

<u>OS197 Type and OS200 TCs</u>

For the OS197 Type and OS200 TCs, a mechanical load stress excursion is significant if its value exceeds [ ] (S_a at 10^6 cycles). The following table describes the potentially significant mechanical load fluctuation cycles that occur during a single DSC use, which includes lifting, loading, transfer to the HSM, and inserting the DSC into the HSM, and identifies which conditions exceed the [ ] threshold value.

Potentially Significant Mechanical Load Fluctuation Cycles for OS197 Type / OS200 TCs

[ ]

Load Seq. No.	[ ]
1(1)	10
2(1)	10
3(1)	10
4	39.4
5	16.4
6(2)	42.2, -26.4
7	16.4
Max Range:	**68.6**

Notes:

[ ]

2. The stress range in sequence 6 corresponds to ±1g loads from sudden start and stop of the trailer during transfer, offset by the cask deadweight stress.

From the table above, there are only two significant load fluctuation cycles (for load sequences 4 and 6) per DSC use. The maximum total range of mechanical load fluctuations for these normal use cycles is 68.6 ksi. [ ].

<u>OS197 Type and OS200 TCs</u>

From Figure I-9.2.1 and Table I-9.1of Appendix I of [3B.4.2 and 3B.4.3]:

Subscript	N (cycles)	S (ksi)
i	2000	97
x	[	]
j	5000	76

As the table shows, [ ], and is above the maximum mechanical load stress range of 68.6 ksi from before. Even at 5,000 cycles, this is true.

Standardized Transfer Cask

For the Standardized TC, a mechanical load stress excursion is significant if its value exceeds 12.5 ksi (S_a for the SA-516 Gr. 70 material at 10^6 cycles). Due to this relatively low stress threshold value for significance, and from a review of the mechanical load stresses, a partially loaded lift cycle, a fully loaded lift cycle, a transfer condition cycle, and an HSM insertion cycle are considered. This gives a total of four significant mechanical load cycles per use for the Standardized TC. [

].

From Figure I-9.1 (UTS < 80 ksi) and Table I-9.1 of Appendix I of [3B.4.3]:

Subscript	N (cycles)	S (ksi)
i	5000	48
x	[	]
j	10000	38

As the table shows, [

].

Trunnions (OS197 Type TCs, OS200 TCs, Standardized TC)

For the trunnions themselves, based on a review of the structural analysis calculations, stress values are much lower than those in the TC structural shell near the lower trunnions and are not controlling.

Therefore, the sixth criterion is satisfied for the TCs.

3B.3 Conclusions

The evaluation demonstrates that the six criteria (a) through (f) contained in NC-3219.2 are satisfied for all components of the TCs, as listed in Table 3B-1 and Table 3B-2. ASME Code criteria listed in NC-3219.2 were evaluated, based on 1,440 TC use cycles (over a period of 60 years), to demonstrate that there is no need for a fatigue analysis of the OS197 Type TCs, OS200 TC and the Standardized TC.

3B.4 References

3B.4.1 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3B.4.2 ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1998 Edition through 2000 Addenda.

3B.4.3 ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1983 Edition through 1985 Addenda.

Table 3B-1
OS197 Types and OS200 TC Material Specifications

Components	Material Specifications
Structural Shell (includes flanges)	SA-240 Type 304
Inner Liner Plate	SA-240 Type 304
Top Cover Plate	SA-240 Type 304
Bottom End Plate	SA-240 Type 304
Upper Trunnion & Sleeve	SA-182 Type F304
Trunnion Insert Plate	SA-240 Type 304
Upper Trunnion Pad	SA-240 Type 304
Lower Trunnion Sleeve	SA-182 Type F304N
One-Piece Upper Trunnion	SA-182 Type FXM-19
One-Piece Lower Trunnion	SA-182 Type F304N

Table 3B-2
Standardized TC Material Specifications

Components	Material Specifications
Structural Shell (includes flanges)	SA-516 Gr. 70
Inner Liner Plate and SS Trunnion Plate	SA-240 Type 304
Top Cover Plate	SA-516 Gr. 70
Bottom End Plate	SA-240 Type 304
Upper Trunnion Sleeve	SA-533 Gr. B, Cl. 2 or SA-508 Cl. 3A
Upper Trunnion	SA-564 Gr. 630 PH
Trunnion Insert Plate	SA-516 Gr. 70
Lower Trunnion Sleeve	SA-516 Gr. 70 or SA-508 Cl. 3A
Lower Trunnion	SA-479 Type 304

Table 3B-3
OS197 Types and OS200 TC Material Properties at 400 °F

Material[1]	S_a(psi)[2]	S_u(psi)	E(psi)	α_{inst} (in/in/°F)
SA-240 Type 304	28300	64000	26.5E+06	10.2E-06
SA-182 F304N	28300	73200	26.5E+06	10.2E-06
SA-182 Type FXM-19	28300	91100	26.5E+06	9.2E-06

Notes:

1. Properties are bounding values from different Code years [3B.4.2, 3B.4.3].
2. Sa at 1E6 cycles from Code design fatigue curves.

Table 3B-4
Standardized TC Material Properties at 400 °F

Material	S_a(psi)[1]	S_u(psi)	E(psi)	α_{inst} (in/in/°F)
SA-240 Type 304 SA-479 Type 304	28300	64400	26.5E+06	9.80E-06
SA-516 Gr. 70	12500	70000	27.7E+06	7.60E-06
SA-564 Gr. 630 PH	20000	141000	26.5E+06	5.91E-06
SA-533 Gr. B, Cl. 2	14643[2]	90000	27.4E+06	8.01E-06
SA-508 Cl. 3A	14643[2]	90000	26.1E+06	7.66E-06

Notes:

1. Sa at 1E6 cycles from Code design fatigue curves.
2. For 90 ksi steel, interpolated Sa value between 80 ksi steel and 115 ksi steel Sa values.

APPENDIX 3C
Horizontal Storage Module Concrete and Dry Shielded Canister Steel Support Structure Thermal Fatigue, Corrosion, and Temperature Effects Evaluation

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3C.1 Summary Description

This appendix evaluates time-dependent aging mechanisms associated with potential degradation of the HSM component. The HSMs subject to these evaluations are the HSM Models 80 and 102, HSM Model 152, and HSM-H (HSM-HS and HSM Model 202). The HSM-HS and HSM Model 202 are the same as the HSM-H for purposes of these evaluations. The evaluations presented herein are bounding for the six HSM types. All the storage modules are identified as HSM in these evaluations unless the specific HSM type is noted.

The effect of radiation on the HSM materials is evaluated in Appendix 3E for a service life of [ ]. The evaluation concludes that there are no adverse effects on the HSM structure due to neutron fluence or gamma radiation over the period of extended operation.

The HSM is evaluated for sustained elevated temperature effects, thermal fatigue, and corrosion of the reinforcing steel.

The DSC support structure is evaluated for the effects of corrosion and thermal fatigue. The sliding surfaces of the DSC support structure are fabricated from NITRONIC® 60 austenitic stainless steel, which is coated with a dry film lubricant to minimize friction during insertion and retrieval of the DSC. The effect of radiation is evaluated for the lubricant.

The heat shields are designed to limit concrete temperature to within acceptable limits. The heat shields are evaluated for corrosion effects.

3C.2 Analysis

Concrete HSM Elevated Temperature Effects Evaluation

The maximum predicted temperatures in the horizontal storage module (HSM) concrete at the beginning of storage for each HSM are shown in Table 3C-1. The controlling maximum temperatures of 290 °F and 294 °F for normal and off-normal conditions, respectively, are below the temperature limit of 300 °F per Section 3.0 of [3C.4.1] and Section 3.5.1.2 (i)(2)(b) of [3C.4.2], subject to meeting certain requirements for the aggregates, as specified in the noted sections of [3C.4.1] and [3C.4.2].

Under normal storage conditions, the concrete temperature in the HSM concrete reaches a maximum at the beginning of storage and will experience a gradual decrease over the service life of the HSM, with only daily or seasonal fluctuations due to the prevalent ambient conditions. Appendix 3G evaluates the thermal performance of HSM Models 80 and 102, and HSM Model 152 loaded with a 32PT DSC with heat loads that range from 2 kW to 22 kW, and the HSM-H loaded with a 32PTH1 DSC with heat loads that range from 2 kW to 32 kW. The table below summarizes the maximum concrete temperatures for each of the HSM types corresponding to Figure 3G-8 of Appendix 3G. After 20 years of storage, there is a further but slower rate of decrease. Hence, the heating effect on the concrete, for the 40 years renewal period, will be much less severe than the initial 20 years of service. Maximum long-term concrete temperatures are below or trend towards the long-term ACI 349 Code [3C.4.3] limits of 150 °F over the period of extended operation. Furthermore, the compressive strength of concrete increases with age. Therefore, degradation due to elevated temperature is not an aging effect requiring management.

Estimated HSM Concrete Maximum Temperatures at 20, 40, and 60 Years of Storage

Storage Time (Years)	HSM Models 80/102 (°F)	HSM Model 152 (°F)	HSM-H (°F)
20			
40			
60			

HSM Reinforced Concrete Fatigue Considerations

The only source of thermal fatigue is daily and seasonal/yearly environmental temperature fluctuations. The maximum average daily fluctuation is 45 °F per Paragraph 8.2.10.5 of [3C.4.4]. The high thermal mass of the HSM and low conductivity of the concrete material limit the magnitude of the thermal forces that could be developed due to this temperature difference. Also, sections are assumed cracked under thermal loads with the reinforcing steel carrying the tension loads.

A bounding thermal fatigue evaluation is performed by considering the maximum bending moment range caused by temperature fluctuations in the thermal analyses of the HSM. [

]. Therefore, thermal fatigue is not an aging effect requiring management for the HSM.

<u>Reinforcing Bar Corrosion Considerations</u>

The HSMs installed on the independent spent fuel storage installation (ISFSI) pad are placed contiguous to each other, either in contact (as for the HSM Model 152 and HSM-H) or separated by a 6-inch gap (as for the HSM Models 80 and 102). In each case, thick (2 feet thick for HSM 80/102; 3 feet thick for HSM-H/HSM 152) “end shield walls” are installed at both ends of the HSM array as well as at the back of the HSMs (“rear shield walls”) if the array consists of a single row of HSMs. These shield walls provide environmental protection to the HSMs proper. Thus, only the external surface of the roof and the front wall are directly exposed to ambient weather conditions. These are very thick components (roof thickness ranges from 3 feet for the HSM Models 80 and 102 to 5 feet for the HSM Model 152; front wall thickness ranges from 2.5 feet for the HSM Models 80 and 102 to 4.5 feet for the HSM-H),which are governed by shielding considerations. [

]. Both of these features mitigate cracking and, thus, provide enhanced corrosion protection.

The HSM concrete mix design is in accordance with Section 4.3 of ACI 318-83 (or Section 5.3 of ACI 318-95) [3C.4.6]. AREVA Inc. specifications place controls on the chloride content [

], air content, cement types [ ], aggregates, and admixtures. These stringent requirements ensure good-quality concrete that is resistant to chemical attack, and together with adequate concrete cover makes the reinforcing steel not susceptible to corrosion. Based on Table 4.10 of [3C.4.7], for a water-cement ratio of 0.50 and a rebar cover of 1 inch, the expected time to corrosion is in the order of 100 years.

Even though environmental degradation of the HSM concrete due to rebar corrosion is not expected to occur, corrosion of rebar is considered an aging effect requiring management for the HSM.

DSC Steel Support Structure Corrosion Evaluation

The materials of construction of the DSC steel support structure for the various HSMs are summarized in Table 3C-2. Paint is applied to the steel surfaces of the DSC support structure except for the Nitronic® 60 plates and the surfaces of slip critical joints. In accordance with AREVA Inc. specifications, a coat of inorganic zinc-rich primer is first applied on the surface of the steel. Then a finish coat of high build epoxy enamel is applied on top for additional protection. These coating systems have excellent adhesion to steel and excellent resistance to alkalies and are intended to provide protection for the steel against corrosion in the harshest environments.

[

]. This is a negligible reduction in the steel thickness; any increase in stress due to thickness reduction is compensated by the fact that the temperature of the support steel decreases over time. The reduction in temperature causes a reduction in the thermal stress and an increase in the allowable stresses. Nevertheless, coating integrity and loss of material due to corrosion of carbon steel are considered aging effects requiring management for the HSM.

[ ]

For HSM Model 152, the DSC support steel is made of stainless steel. Type 304 stainless steel has excellent general corrosion resistance in a wide range of atmospheric environments and many corrosive media. The corrosion resistance is provided by the 18% minimum chromium content. Loss of material due to localized corrosion of the stainless steel is an aging effect requiring management for the HSM.

Steel DSC Support Structure Thermal Fatigue

The only source of thermal fatigue is due to daily environmental temperature fluctuations. The DSC steel support structure is located inside the HSM in an interior-like sheltered environment where the thermal fluctuations due to external ambient temperature fluctuations are significantly dampened due to HSM enclosure walls and roof, and the DSC decay heat. Thermal cycling fatigue due to fluctuations in the ambient conditions is not considered an aging effect requiring management for the DSC steel support structure.

Heat Shield Evaluation

The HSM heat shields are fabricated from carbon steel, aluminum, or stainless steel (See Table 3C-3). The stainless steel and aluminum heat shields have excellent corrosion resistance in a wide range of atmospheric environments and many corrosive media. The carbon steel heat shields are hot-dip galvanized. Hot-dip galvanizing is performed in accordance with the requirements of ASTM A123 [3C.4.10] with a minimum thickness of [ ] mils.

Estimation of the corrosion life of galvanized steels has traditionally been determined through the use of generalized charts of coating thickness versus service life for different types of environments (rural, suburban, marine, industrial) such as those presented in Figure 7 of [3C.4.11]. Per [3C.4.11], for a marine environment, which is bounding for the more corrosive coastal locations of the HSMs, the time for first maintenance is about 75 years. Time to first maintenance is defined as 5% rusting of the base steel surface, which means 95% of the zinc coating is still intact, and an initial maintenance is recommended to extend the life of the structure. Nevertheless, loss of material due to general corrosion of the carbon steel heat shield and crevice and pitting corrosion of stainless steel and aluminum heat shields is an aging effect requiring management.

DSC Support Rail Lubricant

Dry [ ] lubricants are suitable for very high and cryogenic temperature applications. The lubricant is not affected by water and is designed to be highly resistant to aggressive chemicals. The effect of radiation on these lubricants is not specified, but it is expected that radiation effects are minimal since the lubricant material is inorganic and consists entirely of [ ].

3C.3 Conclusions

This time-limited aging analysis evaluated the effects of temperature, thermal cycling fatigue, and corrosion on the HSM components. The evaluation conclusions are as follows:

- Degradation due to elevated temperature is not an aging effect requiring management for the HSM concrete. The long-term temperatures corresponding to maximum design basis heat loads trend toward the allowed long-term temperature limits of the ACI 349 Code.
- Thermal fatigue is not an aging effect requiring management for the HSM concrete. A fatigue usage factor of 0.25 due to daily and seasonal temperature fluctuations is conservatively calculated. Thermal cycling fatigue is not considered an aging effect requiring management.
- Even though environmental degradation of the HSM concrete due to rebar corrosion is not expected to occur, corrosion of rebar is considered an aging effect requiring management for the HSM concrete.
- Loss of material due to general corrosion of carbon steel and crevice and pitting corrosion of stainless steel DSC steel support structure is considered an aging effect requiring management for the HSM DSC steel support structure.
- Loss of material due to general corrosion of the carbon steel heat shield and crevice and pitting corrosion of stainless steel and aluminum heat shields is an aging effect requiring management.

3C.4 References

3C.4.1 Safety Evaluation Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, U.S. NRC, December 1994.

3C.4.2 NUREG-1536, Revision 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility," Final Report, July 2010.

3C.4.3 ACI 349-85 or ACI 349-97, "Nuclear Safety Related Concrete Structures."

3C.4.4 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3C.4.5 ACI 215R-74, Considerations for Design of Concrete Structures Subjected to Fatigue Loading," Revised 1992, Reapproved 1997.

3C.4.6 ACI 318-83 or ACI 318-95, "Building Code Requirements for Reinforced Concrete."

3C.4.7 Oak Ridge National Laboratory, "Primer on Durability of Nuclear Power Plant Reinforced Concrete Structures - A Review of Pertinent Factors," NUREG/CR-6927, February 2007.

3C.4.8 P. Albrecht and T.T. Hall Jr., "Atmospheric Corrosion Resistance of Structural Steels," Journal of Materials in Civil Engineering, January/February 2003.

3C.4.9 Amendment 13 to CoC 1004 Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System.

3C.4.10 ASTM Standard Specification A123/A123M-02. Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

3C.4.11 American Galvanizers Association, Hot-Dip Galvanizing for Corrosion Protection - A Specifier's Guide, 2012.

Table 3C-1
Maximum Concrete Temperature at the Beginning of Storage

HSM Model	Allowed DSC Types	Max. Normal (°F)	Max. Off-Normal (°F)	Max. Accident (°F)	References
HSM Model 80	24P/52B/24PT2/61BT/32PT/ 61BTH Type 1	201	241	479(2)	Table 8.1-24 [3C.4.4]
HSM Model 102	24P/52B/24PT2/61BT/32PT/24PHB/ 24PTH-S-LC/61BTH Type 1	201	241	479(2)	Table 8.1-24 [3C.4.4]
HSM Model 152	24P/52B/24PT2/61BT/32PT/24PHB/ 61BTH Type 1	221	234	397	Table R.4-2 [3C.4.4]
HSM Model 202	24P/52B/24PT2/61BT/32PT/24PHB/ 24PTH-S-LC/61BTH Type 1	N/A(1)	243	381	Table V.4-2 [3C.4.4]
HSM-H	24PTH/24PTH-S-LC/32PTH1/ 61BTH Type 1/ 61BTH Type 2/37PTH/69BTH	290	294	465	Tables U.4-2, U.4-3 [3C.4.4]
HSM-HS	61BT/32PT/24PTH/24PTH-S-LC/ 32PTH1/61BTH Type 1/ 61BTH Type 2/37PTH/69BTH	290	294	465	Tables U.4-2, U.4-3 [3C.4.4]

Notes:

1. Bounded by off-normal.
2. The max accident temperature results for HSM Models80 and 102 are for 120 hours of blocked-vent conditions. As discussed in Section 8.2.7.2 of [3C.4.4], the actual required duration of the blocked vent accident transient is only 40 hours, and the HSM Models 80/102 does satisfy the temperature limits at 40 hours, as shown in Figure 8.2-16 of [3C.4.4].

Table 3C-2
DSC Support Structure Material

HSM Models	DSC Support Structure Material
HSM Model 80	Carbon Steel
HSM Model 102	Carbon Steel
HSM Model 152	Stainless Steel
HSM Model 202	Carbon Steel
HSM-H	Carbon Steel
HSM-HS	Carbon Steel

Table 3C-3
Heat Shield Material

HSM Models	Heat Shield Material
HSM Model 80	Carbon Steel (Galvanized)
HSM Model 102	Carbon Steel (Galvanized)
HSM Model 152	Stainless Steel
HSM Model 202	Stainless Steel
	Aluminum
	Aluminum (Anodized)
HSM-H	Stainless Steel
	Aluminum
	Aluminum (Anodized)
HSM-HS	Stainless Steel

APPENDIX 3D
Dry Shielded Canister Poison Plates Boron Depletion Evaluation

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3D.1 Summary Description

This analysis is performed to document the time-limited aging analysis (TLAA) in support of the aging management review (AMR) on poison plates. Although the proposed renewal period for Certificate of Compliance (CoC) 1004 is 40 years, the TLAA is defined over the 20-year initial license and additional 80 years. The analysis determines the total B-10 depletion incurred by the poison plates over the course of [ ] of storage.

3D.2 Analysis

For this evaluation, an MCNP5 [3D.5.1] model of a bounding fuel assembly (FA) and basket compartment is employed. Because the reaction of interest is B-10 depletion in dry (unmoderated) conditions, either boiling water reactor (BWR) or pressurized water reactor (PWR) fuel could be used. Table 3D.1 shows that the 24PTH DSC has the highest per assembly neutron source reported in the UFSAR [3D.5.2] among all PWR DSC models. The corresponding design basis fuel in the UFSAR is the B&W 15x15 Mark B. Therefore, selecting the design basis PWR fuel with the bounding source term ensures that poison plates in BWR fuel storage DSCs with smaller neutron sources are addressed. [ ], the selected [ ] and neutron source combination will far outweigh the B-10 depletion that takes place in the 52B, since the source term of the 24PTH is 10 times that of the 52B as shown in Table 3D-1.

For this analysis, the complete DSC is not modeled. Instead, a single basket compartment that contains a fuel assembly with compartment dimensions of the 24PTH basket is modeled. A B&W 15x15 FA model is surrounded by a [ ]. The stainless steel compartment is surrounded by aluminum that is [ ] thick with a poison plate modeled on one face of the compartment, as illustrated in Figure 3D-1. [ ]. Reflective boundary conditions are specified on all four sides. The poison plate resulting in the most B-10 depletion is selected for further evaluation. Then the stainless steel compartment and aluminum thickness are varied to determine whether additional depletion occurs. A case with a [ ]. stainless steel compartment wall and no aluminum is also evaluated. All the combinations evaluated represent the various basket-poison configurations encountered in CoC 1004. The results presented also address the utilization of poison rod assemblies (PRAs) in the 32PT DSC by demonstrating that minimal depletion occurs with the irradiation of poison plates.

3D.3 Results

The results in Table 3D-2 present B-10 depletion in poison plates (per unit volume), during [ ] of storage. A negligible amount (not more than 0.001%) of B-10 is depleted over [ ]. Additionally, for a given areal density of B-10, the depletion increases with decreasing poison plate thickness. The thickness of [ ] corresponds to the minimum thickness poison plate specification for the Standardized NUHOMS® System components in [3D.5.3]. Since credit is not taken for poison plate in the 24PT2 and the 52B borated stainless steel thickness is more than the evaluated thickness, the depletion results are bounding. Based on this result, the B-10 concentration in the PRAs is also expected to deplete minimally.

3D.4 Conclusions

The TLAA determines the amount of B-10 depleted in the poison plates due to neutron irradiation during [ ] of storage. Although the license renewal period is 40 years, this evaluation takes into account the initial 20 years and an additional 80 years of storage for a total of [ ]. The evaluation considers a bounding neutron irradiation rate with the least amount of B-10 content available in poison plates and computes the reaction rate density. Compared to the initial amount of B-10 available, analyses indicate that more than 99.999% of B-10 remains in the poison plates after [ ] of irradiation. This TLAA demonstrates the ability of the poison plates and PRAs to maintain sub-criticality over the desired duration of storage.

3D.5 References

3D.5.1 MCNP/MCNPX – "Monte Carlo N-Particle Transport Code System Including MCNP5 1.40 and MCNPX 2.5.0 and Data Libraries," CCC-730, Oak Ridge National Laboratory, RSICC Computer Code Collection, January 2006.

3D.5.2 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3D.5.3 Amendment Number 13 to CoC 1004, Technical Specification for the Standardized NUHOMS® Horizontal Modular Storage System, Docket 72-1004, Effective May 24, 2014.

Table 3D-1
Survey of DSC Source Term and Poison Plate Characteristics

DSC ID	Maximum Neutron Source (n/s/assembly)	Minimum B-10 Content
24P	2.23E+08	no poison plate
24PT2	2.23E+08	Credit for poison not taken
52B	1.83E+08	0.00318 g/cm^2
61BT	1.43E+08	0.0190 g/cm^2
32PT	3.89E+08	0.0063 g/cm^2
24PHB	9.65E+08	no poison plate
24PTH	**1.67E+09**	0.0063 g/cm^2
61BTH	8.58E+08	0.0190 g/cm^2
32PTH1	1.48E+09	0.0063 g/cm^2
69BTH	8.58E+08	0.0189 g/cm^2
37PTH	1.20E+09	0.0180 g/cm^2

Note: Minimum boron content and neutron source obtained from [3D.5.2].

Table 3D-2
Boron-10 Depletion Results

B-10 Areal Density (g/cm^2)	Poison Plate Thickness (inches)	Initial B-10 Number Density (#/barn-cm)	Basket Component Variations	Depleted Amount (#/barn-cm)	Percentage B-10 Remaining
				5.321E-12	99.999
				2.031E-12	99.999
				5.437E-13	99.999
				5.501E-12	99.999
				5.390E-12	99.999
				5.696E-12	99.999
				6.002E-12	99.999

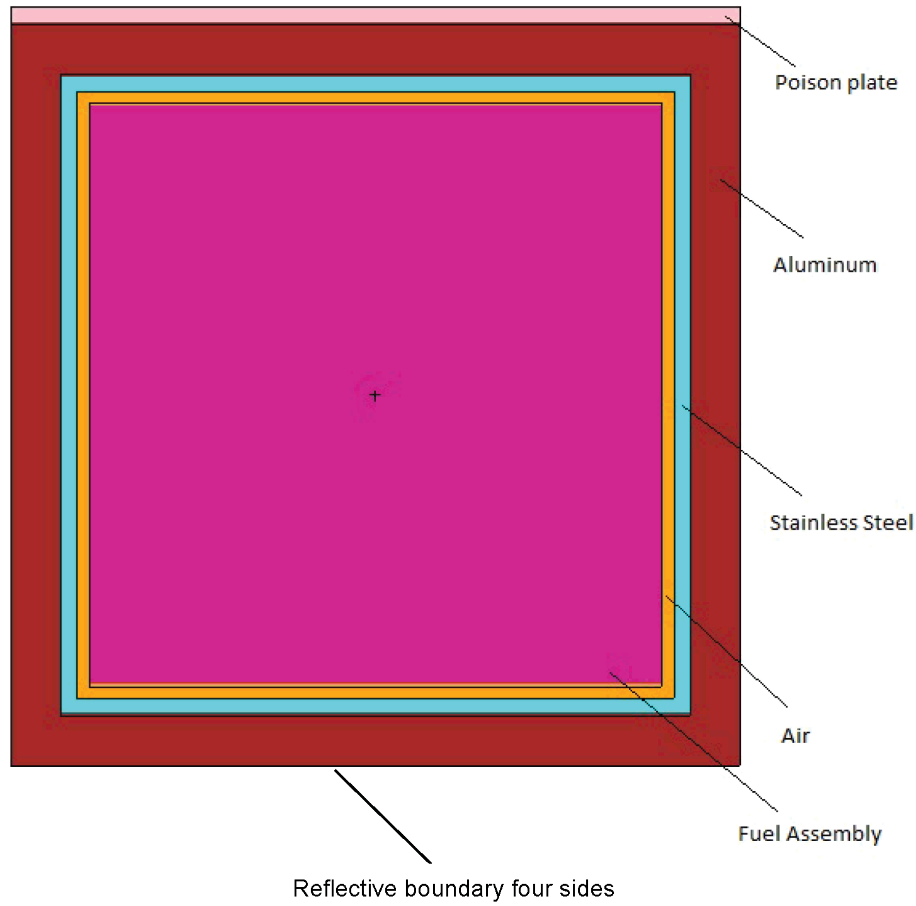

Figure 3D-1
Basket Configuration

APPENDIX 3E
Evaluation of Neutron Fluence and Gamma Radiation on Storage System Structural Materials

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3E.1 Summary Description

This time-limited aging analysis (TLAA) evaluates the effects of neutron fluence and gamma radiation on the mechanical properties of dry shielded canister (DSC) and horizontal storage module (HSM) materials of the Standardized NUHOMS® System.

Irradiation embrittlement can lead to a decrease in fracture toughness of steel materials. Available data indicate that the effects on the mechanical properties of steel are discernable at fluence levels above $1x10^{18}$ neutrons/cm^2 [3E.5.2, 3E.5.5]. Irradiation in the form of neutrons or gamma rays can affect the concrete and reinforcing steel properties. Based on the experimental data presented in ACI SP 55-10 [3E.5.4] concrete experiences a reduction in compressive and tensile strength at neutron fluence exposure levels greater than 10^{19} neutrons/cm^2. A threshold value for gamma radiation levels at which a reduction in compressive and tensile strength was observed is on the order of 10^{10} rads. A threshold level of neutron fluence of 1×10^{18} neutrons/cm^2 has been cited as criteria for alteration of reinforcing steel mechanical properties per [3E.5.2].

Aluminum 6061 material is used for the transition rails of certain DSCs (e.g., 24PTH). These rails form the transition between the rectangular geometry of the basket and the cylindrically shaped shell and, structurally, are typically under compression. Aluminum alloys such as 6061 have minimum neutron absorption rate and their low density results in minimum gamma heating and thus, they are capable of withstanding very high neutron exposures in plant reactor environments (e.g., spent fuel storage racks). Threshold levels for aluminum 6061 are expected to be higher than those for steel.

This TLAA presents the accumulated neutron flux and gamma energy deposition over a period of extended operation of [ ] (for a total service life of [ ]).

3E.2 Analysis

As discussed in Chapter 1, there are eleven DSC types and six HSM models within the scope of CoC 1004 renewal. Table 3.6-1 of Chapter 3 summarizes the possible configurations of the various DSC types that are allowed for storage in each of the HSM models.

Bounding Monte Carlo N-Particle (MCNP) [3E.5.1] models are developed in order to envelop all possible geometry configurations of a DSC stored inside the HSM internal cavity. Two bounding MCNP HSM models are developed: one housing a DSC with source terms associated with pressurized water reactor (PWR) fuel assemblies (FAs) , and another housing a DSC with boiling water reactor (BWR) FAs. These bounding models are conservatively developed with essentially no gap between the DSC and surrounding HSM concrete walls and roof surfaces (0.1 cm is used for modeling purposes) in order to maximize the neutron fluence and gamma energy deposition. Additionally, the heat shields, which are installed for thermal protection of the HSM concrete, are conservatively ignored.

The two MCNP models incorporate the 32PTH1 DSC and the 69BTH DSC, storing 32 PWR and 69 BWR spent fuel assemblies (SFAs), respectively. Each DSC MCNP model incorporates the DSC shell assembly and the internal basket assembly and is developed based on the shielding analyses models documented in the Updated Final Safety Analysis Report (UFSAR) [3E.5.3].

Since the purpose of this calculation is only to determine the bounding neutron fluence and gamma heating levels, the HSM is simply modeled as a 1 foot thick cylindrical concrete shell. Both the front end and back end walls of the HSM are also modeled as 1 foot thick. This pseudo model of the HSM housing a DSC is illustrated in Figure 3E-1 and Figure 3E-2.

[

]. The BWR source is based on General Electric (GE) 7×7 fuel with 0.198 MTU and the PWR source is based on Babcock and Wilcox (B&W) 15×15 fuel with 0.490 MTU. The SAS2 module in SCALE [3E.5.6] is used to generate the source terms using the active fuel input from Appendices Y.5 (69BTH) and Z.5 (37PTH) of the UFSAR [3E.5.3].

The source terms are listed in Tables 3E-1 and 3E-2. Comparison with the UFSAR source terms in Table 3E-3 demonstrates their conservatism. No heat load zoning configuration for the canisters is applied in the models. That is, all FAs have an initial source greater than the design basis source corresponding to the hottest fuel in the zoned loading configurations.

Because the 37PTH and 69BTH DSCs hold the most FAs, these two DSCs present the bounding total source. However, the aluminum rail in 37PTH DSC reduces gamma exposure in the HSM compared to the 32PTH1, and therefore in this evaluation, the 32PTH1 is modeled for the PWR case. Calculated neutron and gamma exposures for the 32PTH1 are scaled by the 37/32 to account for the 37PTH.

3E.3 Results

The stainless steel compartment located at center of the basket is expected to have the maximum neutron flux. The mesh tally applied to the center compartment is located at one side due to symmetry. The mesh tallies on the stainless steel of the center basket compartments of 32PTH1 and 69BTH are illustrated in Figure 3E-3 and Figure 3E-4, respectively.

Neutron fluence levels are calculated at the basket center compartments and at the DSC shell. Neutron fluence and gamma exposure levels are calculated at the concrete surfaces of the pseudo HSM model and correspond to the concrete inside the HSM cavity. [

]. The neutron fluence in the DSC top and bottom shield plug is less than in the DSC shell and basket compartments.

[ ]

[

]. The maximum gamma exposure in the front and back ends of the HSM is significantly less than the maximum gamma heating value at the side due to the DSC shielding plugs.

3E.4 Conclusions

The neutron fluence and gamma dose after [ ] of storage has been calculated for the DSC basket, shell, and HSM concrete using bounding source terms and a conservative model of the DSC and HSM. [ ]. These are well below the 10^{18} n/cm^2 threshold for embrittlement of the basket structure, the DSC shell, or the reinforcing steel in the concrete. The maximum gamma dose at the inside surface of the concrete is [ ], below the 10^{10} rad threshold for damage to the concrete.

Therefore, radiation damage is not an aging mechanism that requires an aging management program.

3E.5 References

3E.5.1 MCNP/MCNPX – “Monte Carlo N-Particle Transport Code System Including MCNP5 1.40 and MCNPX 2.5.0 and Data Libraries,” CCC-730, Oak Ridge National Laboratory, RSICC Computer Code Collection, January 2006.

3E.5.2 Oak Ridge National Laboratory, “Primer on Durability of Nuclear Power Plant Reinforced Concrete Structures - A Review of Pertinent Factors,” NUREG/CR-6927, February 2007.

3E.5.3 AREVA Inc. Document NUH003.0103, “Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel,” Revision 14, September 2014.

3E.5.4 H.K. Hilsdorf et al., “The Effects of Nuclear Radiation on the Mechanical Properties of Concrete, ACI SP-55, Douglas McHenry International Symposium on Concrete and Concrete Structures,” American Concrete Institute, Farmington Hills, Michigan, 1978.

3E.5.5 Electric Power Research Institute, “Plant Support Engineering: Aging Effects for Structures and Structural Components (Structural Tools),” Report No. 1015078, Final Report, December 2007.

3E.5.6 Oak Ridge National Laboratory, RSICC Computer Code Collection, “SCALE 5.0: Modular Code System for Performing Standardized Computer Analysis for Licensing Evaluations for Workstations and Personal Computers,” Oak Ridge National Laboratory, Radiation Shielding Information Center Code Package CCC-725, June 2004.

Table 3E-1
PWR Source Terms

Burn-up (GWD/MTU)		62	62	62	62	62	62	62	62	62	62
U235 initial Enrichment (%)		3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Discharged Time (Years)		3	5	7	10	15	20	30	40	50	75
Energy Group #	Upper Limit Energy (MeV)	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group	Gamma Source (g/s) per group
18	0.005	5.4076E+15	2.3713E+15	1.6131E+15	1.2929E+15	1.0875E+15	9.4957E+14	7.4044E+14	5.8380E+14	4.6320E+14	2.6555E+14
17	0.010	1.6965E+15	6.7587E+14	4.3239E+14	3.4248E+14	2.9412E+14	2.6189E+14	2.1160E+14	1.7292E+14	1.4252E+14	9.1427E+13
16	0.20	1.5486E+15	5.6433E+14	3.3826E+14	2.5487E+14	2.0723E+14	1.7599E+14	1.3115E+14	9.9994E+13	7.7226E+13	4.1648E+13
15	0.30	4.2581E+14	1.6002E+14	9.6879E+13	7.3965E+13	6.1616E+13	5.3234E+13	4.0505E+13	3.1252E+13	2.4321E+13	1.3288E+13
14	0.40	3.2344E+14	1.1294E+14	6.3869E+13	4.7352E+13	3.9899E+13	3.5018E+13	2.7245E+13	2.1265E+13	1.6620E+13	9.0074E+12
13	0.60	3.6882E+15	1.6732E+15	8.1944E+14	3.1140E+14	8.3372E+13	3.7140E+13	2.0304E+13	1.4930E+13	1.1364E+13	5.9839E+12
12	0.80	6.1976E+15	4.2648E+15	3.3201E+15	2.6330E+15	2.1373E+15	1.8620E+15	1.4653E+15	1.1604E+15	9.1999E+14	5.1571E+14
11	1.00	1.4079E+15	7.1748E+14	3.8104E+14	1.5917E+14	4.9483E+13	2.3375E+13	1.0217E+13	5.6762E+12	3.4562E+12	1.3542E+12
10	1.33	6.4781E+14	4.3119E+14	3.1530E+14	2.1173E+14	1.1684E+14	6.7067E+13	2.3984E+13	9.5787E+12	4.3213E+12	1.0077E+12
9	1.66	2.2392E+14	1.3319E+14	8.8327E+13	5.2717E+13	2.5452E+13	1.3323E+13	4.1036E+12	1.4480E+12	6.1008E+11	1.5660E+11
8	2.00	1.0113E+13	2.5530E+12	7.2369E+11	1.9193E+11	1.0508E+11	9.0119E+10	6.9610E+10	5.4065E+10	4.2104E+10	2.2659E+10
7	2.50	2.4559E+13	4.6486E+12	9.1753E+11	9.2290E+10	7.8072E+09	4.9806E+09	3.7020E+09	2.8483E+09	2.2103E+09	1.1855E+09
6	3.00	7.5649E+11	1.9224E+11	4.9214E+10	6.6992E+09	6.1887E+08	3.9630E+08	3.3583E+08	2.8985E+08	2.5255E+08	1.8529E+08
5	4.00	6.9687E+10	1.7943E+10	4.6974E+09	7.2047E+08	1.2853E+08	9.1052E+07	6.2383E+07	4.3285E+07	3.0263E+07	1.3060E+07
4	5.00	5.8582E+07	5.3998E+07	4.9932E+07	4.4490E+07	3.6813E+07	3.0520E+07	2.1058E+07	1.4611E+07	1.0214E+07	4.4063E+06
3	6.50	2.3512E+07	2.1673E+07	2.0040E+07	1.7856E+07	1.4775E+07	1.2249E+07	8.4511E+06	5.8632E+06	4.0985E+06	1.7676E+06
2	8.00	4.6127E+06	4.2518E+06	3.9315E+06	3.5030E+06	2.8985E+06	2.4029E+06	1.6578E+06	1.1501E+06	8.0389E+05	3.4660E+05
1	10.00	9.7941E+05	9.0277E+05	8.3477E+05	7.4379E+05	6.1542E+05	5.1019E+05	3.5198E+05	2.4418E+05	1.7067E+05	7.3568E+04
Total (γ/FA·s)		2.1603E+16	1.1112E+16	7.4703E+15	5.3799E+15	4.1030E+15	3.4787E+15	2.6749E+15	2.1014E+15	1.6637E+15	9.4515E+14
Total (γ/DSC·s)[1]		6.9130E+17	3.5558E+17	2.3905E+17	1.7216E+17	1.3130E+17	1.1132E+17	8.5597E+16	6.7245E+16	5.3238E+16	3.0245E+16
Raw neutron (n/FA·s)		1.7030E+09	1.5670E+09	1.4480E+09	1.2890E+09	1.0660E+09	8.8450E+08	6.1150E+08	4.2580E+08	2.9920E+08	1.3210E+08
Scaled neutron (n/FA·s)		4.2575E+09	3.9175E+09	3.6200E+09	3.2225E+09	2.6650E+09	2.2113E+09	1.5288E+09	1.0645E+09	7.4800E+08	3.3025E+08

Note:

1) DSC refers to the 32PTH1 DSC.

Table 3E-2
BWR Source Terms

Table 3E-3
FSAR Source Terms

PWR									
DSC Type	Neutron Intensity n/(s*FA)	FA Load Capacity FA/DSC	Total Neutron Intensity n/(s*DSC)	UFSAR Source	DSC Type	Gamma Intensity γ/(s*FA)	FA Load Capacity FA/DSC	Total Gamma Intensity γ/(s*DSC)	UFSAR Source
24P	2.23E+08	24	5.35E+09	Table 3.1-1	24P	7.45E+15	24	1.79E+17	Table 3.1-1
24PT2	2.23E+08	24	5.35E+09	Appendix L.5	24PT2	7.45E+15	24	1.79E+17	Appendix L.5
32PT	3.89E+08	32	1.24E+10	Table M.5-14	32PT	2.12E+15	32	6.80E+16	Table M.5-9
24PHB	9.65E+08	24	2.32E+10	Table N.5-13	24PHB	7.23E+15	24	1.74E+17	Table N.5-10
24PTH	1.67E+09	24	4.01E+10	Table P.5-9	24PTH	9.62E+15	24	2.31E+17	Table P.5-9
32PTH1	1.48E+09	32	4.74E+10	Table U.5-8	32PTH1	6.68E+15	32	2.14E+17	Table U.5-8
37PTH	1.20E+09	37	4.44E+10	Table Z.5-12	37PTH	4.80E+15	37	1.78E+17	Table Z.5-12
Max	1.67E+09		4.74E+10		Max	9.62E+15		2.31E+17	
BWR									
DSC Type	Neutron Intensity n/(s*FA)	FA Load Capacity FA/DSC	Total Neutron Intensity n/(s*DSC)	UFSAR Source	DSC Type	Gamma Intensity γ/(s*FA)	FA Load Capacity FA/DSC	Total Gamma Intensity γ/(s*DSC)	UFSAR Source
52B	1.01E+08	52	5.25E+09	Table 3.1-2	52B	2.63E+15	52	1.37E+17	Table 3.1-2
61BT	1.43E+08	61	8.72E+09	Table K.5-12	61BT	1.83E+15	61	1.11E+17	Table K.5-8
61BTH	8.58E+08	61	5.23E+10	Table T.5-12	61BTH	3.19E+15	61	1.94E+17	Table T.5-12
69BTH	8.58E+08	69	5.92E+10	Table Y.5-10	69BTH	3.18E+15	69	2.20E+17	Table Y.5-10
Max	8.58E+08		5.92E+10		Max	3.19E+15		2.20E+17	

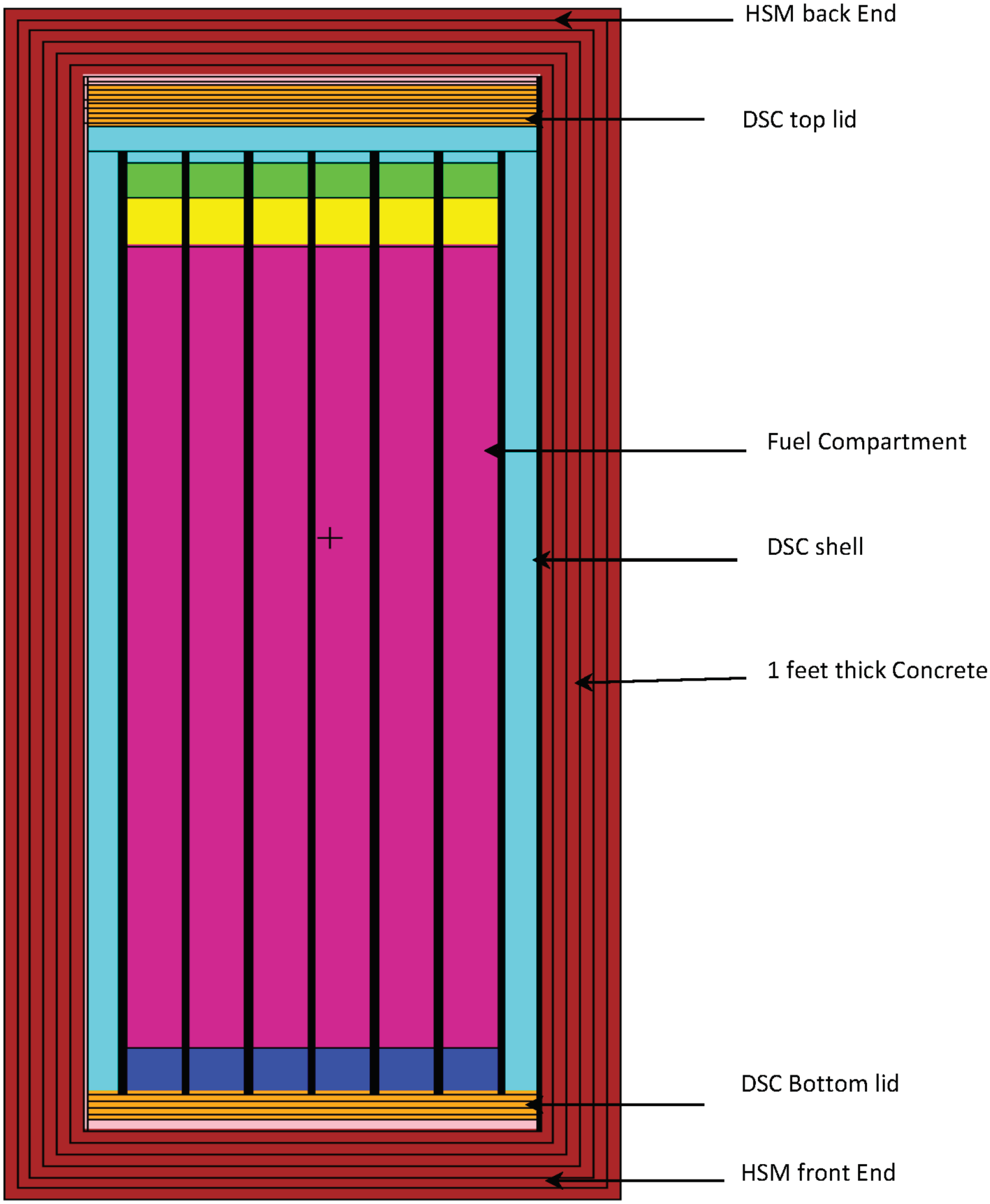

Figure 3E-1
Cross-Section Plan View of MCNP Model

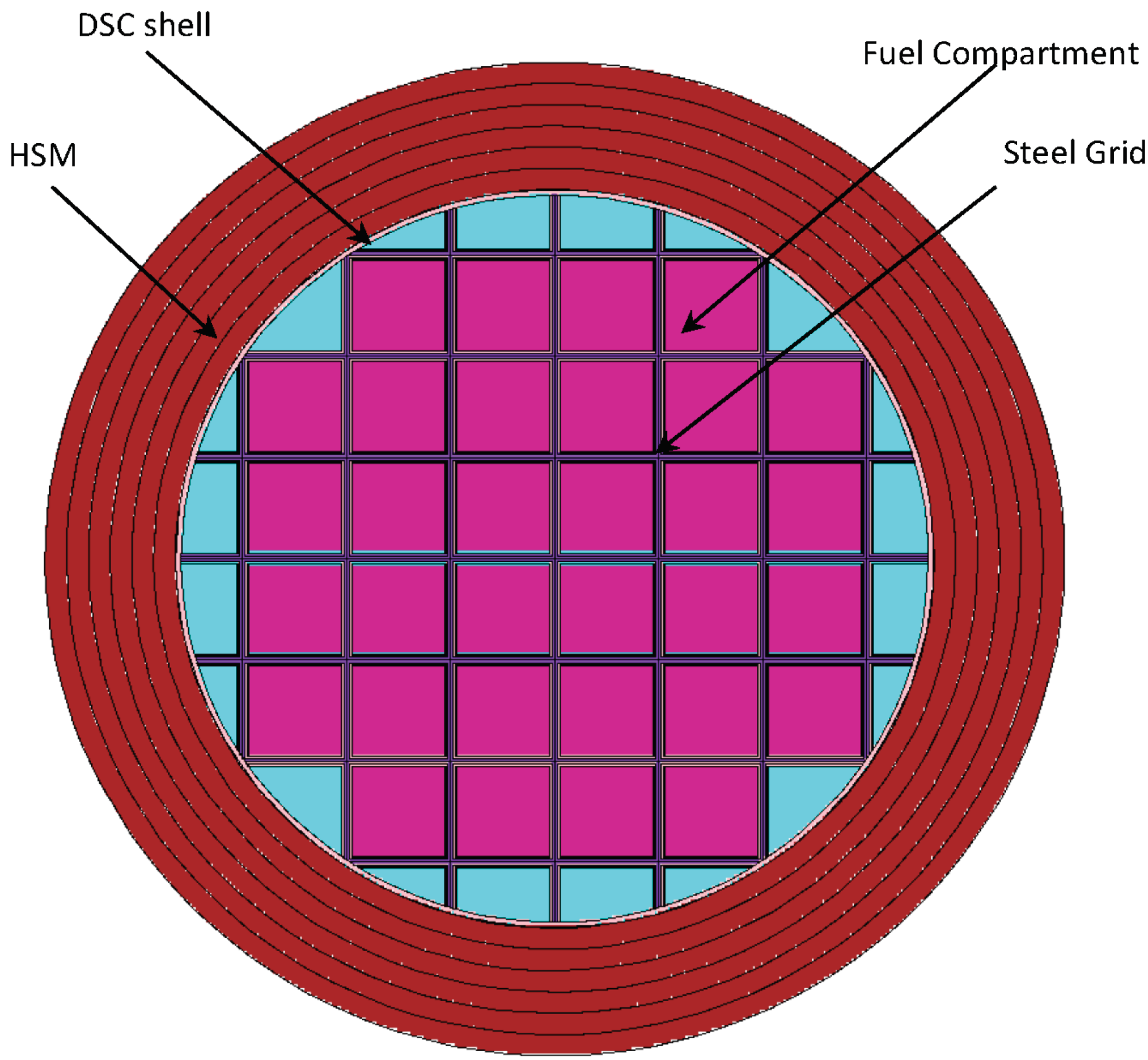

Figure 3E-2
Cross-Section Cut View of MCNP Model with 32PTH1 DSC

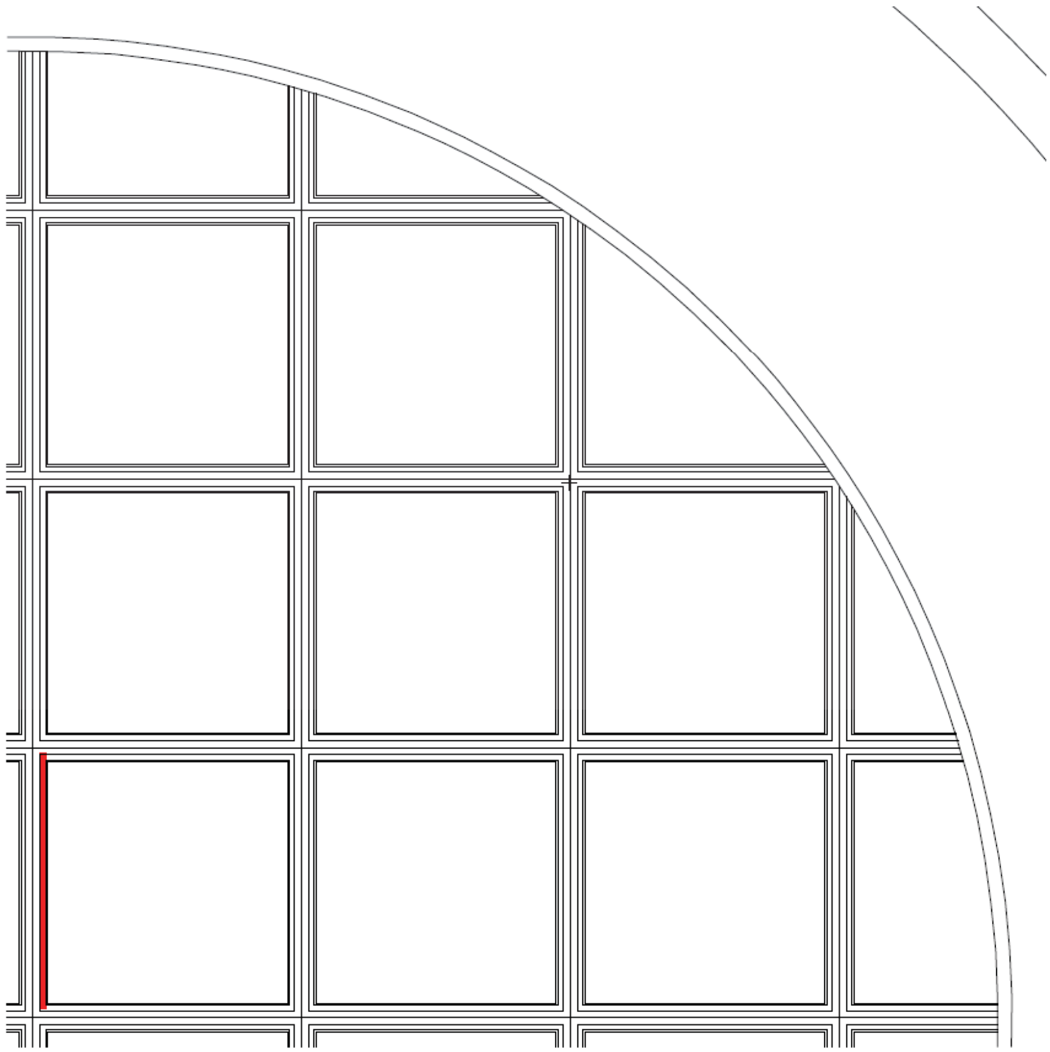

Figure 3E-3
Cross-Section View of Mesh Tally (in red) of 32PTH1 DSC Steel Basket Compartment

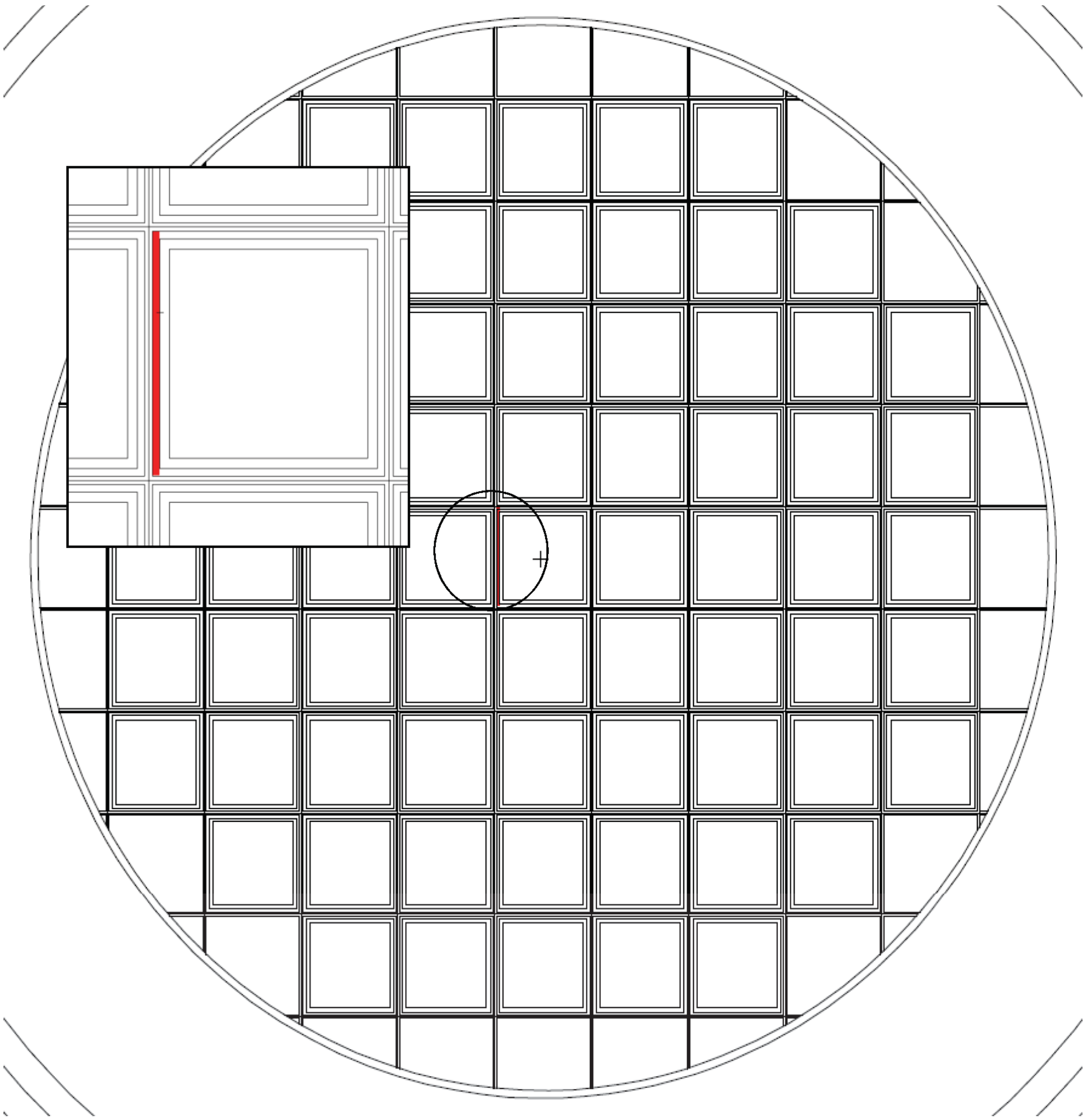

Figure 3E-4
Cross-Section View of Mesh Tally (in red) of 69BTH DSC Steel Basket Compartment

APPENDIX 3F
Confinement Evaluation of 24P and 52B Non-Leaktight DSCs

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3F.1 Summary Description

This time-limited aging analysis (TLAA) evaluated the dose commitments from the 24P and 52B dry storage casks (DSC) during normal, off-normal, and accident conditions from the airborne release of radioactive nuclides after 20 years of storage.

This TLAA updates the analysis of Updated Final Safety Analysis Report (UFSAR) [3F.5.3] Section 8.2.8. The updated analysis uses leakage rates related to the confinement leak test acceptance criterion rather than assuming an instantaneous non-mechanistic failure and follows the Standard Review Plan (SRP) [3F.5.1] in evaluating dispersion factors and organ doses. Normal, off-normal, and accident conditions correspond to the evaluations of UFSAR Section 8.1.

The SRP [3F.5.1] exempts storage casks that are designed and tested to be leak-tight, as defined in the American National Standards Institute (ANSI) standard for Leakage Tests on Packages for Shipment of Radioactive Materials [3F.5.2]. All DSCs under Certificate of Compliance (CoC) 1004, other than the 24P (standard and long), the 24PT2, and 52B have been leak tested to the 10^{-7} ref cm^3/s leak-tight standard and are, therefore, not considered in this TLAA. Because the 24P and the 24PT2 have the same fuel qualification table, (Table 3.1-8a [3F.5.4]), the analysis of the 24P applies to both models. The addition of burnable poison rod assemblies (BPRAs) (Table 3.1-8c [3F.5.4]) to the 24P long model or the 24PT2 requires the same or slightly longer cooling times, so it is bounded by the 24P standard analysis.

This TLAA presents the total dose commitments from a single 24P or 52B at distances of 100 m and 500 m from the DSC after 20 years of storage. The original analyses ([3F.5.3], Section 7.2) were performed using the ORIGEN2 [3F.5.6] computer code. The inventory was revised to use the same inputs, but modeled with the ORIGEN-S/SAS2H [3F.5.7] computer code sequence to more accurately track the amount of radioactive nuclides that could be available for release in any of the operational modes considered.

3F.2 Analysis

The re-analysis of the radionuclide inventory for the 52B created a source based on General Electric (GE) 7x7 fuel. [ ]. This source term is shown in Table 3F-1.

The re-analysis of the radionuclide inventory for the 24P created a source based on B&W 15x15 fuel. [ ]. This source term is shown in Table 3F-2.

A sensitivity analysis verified the suitability of each source term, comparing it to the possible combinations of burnup, enrichment, and cooling times available in the Fuel Qualification Tables.

The fraction of this inventory that is available for release follows the SRP Table 5-2 [3F.5.1]. Release fractions to account for retention within the horizontal storage module are also applied.

Using the method of ANSI N14.5 Appendix B.4 [3F.5.2], the Technical Specification 5.2.4(c) acceptance leak test criterion of 1×10^{-4} ref cm^3/s [3F.5.4], was converted to leak rates of helium at the cavity pressures and temperatures of normal, off-normal, and accident conditions at the start of storage, as given in UFSAR Tables 8.1-6, -7, -26, and -27 [3F.5.3]. The leak rate calculation does not consider the reduced internal gas temperatures and pressures that would occur after twenty years of storage. The leak rates thus determined are given in Table 3F-3.

The meteorology dispersion credit was calculated based on the methodology described in Regulatory Guide (RG) 1.145 [3F.5.5]. Generic parameters from the SRP [3F.5.1] were used to determine the appropriate dispersion factor. These are shown in Table 3F-4.

3F.3 Results

3F.4 Conclusion

Compliance to 10 CFR 72.104 and 10 CFR 72.106 was demonstrated for both the 24P and 52B DSCs, at both 100 m and 500 m distances after 20 years of storage. A comparison of the doses to the applicable regulations is found in Tables 3F-5 and 3F-6.

The least margin occurs for the 24P under normal conditions, for the critical organ dose. The margin is still sufficient to maintain regulatory compliance at a distance of 100 m, assuming 29 DSCs were simultaneously loaded with design basis fuel at the same independent spent fuel storage installation (ISFSI). The consequences of leakage continue to decline during the 20 to 60 year CoC extension period, as the source decays and the internal pressure declines.

3F.5 References

3F.5.1 NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems at a General License Facility," Final Report, Revision 1, July 2010.

3F.5.2 ANSI N14.5-1997, "Standard for Radioactive Materials – Leakage Tests on Packages for Shipments," American National Standards Institute, New York, NY.

3F.5.3 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3F.5.4 Amendment Number 13 to CoC 1004, "Technical Specification for the Standardized NUHOMS® Horizontal Modular Storage System," Docket 72-1004, Effective May 24, 2014.

3F.5.5 Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1.

3F.5.6 Croff, A. G., "A User's Manual for the ORIGEN2 Code," ORNL/TM-7175, Oak Ridge National Laboratory, July 1980.

3F.5.7 Oak Ridge National Laboratory, RSICC Computer Code Collection, "SCALE 5.0: Modular Code System for Performing Standardized Computer Analysis for Licensing Evaluations for Workstations and Personal Computers," Oak Ridge National Laboratory, Radiation Shielding Information Center Code Package CCC-725, June 2004.

Table 3F-1
BWR Fuel Assembly Radionuclide Inventory after 20 Years of Storage

Nuclide	Activity	Group
^{3}H		
Subtotal		
^{238}Pu		
^{239}Pu		
^{240}Pu		
^{241}Pu		
^{241}Am		
^{242m}Am		
^{242}Am		
^{243}Am		
^{243}Cm		
^{244}Cm		
^{245}Cm		
Subtotal		
^{3}H		
^{85}Kr		
^{90}Sr		
^{90}Y		
^{129}I		
^{137}Cs		
^{137m}Ba		
^{151}Sm		
^{154}Eu		
Subtotal		
^{60}Co		
Total		

Table 3F-2
PWR Fuel Assembly Radionuclide Inventory after 20 Years of Storage

Nuclide	Activity	Group
^{3}H		
Subtotal		
^{238}Pu		
^{239}Pu		
^{240}Pu		
^{241}Pu		
^{241}Am		
^{242m}Am		
^{242}Am		
^{243}Am		
^{243}Cm		
^{244}Cm		
^{245}Cm		
Subtotal		
^{3}H		
^{85}Kr		
^{90}Sr		
^{90}Y		
^{129}I		
^{137}Cs		
^{137m}Ba		
^{147}Pm		
^{151}Sm		
Subtotal		
^{60}Co		
Total		

Table 3F-3
Leak Rates for All Operational Conditions

Type	Normal (cm^3/sec He)	Off-Normal (cm^3/sec He)	Accident (cm^3/sec He)
52B			
24P			

Table 3F-4
Meteorological Dispersion Parameters for All Operational Conditions

Distance (m)	Normal (sec/m^3)	Off-Normal (sec/m^3)	Accident (sec/m^3)
100			
500			

Table 3F-5
100 m Dose Summary for the 52B Confinement Calculations

Off-Normal Conditions			
Organ	**10 CFR 72.104 Limit (mrem)**	**Calculated Dose (mrem)**	**Fraction**
Whole Body (TEDE)	25		
Thyroid	75		
Critical Organ	25		
Accident Conditions			
Organ	**10 CFR 72.106 Limit (mrem)**	**Calculated Dose (mrem)**	**Fraction**
Whole Body (TEDE)	5,000		
Critical Organ	50,000		
Skin	50,000		
Lens of the eye	15,000		

Table 3F-6
100 m Dose Summary for the 24P Confinement Calculations

Off-Normal Conditions			
Organ	**10 CFR 72.104 Limit (mrem)**	**Calculated Dose (mrem)**	**Fraction**
Whole Body (TEDE)	25		
Thyroid	75		
Critical Organ	25		

Accident Conditions			
Organ	**10 CFR 72.106 Limit (mrem)**	**Calculated Dose (mrem)**	**Fraction**
Whole Body (TEDE)	5,000		
Critical Organ	50,000		
Skin	50,000		
Lens of the eye	15,000		

APPENDIX 3G
Thermal Performance of Horizontal Storage Modules for the Period of Extended Operation

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LIST OF FIGURES

3G.1 Summary Description

This appendix evaluates the confinement weld temperatures on the outer surface of the NUHOMS® dry shielded canisters (DSCs) and the concrete temperatures over the extended period of storage as input to aging management reviews (AMRs) and time limited aging analyses (TLAAs) for the DSC and the horizontal storage module (HSM). The DSCs subject to this evaluation are stored in one of the three storage module types; Standardized HSM (HSM Models 80 or 102), HSM-H (HSM Model 202 and HSM-HS), or HSM Model 152. All storage modules are identified as HSM in this evaluation unless the specific type of the HSM is noted. Studies of chloride-induced stress corrosion cracking (CISCC) show that stainless steel welds are susceptible to CISSC when the weld temperature is in the range of 30 °C to 80 °C.

To evaluate the confinement weld temperatures various heat loads at steady state condition and average annual temperature of 70 °F are considered in the models. The evaluated heat loads are in the range of 2 kW to 22 kW for DSCs loaded in the Standardized HSM (HSM Model 80 or 102) or HSM Model 152 and in the range of 2 kW to 32 kW for DSCs loaded in the HSM-H.

For these evaluations, half symmetric, three-dimensional computational fluid dynamics (CFD) models generated in ANSYS FLUENT [3G.5.4] are used to simulate the air flow and heat transfer within the each HSM type separately. These evaluations also provide the DSC confinement weld temperature as a function of the heat load and storage time for a DSC during long-term storage time.

3G.2 Description of the Models

A three dimensional, half-symmetric computer-aided design (CAD) model is created in ANSYS Design Modeler [3G.5.2] based on the nominal dimensions obtained from the drawings given in the Updated Final Safety Analysis Report (UFSAR) [3G.5.1] for each HSM and DSC. The model comprises the concrete structure (base, roof, pad, and door), top and side heat shields, DSC support structure, DSC shell assembly and a homogenized basket including the fuel assemblies (FAs). Figure 3G-1 through Figure 3G-3 present perspective views of the CAD models of the HSMs loaded with DSCs.

The CAD model is imported into ANSYS ICEM CFD [3G.5.3] for meshing. A single conformal hexahedral volume mesh across all domains is created in ANSYS ICEM CFD using the “blocking” method. The multi-scale meshing technique is used to improve the computational efficiency while preserving the physics. A coarser mesh is generated in the base, roof, door, pad walls, and flow regions far from the fluid-solid interfaces. A finer mesh is used in the DSC shell and flow regions around the DSC, rail, and heat shield, where temperature and flow velocity gradients are much higher.

The k-ω model with shear stress transport (SST) is used as the turbulence model. The SST model is effectively blending the robust and accurate formulation of the k-ω model in the near-wall region with the free-stream independence of the k-ε model in the far field. The model has an enhanced wall treatment function for predicting the effect of pressure gradient near the wall, which is suitable for partially separated flows. It performs well in the area of wall-bounded boundary layer, free shear, and low Reynolds number flows.

The discrete ordinates (DO) model has been used as a radiation model for the present analysis since the DO model is capable of considering the symmetric boundary conditions, the computational effort is moderate for typical angular discretization, and the memory requirements are modest.

Inlet and outlet vent boundary conditions are specified at the air inlet and air outlet. Pressure and temperature are set to be ambient pressure and temperature. To model the effect of screens located at the inlet and outlet, a flow loss coefficient is specified with a loss coefficient of [ ] with cross-sectional area ratio of screen-to-duct and free area ratio of screen as obtained from drawings in the UFSAR [3G.5.1].

The turbulence boundary conditions at both the inlet and outlets are specified by using the "intensity and hydraulic diameter method." Considering that the air inlet is at atmospheric pressure, [ ]. Based on the dimensions of the inlet and outlet vents, the hydraulic diameter is calculated as:

$$D_h = \frac{2LB}{L+B}$$

where L is the width of the inlet or outlet vent and B is the height of the inlet or outlet vent.

For solution of the model, the SIMPLEC scheme is used for pressure velocity coupling. The PRESTO discretization method is used to discretize the pressure. Second order upwind scheme is used to discretize the remaining parameters such as density, momentum, turbulent kinetic energy, specific dissipation rate (ω), energy, and discrete ordinates.

[ ]. In addition to monitoring the residuals, the balance of the mass flow rate between inlet and outlet for the airflow and the heat balances for the total and radiation heat transfer rates are also verified for convergence.

The roof and the vertical front wall of the HSM dissipate heat to the ambient via radiation, natural convection, and at the same time absorb heat from solar insolation.

The net heat transfer due to the convection, radiation and insolation conditions is modeled using user-defined functions (UDF) in ANSYS FLUENT [3G.5.4] to compute the net heat flux. The solar heat fluxes of 0.8537 Btu/hr-in^2 on the roof and 0.2134 Btu/hr-in^2 on the front wall are considered as specified in the UFSAR [3G.5.1]. The side and back walls of the HSM and the HSM pad have adiabatic boundary condition.

The heat generated from the FAs is applied using volumetric heat generation over the homogenized basket region.

3G.3 Results

The maximum DSC shell temperature and the minimum confinement weld temperatures as a function of heat load are presented in Table 3G-1 for various HSM types. The lowest DSC confinement weld temperature is located close to the DSC top cover plates facing the HSM back wall. Typical temperature distribution of the HSM and DSC is presented in Figure 3G-4.

The estimated DSC heat load at which the DSC confinement weld temperature is 80 °C for each HSM type is determined using linear interpolation of the data presented in Table 3G-1. These heat loads are presented in Table 3G-2.

As seen in Table 3G-2, the DSC confinement weld temperatures remain below 80 °C for heat loads less than 16.3 kW in the standardized HSM, 34.6 kW in HSM-H and 30.5 kW in HSM-152.

The heat loads considered in evaluation of the confinement weld temperatures are correlated to the required cooling times assuming burnup of 45 GWd/MTU and initial enrichment of 4%. The minimum and maximum DSC shell temperatures (confinement weld temperatures) versus storage time are presented in Figure 3G-5 through Figure 3G-7 for various HSM types.

In addition to the DSC shell temperatures, the maximum and minimum concrete temperatures as a function of heat load are retrieved from the models and presented in Table 3G-3. The maximum and minimum concrete temperatures are also correlated to the cooling time and plotted in Figure 3G-8 for various HSM types.

3G.4 Conclusions

This appendix provides the canister and concrete temperature ranges during extended storage, to be used as input for the stress corrosion cracking AMR (Appendix 5B) and the concrete TLAA (Appendix 3C).

3G.5 References

3G.5.1 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3G.5.2 ANSYS Design Modeler, Version 14.0.

3G.5.3 ANSYS ICEM CFD, Version 12.1.

3G.5.4 ANSYS FLUENT™ Software Code, Version 14.0.

Table 3G-1
Maximum and Minimum DSC Shell Temperature as a Function of Decay Heat Load

Table 3G-2
Minimum Heat Load to Maintain Confinement Weld Temperature at or above 80° C

HSM Type	Minimum Heat Load (kW)	Maximum Allowable Heat Load (kW)
Standardized HSM (HSM Models 80 and 102)		24
HSM-H, HSM-HS		40.8
HSM Model 202		24
HSM Model 152		24

Table 3G-3
Maximum and Minimum Temperature of Concrete versus Heat Load

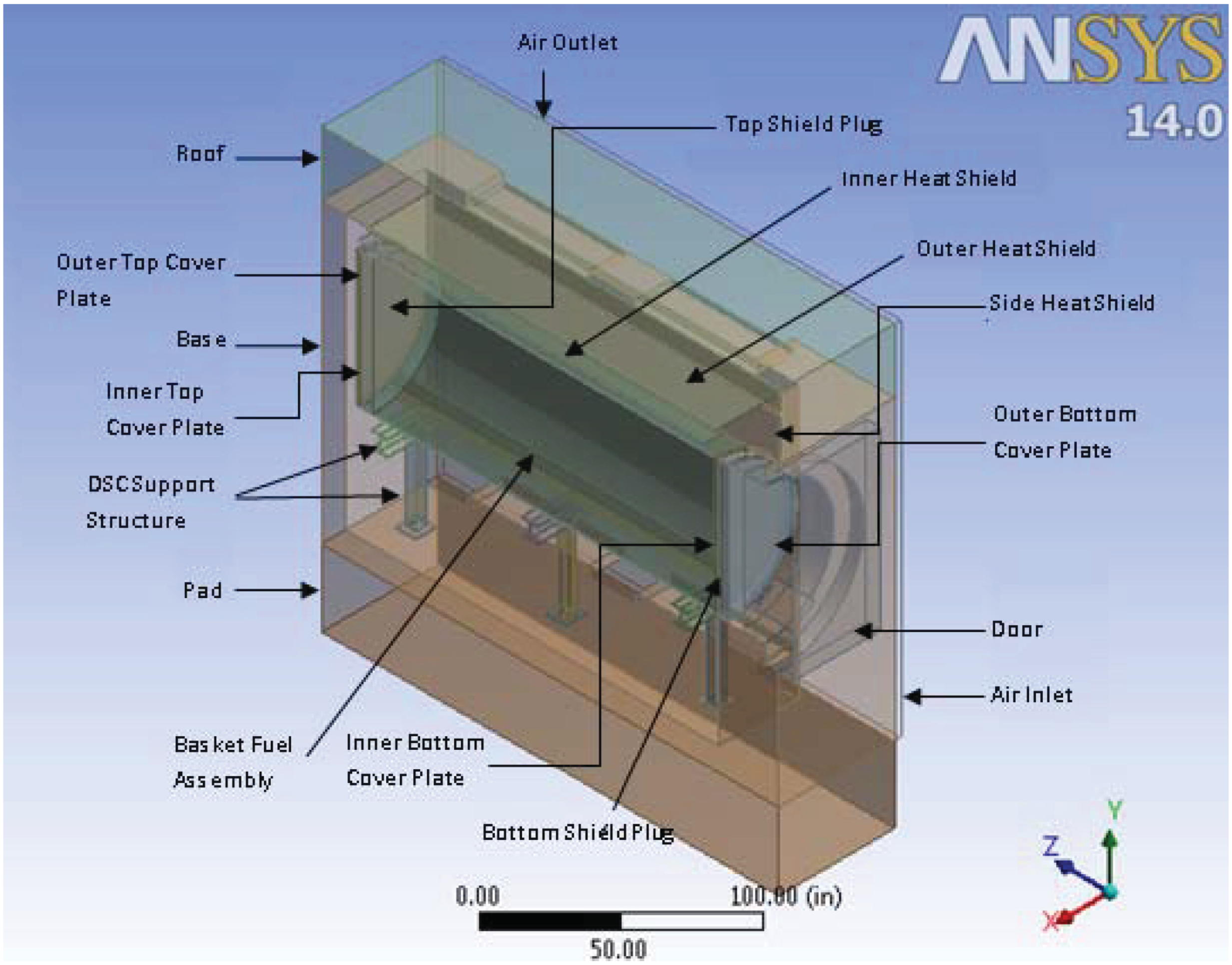

Figure 3G-1
Standardized HSM Loaded with a DSC

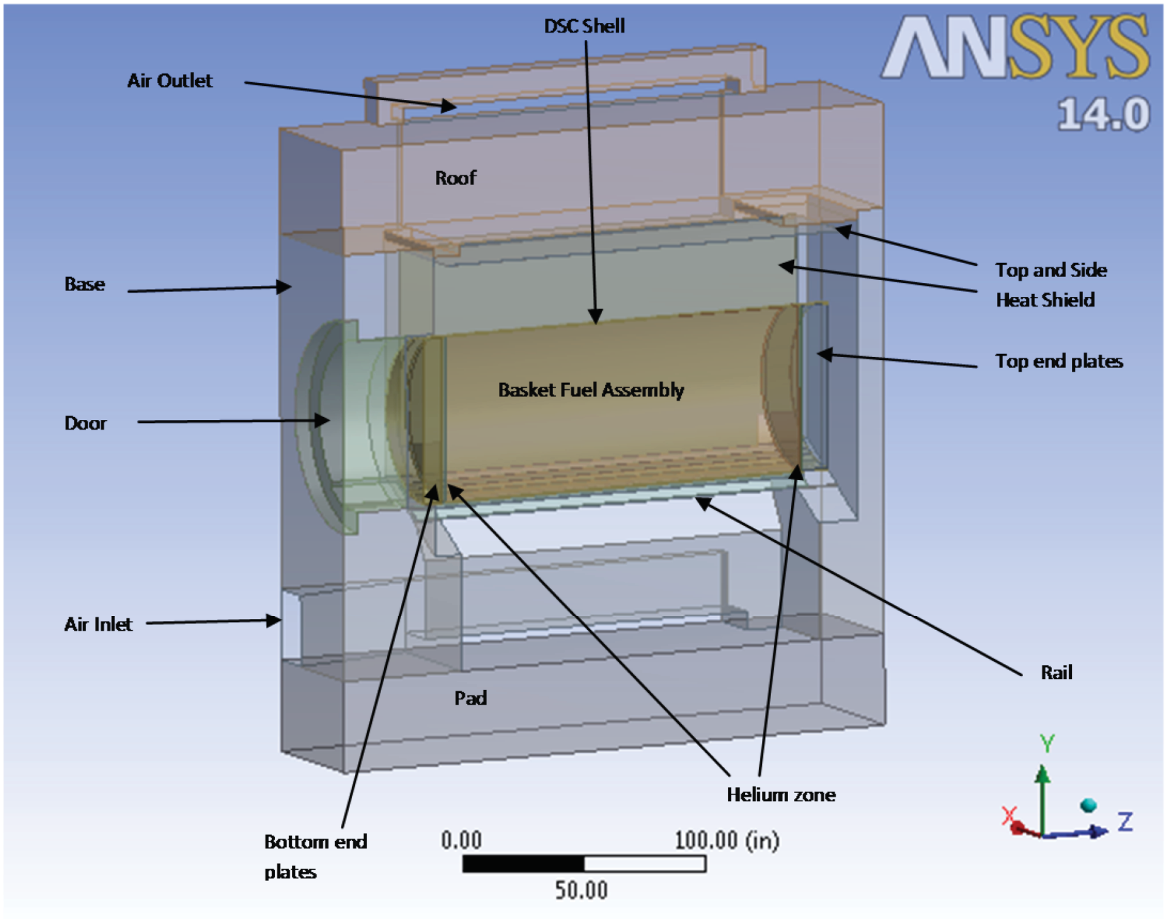

Figure 3G-2
HSM-H Loaded with a DSC

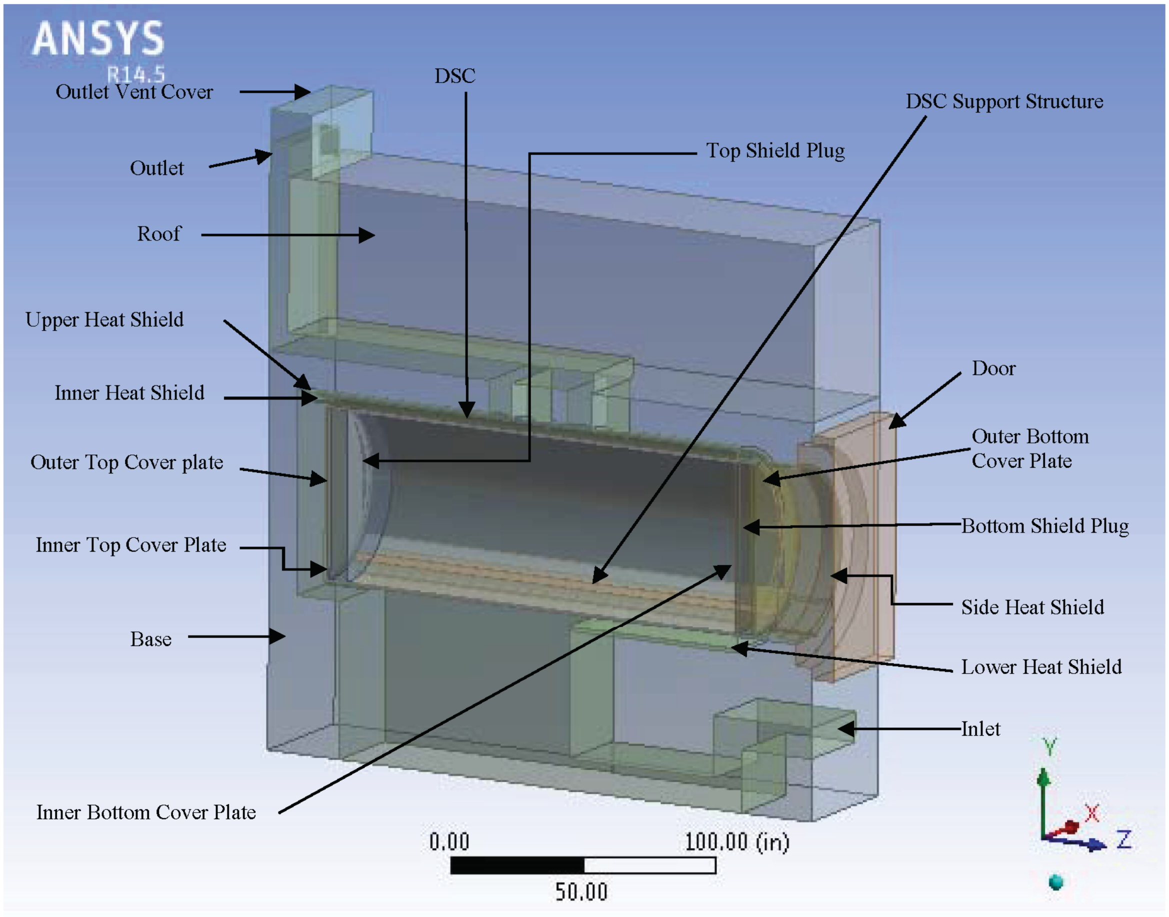

Figure 3G-3
HSM Model 152 Loaded with a DSC

Figure 3G-4
Temperature Contours of Concrete and DSC Shell in HSM-H, with [ ] kW Heat Load

Figure 3G-5
Minimum and Maximum DSC Shell Temperatures
During Storage for Standardized HSM

Figure 3G-6
Minimum and Maximum DSC Shell Temperature
During Storage for 32PTH1-S DSC in HSM-H

Figure 3G-7
Minimum and Maximum DSC Shell Temperatures
During Storage for HSM Model 152

Figure 3G-8
Maximum and Minimum Temperature of
Standardized HSM Concrete versus Storage Time

APPENDIX 3H
Evaluation of Additional Cladding Oxidation and Additional Hydride Formation Assuming Breach of Dry Shielded Canister Confinement Boundary

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3H.1 Summary Description

This time-limited aging analysis (TLAA) evaluates the potential effects of additional cladding oxidation and concurrent hydride formation on the cladding integrity when dry shielded canister (DSC) confinement is hypothetically breached after 40 and 60 years of storage. Using a temperature dependent oxidation model for cladding, the additional oxide thickness formed on the cladding surface when exposed to the ambient air and corresponding clad thinning is calculated as a function of storage time. The calculated clad thinning is compared with the cladding oxide thickness (maximum 120 μm) assumed for structural analysis in the Updated Final Safety Analysis Report (UFSAR) [3H.5.8]. The effects of alloy composition and fuel burnup on the cladding oxidation are also evaluated. Assuming absorption of hydrogen released as a result of cladding oxidation in humid air, the additional amount of hydrogen content and corresponding hydride formation is estimated. The cladding materials evaluated in this TLAA include Zircaloy-2, Zircaloy-4, ZIRLO™, and M5®.

Background Information

The UFSAR [3H.5.8] uses the following cladding thickness reductions for evaluation of fuel integrity under drop accident accelerations:

- 61BT (Section K.3.6.3) 200 μm
- 24PTH (Section P.3.6.3) 120 μm
- 61BTH (Section T.3.5.2) 0.0027 inch (68.6 μm), based on 120 μm oxide thickness
- 32PTH1 (Section U.3.5.1) 0.0027 inch (68.6 μm), based on 120 μm oxide thickness

Appendix 5A of this application evaluates the potential for breaching of the DSC confinement boundary due to stress corrosion cracking for canisters that are stored in locations with significant chloride aerosols. The analysis estimates that, barring aging management, such a breach could occur between 40 and 60 years after the beginning of storage.

[ ].

The following analysis will evaluate storage from [ ] under a hypothetical breached DSC condition, which is conservative compared to a [ ] scenario, in terms of both duration and temperature of cladding exposure to air. The [ ] results are included in the tables and figures, but are not discussed in the text.

3H.2 Analysis

[

]. The reaction schemes for cladding oxidation considered in this TLAA are:

$$Zr + O_2 = ZrO_2 \text{ for dry air} \quad \text{Eq. 3H-1}$$

$$Zr + 2H_2O = ZrO_2 + 4H_{absorbed} \text{ for humid air or water} \quad \text{Eq. 3H-2}$$

[

]

The analysis includes the following conservatisms:

[ ]

3H.3 Results

Cladding Oxidation and Thinning: Effect of Temperature

Cladding Oxidation: Effect of Alloy Composition

Cladding Oxidation: Effect of Fuel Burnup

The initial condition of the cladding before storage is mainly affected by reactor operations, particularly fuel burnup. For a discharge burnup in the range of 60–65 GWd/MTU, the maximum oxide thickness is 100 µm [3H.5.10]; this is already bounded by the 120 µm oxidation layer assumed in the UFSAR [3H.5.8]. The additional thinning of the cladding during hypothetical exposure to air has been demonstrated above to be very small when compared to the initial thinning assumed for the UFSAR accident analysis. This conclusion is not affected by the burnup of the fuel. Thus, there is no adverse impact of high burnup on additional cladding thinning due to air exposure.

Hydride Formation as a Result of Cladding Oxidation

3H.4 Conclusions

Clad Thinning

The calculation results show that the additional oxide formation for Zircaloy-2 and Zircaloy-4 will be very small: an average oxide thickness of [ ] formed during the exposure time of [ ] in air following breaching of the DSC confinement. The corresponding clad thinning averages [ ]. Compared to the cladding thinning of 68.6 μm in the UFSAR, the added thinning of [ ] corresponds to only [ ], and does not change the UFSAR assumption within two significant digits. Because of high corrosion resistance of the new alloys such as ZIRLO™ and M5® compared to Zircaloy-2 and Zircaloy-4, it is expected that the percentage of cladding thickness oxidized will be lower than that of the traditional zirconium based alloys. High burnup has no effect on oxidation and additional clad thinning due to air exposure during dry storage, and the amount of oxidation, 120 μm, originally assumed in the UFSAR already bounds the typical limit of 100 μm expected for fuel burnup in the 60-65 GWd/MTU range. Thus, there is no adverse impact of the postulated air exposure on cladding thinning, including the effects of temperature, alloy composition, and burnup.

Hydride Formation as a Result of Cladding Oxidation

Based on calculation results for irradiated high burnup fuel rods including Zircaloy-4 and ZIRLO™, the amount of additional radial hydride as a result of cladding oxidation during air exposure after 40 years of storage will be less than [ ]. Thus, the postulated air exposure will not have any practical impact on the cladding degradation due to radial hydride formation.

3H.5 References

3H.5.1

3H.5.2

3H.5.3

3H.5.4

3H.5.5

3H.5.6

3H.5.7

3H.5.8 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3H.5.9

3H.5.10

3H.5.11

3H.5.12

3H.5.13

3H.5.14

3H.5.15

3H.5.16

Table 3H-1

Values of [ ] in Eq. 3K-1 from Models of Different Investigators for Zircaloy Oxidation

Table 3H-2
Mean Hydrogen Content, Radial Hydride Content, and Oxide Thickness for Zircaloy-4 after Thermo-Mechanical Treatment at [ ] with Hoop Stress Ranging from [ ] MPa

[ ]

Table 3H-3
Hydrogen Content and Oxide Thickness for Three High Burnup Cladding Materials Heated at [ ] and Estimated Additional Radial Hydrogen Due to Air Exposure

[ ]

Figure 3H-1
Calculated Additional Oxide Thickness on Cladding Surface as a Function of Storage Time According to the Oxidation Models from Different Investigators

[ ]

Figure 3H-2
Calculated Additional Cladding Thinning as a Function of Storage Time According to Different Selections of Parameters [ ]

APPENDIX 3I
Evaluation of Cladding Gross Rupture during Period of Extended Operation

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3I.1 Summary Description

This evaluation determines the maximum exposure time (incubation time) that the fuel cladding within a Standardized NUHOMS® dry shielded canister (DSC) remains undamaged for the hypothetical case in which the DSC confinement is breached during extended operation.

As described in Appendix 5B, chloride-induced stress corrosion cracking (CISCC) could initiate on the DSC confinement boundary welds or heat affected zones after [ ] of storage and could penetrate the confinement boundary after [ ] of storage, depending on the fuel heat load and local chloride aerosol concentration. This evaluation provides a defense-in-depth analysis for the hypothetical case assuming that the confinement boundary of the DSC is breached after [ ] of storage. It is also assumed, in the case of a DSC breach, that the helium retained in the DSC cavity would be replaced instantaneously by air and the fuel cladding would be exposed to oxygen in air. If the temperature of the fuel rods is high enough and small cracks or pinholes are present, UO_2 may convert to U_3O_8 and expand. The expansion of the fuel pellet imposes a stress on the fuel rod cladding, which would cause the cladding to be compromised and split open.

This calculation determines the incubation time for the fuel cladding to remain undamaged when exposed to an oxidizing atmosphere after the DSC shell is compromised. The incubation time is calculated using data provided in [3I.4.2] by Electric Power Research Institute (EPRI). Based on the calculated incubation time, this evaluation demonstrates that ample time would be available prior to release of fissile material even if the DSC confinement is beached in a hypothetical case.

3I.2 Analysis

To maximize the fuel cladding temperature in this evaluation, NUHOMS® 32PTH1 DSC is selected for the analysis because it has the highest heat load and the maximum number of fuel assemblies (FAs) among the DSCs described in the Updated Final Safety Analysis (UFSAR) [3I.4.1].

The material properties used in the model for the 32PTH1 DSC are the same as those listed in the UFSAR, Appendix U. [

], as specified for heat load zone configuration (HLZC) 1 in UFSAR Figure U.4-1. The evaluated heat loads during storage time are presented in Table 3I-1. The methodology to evaluate the fuel cladding temperature is as follows:

- [

  ].
- Determine the DSC shell temperature profile at the same time intervals using results presented in Appendix 3G.
- [

  ].
- Determine the time to propagation of cladding defects (incubation time) due to fuel pellet expansion using data provided by EPRI [3I.4.2]. EPRI tests predict a logarithmic correlation between the incubation time and the inverse of the absolute temperature shown in [3I.4.2] Figure 3-9. Using curve fitting in an Excel spreadsheet provides the following correlation based on EPRI data.

  [ ]

  t_{inc} = incubation time (hr)

  $T_{fuel,max}$ = absolute temperature (K)

3I.3 Results and Conclusion

[

]. The calculated incubation times are also presented in Table 3I-2.

[ ] for conversion of UO_2 to U_3O_8 to affect the fuel cladding and potentially release the fissile material into the DSC confinement when the DSC is hypothetically breached [ ] of dry storage. This assumes a [ ], but during the incubation time of [ ], the fuel cladding temperature will drop below [ ] for [ ] of dry storage. For this temperature, the incubation time increases to [ ]. This behavior continues during the long storage time. It follows that the development of a gross rupture due to a hypothetical breach of the DSC [ ] of dry storage is an unlikely event.

3I.4 References

3I.4.1 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3I.4.2 [ ]

Table 3I-1
Heat Load per FA

Table 3I-2
Maximum FA Cladding Temperature and Incubation Time
for Long-Term DSC Storage in HSM

APPENDIX 3J
Structural Assessment of High Burnup Cladding Performance during Period of Extended Operation

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3J.1 Summary Description

This time-limited aging analysis (TLAA) evaluates the structural performance of high burnup fuel cladding after 20 years of storage and for the duration of the license renewal period. Both pressurized water reactor (PWR) and boiling water reactor (BWR) fuel assemblies are evaluated for normal and off-normal storage loads in order to assess if the cladding structural integrity and fuel assembly (FA) retrievability requirements in 10 CFR 72.122(h)(1) and 72.122(l), respectively, are met for storage periods longer than 20 years.

The applicable loads to be evaluated are self-weight, internal pressure, and handling. The applicable handling loads for the FA are those associated with retrievability of the FA from the dry shielded canister (DSC) in case of repackaging or if the FA needs to be moved back to the spent fuel pool.

3J.2 Analysis

The analysis consists of the following:

- Determine fuel rod internal pressures.
- Determine fuel cladding yield stress including reductions for uncertainties.
- Determine the bounding axial and hoop direction stress in the fuel cladding due to normal and off-normal storage conditions.
- Compare bounding calculated stresses to yield stress to ensure integrity and retrievability of the fuel.

Determine Fuel Rod Internal Pressures

The BWR fuel rod internal pressure is conservatively taken as 1,059 psi, which is based on the maximum beginning-of-storage temperature of 716 °F using minimum fuel rod plenum volume (paragraph Y.3.5.2 and Table Y.3.5-5 of [3J.5.1]).

The PWR fuel rod internal pressure is calculated based on [3J.5.3] as follows:

[ ]

Although the maximum burnup applicable for this equation is 60 GWd/MTU a deviation from this limitation is taken to estimate the pressure for burnup of 62 GWd/MTU which is the maximum burnup allowed in Certificate of Compliance (CoC) 1004 (for the 32PTH1 storage system) [3J.5.1]. The calculated pressure is:

[ ]

Adding one standard deviation to this result the maximum PWR fuel rod internal pressure is:

[ ]

This value of internal pressure bounds the available data set used in [ ] to develop the above equation [ ] even for burnup values up to 64 GWd/MTU. The maximum fuel burnup licensed for the Standardized NUHOMS® System is 62 GWd/MTU [3J.5.1]. Therefore, this pressure is conservative.

[ ]. The maximum PWR fuel rod internal pressure after 20 years of storage is, therefore:

[ ]

Determine Fuel Cladding Yield Stress

The fuel cladding yield stress values for PWR and BWR cladding materials are calculated per [3J.5.2] for Zircaloy-2 and Zircaloy-4. The same procedure as used in Sections Y3.5 and Z3.5 of [3J.5.1] is used, except that strain rate effects are conservatively ignored and a conservatively low fast neutron fluence rate is used, resulting in lower-bound calculation of the yield stress.

The fuel cladding yield stress values for M5® cladding are calculated in the same manner as in [3J.5.1] Section Z3.5, which uses the data and equations from [3J.5.4], but using a low strain rate of [ ].

[ ]

The yield stress is calculated as a function of temperature. The results are shown in Figure 3J-1. [ ]. Furthermore, the lower bound yield stress for the M5® cladding is used for all PWR fuel cladding materials (Zircaloy-4, M5®, and ZIRLO™).

Determine Bounding Fuel Assembly Stresses and Compare to Allowable Values

This analysis considers the axial and hoop direction stresses in the fuel cladding. The entire set of FA types licensed for storage in CoC 1004 is evaluated to develop a subset consisting of the bounding fuel assemblies for each class (i.e., 8x8, 10x10, 14x14, etc.) of BWR and PWR FAs. Three criteria are used to select the bounding FAs:

- Maximum axial stress due to bending.
- Maximum hoop stress due to internal pressure.
- Maximum combined axial stress due to bending plus internal pressure.

The set of bounding fuel assemblies is shown in Table 3J-2 and Table 3J-3 for BWR and PWR fuel assemblies, respectively.

This analysis demonstrates integrity and retrievability of the FAs by evaluating the FAs for the normal handling inertial loads for the DSC from Table 3.2-1 of [3J.5.1]. The bounding handling load case is deadweight + 1 g handling acceleration in the vertical direction, resulting in a total acceleration of 2 g causing bending of the fuel rods. During transfer in the horizontal position, vertical acceleration is transverse relative to the FAs.

The internal pressures calculated above are used to calculate that axial direction pressure stress which is added to the stress due to bending and to calculate the hoop stress.

The calculated stresses are compared to the limiting yield stress value in Table 3J-1. The calculations and resulting safety factors are shown in Table 3J-2 for BWR and Table 3J-3 for PWR FAs.

3J.3 Results

For BWR fuel, the smallest safety factor against yield for axial stress is 6.0, which occurs in the bounding 7x7 assemblies.

For PWR fuel, the smallest safety factor against yield for axial stress is 4.7, which occurs in the bounding 14x14 assembly.

The results shown in Table 3J-2 and Table 3J-3 indicate that the expected stress values do not approach the yield strength of the cladding materials, and therefore there will be no demand on the ductility of the cladding material. Therefore, any possible ductile-to-brittle transition of the cladding does not affect the ability to safely retrieve the FAs after 60 years of storage.

3J.4 Conclusions

As shown in Table 3J-2 and Table 3J-3, the minimum safety factor against material yield is 4.7 for normal handling loads and internal pressure.

This evaluation shows that the fuel can be safely handled after 60 years of storage. The decreasing temperature of the fuel could result in a ductile to brittle transitions but any reduction in ductility due to radial hydrides is not a concern due to the low stress levels. The decrease in fuel rod internal pressure that is expected as a result of the decreasing temperatures has a beneficial effect.

3J.5 References

3J.5.1 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3J.5.2

3J.5.3

3J.5.4

Table 3J-1
Yield Strength Values for High Burnup Fuel Cladding

Table 3J-2
BWR Fuel Assembly Analysis and Results

Table 3J-3
PWR Fuel Assembly Analysis and Results

Figure 3J-1
Yield Stress vs. Temperature for Zircaloy-2, Zircaloy-4, and M5® Fuel Cladding

APPENDIX 3K
Defense-in-Depth Dose Assessment Assuming Breach of Confinement during Period of Extended Operation

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3K.1 Summary Description

This time-limited aging analysis (TLAA) evaluated the dose impact of a breach of confinement during extended operation, investigating the defense-in-depth of the dry shielded canister (DSC). The NUHOMS®-37PTH and -69BTH systems represent the pressurized water reactor (PWR) and boiling water reactor (BWR) models, respectively.

Table 3L-4 in Appendix 3L reports that the internal pressure of the DSC after 60 years of storage would decline to atmospheric pressure, which is insufficient to propel any radionuclides that are free for release. Thus, more conservative input values for internal pressure and cavity gas temperature after 20 years of storage, at off-normal conditions, were taken from Table 3L-3. [ ]. This is much earlier than the time to confinement boundary breach due to CISCC evaluated in Appendix 5B.

The leakage rate used for this defense-in-depth analysis was assumed to be significantly greater than the leakage rate for the confinement evaluation summarized in Appendix 3F. [ ], compared to design basis leak rates of 1×10^{-4} ref cm^3/sec for the 24P, 24PT2, and 52B, and 1×10^{-7} ref cm^3/sec for all other DSCs, to show that even with a significant increase in release rates, the DSC, on its own, would not cause a dose to exceed the regulatory requirements of 10 CFR 72.106. Adding more realistic release fractions, which account for retention of volatiles and fines that would occur outside the DSC, but before a release to the environment, would add a significant margin.

This TLAA presents the total dose commitments from the 37PTH and 69BTH DSC systems, at a distance of [ ] from the DSC. Evaluations were made at 40 and 60 years of storage, to ensure that any impact of transmutation from radioactive decay did not cause an increase in dose at later times (e.g., Am-241 buildup). An analysis of the chemical form of the release material causing dose was also performed for each organ. The maximum leak rate that would still maintain regulatory compliance was determined. Meteorological dispersion factors were used to simulate generic bounding accident conditions as prescribed by the standard review plan (SRP) [3K.5.1]. As in the confinement analysis, the ORIGEN-S/SAS2H sequence [3K.5.3]was used to determine the radionuclide source term.

3K.2 Analysis

The analysis of the radionuclide inventory for the 69BTH generated a source based on the General Electric (GE) 7x7 fuel. Depletion was performed to 62 GWd/MTU, in three cycles, where specific power was 13.34 MW/MTU. The enrichment was 2.60 wt. %. The fuel was cooled five years prior to dry storage, then 40 and 60 years in dry storage.

The analysis of the radionuclide inventory for the 37PTH generated a source based on the Babcock and Wilcox (B&W) 15x15 fuel. Depletion was performed to 62 GWd/MTU in three cycles, where specific power was 37.5 MW/MTU. The enrichment was 4 wt. %. The fuel was cooled five years prior to dry storage, then 40 and 60 years in dry storage.

The leak rate used in this analysis was [ ]. This is the maximum rate at which none of the DSCs exceeds the regulatory limits on accident releases, with an adequate margin.

The meteorology dispersion credit was calculated based on the methodology described in Regulatory Guide 1.145 [3K.5.2]. Generic parameters from the standard review plan [3K.5.1] were used to determine the appropriate dispersion factor in this accident condition. The [ ] accident dispersion parameter was calculated to be [ ]. The exposure duration was two hours.

In addition to the doses compared to the regulatory limit during an accident, additional analysis was done to determine the dose impact by source chemical form for each organ. These are shown in Tables 3K-3 and 3K-4. Only 40 year data are reproduced here, as there is insufficient pressure inside the DSC after 60 years to propel an airborne release of radioactivity.

3K.3 Results

For the 69BTH, the bounding dose to organs was [ ] to the bone surface and, for the 37PTH, the bounding dose was [ ], also to the bone surface, after 40 years of storage. In all of the limiting organ doses, the fines contributed more than [ ] of the total dose. For the total effective dose, this breakdown showed more than [ ] contributed by volatiles and most of the remaining, at approximately [ ] was from the fines.

3K.4 Conclusion

This appendix demonstrates that for design basis fuel and for a DSC leaking at a rate of [ ] after 40 years of storage, dose rates at 100 m from the bounding PWR and BWR canisters remain below the accident dose rate limits of 10 CFR 72.106. At 60 years, there is no internal pressure to drive a release in the event of a confinement breach. A comparison of the doses to the applicable regulation is shown in Tables 3K-5 and 3K-6.

3K.5 References

3K.5.1 NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems at a General License Facility," Final Report, Revision 1, July 2010.

3K.5.2 Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

3K.5.3 Oak Ridge National Laboratory Document ORNL-6698, NUREG/CR-5625, "Technical Support for a Proposed Decay Heat Guide Using SAS2H/ORIGEN-S Data," July 1994.

Table 3K-1
BWR Fuel Assembly Radionuclide Inventory after 40 and 60 Years of Storage

Nuclide	Activity- 40 Years (Ci)	Activity- 60 Years (Ci)	Group
^{3}H	5.02E+00	1.63E+00	Light Elements
Subtotal	5.02E+00	1.63E+00	
^{239}Np	2.27E+01	2.26E+01	Actinides
^{238}Pu	1.04E+03	8.86E+02	
^{239}Pu	6.13E+01	6.13E+01	
^{240}Pu	1.69E+02	1.71E+02	
^{241}Pu	3.72E+03	1.42E+03	
^{242}Pu	1.38E+00	1.38E+00	
^{241}Am	9.33E+02	9.79E+02	
^{242m}Am	8.41E-01	7.62E-01	
^{242}Am	8.37E-01	7.59E-01	
^{243}Am	2.27E+01	2.26E+01	
^{242}Cm	6.92E-01	6.28E-01	
^{243}Cm	4.15E+00	2.55E+00	
^{244}Cm	1.27E+03	5.92E+02	
^{245}Cm	7.64E-01	7.63E-01	
^{246}Cm	Note (1)	4.43E-01	
Subtotal	7.25E+03	4.16E+03	
^{3}H	1.83E+01	5.95E+00	Fission Products
^{85}Kr	1.55E+02	4.25E+01	
^{90}Sr	7.08E+03	4.33E+03	
^{90}Y	7.09E+03	4.33E+03	
^{129}I	1.09E-02	1.09E-02	
^{137}Cs	1.38E+04	8.69E+03	
^{137m}Ba	1.30E+04	8.21E+03	
^{151}Sm	7.31E+01	6.26E+01	
^{154}Eu	7.33E+01	Note (1)	
Subtotal	4.13E+04	2.57E+04	
^{60}Co	3.02E-01	2.173E-02	Crud
Total	4.86E+04	2.98+04	

Note:

1. If a radionuclide contributes less than 0.1% to the total activity, per the SRP, it is not required to be analyzed, with I-129 as an exception.

Table 3K-2
PWR Fuel Assembly Radionuclide Inventory after 40 and 60 Years of Storage

Nuclide	Activity- 40 Years (Ci)	Activity- 60 Years (Ci)	Group
^{3}H	1.23E+01	3.99E+00	Light Elements
Subtotal	1.23E+01	3.99E+00	
^{239}Np	5.05E+01	5.04E+01	Actinides
^{238}Pu	3.13E+03	2.67E+03	
^{239}Pu	1.61E+02	1.61E+02	
^{240}Pu	3.96E+02	3.99E+02	
^{241}Pu	1.00E+04	3.82E+03	
^{242}Pu	3.12E+00	3.11E+00	
^{241}Am	2.56E+03	2.68E+03	
^{242m}Am	4.66E+00	4.22E+00	
^{242}Am	4.64E+00	4.20E+00	
^{243}Am	5.05E+01	5.04E+01	
^{242}Cm	3.83E+00	3.47E+00	
^{243}Cm	1.16E+01	7.11E+00	
^{244}Cm	2.41E+03	1.12E+03	
^{245}Cm	Note (1)	1.52E+00	
Subtotal	1.88E+04	1.10E+04	
^{3}H	4.43E+01	1.44E+01	Fission Products
^{85}Kr	3.89E+02	1.07E+02	
^{90}Sr	1.86E+04	1.14E+04	
^{90}Y	1.86E+04	1.14E+04	
^{129}I	2.64E-02	2.64E-02	
^{137}Cs	3.36E+04	2.12E+04	
^{137m}Ba	3.17E+04	2.00E+04	
^{151}Sm	1.79E+02	1.53E+02	
^{154}Eu	1.76E+02	Note (1)	
Subtotal	1.03E+05	6.42E+04	
^{60}Co	1.05E-01	7.578E-03	Crud
Total	1.22E+05	7.51E+04	

Note:

1. If a radionuclide contributes less than 0.1% to the total activity, per the SRP, it is not required to be analyzed, with I-131 as an exception.

Table 3K-3
Dose Fraction by Chemical Form for BWR Fuel Stored 40 Years

[ ]

Table 3K-4
Dose Fraction by Chemical Form for PWR Fuel Stored 40 Years

Table 3K-5
Dose Summary for the 69BTH Confinement Calculations

Accident Conditions			
Organ	**10 CFR 72.106 Limit (rem)**	**Calculated Dose (rem)**	**Fraction**
Whole Body (TEDE)	5		
Critical Organ	50		
Skin	50		
Lens of the eye	15		

Table 3K-6
Dose Summary for the 37PTH Confinement Calculations

Accident Conditions			
Organ	**10 CFR 72.106 Limit (rem)**	**Calculated Dose (rem)**	**Fraction**
Whole Body (TEDE)	5		
Critical Organ	50		
Skin	50		
Lens of the eye	15		

APPENDIX 3L
Defense-in-Depth Evaluation of Dry Shielded Canister Internal Pressures Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation

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3L.1 Summary Description

The purpose of this evaluation is to determine the confinement boundary internal pressure for the NUHOMS® dry shielded canisters (DSCs) loaded with high burnup fuel assemblies assuming that [ ] of high burnup fuel rods will rupture and release their fill and fission gases into the DSC cavity after 20 years of storage. The calculated DSC internal pressures are used in Appendix 3M to demonstrate that the structural integrity of the DSC confinement boundary is maintained as a defense–in-depth evaluation.

In addition, this calculation determines the bounding normal and off-normal internal pressures in the NUHOMS® DSCs for the following conditions:

a. Normal condition after 20 years of storage assuming that 1% of fuel rods rupture,

b. Off-normal condition after 20 years of storage assuming that 10% of fuel rods rupture,

c. Normal condition after 60 years of storage assuming that 1% of fuel rods rupture.

The bounding normal and off-normal pressures after 20 years of storage (conditions a and b above) are used in a defense–in-depth evaluation in Appendix 3N to calculate the critical DSC shell crack size caused by chloride-induced stress corrosion cracking (CISCC). The calculation of the critical crack size is also a defense-in-depth evaluation.

3L.2 Analysis

There are concerns regarding dry storage of high burnup fuel assemblies beyond 20 years of storage due to potential degradation of the cladding as the high burnup fuel cools to below the ductile to brittle transition temperature (DBTT) during the renewal storage period.

As a defense-in-depth, this calculation assumes that [ ] of the fuel rods will rupture after 20 years of storage and determines the maximum DSC internal pressure due to release of fuel rod fill and fission gases to the DSC cavity.

In addition to the concerns regarding the storage of high burnup fuel, the evaluation of the critical crack size caused by CISCC in Appendix 3N requires the bounding NUHOMS® DSCs normal and off-normal internal pressures after 20 years of storage. The normal and off-normal DSC internal pressures are also determined in this calculation assuming that 1% and 10% of fuel rods rupture for normal and off-normal conditions, respectively.

NUHOMS® DSC normal internal pressure after 60 years of storage is also evaluated in this appendix.

The governing DSC component to demonstrate structural integrity of the DSC confinement boundary due to internal pressure is the inner top cover plate. Thus, the various NUHOMS® DSC models that are allowed for storage of high burnup fuel DSCs are categorized into four main groups according to their inner top cover plate thickness. The DSC with the highest accident pressure is then selected from each of the four categories for further evaluation. As seen from Table 3L-1, the four DSCs selected for evaluation are:

- Category 1: the 61BTH Type 1 DSC (inner top cover plate thickness = 0.75 in)
- Category 2: the 32PT-S125 DSC (inner top cover plate thickness = 1.25 in)
- Category 3: the 24PTH-S-LC and 24PHB DSCs
- Category 4: the 32PTH1-S DSC (inner top cover plate thickness = 2.00 in).

The pressure of the bounding DSC for each category is underlined in Table 3L-1. DSCs in category 3 include a composite thick lead shield plug/inner top cover plate, which results in low stresses in the DSC confinement boundary. Therefore, no internal pressure calculation is required for this category.

The DSC internal pressures are calculated using the ideal gas law following the methodologies described in the UFSAR [3L.4.2]. The additional assumptions are listed below.

- Hypothetically, all fuel rods rupture after 20 years of storage to provide bounding DSC internal pressures for a the defense-in-depth evaluation of the confinement boundary.

- 1% and 10% of the fuel rods are ruptured for normal and off-normal conditions, respectively, after 20 years of storage to provide the bounding DSC internal pressures for a defense-in-depth evaluation of the critical crack size due to CISCC.
- 1% of the fuel rods are ruptured for normal conditions after 60 years of storage to provide the bounding DSC internal pressures for a defense-in-depth evaluation of the dose rate effects.
- For ruptured fuel rods, the release rate of fuel rod fill gas is [ ] and the release rate of the fission gases is 30%, according to NUREG-1536 [3L.4.1].
- The annual average ambient temperature of 70 °F is considered to evaluate the DSC cavity gas temperature for normal conditions after 20 or 60 years of dry storage. The 47 °F temperature difference between the highest off-normal ambient temperature of 117 °F and the annual average ambient temperature of 70 °F is added to the average cavity gas temperature for normal condition to determine the bounding cavity gas temperature for the off-normal condition.

The DSC models and material properties are the same as those described in the Updated Safety Analysis Report (UFSAR) [3L.4.2]. The heat loads after 20 or 60 years of storage are calculated assuming the maximum burnup (62 GWd/MTU for 61BTH Type 1 and 32PTH1-S DSCs and 55 GWd/MTU for 32PT-S125 DSC), and the maximum initial enrichment of 5 wt. % U-235. The DSC shell temperature profiles are taken from the evaluations performed in Appendix 3G for each applicable horizontal storage module (HSM) and DSC type. To provide the bounding DSC shell temperature profiles consistent with the UFSAR, the DSC shell temperature profiles for the 61BTH Type 1 and 32PT-S125 DSCs are determined as they are loaded in the Standardized HSM, and the DSC shell temperature profile for the 32PTH1-S DSC is determined as it is loaded in the HSM-H.

3L.3 Results

The resulting DSC internal pressures calculated for the bounding cases to be used for evaluation of the confinement boundary in Appendix 3M are shown in Table 3L-2. These pressures are determined assuming [ ] of high burnup fuel rods are ruptured. The DSC types, the calculated total heat load of each DSC at the start and after 20 years of dry storage, the maximum fuel cladding temperatures, and the average cavity gas temperatures are also listed in Table 3L-2 for reference. The DSC shell temperature profiles for the 61BTH Type 1, 32PT-S125, and 32PTH1-S DSCs are shown in Figures 3L-1 through 3L-3.

The bounding DSC internal pressures for normal and off-normal conditions after 20 years of dry storage to be used for evaluation of the DSC confinement integrity in Appendix 3N are shown in Table 3L-3. The average cavity gas temperatures for normal and off-normal conditions are listed in Table 3L-3 for reference.

The bounding DSC internal pressures for normal condition after 60 years of dry storage are shown in Table 3L-4. For this case, the heat load and the maximum fuel cladding temperature are also listed for reference.

3L.4 References

3L.4.1 NUREG-1536, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility," Revision 1, July 2010.

3L.4.2 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

Table 3L-1
DSC Categories

Table 3L-2
Maximum DSC Internal Pressure after 20-Year Storage
with [ ] High Burnup Fuel Rod Rupture

[ ]

Table 3L-3
Normal and Off-Normal DSC Internal Pressures after 20-Year Storage

Table 3L-4
Normal DSC Internal Pressures after 60-Year Storage

Figure 3L-1
DSC Shell Temperature Profile for 61BTH Type 1 DSC after 20-Year Storage in Standardized HSM

Figure 3L-2
DSC Shell Temperature Profile for 32PT-S125 DSC after 20-Year Storage in Standardized HSM

Figure 3L-3
DSC Shell Temperature Profile for 32PTH1-S DSC after 20-Year Storage in HSM-H

APPENDIX 3M
Defense-in-Depth Structural Evaluation of Dry Shielded Canister Confinement and Retrievability Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation

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3M.1 Summary Description

This time-limited aging analysis (TLAA) evaluates the dry shielded canisters (DSCs) loaded with high burnup fuel assemblies for normal and off-normal conditions. It is assumed that there is a [ ] % rupture of high burnup fuel after 20 years of storage.

The DSCs that may be loaded with high burnup fuel are the 61BTH (Type 1 and 2), 32PT (S100, S125, L100, and L125), 24PTH (S, L, and S-LC), 24PHB, 32PTH1 (S, M, and L), 37PTH (S and M), and 69BTH. These DSCs are categorized into four groups based on their designs. Table 3M-1 lists all the key important parameters of these DSCs.

For the internal pressure load case, the top cover assembly is the most critical section. As seen from the bending stresses in the top cover plates in Table 3M-1, it could be concluded that Group 1 and Group 2 DSCs are bounding. In these two groups, the 61BTH Type 1 and 32PT-S125 have the highest internal pressure of [ ] psi and [ ] psi, respectively. The evaluation is performed for these two types of DSCs.

3M.2 Analysis

The structural evaluations of 61BTH Type 1 and 32PT are documented in Updated Safety Analysis Report (UFSAR) [3M.5.1] Sections T.3 and M.3, respectively. These DSCs are re-evaluated for the higher pressures and lower thermal loads after 20 years with [ ] % rupture of the high burnup fuel. Appendix 3L calculates the internal pressures with reduced temperature profiles after 20 years of storage and [ ] % rupture of the high burnup fuel. The finite element models (FEMs) used for the evaluations below are similar to those in the UFSAR, Appendix T for the 61BTH and Appendix M for the 32PT. The CONTAC elements used in the UFSAR FEMs are no longer supported by the current ANSYS [3M.5.3] version, so CONTAC49 elements from those models are replaced by surface-to-surface CONTA173. The design criteria and the material properties are the same as the UFSAR. The stress allowables are adjusted according to the reduced temperatures.

Internal Pressure:

The DSCs are evaluated for internal pressure load on the confinement boundary. The confinement boundary is defined by the DSC shell, the inner bottom cover plate, the inner top cover plate, the siphon/vent block, the port covers, and the associated welds.

Appendix 3L, Table 3L.2 lists the internal pressures applicable to the 61BTH Type 1 and 32PT DSC. The pressures are rounded up for this evaluation:

61BTH Type 1	Normal (Level A and B)	[ ] psig
32PT	Normal (Level A and B)	[ ] psig

Note that the internal pressure for Group 4 (32PTH1, 37PTH, and 69BTH) DSCs is slightly higher ([ ] psig) compared to the 32PT DSC ([ ] psig). However, the inner and outer top cover plates for Group 4 are [ ] in. each, compared to the 32PT DSCs, which are [ ], respectively. Hence, the evaluation for the 32PT DSC is bounding for Group 4 DSCs.

The stress intensity plot for the 61BTH Type 1 DSC top end is shown in Figure 3M-1, and for the bottom end in Figure 3M-3. The stress intensity plot for the 32PT DSC top end is shown in Figure 3M-5, and for the bottom end in Figure 3M-7.

Thermal Stress:

The DSCs are evaluated for thermal stresses resulting from thermal expansion and gradients between the various DSC components. These stresses are classified as secondary (Q) stresses that need be evaluated only for Service Level A and B conditions.

Appendix 3L provides calculation results of the temperature distribution for 61BTH Type 1 and 32PT DSCs after 20 years of dry storage. The existing evaluations for thermal stress of 61BTH Type 1 and 32PT from the UFSAR are re-evaluated for lower thermal loads. Temperature and stress intensity distribution plots for the 61BTH Type 1 DSC top end are shown in Figure 3M-2, and for the bottom end in Figure 3M-4. Temperature and stress intensity distribution plots for the 32PT DSC top end are shown in Figure 3M-6, and for the bottom end in Figure 3M-8.

3M.3 Results

All the load combinations listed in [3M.5.1] for the 32PT and 61BTH Type 1 DSCs are re-evaluated for higher internal pressure and reduced thermal loads after 20 years of storage. Material allowables are taken conservatively at 300 °F for the 32PT DSC and 61BTH Type 1 DSC. After 20 years of storage, this is a bounding temperature for both DSCs per Appendix 3L. The bounding stress results for confinement boundary components are listed in Table 3M-2 and Table 3M-3 for the 32PT, and Table 3M-4 and Table 3M-5 for the 61BTH Type 1.

3M.4 Conclusions

Based on the evaluation performed, the DSCs listed in CoC 1004 are structurally adequate for a hypothetical condition of [ ] % rupture of high burnup fuel assemblies after 20 years of storage.

3M.5 References

3M.5.1 AREVA Inc. Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3M.5.2 W.C. Young and R.G. Budynas, "Roark's Formulas for Stress and Strain," Seventh Edition, McGraw-Hill, New York, 2002.

3M.5.3 ANSYS Computer Code and user manuals, version 14.0.3.

Table 3M-1
DSC Loaded with High Burnup Fuel from CoC 1004

DSC Types	Group 1	Group 2 (1)						Group 3 (2)		Group 4 (3)		
	61BTH Type 1	61BTH Type 2	32PT-S100	32PT-S125	32PT-L100	32PT-L125	24PTH (S and L)	24PTH-S-LC	24PHB	32PTH1 (M & L)	37PTH (S & M)	69BTH
Outer Top Cover Plate (in)												
Inner Top Cover Plate (in)												
Top Shield Plug (in)												
Diameter (in)												
Internal Pressure (psi)(4)												
Combined Top Cover Plates Bending Moment (lbs-in)(5)												
Combined Top Cover Plates Bending Stress (psi)(6)												

Notes:

(1) Per Appendix 3L, 32PT-S125 has the bounding internal pressure for the Group 2 DSCs.

(2) For Group 3 the inner top cover plate and the top shield plug top casing plate form a composite plate encasing the top shield plug. Hence, for this group, the top end assembly is very stiff compared to other designs, hence is not considered bounding for internal pressure load.

(3) Per Appendix 3L, 32PTH1-S has the bounding internal pressure for the Group 4 DSCs.

(4) The internal pressures are taken from Appendix 3L.

(5) Bending moment at the center of the top cover plate with simply supported boundary condition is calculated as M =pr2(3+v)/16 [3M.5.2, Table 11.2].

(6) The bending stress in the top cover plates is calculated as S=6M/(t12+t22) [3M.5.2, Table 11.2].

Table 3M-2
Summary of 32PT DSC (Top Half) Confinement Boundary Stresses

Component	Service Level	Stress Category	Loads	Stress Intensity (ksi)	Allowable Stress (ksi)	Stress Ratio
Shell (Top Half)	A	P_m	DWH + PI(61) + 1g Vert.			
	A	P_L+P_b	DWH + PI(61) + 0.5g X, Y, Z			
	A	P_L+P_b+Q	DWH + PI(61) + 1g Vert. + TH			
Outer Top Cover Plate	A	P_m	DWH + PI(61) + 1g Vert.			
	A	P_L+P_b	DWH + PI(61) + 1g Vert.			
	A	P_L+P_b+Q	DWH + PI(61) + 1g Vert. + TH			
Inner Top Cover Plate	A	P_m	DWH + PI(61) + 1g Axial			
	A	P_L+P_b	DWH + PI(61) + 0.5g X, Y, Z			
	A	P_L+P_b+Q	DWH + PI(61) + 0.5g X,Y,Z + TH			

Note:

The outer top cover plate is not part of the confinement boundary, but provides structural support to the inner top cover plate.

Table 3M-3
Summary of 32PT DSC (Bottom Half) Confinement Boundary Stresses

Component	Service Level	Stress Category	Loads	Stress Intensity (ksi)	Allowable Stress (ksi)	Stress Ratio
Shell (Bottom Half)	B	P_m	DWH + PI(61) + 60k Grapple			
	A	P_L+P_b	DWH + PI(61) + 0.5g X, Y, Z			
	B	P_L+P_b+Q	DWH + PI(61) + 60k Grap + TH			
Inner Bottom Cover Plate	B	P_m	DWH + PI(61) + 80k Ram			
	B	P_L+P_b	DWH + PI(61) + 80k Ram			
	B	P_L+P_b+Q	DWH + PI(61) + 80k Ram + TH			

Table 3M-4
Summary of 61BTH Type 1 DSC (Top Half) Confinement Boundary Stresses

Component	Service Level	Stress Category	Loads	Stress Intensity (ksi)	Allowable Stress (ksi)	Stress Ratio
Shell (Top Half)	A	P_m	DWH + PI(35) + 1g Vert.			
	A	P_L+P_b	DWH + PI(35) + 1g Vert.			
	A	P_L+P_b+Q	DWH + PI(35) + 1g Vert. + TH			
Outer Top Cover Plate	A	P_m	DWH + PI(35) + 1g Vert.			
	A	P_L+P_b	DWH + PI(35) + 1g Vert.			
	A	P_L+P_b+Q	DWH + PI(35) + 1g Vert. + TH			
Inner Top Cover Plate	A	P_m	DWH + PI(35) + 1g Axial			
	A	P_L+P_b	DWH + PI(35) + 1g Axial			
	A	P_L+P_b+Q	DWH + PI(35) + 1g Axial + TH			

Note:

The outer top cover plate is not part of the confinement boundary, but provides structural support to the inner top cover plate.

Table 3M-5
Summary of 61BTH Type 1 DSC (Bottom Half) Confinement Boundary Stresses

Component	Service Level	Stress Category	Loads	Stress Intensity (ksi)	Allowable Stress (ksi)	Stress Ratio
Shell (Bottom Half)	B	P_m	DWH + PI(35) + 60k Grapple			
	B	P_L+P_b	DWH + PI(35) + 60k Grapple			
	B	P_L+P_b+Q	DWH + PI(35) + 80k Ram + TH			
Inner Bottom Cover Plate	B	P_m	DWH + PI(35) + 60k Grapple			
	B	P_L+P_b	DWH + PI(35) + 60k Grapple			
	B	P_L+P_b+Q	DWH + PI(35) + 80k Ram + TH			

Figure 3M-1
61BTH Type 1 Top End Internal Pressure
Boundary Condition and Stress Intensity Plots

Figure 3M-2
61BTH Type 1 Top End Thermal
Temperature Distribution and Stress Intensity Plots

Figure 3M-3
61BTH Type 1 Bottom End Internal Pressure
Boundary Condition and Stress Intensity Plots

Figure 3M-4
61BTH Type 1 Bottom End Thermal
Temperature Distribution and Stress Intensity Plots

Figure 3M-5
32PT Top End Internal Pressure
Boundary Condition and Stress Intensity Plots

Figure 3M-6
32PT Top End Thermal
Temperature Distribution and Stress Intensity Plots

Figure 3M-7
32PT Bottom End Internal Pressure
Boundary Condition and Stress Intensity Plots

Figure 3M-8
32PT Bottom End Thermal
Temperature Distribution and Stress Intensity Plots

APPENDIX 3N
Bounding Evaluation of Dry Shielded Canister with Reduced Shell Thickness Due to Chloride-Induced Stress Corrosion Cracking under Normal and Off Normal Conditions of Storage during Renewal Period

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3N.1 Summary Description

The purpose of this appendix is to determine the minimum thickness of the dry storage cask (DSC) shell required to demonstrate that the confinement function of the DSC is maintained and the requirement for ready retrieval of the DSC from the horizontal storage module (HSM) is met. The confinement function is considered to be met if the DSC confinement boundary stresses due to normal and off-normal loads meet the American Society of Mechanical Engineers (ASME) code stress limits for Level A and B conditions [3N.5.4]. The minimum thickness is governed by the crack depth postulated to occur due to chloride-induced stress corrosion cracking (CISCC). The time required to propagate the crack to reach the minimum thickness is also determined in this appendix.

3N.2 Methodology

The minimum shell thickness needs to be determined for NUHOMS® DSC shells 52B, 24P, 24PT2, 24PHB, 61BT, 32PT, 24PTH, 61BTH, 32PTH1, 69BTH, and 37PTH to support the license renewal (LR) application [3N.5.1]. Considering all these DSC designs certified under Certificate of Compliance (CoC) 1004, the 32PTH1 (L Configuration) DSC shell is bounding, having a nominal DSC shell thickness of 0.50 inch and a total bottom end thickness of 6.50 inches, comprising an inner bottom cover plate (2.25 inches), bottom shield plug (2.25 inches), and outer bottom cover plate (2.0 inches). This DSC has a pull load of 80 kips for its retrieval from the HSM modules. The 32PTH1 DSC is selected as the bounding DSC for this evaluation based on shell thickness, bottom cover assembly thickness, transfer push and pull loads, design pressure and heat load. The evaluation is performed on the 32PTH1 DSC for normal and off-normal storage loads and load combinations (Level A and B) for retrieval of the DSC from the HSM module. The confinement boundary is evaluated based on the stresses due to maximum internal pressure and pull loads. The welds of the DSC outer bottom cover plate and grapple ring are not evaluated because they are readily accessible for inspection and, if necessary, repair at the time of DSC retrieval.

Updated Final Safety Analysis Report (UFSAR) [3N.5.2], Appendix U, describes the analysis, loads, and load combination results for 32PTH1 DSC. Based on the review of results for different load combinations from UFSAR Table U.3.7-18, HSM unloading combination UL-6 and HSM loading combination LD-5 are bounding for Level A and B limits for the DSC shell. Because the purpose of this appendix is to evaluate retrieval rather than loading, load case LD5 will be ignored, and HSM unloading combination (UL-6) for the retrieval of the DSC from the HSM module is considered for the analysis.

3N.3 Finite Element Analysis

3N.3.1 Analysis of 32PTH1 DSC Assuming Shell Thickness is Reduced by 50 Percent

The finite element model (FEM) description for this DSC is provided in UFSAR Section U.3.6.1.2 [3N.5.2]. The analysis in this section is performed assuming that the DSC total thickness is reduced by half. Conservatively analysis is performed assuming the initial design internal pressure of 20 psig and initial storage temperatures. ANSYS [3N.5.3] software is used for the analysis. The only modification made to the input file for FEM is changing the DSC shell thickness from 0.50 inch to 0.25 inch. The entire FEM, loads, and boundary conditions and analysis options remain as described in the UFSAR. Individual analyses were performed for unloading dead weight (DWH), internal pressure (20 psig), grapple pull (80 kips), and thermal load. Maximum stresses were conservatively added regardless of the high stress location from each load case. The stress from each individual load case is combined as shown in Table 3N-1. The internal pressure and grapple pull stress intensity plots are shown in Figure 3N-1 and Figure 3N-2, respectively.

3N.3.2 Analysis to Determine the Minimum DSC Shell Thickness before It Reaches the ASME Code Allowable Stress Limits

The FEM description for this DSC is provided in UFSAR, Section U.3.6.1.2. In order to determine the minimum DSC shell thickness whose stresses approach the ASME code allowable, some conservatism in the analysis is removed. The evaluation and results provided in the UFSAR for the 32PTH1 DSC shell are based on initial storage maximum internal pressure of 20 psig and initial storage maximum shell temperature. Based on Appendix 3L of this application, the internal pressure will be reduced to 10 psig (off-normal) after 20 years in storage and the maximum DSC shell temperature is found to be approximately [ ] °F. The evaluation uses this reduced pressure and temperature. ANSYS [3N.5.3] software is used for the analysis. All other loads and boundary conditions remain unchanged from UFSAR load case UL-6.

The DSC shell thickness in the analysis was progressively reduced from [ ] inch, until at [ ] inch, the stresses approached the ASME code allowable. Any further reduction in the thickness will exceed the allowable for grapple pull load. The stress from each individual load case is combined as shown in Table 3N-2. The internal pressure and grapple pull stress intensity plots are shown in Figure 3N-3 and Figure 3N-4, respectively.

3N.3.3 Chloride-Induced Stress Corrosion Cracking for the Reduced DSC Shell

Detailed discussion on CISCC is provided in Appendix 5 of this application. As presented in Figure 5B-10 from Appendix 5, the results show that for the maximum temperature location on the canister surface, the crack penetration depth of [ ] inch ([ ] mm) can be reached at the earliest after [ ] years of storage.

3N.4 Results and Conclusions

The maximum stress ratio is found to be [ ] for unloading load combination UL-6 for a DSC shell thickness of [ ] inch considering maximum initial pressure and shell temperature.

Based on the analysis, a DSC shell thickness of [ ] inch is adequate to maintain confinement and retrievability of the DSC from horizontal storage modules. The analysis shows that the DSC with [ ] inch thickness can accommodate the stresses due to normal and off-normal loads while meeting the ASME Code stress limits. CISCC will not penetrate [ ] inch into a DSC shell for at least [ ] years of storage. Therefore, DSCs with a minimum shell thickness of 0.50 inch remain safe for storage and retrieval for this duration.

As a defense-in-depth, the DSC shell thickness was re-evaluated with the reduced pressure and temperature at the end of 20 years of storage, resulting in a minimum thickness of [ ] inch for load combination UL-6. Based on Figure 5B-10, a minimum storage time of [ ] years is required for CISCC to progress to a depth of [ ] inch ([ ] mm), leaving a reduced thickness of [ ] inch in a 0.5 inch shell.

3N.5 References

3N.5.1 NUREG 1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," March 2011.

3N.5.2 AREVA Inc., Document NUH003.0103, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 14, September 2014.

3N.5.3 ANSYS, Inc., "ANSYS Computer Code and User's Manual," Version 10.0, Release A1, ANSYS, Inc., Canonsburg, Pennsylvania, August 2005.

3N.5.4 American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NB, 1998 Edition including 2000 Addenda.

Table 3N-1
Summary of Stresses within Pressure Boundary for Bounding Load Combination
(32PTH1 DSC for Shell Thickness of [ ] inch)

Load Case	Service Level	Stress Category	Loads	Stress Intensity (ksi)	Allowable Stress (ksi)(1)	Stress Ratio
Unloading Load Combination UL-6	B	$P_L + P_b$	DWH + PI(20) + Grapple Pull	[ ]	[ ]	[ ]
		$P_L + P_b + Q$	DWH + PI(20) + Grapple Pull+ THS	[ ]	[ ]	[ ]

Notes:

1. Stress allowable values are conservatively taken at initial storage temperature of [ ]°F.
2. Membrane + Bending stresses are conservatively compared against membrane stress values.

Table 3N-2
Summary of Stresses within Pressure Boundary for Bounding Load Combination
(32PTH1 DSC for Reduced Shell Thickness of [ ] inch)

Load Case	**Service Level**	**Stress Category**	**Loads**	**Stress Intensity (ksi)**	**Allowable Stress (ksi)[1]**	**Stress Ratio**
Unloading Load Combination UL-6	B	P_m	DWH + PI(10) + Grapple Pull	[ ]	[ ]	[ ]
		$P_L + P_b$	DWH + PI(10) + Grapple Pull	[ ]	[ ]	[ ]
		$P_L + P_b + Q$	DWH + PI(10) + Grapple Pull + THS	[ ]	[ ]	[ ]

Notes:

1. Stress allowable values are taken at [ ]°F.

Figure 3N-1
Pressure Boundary Stresses for NUHOMS®-32PTH1 DSC Shell Line Break -
[ ] Inch Thick, Internal Pressure [ ] psig

Figure 3N-2
Pressure Boundary Stresses for NUHOMS®-32PTH1 DSC Shell Line Break -
[ ] Inch Thick (Grapple-Pull)

Figure 3N-3
Pressure Boundary Stresses for NUHOMS®-32PTH1 DSC Shell Line Break -
[ ] Inch Thick, Internal Pressure [ ] psig

[ ]

Figure 3N-4
Pressure Boundary Stresses for NUHOMS®-32PTH1 DSC Shell Line Break -
[ ] Inch Thick (Grapple-Pull)

APPENDIX 4:

Lead Canister Inspection

APPENDIX 4A
Lead Canister Inspection

CONTENTS

4A.1 Summary Description

Appendix E of NUREG-1927 [4A.4.1], "Component-Specific Aging Management" states "This [lead canister] inspection is expected to be performed before submittal of the license renewal application." The purpose of lead canister inspection is to demonstrate that canisters have not undergone unanticipated degradation to ensure confinement function of the canister for the license renewal.

A lead canister inspection was not performed prior to the renewal submittal for the NUHOMS® DSRS loaded vendor Certificate of Compliance (CoC) 1004. As a CoC holder, AREVA Inc. does not have direct authority over general licensee storage systems. However, AREVA Inc. did consider lead canister inspection reports and baseline inspections from similar NUHOMS®-based site-specific independent spent fuel storage installation (ISFSI) renewal applications [4A.4.2, 4A.4.5, 4A.4.6]. Information from these lead canister and baseline inspection reports were evaluated as part of the aging management review (AMR) process to confirm applicable actual or potential aging effects and associated aging mechanisms specific to the NUHOMS® storage system components. These NUHOMS®-based site-specific ISFSI lead canister and baseline inspection reports demonstrated that NUHOMS® canisters have not undergone unanticipated degradation ensuring confinement function of the canister for the license renewal.

The review of previous NUHOMS®-based lead canister and baseline inspections contributed to the identification of applicable aging effects in the AMR and determination of aging effects that should be managed for the period of extended storage. In addition, the review aided in the development of aging management program (AMP) inspection scope, evaluation of parameters, detection of aging effects, monitoring and trending, and acceptance criteria elements of an AMP.

The CoC 1004 renewal application proposes license conditions that require general licensees to perform dry shielded canister (DSC) and horizontal storage module (HSM) AMPs. These AMPs include a requirement for baseline inspections (a lead canister inspection at the licensee's ISFSI) prior to entering the period of extended storage or as prescribed in the baseline inspection implementation schedule detailed in Appendices 6A.3 through 6A.5.

The combination of incorporating operating experience (OE) learned from previous NUHOMS®-based inspections and including a requirement for a baseline inspection at general licensee's ISFSI meet the intent of NUREG-1927 Appendix E guidance and is in compliance with 10 CFR 72.240(c)(3) and 10 CFR 72.240(d).

4A.2 NUHOMS®-based Site-specific ISFSI Lead Canister and Baseline Inspection Review

Information from the lead canister and baseline inspection reports from similar NUHOMS®-based site-specific ISFSI renewal applications were evaluated as part of the AMR process. These include the site-specific renewal applications inspection reports for Calvert Cliffs Nuclear Power Plant ISFSI [4A.4.2], Oconee Nuclear Station ISFSI [4A.4.3], and H.B. Robinson Steam Electric Plant ISFSI [4A.4.4, 4A.4.5]. These inspections reports are considered relevant because their ISFSIs are based on similar NUHOMS®-based storage system designs.

A summary of the inspections is provided below:

Calvert Cliffs Nuclear Power Plant ISFSI, Material License No. SNM-2505

The Calvert Cliffs ISFSI was originally licensed with the NUHOMS®-24P dry storage system in November 1992. The principal components are an HSM composed of concrete and structural steel, and a stainless steel DSC with an internal basket that holds the spent fuel. The exterior walls and roof of the HSM are 3-feet thick, and the interior walls are 2-feet thick.

On June 27th and 28th, 2012, Calvert Cliffs performed an inspection of the interior of two HSMs, and the exterior of the DSCs contained therein. The inspection was conducted in accordance with Calvert Cliffs Nuclear Power Plant Engineering Test Procedure, "Aging Management and Marine Environment Effects Inspection of ISFSI Horizontal Storage Module and Dry Storage Canisters." The first module examined was HSM-15, which was loaded in November 1996 and contained the "lead canister" DSC for the purpose of meeting the NUREG-1927 Appendix E guidance. The second module inspected was HSM-1, which was loaded in November 1993 (the first loading) and represents one of the lowest heat load canisters presently loaded (estimated at 4.2 kW). This canister was added as part of the Electric Power Research Institute (EPRI) research efforts on evaluating stress corrosion cracking of stainless steel canisters used for dry storage. This inspection included salt concentration measurements on the upper shell of the DSC, collection of samples of the deposits on the upper shell of the DSC for offsite analysis, and surface temperature measurements via contact thermocouple for the purpose of benchmarking best-estimate thermal models.

The visual inspection was conducted in both HSM-15 and HSM-1 by remote and direct means. The remote inspection was performed by lowering a remote controlled, high definition pan-tilt-zoom (PTZ) camera system with a 100 mm head camera inserted through the rear outlet vent which allowed viewing of the majority of the DSC, its support structure, and the interior surfaces of the HSM. The direct inspection was performed through the partially open door by mounting the camera on a pole. This allowed for views of the bottom end of the DSC, the seismic restraint, HSM doorway opening, and the backside of the HSM door. Varying levels of camera magnification were utilized to highlight various areas of interest during the inspection.

Based on the visual examinations described above, it was concluded that the Calvert Cliffs baseline inspection of HSM and DSC structures were performing as expected. The inspection did not indicate any aging-related deficiencies with the DSC components. Some minor degradations on HSM external concrete surfaces have been noted. There was evidence of localized water intrusion to the interior of the HSM in the vicinity of the rear outlet vents. A coating of dust and dirt was present on the floors of each HSM but no debris or standing water was observed. There was some general surface corrosion noted on the carbon steel surface and bolting hardware. Noted deficiencies have been entered into corrective action program for evaluation.

<u>Oconee Nuclear Station ISFSI, Material License No. SNM-2503</u>

The Oconee Nuclear Station ISFSI was originally licensed on January 29, 1990. The 20-year license expired on January 31, 2010. A 40-year license extension was approved on May 29, 2009, and expires January 31, 2050.

The principal components are a concrete HSM and a stainless steel DSC with an internal basket which holds the spent fuel assemblies (SFAs). Each HSM contains one DSC and each DSC contains 24 fuel assemblies.

The initial phase (Phase I) of construction, which included twenty modules, was completed in May 1990. Phase II of twenty modules was completed in January 1992. The reinforced concrete HSMs were constructed in place at the storage location. Phase III began in 1997 when Oconee switched to the Standardized NUHOMS®-24P as a general licensee of the CoC 1004 system design. The two dry storage systems are similar; the Standardized NUHOMS® System HSMs are constructed offsite and assembled onsite. The 24P DSCs used in Phases I and II are essentially the same as the general license 24P DSCs under Phase III.

A baseline Civil/Structural Inspection of the Oconee Nuclear Site ISFSI Phase I and II structures was conducted on December 4th and 5th, 2006. The purpose of these inspections was to evaluate the current condition of the structures as part of the site-specific ISFSI License Renewal Project. The entire exterior of both structures was examined in detail. The interior of three HSMs was examined to the extent possible using remote and direct methods. One door was raised for direct inspection of the HSM opening. The conclusion was there were no indications of structural distress or degradation that would render the facility incapable of performing its intended function. The DSCs were not inspected. In the safety evaluation report (SER), the NRC noted: "There are no aging effects that require management during the renewed license period for subcomponents located inside an HSM. This is due to the more benign HSM interior environment. The external components made of identical materials act as leading indicators for deleterious corrosion conditions that could be postulated to occur to components located inside an HSM." [4A.4.6]

Based on the visual examinations described above, it was concluded that the Oconee Nuclear Site ISFSI Phase I and II structures were performing as expected. Some minor maintenance was recommended to address limited loss of coatings and corrosion, and missing alignment targets.

<u>H.B. Robinson Steam Electric Plant ISFSI, Material License No. SNM-2502</u>

The H.B. Robinson Steam Electric Station ISFSI was originally licensed on August 31, 1986. The 20-year license expired on August 31, 2006. A 40-year license extension was approved on March 30, 2005 and expires on August 31, 2046.

The principal components are a concrete HSM and a steel DSC with an internal basket which holds the SFAs. The ISFSI contains a total of eight modules. These were built in two units: a three-module unit and a five-module unit. Each unit is a reinforced concrete monolithically poured-in-place unit. The modules in each unit are constructed on a common foundation and are interconnected. The outer, exposed walls are 3 1/2-feet thick concrete to provide the necessary shielding. Each HSM houses one DSC, and each DSC is loaded with seven fuel assemblies (7P DSC). The 7P DSC basket is a spacer disc design with guidesleeves and support rods similar to the CoC 1004 24P design. Both the HSM and the DSC consists of generally the same main parts as those of the CoC 1004 HSM and 24P DSCs (i.e., reinforced concrete, carbon steel support structure, embedments for the HSM; 304 stainless steel shell with lead end shields and an internal spacer disc with support rods basket). These components perform in the same manner and have the same safety functions as those in the CoC 1004.

Two interior remote inspections of the HSM were performed using a video camera. The first inspection was performed in 1993 as supporting documentation for a license amendment. The second inspection was performed in March 1999 as a 10-year follow-up licensing commitment. Both inspections focused on the HSM inlets and outlets to ascertain that there was no blockage internal to the HSM. No inspections of the DSC were performed. In the NRC SER for license renewal, the NRC noted that since no degradation was observed and as a result of the NRC acceptance of the results of these inspections: "….interior inspections were discontinued. No additional remote inspections of the interior concrete and steel surfaces are planned during the renewal period because of the durable corrosion resistant materials used and the lack of an aggressive environment….Consideration of the radiation exposures (to inspection personnel) are contrary to the ALARA principle in the absence of significant benefit." [4A.4.7]

Environmental Factors Review

Calvert Cliffs is in a coastal brackish environment. Oconee and Robinson are inland sites. HSMs inspected at these sites showed no aging-related degradation to the concrete on the interior of the HSM. However, at Calvert Cliffs, the HSM showed water marks on the DSC and concrete leaching where it appeared that wind-blown water had entered through the rear vent. At both sites, there was coating failure and corrosion on the internal HSM steel. For Oconee, no corrosion was observed on the support brackets for the DSC support structure. Coatings had failed and there was surface corrosion on the attachment welds for the support angle supporting the front inlet plenum. Paint-flaking and corrosion were noted on the door support frame and exterior steel surfaces of some doors. For Calvert Cliffs, there was coating failure and corrosion on welds attaching one angle support for the support rails structure. Also, one of the attachment bolts showed corrosion.

For the DSC at Calvert Cliffs, there were minor corrosion spots on the canister indicative of carbon steel contamination during fabrication or installation. The loose dry deposit found on the top of the canister that was investigated for chloride content.

4A.3 Conclusions

The site-specific NUHOMS® dry storage system components are of similar design as those in the CoC 1004 general license designs.

The 24P DSC for Calvert Cliffs and Oconee site-specific licenses are essentially the same as the 24P in the CoC 1004 general license. Both designs consist of a stainless steel shell and top and bottom cover plates assemblies and an internal spacer disc type basket assembly. Similar welding and fabrication processes, that is, cold rolled plate, full penetration welded seams are used in the fabrication of these DSCs. In some cases, the same fabricator was used.

Although the method of construction of the HSMs is different (the site-specific HSMs are constructed in place and the CoC 1004 HSMs are modular units constructed offsite and assembled on the ISFSI pad), the basic HSM design principles and design functions are similar. In both instances the HSMs consist of (1) reinforced concrete walls and roof to provide shielding and environment/natural phenomena hazard protection, (2) an internal carbon steel structure that provides structural support for the DSC, (3) coated carbon steel heat shields to protect the concrete from radiating temperatures, and (4) inlet/outlet vents for passive decay heat air circulation.

In addition to NUHOMS® storage system-specific OE, the development of CoC 1004 AMR and AMPs considered analysis tools and reports provided by EPRI, NUREG/CRs, and industry OE.

In conclusion, existing site-specific ISFSIs lead canister and baseline inspection results contributed valuable input to the overall CoC 1004 AMR process and development of AMPs for the CoC 1004 renewal application. Previous NUHOMS®-based site-specific ISFSI lead canister and baseline inspection reports demonstrated that NUHOMS® canisters have not undergone unanticipated degradation. Therefore, the intent of NUREG-1927 Appendix E guidance is met.

4A.4 References

4A.4.1 NUREG 1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," March 2011.

4A.4.2 Calvert Cliffs Nuclear Power Plant, "Independent Spent Fuel Storage Installation, Material License No. SNM-2505, Docket No. 72-8, Response to Request for Supplemental Information, RE: Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal Application," (TAC No. L24475), ADAMS ML12212A216, July 27, 2012.

4A.4.3 Duke Energy Carolinas, LLC, "Oconee Nuclear Station, Docket No. 72-4, License No. SNM-2503, License Renewal Application for the Site-Specific Independent Spent Fuel Storage Installation (ISFSI) - Response to Requests for Additional Information, License Amendment Request No. 2007-06," ADAMS ML090370066, January 30, 2009.

4A.4.4 H.B. Robinson Steam Electric Plant, Unit No. 2, "Independent Spent Fuel Storage Installation, Docket No. 72-3/License No. SNM-2502, Independent Spent Fuel Storage Installation (ISFSI) Inspection Report," January 31, 1994.

4A.4.5 H.B. Robinson Steam Electric Plant, Unit No. 2, "Independent Spent Fuel Storage Installation, Docket No. 72-3/License No. SNM-2502, Independent Spent Fuel Storage Installation (ISFSI) Inspection Report," May 5, 2000.

4A.4.6 U.S. Nuclear Regulatory Commission, Safety Evaluation Report, Docket No. 72-04 "Oconee Nuclear Station Independent Spent Fuel Storage Installation," License No. SNM-2503 License Renewal, May 29, 2009, ADAMS ML091520159.

4A.4.7 U.S. Nuclear Regulatory Commission, Safety Evaluation Report Docket No. 72-3, "H. B. Robinson Independent Spent Fuel Storage Installation," License No. SNM-2502 License Renewal, March 30, 2005, ADAMS ML050890397.

APPENDIX 5:

CISCC Information

Proprietary Information on Pages 5A-i and 5A-ii, and 5A-1 through 5A-39
Withheld Pursuant to 10 CFR 2.390

Proprietary Information on Pages 5B-i and 5B-ii, and 5B-1 through 5B-38
Withheld Pursuant to 10 CFR 2.390

APPENDIX 6:

Aging Management Program

APPENDIX 6A
Aging Management Program

CONTENTS

LIST OF TABLES

6A.1 Introduction

This appendix describes the aging management program (AMP) credited for managing each of the identified aging effects for the in-scope structures, systems, and components (SSCs) of the NUHOMS® dry storage system. The purpose of the AMP is to ensure that no aging effects result in a loss of intended function of the SSCs that are within the scope of renewal, for the term of the renewal [6A.9.1]. The AMP is based on the results of the aging management review (AMR) for the dry shielded canisters (DSCs), horizontal storage modules (HSMs), and transfer casks (TCs) presented in Chapter 3, Sections 3.5, 3.6, and 3.7, respectively. The tables in the AMR section in each of Appendices 1A through 1J summarize the results of the AMR for each of the SSCs under Amendment 0 through Amendment 11 and Amendment 13, and identify the aging management activity (AMA) credited for managing each aging effect and aging mechanism for each component or subcomponent evaluated in the AMR.

The AMP applies under the extended Certificate of Compliance (CoC) terms, that is, implementation of the AMP is a CoC condition for the NUHOMS® storage system components in service after the initial 20-year period. The requirement for implementation of the proposed AMP is set forth under the terms and conditions of the renewed certificate, which includes high-level requirements for each general licensee to have a program to establish, implement, and maintain written procedures for each implementing AMP as described in new Section 12.3 of the UFSAR [6A.9.34]. This is in accordance with regulation outlined under 10 CFR 72.240(e), which states that the U.S. Nuclear Regulatory Commission (NRC) may, as part of the approval of a CoC renewal application, revise the terms, conditions, and specifications of the CoC to require the implementation of an AMP.

The AMP under the extended CoC terms adopts the tollgate process from NEI 14-03 [6A.9.2]. Licensees and AREVA Inc. assess new information relevant to aging management, as it becomes available, in accordance with normal corrective action and operating experience (OE) programs. Tollgates provide an opportunity to seek out other information that may be available, and to perform an aggregate assessment. The tollgate process amplifies the existing practice of continual evaluation of site-specific and industrywide dry cask storage (DCS) OE for impacts on a given licensee's DCS AMP.

- The AMPs developed to manage aging effects for the period of extended operation are:
- DSC External Surfaces Aging Management Program (applicable to DSC)
- DSC Aging Management Program for the Effects of Chloride-Induced Stress Corrosion Cracking (applicable to DSC)
- Horizontal Storage Module Aging Management Program for External and Internal Surfaces (applicable to HSM and DSC support structure)

- HSM Inlets and Outlets Ventilation Aging Management Program (applicable to HSM)
- Transfer Cask Aging Management Program (applicable to TC)
- High Burnup Fuel Aging Management Program (applicable to DSC containing high burnup (HBU) fuel)

In this Appendix, the terms DSC, HSM, and TC are used in a generic sense, and are intended to apply to the various types of DSCs, HSMs and TCs under CoC 1004 certification.

6A.2 Aging Management Program Elements

The structure of the AMPs is consistent with the 10 program elements described in NUREG-1927, as follows:

1. Scope of the program: The scope of the program should include the specific structures and components subject to an AMR.
2. Preventive actions: Preventive actions should mitigate or prevent the applicable aging effects.
3. Parameters monitored or inspected: Parameters monitored or inspected should be linked to the effects of aging on the intended functions of the particular structure and component.
4. Detection of aging effects: Detection of aging effects should occur before there is a loss of any structure and component intended function. This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new or one-time inspections to ensure timely detection of aging effects.
5. Monitoring and trending: Monitoring and trending should provide for prediction of the extent of the effects of aging and timely corrective or mitigative actions.
6. Acceptance criteria: Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the particular structure and component intended functions are maintained under the existing licensing-basis design conditions during the period of extended operation.
7. Corrective actions: Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8. Confirmation process: The confirmation process should ensure that preventive actions are adequate and appropriate corrective actions have been completed and are effective.
9. Administrative controls: Administrative controls should provide a formal review and approval process.
10. Operating experience: OE involving the AMP, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support a determination that the effects of aging will be adequately managed so that the structure and component intended functions will be maintained during the period of extended operation.

Proprietary Information on Pages 6A-4 through 6A-57
Withheld Pursuant to 10 CFR 2.390

ATTACHMENT A
CHANGES TO THE COC 1004 UPDATED FINAL SAFETY ANALYSIS REPORT

CONTENTS

LIST OF TABLES

A.1 Introduction

The proposed changes to the Certificate of Compliance (CoC) 1004 Updated Final Safety Analysis Report (UFSAR) for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel to support the CoC 1004 renewal are discussed and described in this attachment.

Table A-1 provides a list of changed UFSAR pages, a description of each change, and the basis for the change. Table A-2 through Table A-7 provide the format and referenced content for new UFSAR Chapter 12 Tables.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	**UFSAR Revision 14 Page**	**Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)**	**Basis for Change**
Section 1	1.1-1	Following the fourth paragraph, add the following new note: "**<u>NOTE: CoC 1004 was originally licensed for 20 years. On [mm/dd/yy], the NRC approved renewal of CoC 1004 for an additional 40 years. The aging management activities associated with this renewal apply to the previously approved amendments, and future amendments will include an aging management review (AMR) and any resultant, required aging management activities. The current aging management results are detailed in Chapter 12.</u>** **<u>These original UFSAR chapters, plus the appendices, which report the analysis of additional DSCs, HSMs, and transfer casks (TCs), indicate design life and service life values of 40 years or 50 years. The new design life is 60 years. Time-limited aging-analyses (TLAAs) associated with original analyses, which involved time-limited assumptions defined by the original operating term, are detailed in Chapter 12, Section 12.2.</u>** **<u>Analysis discussion and details in these original UFSAR chapters and appendices are not revised as a result of renewal, but notes discussing renewal and referencing Chapter 12 are included for clarity throughout this UFSAR.</u>**"	CoC renewal discussion provided in this historical introductory UFSAR section, with pointers to AMR results.
Table 1.2-2	1.2-8	Change Table 1.2-2 entry for Dry Shielded Canister Service Life to read: "50 years~~[1]~~**<u>[(1)(2)]</u>**"	Extended storage period.
Table 1.2-2	1.2-8	Change Table 1.2-2 entry for Onsite TC Service Life to read: "50 years**<u>[(2)]</u>**"	Extended storage period.
Table 1.2-2	1.2-8	Change footnote 1 to read: "Expected life is much longer (hundreds of years), however, for the purpose of this generic FSAR, the service life is taken as 50 years**<u>[(2)]</u>**"	Extended storage period.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
Table 1.2-2	1.2-8	Add footnote 2, to read: "**<u>(2) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
Table 1.2-2	1.2-9	Change Table 1.2-2 entry for Horizontal Storage Module Service Life to read: "50 years<u>(2)</u>"	Extended storage period.
Table 1.2-2	1.2-9	Add footnote 2, to read: "**<u>(2) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
1.3.1.1	1.3-1	At the end of the discussion under "1.3.1.1 <u>Dry Shielded Canister</u>," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>Aging management program (AMP) requirements for use of the 24P and 52B DSC during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	
1.3.1.2	1.3-2	At the end of the discussion under "1.3.1.2 <u>Horizontal Storage Module</u>," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the HSM during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
1.3.1.3	1.3-3	At the end of the discussion under "1.3.1.3 Onsite Transfer Cask," add an un-numbered heading "**Aging Management Program Requirements**" Add text: "**AMP requirements for use of the Onsite TC during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.**"	
8.1.1.1	8.1-4	Change the second paragraph to read: "The long-term average normal ambient temperature for the 50 year design life**(1)** of the system is assumed to be 70 °F."	Extended storage period.
8.1.1.1	8.1-4	Add footnote 1, to read: "**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**"	Extended storage period.
8.1.1.5	8.1-21	Change the first paragraph under D. to read: "The accumulated neutron flux over the 50 year service life**(1)** of the HSM is estimated to be 1.7E14 neutrons/cm^2."	Extended storage period.
8.1.1.5	8.1-21	Add footnote 1, to read: "**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**"	Extended storage period.
8.1.3	8.1-34	Change fourth sentence of bullet A. to read: "The lifetime average ambient temperature for the 50 year service life**(1)** is taken as 70 °F."	Extended storage period.
8.1.3	8.1-34	Add footnote 1, to read: "**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**"	Extended storage period.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
8.2.10.5	8.2-48	Add a new first paragraph, in the form of a note, as follows: "**NOTE: The discussion that follows is for the HSM thermal cycling for the period of initial licensing. The TLAA that includes HSM thermal fatigue performed for the initial CoC 1004 renewal application is provided in Section 12.2.3.**"	Add a note in the UFSAR where the original HSM thermal cycling discussion is provided, referencing the UFSAR section that provides the TLAA that updates this information.
B 10.5.2.4.c Leak Test	10-29	Change the first two sentences of the BASES to read: "If the DSC leaked at the maximum acceptable rate of $1.0x10^{-4}$ atm cm^3/s for a period of ~~20~~ **60** years, about ~~63,100~~**189,600** cc of helium would escape from the DSC. This is about ~~1~~**3.25**% of the ~~6.3~~**5.83** x 10^6 cm^3 of helium initially introduced in the DSC."	Extended storage period.
Chapter 12	12-1	Add centered heading "**12. AGING MANAGEMENT**" with only "AGING MANAGEMENT" underlined.	New UFSAR chapter.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.1 (new)	new	Add heading "**<u>12.1 Aging Management Review</u>**" with only "Aging Management Review" underlined. Add text: "**<u>The AMR of the Standardized NUHOMS® System contained in the application for initial CoC renewal provides an assessment of aging effects that could adversely affect the ability of in-scope SSC to perform their intended functions during the extended storage period. Aging effects, and the mechanisms that cause them, are evaluated for the combinations of materials and environments identified for the subcomponent of the in-scope structures, systems, and components (SSCs) based on a review of relevant technical literature, available industry operating experience (OE), and AREVA Inc. OE. Aging effects that could adversely affect the ability of the in-scope SSC to perform their safety function(s) require additional aging management activity to address potential degradation that may occur during the extended storage period. The TLAAs and AMPs that are credited with managing aging effects during the extended storage period are discussed in Sections 12.2 and 12.3, respectively.</u>**"	New section describing AMR.
12.2 (new)	new	Add heading "**<u>12.2 Time-Limited Aging Analyses and Other Supporting Evaluations</u>**" with only "Time-Limited Aging Analyses and Other Supporting Evaluations" underlined. Add text: "**<u>A comprehensive review to identify the TLAAs for the in-scope SSCs of the Standardized NUHOMS® System was performed to determine the analyses that could be credited with managing aging effects over the extended storage period. The TLAAs identified involved the in-scope SSCs, considered the effects of aging, involved explicit time-limited assumptions, provided conclusions regarding the capability of the SSC to perform its intended function through the operating term, and were contained or incorporated in</u>**	New section discusses TLAAs that are credited with managing aging effect during the extended storage period.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
		the licensing basis. The TLAAs identified and other supporting evaluations include: **(1) Fatigue Evaluation of the Dry Shielded Canister** **(2) Fatigue Evaluation of the Transfer Casks** **(3) Horizontal Storage Module Concrete and Dry Shielded Canister Steel Support Structure Thermal Fatigue, Corrosion, and Temperature Effects Evaluation** **(4) Dry Shielded Canister Poison Plates Boron Depletion Evaluation** **(5) Evaluation of Neutron Fluence and Gamma Radiation on Storage System Structural Materials** **(6) Confinement Evaluation of 24P and 52B Non-Leaktight Dry Shielded Canisters** **(7) Thermal Performance of Horizontal Storage Modules for the Period of Extended Operation** **(8) Evaluation of Additional Cladding Oxidation and Additional Hydride Formation Assuming Breach of Dry Shielded Canister Confinement Boundary** **(9) Evaluation of Cladding Gross Rupture during Period of Extended Operation** **(10) Structural Assessment of High Burnup Cladding Performance during Period of Extended Operation** **(11) Defense-in-Depth Dose Assessment Assuming Breach of Confinement during Period of Extended Operation**	

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
		<u>(12) Defense-in-Depth Thermal Evaluation of Dry Shielded Canister Internal Pressures Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation</u> **<u>(13) Defense-in-Depth Structural Evaluation of Dry Shielded Canister Confinement and Retrievability Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation</u>** **<u>(14) Bounding Evaluation of Dry Shielded Canister with Reduced Shell Thickness Due to Chloride-Induced Stress Corrosion Cracking under Normal and Off-Normal Conditions of Storage during Renewal Period</u>** **<u>Sections 12.2.1 through 12.2.14 provide a summary description and the conclusions for each TLAA.</u>**”	
12.2.1 (new)	new	Add heading “**<u>12.2.1 Fatigue Evaluation of the Dry Shielded Canister</u>**” with only “Fatigue Evaluation of the Dry Shielded Canister” underlined. Add heading “**<u>12.2.1.1 Summary Description</u>**” with only “Summary Description” underlined. Add the information from Appendix 3A, Section 3A.1, addressing references and adding referenced tables or figures, as necessary. Add heading “**<u>12.2.1.2 Conclusions</u>**” with only “Conclusions” underlined. Add the information from Appendix 3A, Section 3A.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.2 (new)	new	Add heading "**<u>12.2.2 Fatigue Evaluation of the Transfer Casks</u>**" with only "Fatigue Evaluation of the Transfer Casks" underlined. Add heading "**<u>12.2.2.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3B, Section 3B.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.2.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3B, Section 3B.3, addressing references and adding referenced tables or figures, as necessary."	New section to discuss this TLAA.
12.2.3 (new)	new	Add heading "**<u>12.2.3 Horizontal Storage Module Concrete and Dry Shielded Canister Steel Support Structure Thermal Fatigue, Corrosion, and Temperature Effects Evaluation</u>**" with only "Horizontal Storage Module Concrete and Dry Shielded Canister Steel Support Structure Thermal Fatigue, Corrosion, and Temperature Effects Evaluation" underlined. Add heading "**<u>12.2.3.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3C, Section 3C.1, addressing references and adding referenced tables or figures, as necessary." Add heading "**<u>12.2.3.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3C, Section 3C.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.4 (new)	new	Add heading "**<u>12.2.4 Dry Shielded Canister Poison Plates Boron Depletion Evaluation</u>**" with only "Dry Shielded Canister Poison Plates Boron Depletion Evaluation" underlined. Add heading "**<u>12.2.4.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3D, Section 3D.1, addressing references and adding referenced tables or figures, as necessary." Add heading "**<u>12.2.4.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3D, Section 3D.3, addressing references and adding referenced tables or figures, as necessary."	New section to discuss this TLAA.
12.2.5 (new)	new	Add heading "**<u>12.2.5 Evaluation of Neutron Fluence and Gamma Radiation on Storage System Structural Materials</u>**" with only "Evaluation of Neutron Fluence and Gamma Radiation on Storage System Structural Materials" underlined. Add heading "**<u>12.2.5.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3E, Section 3E.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.5.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3E, Section 3E.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.6 (new)	new	Add heading "**<u>12.2.6 Confinement Evaluation of 24P and 52B Non-Leaktight Dry Shielded Canisters</u>**" with only "Confinement Evaluation of 24P and 52B Non-Leaktight Dry Shielded Canisters" underlined. Add heading "**<u>12.2.6.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3F, Section 3F.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.6.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3F, Section 3F.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.
12.2.7 (new)	new	Add heading "**<u>12.2.7 Thermal Performance of Horizontal Storage Modules for the Period of Extended Operation</u>**" with only "Thermal Performance of Horizontal Storage Modules for the Period of Extended Operation" underlined. Add heading "**<u>12.2.7.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3G, Section 3G.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.7.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3G, Section 3G.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this evaluation.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.8 (new)	new	Add heading "**<u>12.2.8 Evaluation of Additional Cladding Oxidation and Additional Hydride Formation Assuming Breach of Dry Shielded Canister Confinement Boundary</u>**" with only "Evaluation of Additional Cladding Oxidation and Additional Hydride Formation Assuming Breach of Dry Shielded Canister Confinement Boundary " underlined. Add heading "**<u>12.2.8.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3H, Section 3H.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.8.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3H, Section 3H.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.
12.2.9 (new)	new	Add heading "**<u>12.2.9 Evaluation of Cladding Gross Rupture during Period of Extended Operation</u>**" with only "Evaluation of Cladding Gross Rupture during Period of Extended Operation" underlined. Add heading "**<u>12.2.9.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3I, Section 3I.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.9.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3I, Section 3I.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this evaluation.

Table A-1
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(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.10 (new)	new	Add heading "**<u>12.2.10 Structural Assessment of High Burnup Cladding Performance during Period of Extended Operation</u>**" with only "Structural Assessment of High Burnup Cladding Performance during Period of Extended Operation" underlined. Add heading "**<u>12.2.10.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3J, Section 3J.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.10.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3J, Section 3J.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.
12.2.11 (new)	new	Add heading "**<u>12.2.11 Defense-in-Depth Dose Assessment Assuming Breach of Confinement during Period of Extended Operation</u>**" with only "Defense-in-Depth Dose Assessment Assuming Breach of Confinement during Period of Extended Operation" underlined. Add heading "**<u>12.2.11.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3K, Section 3K.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.11.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3K, Section 3K.3, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.

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(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.12 (new)	new	Add heading "**<u>12.2.12 Defense-in-Depth Thermal Evaluation of Dry Shielded Canister Internal Pressures Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation</u>**" with only "Defense-in-Depth Thermal Evaluation of Dry Shielded Canister Internal Pressures Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation" underlined. Add heading "**<u>12.2.12.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3L, Section 3L.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**<u>12.2.12.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3L, Section 3L.3.	New section to discuss this evaluation.

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(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.13 (new)	new	Add heading "**12.2.13 Defense-in-Depth Structural Evaluation of Dry Shielded Canister Confinement and Retrievability Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation**" with only "Defense-in-Depth Structural Evaluation of Dry Shielded Canister Confinement and Retrievability Assuming High Burnup Fuel Cladding Failure during Period of Extended Operation" underlined. Add heading "**12.2.13.1 Summary Description**" with only "Summary Description" underlined. Add the information from Appendix 3M, Section 3M.1, addressing references and adding referenced tables or figures, as necessary. Add heading "**12.2.13.2 Conclusions**" with only "Conclusions" underlined. Add the information from Appendix 3M, Section 3M.4, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this TLAA.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.2.14 (new)	new	Add heading "**<u>12.2.14 Bounding Evaluation of Dry Shielded Canister with Reduced Shell Thickness Due to Chloride-Induced Stress Corrosion Cracking under Normal and Off-Normal Conditions of Storage during Renewal Period</u>**" with only "Bounding Evaluation of Dry Shielded Canister with Reduced Shell Thickness Due to Chloride Induced Stress Corrosion Cracking under Normal and Off Normal Conditions of Storage during Renewal Period" underlined. Add heading "**<u>12.2.14.1 Summary Description</u>**" with only "Summary Description" underlined. Add the information from Appendix 3N, Section 3N.1. Add heading "**<u>12.2.14.2 Conclusions</u>**" with only "Conclusions" underlined. Add the information from Appendix 3N, Section 3N.4, addressing references and adding referenced tables or figures, as necessary.	New section to discuss this evaluation.

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(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.3 (new)	new	Add heading "**12.3 Aging Management Program**" with only "Aging Management Program" underlined. Add text: "**Aging effects that could result in the loss of in-scope SSCs' intended function(s) are managed during the extended storage period. Many aging effects are adequately managed for the extended storage period using TLAA, as discussed in Section 12.2. An AMP is used to manage those aging effects that are not managed by TLAA. The AMPs that manage each of the identified aging effects for all in-scope SSCs include the following:** **1. DSC External Surfaces Aging Management Program** **2. DSC Aging Management Program for the Effects of Choride-Induced Stress Corrosion Cracking (Coastal Locations, Near Salted Roads, or in the Path of Effluent Downwind from the Cooling Tower(s))** **3. Horizontal Storage Module Aging Management Program for External and Internal Surfaces** **4. Horizontal Storage Module Inlets and Outlets Ventilation Aging Management Program** **5. Transfer Cask Aging Management Program** **6. High Burnup Fuel Aging Management Program** **The AMPs are summarized in Tables 12-1 through 12-6. Additional details are available in the CoC 1004 renewal application, initially submitted in 2014.**"	New section summarizing the aging management program credited with managing aging during the extended storage period. New subsections below provide the detailed discussion and requirements of each individual aging management program.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.3 (new)	new	Add table heading "**<u>Table 12-1 DSC External Surfaces Aging Management Program</u>**" with only "DSC External Surfaces Aging Management Program" underlined. Add the information from Table A-2	New table to summarize this AMP.
12.3 (new)	new	Add table heading "**<u>Table 12-2 DSC Aging Management Program for the Effects of CISCC (Coastal Locations, Near Salted Roads, or in the Path of Effluent Downwind from the Cooling Tower(s))</u>**" with only "DSC Aging Management Program for the Effects of CISCC (Coastal Locations, Near Salted Roads, or in the Path of Effluent Downwind from the Cooling Tower(s))" underlined. Add the information from Table A-3.	New table to summarize this AMP.
12.3 (new)	new	Add table heading "**<u>Table 12-3 HSM Aging Management Program for External and Internal Surfaces</u>**" with only "HSM Aging Management Program for External and Internal Surfaces" underlined. Add the information from Table A-4.	New table to summarize this AMP.
12.3 (new)	new	Add table heading "**<u>Table 12-4 HSM Inlets and Outlets Ventilation Aging Management Program</u>**" with only "HSM Inlets and Outlets Ventilation Aging Management Program" underlined. Add the information from Table A-5.	New table to summarize this AMP.

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(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
12.3 (new)	new	Add table heading "**<u>Table 12-5 Transfer Cask Aging Management Program</u>**" with only "Transfer Cask Aging Management Program" underlined. Add the information from Table A-6.	New table to summarize this AMP.
12.3 (new)	new	Add table heading "**<u>Table 12-6 High Burnup Fuel Aging Management Program</u>**" with only "High Burnup Fuel Aging Management Program" underlined. Add the information from Table A-7.	New table to summarize this AMP.
12.4 (new)	new	Add heading "**<u>12.4 Retrievability</u>**" with only "Retrievability" underlined. Add the information from Section 3.9, "Retrievability".	New section addressing fuel retrievability during the extended storage period.
12.5 (new)	new	Add heading "**<u>12.5 Tollgate Assessments</u>**" with only "Tollgate Assessments" underlined. Add text: "**<u>Tollgate assessments are written evaluations, performed by licensees at each tollgate, of the aggregate impact of aging-related dry cask storage system OE, research, monitoring, and inspections on the intended functions of in-scope SSCs. Tollgate assessments are intended to include non-nuclear and international operating information on a best-effort basis. Corrective or mitigative actions arising from tollgate assessments are managed through the corrective action program of the licensee and/or the CoC holder.</u>** **<u>General licensees have tollgate assessment responsibilities, as discussed below.</u>**"	New section on tollgate assessments, with a brief overview.
12.5.1	new	Add heading "**<u>12.5.1 Tollgate Assessments by General Licensees</u>**" with only	New section describing

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UFSAR Revision 14 Part	**UFSAR Revision 14 Page**	**Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)**	**Basis for Change**
(new)		"Tollgate Assessments by General Licensees" underlined. Add text: "**<u>During the twenty-fifth calendar year following initial loading of a general licensee ISFSI, that general licensee shall conduct and document a tollgate assessment, which should address the following areas:</u>** • **<u>A summary of research findings, OE, monitoring data, and inspection results</u>** • **<u>Aggregate impact of findings</u>** • **<u>Consistency with assumptions and inputs in TLAAs</u>** • **<u>Effectiveness of AMPs</u>** • **<u>Corrective actions</u>** • **<u>Summary and conclusions</u>** **<u>Evaluate information from the following sources and perform a written assessment of the aggregate impact of the information:</u>** ○ **<u>DOE/EPRI High Burnup Dry Storage Cask Research and Development Project" (HDRP)</u>** ○ **<u>EPRI chloride-induced stress corrosion cracking (CISCC) research</u>** • **<u>Relevant results of other domestic and international research (including non-nuclear)</u>** • **<u>Relevant domestic and international OE (including non-nuclear)</u>** • **<u>Relevant results of domestic and international ISFSI and dry cask storage system performance monitoring</u>** • **<u>Relevant results of domestic and international ISFSI and dry cask storage</u>**	tollgate assessments by general licensees.

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(28 Pages)

UFSAR Revision 14 Part	**UFSAR Revision 14 Page**	**Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)**	**Basis for Change**
		<u>system inspections</u> **<u>See Section 12.5.3 for description of CoC 1004 aging management tollgates.</u>**"	
12.5.2 (new)	new	Add heading "**<u>12.5.2 The Role of the CoC Holder for Tollgate Assessments</u>**" with only "The Role of the CoC Holder for Tollgate Assessments" underlined. Add text: "**<u>Upon request, the CoC holder shall use OE information provided by the general licensees related to the areas required to be covered in the tollgate assessment.</u>**"	New section describing the CoC holder role in tollgate assessments.
12.5.3 (new)	new	Add heading "**<u>12.5.3 Aging Management Tollgates</u>**" with only "Aging Management Tollgates" underlined. Add the information from Chapter 4, "Aging Management Tollgates," creating logical headings and information arrangement.	New section describing certain generic tollgate activities.
C.4.1	C4-2	Add a new first paragraph, in the form of a note, as follows: "**<u>NOTE: The discussion that follows is for the DSC fatigue analysis for the period of initial licensing. The TLAA for DSC fatigue analysis, performed for the initial CoC 1004 renewal application, is provided in Section 12.2.1.</u>**"	Add a note in the UFSAR where the original DSC fatigue analysis is provided, referencing the UFSAR section that provides the TLAA that updates this analysis.
C.4.1	C4-3	Change the first full sentence on the page to read: "However, this normal operational cycle occurs only once in the 50-year design service life[(1)] of a DSC."	Extended storage period.

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(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
C.4.1	C4-3	Add footnote 1, to read: "[(1)] **<u>Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
C.4.2	C4-5	Add a new first paragraph, in the form of a note, as follows: "**<u>NOTE: The discussion that follows is for the TC fatigue analysis for the period of initial licensing. The TLAA for TC fatigue analysis, performed for the initial CoC 1004 renewal application, is provided in Section 12.2.2.</u>**"	Add a note in the UFSAR where the original TC fatigue analysis is provided, referencing the UFSAR section that provides the TLAA that updates that analysis.
H.1	H.2	At the end of the initial discussion under "H.1.1 <u>Introduction</u>," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 24P Long Cavity System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
J.1	J.1-1	At the end of the initial discussion under "J.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 24P Long Cavity System during the period of extended storage operations are contained in Section 12.3. TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
K.1	K.1-1	At the end of the initial discussion under "K.1 General Discussion," add an un-numbered heading "**Aging Management Program Requirements**" Add text: "**AMP requirements for use of the 61BT System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
K.2.3.1	K.2-7	Change the first sentence to read: "The NUHOMS®-61BT DSC is designed to provide storage of spent fuel for at least 40 years**(1)**."	Extended storage period.
K.2.3.1	K.2-7	Add footnote 1, to read: "**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**"	Extended storage period.
K.2.5	K.2-10	Change the first sentence of the second paragraph to read: "The maximum total heat generation rate of the stored fuel is limited to 0.3 kW per fuel assembly and 18.3 kW per NUHOMS®-61BT DSC in order to keep the maximum fuel cladding temperature below the limit necessary to ensure cladding integrity for 40 years **of** storage [2.4]**(1)**."	Extended storage period.
K.2.5	K.2-10	Add footnote 1, to read: "**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**"	Extended storage period.
K.4.4.1	K.4-8	Change the bullet at the bottom of the page to read: "Maximum normal ambient temperature of 100 °F with insolation. This case bounds the lifetime average ambient temperature of 70 °F for 50 years **of** service life**(1)**."	Extended storage period.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
K.4.4.1	K.4-8	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
L.1	L.1-1	At the end of the initial discussion under "L.1 <u>General Discussion</u>," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 24PT2 System during the period of extended storage operations are contained in Section 12.3. Applicable time-limited aging analyses performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
L.2.3.1	L.2-4	Change the first sentence to read: "The NUHOMS®-24PT2 DSC is designed to provide storage of spent fuel for at least 40 years**<u>(1)</u>**."	Extended storage period.
L.2.3.1	L.2-4	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
M.1	M.1-1	At the end of the initial discussion under "M.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 32PT System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
M.2.3.1	M.2-8	Change the first sentence to read: "The NUHOMS®-32PT DSC is designed to provide storage of spent fuel for at least 40 years**<u>(1)</u>**."	Extended storage period.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
M.2.3.1	M.2-8	Add footnote 1, to read: “**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**”	Extended storage period.
M.9.1.7.10	M.9-11	Change the final sentence to read: “Finally, according to [9.11], the first intergranular cracks do not start to appear until fluences are 5.5 orders of magnitude greater than those calculated for 50 year**s of** operation**(1)**.	Extended storage period.
M.9.1.7.10	M.9-11	Add footnote 1, to read: “**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**”	Extended storage period.
N.1	N.1-2	At the end of the initial discussion under “N.1 General Discussion,” add an un-numbered heading “**Aging Management Program Requirements**” Add text: “**AMP requirements for use of the 24PHB System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.**”	Provide a reference to where in the UFSAR the aging management requirements are provided.
N.2.3.1	N.2-4	Change the first sentence to read: “The NUHOMS®-24PHB DSC is designed to provide storage of spent fuel for at least 40 years**(1)**.”	Extended storage period.
N.2.3.1	N.2-4	Add footnote 1, to read: “**(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.**”	Extended storage period.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
P.1	P.1-2	At the end of the initial discussion under "P.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 24PTH System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
P.2.3.1	P.2-14	Change the first sentence to read: "The NUHOMS®-24PTH DSC is designed to provide storage of spent fuel for at least 40 years<u>(1)</u>."	Extended storage period.
P.2.3.1	P.2-14	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
R.1	R.1-1	At the end of the initial discussion under "R.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the HSM Model 152 during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.

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UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
T.1	T.1-2	At the end of the initial discussion under "T.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 61BTH System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
T.2.3.1	T.2-9	Change the first sentence to read: "The NUHOMS®-61BTH DSC is designed to provide storage of spent fuel for at least 40 years**<u>(1)</u>**."	Extended storage period.
T.2.3.1	T.2-9	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
U.1	U.1-2	At the end of the initial discussion under "U.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 32PTH1 System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
U.2.3.1	U.2-9	Change the first sentence to read: "The NUHOMS®-32PTH1 DSC is designed to provide storage of spent fuel for at least 40 years**<u>(1)</u>**."	Extended storage period.
U.2.3.1	U.2-9	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
V.1	V.1-1	At the end of the initial discussion under "V.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the HSM Model 202 during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
W.1	W.1-1	At the end of the initial discussion under "W.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the OS197L TC during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
Y.1	Y.1-2	At the end of the initial discussion under "Y.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 69BTH System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
Y.2.3.1	Y.2-9	Change the first sentence to read: "The NUHOMS®-69BTH System is designed to provide storage of spent fuel for at least 40 years**<u>(1)</u>**."	Extended storage period.

Table A-1
List of UFSAR Changes Associated with CoC 1004 Renewal
(28 Pages)

UFSAR Revision 14 Part	UFSAR Revision 14 Page	Description of Change (Newly inserted text is shown as bold and underlined; deleted text is shown by a single strike-through.)	Basis for Change
Y.2.3.1	Y.2-9	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.
Z.1	Z.1-2	At the end of the initial discussion under "Z.1 General Discussion," add an un-numbered heading "**<u>Aging Management Program Requirements</u>**" Add text: "**<u>AMP requirements for use of the 37PTH System during the period of extended storage operations are contained in Section 12.3. Applicable TLAAs performed for the initial CoC 1004 renewal application are provided in Section 12.2.</u>**"	Provide a reference to where in the UFSAR the aging management requirements are provided.
Z.2.3.1	Z.2-10	Change the first sentence to read: "The NUHOMS®-37PTH DSC is designed to provide storage of spent fuel for at least 40 years<u>(1)</u>."	Extended storage period.
Z.2.3.1	Z.2-10	Add footnote 1, to read: "**<u>(1) Note that CoC 1004 has been renewed, with a new design life of 60 years. Certain associated analyses and aging management results are provided in Chapter 12.</u>**"	Extended storage period.

Table A-2
DSC External Surfaces Aging Management Program
(2 Pages)

Table A-2
DSC External Surfaces Aging Management Program
(2 Pages)

Table A-3
DSC Aging Management Program for the Effects of CISCC (Coastal Locations, Near Salted Roads, or in the Path of Effluent Downwind from the Cooling Tower(s))
(2 Pages)

Table A-3
DSC Aging Management Program for the Effects of CISCC (Coastal Locations, Near Salted Roads, or in the Path of Effluent Downwind from the Cooling Tower(s))
(2 Pages)

Table A-4
HSM Aging Management Program for External and Internal Surfaces
(4 Pages)

Table A-4
HSM Aging Management Program for External and Internal Surfaces
(4 Pages)

Table A-4
HSM Aging Management Program for External and Internal Surfaces
(4 Pages)

Table A-4
HSM Aging Management Program for External and Internal Surfaces
(4 Pages)

Table A-5
HSM Inlets and Outlets Ventilation Aging Management Program
(2 Pages)

Table A-5
HSM Inlets and Outlets Ventilation Aging Management Program
(2 Pages)

Table A-6
Transfer Cask Aging Management Program
(2 Pages)

Table A-6
Transfer Cask Aging Management Program
(2 Pages)

Table A-7
High Burnup Fuel Aging Management Program
(2 Pages)

Table A-7
High Burnup Fuel Aging Management Program
(2 Pages)

ATTACHMENT B
CHANGES TO THE COC 1004 TECHNICAL SPECIFICATIONS

CONTENTS

B.1 Introduction and Details of Proposed Changes

The following changes are proposed to the Technical Specifications (TS) associated with Certificate of Compliance (CoC) 1004 initial Amendment 0, Amendments 1 through 11, and Amendment 13 (an Amendment 12 application, associated with a United States Department of Energy project, was submitted, but was returned due to review-funding considerations.) to support the CoC 1004 renewal:

Amendments 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10

Revise TS Section 1.1.2, "Operating Procedures," as follows:

- Add the following new header and paragraphs to the end of Section 1.1.2:

  Aging Management Program Procedures and Reporting

  Each general licensee shall have a program to establish, implement, and maintain written procedures for each aging management program (AMP) described in Updated Final Safety Analysis Report (UFSAR) Chapter 12.3. The program shall include provisions for changing AMP elements, as necessary, 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.

  Each general licensee shall complete the Tollgate Assessment requirements described in UFSAR Section 12.5.1.

- Change TS 1.2.4, Bases paragraph, first two sentences, as indicated:

  If the DSC leaked at the maximum acceptable rate of $1.0x10^{-4}$ atm cm^3/s for a period of ~~20~~**60** years, about ~~63,100~~**189,600** cc of helium would escape from the DSC. This is about ~~1~~**3.25**% of the ~~6.3~~**5.83** x 10^6 cm^3 of helium initially introduced in the DSC.

Amendments 11 and 13

Revise Technical Specifications Section 5.1, "Procedures," as follows:

- Add the following new subsection:

  5.1.3 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 UFSAR Chapter 12.3. The program shall include provisions for changing AMP elements, as necessary, 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.

Each general licensee shall complete the Tollgate Assessment requirements described in UFSAR Section 12.5.1.