71-9270

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September 27, 2002

U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Attn: Document Control Desk

Subject: Submittal of Supplemental Responses to the NRC Questions on the UMS® Universal Transport Cask Application

Docket No. 71-9270

References:
1. Submittal of Supplemental Information for UMS® Universal Transport Cask Application, Revision UMST-02A, NAC International, January 31, 2002
2. Submittal of Supplemental Information for the NAC-UMS® Universal Transport Cask Application, Revision UMST-02B, NAC International, March 13, 2002
3. Submittal of NAC Responses to the NRC Revised Issues Related to the Review of the UMS® Universal Transport Cask Application, NAC International, August 12, 2002
4. Conference Call, Questions Related to the Review of the NAC-UMS® Universal Transport Package Application, U.S. Nuclear Regulatory Commission and NAC International, September 4, 2002

In accordance with the discussions of Reference 3, NAC International (NAC) herewith submits eight copies of the Responses to the Questions related to the review of the NAC-UMS® Universal Transport Package application.

This submittal includes the questions (Reference 4) and the NAC responses to those questions presented in the standard NAC response format, followed by the associated NAC-UMS® Safety Analysis Report (SAR) changed pages, which are designated as Revision UMST-02D and include one revised license drawing. Note: The enclosed SAR changed pages are to be inserted as replacement or new additional pages, as applicable, into the existing NAC-UMS® SAR binders. The List of Effective Pages provided in this submittal can be used to ensure that the correct page revisions are incorporated in the SAR binders.

The Revision UMST-02D changed pages have been prepared in accordance with the following conventions:

- Revision indicators (shading and revision bars) are used to highlight changes. Shading indicates a revision from NAC-UMS® SAR, Revision 0, while a revision bar indicates a change in the SAR from a previous revision, subsequent to Revision 0.

- Revision bars also indicate text flow.

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- The changed pages for this submittal are designated as Revision UMST-02D to provide a unique identification of the pages and changes.

- All of the pages in the List of Effective Pages are designated Revision UMST-02D and no revision bars are used on those pages.

As previously discussed, NAC is anxious to complete the review and certification process for this UMS® Universal Transport Cask Application in accordance with the published schedule. NAC appreciates the continued efforts of the NRC staff to complete this application process.

If you have any comments or questions, please contact me on my direct line at 678-328-1321.

Sincerely,

T. C. Thompson

Thomas C. Thompson
Director, Licensing
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Enclosures

cc: Paul Plante (MY)
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NAC-UMS
Docket # 71-9270
TAC # L22452

NAC INTERNATIONAL

RESPONSE TO THE

UNITED STATES
NUCLEAR REGULATORY COMMISSION

NAC UNIVERSAL TRANSPORT SYSTEM (NAC-UMS®)

SUPPLEMENTAL INFORMATION, SEPTEMBER 4, 2002

(TAC. NO. L22452, DOCKET NO. 71-9270)

SAR SUBMITTAL – REVISION UMST-02D

SEPTEMBER 27, 2002

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR SUPPLEMENTAL INFORMATION

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NAC INTERNATIONAL RESPONSE
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CHAPTER 1: GENERAL INFORMATION

1-1 (a) Sketch of the containment boundary was placed in Chapter 4 by NAC. NRC would prefer that it be put in Chapter 1 with the drawings, but they can also reference the figure in Chapter 4.

(b) The density of NS-4-FR was not provided on the drawing.

(c) The contents weight for PWR fuel was not provided on the drawing.

NAC Response

(a) As discussed with the NRC, the containment boundary sketch will be left in Chapter 4 and the Certificate of Compliance will reference Figure 4.1-1 of Chapter 4 of the Safety Analysis Report.

(b) License Drawing 790-502 is revised to define the density range of the NS-4-FR in Note 1 of the drawing.

(c) As discussed with the NRC, the requested information is shown on Drawings 790-516 and 790-519, but not on Drawing 790-502. The presentation of contents weight on Drawings 790-516 and 790-519 was determined to be acceptable to the NRC.

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR SUPPLEMENTAL INFORMATION

CHAPTER 1: GENERAL INFORMATION

1-5 The drawing revision is not consistent with the response provided: Response said .100 - .113; drawing shows .10 - .12.

NAC Response

The dimension of .10 - .12 shown in Revision 2 of License Drawing 790-504 is correct.

The text of NAC's August 12, 2002, response to Question 1.5 incorrectly identified the dimension as .100 - .113. The correct dimension is .10 - .12, as shown on the drawing.

NAC INTERNATIONAL RESPONSE
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CHAPTER 1: GENERAL INFORMATION

1.7 & 1-8 Tolerances: Need to change – i.e., drawings to show dimensions that preclude interference. These could be the same as the design drawings.

NAC Response

As discussed with the NRC, NAC agreed to provide the basic calculations of the worst-case clearances and also of the differential thermal expansion between the fuel tube and the heat transfer disk to demonstrate that no interferences exist based on the Licensing Drawing dimensions and tolerances.

The worst case clearance between the fuel tube and the heat transfer disk:

BWR Case

Maximum fuel tube: [(6.00+.03) + (.135+.005) + (.018+.003)] = 6.191
Minimum heat transfer disk opening: 6.28 - .06 = 6.22.

6.22 – 6.191 = .029 Clearance

PWR Case

Maximum fuel tube: [(8.86+.03) + 2(.075+.005) + 2(.018+.003)] = 9.092
Minimum heat transfer disk opening: 9.2 - .1 = 9.1

9.100 – 9.092 = .008 Clearance

Note: The tolerance for the .018 plate is from ASTM A480, Table A1.2.

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NAC Response to Question 1.7 & 1.8 (continued)

For the differential thermal expansion between the fuel tube and the heat transfer disk:

BWR Case

$T_{max} \approx 525°F$, $\Delta T_{max} = 50°F$ (Fuel cladding – maximum heat transfer disk temperature.)
$\alpha_{Al} = 13.85e\text{-}6$ in./in./°F
$\alpha_{304} = 9.44e\text{-}6$ in./in./°F
$L_{htd} = 6.2$ in. (heat transfer disk opening.)
Δgrowth = (0.0348 – 0.0266) = 0.0082 in.

The aluminum heat transfer disk grows 0.0082 inch more than the fuel tube.

PWR Case

$T_{max} \approx 600°F$, $\Delta T_{max} = 75°F$ (Fuel cladding - maximum heat transfer disk temperature.)
$\alpha_{Al} = 14.3e\text{-}6$ in./in./°F
$\alpha_{304} = 9.63e\text{-}6$ in./in./°F
$L_{htd} = 9.2$ in. (heat transfer disk opening.)
Δgrowth = (0.0599 – 0.047) = 0.0129 in.

The aluminum heat transfer disk grows 0.0129 inch more than the fuel tube.

Therefore, the clearance between the fuel tube and heat transfer disk (for both the BWR and PWR configurations) increases due to the differential thermal growth between the fuel tube and the heat transfer disk. Thus, no interference exists between the fuel tube and the heat transfer disk during fabrication or operations.

NAC INTERNATIONAL RESPONSE
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CHAPTER 3: THERMAL EVALUATION

3-1 The time limit was put in, but the basis/analysis is not shown in the SAR.

NAC Response

To preclude the possibility of the loaded transport cask remaining in the vertical orientation for an extended period of time, a new Step 35 is added on page 7.1-7 of Section 7.1.4, "Loading Transportable Storage Canister into Universal Transport Cask," to provide for the timely placing of the transport cask in the horizontal position.

The added step is the final step in the generic cask loading procedure and states: "Using the cask lifting yoke attached to the crane hook, engage the yoke with the primary lifting trunnions on the cask and lower the cask into a horizontal position."

NAC INTERNATIONAL RESPONSE
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CHAPTER 5: SHIELDING EVALUATION

5-2 The surface dose rate section does identify that exclusive use shipment per 10 CFR 71.47 is required, but 10 CFR 71.47 requires the package to be in a closed transport vehicle, which is defined in 49 CFR 173.403 (closed conveyance). The SAR needs discussion to clarify how the personnel barrier meets the definition for a closed conveyance.

NAC Response

Section 5.0 is revised to include a description of the personnel barrier as a screened or grated metal frame structure intended to preclude access to the transport cask surface. The personnel barrier is attached to the bed of the railcar and is intended to remain in place during all of the normal conditions of transport. Thus, the loaded cask, with the personnel barrier on the railcar ready for transport, meets the definition for a closed conveyance.

Section 1.1 is also revised to include this description of the exclusive use, closed conveyance, condition.

NAC INTERNATIONAL RESPONSE
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CHAPTER 7: OPERATING PROCEDURES

7-1 The NRC does not want references to the storage FSAR in the procedures because the FSAR can be changed by 72.48, possibly without being resolved with the transport SAR. NRC indicated that they do not want the detailed procedures that are in the FSAR, rather more general ones that provide reasonable guidance.

NAC Response

The general steps for handling, loading and closing the Transportable Storage Canister are provided in revised Section 7.1.3, entitled "Loading the Transportable Storage Canister."

The procedure for "Loading Transportable Storage Canister into Universal Transport Cask," is renumbered as Section 7.1.4 to preserve the anticipated chronology of canister handling, loading and closing, and the subsequent loading of the closed canister into the transport cask.

NAC INTERNATIONAL RESPONSE
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CHAPTER 8: ACCEPTANCE TEST AND MAINTENANCE PROGRAM

8-1 The NRC wants to ensure that the TSC meets Part 71 SAR drawing requirements by having some acceptance criteria stated; these steps can be done at beginning of storage, but recall that storage is not required, so transport may be immediately. The acceptance actions are not time dependent – i.e., just indicate that they are done, not when they are done.

NAC Response

The canister is fabricated and assembled in accordance with approved drawing and procedures from components procured in accordance with approved quality assurance programs and controls. The documentation from these activities is available through the life of the canister and provides adequate assurance that the canister is in accordance with the drawings and controls in effect at the time of its fabrication and assembly.

The canister is handled, loaded and sealed in accordance with approved procedures that assure:

- that the fuel is selected to meet the loading condition requirements (for storage or for transport),
- that the canister is loaded in accordance with an approved fuel loading plan,
- that closure welding is correctly performed and its integrity is demonstrated by recorded inspection and testing,
- that the canister is leak tight as defined by ANSI N 14.5 and that the leak tight condition is demonstrated by record,
- that the canister does not contain free water, and
- that the canister has been correctly loaded and closed in accordance with the licensing conditions.

NAC INTERNATIONAL RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION

NAC Response to Question 8.1 (continued)

The documentation of these actions is available through the life of the canister and provides assurance that the canister is correctly loaded and closed in accordance with its license conditions.

The records of fabrication, assembly, loading and closing are retained by the licensee as lifetime records and may be reviewed any time there is a question regarding any of these actions.

These records, taken together, provide significant evidence that the canister is as licensed.

For transport, it must be verified that the fuel loaded in the canister conforms to the transport Certificate of Compliance. This verification must be based on the consideration of the fuel loaded in a canister, as confirmed by the canister serial number and loading record. A second consideration is verification that, during the storage, the canister has only been in normal storage conditions. Off-normal and accident event conditions require that the canister be fully evaluated prior to transport.

Section 8.1 is revised to specifically require a review of the canister fuel loading plan to verify that the fuel conforms to the transport Certificate of Compliance and that the site record be reviewed, based on canister serial number, to verify normal conditions of storage. The revision provides for the review of all of the additional records in the event that a need to do so is identified.

NAC INTERNATIONAL RESPONSE
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CHAPTER 8: ACCEPTANCE TEST AND MAINTENANCE PROGRAM

8-4 Impact limiter maintenance: The NRC requests that a visual inspection and a "weighing" would be a possibility at some defined interval.

NAC Response

Section 8.2.3, "Subsystem Maintenance," is revised to require that the impact limiters be weighed at least once every five years to verify that the impact limiter weight is within ± 3 % of the original weight indicated on the impact limiter nameplate. In addition, a repaired impact limiter must be weighed to verify its weight following the repair.

EA790-SAR-001

DOCKET NO. 71-9270

UMS®

UNIVERSAL MPC SYSTEM®

SAFETY ANALYSIS REPORT

for the

UMS® Universal Transport Cask

SEPTEMBER 2002 UMST-02D

VOLUME 1 OF 2

NAC INTERNATIONAL

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Chapter 1

1.1 Introduction

The Universal Transport Cask is designed to safely transport a Transportable Storage Canister containing 24 intact PWR spent fuel assemblies, 56 intact BWR spent fuel assemblies or Greater Than Class C (GTCC) waste. Intact fuel assemblies are defined as those assemblies that are structurally intact and that do not have cladding defects greater than hair line cracks or pin holes. On the basis primarily of their lengths, three classes of PWR fuel assemblies and two classes of BWR fuel assemblies have been evaluated for transport. Three canisters of different lengths are designed to transport the three classes of PWR fuel assemblies, and two canisters of different lengths are designed to transport the two classes of BWR fuel assemblies.

Characteristics of PWR and BWR fuel assembly classes are presented in Tables 1.2-4 and 1.2-5, respectively. Spent fuel for UMS canister classes 1 and 2, specifically Westinghouse and B&W fuel assemblies, may contain control component hardware (i.e., burnable poison rods and guide tube thimble plugs). The assembly weights listed in Tables 2.2-1 and Table 2.2-2 include the control component hardware weight.

The cask contents may also include site specific fuel or GTCC waste, as defined in Table 1-1 and described in Section 1.3.1, provided that the contents characteristics are bounded by the analysis presented for the design basis fuel or the contents are separately evaluated and shown to be acceptable. The loading of site specific fuels that include control component hardware may require the use of a longer Transportable Storage Canister than would be used if the hardware were excluded.

The Universal Transport Cask provides a radioactive material containment boundary to ensure maximum safety during the handling and transport operations required for shipment. The general configuration of the Universal Transport Cask and the major cask dimensions are shown in Figure 1.1-1. Figure 1.1-2 illustrates the transport configuration of the cask including the support and tiedown devices.

The transport cask with its impact limiters is securely attached to the bed of a railcar. To restrict unauthorized personnel from gaining access to the top, sides, and bottom of the transport cask, a personnel barrier is installed around the transport cask. The personnel barrier is securely attached to the bed of the railcar during normal transportation and it consists of a metal frame structure covered with expanded metal (i.e., a metal grating or screen). Thus the loaded cask, with the personnel barrier on the railcar ready for transport meets the exclusive use definition of a closed conveyance.

The cask transport containment boundary is defined by the following components:

1. Inner shell.
2. Bottom forging.
3. Top forging.
4. Cask lid and lid inner O-ring.
5. Vent port coverplate and vent port coverplate inner O-ring.
6. Drain port coverplate and drain port coverplate inner O-ring.

The Universal Transport Cask is designed to meet 10 CFR 71 and IAEA Safety Series No. 6 licensing requirements for radioactive material transport packages. Other applicable codes and standards, as well as specific exceptions to those codes and standards, are discussed in Section 2.1.2.2. The transport licensing requirements include provision for safe containment during the handling and transport of the cask containing radioactive material. The value of the Transport Index for nuclear criticality control for the cask containing PWR or BWR spent fuel is determined to be zero (0) in accordance with 10 CFR 71.59. The Transport Index based on dose rate evaluations is eighteen (18) as determined in accordance with 10 CFR 71.4.

The design features of the transport cask include the lid, redundant seals at each containment boundary penetration, cavity penetrations located in the lid and bottom forging, and a puncture-resistant outer shell, rotation pockets, redundant lifting trunnions, impact limiters, and canister spacers.

The cask lid and its inner O-ring are part of the containment boundary. The O-ring provides the lid seal between the lid and top-forging seal surface. During transport, the port coverplate and the cask lid protect the vent port from external puncture events. A second O-ring of slightly larger diameter provides an interseal region that permits leak-testing of the inner O-ring. The O-rings provide long-term sealing capability in an elevated temperature and radiation environment.

The vent and drain port coverplates, which protect the vent and drain ports, are also part of the containment. Each coverplate is sealed by two O-rings. After initial installation, all of the primary containment seals are leak tested to verify proper containment sealing.

The body of the Universal Transport Cask is a smooth, right-circular cylinder of multiwall construction that consists of stainless steel inner and outer shells separated by lead gamma

1.3.4 License Drawings

This section contains the License Drawings pertinent to the Universal Transport Cask. The dimensions indicated on the drawings are generally limited to one significant digit past the decimal point. Note that analysis of systems or components may present dimensions with additional significant digits based on more detailed engineering drawings.

Drawing No.	Rev. No.	Title
790-209	1	Impact Limiter Assembly-Upper, Cask, NAC-UMS®
790-210	1	Impact Limiter Assembly-Lower, Cask, NAC-UMS®
790-500	2	Assembly, Universal Transport Cask, Overpack, NAC-UMS®
790-501	3	Canister/Basket Assembly Table, NAC-UMS®
790-502	6	Cask Body, Transport Cask, NAC-UMS®
790-503	2	Lid Assembly, NAC-UMS® Cask
790-504	2	Port Coverplate Assembly, NAC-UMS®
790-505	1	Lifting Trunnion, NAC-UMS®
790-508	2	Misc. Details, Transport Cask, NAC-UMS®
790-509	2	Nameplates - NAC-UMS®
790-516	2	Package Assembly, Universal Transport Cask (UTC), NAC-UMS®
790-519	1	Package Assembly, Transport, Universal Transport Cask (UTC), NAC-UMS®
790-520	2	Spacers, Universal Transport Cask, NAC-UMS®
790-570	4	Fuel Basket Assembly, 56 Element BWR, NAC-UMS®
790-571	2	Bottom Weldment, Fuel Basket, 56 Element BWR, NAC-UMS®

Licensed Drawings (Continued)

Drawing No.	Rev. No.	Title
790-572	4	Top Weldment, Fuel Basket, 56 Element BWR, NAC-UMS®
790-573	7	Support Disk and Misc. Basket Details, 56 Element BWR, NAC-UMS®
790-574	3	Heat Transfer Disk Fuel Basket, 56 Element BWR, NAC-UMS®
790-575	7	BWR Fuel Tube, NAC-UMS®
790-581	5	PWR Fuel Tube, NAC-UMS®
790-582	7	Shell Weldment, Canister, NAC-UMS®
790-583	4	Assembly, Drain Tube, Canister, NAC-UMS®
790-584	11	Details, Canister, NAC-UMS®
790-585	8	Transportable Storage Canister (TSC), NAC-UMS®
790-591	2	Bottom Weldment, Fuel Basket, 24 Element PWR, NAC-UMS®
790-592	5	Top Weldment, Fuel Basket, 24 Element PWR, NAC-UMS®
790-593	4	Support Disk and Misc. Basket Details, 24 Element PWR, NAC-UMS®
790-594	2	Heat Transfer Disk, Fuel Basket, 24 Element PWR, NAC-UMS®
790-595	5	Fuel Basket Assembly, 24 Element PWR, NAC-UMS®
790-605	8	BWR Fuel Tube, Over-Sized Fuel, NAC-UMS®
790-611	3	GTCC Waste Basket, Maine Yankee, NAC-UMS®
790-612	3	GTCC Waste Canister, Maine Yankee, NAC-UMS®
412-501	2	Spent Fuel Can Assembly, Maine Yankee (MY), NAC-UMS®
412-502	2	Fuel Can Details, Maine Yankee (MY), NAC-UMS®

FIGURE WITHHELD UNDER 10 CFR 2.390

DIMENSIONING AND TOLERANCING SHALL BE PER ANSI Y14.5-82
UNSPECIFIED DIMENSIONS AND TOLERANCES SHOWN BELOW.
DIMENSIONS ARE IN INCHES. FRACTIONAL TOLERANCE: ±1/8

SYM.	GEOMETRY	.XXX	TOL.	.XX	TOL.
	FLATNESS	UNDER 3		UNDER 6	±.04
		3-12		6-18	±.08
	STRAIGHTNESS	OVER 12		OVER 18	±.08
	ANGULARITY	.X	±.1	ANGLES ±.5°	
		ALL UNSPECIFIED TOOL RADII: .01 - .03			
	PERPENDICULARITY	BREAK ALL SHARP CORNERS .01 - .03			
	PARALLELISM	ALL UNSPECIFIED MACHINED SURFACES SHALL BE 63 OR BETTER			
	CONCENTRICITY	NEXT ASSEMBLY: 790-500			
	TRUE POSITION	DRAWING TYPE: LICENSE			

GROUP	NAME	DATE
PREPARER	S. Graham	9-18-02
CHECKER	R. Walker	9-18-02
PROJECT MANAGER	[illegible]	9/19/02
DIRECTOR DESIGN AND ANALYSIS	[illegible]	9-19-02
DIRECTOR LICENSING	[illegible]	9/19/02
VICE PRESIDENT, QUALITY	M Mels for	9/20/02

CASK BODY,
TRANSPORT CASK
NAC-UMS®

PROJECT 790		DRAWING 502	REV 6
SCALE 1/10	EST. WT. 153,500#	SH 1 OF 5	8:57AM 9-18-2002

FIGURE WITHHELD UNDER 10 CFR 2.390

FIGURE WITHHELD UNDER 10 CFR 2.390

FIGURE WITHHELD UNDER 10 CFR 2.390

NAC INTERNATIONAL

CASK BODY,
TRANSPORT CASK
NAC-UMS®

PROJECT 790		DRAWING 502	REV 6
SCALE NOTED	EST. WT.	SH 4 OF 5	1:47PM 8-13-2002

FIGURE WITHHELD UNDER 10 CFR 2.390

NAC INTERNATIONAL

CASK BODY,
TRANSPORT CASK
NAC-UMS®

PROJECT 790		DRAWING 502	REV 6
SCALE NOTED	EST. WT.	SH 4 OF 5	1:47PM 8-13-2002

EA790-SAR-001

DOCKET NO. 71-9270

UMS®

UNIVERSAL MPC SYSTEM®

SAFETY ANALYSIS REPORT

for the

UMS® Universal Transport Cask

SEPTEMBER 2002 UMST-02D

VOLUME 2 OF 2

NAC INTERNATIONAL

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Chapter 5

5.0 SHIELDING EVALUATION

The Universal Transport Cask meets the 10 CFR 71 [1] requirements for transportation dose rate limits. The optimized multiwall design provides an efficient shielding arrangement for the transportation of 24 PWR or 56 BWR spent fuel assemblies. This chapter describes the shielding design and the analysis used to establish bounding radiological dose rates for the transport of various PWR and BWR fuels.

The Universal Transport Cask is assigned a nominal Transport Index for shielding of 20 (TI = 20) based on the requirement of 10 CFR 71.4 and the analysis of Section 5.4. The maximum dose rate at 1 meter from the Universal Transport Cask in normal conditions of transport is 19.3 mrem per hour, based on the analysis of the Westinghouse 17×17 Std assembly in a Class 3 canister.

The shielding design criteria for the Universal Transport Cask are in accordance with the requirements established in 10 CFR Parts 71.47 and 71.51 and IAEA Safety Standard Series No. ST-1 for normal conditions of transport and hypothetical accident conditions. The 10 CFR 71.47 and IAEA Safety Standard Series No. ST-1 (paragraph 572) requirements for the exclusive use transport of spent fuel under normal conditions of transport include the following:

- The dose rate on the surface of the enclosed package must not exceed 1000 mrem/hr.
- The dose rate on the outer surfaces of the transport vehicle must not exceed 200 mrem/hr.
- The dose rate on a plane two meters from the lateral surfaces of the railcar must not exceed 10 mrem/hr.
- The dose rate in any normally occupied positions of the railcar must not exceed 2 mrem/hr.

The 10 CFR 71.51 and IAEA Safety Standard Series No. ST-1 (paragraph 656) requirements state that the dose rate under hypothetical accident conditions must not exceed 1,000 mrem/hr at 1 meter from the surface of the cask. A summary description of the modeling methodology and dose rate results is provided in Section 5.1.

The transport cask with its impact limiters is securely attached to the bed of a railcar. To restrict unauthorized personnel from gaining access to the top, sides, and bottom of the transport cask, a personnel barrier is installed around the transport cask. The personnel barrier is securely attached to the bed of the railcar during normal transportation and it consists of a metal frame structure covered with expanded metal (i.e., a metal grating or screen). Thus the loaded cask, with the personnel barrier on the railcar ready for transport meets the exclusive use definition of a closed conveyance.

The shielding analysis is performed on the basis of design basis fuel descriptions for both PWR and BWR fuel. The design basis PWR fuel is a Westinghouse 17×17 assembly with a burnup of 45,000 MWD/MTU, an initial enrichment of 3.7 wt % ^{235}U, and a 10-year cooling time. The design basis BWR fuel is a GE 9×9 assembly design with a burnup of 40,000 MWD/MTU, an initial enrichment of 3.25 wt % ^{235}U, and a 10-year cooling time. A detailed description of the source term specification is provided in Section 5.2.

In the Universal Transport Cask design, the spent fuel assemblies are surrounded by a multiwalled arrangement of shielding materials. However, structural design requirements lead to cask extremity regions, such as rotation pockets, in which shield materials are reduced or penetrated. Detailed analytical treatment of these shield transition regions is required to assess the radiological consequences of the design. Section 5.3 describes the three-dimensional shielding models employed in this analysis.

Dose rate results are obtained for both normal conditions of transport and hypothetical accident conditions. Under accident conditions, the cask is analyzed for the simultaneous effects of complete loss of radial neutron shielding including loss of the outer neutron shield shell; loss of impact limiters; and combined radial and axial lead slumps resulting from postulated cask side and end drops. Analytical details and dose rate results are given in Section 5.4. Under all postulated conditions, the fully loaded cask is shown to meet regulatory radiological limits.

The design basis fuel descriptions characterize Universal Transport Cask dose and heat generation rates at nominal conditions of burnup and initial enrichment for a particular PWR and BWR fuel type. In order to extend the results to other fuel types and various combinations of initial enrichment and burnup, a detailed analysis is conducted that determines, for any given fuel type, enrichment, and burnup combination, the cool time required for radiation dose and heat generation rates to fall below the design basis values. The analysis explicitly models the source term for the various fuel combinations based on SAS2H results, and the dose rate evaluation is

made on the basis of computed one-dimensional dose rates which explicitly consider the effects of radiation spectrum and cask shielding properties rather than a simple source rate comparison.

For clarity, the various fuel assembly types considered are classified according to array size, with the results for the most limiting fuel type within each array size taken as the minimum required cool time for all assemblies within that size. The result of the analysis is a fuel assembly loading table showing the required cool time for any combination of fuel array size, initial enrichment, and burnup. Results are summarized in Section 5.1.3.

An analysis is performed for fuel at various combinations of burnup and initial enrichment to determine the required cool time for the fuel to fall below the design basis dose and decay heat levels. The bounding cool time is determined considering the cask normal and accident condition dose rates and total decay in the cask. This analysis is presented in Section 5.4.3.

Site specific fuel and GTCC waste is evaluated in Section 5.5.1.

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2. Detorque and remove the vent coverplate bolts.
3. Remove the vent port coverplate from the lid.

   Note: The drain port coverplate need not be removed for dry loading or unloading.
4. Visually inspect the port coverplate o-rings for damage or defects and replace if necessary. Store the coverplate so that the o-rings and o-ring grooves are protected from incidental damage.
5. Detorque the cask lid bolts using the reverse torquing sequence.
6. Remove the bolts and store them in a temporary storage area.
7. Clean and visually inspect bolts for damage. Replace any damaged bolts.
8. Install the two cask lid alignment pins.
9. Install lifting hoist rings in the lid-lifting holes.
10. Attach the lid-lifting device to the lid and an overhead crane.

    Caution: Ensure that the o-rings and o-ring grooves in the lid are protected from any incidental damage to the seal area in its temporary storage position.
11. Remove the lid and store in a temporary storage area.
12. Decontaminate the lid and visually inspect the lid o-rings for damage and wear and replace as necessary.

    Note: Visually Inspecting and cleaning of bolts can be performed in parallel to other operations performed in this procedure.

13. Clean and visually inspect the threaded connections in the top forging.
14. Remove the two cask lid alignment pins.
15. Visually examine the internal cavity to ensure that no damage has occurred during transit and that no foreign materials are present.
16. Record all inspection results.
17. Install the cask adapter ring to protect the cask sealing surfaces.
18. If a canister spacer is to be installed:
    a) Attach the spacer lift fixture to the spacer.
    b) Using an appropriate crane, lower the spacer into the cask cavity and remove the lift fixture.
19. Install the transfer cask adapter plate guide pins.
20. Install the adapter plate on top of the cask.
21. Remove the adapter plate guide pins.
22. Install the transfer cask on the adapter plate.

7.1.3 Loading the Transportable Storage Canister

1. Visually inspect the Transportable Storage Canister (canister) to ensure that it is clean and free of debris.
2. Place the canister in the Transfer Cask.
3. Place the transfer cask and canister into the fuel loading pool.
4. Load the previously designated fuel assemblies into the canister.
5. Place the shield lid on top of the loaded canister.
6. Remove the transfer cask with the loaded canister from the fuel loading pool.
7. Insert the drain tube assembly and remove approximately 70 gallons of water.
8. Weld the shield lid in place and verify the adequacy of welds with liquid penetrant examinations. Record results of examinations as required.
9. Pressurize the canister to 35 psia with air or nitrogen and hold the pressure.
10. Release the pressure.
11. Drain the remaining water from the canister.
12. Vacuum dry the canister.
13. Backfill the canister with helium.
14. Evacuate the canister to a vacuum of 3 mm mercury.
15. Backfill the canister with helium.
16. Evacuate the canister to a vacuum of 3 mm of mercury.
17. Backfill the canister with helium.
18. Close vent and drain ports and weld port covers in place and verify the adequacy of welds with liquid penetrant examinations. Record results of examinations as required.
19. Attach the leak detector system to the canister and verify the leaktightness of the canister.
20. Install the structural lid in place.
21. Weld the structural lid in place and verify the adequacy of welds with liquid penetrant examinations. Record results of examinations as required.
22. Perform a smear survey of the accessible areas of the canister to ensure that the surface contamination is within limits.
23. Install the transfer cask retaining ring.
24. Decontaminate the external surface of the transfer cask to the limits established for the site.

7.1.4 Loading Transportable Storage Canister into Universal Transport Cask

1. Verify that the retaining ring is installed on the transfer cask.
2. Lift the transfer cask and lower it on top of the adapter plate on the transport cask and engage the hydraulic cylinders with the doors.
3. Engage the transportable storage canister lifting sling's master ring with the crane hook and engage the individual sling hooks with their respective hoist rings located on the structural lid of the transportable storage canister.
4. Raise the canister enough to remove the load on the Transfer Cask doors and then open the doors.

   CAUTION: While lowering the canister in Step 5, be careful to avoid contact with the interior cavity wall of the Universal Transport Cask.
5. Lower the canister into the Universal Transport Cask.
6. Disengage the lift sling hooks from the hoist rings and close the Transfer Cask doors.
7. Remove the Transfer Cask and store it in the designated location.
8. Remove the hoist rings from the top of the canister structural lid and install threaded plugs.
9. Attach the adapter plate lifting sling to the adapter plate.
10. Remove the four bolts attaching the adapter plate to the Universal Transport Cask.
11. Remove the adapter plate and store it in the designated location.
12. Remove the cask adapter ring and clean the sealing surface.
13.
14. Install the cask lid alignment pins.
15. Attach the lid-lifting device to the lid and to the overhead crane.
16. Install the lid, using the alignment pins to assist in proper seating.
17. Install 10 cask lid bolts equally spaced and torque hand-tight.
18. Remove the lid alignment pins.
19. Install the remaining cask lid bolts and torque all of the bolts to the value specified in Table 7-1.
20. If previously removed, re-install the drain port coverplate.

21. Connect a pressure test fixture to the drain port coverplate o-ring test port and pressurize to 15 (+2, -0) psig and hold for a minimum of 10 minutes. There must be no pressure drop in the test period.

    Note: If the test condition is not met, remove the drain port coverplate and inspect and clean the o-rings and o-ring sealing surfaces and re-perform the test. If the test condition is not met on the second attempt, replace the o-rings, cleaning the o-ring grooves and sealing surface. A small amount of vacuum grease may be used to lubricate new o-rings.

    Caution: If the drain port o-rings are replaced as a result of the inspection, then a helium leak test of the new o-rings must be performed at Step 29. Using a helium leak detector with a sensitivity of 3.25×10^{-6} cm^3/sec, establish a vacuum in the o-ring annulus and test for helium leakage. The leak rate must be less than 6.5×10^{-6} cm^3/sec (helium) in accordance with Table 7-2.
22. Connect the Vacuum Drying System vacuum pump to the cask vent port and evacuate the cask cavity to a stable vacuum pressure of 3 mm Hg for 10 minutes.
23. Backfill the cask with high purity helium (99.9% minimum) to 1 atm (absolute) pressure.
24. Operate the vacuum system to obtain a vacuum pressure of 3 mm Hg. When the vacuum pressure is obtained, backfill the cask with high purity helium (99.9% minimum) to 1 atm (absolute) pressure.
25. Disconnect the vacuum system and helium supply.
26. Install the vent port coverplate and torque the bolts as specified in Table 7-1.
27. Connect a pressure test fixture to the lid o-ring test port (marked "Seal Test" on cask lid) and pressurize to 15 (+2, -0) psig and hold for a minimum of 15 minutes. There must be no pressure drop in the test period.

    Note: If the test condition is not met, replace the o-rings, cleaning the o-ring grooves and sealing surface. A small amount of vacuum grease may be used to lubricate new o-rings.

    Caution: If the lid o-rings are replaced as a result of the inspection in Step 12 of Section 7.1.2, then a helium leak test of the new o-rings must be performed. Using a helium leak detector with a sensitivity of 3.25×10^{-6} cm^3/sec, establish a vacuum in the o-ring annulus and test for helium leakage. The leak rate must be less than 6.5×10^{-6} cm^3/sec in accordance with Table 7-2.
28. Install the plug in the lid Seal Test port, verifying that the test plug o-ring is in place, and torque the plug to the value specified in Table 7-1.
29. Connect a pressure test fixture to the vent coverplate o-ring test port and pressurize to 15 (+2, -0) psig and hold for a minimum of 10 minutes. There must be no pressure drop in the test period.

Note: If the test condition is not met, remove the vent port coverplate and inspect and clean the o-rings and o-ring sealing surfaces and re-perform the test. If the test condition is not met on the second attempt, replace the o-rings, cleaning the o-ring grooves and sealing surface. A small amount of vacuum grease may be used to lubricate new o-rings.

Caution: If the vent and/or drain port o-rings are replaced as a result of the inspection, then a helium leak test of the new o-rings must be performed. Using a helium leak detector with a sensitivity of 3.25×10^{-6} cm^3/sec, establish a vacuum in the o-ring annulus and test for helium leakage. The leak rate must be less than 6.5×10^{-6} cm^3/sec in accordance with Table 7-2.

30. Install the vent port o-ring test plug, verifying that the test plug o-ring is in place and torque the test plug to the value specified in Table 7-1.
31. Perform external decontamination activities and radiation surveys to verify that contamination is within acceptable levels (2,200 dpm/100 cm^2 β, γ, and 220 dpm/100 cm^2 α) as identified in 10 CFR 71.87 [2].
32. Record the results of the survey.
33. Review the loading checklist and verify that all required activities have been accomplished.
34. Visually inspect the cask to verify that the cask has been assembled in accordance with the requirements of the Certificate of Compliance.
35. Using the cask lifting yoke attached to the crane hook, engage the yoke with the primary lifting trunnions on the cask and lower the cask into a horizontal position.

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Chapter 8

8.1 Fabrication Requirements and Acceptance Tests

Prior to first use of the Universal Transport Cask, the inspections and tests that must be performed on the cask are visual inspection, structural and pressure tests, leakage tests, component tests, tests for shielding integrity, and a thermal acceptance test. These inspections and tests are described in the following sections.

As required to establish the suitability of the canister for transport, canister records for fabrication, assembly, loading, closing, sealing and storage, shall be verified by review based on canister serial number. Prior to placing a loaded canister into the Universal Transport Cask, the canister fuel loading plan must be reviewed, as confirmed by canister serial number, to verify that the fuel conforms to the transport Certificate of Compliance requirements. If the canister has been in storage, the site records shall be reviewed to verify that the canister has been in normal storage conditions since loading. Canisters involved in off-normal or accident storage events shall be reviewed to verify integrity prior to transport.

8.1.1 Visual Inspection

Prior to construction, all cask materials are visually examined by qualified personnel in accordance with the License Drawings (Section 1.3.4) and in accordance with approved written procedures (fabrication specifications). The purpose of the examination is to verify that the materials used in the fabrication of the cask are as specified on the License Drawings.

The finished surfaces of all welds on the cask are visually examined in accordance with ASME Code, Section V, Article 9 [3]. The purpose of the examination is to verify that the cask components are assembled in accordance with the License Drawings and that the components are free of nicks, gouges, or other damage. The acceptance criteria for the visually examined welds are in accordance with ASME Code, Section VIII, Division 1, UW-35 and UW-36 [4]. Unacceptable welds are repaired as required and reexamined in accordance with the original acceptance criteria.

All weld inspections are performed by qualified personnel in accordance with written procedures. The inspection personnel are qualified in accordance with SNT-TC-1A, "Personnel Qualifications and Certification in Nondestructive Testing" [5], as specified by the ASME Code, Section III, Division 1, Subsection NB, Paragraph NB-5520 [6].

8.1.2 Structural and Pressure Tests

These structural tests include load testing of the lifting trunnions, load testing of the rotation pockets, and pressure testing of the containment boundary.

8.1.2.1 Lifting Trunnion Load Testing

Each pair of the Universal Transport Cask lifting trunnions is designed and load tested in accordance with the requirements of ANSI N14.6, "Special Lifting Devices for Shipping Containers Weighing 10,000 lb (4500 kg) or More for Nuclear Materials" [7]. A primary pair of diametrically opposed trunnions is welded to the upper forging of the cask. A secondary pair of trunnions can be bolted to the upper forging for redundant lifts. The primary trunnions are designed to satisfy the critical load (non-redundant) lifting requirements of ANSI N14.6. The secondary trunnions are designed to satisfy the redundant lifting requirements of ANSI N14.6. Load tests of both pairs of trunnions are performed in accordance with ANSI N14.6 and approved written procedures.

Each primary and secondary trunnion pair is separately tested. A load of 780,000 lb, which is 300% of the maximum service load (combined weight of the heaviest, loaded transport cask), is applied to the primary trunnion pair. A load of 390,000 lb, which is 150% of the maximum service load, is applied to the secondary trunnion pair. In each test, the load is applied in a vertical direction, equally distributed between the two trunnions. Trunnions have a "land" width of 3.0 in. The cask lid is bolted in place for the test. The test may be carried out by attaching to the trunnion pair either calibrated hydraulic rams (combined with a load-spreading beam) or the cask-lifting yoke. The load is held for a minimum of 10 minutes.

Following completion of the lifting trunnion load tests, all trunnion welds, trunnion bolt load-bearing surfaces, and welds that are part of the load path are visually inspected for permanent deformation, galling, or cracking. Liquid penetrant examinations are performed in accordance with the ASME Boiler and Pressure Vessel Code, Section V, Article 6 [3]. Liquid penetrant acceptance standards are those of Paragraph NF-5350 of the ASME Boiler and Pressure Vessel Code, Section III, Division 1 [9].

Any evidence of permanent deformation, cracking, galling of the load-bearing surfaces, or unacceptable dye penetrant results is cause for rejection of the trunnion or related welds. Any identified defects must be repaired and the load test repeated prior to final acceptance.

8.2 Maintenance Program

A maintenance program for the Universal Transport Cask is established to ensure continued performance and use of the package. The cask maintenance program specifies the inspections, tests, and replacement of components to be performed and the frequency and schedule for these activities. This section describes the overall requirements of the maintenance program and establishes the frequency and schedule for the maintenance activities. The detailed, written inspection, test, component replacement, and repair procedures will be included in the Universal Transport Cask Operations Manual. The Operations Manual is issued to users of the packaging prior to their use of the cask.

The welded Transportable Storage Canister containing fuel does not require any maintenance.

8.2.1 Structural and Pressure Tests

The four lifting trunnions or two trunnions if the secondary trunnions are not attached and the two rotation pockets are visually inspected prior to each shipment. The visual inspections are performed in accordance with approved written procedures, and the results are evaluated against established acceptance criteria.

Evidence of cracking on the load-bearing surfaces is cause for rejection of the affected trunnion until an approved repair is completed and the surfaces are reinspected and accepted. Such repairs are implemented and documented in accordance with an approved quality assurance program. Any identified damage to the bolted trunnions and the rotation pockets, such as cracking and wear, must be evaluated to determine if replacement of the affected components is necessary.

The lifting trunnions are also inspected annually in accordance with Paragraph 6.3.1(b) of ANSI N14.6 [7]. All trunnion welds, trunnion bolts, trunnion bolt load-bearing surfaces, and welds that are part of the load path are visually inspected for permanent deformation, galling, or cracking. Liquid penetrant examinations of welds and load bearing surfaces are performed in accordance with the ASME Code, Section V, Articles 6 [3]. Liquid penetrant acceptance standards are those of Paragraph NF-5350 of the ASME Boiler and Pressure Vessel Code, Section III, Division 1 [9].

During periods of nonuse of the transport cask, the inspection of the trunnions may be omitted provided that the trunnions are inspected in accordance with this section prior to the next use.

8.2.2 Leak Tests

8.2.2.1 Containment Periodic Verification Leak Testing

As shown in Table 8.2-1, the periodic verification leak test is performed in accordance with approved written test procedures and the test requirements and acceptance criteria established in Section 8.1.3 for the containment fabrication verification leak test.

The periodic verification leak test is performed on each cask after the third use (prior to fourth cask loading sequence), and every 12 months thereafter to verify the containment capability, and whenever a replaceable containment component (containment o-ring set or port coverplate) is replaced.

When the cask is not in use , the periodic verification leak test need not be performed annually but must be re-performed before returning the cask to service .

Leak tests are performed in accordance with the methodologies and requirements of ANSN14.5-1997, using approved written procedures. Personnel performing tests shall be qualified in accordance with Section 8.5 of ANSI N14.5-1997.

8.2.2.2 Periodic Verification Leak Test Acceptance Criteria

The maximum allowable leak rate requirements and the minimum required test sensitivity for the containment fabrication verification and periodic verification leak tests are provided in Section 8.1.3. Unacceptable leak test results are cause for rejection of the component tested. Corrective actions, including repair or replacement of the o-rings or closure component, are taken and documented as appropriate. Before the cask is returned to service, the leak test and corrective actions are repeated until acceptable results are achieved.

8.2.3 Subsystems Maintenance

Impact limiters will be visually inspected for damage prior to each use.

Each impact limiter will be weighed once every five years to verify the impact limiter weight is within ± 3 % of the original weight indicated on the impact limiter nameplate. An impact limiter

not meeting this limit must be returned to the licensed condition by repair or must be removed from service. Any repaired impact limiter must be weighed to verify its weight following repair.

8.2.4 Valves, Rupture Disks, and Gaskets on the Containment Vessel

No valves providing a containment function are present on the cask packaging. Three quick disconnects, one each on the vent, drain, and lid seal test ports, are provided for ease of cask operation. The Universal Transport Cask containment vessel has no rupture disks.

The quick disconnects are inspected for proper performance and function during each cask loading and unloading operation and replaced as necessary. The quick disconnects are also replaced every 2 years during transport operations.

The closure lid and vent port coverplate o-rings are visually inspected for damage during each cask closure operation. The drain port coverplate o-rings are inspected during each cask closure operation when the drain port is used. Any identified damage is cause for replacement. Containment boundary o-rings are leak tested as specified in Table 7-2. As shown in the table, containment boundary o-rings are replaced as required by inspection or test, but are replaced at least annually during routine use of the cask.

8.2.5 Shielding

The gamma and neutron shields of the Universal Transport Cask do not degrade with time or usage. The radiation surveys performed by the cask user prior to transport and upon receipt of the loaded cask provide continuing validation of the shield effectiveness.

8.2.6 Miscellaneous Inspections

Prior to each shipment, the impact limiters are visually inspected for gross damage or cracking of the stainless steel shells in accordance with 10 CFR 71.87 and approved written procedures and established acceptance criteria. Impact limiters not meeting the established acceptance criteria are removed from service until repairs are performed and the component reinspected and accepted.

The cask cavity is visually inspected prior to each fuel loading. The overall cask exterior and cavity are visually inspected for evidence of foreign material, obstructions or damage prior to the

The cask cavity is visually inspected prior to each fuel loading. The overall cask exterior and cavity are visually inspected for evidence of foreign material, obstructions or damage prior to the loading of each canister. Foreign material and obstructions shall be discarded or appropriately removed. Damage to any sealing surface between the cask lid or upper forging seal surface or port cover and corresponding recessed seal surface, shall be assessed and repaired if necessary. Evidence of damage to the inner shell shall be examined, assessed and repaired as necessary. All repairs shall conclude with a re-inspection of the affected area and acceptance to criteria appropriate for the repair made, as described previously.

For each cask loaded for transport, the following information is included in the cask loading report: results of the visual inspections, leak tests, shielding, and radiological contamination surveys; fuel identification information for the package contents; date, time, and location of the cask loading operations; and remarks regarding replaced components. The specific requirements of the cask loading report are detailed in the Universal Transport Cask Operations Manual.

8.2.7 Maintenance Program Schedule

Table 8.2-1 presents the overall maintenance program schedule for the Universal Transport Cask.