AMERICA'S NUCLEAR SOLUTION

Consolidated Interim Storage of Spent Nuclear Fuel & Reactor Related GTCC Waste

Subjects: Referencing, GTCC Waste, Section 1.2.4 & Confinement

— PUBLIC VERSION —

Public Meeting
22 November 2016

Agenda

Public Session		
Topic	Time	Speaker
Introductions and opening remarks	10:00 – 10:15 AM	(NRC/WCS)
Referencing	10:15 – 11:00 AM	(NRC/WCS)
Greater-Than-Class-C (GTCC) Waste	11:00 – 12:00 AM	(NRC/WCS)
Lunch Break	12:00 AM – 12:45 PM	(ALL)
Section 1.2.4 Process	12:45 – 1:45 PM	(NRC/WCS)
Public Session Questions And Comments	1:45 - 2:15 PM	(NRC/Public)
Public Session Closing Remarks	2:15 – 2:30 PM	(NRC/WCS)
Closed Session		
Confinement	2:30 – 3:30 PM	(NRC/WCS)

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PUBLIC SESSION

Opening Remarks

- NRC
- WCS

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REFERENCING

Referencing

- WCS is referencing approved
  - CofC's & specific licenses in our application
  - FSARs &
  - SARs
- "Adequate" referencing has been a source of significant discussion between WCS & NRC.

10 CFR 72.18

- Requirement Driving Referencing Practice
- § 72.18 “Elimination of repetition”
  - *“In any application under this part, the applicant may incorporate by reference information contained in previous applications, statements, or reports filed with the Commission:”*
  - *“Provided that such references are **clear and specific**.” [emphasis added]*

Example 4.5

- RSI NP 4.5: NRC staff request to provide “clear and specific” references for SSCs and design criteria
- Approach to original response was to point to a listing of 82 NAC drawings vs. listing all 82 drawings as individual references in the SAR.
- Illustrates the challenges represented by both
  - Differing approaches in vendor’s FSARs, and
  - Degree of referencing needed to achieve proper specificity

RSI NP 4.5 Response for NUHOMS Systems

A.4.6 Supplemental Data Drawings

The following drawings are incorporated by reference or enclosed as noted below:

1. "NUHOMS FO-DSC and FC-DSC for PWR Fuel Main Assembly (four sheets)," NUH-05-4004, Revision 16 (See Volume 4 of the "Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report" [A.4-4]).

2. "NUHOMS FF-DSC for PWR Fuel Main Assembly (four sheets)," NUH-05-4005, Revision 14 (See Volume 4 of the "Rancho Seco Independent Spent Fuel Storage Installation Safety Analysis Report" [A.4-4]).

3. "NUHOMS® System GTCC Canister Main Assembly (five sheets)," 13302-1005, Revision 0 (Included at the end of this Section).

4. "NUHOMS® System GTCC Canister Closure Installation (one sheet)," 13302-1007, Revision 0 (Included at the end of this Section).

5. "Standardized NUHOMS® ISFSI Horizontal Storage Module ISFSI General Arrangement (three sheets)," NUH-03-6008-SAR, Revision 10 (See Section E.2 of Appendix E of the "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel" [A.4-1]).

RSI NP 4.5 Response for MPC Systems

Specific Reference

E.4.4 Supplemental Data

The licensing drawings for the NAC-MPC system are listed in Section 1.7, *Drawings,* and Section 1.A.7, *MPC-LACBWR Licensing Drawings,* in volume 1 of the *NAC-MPC Final Safety Analysis Report*, Revision 10 [E.4-1].

Section 1.7.1 lists the Yankee-MPC license drawings; Section 1.7.2 lists the Yankee Class Reconfigured Fuel Assembly License drawings; and Section 1.7.3 lists the CY-MPC license drawings. These drawings appear in the FSAR immediately after the drawing lists in Section 1.7.

Section 1.A.7 lists the MPC-LACBWR licensing drawings. These drawings appear in the FSAR immediately after the drawing list in Section 1.A.7.

The following drawings are located as noted below for the GTCC-Canister-CY and GTCC-Canister-YR GTCC Waste Canisters and Storage configurations:

1. "Basket Assembly, GTCC, CY-MPC," Sheets 1 thru 4, 414-887, Rev. 4 (See Section 1.3.2 of the "NAC-STC, NAC Storage Transport Cask Safety Analysis Report" [E.4-2])

2. "Canister Shell, GTCC, CY-MPC," Sheets 1 thru 2, 414-888, Rev. 4 (See Section 1.3.2 of the "NAC-STC, NAC Storage Transport Cask Safety Analysis Report" [E.4-2])

3. "Assembly, Transportable Storage Canister (TSC), GTCC, CY-MPC," Sheets 1 through 3, 414-889, Rev. 7 (See Section 1.3.2 of the "NAC-STC, NAC Storage Transport Cask Safety Analysis Report" [E.4-2])

Referenced Location for NAC-MPC FSAR

1.A.7 MPC-LACBWR License Drawings

This section presents the License Drawings for the MPC-LACBWR System.

Drawing Number	Title	Revision No.	No. of Sheets
630045-861	Weldment, Structure, Vertical Concrete Cask (VCC), MPC-LACBWR	4	3
630045-862	Loaded Vertical Concrete Cask (VCC), MPC-LACBWR	0	1
630045-863	Lid Assembly, Vertical Concrete Cask (VCC), MPC-LACBWR	2	1
630045-864	Name Plate, Vertical Concrete Cask (VCC) MPC-LACBWR	2	1
630045-866	Reinforcing Bar and Concrete Placement, Vertical Concrete Cask (VCC), MPC-LACBWR	1	5
630045-870	Shell Weldment Canister (TSC), MPC-LACBWR	3	1
630045-871	Details TSC, MPC-LACBWR	5	4

Question on Referencing

- How do we balance
  - "Elimination of repetition" while
  - Providing references that are "clear and specific"?
- Seeking discussion on NRC view of "specific."

Conclusion on Referencing

- RSI responses & Rev 1 will improve upon clarity and will facilitate identification of references
- RSI responses & Rev. 1 product will benefit from NRC staff feedback.

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GREATER-THAN-CLASS-C (GTCC) WASTE

Greater-Than-Class-C (GTCC) Waste

- 10 CFR Part 72.6 (a)
  - "Licenses for the receipt, handling, storage, and transfer of spent fuel or high-level radioactive waste are of two types: general and specific.
  - Licenses for the receipt, handling, storage, and transfer of reactor related GTCC are ***specific licenses***.
  - Any general license provided in this part is effective without the filing of an application with the Commission or the issuance of a licensing document to a particular person.
  - A specific license is issued to a named person upon application filed pursuant to regulations in this part.

WCS Approach to GTCC Waste

- External design characteristics of the GTCC waste canisters
  - Based on those of the fuel canisters.
- Final storage configuration of the GTCC waste canisters
  - Identical to SF canister storage.
- To the extent possible,
  - Same procedures and individuals w/ same training and qualifications as those used in SF transfer operations will be used.

WCS Approach to GTCC Waste

- Organization, programs, and protective measures in place to ensure safe storage of the SNF
  - Will remain in place to ensure continued safe storage of the fuel and the GTCC waste.
- Storage of GTCC waste at the WCS CISF
  - *Will have no adverse effect* on the Safe Storage of the SNF and Safe Operation of the CISF.
- The storage of the GTCC waste
  - *Will have no adverse effect* on public health and safety or the environment.

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SECTION 1.2.4 PROCESS

Licensing Basis

- WCS CISF SAR
  - Incorporates FSARs of six NRC approved storage systems by reference
  - Analyzes approved storage systems for WCS site parameters
  - Focused on unloading of transportation casks, and the transfer and storage of spent fuel at WCS site.
  - Limits contents and canister designs to those authorized under specific NRC approved CofC's and Site Specific licenses.

Activities since August 22

- Drafted new SAR text
  - Better reflects our approach (to be included with Revisions resulting from RSIs, etc.)
- Developed an expanded checklist from the one presented on August 22.
  - Prepared, based on biennial summaries of 10 CFR 72.48s
- Tested checklist during a site visit last week (shown below).

Regulatory History of NAC-MPC Storage System

Certificate Amendment 72-1025	FSAR Revision	Tech Specs Compatible with WCS Configuration NAC-MPC FSAR Revision 10		
		Canister Type	Contents	Loading Procedures
6 (10/14/2010)	Revision 10 (10/2014)	Yankee Class Connecticut Yankee LACBWR	Adds for MPC-LACBWR: Section B.2.1.3 – SNF Description Table B2-7 – Assembly Limits Table B2-8 – Assembly Characteristics Fig B2-3 – Loading Plan	Adds loading procedures for MPC-LACBWR Fuel No changes for Connecticut or Yankee Class Fuel
	Revision 9 (4/2012)			
	Revision 8 (2/2011)			
5 (7/24/2007)	Revision 7 (1/2008)	Connecticut Yankee Yankee Class	No Change	Revises technical specifications to change reporting and monitoring requirements, incorporates guidance from NRC ISG-22, removes requirement for tamper-indicating devices on the VCC
4 (10/27/2004)	Revision 6 (4/2006)	Yankee Class Connecticut Yankee	No Change	Increased vacuum drying times. Decreased time limits for canisters in transfer casks.
	Revision 5 (10/2004)			
3 (10/1/2003)	Revision 4 (4/2004)	Yankee Class Connecticut Yankee	Adds for Yankee Class SNF: • Damaged fuel cans • Reconfigured fuel assemblies Corrects CY SNF fuel parameters.	No changes for Connecticut or Yankee Class Fuel
	Revision 3 (10/2003)			
2 (5/29/2002)	Revision 2 (11/2002)	Yankee Class Connecticut Yankee	Adds for Connecticut Yankee: Section B.1.1 SNF Description Table B2-3 CY SNF Fuel Assembly Limits Table B2-4 CY SNF Intact Fuel Assembly Characteristics	Adds loading procedures for Connecticut Yankee Fuel No changes for Yankee Class Fuel
1 (11/13/2001)	Amendment 1 (2/2002)	Yankee Class	Adds for Yankee Class SNF: Preferential loading to increase operational time limits for vacuum drying	Allows an alternate fuel basket design, increased canister loading operational time limits, and an increase in the canister surface contamination limits.
0 (4/10/2000)	Revision 0 (4/2000)	Yankee Class	Adds for Yankee Class SNF: Section A2.1.1 SNF Description Table A2-1 Fuel Assembly Limits Table A2-2 Intact Fuel Assembly Characteristics	Adds loading procedures for Connecticut Yankee Fuel

72.48 Checklist – La Crosse, WI NAC-MPC Example

Verification Checklist for Licensee 72.48 Changes	Example (LACBWR)
1. Determine cask/canister serial number	Cask Specific
2. Determine date of loading	After October 12, 2012
3. Determine NRC Certificate Number	All LACBWR fuel was loaded under NAC- MPC Certificate of Compliance No. 72-1025, Amendment 6
4. Determine appropriate FSAR	FSAR Revision 8A, as updated
5. Review Licensee's 10 CFR Part 72.48 evaluations which apply to cask.	None for 2013, 2014 or 2015. <u>For 2012:</u> Numerous 72.48 changes to NAC-MPC hardware, operation, and maintenance. Two deviations were authorized under 10 CFR 72.48 as part of 10 CFR 72.212 report (Revision 1) dealing with different TSC design pressure, and site-specific analysis of the TFR/TSC tornado missile not addressed in NAC-MPC SAR . Use of alternative methodology (other than that used in SAR) was used to analyze building fires, chemical explosions and structure fall hazards in revising 10 CFR 72.212 report (Revision 2)
6. Determine if any 72.48 changes have been incorporated into Cask FSAR	72.48 changes to NAC-MPC hardware, operation, and maintenance incorporated into FSAR, rev.9
7. Determine if unincorporated 72.48 changes would affect storage at WCS	Remaining changes do not affect storage at WCS
8. If 72.48 changes can affect storage at WCS, perform a WCS site-specific 72.48 evaluation.	

What the “checklist” encompasses…

- Determines under what NRC CofC/License amendments SNF was loaded
- Reviews which 72.48s evaluations were performed
- Determines whether 72.48s have been rolled into an FSAR update
- Review examples of “fairly recent” 72.48 evaluations that haven’t yet been rolled up in an FSAR update
- Examples that represent a change in evaluation methods, design specifications, and dimensional changes made during fabrication.

Expanding Section 1.2.4 of WCS SAR

- List six (6) storage systems previously approved by the NRC
  - Including approved contents under applicable amendments to CofCs or specific license(s).
- Specify that WCS would verify that every spent fuel canister received at WCS would
  - Comply with the terms, conditions of use, and technical specifications of one of the six storage systems listed in Section 1.2.4 when stored in the canister's approved overpack.

Expanding Section 1.2.4 of WCS SAR

- Verification would include a determination of the CofC (or specific license) amendment under which the canister was loaded and an evaluation of any changes made to the canister under 10 CFR 72.48.

Expanding Section 1.2.4 of WCS SAR

- Prior to shipment, if it is determined that
  - A loaded canister does not comply and/or
  - The corresponding overpack at WCS requires a design change
- WCS would undertake further evaluation to determine
  - If the WCS site specific license should be amended, or
  - If an evaluation done under 10 CFR 72.48 for the WCS CISF would support such a design change without an amendment.

Expanding Section 1.2.4 of WCS SAR

- WCS
  - Would not rely on 10 CFR 72.48 evaluations completed by other licensees or CofC holders
  - Unless these evaluations can be *clearly* shown to be applicable to the WCS CISF.

Role of “Checklist”

- Envision “Checklist” to be included in site Operating Procedures rather than inclusion in FSAR.

Summary

- Believe this will address “Open Endedness” concerns
- Believe DOE will have to accomplish same process prior to shipment from sites
- Looking for Feedback and Questions from NRC staff.

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PUBLIC SESSION QUESTIONS & COMMENTS

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PUBLIC SESSION CLOSING REMARKS

Closing Remarks

- NRC
- WCS

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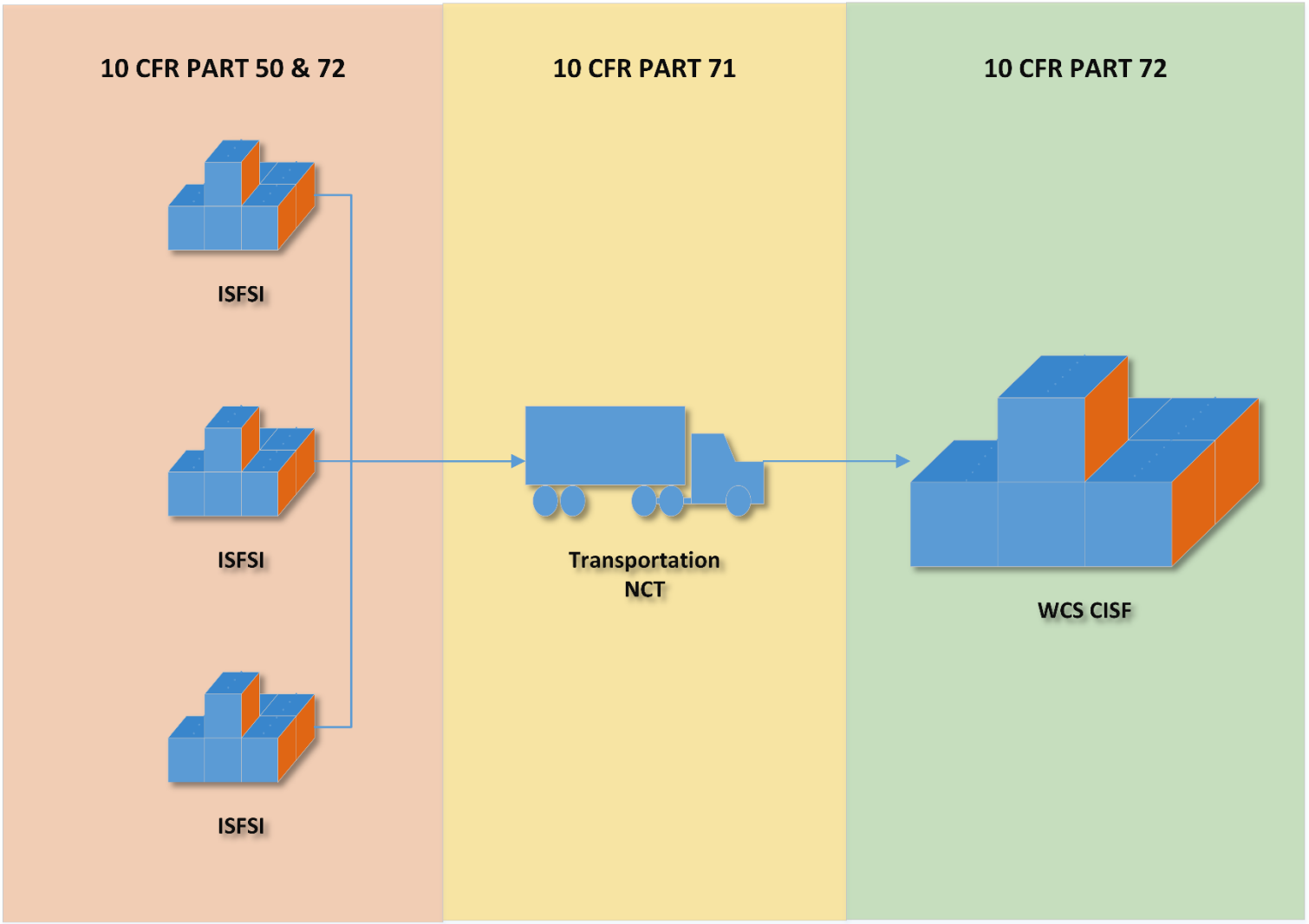
Closed Session

CONFINEMENT

Introduction

- Initial confinement demonstrated as a condition of loading a canister into storage configuration
- Confinement is confirmed after shipment to WCS by showing that loads during normal conditions of transport do not exceed Class A Service Levels in ASME B&PV Code
- Post shipment leak test of accessible portions of confinement boundary performed as prudent measure.

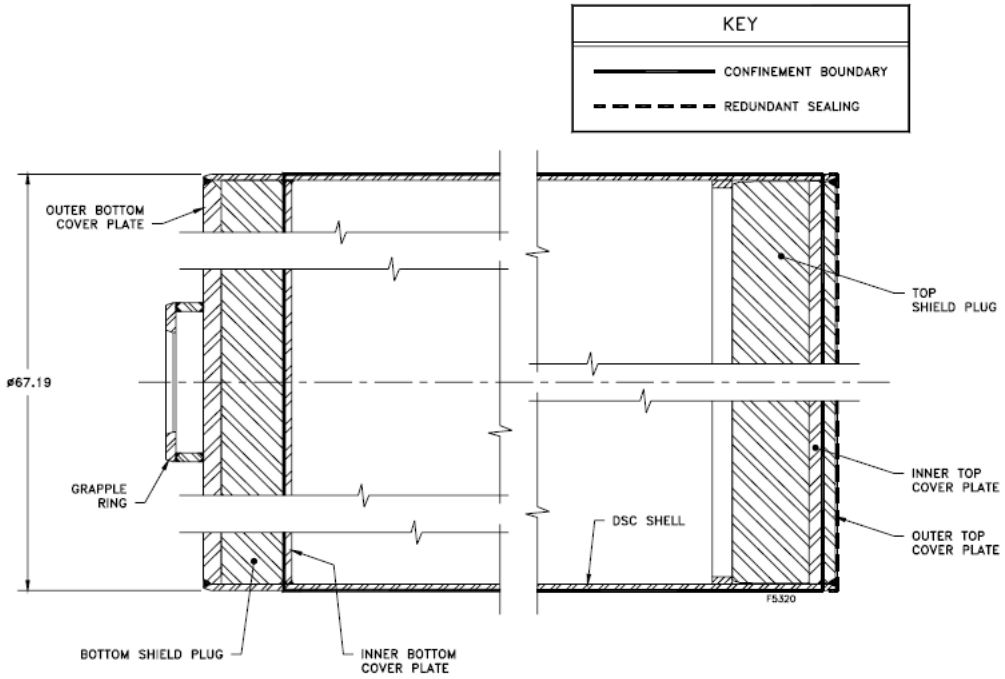
Overview

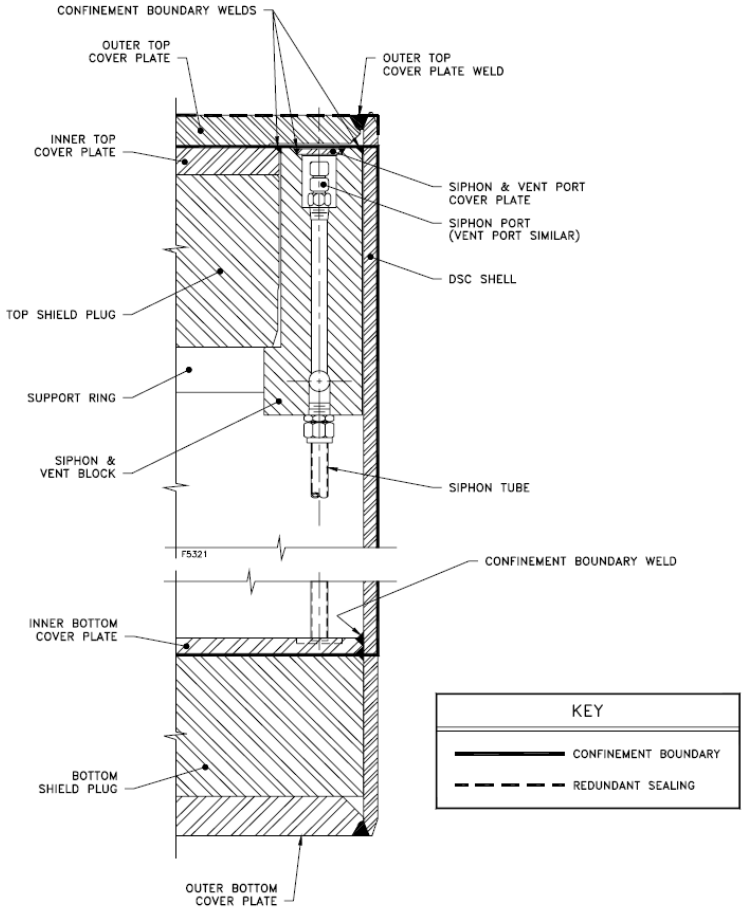

10 CFR PART 50 & 72
10 CFR PART 71
10 CFR PART 72
ISFSI
ISFSI
ISFSI
Transportation
NCT
WCS CISF

Confinement of the Canisters is Demonstrated by Analysis

- Confinement is provided by a welded canister shell and redundant closures
- Fuel Cladding integrity is ensured by
  - maintaining the storage cladding temperatures below levels that are known to cause degradation of the cladding.
  - The SNF is stored in an inert helium atmosphere to prevent degradation of the cladding, specifically cladding rupture due to oxidation and its resulting volumetric expansion of the SNF.

Canister Confinement Boundary Example





Stresses Below ASME B&PV Code Service Levels A, B, C, and D

- Canister confinement boundaries (shell and closure) are designed and fabricated to the maximum practicable extent as a Class I component in accordance with the rules of the ASME B&PV Code, Section III, Subsection NB, Article NB-3200

Code Alternatives Previously Approved by NRC

- Each Canister design includes a set of approved Code Alternatives which vary somewhat between the various canister designs
- Confinement boundaries and code alternatives are incorporated by reference into the WCS CISF SAR

Normal Conditions of Transport (NCT)

- NCT defined in
  - 10 CFR Part 71
  - 49 CFR Part 173
- NCT include vibration and 1-foot drop.
- Loads from NCT must not exceed ASME B&PV Code Service Level A to verify confinement remains intact.

Added Explicit Evaluations of Impact of Transportation of Canister to the WCS CISF Evaluation

- All of the Transportation Casks, Except the NUHOMS®-MP187 Cask, authorized to transport canisters to the WCS CISF (See Table 1-1 of WCS CISF SAR for the list), include evaluations of the canister shells (Part 72 Confinement Boundary) that demonstrate that the maximum stresses during NCT remain below Level A allowables
  - These evaluations are incorporated by reference from the Part 71 SARs into the WCS CISF SAR
- For the canisters to be transported to the WCS CISF in the NUHOMS®-MP187 Cask evaluations (calculations) are added to the WCS CISF SAR
  - FO-, FC-, FF-DSCs and the 24PT1 DSC

61BT and 61BTH Type 1 Shell Qualified in NUHOMS®-MP197HB Cask

- Section A.2.6.15.2 of the MP197HB Rev.-17 SAR for NCT, demonstrate that both DSCs maintain structural integrity (including at the weldments) of confinement boundary components
- The bases for allowable stresses are ASME Subsection article NB-3200 for NCT (Level A) loads
- Section A.2.13.7 MP197HB DSC (Shell Assembly) Structural Evaluation summarizes the calculations performed qualify the canister shells

61BT and 61BTH Type 1 Shell Qualified in NUHOMS®-MP197HB Cask

- Load Cases Explicitly Evaluated

DSC Normal Condition (NCT) Load Cases

Loading	Analysis Type	Service Level	Load	Analysis Method
Hot Environment Thermal Load	Elastic Analysis	A	Hot Ambient	Finite Element Analysis (2D, axisymmetric model)
Cold Environment Thermal Load	Elastic Analysis	A	Cold Ambient	Finite Element Analysis (2D, axisymmetric model)
Internal Pressure	Elastic Analysis	A	Internal Pressure	Finite Element Analysis (included in drop analyses)
External Pressure	Elastic Analysis	A	External Pressure	Finite Element Analysis (included in drop analyses)
1 Foot Side Drop	Elastic Analysis	A	Lateral g-Load	Finite Element Analysis (3D, 180 deg. model)
1 Foot Top End Drop	Elastic Analysis	A	Axial g-Load	Finite Element Analysis (2D, axisymmetric model)
1 Foot Bottom End Drop	Elastic Analysis	A	Axial g-Load	Finite Element Analysis (2D, axisymmetric model)

Canister Shells Meet Level A Allowables

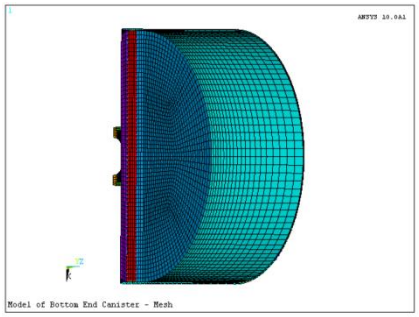
- Load Combinations Evaluated
- 25g drops bound vibration loads

DSC Normal Condition (NCT) Load Combinations

Load Case	Individual Loads						
	25g[(1)] Side Drop	30g Top End Drop	30g Bottom End Drop	15 psig[(2)] Internal Pressure	15 psig External Pressure	Hot Ambient Environment	Cold Ambient Environment
1	X			X		X	
2	X				X		X
3		X		X		X	
4		X			X		X
5			X	X		X	
6			X		X		X

*Notes:

1. The Group 1 DSC analyses conservatively used 30g for the normal side drop.
2. The internal pressures used in the analyses are as follow:
   Group 1 DSCs: 30 psig
   Group 2 DSCs: 15 psig
   Group 3 DSCs: 15 psig
   Group 4 DSCs: 20 psig



FE Model

New Analysis for Canisters Transported via the NUHOMS®-MP187 Cask

- Included in Section A.7 and B.7 of the WCS CISF SAR.
- Finite Element Models (FEM) are used for analyzing the DSCs with enveloping dimensions and loads
  - One Model for the FO-DSC and 24PTH1 DSC
  - One Model for the FC- and FO-DSCs
- The DSC shell assembly is analyzed for the postulated load conditions using three-dimensional (3D) 180° half-symmetric FEMs

Load Cases for End/Side Drop Normal Condition of Transport (NCT)

Load Case Number	Loading Condition	Service Level	Case Description
1NCT	25g Lateral Load (Side Drop Away From Rails)	A	Horizontal cask, supported on side, 25g transverse acceleration. Impact away from transport cask rails.
2NCT	25g Lateral Load + 10.5 psi Internal Pressure (Side Drop Away From Rails with Internal Pressure)	A	Horizontal cask, supported on side, 25g transverse acceleration + 8 psi Internal Pressure. Impact away from transport cask rails.
3NCT	25g Lateral Load + 8 psi External Pressure (Side Drop Away From Rails with External Pressure)	A	Horizontal cask supported on side, 25g transverse acceleration + 8 psi External Pressure. Impact away from transport cask rails.
4NCT	25g Lateral Load (Side Drop on Rails)	A	Horizontal cask, supported on side, 25g transverse acceleration. Impact onto the cask rails.
5NCT	25g Lateral Load + 10.5 psi Internal Pressure (Side Drop on Rails with Internal Pressure)	A	Horizontal cask supported on side, 25g transverse acceleration + 8 psi Internal Pressure. Impact onto the cask rails.
6NCT	25g Lateral Load + 8 psi External Pressure (Side Drop on Rails with External Pressure)	A	Horizontal cask supported on side, 25g transverse acceleration + 8 psi External Pressure. Impact onto the cask rails.

Load Cases for End/Side Drop Normal Condition of Transport (NCT)

Load Case Number	Loading Condition	Service Level	Case Description
7NCT	30g Vertical Load on Top End (Top End Drop)	A	Vertical cask, supported on top end, 30g axial acceleration. Impact onto the OTCP
8NCT	30g Vertical Load on Top End + 10.5 psi Internal Pressure (Top End Drop with Internal Pressure)	A	Vertical cask supported on top end, 30g axial acceleration + 8 psi Internal Pressure. Impact onto the OTCP
9NCT	30g Vertical Load on Top End + 8 psi External Pressure (Top End Drop with External Pressure)	A	Vertical cask supported on top end, 30g axial acceleration + 8 psi External Pressure. Impact onto the OTCP
10NCT	30g Vertical Load on Bottom End (Bottom End Drop)	A	Vertical cask, supported on top end, 30g axial acceleration. Impact onto the BSP Assembly
11NCT	30g Vertical Load on Bottom End + 10.5 psi Internal Pressure (Bottom End Drop with Internal Pressure)	A	Vertical cask supported on top end, 30g axial acceleration + 8 psi Internal Pressure. Impact onto the BSP Assembly
12NCT	30g Vertical Load on Bottom End + 8 psi External Pressure (Bottom End Drop with External Pressure)	A	Vertical cask supported on top end, 30g axial acceleration + 8 psi External Pressure. Impact onto the BSP Assembly

Stress Criteria for NB Shell and Cover Plates

Service Level	Stress Category	References	Notes
Design [NB-3221]	$P_m \le 1.0S_m$ $P_L \le 1.5S_m$ $P_m(or\ P_L) + P_b \le 1.5S_m$ $F_p \le 1.0S_y\ or\ 1.5S_y$ $\sigma_1 + \sigma_2 + \sigma_3 \le 4S_m$ External Pressure: NB-3133	NB-3221.1, NB-3221.2, NB-3221.3, NB-3227.1 and NB-3227.4	Note 2
Level A [NB-3222]	$P_m \le 1.0S_m$ $P_L \le 1.5S_m$ $P_m(or\ P_L) + P_b \le 1.5S_m$ $P_m(or\ P_L) + P_b + Q \le 3.0S_m$ $F_p \le 1.0S_y\ or\ 1.5S_y$ $\sigma_1 + \sigma_2 + \sigma_3 \le 4S_m$ External Pressure: NB-3133	NB-3222, NB-3227.1, & NB-3227.4	Notes 1 & 2

Notes:

1. The Level A limit of NB-3222.2 may be exceeded provided the criteria of NB-3228.5 are satisfied.
2. There are no specific limits on primary stresses for Level A events. However, the stresses due to primary loads during normal service must be computed and combined with the effects of other loadings in satisfying other limits. See NB-3222.1. The Code Design limits on primary stresses shall be used for Service Level A.

Weld Stress Criteria for Pressure Boundary Partial Penetration Welds

Service Level	Stress Region / Category	Stress Criteria	Allowable Stress Value at 400 °F [ksi]
Pressure Boundary Partial Penetration Welds			
Level A / Level B	Weld Stress away from Impact Zone	0.6 [1.5 Sm]	16.83
	Weld Stress in local area near Impact Zone	0.6 [1.5 Sm]	33.66
Non-Pressure Boundary Partial Penetration and Fillet Welds			
Service Level	**Allowable Stress**		**Basis**
Level A	$F_w=0.30S_u$ (weld metal) $F_w=0.40S_y$ (base metal)		Table NF-3324.5(a)-1

Stress Results FO-DSC/24PT1 – Stress Results Summary

Sl. No	Component	Stress Category	BED (ksi)	TED (ksi)	SD (ksi)	Allowable Stress (ksi)	Max Stress Ratio
1	Cylindrical Shell	Pm	4.10	4.04	13.09	19.3	0.68
		PL	NA	NA	19.83	28.95	0.68
		Pm + Pb	6.53	10.78	22.05	28.95	0.76
2	Outer Top Cover Plate	Pm	0.15	0.68	7.81	19.3	0.40
		Pm + Pb	0.49	0.69	12.79	28.95	0.44
3	Inner Top Cover Plate	Pm	0.18	0.72	8.32	19.3	0.43
		Pm + Pb	0.42	0.72	11.27	28.95	0.39
4	Outer Bottom Cover Plate	Pm	2.16	0.31	8.52	19.3	0.44
		Pm + Pb	2.63	1.32	14.46	28.95	0.50
5	Inner Bottom Cover Plate	Pm	0.78	1.37	14.39	19.3	0.75
		Pm + Pb	1.99	8.57	15.98	28.95	0.55
6	Grapple Support Plate	Pm	0.57	0.79	1.18	19.3	0.06
		Pm + Pb	1.31	1.79	1.90	28.95	0.07

Stress Results FO-DSC/24PT1 – Stress Results Summary

Sl. No	Component	Stress Category	BED (ksi)	TED (ksi)	SD (ksi)	Allowable Stress (ksi)	Max Stress Ratio
7	Grapple Ring	Pm	0.07	0.10	1.27	19.3	0.07
		Pm + Pb	0.17	0.26	1.40	28.95	0.05
8	Support Ring	Pm	2.43	1.98	12.79	19.3	0.66
		Pm + Pb	4.20	3.57	22.63	28.95	0.78
9	Cylindrical Shell - OTCP Weld	PL (Away Impact Zone)	0.26	1.10	16.63	17.37	0.96
		PL (Near Impact Zone)	NA	NA	21.13	34.74	0.61
10	Cylindrical Shell - ITCP Weld	PL (Away Impact Zone)	0.94	0.63	11.53	17.37	0.66
		PL (Near Impact Zone)	NA	NA	18.15	34.74	0.52
11	Cylindrical Shell - OBCP Weld	PL (Away Impact Zone)	1.33	0.73	8.07	17.37	0.46
		PL (Near Impact Zone)	NA	NA	14.49	34.74	0.42
12	Cylindrical Shell - Support Ring Weld	PL	4.74	3.98	12.86	17.37	0.74

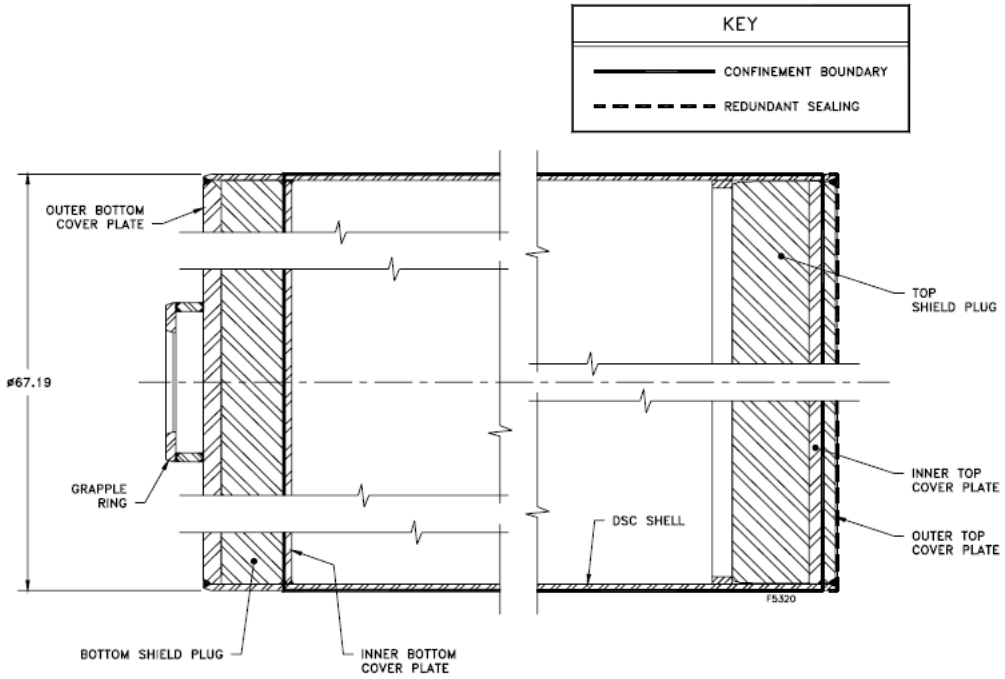
Stress Results FC- FF-DSC – Stress Results Summary

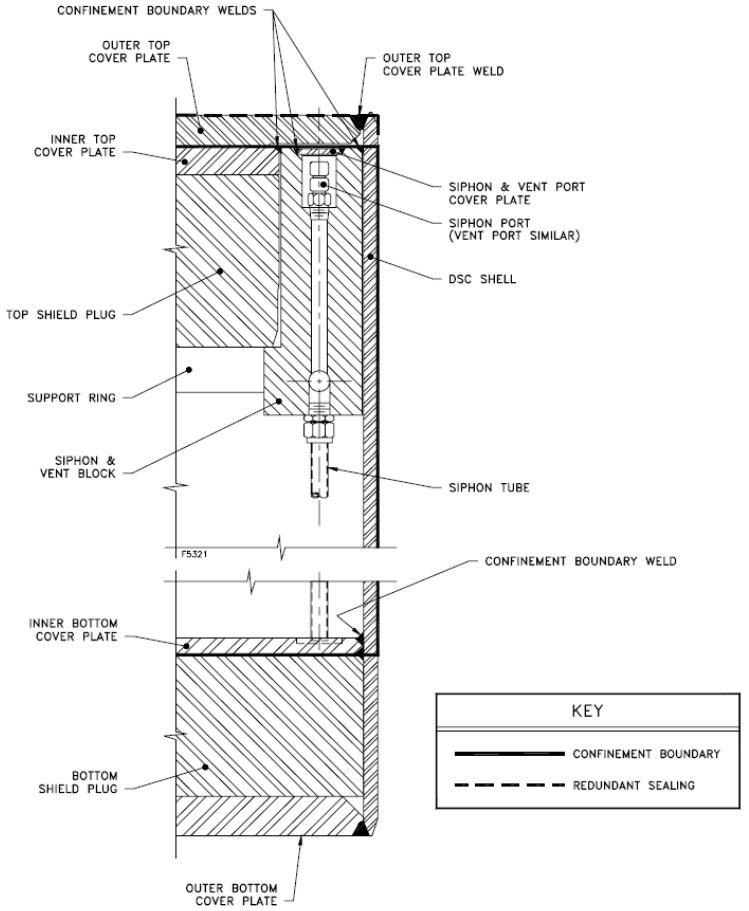
Part. No	Component	Stress Category	BED (ksi)	TED (ksi)	SD (ksi)	Allowable Stress (ksi)	Max Stress Ratio
1	Cylindrical Shell	Pm	5.07	4.40	13.60	18.60	0.73
		PL + Pb	9.17	9.71	24.68	27.90	0.88
2	Outer Top Cover Plate	Pm	0.59	1.08	7.97	18.60	0.43
		PL + Pb	2.05	1.15	11.14	27.90	0.40
3	Inner Top Cover Plate	Pm	1.71	1.78	8.52	18.60	0.46
		PL + Pb	2.30	2.30	10.32	27.90	0.37
4	Inner Bottom Cover Plate	Pm	7.47	2.30	10.49	18.60	0.56
		PL + Pb	8.76	3.65	18.70	27.90	0.67
5	Cylindrical Shell - OTCP Weld	PL	3.01	1.16	15.70	16.74	0.94
		PL (Impact Zone)			19.95	33.48	0.60
6	Cylindrical Shell - ITCP Weld	PL	3.40	2.79	12.37	16.74	0.74
		PL (Impact Zone)			18.19	33.48	0.54

Prudent Measures

- Post-transportation evacuated volume helium leak test on each transportation cask received to demonstrate the accessible portions of the canister confinement boundary remains intact following shipment
  - Helium leak testing shall comply with ANSI N 14.5 – 1997
  - Varian Vacuum Products, Model VSMR151, VSMD30 Mass Spectrometer Leak Detector (MSLD), or equal, having a sensitivity of at least $1x10^{-9}$ atm cm^3/sec He.
  - Leak Standard: Shall be calibrated permeation type leak through fused glass or quartz. The standard shall have a helium leakage rate in the range of $1x10^{-7}$ to $1x10^{-10}$ atm cm^3/sec He.
  - The composition of the helium gas shall be certified.
  - The Helium Leak Rate Test is acceptable when the corrected actual leakage rate is equal to or less than $1x10^{-7}$ atm cm^3/sec He.

Canister Confinement Boundary Example





Summary

- Confinement verified as a condition of loading a canister into storage.
- Confinement is re-verified after shipment to WCS by demonstrating that loads during normal conditions of transport are not large enough to exceed Class A Service Levels in ASME B&PV code.
- Post shipment leak test performed as prudent measure.

AMERICA'S NUCLEAR SOLUTION

BACKUP SLIDES

WCS CISF SAR Summary Tables, App. Ch. 3

- Document canister evaluations
- Cover Canisters at the WCS CISF
- Each Appendix Chapter 3 includes a table comparing site conditions to the condition used in the design and licensing basis analysis

Appendix Chapter 3 Example

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Table E.3-1
Summary of WCS CISF Principal Design Criteria
(5 pages)

Design Parameter	WCS CISF Design Criteria	Condition	NAC-MPC Design Criteria
Type of fuel	Commercial, light water reactor spent fuel	Normal (Bounded)	NAC-MPC FSAR Section 2.1
Storage Systems	Transportable canisters and storage overpacks docketed by the NRC	Normal (Bounded)	72-1025 71-9235
Fuel Characteristics	Criteria as specified in previously approved licenses for included systems	Normal (Bounded)	NAC-MPC FSAR Section 2.1
Tornado (Wind Load)	Max translational speed: 40 mph Max rotational speed: 160 mph Max tornado wind speed: 200 mph Radius of max rotational speed: 150 ft Tornado pressure drop: 0.9 psi Rate of pressure drop: 0.4 psi/sec	Accident (Bounded)	**NAC-MPC FSAR Section 2.2.1.1** Max translational speed: 70 mph Max rotational speed: 290 mph Max tornado wind speed: 360 mph Radius of max rotational speed: 150 ft Tornado pressure drop: 3.0 psi Rate of pressure drop: 2.0 psi/sec
Tornado (Missile)	Automobile: 4000 lb, 112 ft/s (76.4 mph) Schedule 40 Pipe: 287 lb, 112 ft/s (76.4 mph) Solid Steel Sphere: 0.147 lb, 23 ft/s (15.7 mph)	Accident (Bounded)	**NAC-MPC FSAR Section 2.2.1.3** Massive Missile: 3960 lb, 126 mph Rigid hardened steel: 275 lb, 126 mph Solid Steel Sphere: 0.15 lb, 126 mph
Floods	Flood height: 1.1 inches (0.0917 ft) Water velocity: 1.7 ft/s	Accident (Bounded)	**NAC-MPC FSAR Section 2.2.2.1** Flood height: 50 ft Water velocity: 15 ft/s

Evaluations Cover Conditions of Transfer/Storage at the WCS CISF

- Bounding structural analysis of the confinement boundary incorporated by reference for conditions of storage where possible
- Where required, reconciliation evaluations are included in the appropriate section of the WCS CISF SAR Appendix
  - The Appendix Chapter 3 Tables point to the location of the reconciliation evaluations in the WCS CISF SAR.