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Storage and Transport Cask Data For Used Commercial Nuclear Fuel

– 2013 U.S. Edition –

9 August 2013

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Disclaimer

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Dedication

This report is dedicated to the memory of Mr. Edway "Ed" R. Johnson (1927-2012). During a remarkable career spanning over six decades, Ed was recognized as a leader in the nuclear fuels industry, and a friend and mentor to countless individuals who had the good fortune to know him. Ed's legacy as a consummate engineer; industry leader; caring mentor; and loving husband, father, and friend lives on in the hearts and lives of those whom he touched.

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ACRONYMS AND SYMBOLS

Al	Aluminum
ALARA	As Low As Reasonably Achievable
B	Boron
BWR	Boiling Water Reactor
CEC	Cavity Enclosure Container
CoC	Certificate of Compliance
CS	Carbon Steel
DOE	U.S. Department of Energy
DSC	Dry Shielded Canister
DU	Depleted Uranium
FSV	Fort St. Vrain
GTCC	Greater Than Class C Radioactive Waste
He	Helium
HSM	Horizontal Storage Module
HTGR	High Temperature Gas Reactor
ISFSI	Independent Spent Fuel Storage Installation
LWT	Legal Weight Truck
MPC	Multi-Purpose Canister
MEB	Multi-Element Bottle
MMC	Metal Matrix Composite
MSB	Multi-Assembly Sealed Basket
MTC	MSB Transfer Cask *(EnergySolutions usage)*
MTC	MAGNASTOR Transfer Cask *(NAC International usage)*
n/a	Not Applicable
N/A	Not Available
NPP	Nuclear Power Plant
NRC	U.S. Nuclear Regulatory Commission
OWT	Over-Weight Truck
Pb	Lead
pcf	Pounds per Cubic Foot
S&T	Storage & Transport
SAR	Safety Analysis Report
SS	Stainless Steel
TSC	Transportable Storage Canister
U	Uranium
UMS	Universal MPC System
U.S.	United States
VCC	Ventilated Concrete Cask *(Holtec International usage)*
VCC	Vertical Concrete Cask *(EnergySolutions/NAC International usage)*
VCT	Vertical Cask Transporter
VVM	Vertical Ventilated Module
Zn	Zinc

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INTRODUCTION

This document is a compilation of publically-available information on spent/used nuclear fuel storage and transport casks in use in the United States as of the summer of 2013. As such, it is a functional update and extension of JAI-582, "*Shipping and Storage Cask Data For Commercial Spent Nuclear Fuel*," originally published by JAI Corporation in March 2005[1]. This report is intended to provide a convenient reference for those with interest in, or those engaged in the production, handling, storage, transport, and disposition of spent/used commercial nuclear fuel. Data for each cask is tabulated in a standardized table format to facilitate rapid access to key design and performance information, and to enable the document user to more rapidly conduct comparative analyses of cask design and performance parameters.

Multiple-assembly "canisters," and both canister-based and non-canistered packages are included in the main body of the report. Packages that have been used in the past, but which are no longer in active use in the U.S., are included in Appendix A.

Terminology

Used Nuclear Fuel – the term "*used* nuclear fuel" has been broadly adopted in recent years as an alternative to the more traditional term, "*spent* nuclear fuel". The term "used" is employed primarily as a means to communicate the technical reality that "once-used" nuclear fuel still contains significant energy value that could be recovered if the fuel were recycled and reused (without passing judgment on the efficacy of such reprocessing). Thus the fuel is *not* "spent," in the sense of being completely expended or exhausted in its potential utility. Consistent with this usage trend, the term "used nuclear fuel" will be employed throughout this report.

Canister – "Canisters" or "multiple-assembly canisters" are sealed inner containers employed in many used fuel storage and transport cask systems. These canisters both secure the physical location of used fuel assemblies within a transfer, storage, or transport cask; and provide a mechanism for integrating different types and numbers of fuel assemblies with standardized transfer, storage, or transport casks.

Transfer Cask – a used fuel cask that is employed strictly for transferring used nuclear fuel (individual assemblies or canisters) into storage or transport casks.

Storage Cask – a used fuel cask that is employed strictly for storage of used nuclear fuel.

Transport Cask – a used fuel cask that is employed strictly for off-site shipping (over the road or by rail) of used nuclear fuel.

Dual-Use Cask – a used fuel cask that may be used for both storage and transport of used nuclear fuel.

INTRODUCTION

Data Synthesis Process

As previously noted, this report is essentially an update and extension of the data originally presented in "Shipping and Storage Cask Data For Commercial Spent Nuclear Fuel," JAI-582, JAI Corporation, March 1985[1]. Thus, *both the specific data parameter set reported, and the data values presented* in JAI-582 served as the starting point for the synthesis of the data presented in this report.

While significant effort has been expended to ensure the accuracy and timeliness of the data presented in this report, users of the document should be aware of the inherit limitations imposed by the data synthesis process employed by the report development team.

In the case of canisters and casks that were originally included in JAI-582, the canister and cask specifications presented in JAI-582 were adopted as presented in that report. Licensing status and current commercial usage information was updated based on non-proprietary NRC licensing information and published accounts available to the team. This information package was then presented to the cask vendors for review, and the comments provided by the cask vendors were incorporated into the report.

In the case of canisters and casks that were ***not*** *included in JAI-582* (that is, canisters and casks which were developed subsequent to March 2005), blank specification data tables were provided to the vendors, who were asked to complete the tables. The vendors directly supplied the requested specification (and licensing status) data in all but a few cases. For cases in which the vendors did not supply the requested information, the report development team harvested the specification data directly from the relevant non-proprietary sections of the Certificate of Compliance and Final Safety Analysis Report. Regardless of the manner in which the initial specification data for these canisters and casks were synthesized, each vendor was provided a second opportunity to review and correct the information after it had been cast into the final report format.

Thus the central role of the cask vendors in data synthesis and data quality assurance is apparent, and their cooperation in developing this report is gratefully acknowledged.

Data Consistency

Readers should be aware that complete consistency in canister and cask specifications data is not possible in all cases. For instance, vendors do not always employ consistent methods of reporting specification parameters such as package atmospheric leak rates, or surface dose rates for loaded packages. In some cases, vendors have chosen simply to report the maximum allowable values, while in other cases vendors reported measured values, calculated worst-case values, or average values.

INTRODUCTION

Data Timeliness and Completeness

There are at least three ways in which the information presented in this report is unavoidably "dated," and must be viewed as "a snapshot in time".

The first, and most obvious time-dependence is that the specific collection of casks included in the report is limited to those that are now (Summer 2013), or have been in the past, licensed in or developed for use in the U.S.

The second manner in which the information presented in this report is unavoidably dated has to do with the constantly evolving nature of the used fuel cask and storage licensing and license amendment process. Cask vendors and used fuel managers periodically update and amend their licenses to comply with evolving regulatory requirements, changing cask design specifications, or changes in used fuel storage management strategies. Thus it is unavoidably true that the current license amendment / supplements referenced in this report will be superseded as time passes.

Finally, the "extent of usage" information presented in this report is incomplete. The information is dated and limited both by the evolving nature of cask usage by used fuel managers, by cask product market penetration dynamics, and by the limitations of cask vendor knowledge. With regard to the later, it should be noted that while canister and cask vendors are aware of who has purchased their products, they may or may not be fully aware of the current extent of use of their products. Additionally, some cask vendors regard some aspects of their current and on-going sales activities to be proprietary in nature. In the course of preparing this report, cask vendors frequently declined to offer information regarding the "extent of usage" of their products. Additionally, it was not possible within the time and resource constraints of this project to conduct a comprehensive survey of the specific canister and cask usage activities of every domestic used fuel manager. Thus the "extent of usage" information presented in this report should be viewed simply as examples of individual product usage – rather than a comprehensive and definitive accounting of product utilization in the U.S.

Implications of Cask Certificate of Compliance "Vintage"

The U.S. Nuclear Regulatory Commission (NRC) amended 10 CFR Part 71, effective October 1, 2004, to be compatible with the International Atomic Energy Agency's "*Regulations for the Safe Transport of Radioactive Material 1996 Edition (Revised)*"[2]. Casks complying with current regulations have a type "-96" certification. Casks certified before October 2004 have a type "-85" certificate (*unless their license has been amended to meet the "-96" requirements*). As an example of the nature of the changes between the "-96" and "-85" licensing requirements, casks certified under the "-96" licensing regime must conduct drop tests to demonstrate compliance with performance requirements, while drop testing was not required by the "-85" certification process.

Type "-85" certificates for existing casks can still be renewed every 5 years – provided that maintenance activities maintain these packages intact and in working order. However, these casks (and their associated impact limiters) can no longer be fabricated unless and until their Certificate of Compliance is updated. Unless otherwise indicated, all casks discussed in the main body of this report have Type “-96” certifications.

Data Usage

In view of the foregoing discussion, readers are encouraged to directly contact individual cask vendors for their assistance in evaluating the suitability of their products for specific applications. Vendor contact information is provided at the beginning of each product data sheet section.

Burnup Credit Considerations

Criticality safety analyses for commercial light water reactor used fuel transport and storage casks traditionally assumed the fuel to be "fresh" (unirradiated) fuel with uniform isotopic composition. This conservative approach ignores the net decrease in fuel reactivity due to "burnup" (the depletion of fissile atom inventory in the fuel as it is irradiated) – and results in significantly lower cask fuel inventories than would otherwise be the case. In order to support increased cask inventories, the U.S. Nuclear Regulatory Commission and used fuel cask vendors have, for several years, been evaluating the efficacy of incorporating various aspects of "burnup credit" in the cask licensing analyses. As of the publication date of this report, only three casks have Certificates of Compliance that incorporate burnup credit: the Holtec HI-STAR 100 and HI-STAR 180, and the Transnuclear TN-40 Prairie Island cask.

Spent/Used Nuclear Fuel Package Functions

Used nuclear fuel storage and transport packages provide four key functions:

- Containment of radioactive materials
- Shielding from radiation (gamma and neutron) emitted by the fuel
- Criticality control
- Temperature control / decay heat removal

The canisters in canister-based systems provide criticality control through neutron poisons contained within the spent fuel assembly positioning structure of the canister, transfer of thermal energy to the external wall of the canister, and containment. The storage or transport cask provides shielding, additional containment, and the final link in the heat transfer path to ensure adequate heat rejection to the surrounding environment. Thus, the capabilities of the canister are key to the performance of canister-based systems. Non-canistered systems rely on the cask itself (along with the internal basket structure) to provide these four key functions.

INTRODUCTION

Data Summary

Table 1 presents an overall summary of the packages included in this report, their intended application, and their usage and licensing status. Tables 2-6 present a more-detailed summary of the principal design attributes of the packages:

- Table 2 presents the characteristics of multiple assembly canisters employed in canister-based storage systems
- Tables 3 and 4 summarize the characteristics of **storage casks**.
  - Table 3 summarizes the design attributes of canister-based storage systems,
  - Table 4 summarizes the design attributes of non-canister-based storage casks and dual-purpose (storage and transport) casks.
- Tables 5 and 6 summarize the characteristics of **transport casks**
  - Table 5 summarizes the design attributes of canister-based transport cask systems,
  - Table 6 summaries the design attributes of non-canistered transport systems.

Tables 1-6 are summaries of a few key package design parameters. Readers should refer to the individual package data sheets in the report for more detailed information.

TABLE 1
SUMMARY OF U.S. COMMERCIAL USED NUCLEAR FUEL PACKAGE USAGE

Vendor	System	Cask	Maximum Loaded Weight (lbs)[a]	Usage			NRC Licensing Status		
				Storage	Transport				
					Truck	Rail	Active	Pending	Expired
Energy*Solutions*	FuelSolutions™	W150 Storage Cask	334,000	X			X		
Energy*Solutions*	FuelSolutions™	TS125 Transport Cask	285,000[b]			X	X		
Energy*Solutions*	VSC-24	Vertical Concrete Cask (VCC)	287,920	X			X (CoC Renewal Pending)		
Holtec International	HI-STORM 100	HI-STORM 100 Storage Overpack	360,000	X			X		
Holtec International	HI-STORM 100	HI-STORM 100U Vertical Ventilated Module (VVM)	n/a	X			X		
Holtec International	HI-STORM 100	HI-STAR 100 S/T Overpack	279,893[b]			X	X		
Holtec International	HI-STORM FW	HI-STORM FW Storage Overpack	425,700	X			X		
Holtec International	HI-STORM FW	HI-STAR 190 S/T Overpack	N/A			X		X (Initial License Application to be submitted by end of 2013)	
Holtec International	HI-STORM UMAX	HI-STORM UMAX Vertical Ventilated Module (VVM)	n/a	X				X (Under NRC Review - Docket #72-1040)	
Holtec International	HI-STORM UMAX	HI-STAR 190 S/T Overpack	N/A			X		X (Initial License Application to be submitted by end of 2013)	
Holtec International	HI-STAR 100	HI-STAR 100 S/T Overpack	279,893[b]	X		X	X		
Holtec International	HI-STAR 100	HI-STAR 100HB S/T Overpack	187,200[b]	X		X	X		
Holtec International	HI-STAR 190	HI-STAR 190 S/T Overpack	N/A	X		X		X (Initial License Application to be submitted by end of 2013)	
NAC International	NAC-MPC S/T	Vertical Concrete Cask (VCC)	251,771	X			X		
NAC International	NAC-MPC S/T	NAC-STC Transport Cask	254,588[b]			X	X		
NAC International	NAC-UMS S/T	Class 1 Vertical Concrete Cask (VCC)	294,100	X			X		

TABLE 1
SUMMARY OF U.S. COMMERCIAL USED NUCLEAR FUEL PACKAGE USAGE (Continued)

Vendor	System	Cask	Maximum Loaded Weight (lbs)[a]	Usage			NRC Licensing Status		
				Storage	Transport				
					Truck	Rail	Active	Pending	Expired
NAC International	NAC-UMS S/T	Class 2 Vertical Concrete Cask (VCC)	305,100	X			X		
NAC International	NAC-UMS S/T	Class 3 Vertical Concrete Cask (VCC)	310,400	X			X		
NAC International	NAC-UMS S/T	Class 4 Vertical Concrete Cask (VCC)	308,700	X			X		
NAC International	NAC-UMS S/T	Class 5 Vertical Concrete Cask (VCC)	313,900	X			X		
NAC International	NAC-UMS S/T	Universal Transport Cask	255,022[b]			X	X		
NAC International	NAC-MAGNASTOR	Vertical Concrete Cask (VCC)	322,500	X			X		
NAC International	NAC-MAGNASTOR	MAGNATRAN Transport Cask	350,000[b]			X		X (Under NRC Review - Docket #71-9356)	
Transnuclear Inc.	NUHOMS S/T	Horizontal Storage Module (HSM) (7 variants, each have 1 dry shielded canister storage capacity)	N/A	X			X	Advanced HSM-HS (Under NRC Review - Docket #72-1029, Amend. #3)	
Transnuclear Inc.	NUHOMS S/T	MP187 Transport Cask	271,300[b]			X	X		
Transnuclear Inc.	NUHOMS S/T	MP197 Transport Cask	265,100[b]			X	X		
Transnuclear Inc.	NUHOMS S/T	MP197HB Transport Cask	303,600[b]			X	X (Low burnup fuel)	X (High burnup fuel)	
GNS	n/a	CASTOR V/21 Storage Cask	234,000	X			Site Specific License (Surry NPP)		
GNS	n/a	CASTOR X/33 Storage Cask	212,000	X			Site Specific License (Surry NPP)		
NAC International	n/a	I28 S/T Cask	206,000	X			Site Specific License (Surry NPP) / not licensed for transport		
Ridihalgh, Eggers & Associates	n/a	REA-2023 Storage Cask	196,000	X					NRC License never issued
Transnuclear Inc.	n/a	TN-24 Storage Cask (TN-24 / TN-24P)	226,000	X			X		
Transnuclear Inc.	n/a	TN-32 Storage Cask (TN-32 / TN-32A / TN-32B)[d]	231,200	X			X		

TABLE 1
SUMMARY OF U.S. COMMERCIAL USED NUCLEAR FUEL PACKAGE USAGE (Continued)

Vendor	System	Cask	Maximum Loaded Weight (lbs)[a]	Usage: Storage	Usage: Transport: Truck	Usage: Transport: Rail	NRC Licensing Status: Active	NRC Licensing Status: Pending	NRC Licensing Status: Expired
Transnuclear Inc.	n/a	TN-40 S/T Cask (TN-40 / TN-40HT)	271,500[b]	X		X	Storage - Site Specific License (Prairie Island NPP) / Transport - Active (except TN-40 HT)		
Transnuclear Inc.	n/a	TN-68 S/T Cask	272,000[b]	X		X	X		
Westinghouse[c]	n/a	MC-10 Storage Cask	239,600	X			Site Specific License (Surry NPP)[c]		
Transnuclear Inc.	n/a	TN FSV LWT Transport Cask	47,000[b]		X		X		
General Atomics	n/a	GA-4 LWT Transport Cask	55,000[b]		X		X		
Holtec International	n/a	HI-STAR 60 Transport Cask	164,000[b]			X	X		
Holtec International	n/a	HI-STAR 180 Transport Cask	308,647[b]			X	X		
NAC International	n/a	NAC-LWT Transport Cask	51,200[b]		X		X		
Transnuclear Inc.	n/a	TN-LC Transport Cask	51,000[b]		X		X		
General Atomics	n/a	FSV-1 LWT Transport Cask	47,600		X				X
General Atomics	n/a	GA-9 Transport Cask	54,000		X				NRC license never issued
General Electric	n/a	IF-300 Transport Cask	140,000			X			X
NAC International	n/a	NAC I26 S/T Cask	200,000	X		X			X (Storage expired / never licensed for Transport)
NAC International	n/a	NAC C/28 S/T Cask	230,000	X		X			X
NAC International	n/a	NLI 1/2 LWT Transport Cask	46,200		X				X
NAC International	n/a	NLI 10/24 Transport Cask	194,000			X			X
Nuclear Packaging Inc.	n/a	125-B TMI-2 Transport Cask	181,500			X			X

TABLE 1
SUMMARY OF U.S. COMMERCIAL USED NUCLEAR FUEL PACKAGE USAGE (Continued)

Vendor	System	Cask	Maximum Loaded Weight (lbs)[a]	Usage			NRC Licensing Status		
				Storage	Transport				
					Truck	Rail	Active	Pending	Expired
Transnuclear Inc.	n/a	TN-REG S/T Cask	233,200	X		X			X
Transnuclear Inc.	n/a	TN-BRP S/T Cask	222,700	X		X			X
Transnuclear Inc.	n/a	TN-8 / TN-8L OWT Transport Cask	78,600		X				X
Transnuclear Inc.	n/a	TN-9 OWT Transport Cask	78,200		X				X

n/a denotes not applicable
N/A denotes Not Available

[a] Cask weight when loaded with heaviest compatible canister or basket.
[b] Maximum Transport Cask weight includes impact limiters.
[c] The MC-10 cask in use at the Idaho Nuclear Technology and Engineering Center (INTEC) is not licensed. It is maintained under the U.S. Department of Energy regulatory regime. The MC-10 cask in use at Surry NPP is under a NRC site-specific license.
[d] The TN-32 storage cask may be licensable in the U.S. for transport (at least for a single transport).

TABLE 2
SUMMARY OF CANISTER-BASED STORAGE/TRANSPORT SYSTEMS CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL

Canister Designation	Canister Type[a]	Vendor	Capacity (Assys)	Weight Loaded (lb)	Design Heat Rejection[b] (kW)	Max. Fuel Burnup[c] (GWD/MTU)	U.S. Licensing Status	For Use With		
								Transfer Cask	Storage Overpacks/VVM	Transport Cask
W21M-LD	S&T	Energy *Solutions*	21 PWR	75,022	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21LM-LS	S&T	Energy *Solutions*	21 PWR	80,888	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21M-SD	S&T	Energy *Solutions*	21 PWR	78,538	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21M-SS	S&T	Energy *Solutions*	21 PWR	75,360	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21T-LL	S&T	Energy *Solutions*	21 PWR	72,584	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21T-LS	S&T	Energy *Solutions*	21 PWR	79,873	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21T-SL	S&T	Energy *Solutions*	21 PWR	76,635	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W21T-SS	S&T	Energy *Solutions*	21 PWR	74,346	25.1/22.0	60.0	Licensed for S&T	W100	W150	TS125
W74M	S&T	Energy *Solutions*	64 BWR	77,539	24.8/17.6	40.0	Licensed for S&T	W100	W150	TS125
W74T	S&T	Energy *Solutions*	64 BWR	75,375	24.8/17.6	40.0	Licensed for S&T	W100	W150	TS125
MSB	Storage Only	Energy *Solutions*	24 PWR	68,685	24.0	45.0	Licensed for Storage	MTC	VCC	n/a
MPC-24	S&T	Holtec International	24 PWR	90,000	36.9/20.0	68.2/37.0[f]	Licensed for S&T	HI-TRAC 100/125/125D	HI-STORM 100/100U	HI-STAR 100
MPC-24	S&T	Holtec International	24 PWR	90,000	19.0/20.0	38.2/37.0[g]	Licensed for S&T	n/a	HI-STAR 100	HI-STAR 100
MPC-24E/ 24EF	S&T	Holtec International	24 PWR	90,000	36.9/20.0	68.2/37.0[f]	Licensed for S&T	HI-TRAC 100/125/125D	HI-STORM 100/100U	HI-STAR 100
MPC-24E/ 24EF	S&T	Holtec International	24 PWR	90,000	N/A/22.0	N/A/37.0[g]	Licensed for S&T	n/a	HI-STAR 100	HI-STAR 100
MPC-32	S&T	Holtec International	32 PWR	90,000	36.9/20.0	68.2/31.2[f]	Licensed for S&T	HI-TRAC 100/125/125D	HI-STORM 100/100U	HI-STAR 100
MPC-32	S&T	Holtec International	32 PWR	90,000	N/A/20.0	N/A/31.2[g]	Licensed for S&T	n/a	HI-STAR 100	HI-STAR 100
MPC-32F	S&T	Holtec International	32 PWR	90,000	36.9/20.0	68.2/31.2[f]	Licensed for Storage[d]	HI-TRAC 100/125/125D	HI-STORM 100/100U	HI-STAR 100
MPC-68/68F	S&T	Holtec International	68 BWR	90,000	36.9/18.5	65.0/32.0[f]	Licensed for S&T	HI-TRAC 100/125/125D	HI-STORM 100/100U	HI-STAR 100
MPC-68/68F	S&T	Holtec International	68 BWR	90,000	18.5/18.5	33.8/32.0[g]	Licensed for S&T	n/a	HI-STAR 100	HI-STAR 100
MPC-68FF/ 68M	S&T	Holtec International	68 BWR	90,000	36.9/18.5	65.0/32.0[f]	Licensed for Storage[d]	HI-TRAC 100/125/125D	HI-STORM 100/100U	HI-STAR 100
MPC-HB	S&T	Holtec International	80 BWR	59,000	2.0/2.0	23.0/23.0[h]	Licensed for S&T	n/a	HI-STAR 100HB	HI-STAR 100HB

TABLE 2
SUMMARY OF CANISTER-BASED STORAGE/TRANSPORT SYSTEMS CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL (Continued)

Canister Designation	Canister Type[a]	Vendor	Capacity (Assys)	Weight Loaded (lb)	Design Heat Rejection[b] (kW)	Max. Fuel Burnup[c] (GWD/MTU)	U.S. Licensing Status	For Use With		
								Transfer Cask	Storage Overpacks/VVM	Transport Cask
MPC-37	S&T	Holtec International	37 PWR	116,400	47.05/N/A	68.2/N/A[f]	Licensed for Storage[d]	HI-TRAC VW	HI-STORM FW (UMAX Pending)	HI-STAR 190[e]
MPC-89	S&T	Holtec International	89 BWR	116,400	46.36/N/A	65.0/N/A[f]	Licensed for Storage[d]	HI-TRAC VW	HI-STORM FW (UMAX Pending)	HI-STAR 190[e]
DPC/Yankee MPC	S&T	NAC International	36 PWR/ 68 BWR	54,730	12.5	36.0	Licensed for S&T	DPC/Yankee MPC	VCC-DPC/ Yankee MPC	NAC-STC
CY-MPC	S&T	NAC International	24 PWR	62,909	16.2/15.7	43.0	Licensed for S&T	CY-MPC	VCC-CY-MPC	NAC-STC
CY-MPC	S&T	NAC International	26 PWR	65,821	17.5/17.0	43.0	Licensed for S&T	CY-MPC	VCC-CY-MPC	NAC-STC
TSC-Class 1	S&T	NAC International	24 PWR	70,600	23.0/20.0	60.0	Licensed for Storage[d]	Class 1	VCC-Class 1	UTC
TSC-Class 2	S&T	NAC International	24 PWR	72,900	23.0/20.0	60.0	Licensed for Storage[d]	Class 2	VCC-Class 2	UTC
TSC-Class 3	S&T	NAC International	24 PWR	70,800	23.0/20.0	60.0	Licensed for Storage[d]	Class 3	VCC-Class 3	UTC
TSC-Class 4	S&T	NAC International	56 BWR	75,000	23.0/16.0	60.0	Licensed for Storage[d]	Class 4	VCC-Class 4	UTC
TSC-Class 5	S&T	NAC International	56 BWR	75,600	23.0/16.0	60.0	Licensed for Storage[d]	Class 5	VCC-Class 5	UTC
MAGNASTOR PWR TSC	S&T	NAC International	37 PWR	102,500	35.5/33.0	60.0	Licensed for Storage[d]	MTC	VCC	MAGNATRAN
MAGNASTOR BWR TSC	S&T	NAC International	87 BWR	103,500	35.5/33.0	60.0	Licensed for Storage[d]	MTC	VCC	MAGNATRAN
NUHOMS®-24PS	Storage Only	Transnuclear Inc.	24 PWR	78,128	24.0	45.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 80 or 102	n/a
NUHOMS®-24PL	Storage Only	Transnuclear Inc.	24 PWR	75,794	24.0	45.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 80 or 102	n/a
NUHOMS®-24PHBS	Storage Only	Transnuclear Inc.	24 PWR	78,128	24.0	55.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 102	n/a
NUHOMS®-24PHBL	Storage Only	Transnuclear Inc.	24 PWR	75,794	24.0	55.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 102	n/a
NUHOMS®-24PTH-S	S&T	Transnuclear Inc.	24 PWR	92,400	40.8	62.0	Licensed for Storage[d]	OS197/OS197H/ OS197FC	HSM-H	MP197HB
NUHOMS®-24PTH-L	S&T	Transnuclear Inc.	24 PWR	93,700	40.8	62.0	Licensed for Storage[d]	OS197/OS197H/ OS197FC	HSM-H	MP197HB
NUHOMS®-24PTH-LC	S&T	Transnuclear Inc.	24 PWR	89,500	24.0	62.0	Licensed for Storage[d]	Standard	HSM-H or Model 102	MP197HB
NUHOMS®-24PT-2S	S&T	Transnuclear Inc.	24 PWR	84,319	24.0	45.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 80 or 102	n/a

TABLE 2
SUMMARY OF CANISTER-BASED STORAGE/TRANSPORT SYSTEMS CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL (Continued)

-Canister Designation	Canister Type[a]	Vendor	Capacity (Assys)	Weight Loaded (lb)	Design Heat Rejection[b] (kW)	Max. Fuel Burnup[c] (GWD/MTU)	U.S. Licensing Status	For Use With		
								Transfer Cask	Storage Overpacks/VVM	Transport Cask
NUHOMS®-24PT-2L	S&T	Transnuclear Inc.	24 PWR	81,968	24.0	45.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 80 or 102	n/a
NUHOMS®-32PT-S100	S&T	Transnuclear Inc.	32 PWR	88,150	24.0	45.0	Licensed for Storage[d]	OS197/OS197H	HSM Model 80 or 102	MP197HB
NUHOMS®-32PT-S125	S&T	Transnuclear Inc.	32 PWR	100,380	24.0	45.0	Licensed for Storage[d]	OS197/OS197H	HSM Model 80 or 102	MP197HB
NUHOMS®-32PT-L100	S&T	Transnuclear Inc.	32 PWR	89,140	24.0	45.0	Licensed for Storage[d]	OS197/OS197H	HSM Model 80 or 102	MP197HB
NUHOMS®-32PT-L125	S&T	Transnuclear Inc.	32 PWR	101,380	24.0	45.0	Licensed for Storage[d]	OS197/OS197H	HSM Model 80 or 102	MP197HB
NUHOMS®-32PTH	S&T	Transnuclear Inc.	32 PWR	108,850	34.8	60.0	Licensed for Storage[d]	OS187H	HSM-H	MP197HB
NUHOMS®-32PTH1-S-M-L	S&T	Transnuclear Inc	32 PWR	108,850	40.8	62.0	Licensed for Storage[d]	OS187H/OS200	HSM-H/HS	MP197HB
NUHOMS®-32PTH2	S&T	Transnuclear Inc	32 PWR	110,000	37.2	62.5	Licensed for Storage[d]	OS200FC	HSM-Advanced Model	MP197HB
NUHOMS®-37PTH-S	S&T	Transnuclear Inc	37 PWR	108,100	30.0	62.0	License for S&T (Pending)	OS200/OS200FC	HSM-H	MP197HB
NUHOMS®-37PTH-M	S&T	Transnuclear Inc	37 PWR	109,300	30.0	62.0	License for S&T (Pending)	OS200/OS200FC	HSM-H	MP197HB
NUHOMS® FO-DSC	S&T	Transnuclear Inc.	24 PWR	80,710	13.5	40.0	Licensed for S&T[i]	MP187	HSM (Rancho Seco)	MP187
NUHOMS® FC-DSC	S&T	Transnuclear Inc.	24 PWR	81,120	13.5	40.0	Licensed for S&T[i]	MP187	HSM (Rancho Seco)	MP187
NUHOMS® FF-DSC	S&T	Transnuclear Inc.	13 PWR	74,900	9.9	40.0	Licensed for S&T[i]	MP187	HSM (Rancho Seco)	MP187
NUHOMS®-24PT1	S&T	Transnuclear Inc.	24 PWR	78,400	14.0	45.0	Licensed for S&T	OS197	HSM-Advanced Model	MP187
NUHOMS®-24PT4	S&T	Transnuclear Inc.	24 PWR	85,000	24.0	60.0	Licensed for Storage[d]	OS197	HSM-Advanced Model	MP197
NUHOMS®-52B	Storage Only	Transnuclear Inc.	52 BWR	74,925	19.2	35.0	Licensed for Storage	Standard/ OS197/OS197H	HSM Model 80 or 102	n/a
NUHOMS®-61BT	S&T	Transnuclear Inc.	61 BWR	88,390	18.3/15.9	40.0	Licensed for S&T	OS197	HSM Model 80 or 102	MP197/MP197HB
NUHOMS®-61BTH	S&T	Transnuclear Inc.	61 BWR	93,120	31.2	62.0/45.0	Licensed for S&T	OS197/OS200	HSM-H/HS	MP197/MP197HB

TABLE 2
SUMMARY OF CANISTER-BASED STORAGE/TRANSPORT SYSTEMS CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL (Continued)

Canister Designation	Canister Type[a]	Vendor	Capacity (Assys)	Weight Loaded (lb)	Design Heat Rejection[b] (kW)	Max. Fuel Burnup[c] (GWD/MTU)	U.S. Licensing Status	For Use With		
								Transfer Cask	Storage Overpacks	Transport Cask
NUHOMS®-69BTH	S&T	Transnuclear Inc.	69 BWR	106,000	26.0 – 32.0	45.0	Licensed for Transport	OS200	HSM-H/HS	MP197/MP197HB
NUHOMS®-12T	S&T	Transnuclear Inc.	12-TMI2 Fuel Debris Canisters	70,000	0.8	3.2	Licensed for Storage	MP187	NUHOMS® 12T HSM	MP187
NUHOMS®-07P	Storage Only	Transnuclear Inc.	7 PWR	22,000	7.0	N/A	Licensed for Storage	IF-300	NUHOMS®-07P HSM	n/a

N/A denotes Not Available
n/a denotes not applicable
TBD denotes to be determined

[a] S = storage; T = transport.
[b] First value is for storage; second value is for transport.
[c] The maximum burnup shown for the canisters is the bounding maximum for any age (unless otherwise noted).
[d] Transport license pending.
[e] Initial license application for HI-STAR 190 scheduled to be submitted to NRC by end of 2013.
[f] The maximum burnup values are for 3-year cooled fuel (Storage 72-1014) and 10-year cooled fuel (Transport 71-9261)[10,16].
[g] The maximum burnup is for 10-year cooled fuel.
[h] Average burnup per assembly is for greater than 29-year cooled fuel.
[i] NUHOMS®- FO-DSC, FC-DSC, and FF-DSC are licensed for storage at Rancho Seco under Site-Specific license SNM-2510.

TABLE 3

SUMMARY OF CANISTER-BASED STORAGE CASK CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL[a]

Cask Designation	Materials of Construction	Vendor	Capacity[b]	Max. Weight Loaded[c] (Tons)	Design Heat Rejection[b,d] (kW)	U.S. Licensing Status
W-150	Concrete	Energy*Solutions*	21 PWR/64 BWR	167	25.1/24.8	Licensed
Ventilated Concrete Cask (VCC)	Steel/Concrete	Energy*Solutions*	24 PWR	144	24	License Extension Pending
HI-STORM 100	Steel/Concrete	Holtec International	24 or 32 PWR/68 BWR	180	36.9/36.9	Licensed
HI-STORM FW	Steel/Concrete	Holtec International	37 PWR/89 BWR	213	47.0/46.4	Licensed
HI-STAR 100	Multi-Layered Steel	Holtec International	24 or 32 PWR/68 BWR	127	19.0/18.5	Licensed
HI-STAR 100HB	Multi-Layered Steel	Holtec International	80 BWR	81	2.0	Licensed
HI-STAR 190	Multi-Layered Steel	Holtec International	37 PWR/89 BWR	N/A	47.0/46.4	Not Licensed (Submittal Target 4Q 2013)
VCC- DPC/Yankee MPC	Steel/Concrete	NAC International	36 PWR/68 BWR	103	12.5	Licensed
VCC-CY MPC	Steel/Concrete	NAC International	24 OR 26 PWR	126	16.2(24 PWR)/ 17.5(26 PWR)	Licensed
VCC-Class 1	Steel/Concrete	NAC International	24 PWR	147	23.0	Licensed
VCC-Class 2	Steel/Concrete	NAC International	24 PWR	153	23.0	Licensed
VCC-Class 3	Steel/Concrete	NAC International	24 PWR	155	23.0	Licensed
VCC-Class 4	Steel/Concrete	NAC International	56 BWR	154	23.0	Licensed
VCC-Class 5	Steel/Concrete	HI-STORM NAC International	56 BWR	157	23.0	Licensed
MAGNASTOR (VCC)	Steel/Concrete	NAC International	37 PWR/87 BWR	161	35.5/33.0	Licensed

N/A denotes Not Available

[a] Table does not include NUHOMS® HSMs, HI-STORM 100U (VVM), or the HI-STORM UMAX (VVM) since they are vault type structures (not moveable) and the heat rejection characteristics are the same as the specific canisters which are licensed for storage in the specific HSMs or VVM (see Table 1).

[b] All of these casks are loaded with one multiple assembly canister containing the used fuel assemblies. Thus, the capacity and the heat rejection characteristics of the cask are the same as the canister contained in the cask.

[c] Value depends on the specific canister used. Weight column provides maximum weight of casks placed on the storage pad.

[d] Design heat rejection for PWR fuel assemblies/BWR fuel assemblies.

TABLE 4
SUMMARY OF NON-CANISTERED STORAGE CASK AND DUAL-PURPOSE CASK CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL[a]

Cask Designation	Cask Type[b]	Materials of Construction	Vendor	Capacity (Assys)	Max. Weight Loaded[d] (Tons)	Design Heat Rejection (kW)	Max. Fuel Burnup[e] (GWD/MTU)	U.S. Licensing Status
CASTOR V/21	Storage	Nodular Cast Iron	GNS	21 PWR	117	21.0	35.0	Licensed
CASTOR X/33	Storage	Ductile Cast Iron	GNS	33 PWR	106	16.6	N/A	Licensed
NAC I28 S/T	S&T	SS/Pb	NAC International	28 PWR	103	17.4	35.0	Licensed for Storage
REA-2023	Storage[c]	SS/Pb	Ridihalgh Eggers & Associates	24 PWR/ 52 BWR	98	24.0/20.8	33.0	No License (DOE Demonstration Cask)
TN-24	Storage[c]	Forged Steel	Transnuclear Inc.	24 PWR	113	24.0	35.0	Licensed for Storage
TN-24P	Storage[c]	Forged Steel	Transnuclear Inc.	24 PWR	113	20.6	35.0	Licensed for Storage
TN-32	Storage[c]	Multi-Layered Steel	Transnuclear Inc.	32 PWR	116	32.7	40.0	Licensed for Storage
TN-40	S&T	Multi-Layered Steel	Transnuclear Inc.	40 PWR	113	27.0	45.0	Licensed for S&T
TN-40HT	Storage[c]	Multi-Layered Steel	Transnuclear Inc.	40 PWR	121	32.0	60.0	Licensed for Storage
TN-68	S&T	Multi-Layered Steel	Transnuclear Inc.	68 BWR	115	21.2	40.0	Licensed for S&T
MC-10	Storage	Forged Steel	Westinghouse	24 PWR/ 49 BWR	120	13.5	35.0	License Expired

[a] Casks are designed for storage of individual ("bare") used fuel assemblies (i.e., fuel assemblies not contained in large multiple-assembly canisters). However, these casks are capable of handling canisters whose cross-sectional dimensions are only slightly larger than the corresponding fuel assemblies (for failed fuel, etc.).
[b] S&T means storage and transport (dual purpose).
[c] These casks maybe licensable in the U.S. for transport (at least for a single transport).
[d] Maximum weight of casks on storage pad.
[e] Some of these values are conditioned on length of cooling time, or only applicable to a fraction of the total cask loading, etc.

TABLE 5
SUMMARY OF CANISTER-BASED TRANSPORT CASK CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL[a]

Cask Designation	Materials of Construction	Vendor	Capacity[b]	Weight Loaded[d] (Tons)	Design Heat Rejection[d] (kW)	U.S. Licensing Status
TS-125	SS/CS/Pb	Energy*Solutions*	21 PWR/64 BWR	142.5 (121.4)	17.6 - 22.0	Licensed
HI-STAR 100	Multi-Layered Steel	Holtec International	24 & 32 PWR/68 BWR	137.7 (124.7)-24 PWR 139.9 (126.9)-32 PWR 138.6 (125.6) 68 BWR	18.5 - 20.0	Licensed
HI-STAR 100HB	Multi-Layered Steel	Holtec International	80 BWR	93.6 (80.6)	0.5	Licensed
HI-STAR 190	Multi-Layered Steel	Holtec International	37 PWR/89 BWR	N/A	N/A	Not Licensed (Initial submittal by end of 2013)
NAC-STC[c]	SS/Pb	NAC International	24, 26 & 36 PWR/68 BWR	124.6 (115.3) – DPC / Yankee MPC (68/36) 125.8 (119.4)-CY MPC (24) 127.3 (120.9)-CY MPC (26) 124.8- 26 Direct Loaded PWR FA	12.5 - 17.0	Licensed
NAC-Universal Transport Cask	SS/Pb	NAC International	24 PWR/56 BWR	125.0 (115.5)- Class 1 TSC 125.8 (116.3)- Class 2 TSC 124.2 (114.7)- Class 3 TSC 127.5 (118.0)- Class 4 TSC 127.0 (117.5) Class 5 TSC	16.0 - 20.0	License Extension Pending
MAGNATRAN	SS/Pb	NAC International	37 PWR/87 BWR	175.0 (160.0)	33.0 - 35.5	License Pending
NUHOMS-MP187	SS/Pb	Transnuclear Inc.	24 PWR[e] (FO-DSC, FC-DSC & 24PT1) 13 PWR (FF-DSC)	135.4 (119.6) FO-DSC 135.6 (119.8) FC-DSC 132.6 (116.8) FF-DSC 134.4 (118.6)-24PT1 DSC	9.9 - 14.0	Licensed
NUHOMS-MP197	SS/Pb	Transnuclear Inc.	24 PWR/61 & 69 BWR	132.6 (118.6) -61BT DSC	15.9 - 32.0	Licensed
NUHOMS-MP197HB	SS/Pb	Transnuclear Inc.	24, 32 & 37 PWR/ 61 & 69 BWR	133.7 (121.2) -61BT DSC	15.9 - 40.8	Licensed (-61BT, -61BTH, -69BTH & 24PT4)

N/A denotes Not Available

[a] All casks shown in table are rail casks. Cask weight includes Impact Limiters. Cask weight without Impact Limiters is shown in (__).

[b] All of these casks are loaded with one multiple assembly canister containing the used fuel assemblies. Thus, the capacity and the heat rejection characteristics of the cask are the same as the canister contained in the cask.

[c] The NAC-STC can also be used to transport 26 non-canistered fuel assemblies.

[d] Value depends on the specific canister used.

[e] Can also accommodate a canister containing 13 damaged PWR assemblies (NUHOMS® FF-DSC canister) as well as a canister containing 24 PWR MOX fuel assemblies.

TABLE 6
SUMMARY OF NON-CANISTERED TRANSPORT CASK CHARACTERISTICS FOR U.S. COMMERCIAL USED NUCLEAR FUEL[a]

Cask Designation	Materials of Construction	Vendor	Mode of Transport	Capacity (Assys)	Max. Weight Loaded[b] (Tons)	Design Heat Rejection (kW)	Max. Fuel Burnup[c] (GWD/MTU)	U.S. Licensing Status	Comments
GA-4	SS/DU	General Atomics	Truck	4 PWR	27.5(25.5)	2.5	35.0 (10 yr. cooled)/ 45.0 (15 yr. cooled)	Licensed	None fabricated to date/License expires 10/2013
HI-STAR 60	Multi-Layered Steel	Holtec International	Rail	12 PWR	82.0	10.5	45.0	Licensed	Designed for 15x15 PWR FAs (currently not in use in the U.S.)
HI-STAR 180	Multi-Layered Steel	Holtec International	Rail	32 or 37 PWR	154.3 (37 PWR)	32.0	66.0	Licensed	Designed for 14x14 PWR FAs (currently not in us in the U.S.)
NAC-LWT	SS/Pb	NAC International	Truck	1 PWR/2 BWR	25.6 (24.1)	2.5	35.0	Licensed	8 casks licensed
TN FSV	SS/Pb	Transnuclear Inc.	Truck	6 HTGR/7 PWR	23.5 (6 HTGR)	0.4	70.0-73.0 (HTGR)/ 80.0 PWR	Licensed	Limited Use
TN-LC	SS/Pb	Transnuclear Inc.	Truck/Ship	1 PWR/1 BWR[d]	25.5 (24.0)	3.0 PWR/ 2.0 BWR	62.0	Licensed	Delivery of 1st cask expected in early 2015

N/A means Not Available

[a] Casks are designed for storage of individual ("bare") used fuel assemblies (i.e., fuel assemblies not contained in large multiple-assembly canisters). However, these casks are capable of handling canisters whose cross-sectional dimensions are only slightly larger than the corresponding fuel assemblies (for failed fuel, etc.).

[b] Maximum cask weight includes impact limiters. Cask weight without impact limiters is shown in (_).

[c] Some of these values are conditioned on length of cooling time, or only applicable to a fraction of the total cask loading, etc.

[d] TN-LC Cask is also designed/licensed for:

- 25 PWR/BWR fuel rods
- 26 NRU Fuel Assemblies
- 26 NRX Fuel Assemblies
- 54 MTR Fuel Assemblies
- 180 TRIGA Fuel Elements

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CANISTERED STORAGE/ TRANSPORT SYSTEMS

Canistered storage/transport systems are those in which the used fuel is first emplaced in large multiple assembly canisters, sealed, and the sealed canister is transferred and loaded in either a metal or concrete storage cask using a transfer cask. If the storage casks are not transportable under the cognizant regulatory authorities, the loaded canisters are transferred from the storage-only casks to a transport cask prior to off-site transport. If the storage casks are transportable, they can be transported directly off-site without unloading the sealed canisters.

This section describes eleven different systems that are licensed (or soon will be) for use in the U.S.:

(1) FuelSolutions™ Used Fuel Storage and Transport System
(2) VSC-24 Used Fuel Storage System
(3) HI-STORM 100 Used Fuel Storage and Transport System
(4) HI-STORM FW Used Fuel Storage System
(5) HI-STORM UMAX Underground Used Fuel Storage System
(6) HI-STAR 100 Used Fuel Storage and Transport System
(7) HI-STAR 190 Used Fuel Storage and Transport System
(8) NAC-MPC Used Fuel Storage and Transport System
(9) NAC-UMS Used Fuel Storage and Transport System
(10) NAC-MAGNASTOR Used Fuel Storage and Transport System
(11) NUHOMS® Used Fuel Storage and Transport System

The attributes of the components of these systems have been summarized in Tables 1, 2, 3, and 5 of the Introduction.

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FUELSOLUTIONS™ USED FUEL STORAGE AND TRANSPORT SYSTEM

Contact:
Energy*Solutions*
Tel: (408) 558-3500
www.energysolutions.com

Introduction

The FuelSolutions™ system, designed and built by Energy*Solutions*, is a storage and transport system that provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the Multi-Purpose Canister (MPC) concept, is comprised of the following components:

- Multi-Assembly Canister
- W150 Storage Cask
- W100 Transfer Cask
- TS125 Transport Cask.

The FuelSolutions™ system loads used nuclear fuel into a canister and then handles the canister as a distinct unit until disposal or final packaging for disposal in a geologic repository.

The FuelSolutions™ system is typically loaded wet. An empty multi-assembly canister is placed within the transfer cask and lowered into the fuel pool. Used fuel assemblies are loaded into the canister and a crane is used to lower the shield plug on top of the canister. The transfer cask is moved to the decontamination area and the canister is drained, dried, and welded. Alternately, the canister can be loaded outside the pool, but inside the plant's fuel building, using a fuel assembly transfer cask and a shielded loading collar.

This section describes each component of the system, starting with the Multi-Assembly Canister.

FUELSOLUTIONS™ USED FUEL STORAGE AND TRANSPORT SYSTEM

Multi-Assembly Canisters

Description

The multi-assembly canister consists of a cylindrical stainless steel shell with top and bottom cover plates forming a containment boundary. Within the canister are baskets that provide heat transfer paths, criticality control, and structural support. One canister is loaded per concrete storage cask.

Specifications[3,5]

Attribute	Type of Multi-Assembly Canister	
	W21M-LD	**W21M-LS**
a. Capacity (intact assemblies)	21 PWR	21 PWR
b. Weight (lb)		
Empty	44,992	45,608
Loaded	75,022	80,888
c. Thermal		
Design Heat Rejection (kW)	25.1 stor/22.0 trans	25.1 stor/22.0 trans
Maximum Burnup (GWD/MTU)	60	60
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	192.3	192.3
Overall Cross Section	66.0	66.0
Cavity Length	180.0	173.0
Cavity Cross Section	64.75	64.75
Wall Thickness	0.625	0.625
Lid Thickness	6.88	10.25
Bottom Thickness	4.88	8.5
Basket Length	179.5	172.5
f. Materials of Construction		
Canister Body	SS	SS
Canister Internals	Steel/Boral	Steel/Boral
Shield Plugs	DU/SS	SS/CS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec, air)	8.52×10^{-6}	8.52×10^{-6}

Multi-Assembly Canisters (Continued)

Attribute	Type of Multi-Assembly Canister	
	W21M-SD	W21M-SS
a. Capacity (intact assemblies)	21 PWR	21 PWR
b. Weight (lb)		
Empty	44,161	44,238
Loaded	78,538	75,360
c. Thermal		
Design Heat Rejection (kW)	25.1 stor/22.0 trans	25.1 stor/22.0 trans
Maximum Burnup (GWD/MTU)	60	60
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	182.3	182.3
Overall Cross Section	66.0	66.0
Cavity Length	167.5	163.0
Cavity Cross Section	64.75	64.75
Wall Thickness	0.625	0.625
Lid Thickness	8.00	10.25
Bottom Thickness	6.26	8.5
Basket Length	166.9	162.5
f. Materials of Construction		
Canister Body	SS	SS
Canister Internals	Steel/Boral	Steel/Boral
Shield Plugs	DU/Pb/SS	SS/CS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec, air)	8.52 x 10^{-6}	8.52 x 10^{-6}

Multi-Assembly Canisters (Continued)

Attribute	Type of Multi-Assembly Canister	
	W21T-LL	W21T-LS
a. Capacity (intact assemblies)	21 PWR	21 PWR
b. Weight (lb)		
Empty	42,554	44,593
Loaded	72,584	79,873
c. Thermal		
Design Heat Rejection (kW)	25.1 stor/22.0 trans	25.1 stor/22.0 trans
Maximum Burnup (GWD/MTU)	60	60
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	192.3	192.3
Overall Cross Section	66.0	66.0
Cavity Length	178.5	173.0
Cavity Cross Section	64.75	64.75
Wall Thickness	0.625	0.625
Lid Thickness	8.13	10.25
Bottom Thickness	5.13	8.5
Basket Length	178.0	172.5
f. Materials of Construction		
Canister Body	SS	SS
Canister Internals	Steel/Boral	Steel/Boral
Shield Plugs	Pb/SS	CS/SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec, air)	8.52×10^{-6}	8.52×10^{-6}

EnergySolutions

FUELSOLUTIONS™ USED FUEL STORAGE AND TRANSPORT SYSTEM

Multi-Assembly Canisters (Continued)

Attribute	Type of Multi-Assembly Canister	
	W21T-SL	W21T-SS
a. Capacity (intact assemblies)	21 PWR	21 PWR
b. Weight (lb)		
Empty	42,258	43,224
Loaded	76,635	74,346
c. Thermal		
Design Heat Rejection (kW)	25.1 stor/22.0 trans	25.1 stor/22.0 trans
Maximum Burnup (GWD/MTU)	60	60
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	182.3	182.3
Overall Cross Section	66.0	66.0
Cavity Length	167.4	163.0
Cavity Cross Section	64.75	64.75
Wall Thickness	0.625	0.625
Lid Thickness	8.5	10.25
Bottom Thickness	5.88	8.5
Basket Length	166.9	162.5
f. Materials of Construction		
Canister Body	SS	SS
Canister Internals	Steel/Boral	Steel/Boral
Shield Plugs	Pb/SS	SS/CS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec, air)	8.52×10^{-6}	8.52×10^{-6}

Licensing Status

The W21 canisters are licensed for storage within the W150 overpack under Certificate of Compliance 72-1026, Amendment 4, which expires on February 15, 2021. The canisters are licensed for transport within the TS125 overpack under Certificate of Compliance 71-9276, Revision 4, which expires on October 31, 2017.

Extent of Commercial Use

To date, no W21 canisters have been loaded.

Comments

The ‘M’ in the model designation refers to a multi-purpose canister licensed for storage and transportation, and intended for disposal. The ‘T’ refers to a transportable storage canister for storage and transportation.

Multi-Assembly Canisters (Continued)

Attribute	Type of Multi-Assembly Canister	
	W74M	W74T
a. Capacity (intact assemblies)	64 BWR	64 BWR
b. Maximum Weight (lb)		
Empty	44,899	42,200
Loaded	77,539	75,375
c. Thermal		
Design Heat Rejection (kW)	24.8 stor/17.6 trans	24.8 stor/17.6 trans
Maximum Burnup (GWD/MTU)	40	40
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	192.25	192.25
Overall Cross Section	66.0	66.0
Cavity Length	173.0	173.0
Cavity Cross Section	64.75	64.75
Wall Thickness	0.625	0.625
Lid Thickness	10.25	10.25
Bottom Thickness	8.5	8.5
Basket Length	88.25 Top/85.25 Bottom	88.25 Top/85.25 Bottom
f. Materials of Construction		
Canister Body	SS	SS
Canister Internals	SS/CS/Borated SS	SS/CS/Borated SS
Shield Plugs	SS/CS	SS/CS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec, air)	8.52×10^{-6}	8.52×10^{-6}

Licensing Status

The W74 canisters are licensed for storage within the W150 overpack under Certificate of Compliance 72-1026, Amendment 4, which expires on February 15, 2021. The canisters are licensed for transport within the TS125 overpack under Certificate of Compliance 71-9276, Revision 4, which expires on October 31, 2017.

Extent of Commercial Use

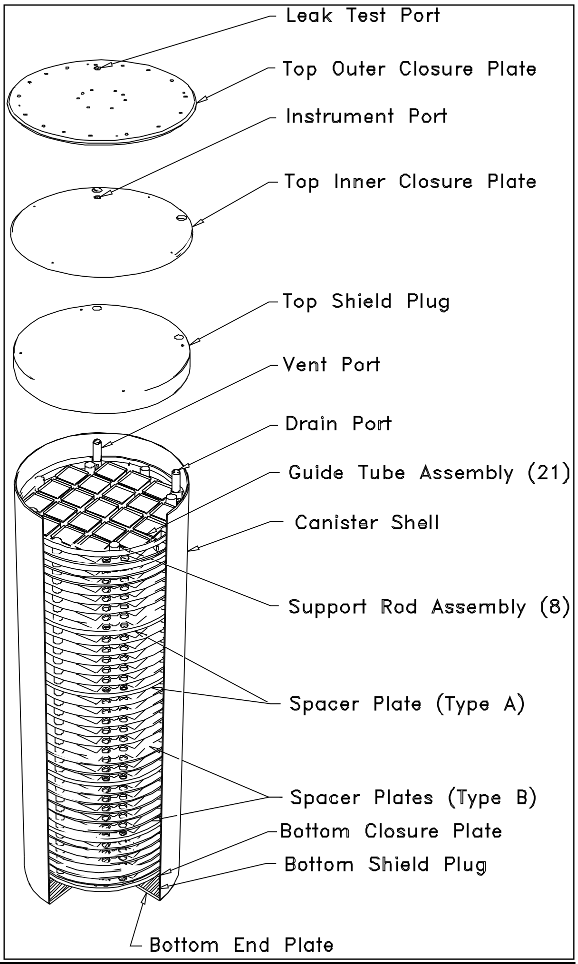
Seven W74 FuelSolutions™ canisters have been loaded at the Big Rock Point Nuclear Plant.

Comments

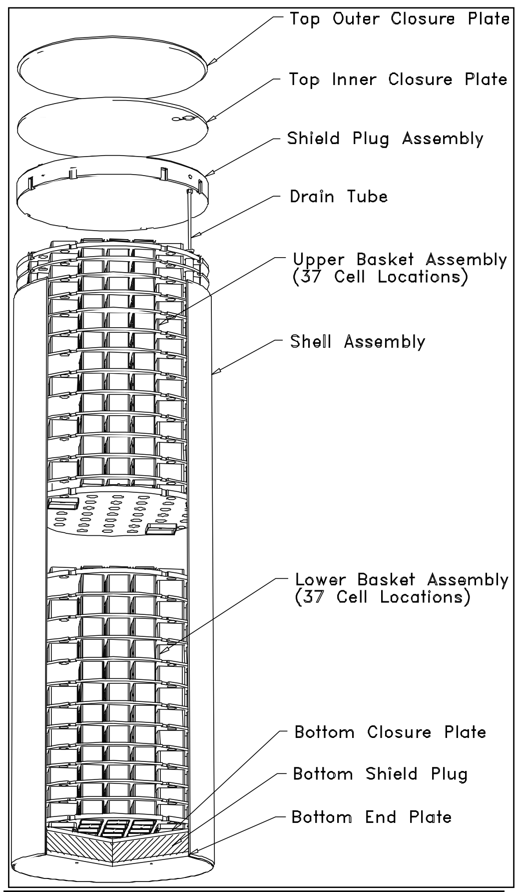
The ‘M’ in the model designation refers to a multi-purpose canister licensed for storage and transportation, and intended for disposal. The ‘T’ refers to a transportable storage canister for storage and transportation.

FUELSOLUTIONS™ USED FUEL STORAGE AND TRANSPORT SYSTEM

Multi-Assembly Canisters (Continued)



FuelSolutions™ W21 Canister



FuelSolutions™ W74 Canister

W150 Storage Cask

Description

The W150 storage cask is a reinforced concrete overpack with a steel liner that stores a multi-assembly canister vertically with an annular air passage located at the top and bottom for airflow. The cask comes in both short and long configurations to accommodate the varying canister lengths.

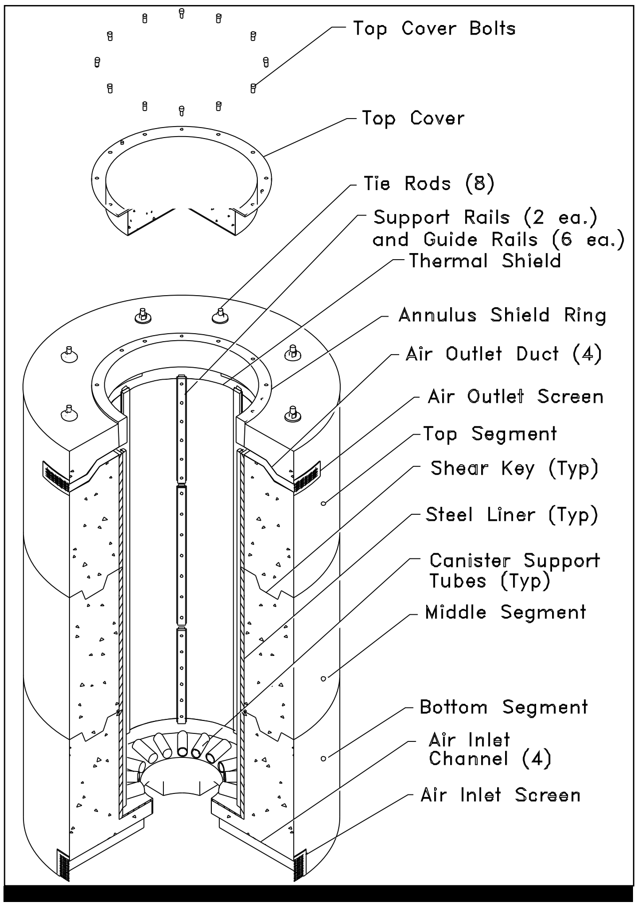
Specifications[3,5]

Attribute	Type of Vertical Multi-Segment or Monolithic Concrete Storage Cask	
	Short Configuration	Long Configuration
a. Capacity (canisters)	1	1
b. Weight (lb)		
Empty	242,500	253,200
Loaded	316,000-324,000	326,000-334,000
c. Thermal		
Design Heat Rejection (kW)	28	28
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	220	230
Overall Cross Section	138	138
Cavity Length	183	193
Cavity Cross Section	73.0	73.0
Wall Thickness	32.5	32.5
Lid Thickness	14.3	14.3
Bottom Thickness	18.0	18.0
f. Neutron Shield (in)		
Side Thickness	None	None
Lid Thickness	None	None
Bottom Thickness	None	None
g. Materials of Construction		
Cask Body	Concrete (reinforced)/CS	Concrete (reinforced)/CS
Neutron Shield	None	None
h Outside Surface Dose (mrem/hr)	<50 (Side)/<25 (Top)	<50 (Side)/<25 (Top)
i. Maximum Leak Rate (atm-cm^3/sec, air)	Per Canister	Per Canister

Licensing Status

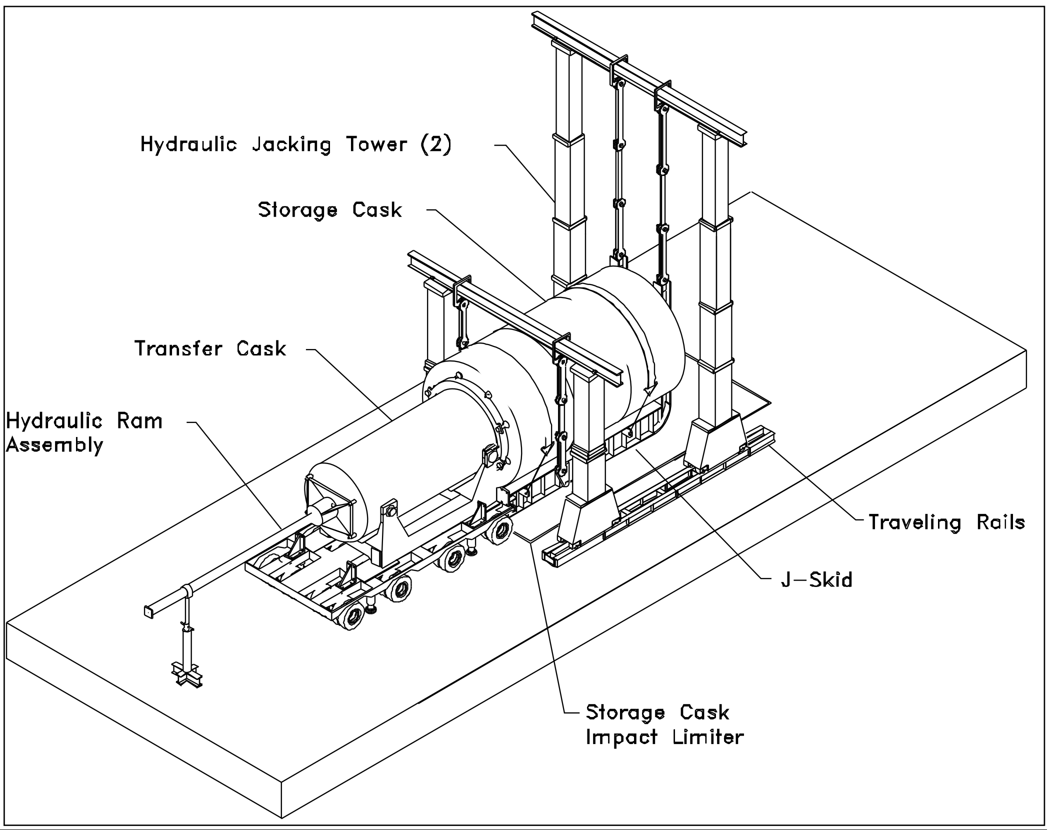
The W150 storage casks are licensed under Certificate of Compliance 72-1026, Amendment 4, which expires on February 15, 2021.

W150 Storage Cask (Continued)



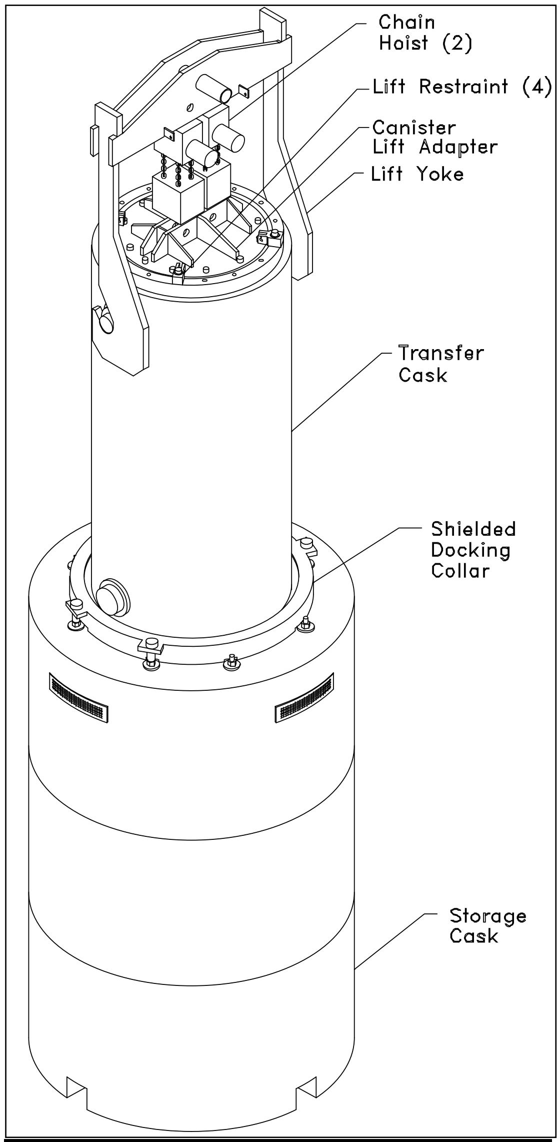
FuelSolutions™ W150 Storage Cask

W150 Storage Cask (Continued)



W150 Horizontal Loading

W150 Storage Cask (Continued)



W150 Vertical Loading

FUELSOLUTIONS™ USED FUEL STORAGE AND TRANSPORT SYSTEM

W100 Transfer Cask

Description

The W100 transfer cask is used for loading the multi-assembly canister within the used fuel pool as well as transfer of the canister to and from the W150 storage overpack. The transfer cask is a cylindrical vessel with a steel-lead-steel multi-wall design. Covers are bolted to either end of the cask to allow access to the cavity from either the top or bottom.

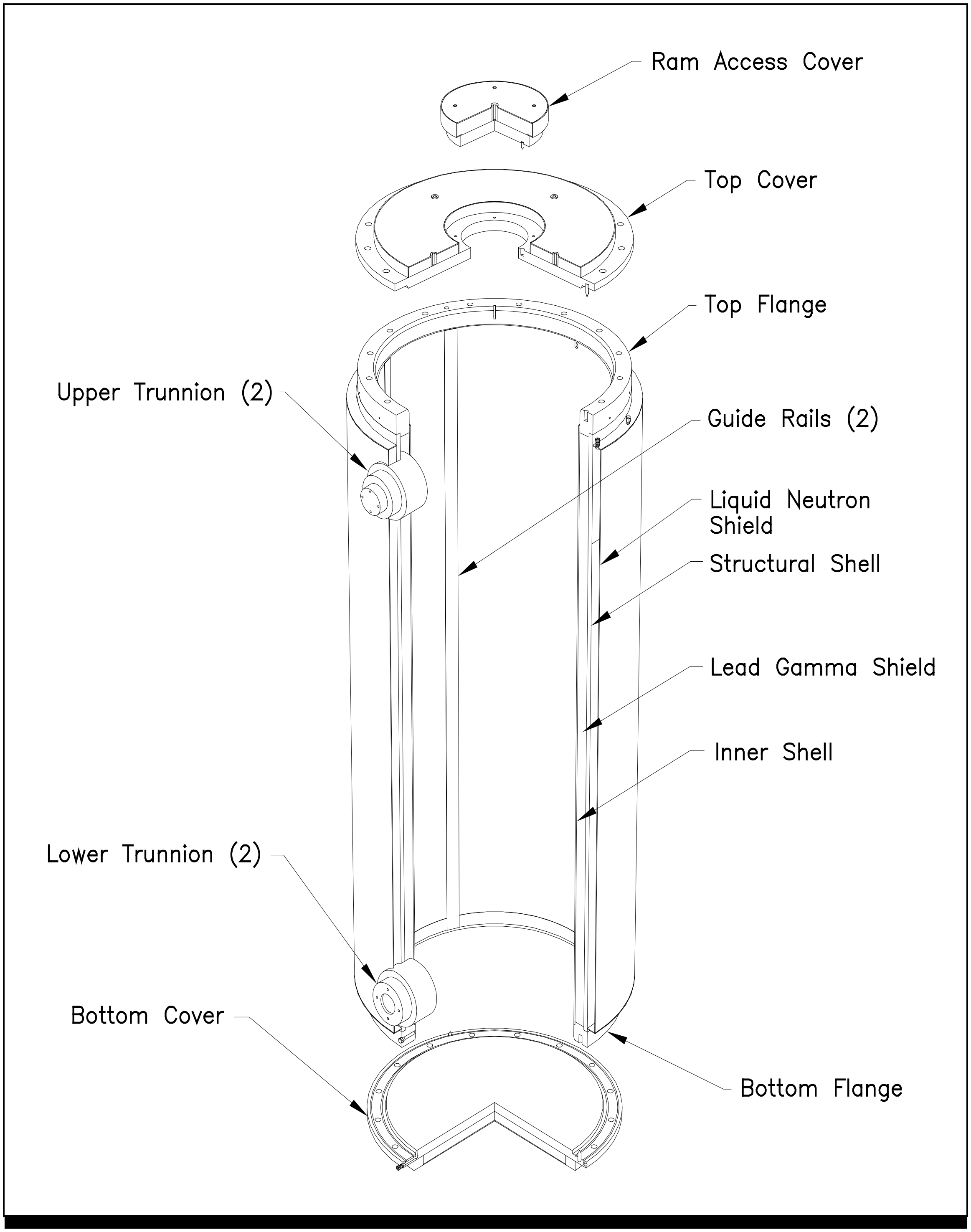
Specifications[3,5]

Attribute	W100 Transfer Cask
a. Capacity (canisters)	1
b. Weight, Empty (lb)	112,100
c. Design Heat Rejection (kW)	28
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	209.0
Overall Cross Section	84.9
Cavity Length	192.8
Cavity Cross Section	67.0
Wall Thickness	8.95
Top Lid Thickness	6.0
Bottom Lid Thickness	6.3
f. Neutron Shield (in)	
Side Thickness	3.0
Lid Thickness	2.75
Bottom Thickness	3.0
g. Materials of Construction	
Cask Body	SS, Pb
Neutron Shield	RX-277 or NS-3 (lids), Water (side)
h. Outside Surface Dose (mrem/hr)	ALARA
i. Maximum Leak Rate (atm-cm^3/s, air)	Per Canister

Licensing Status

The W100 transfer cask is licensed for use with the FuelSolutions™ Storage System under Certificate of Compliance 72-1026, Amendment 4, which expires on February 15, 2021.

W100 Transfer Cask (Continued)



FuelSolutions™ W100 Transfer Cask

FUELSOLUTIONS™ USED FUEL STORAGE AND TRANSPORT SYSTEM

TS125 Transport Cask

Description

The TS125 transport cask has been licensed to provide a means of transporting canisters off-site directly from the used fuel pool or from on-site storage within the W150 storage overpack. The cask consists of concentric steel-lead-steel cylindrical shells with solid neutron shielding.

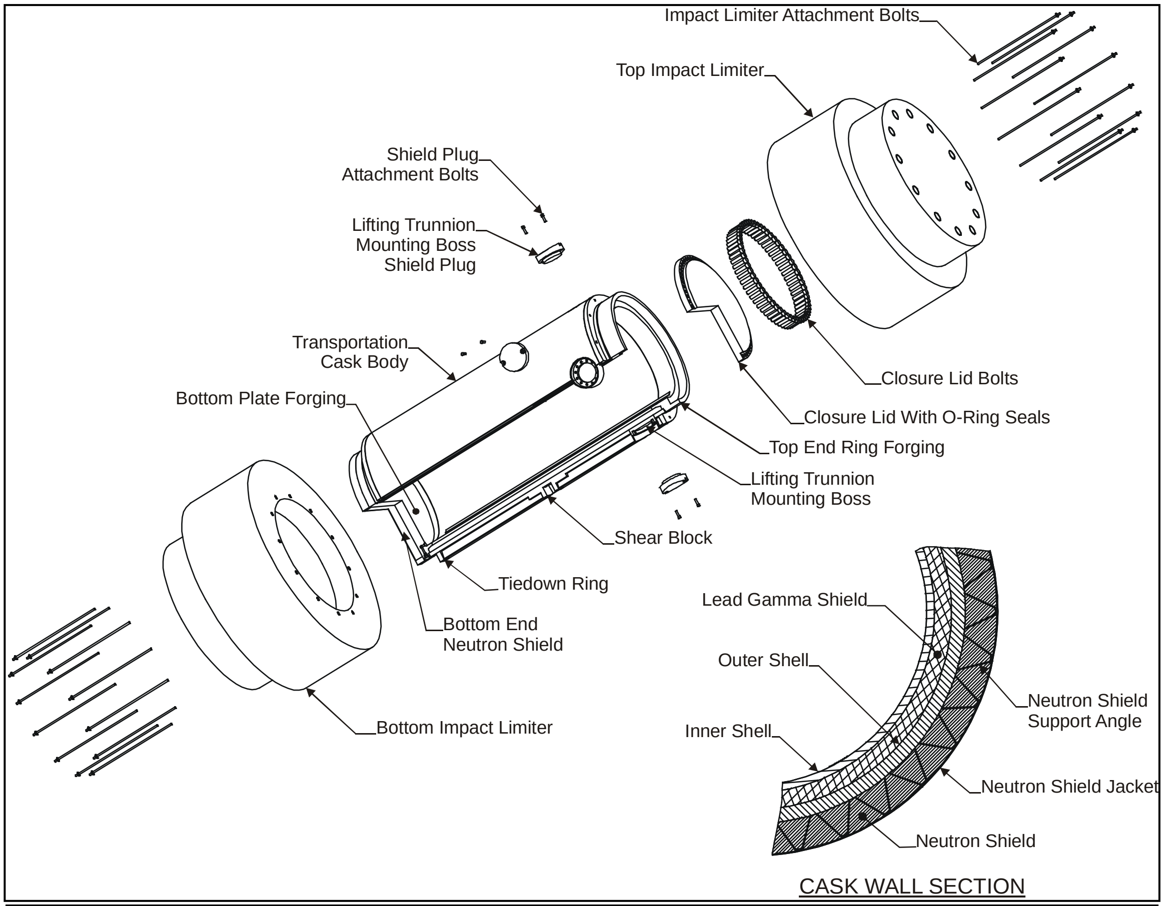
Specifications[4]

Attribute	TS125 Transport Cask
a. Capacity (canisters)	1
b. Maximum Weight (lb)	
Cask Body	153,424
Closure Lid	7,362
Loaded, without Impact Limiters	242,831
Loaded, with Impact Limiters	285,000
c. Thermal	
Design Heat Rejection (kW)	22.0
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/o impact limiters	210.4
Overall Length w/ impact limiters	342.4
Overall Cross Section w/o impact limiters	94.2
Overall Cross Section w/ impact limiters	143.5
Cavity Length	193.0
Cavity Cross Section	67.0
Wall Thickness	13.6
Lid Thickness	6.0
Bottom Thickness	11.25
f. Neutron Shield (in)	
Side Thickness	6.0
Lid Thickness	None
Bottom Thickness	5.0
g. Materials of Construction	
Cask Body	SS/CS/Pb
Neutron Shield	NS-4-FR
Impact Limiters	Al Honeycomb/SS
h. Cask Cavity Atmosphere	He
i. Outside Surface Dose (mrem/hr)	<1000 @ package surface, <200 (contact) , <10 (at 2m)
j. Maximum Leak Rate (atm-cm^3/s, air)	1×10^{-7}

Licensing Status

The TS125 is licensed for transportation under Certificate of Compliance 71-9276, Revision 4, which expires on October 31, 2017. The TS125 transportation cask cannot be fabricated until the CoC is updated from a -85 certificate to a -96 certificate.

TS125 Transport Cask (Continued)



FuelSolutions™ TS125 Transportation Cask

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VSC-24 USED FUEL STORAGE SYSTEM

Contact:
Energy*Solutions*
Tel: (408) 558-3500
www.energysolutions.com

Introduction

The VSC-24, designed and built by Energy*Solutions*, is a storage system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, described on the following pages, is comprised of the following:

- Multi-Assembly Sealed Basket (MSB)
- Ventilated Concrete Cask (VCC)
- MSB transfer cask (MTC)

This section describes each component of the system, starting with the Multi-Assembly Sealed Basket (MSB).

Multi-Assembly Sealed Basket

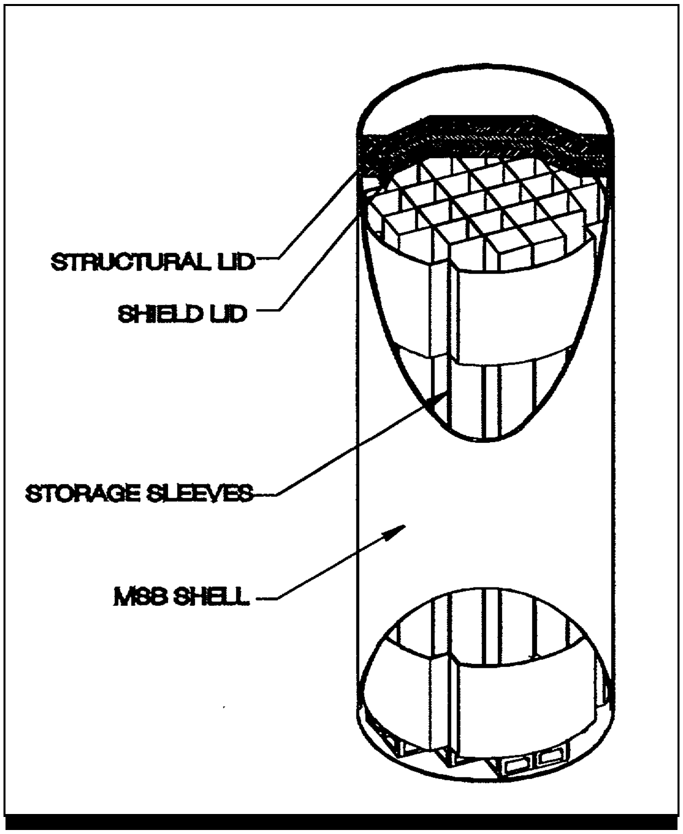
Description

The Multi-Assembly Sealed Basket (MSB) canister consists of a steel cylindrical shell sealed at the bottom with a welded steel plate and at the top with welded steel shielding and structural lids. Within the canister is the fuel basket, a welded steel structure that provides structural support for up to 24 PWR fuel assemblies. The MSB provides confinement, criticality control, and structural support during storage, loading, and on-site transfer to the storage pad.

Specifications[6,7,8]

Attribute	Multi-Assembly Sealed Basket
a. Capacity (intact assemblies)	24 PWR
b. Maximum Weight (lb)	
Empty, w/o lids	21,686
Loaded	68,685
c. Thermal	
Design Heat Rejection (kW)	24
Maximum Per Assy Heat Load (kW)	1.0
Maximum Burnup (GWd/MTU)	45.0
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	164.2 – 192.25
Basket Length	147.5 – 163.6
Cross Section	62.5
Wall Thickness	1.00
Lid Assembly Thickness	12.5
Bottom Plate Thickness	0.75
f. Materials of Construction	
Canister Body	CS
Canister Internals	CS
Shield Plugs	CS, RX-277
g. Cavity Atmosphere	He
h. Maximum Leak Rate (atm-cm^3/sec, air)	1 x 10^{-4}

Multi-Assembly Sealed Basket (Continued)



VSC-24 Multi-Assembly Sealed Basket

Ventilated Concrete Cask

Description

The Ventilated Concrete Cask (VCC) is a vertically oriented reinforced concrete cask that provides structural support, shielding, and natural convection cooling to the MSB. It contains four air inlets at both the top and bottom of the cask, protected by wire mesh screens to prevent debris intrusion. The internal cavity, air inlets, and air outlets are all steel-lined.

Specifications[6,7,8]

Attribute	Ventilated Concrete Cask
a. Capacity (MSB)	1
b. Maximum Loaded Weight (lb)	287,920
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	196.7 – 225.1
Overall Cross Section	132.0
Cavity Length	174.7 – 203.1
Cavity Cross Section	70.5
Concrete Thickness	29.0
Steel Inner Shell Thickness	1.75
Lid Thickness	0.75
Bottom Thickness	24.0
f. Materials of Construction	
Cask Body	Concrete (reinforced)/Steel
g. Outside Surface Dose (mrem/hr)	<100 (Side) / <200 (Top)

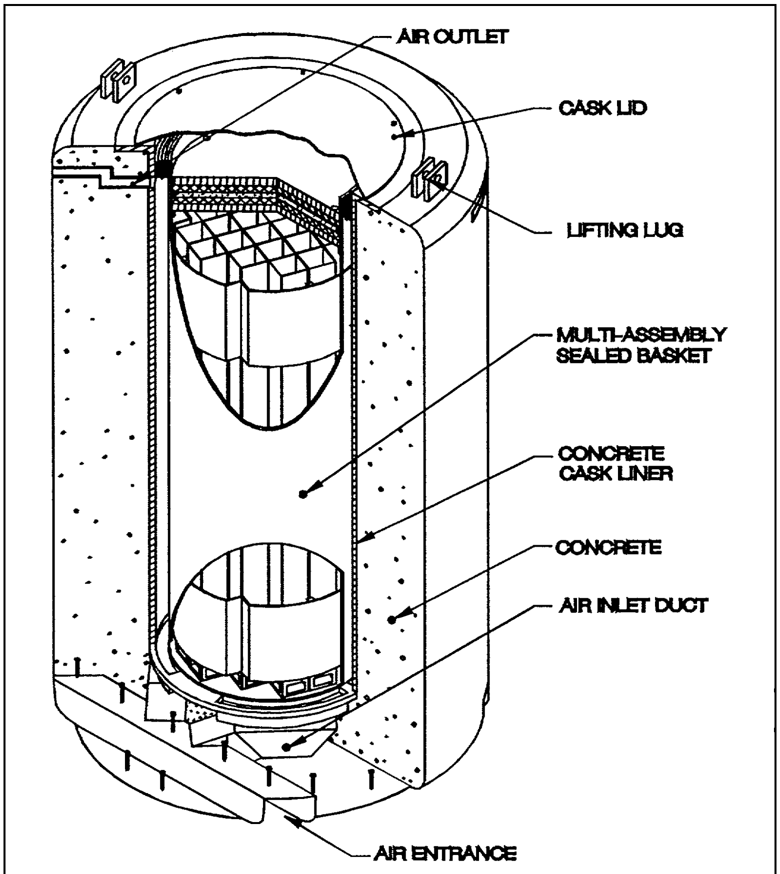
Licensing Status

The VSC-24 is a licensed storage system under Certificate of Compliance 72-1007 Amendment 4, which expires on May 07, 2013. A Certificate of Compliance renewal application to extend the expiration date to May 7, 2053 has been submitted to the NRC.

Extent of Commercial Use

Twenty-four VSC-24 casks have been loaded at Entergy's Arkansas Nuclear One. Sixteen have been loaded at NextEra Energy's Point Beach Nuclear Power Plant (NPP). Eighteen have been loaded at Entergy's Palisades NPP.

Ventilated Concrete Cask (Continued)



VSC-24 Ventilated Concrete Cask

MSB Transfer Cask

Description

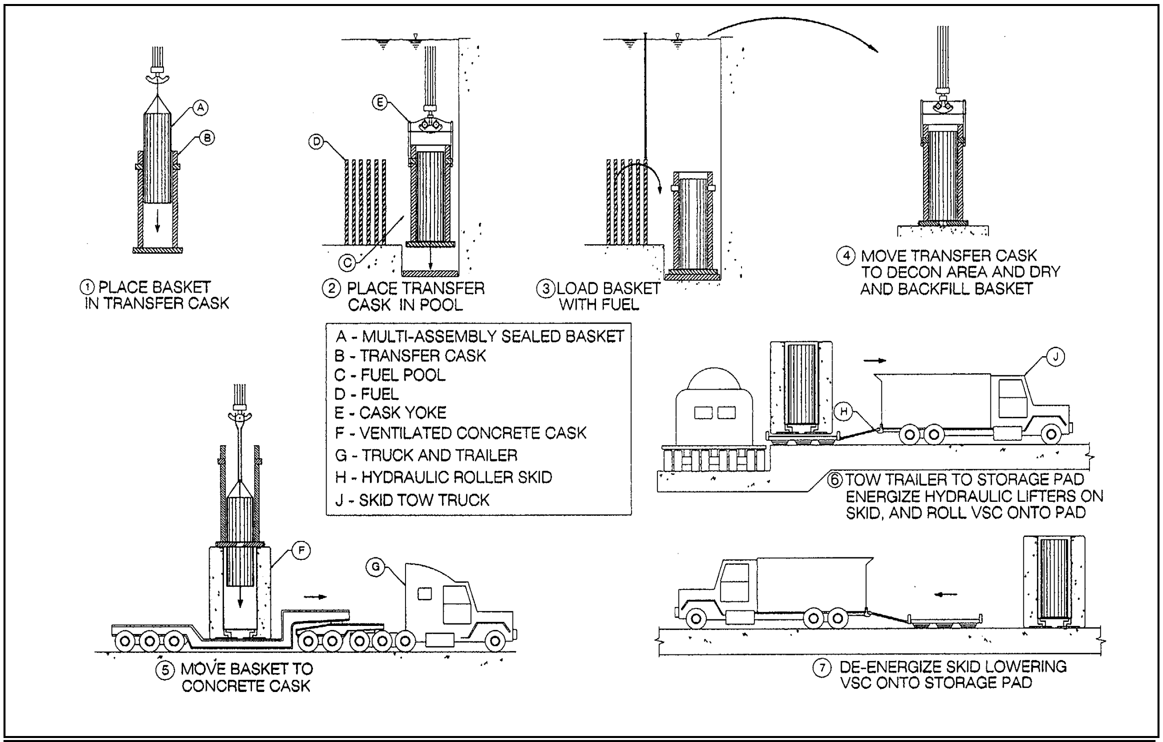
The MSB Transfer Cask (MTC) is used during loading and unloading operations of the MSB and VCC. The MTC has hydraulically operated shielded doors at its bottom, through which the MSB can pass.

Specifications[6,7,8]

Attribute	MSB Transfer Cask
a. Capacity (MSB)	1
b. Maximum Weight (lb)	
Empty	118,939
Loaded	181,964
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length	204.4
Overall Cross Section	83.5
Cavity Length	192.8
Cavity Cross Section	63.5
Wall Thickness	10.0
Bottom Thickness	9.0
e. Neutron Shield (in)	
Side Thickness	4.06
Lid Thickness	N/A
Bottom Thickness	N/A
g. Materials of Construction	
Cask Body	Steel/Pb
Neutron Shield, Radial	RX-277
h. Outside Surface Dose, Side (mrem/hr)	<250 @ 1 meter
i. Maximum Leak Rate (atm-cm^3/sec)	n/a

N/A denotes Not Available
n/a denotes not applicable

MSB Transfer Cask (Continued)



VSC-24 Transfer Cask Loading Operations

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HI-STORM 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

Contact:
Holtec International
Tel: (856) 797-0900
Fax: (856) 797-0909
www.holtecinternational.com

Introduction

The HI-STORM 100 (Holtec International Storage Module) storage system, designed and fabricated by Holtec International, is a storage and transport system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the Multi-Purpose Canister (MPC) concept, is comprised of the following components:

- Multi-Purpose Canister (MPC)
- HI-TRAC 100/125 On-Site Transfer Cask
- HI-STORM 100 Storage Overpack (surface and underground versions)
- HI-STAR 100 Storage/Transport Overpack

MPC transfer from the HI-TRAC transfer cask into the overpack may be performed inside or outside the fuel building. Similarly, HI-TRAC and HI-STORM may be transferred to the ISFSI in several different ways. The loaded HI-TRAC may be handled in the vertical or horizontal orientation. The loaded HI-STORM can only be handled vertically.

To load a system for storage, an empty MPC is placed within the HI-TRAC transfer cask, which is then lowered into the used fuel pool. The used fuel assemblies are loaded into the MPC and the MPC lid is installed while the transfer cask is submerged in the pool. The transfer cask is then removed from the pool and placed in the decontamination area where the MPC lid is seal-welded. The MPC is then drained, dried (either using a vacuum drying system or Holtec's Forced Helium Dehydrator), and backfilled with helium. The MPC closure ring is placed on the MPC and seal welded, providing redundant closure of the MPC lid.

For MPC Transfer inside the fuel building, the HI-TRAC transfer cask top lid is installed and the MPC / transfer cask is lifted vertically and placed on top of the HI-STORM storage overpack (with the aid of a "mating" or alignment device, if needed). The MPC is then raised slightly in order to remove the transfer door locking pins and open the transfer doors. The MPC is lowered into the HI-STORM storage overpack. The doors are then closed and the HI-TRAC transfer cask is lifted off the HI-STORM storage overpack. The HI-STORM storage overpack lid is then installed and the loaded HI-STORM storage overpack is transferred (vertical orientation) to the Independent Spent Fuel Storage Installation (ISFSI) storage pad by the Vertical Cask Transporter (VCT).

For MPC transfers outside the fuel building, the loaded HI-TRAC is transported to the cask transfer facility in the vertical or horizontal orientation. After the loaded HI-TRAC arrives at the cask transfer facility, the loaded HI-TRAC is then placed, using the crane located in the transfer area, on top of the HI-STORM 100, which has been inspected and staged with the lid removed, vent duct shield inserts installed, the alignment devices positioned, and the mating device installed. The MPC is raised slightly and the transfer lid door locking pins are removed, the doors are opened, and the MPC is lowered into the HI-STORM. The doors are closed and HI-TRAC is removed from the top of HI-STORM. The alignment device, vent duct shield inserts, and mating device are removed and the HI-STORM lid is installed. The HI-STORM is then moved to its designated position on the ISFSI pad.

The following table and figure illustrates the compatibility among the components of the HI-STORM and HI-STAR dry storage and transport systems. HI-STAR 100 is the licensed off-site transportation overpack for the HI-STORM 100 storage system. As shown, the MPCs are compatible with both the HI-STORM (storage) overpack and the HI-STAR (storage/transport) overpack. This compatibility eliminates the need to repackage the used fuel prior to off-site transport.

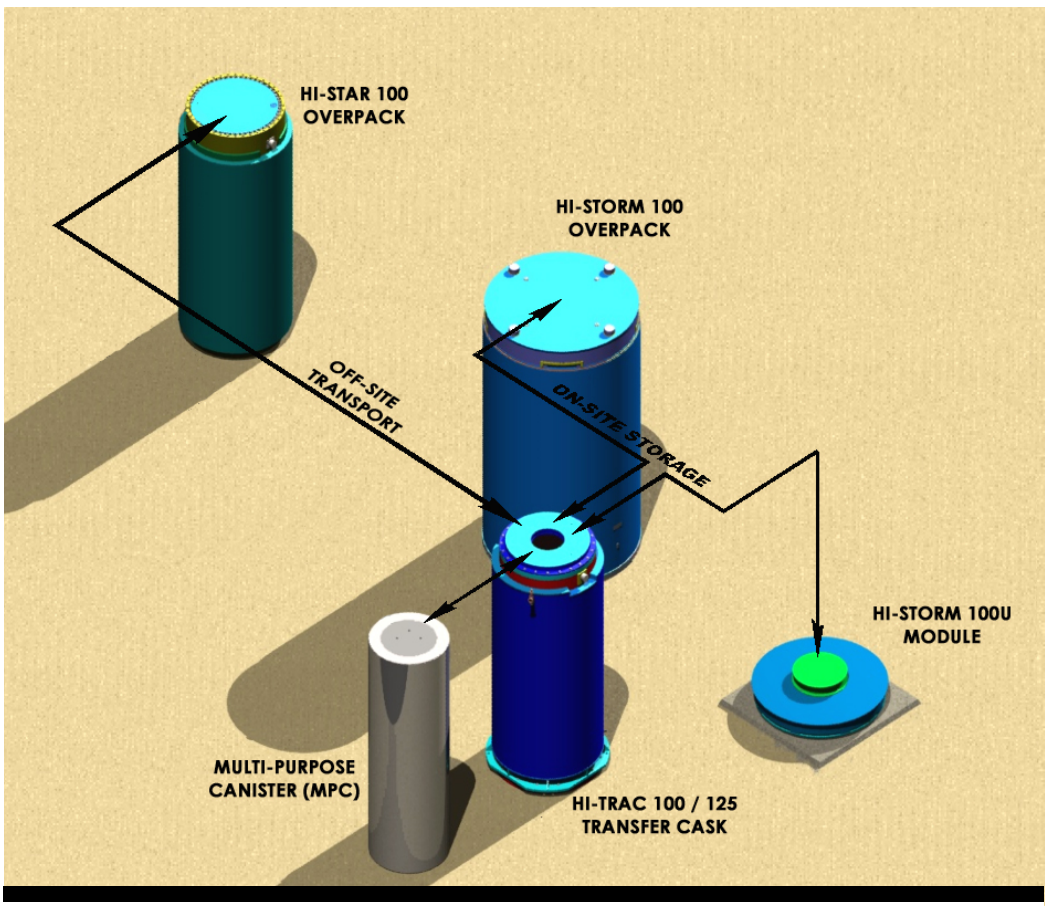
HI-STORM STORAGE SYSTEM

System[a]	HI-STORM 100/100U	HI-STORM 100/100U
Function	Storage & Transport	Storage & Transport
Fuel Type	PWR	BWR
MPC	MPC-24, 24E, 24EF, 32, & 32F	MPC-68, 68F, 68FF, & 68M
Storage Cask/Module	HI-STORM 100/HI-STORM 100U (VVM)[b]	HI-STORM 100/HI-STORM 100U (VVM)[b]
Transfer Cask	HI-TRAC 100/125	HI-TRAC 100/125
Transport Cask	HI-STAR 100	HI-STAR 100

[a]System Storage Configurations

- Above Ground (HI-STORM 100)
- Below Ground (HI-STORM 100U)

[b]HI-STORM 100U (VVM) is the underground vertical ventilated module (VVM) for the HI-STORM 100U storage module



HI-STORM 100/HI-STAR 100 Dry Storage/Transport System Compatibility

This section describes each component of the system, starting with the Multi-Purpose Canister (MPC).

HI-STORM 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

The Multi-Purpose Canister

Description

The MPC is a welded, cylindrical, stainless steel canister that maintains the vertical configuration of the used nuclear fuel and is the confinement boundary between the fuel and the environment while permanently enclosing the used fuel assemblies for storage or transport. The sealed canister consists of a honeycombed fuel basket and a cylindrical canister shell, the MPC Enclosure Vessel. The honeycombed fuel basket is constructed from stainless steel and utilizes Holtec fabricated Metamic™ Classic panels as the neutron absorber. The honeycombed fuel baskets provide criticality control, structural support, and heat removal features. Once loaded with used fuel and sealed, the MPC is placed in the appropriate purpose specific overpack - HI-STORM (storage) or HI-STAR (off-site transport). One MPC is loaded per HI-STORM or HI-STAR overpack.

The HI-STORM/HI-STAR systems utilize multiple MPC designs to accommodate storage and transport of varying contents:

Canister	Fuel Type	Capacity
MPC-24	PWR	24 fuel assemblies (intact) with or without non-fuel hardware
MPC-24E/24EF	PWR	24 openings, of which 4 can store damaged fuel or fuel debris
MPC-32/32F	PWR	32 openings, of which 8 can store damaged fuel or fuel debris
MPC-68/68FF	BWR	68 openings, of which 16 can store damaged fuel or fuel debris and up to 8 damaged fuel containers containing fuel debris in certain locations
MPC-68M[a]	BWR	68 openings, of which 16 can store damaged fuel or fuel debris and up to 8 damaged fuel containers containing fuel debris in certain locations
MPC-68F	BWR	68 openings, of which 4 can store damaged fuel or fuel debris (specific for storage of Dresden 1 and Humboldt Bay used fuel)

[a]The MPC-68M basket differs from the other MPC baskets in that the MPC-68M basket is entirely made of the neutron absorber Metamic™-HT.

HI-STORM 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

The Multi-Purpose Canister (Continued)

Specifications[9,10]

Attribute	Type of Multi-Purpose Canister	
	MPC-24	**MPC-24E / -24EF**
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Maximum Weight (lb)		
Empty	42,000	45,000
Loaded	90,000	90,000
c. Thermal		
Design Heat Rejection (kW)		
HI-STORM Storage	36.9	36.9
HI-STAR Transport	20.0	20.0
Max. Per Assy. Heat Load (kW)		
HI-STORM Storage	1.537	1.537
HI-STAR Transport	0.833	0.833
Maximum Burnup (GWD/MTU)		
HI-STORM Storage	68.2 (3 yr cooled)	68.2 (3 yr cooled)
HI-STAR Transport	37.0 (10 yr cooled)	37.0 (10 yr cooled)
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length (Reference)	190.31	190.31
Cavity Length	178.31	178.31
Cross Section (Reference)	68.5	68.5
Wall Thickness	0.5	0.5
Lid Thickness	9.5	9.5
Bottom Thickness	2.5	2.5
Basket Length	176.5	176.5
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/Metamic™ Classic	SS/Metamic™ Classic
Shield Plugs	SS	SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	5 x 10^{-6}	5 x 10^{-6}

N/A denotes Not Available

Licensing Status

The MPC-24, -24E, and -24EF are licensed for storage within the HI-STORM overpack under Certificate of Compliance 72-1014, Amendment 8, which expires on May 31, 2020. The MPC-24, -24E, and -24EF are licensed for transport within the HI-STAR overpack under Certificate of Compliance 71-9261, Revision 8, which expires on March 31, 2014.

HI-STORM 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

The Multi-Purpose Canister (Continued)

Specifications[9,10]

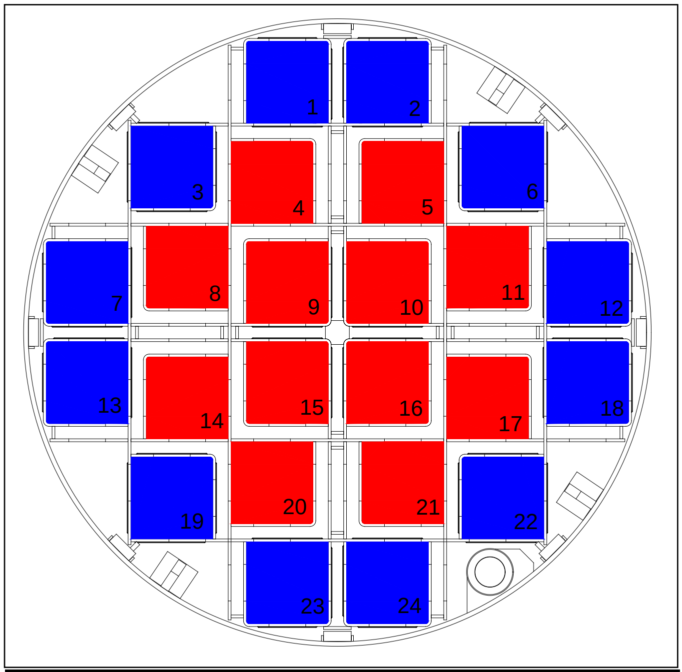
Attribute	Type of Multi-Purpose Canister	
	MPC-32/32F	**MPC-68/-68F/-68FF/ -68M**
a. Capacity (intact assemblies)	32 PWR	68 BWR
b. Weight (lb)		
Empty	36,000	39,000
Loaded	90,000	90,000
c. Thermal		
Design Heat Rejection (kW)		
HI-STORM Storage	36.9	36.9
HI-STAR Transport	20	18.5
Max. Per Assy. Heat Load (kW)		
HI-STORM Storage	1.153	0.543
HI-STAR Transport	0.625	0.272
Maximum Burnup (GWD/MTU)		
HI-STORM Storage	68.2 (3 yr cooled)	65 (3 yr cooled)
HI-STAR Transport	31.2 (10 yr cooled)	32.0 (10 yr cooled)
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length (Reference)	190.3125	190.3125
Cavity Length	178.3125	178.3125
Cross Section (Reference)	68.5	68.5
Wall Thickness	0.5	0.5
Lid Thickness	9.5	9.5
Bottom Thickness	2.5	2.5
Basket Length	176.5	176.0
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/Metamic™ Classic/Al	SS/Metamic™ Classic (Metamic™-HT (MPC-68M))/Al
Shield Plugs	SS	SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	5 x 10^{-6}	5 x 10^{-6}

N/A denotes Not Available

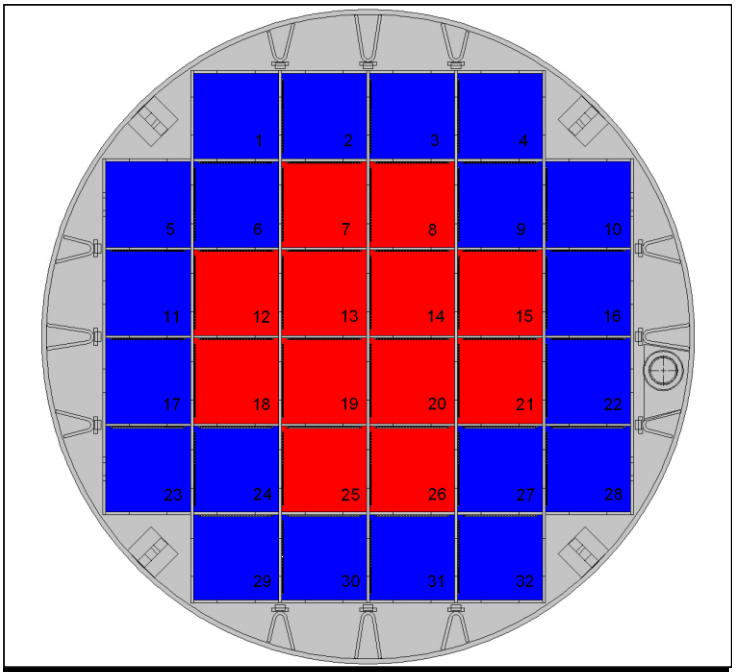
Licensing Status

The MPC-32, -32F, -68, -68F, -68FF, and -68M are licensed for storage within the HI-STORM overpack under Certificate of Compliance 72-1014, Amendment 8, which expires on May 31, 2020. The MPC-32, -68, and -68F, are licensed for transport within the HI-STAR overpack under Certificate of Compliance 71-9261, Revision 8, which expires on March 31, 2014.

The Multi-Purpose Canister (Continued)

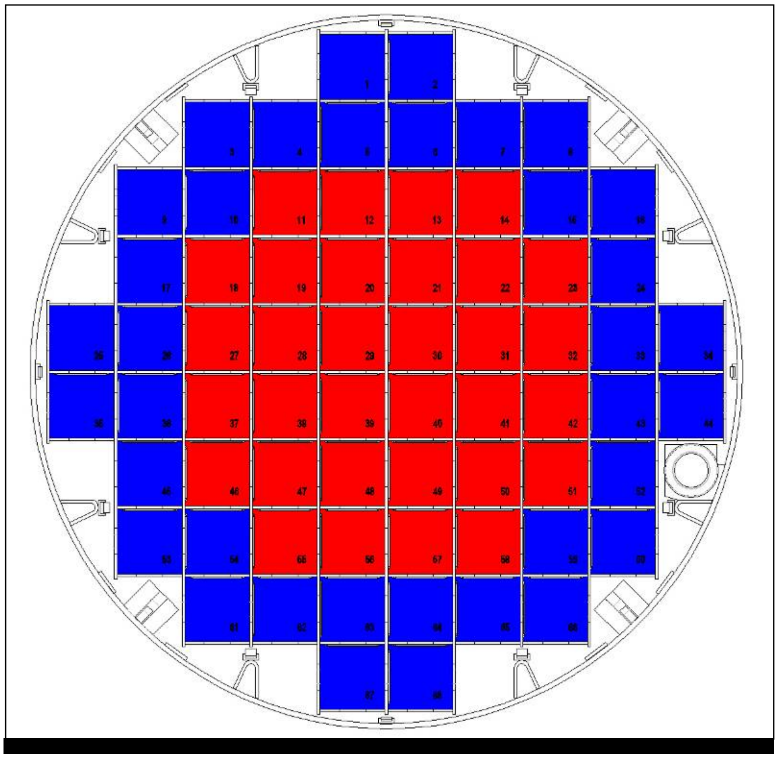


Cross-Section of MPC-24 Showing Regionalized Loading



Cross-Section of MPC-32 Showing Regionalized Loading

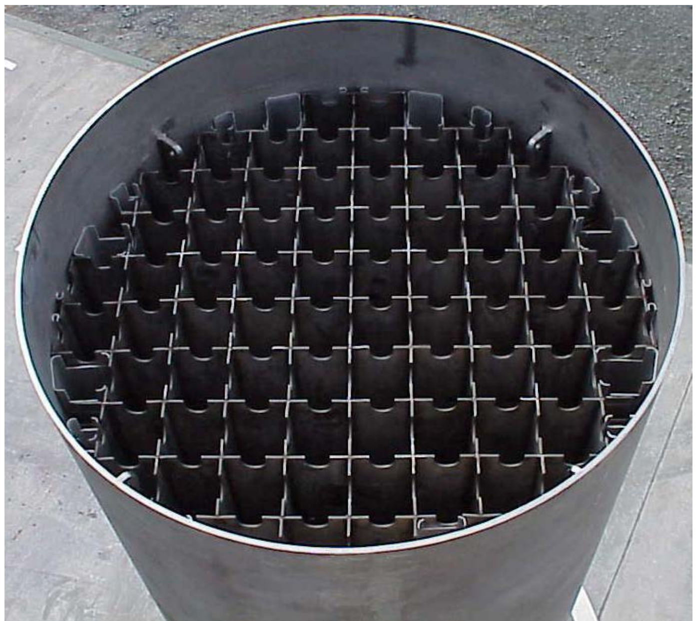
The Multi-Purpose Canister (Continued)



Cross-Section of MPC-68 Showing Regionalized Loading

- Represents Older (Lower Dose) Fuel Assemblies
- Represents Younger (Higher Dose) Fuel Assemblies

The Multi-Purpose Canister (Continued)



Top View of the MPC-68

HI-STORM 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

HI-STORM 100 Aboveground Storage Overpack

Description

The HI-STORM 100 is an aboveground storage overpack that provides protection, shielding, and passive heat removal for the fuel laden MPCs (vertical position) during interim storage. The unique steel-concrete-steel design affords the HI-STORM 100 overpack the structural rigidity required to protect its radioactive contents against the most adverse accident events.

The HI-STORM overpack consists of a heavy-walled steel weldment with concrete installed in the annular space between the inner and outer steel shells. The concrete, installed by Holtec at the site, provides radiation shielding and does not serve as a structural component. The overpack cross-section is comprised of two 1-inch thick concentric shells joined by radial connectors to create an extremely rigid steel weldment. The composite steel weldment is enclosed by a 2-inch thick bottom plate.

The HI-STORM 100 overpack has a heavy bolted concrete-filled steel lid and contains four air inlets at bottom and four air outlets at top for airflow. The inner steel shell of the overpack contains channels to guide the MPC during insertion.

HI-STORM 100

HI-STORM 100 Aboveground Storage Overpack (Continued)

Specifications[9,10]

Attribute	HI-STORM 100S Vertical Steel/Concrete/Steel Cask
a. Capacity (MPC)	1
b. Weight (lb) (150 pcf concrete)	
Empty	270,000
Loaded w/ MPC-24	360,000
Loaded w/ MPC-24E, -24EF	360,000
Loaded w/ MPC-32, -32F	360,000
Loaded w/ MPC-68, -68F, -68FF	360,000
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length (Reference)	231.25
Overall Cross Section	132.5
Cavity Length (Reference)	191.5 or 203.0
Cavity Cross Section	73.5
Wall Thickness	29.5
Lid Thickness	22.25
Bottom Thickness	19.0
e. Neutron Shield (in)	
Side Thickness	n/a
Lid Thickness	n/a
Bottom Thickness	n/a
f. Materials of Construction	
Cask Body	CS/Concrete
Neutron Shield	Concrete/CS
g. Outside Surface Dose (mrem/hr)	Varies
h. Maximum Leak Rate (atm-cm^3/sec)	Per MPC

n/a denotes not applicable

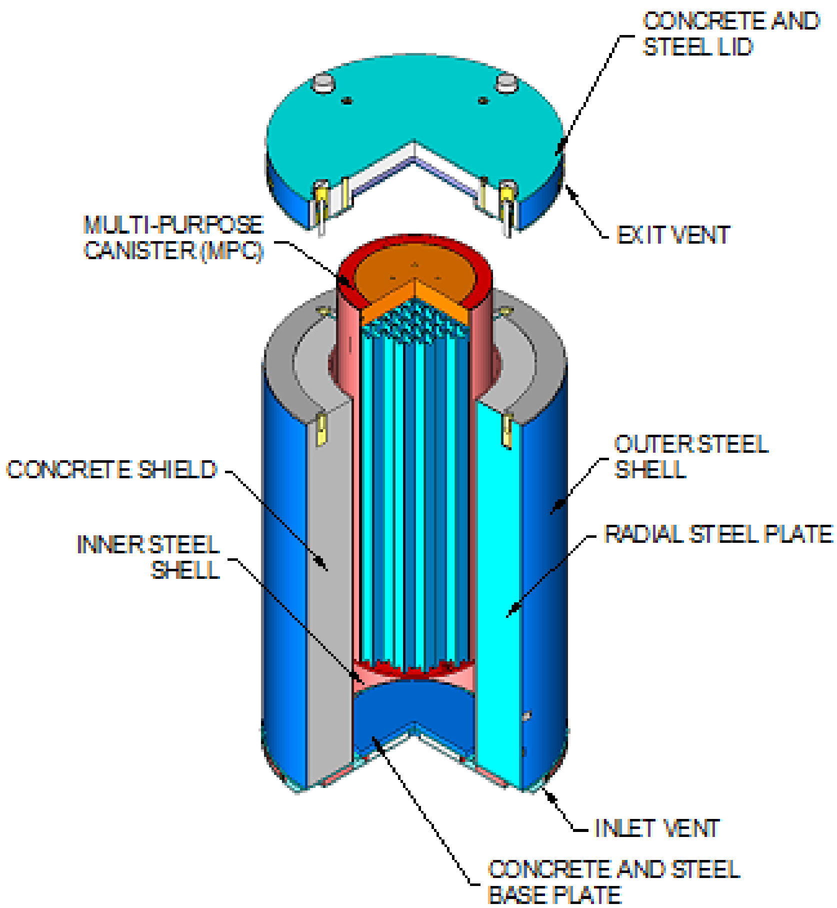
Licensing Status

The HI-STORM 100 storage system is licensed under Certificate of Compliance 72-1014, Amendment 8, which expires on May 31, 2020. In addition, the NRC has also granted two site-specific licenses for using the HI-STORM technology: a site specific license to PFS, LLC to store up to 4,000 HI-STORM 100 in Skull Valley, Utah (SNM-2513 (2006)); and for PG&E to deploy HI-STORM 100s in an anchored configuration at the utility's Diablo Canyon Nuclear Plant (SNM-2511 (2004)).

Extent of Commercial Use

Five hundred fifty HI-STORM 100 aboveground systems are in use at 51nuclear plants (30 PWR/21 BWR) worldwide. Of the 51 nuclear plants, 48 are in the United States and 3 international.

HI-STORM 100 Aboveground Storage Overpack (Continued)



HI-STORM 100 Aboveground Overpack and MPC Shown in Cut-Away View

HI-STORM 100 Aboveground Storage Overpack (Continued)

The figure below shows a HI-STORM overpack delivery to a nuclear power plant site. Delivery is made by truck. Cranes are utilized to upright the overpack, then the concrete is placed between the overpack's steel walls.

HI-STORM 100 Overpack Delivery to NPP

After loading used fuel into the MPC and insertion of the MPC into the HI-STORM overpack, the HI-STORM overpack is transferred by the Vertical Cask Transporter (VCT) to the ISFSI pad for interim storage.

HI-STORM Overpack Transferred to ISFSI Pad for Interim Storage On-Site

HI-STORM 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

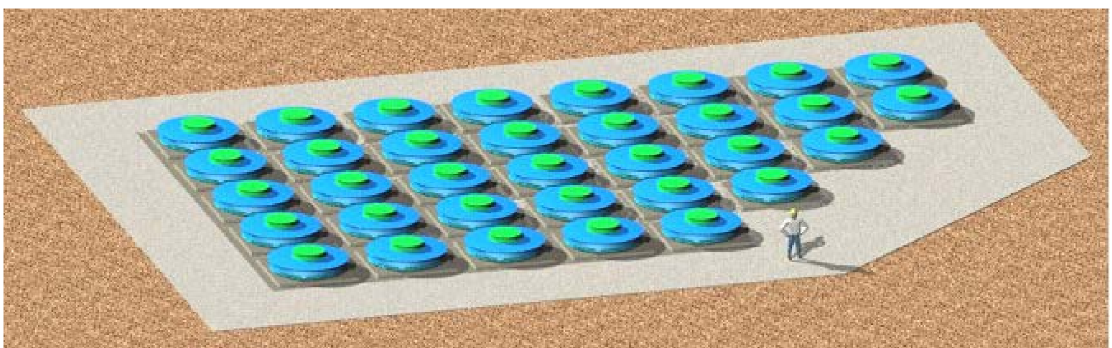
HI-STORM 100U Underground Storage VVM

Description

The HI-STORM 100U is a subsurface dry cask storage system designed to accommodate all NRC-approved Holtec MPCs for the HI-STORM 100 system. The subsurface cask, referred to as the Vertical Ventilated Module (VVM), consists of a below-grade cylindrical vertical storage cavity and closure lid which provides radiation shielding and structural protection of the MPC during storage.

Each HI-STORM 100U VVM provides storage of one MPC in a vertical configuration inside a cylindrical cavity located entirely below-grade. The MPC storage cavity is defined by the welded steel shell Cavity Enclosure Container (CEC). The CEC is a closed bottom, open top, thick walled cylindrical vessel that has no penetrations or openings. The closure lid completes the physical embodiment of the HI-STORM 100U VVM once the loaded MPC is placed inside the CEC. In its installed configuration, the CEC interfaces with the surrounding subgrade for most of its height. The bottom of the CEC sits on the Support Foundation Pad and the HI-STORM 100U VVM closure lid sits on top of the ISFSI surface pad (consisting of both the VVM Interface Pad and the Top Surface Pad).

The HI-STORM 100U, like the aboveground version, is a vertical ventilated dry used fuel storage system designed to be fully compatible with the 100-ton and 125-ton HI-TRAC transfer casks for MPC transfer operations. ISFSIs employing the HI-STORM 100U may be designed for any number of MPCs and expanded to add additional storage modules as the need arises. The design of the storage array allows for any MPC located in a VVM to be independently accessed and retrieved using the HI-TRAC On-Site Transfer Cask.



Conceptual Layout: HI-STORM 100U ISFSI

HI-STORM 100U Underground Storage VVM (Continued)

Specifications[9,10]

Attribute	HI-STORM 100U VVM
a. Capacity (MPC)	1
b. Weight (lb)	
Empty (with closure lid)	57,000
Loaded w/ MPC-24	147,000
Loaded w/ MPC-24E, -24EF	147,000
Loaded w/ MPC-32, -32F	147,000
Loaded w/ MPC-68, -68F, -68FF	147,000
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length (Reference)	244.8125
Overall Cross Section	97.25
Cavity Length (Reference)	220.8125
Cavity Cross Section	72.5
Wall Thickness	N/A
Lid Thickness	42.5
Bottom Thickness	N/A
e. Neutron Shield (in)	
Side Thickness	n/a
Lid Thickness	n/a
Bottom Thickness	n/a
f. Materials of Construction	
VVM Body	CS
Neutron Shield	n/a
g. Outside Surface Dose (mrem/hr)	n/a
h. Maximum Leak Rate (atm-cm^3/sec)	per MPC

N/A denotes Not Available
n/a denotes not applicable

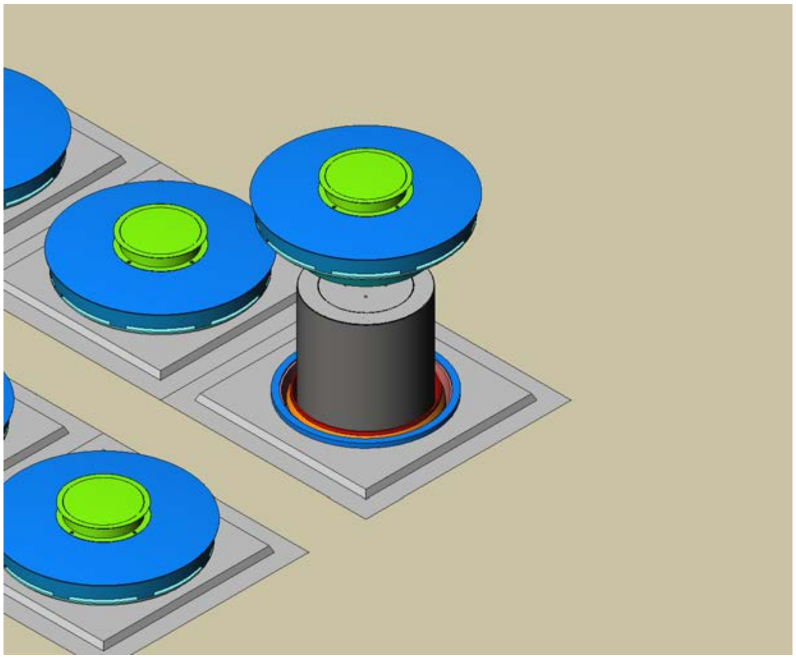
Licensing Status

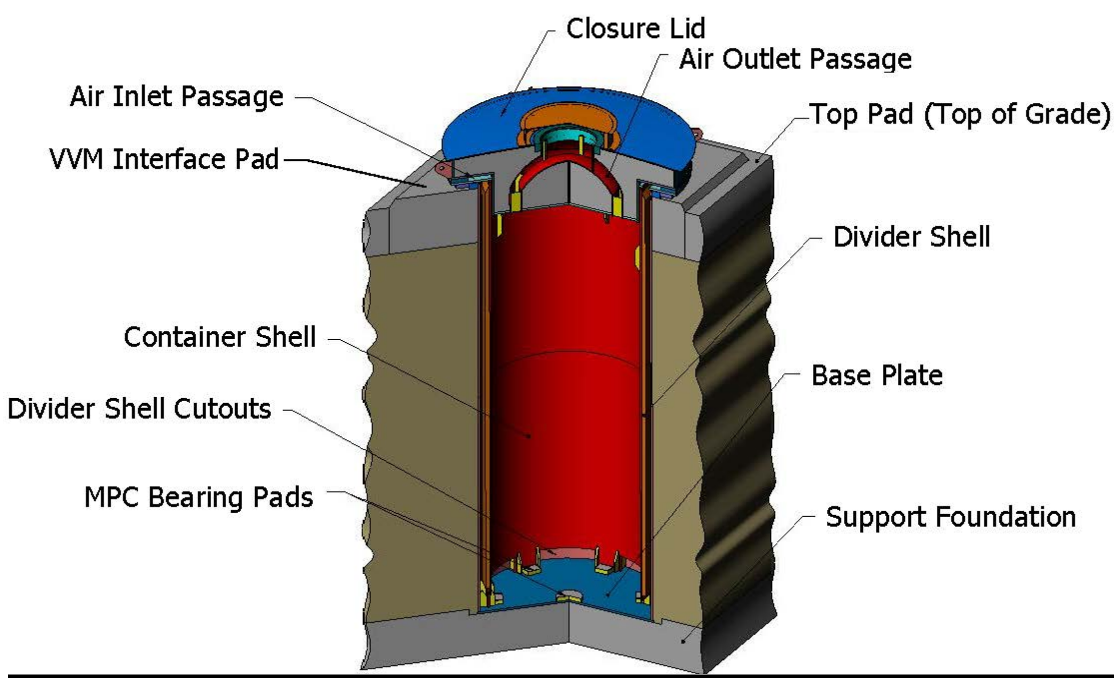
The HI-STORM 100U storage system is licensed under Certificate of Compliance 72-1014, Amendment 8, which expires on May 31, 2020.

Extent of Commercial Use

The HI-STORM 100U Storage VVM has not be commercially deployed as of the date of this report.

HI-STORM 100U Underground Storage VVM (Continued)





HI-STORM 100U Vertical Ventilated Module

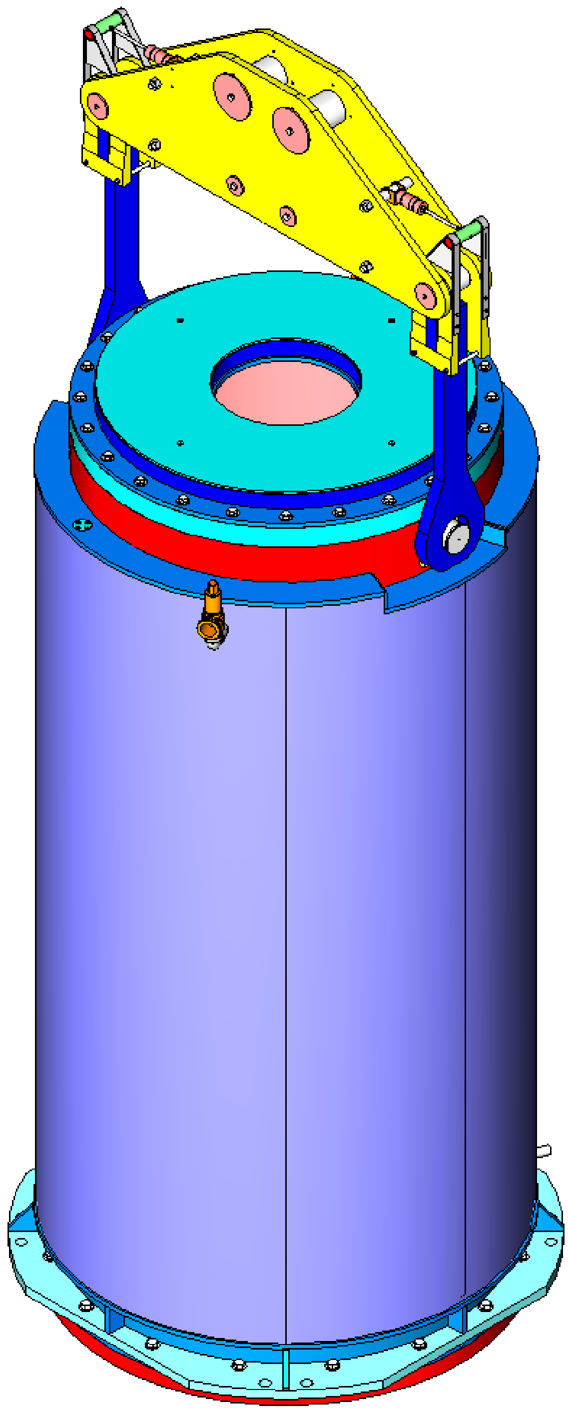
HI-TRAC Transfer Casks

Description

The Holtec International Transfer Cask (HI-TRAC) is the on-site transfer cask, or “shuttle cask”, for the HI-STORM overpacks/VVM (HI-STORM 100 or HI-STORM 100U). The transfer cask provides structural support and radiation protection for the MPC during loading, unloading, and transfer operations. HI-TRAC is a multi-walled (carbon steel/lead/carbon steel) cylindrical vessel with a removable bottom and top lid to permit the insertion or removal of the MPC. Attached to the exterior of the HI-TRAC is a dose attenuating water jacket or a solid jacket fabricated with Holtite™. The water jacket design provides the flexibility to add shielding during loading operations and to remove the shielding weight during critical lifts. The HI-TRAC is used for loading MPCs and transferring MPCs into storage overpacks and transport casks at the fuel storage building or at the ISFSI storage pad.

HI-TRAC is a licensed component of the HI-STORM dry cask storage system and comes in two sizes – the 125 ton (HI-TRAC 125) and the 100 ton (HI-TRAC 100). Both transfer casks have identical cavity diameters. The HI-TRAC 125 has a thicker layer of shielding and thus larger outside dimensions. The HI-TRAC designated for use at each site is based on the site’s overhead crane capacity.

HI-TRAC Transfer Casks (Continued)



HI-TRAC Transfer Cask

HI-TRAC Transfer Casks (Continued)

Specifications[9,10]

Attribute	Type of Transfer Cask		
	HI-TRAC 100	**HI-TRAC 125**	**HI-TRAC 125D[a]**
a. Capacity (MPC)	1	1	1
b. Maximum Weight (lb) (water jacket filled, with Top Lid & Transfer Lid)			
Empty	111,000	155,000	146,000
Loaded w/ MPC-24	192,000	237,500	228,500
Loaded w/ MPC-24E/EF	194,500	240,500	231,500
Loaded w/ MPC-32	199,000	245,000	236,000
Loaded w/ MPC-68/68F/68FF	196,500	242,500	233,500
c. Shape	Cylindrical	Cylindrical	Cylindrical
d. Dimensions (in)			
Overall Length (Reference)	196.25	201.5	201.5
Nominal Cross Section	91.25	94.625	93.75
Cavity Length (Reference)	191.25	191.25	191.25
Cavity Cross Section	68.75	68.75	68.75
Wall Thickness	10	12.111	12.5
Top Lid Thickness	1.0	4.75	4.75
Bottom Thickness	4.0	5.5	5.5
e. Neutron Shield (in)			
Side Thickness	5.0	5.361	5.75
Top Lid Thickness	n/a	3.25	3.25
Bottom Thickness	n/a	n/a	n/a
f. Materials of Construction			
Cask Body	CS/Pb	CS/Pb	CS/Pb
Neutron Shield	Water, Holtite-A	Water, Holtite-A	Water, Holtite-A
g. Outside Surface Dose (mrem/hr)	ALARA	ALARA	ALARA

n/a denotes not applicable
[a]HI-TRAC 125D designed for use at Indian Point 1

Licensing Status

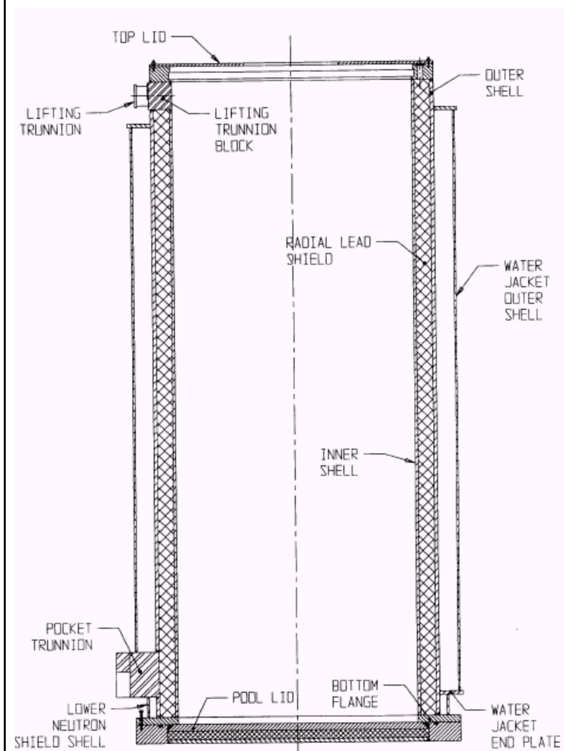
The HI-TRAC transfer cask is licensed for use under the HI-STORM storage system Certificate of Compliance 72-1014, Amendment 8, which expires on May 31, 2020.

Extent of Commercial Use (as of May 2013)

All sites using the HI-STORM system use the HI-TRAC transfer cask.

HI-TRAC Transfer Casks (Continued)

100 Ton HI-TRAC Transfer Cask



Cutaway View 100 Ton HI-TRAC Transfer Cask

125 Ton HI-TRAC Transfer Cask and Transporter

HI-TRAC Transfer Casks (Continued)

MPC Transfer Operation from HI-TRAC Transfer Cask to HI-STORM Storage Overpack

HI-STAR 100 Storage/Transport Overpack

Description

The HI-STAR 100 is the NRC-licensed off-site transportation cask for the HI-STORM storage system. HI-STAR 100 is fully compatible with the MPCs licensed for storage in the HI-STORM 100 and HI-STORM 100U systems. The MPCs can be removed intact from the HI-STORM storage overpack and loaded into the HI-STAR 100 transportation overpack, eliminating the need to repackage the used fuel prior to off-site transport.

See the section for the HI-STAR 100 Used Fuel Storage and Transport System for additional details.

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HI-STORM FW USED FUEL STORAGE SYSTEM

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Introduction

The HI-STORM FW (Holtec International Storage Module Flood and Wind) is Holtec International's next-generation, highest capacity Multi-Purpose Canister (MPC) system for the dry storage of used nuclear fuel. The HI-STORM FW is a storage and transport system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the Multi-Purpose Canister (MPC) concept, is comprised of the following components:

- Multi-Purpose Canisters (MPC)
- HI-TRAC Variable Weight (VW) On-Site Transfer Cask
- HI-STORM FW Storage Overpack
- HI-STAR 190 Storage/Transport Overpack (under development)

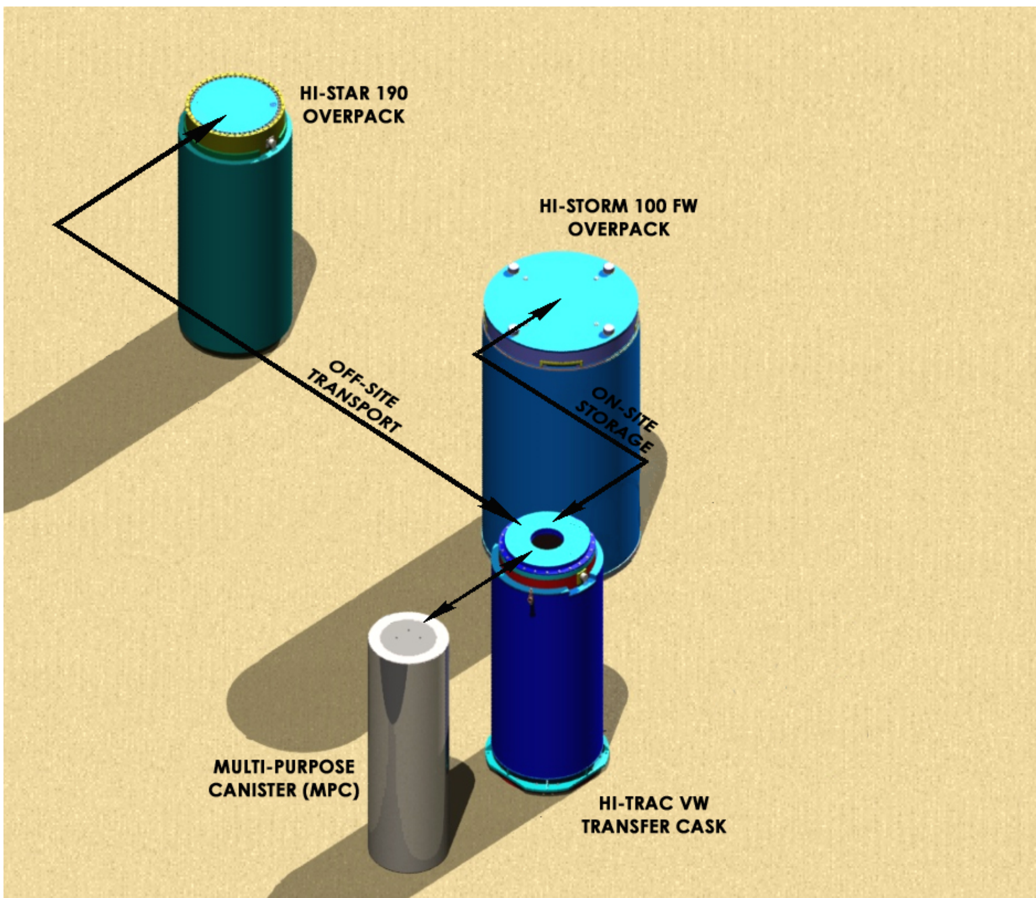
To load a system for storage, an empty MPC is placed within the HI-TRAC VW transfer cask, which is then lowered into the used fuel pool. The used fuel assemblies are loaded into the MPC and the MPC lid is installed while the transfer cask is submerged in the pool. The transfer cask is then removed from the pool and placed in the decontamination area where the MPC lid is seal-welded. The MPC is then drained, dried (either using a vacuum drying system or Holtec's Forced Helium Dehydrator), and backfilled with helium. The MPC closure ring is placed on the MPC and seal welded, providing redundant closure of the MPC lid.

The HI-TRAC VW transfer cask top lid is installed and the MPC/transfer cask is lifted vertically and placed on top of the HI-STORM FW storage overpack. The MPC is then raised slightly in order to remove the transfer door locking pins and open the transfer doors. The MPC is lowered into the HI-STORM FW storage overpack. The doors are then closed and the HI-TRAC VW transfer cask is lifted off the HI-STORM FW storage overpack. The HI-STORM FW storage overpack lid is then installed and the loaded HI-STORM FW storage overpack is transferred (vertical orientation) to the ISFSI storage pad by the Vertical Cask Transporter.

The following table and figure illustrates the compatibility among the components of the HI-STORM FW and HI-STAR 190 dry storage and transport systems. The HI-STAR 190 is currently under development (initial license application scheduled to be submitted to NRC by end of 2013) to function as the off-site transportation overpack for the HI-STORM FW storage system. As shown, the MPCs are compatible with both the HI-STORM FW (storage) overpack and the HI-STAR 190 (storage /transport) overpack. This compatibility eliminates the need to repackage the used fuel prior to off-site transport.

HI-STORM FW STORAGE SYSTEM

System	HI-STORM FW	HI-STORM FW
Function	Storage	Storage
Fuel Type	PWR	BWR
MPC	MPC-37	MPC-89
Storage Cask / Module	HI-STORM FW	HI-STORM FW
Transfer Cask	HI-TRAC VW	HI-TRAC VW
Transport Cask	HI-STAR 190 (under development)	HI-STAR 190 (under development)



HI-STORM FW/HI-STAR 190 Dry Storage/Transport System Compatibility

This section describes each component of the system, starting with the Multi-Purpose Canister.

The Multi-Purpose Canister

Description

The MPC is a welded, cylindrical, stainless steel canister that maintains the vertical configuration of the used nuclear fuel and is the confinement boundary between the fuel and the environment while permanently enclosing the used fuel assemblies for storage or transport. The MPCs licensed for use in the HI-STORM FW aboveground dry cask storage are the MPC-37 (PWR fuel) and MPC-89 (BWR fuel). The outer diameter of the MPC and HI-STORM FW overpack remains unchanged for either of the MPC configurations.

The sealed canister consists of a honeycombed fuel basket and a cylindrical canister shell, the MPC Enclosure Vessel. Metamic™-HT is the licensed neutron absorber and the structural material for the HI-STORM FW MPC fuel basket. The honeycombed fuel baskets provide criticality control, structural support, and heat removal features. Once loaded with used fuel and sealed, the MPC is placed in the appropriate purpose specific overpack – HI-STORM FW (storage) or HI-STAR 190 (off-site transport (under development)). One MPC is loaded per HI-STORM FW or HI-STAR 190 overpack.

The HI-STORM FW system utilizes the following MPC designs to accommodate storage and transport of varying contents:

Canister	Fuel Type	Capacity
MPC-37	PWR	37 openings, of which 12 can store damaged fuel or fuel debris
MPC-89	BWR	89 openings, of which 16 can store damaged fuel or fuel debris

The Multi-Purpose Canister (Continued)

Specifications[11,12]

Attribute	Type of Multi-Purpose Canister	
	MPC-37	**MPC-89**
a. Capacity (intact assemblies)	37 PWR	89 BWR
b. Maximum Weight (lb)		
Empty	40,500	36,600
Loaded	116,400	116,400
c. Thermal		
Design Heat Rejection (kW)		
HI-STORM FW Storage	47.05	46.36
HI-STAR 190 Transport	N/A	N/A
Max. Per Assy. Heat Load (kW)		
HI-STORM FW Storage	1.27	0.52
Maximum Burnup (GWD/MTU)		
HI-STORM FW Storage	68.2 (3 yr cooled)	65.0 (3 yr cooled)
HI-STAR 190 Transport	N/A	N/A
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length (Reference)	181	190
Cavity Length (Reference)	169	178
Cross Section (Cavity/Overall)	74.5/75.5	74.5/75.5
Wall Thickness	0.5	0.5
Lid Thickness	9	9
Bottom Thickness	3	3
Basket Length (Reference)	167.5	176.5
f. Materials of Construction		
Canister Body	SS	SS
Basket	Metamic™-HT	Metamic™-HT
Shield Plugs	SS	SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	5x10^{-6}	5x10^{-6}

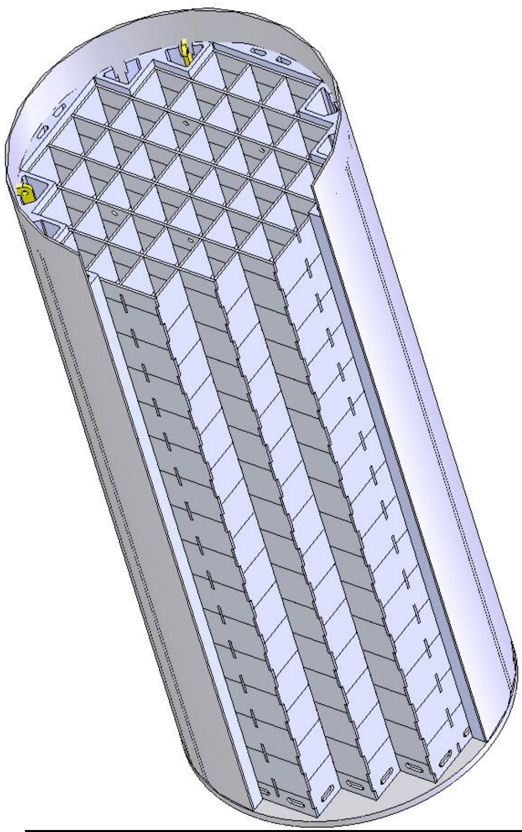
N/A denotes Not Available (HI-STAR 190 under development)

Licensing Status

The MPC-37 and MPC-89 are licensed for storage in the HI-STORM FW overpack under Certificate of Compliance 72-1032, Amendment 0 (2011), which expires on June 13, 2031. The MPC-37 and MPC-89 are not currently licensed for transport in the HI-STAR 190 overpack – the initial licensing submittal to the NRC for HI-STAR 190 is currently scheduled to occur by the end of 2013.

The Multi-Purpose Canister (Continued)

Metamic™-HT Basket



MPC-37

HI-STORM FW Storage Overpack

Description

The HI-STORM FW is an aboveground storage overpack that provides protection, shielding, and passive heat removal for the fuel laden MPCs (vertical position) during interim storage on an ISFSI pad. The unique steel-concrete-steel design affords the HI-STORM FW overpack the structural rigidity required to protect its radioactive contents against the most adverse accident events. Referred to as a METCON® structure (metal/concrete composite), the main structural function of the storage overpack is provided by carbon steel, and the main shielding function is provided by plain (unreinforced) concrete poured on-site in the annular space between the two carbon steel shells.

The HI-STORM FW consists of two major parts: (i) dual wall cylindrical container with a set of inlet ducts near its bottom extremity, and an integrally welded baseplate; and (ii) a removable top lid equipped with a radially symmetric exit vent. The overpack lid has appropriate concrete shielding to provide neutron and gamma attenuation to minimize skyshine.

By virtue of its geometry, the HI-STORM FW overpack provides enhanced performance related to seismic, flooding, and wind design basis.

HI-STORM FW Storage Overpack (Continued)

Specifications[11,12]

Attribute	HI-STORM FW Vertical Concrete Overpack
a. Capacity (MPC)	1
b. Weight (lb)	
Empty	Varies
Loaded w/MPC-37	425,700
Loaded w/MPC-89	425,700
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length (Reference)	207.75
Overall Cross Section	140
Cavity Length (Reference)	179
Cavity Cross Section	81
Wall Thickness	29
Lid Thickness	23.75
Bottom Thickness	3
e. Neutron Shield (in)	
Side Thickness (radially)	27.5
Lid Thickness	18.75
Bottom Thickness	N/A
f. Materials of Construction	
Cask Body	CS/Concrete
Neutron Shield	N/A
g. Outside Surface Dose (mrem/hr)	N/A
h. Maximum Leak Rate (atm-cm^3/sec)	per MPC

N/A denotes Not Available

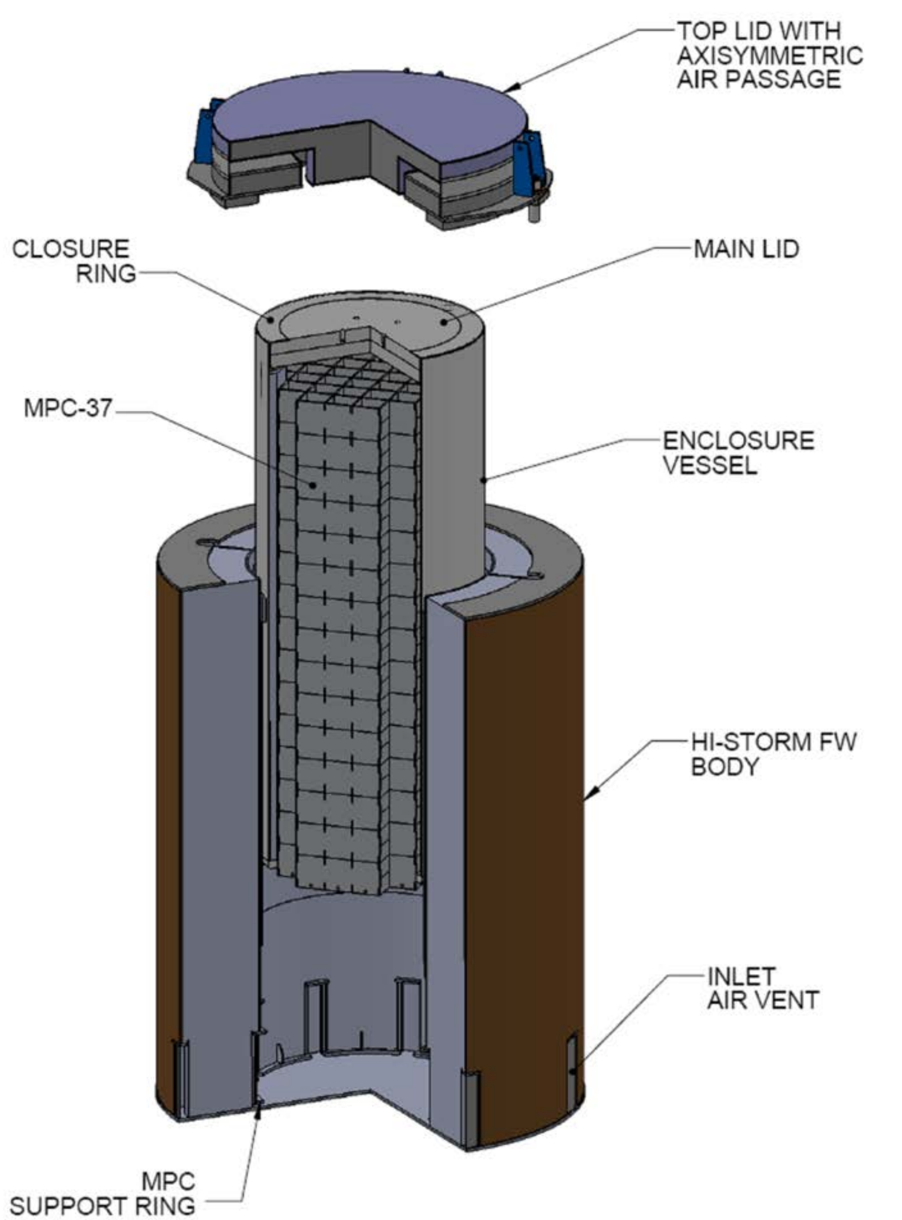
Licensing Status

The HI-STORM FW storage system is licensed under Certificate of Compliance 72-1032, Amendment 0 (2011), which expires on June 13, 2031.

Extent of Commercial Use

The HI-STORM FW dry cask storage system is not currently deployed. Holtec is currently contracted to deliver 39 HI-STORM FW systems from September 2013 through May 2015 to clients across the U.S. The first of these systems will be loaded with used nuclear fuel by the end of 2013.

HI-STORM FW Storage Overpack (Continued)



HI-STORM FW Cut-Away View

HI-TRAC VW Transfer Cask

Description

The Holtec International Transfer Cask Variable Weight (HI-TRAC VW) is the on-site transfer cask, or “shuttle cask”, for the HI-STORM FW overpack. The transfer cask provides structural support and radiation protection for the MPC during loading, unloading, and transfer operations. The variable weight feature incorporated in the HI-TRAC VW design enables the lead thickness shielding to be maximized for a crane lifting capacity up to 130 tons, optimizing the amount of shielding for the site’s cask handling crane capacity.

The HI-TRAC VW is a cylindrical cask with removable bottom and top lids. The transfer cask is used to load the MPC in the used fuel pool and transfer the MPC to the HI-STORM FW overpack. The HI-TRAC VW transfer cask can be mounted on top of a HI-STORM FW storage overpack or HI-STAR 190 off-site transportation overpack (under development) to deliver or retrieve an MPC.

The HI-TRAC VW consists of two major parts: (i) a cylindrical cask body made of three concentric shells; and (ii) a quick connect/disconnect bottom lid. The space between the innermost and the middle shell is occupied by lead, which provides the bulk of the cask’s radiation shielding capability and accounts for a major portion of its weight. Between the middle shell and the outermost shell is the space referred to as the water jacket. This annular space is filled with water, providing significant neutron shielding capability to the cask. The water jacket is outfitted with pressure release devices to prevent over-pressurization in the case of an abnormal event that causes the water mass to boil.

The HI-TRAC VW is a licensed component of the HI-STORM FW dry cask storage system.

HI-TRAC VW Transfer Cask (Continued)

Specifications[11,12]

Attribute	Transfer Cask
	HI-TRAC VW
a. Capacity (MPC)	1
b. Maximum Weight (lb)	
Empty (w/ max. lead shielding)	Varies
Loaded w/ MPC-37	270,000
Loaded w/ MPC-89	270,000
Empty (w/ min. lead shielding)	Varies
Loaded w/ MPC-37	186,000
Loaded w/ MPC-89	186,000
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length(Ref. PWR/BWR)	187.5/196.5
Nominal Cross Section (PWR/BWR)	95.75/95.25
Cavity Length (Ref. PWR/BWR)	176/185
Cavity Cross Section	76
Wall Thickness (PWR/BWR)	9.5/9.25
Top Lid Thickness	6
Bottom Thickness	5.5
e. Neutron Shield (in)	
Side Thickness	9
Top Lid Thickness	n/a
Bottom Thickness	n/a
f. Materials of Construction	
Cask Body	CS/Pb
Neutron Shield	Pb, Water Jacket or Holtite™ Jacket
g. Outside Surface Dose (mrem/hr)	4,403

n/a denotes not applicable

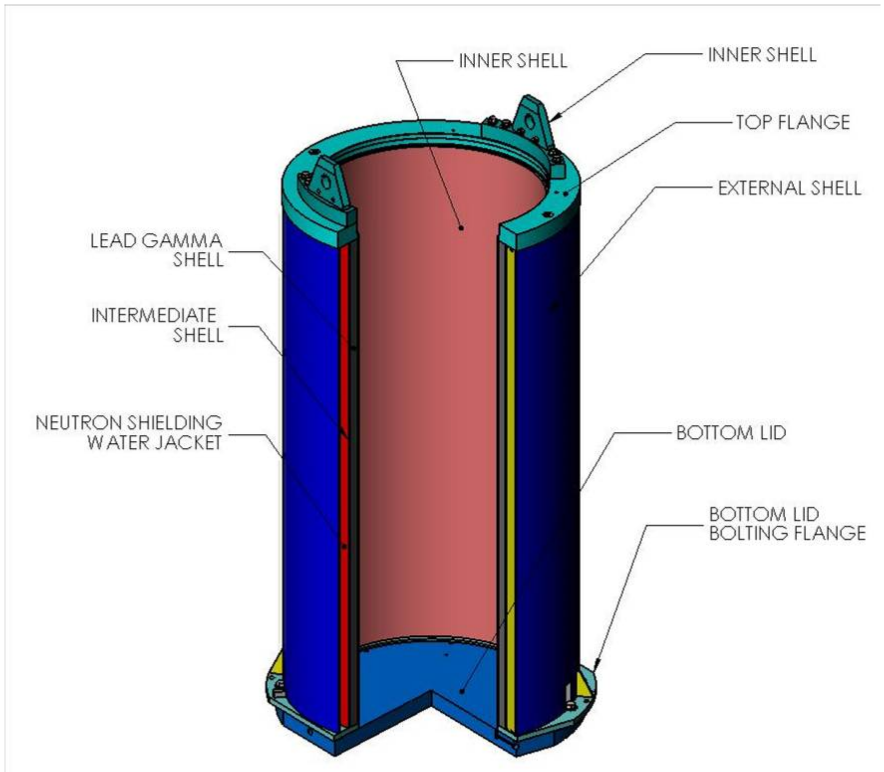
Licensing Status

The HI-TRAC VW transfer cask is licensed for use under the HI-STORM FW storage system Certificate of Compliance 72-1032, Amendment 0 (2011), which expires on June 13, 2031.

Extent of Commercial Use (as of May 2013)

All sites using the HI-STORM FW system will use the HI-TRAC VW transfer cask. (Note: The HI-STORM FW dry cask storage system is not currently deployed.)

HI-TRAC VW Transfer Cask (Continued)



HI-TRAC VW Cut-Away View

HI-STAR 190 Storage/Transport Overpack

Description

The HI-STAR 190 storage/transport system is currently being developed by Holtec International. The HI-STAR 190 overpack will be fully compatible with the MPCs (MPC-37/MPC-89) licensed for storage in the HI-STORM FW storage system. The MPCs can be removed intact from the HI-STORM FW overpack and loaded into the HI-STAR 190 transport overpack which eliminates the need to repackage the used fuel prior to off-site transport.

See the section for the HI-STAR 190 Used Fuel Storage and Transport System for additional details.

HI-STORM UMAX UNDERGROUND USED FUEL STORAGE SYSTEM

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Introduction

The HI-STORM UMAX is Holtec International's next-generation, highest capacity MPC underground system for the dry storage of used nuclear fuel. The HI-STORM UMAX is a storage and transport system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the MPC concept, is comprised of the following components:

- Multi-Purpose Canisters (MPC)
- HI-TRAC VW On-Site Transfer Cask
- HI-STORM UMAX Vertical Ventilated Module (VVM)
- HI-STAR 190 Storage/Transport Overpack (under development).

The HI-STORM UMAX is based on the robust design of HI-STORM 100U which is currently licensed in NRC Docket No. 72-1014. The major difference between the HI-STORM UMAX and 100U is the ability of the HI-STORM UMAX to store higher capacity MPCs, the MPC-37 and MPC-89. The HI-STORM UMAX was accepted for review by the NRC, and as of the date of this report, is in the final stage of licensing review.

To load the HI-STORM UMAX system for storage, an empty MPC is placed within the HI-TRAC VW transfer cask, and the transfer cask is then lowered into the used fuel pool. The used fuel assemblies are loaded into the MPC and the MPC lid is installed while the transfer cask is submerged in the pool. The transfer cask is then removed from the pool and placed in the decontamination area where the MPC lid is seal-welded. The MPC is then drained, dried (either using a vacuum drying system or Holtec's Forced Helium Dehydrator), and backfilled with helium. The MPC closure ring is placed on the MPC and seal welded, providing redundant closure of the MPC lid.

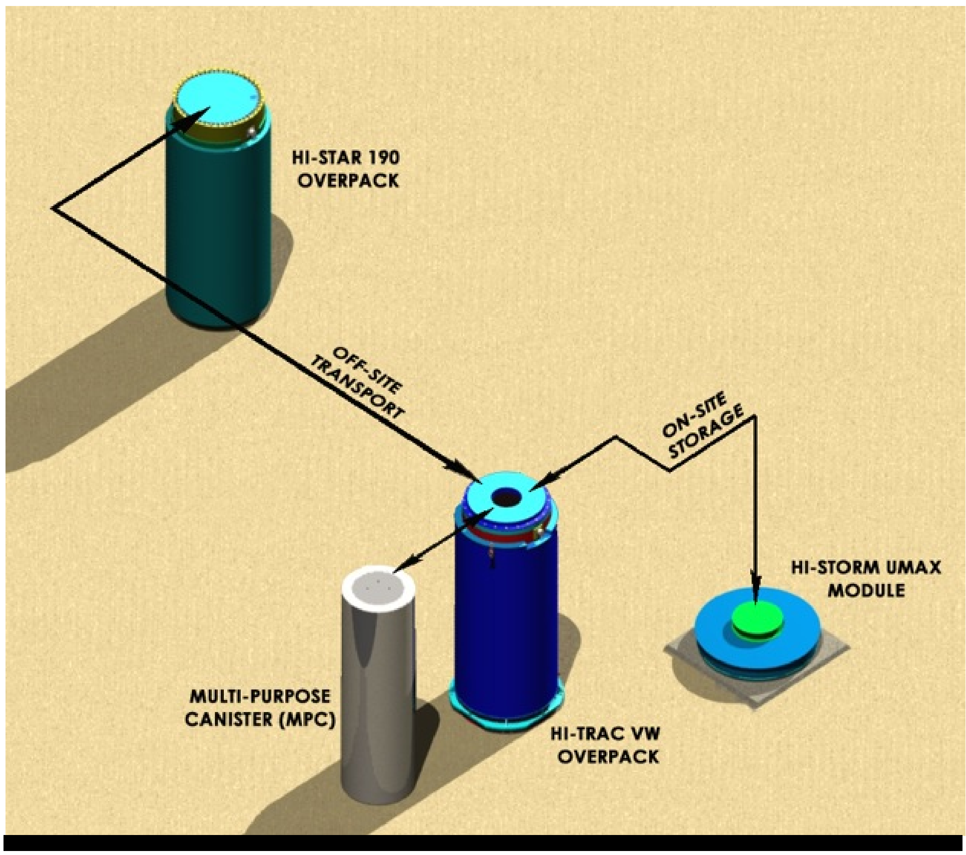
The HI-TRAC VW transfer cask top lid is installed and the MPC/transfer cask is transferred (vertical orientation) to the ISFSI storage pad by the VCT. The HI-TRAC VW transfer cask is placed on top of the HI-STORM UMAX VVM and the MPC is lowered into the Cavity Enclosure Container (CEC). The HI-TRAC VW transfer cask is then removed and the VVM lid is installed.

The following table and figure illustrates the compatibility among the components of the HI-STORM UMAX underground storage system. As shown, the MPCs will be compatible with both the HI-STORM UMAX VVM storage system and the HI-STAR 190 storage/transport overpack, which is currently under development. This compatibility will eliminate the need to repackage the used fuel prior to off-site transport.

HI-STORM UMAX UNDERGROUND USED FUEL STORAGE SYSTEM

HI-STORM UMAX STORAGE SYSTEM

System	HI-STORM UMAX	HI-STORM UMAX
Function	Storage	Storage
Fuel Type	PWR	BWR
MPC	MPC-37	MPC-89
Storage Cask / Module	HI-STORM UMAX VVM	HI-STORM UMAX VVM
Transfer Cask	HI-TRAC VW	HI-TRAC VW
Transport Cask	HI-STAR 190 (under development)	HI-STAR 190 (under development)



HI-STORM UMAX/HI-STAR System

This section describes each component of the system, starting with the Multi-Purpose Canister.

The Multi-Purpose Canister

Description

The MPC is a welded, cylindrical, stainless steel canister that maintains the vertical configuration of the used nuclear fuel and is the confinement boundary between the fuel and the environment while permanently enclosing the used fuel assemblies for storage or transport. The same MPCs licensed for storage in the HI-STORM FW overpack (MPC-37, -89) can be stored in the HI-STORM UMAX VVM. One MPC is loaded per HI-STORM UMAX VVM.

See HI-STORM FW Used Fuel Storage System section for additional description and details of the MPCs compatible with the HI-STORM UMAX storage system.

HI-STORM UMAX Underground Vertical Ventilated Module

Description

The HI-STORM UMAX Vertical Ventilated Module (VVM) is a subsurface storage system designed to accommodate all NRC licensed Holtec MPCs, but the pending license application only includes MPC-37 and MPC-89. Each HI-STORM UMAX VVM provides storage of one MPC in a vertical configuration inside a cylindrical cavity located entirely below-grade.

The MPC storage cavity is defined by the welded steel shell CEC. The CEC is a closed bottom, open top, thick walled cylindrical vessel that has no penetrations or openings. The closure lid completes the physical embodiment of the HI-STORM UMAX VVM once the loaded MPC is placed inside the CEC. In its installed configuration, the CEC interfaces with the surrounding subgrade for most of its height. The bottom of the CEC sits on the Support Foundation Pad and the HI-STORM UMAX VVM closure lid sits on top of the ISFSI surface pad (consisting of both the VVM Interface Pad and the Top Surface Pad).

The HI-STORM UMAX storage system is designed to be fully compatible with the HI-TRAC transfer casks for MPC transfer operations. Independent used fuel storage installations (ISFSIs) employing the HI-STORM UMAX may be designed for any number of MPCs and expanded to add additional storage modules as the need arises. The design of the storage array allows for any MPC located in a VVM to be independently accessed and retrieved using the HI-TRAC On-Site Transfer Cask.

Holtec is also planning to develop/license a new system called the HI-STORM CIS (Holtec International Storage Module Consolidated Interim Storage). The HI-STORM CIS is envisioned to be a double capacity HI-STORM UMAX. In this next generation underground storage design, the HI-STORM CIS VVM will store two MPCs stacked vertically. The HI-STORM CIS is also envisioned to be able to accommodate all canisters supplied by industry vendors.

HI-STORM UMAX Underground Vertical Ventilated Module (Continued)

Specifications[13]

Attribute	HI-STORM UMAX VVM
a. Capacity (MPC)	1
b. Weight (lb)	
Empty	28,375
Loaded w/ MPC-37 (closed lid)	173,375
Loaded w/ MPC-89 (closed lid)	173,375
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length (Ref. PWR/BWR)	297.125/306.13
Overall Cross Section	101.5
Cavity Length (Ref. PWR/BWR)	181/190
Cavity Cross Section	86
Wall Thickness	7.75
Lid Thickness	92.125
Bottom Thickness	1.5
e. Neutron Shield (in)	
Side Thickness	n/a
Lid Thickness	38.5
Bottom Thickness	n/a
f. Materials of Construction	
VVM	CS/Concrete
Neutron Shield	Concrete
g. Outside Surface Dose (mrem/hr)	37.99
h. Maximum Leak Rate (atm-cm^3/sec)	5 x 10^{-6}

n/a denotes not applicable

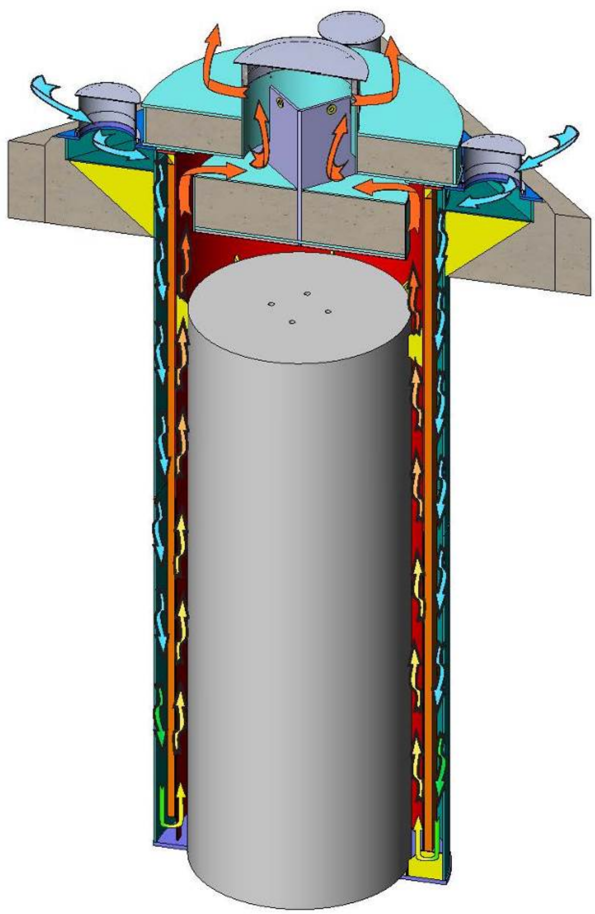
Licensing Status

The HI-STORM UMAX is pending approval from the U.S. Nuclear Regulatory Commission. Holtec submitted a new Safety Analysis Report (SAR) for HI-STORM UMAX in June 2012. The HI-STORM UMAX application was accepted by the NRC (Docket Number 72-1040) and is currently under review.

Extent of Commercial Use

HI-STORM UMAX is not currently in use. The first HI-STORM UMAX installation is scheduled to be loaded with fuel laden MPCs by 2016.

HI-STORM UMAX Underground Vertical Ventilated Module (Continued)



HI-STORM UMAX Air Flow Diagram

HI-TRAC Transfer Cask

Description

The HI-TRAC VW transfer cask is the on-site transfer cask, or “shuttle cask”, for the HI-STORM UMAX VVM. The HI-TRAC VW transfer cask provides structural support and radiation protection for the MPC during loading, unloading, and transfer operations.

See the HI-STORM FW Used Fuel Storage System section for additional details on the HI-TRAC VW transfer cask.

HI-STAR 190 Storage/Transport Overpack

Description

The HI-STAR 190 storage/transport system is currently being developed by Holtec International. The HI-STAR 190 overpack will be an off-site transport cask for the high capacity MPCs (MPC-37/MPC-89) licensed for storage in the HI-STORM UMAX storage system.

The MPCs can be removed intact from the HI-STORM UMAX VVM and loaded directly into the HI-STAR 190 transport overpack which eliminates the need to repackage the used fuel prior to off-site transport.

See the HI-STAR 190 Used Fuel Storage and Transport System section for additional details on the HI-STAR 190 transport overpack.

HI-STAR 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

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Introduction

The HI-STAR 100 (Holtec International Storage, Transport & Repository) storage and transport system, designed and fabricated by Holtec International, is a storage and off-site transport system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the MPC concept, is comprised of the following components:

- Multi-Purpose Canisters (MPC)
- HI-STAR 100 Storage/Transport Overpack.

The HI-STAR 100 storage/transport overpack serves the dual-purpose of on-site storage and off-site transport of used nuclear fuel. In the storage application, the HI-STAR 100 overpack is loaded with an MPC containing used fuel and placed on an aboveground ISFSI storage pad. In the transportation mode, the HI-STAR overpack is loaded on a rail car and impact limiters are attached prior to off-site transport of package.

To load the system for storage or transport, an empty MPC is placed within the HI-STAR 100 overpack, which is then lowered into the used fuel pool without closure plate and MPC lid. The used fuel assemblies are loaded into the MPC and the MPC lid is installed while the HI-STAR overpack is submerged in the pool. The HI-STAR overpack/MPC is then moved to the designated preparation area and the MPC lid is welded in place, examined, pressure tested, and leak tested. The MPC is dewatered, dried, backfilled with helium, and the vent / drain port cover plates and closure ring are welded. The MPC closure ring is then placed on the MPC and seal welded, providing redundant closure of the MPC enclosure vessel closure welds. The HI-STAR overpack annulus is drained and the overpack closure plate is installed and bolts are torqued. The HI-STAR overpack annulus is dried using the vacuum drying system. The overpack annulus is then backfilled with helium gas and then leak tested. The HI-STAR overpack is then surveyed for removable contamination and prepared for transport either to on-site ISFSI storage pad or directly to off-site storage/disposal location. The HI-STAR system's ability to both store and transport used nuclear fuel eliminates repackaging of the MPC's and/or the fuel assemblies.

The following table illustrates the compatibility among the components of the HI-STAR storage and transport system.

HI-STAR 100 STORAGE AND TRANSPORT SYSTEM

System	HI-STAR 100	HI-STAR 100	HI-STAR 100HB
Function	Storage & Transport	Storage & Transport	Storage & Transport
Fuel Type	PWR	BWR	BWR
MPC	MPC-24, 24E*, 24EF*, & 32*	MPC-68, & -68F	MPC-HB*
Storage Cask / Module	HI-STAR 100	HI-STAR 100	HI-STAR 100HB
Transfer Cask	n/a	n/a	n/a
Transport Cask	HI-STAR 100	HI-STAR 100	HI-STAR 100HB

n/a denotes not applicable
*MPC-24E, -24EF, -32, and -HB are not generically licensed for storage, but are licensed for transport under Certificate of Compliance 71-9261.

This section describes each component of the system, starting with the MPCs.

HI-STAR 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

The Multi-Purpose Canister

Description

The MPC is a welded, cylindrical, stainless steel canister that maintains the vertical configuration of the used nuclear fuel and is the confinement boundary between the fuel and the environment while permanently enclosing the used fuel assemblies for storage or transport. The sealed canister consists of a honeycombed fuel basket and a cylindrical canister shell, the MPC Enclosure Vessel. The honeycombed fuel basket is constructed from stainless steel and utilizes Holtec fabricated B_4C based panels as the neutron absorber. The honeycombed fuel baskets provide criticality control, structural support, and heat removal features. Once loaded with used fuel and sealed, the MPC is placed in the HI-STAR storage and transport overpack. One MPC is loaded per HI-STAR overpack.

The HI-STAR system utilizes multiple MPC designs to accommodate storage and transport of varying contents:

Canister	Fuel Type	Capacity
MPC-24	PWR	24 fuel assemblies (intact) with or without non-fuel hardware
MPC-24E / 24EF	PWR	24 openings, of which 4 can store damaged fuel or fuel debris (specific for Trojan used fuel)
MPC-32	PWR	32 fuel assemblies (intact) with or without non-fuel hardware
MPC-68	BWR	68 openings, of which 16 can store damaged fuel or fuel debris and up to 8 damaged fuel containers containing fuel debris in certain locations
MPC-68F	BWR	68 openings, of which 4 can store damaged fuel or fuel debris (specific for Dresden Unit 1 used fuel)
MPC-HB	BWR	80 openings, of which 40 can store damaged fuel or fuel debris in certain locations (specific for Humboldt Bay used fuel)

The Multi-Purpose Canister (Continued)

Specifications[14,16]

Attribute	Type of Multi-Purpose Canister	
	MPC-24	**MPC-24E/-24EF***
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Maximum Weight (lb)		
Empty	42,000	45,000
Loaded	90,000	90,000
c. Thermal		
Design Heat Rejection (kW)		
HI-STAR Storage	19.0	N/A
HI-STAR Transport	20.0	20.0
Max. Per Assy. Heat Load (kW)		
HI-STAR Storage	0.792	N/A
HI-STAR Transport	0.833	0.833
Maximum Burnup (GWD/MTU)		
HI-STAR Storage	38.2 (10 yr cooled)	N/A
HI-STAR Transport	37.0 (10 yr cooled)	37.0 (10 yr cooled)
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	190.3	190.3
Cavity Length	178.3	178.3
Cross Section	68.5	68.5
Wall Thickness	0.5	0.5
Lid Thickness	9.5	9.5
Bottom Thickness	2.5	2.5
Basket Length	176.5	176.5
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/Boral/Al	SS/Metamic®/Al
Shield Plugs	SS	SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	5 x 10^{-6}	5 x 10^{-6}

N/A denotes Not Available
*MPC-24E/24EF is licensed specifically for Trojan used fuel

Licensing Status

The MPC-24 is licensed for storage within the HI-STAR overpack under Certificate of Compliance 72-1008, Amendment 2, which expires on October 4, 2019. The MPC-24, -24E, and -24EF are licensed for transport within the HI-STAR overpack under Certificate of Compliance 71-9261, Revision 8, which expires on March 31, 2014.

The Multi-Purpose Canister (Continued)

Specifications[14,16]

Attribute	Type of Multi-Purpose Canister	
	MPC-32	**MPC-68/-68F***
a. Capacity (intact assemblies)	32 PWR	68 BWR
b. Weight (lb)		
Empty	36,000	39,000
Loaded	90,000	90,000
c. Thermal		
Design Heat Rejection (kW)		
HI-STAR Storage	N/A	18.5
HI-STAR Transport	20	18.5
Max. Per Assy. Heat Load (kW)		
HI-STAR Storage	N/A	0.272
HI-STAR Transport	0.625	0.272
Maximum Burnup (GWD/MTU)		
HI-STAR Storage	N/A	33.8 (10 yr cooled)
HI-STAR Transport	31.2 (10 yr cooled)	32.0 (10 yr cooled)
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	190.3	190.3
Cavity Length	178.3	178.3
Cross Section	68.5	68.5
Wall Thickness	0.5	0.5
Lid Thickness	9.5	9.5
Bottom Thickness	2.5	2.5
Basket Length	176.5	176.0
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/Boral/Al	SS/Boral/Al
Shield Plugs	SS	SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	5×10^{-6}	5×10^{-6}

N/A denotes Not Available
*MPC-68F is licensed specifically for Dresden Unit 1 used fuel

Licensing Status

The MPC-68 and -68F are licensed for storage within the HI-STAR overpack under Certificate of Compliance 72-1008, Amendment 2, which expires on October 4, 2019. The MPC-32, -68, and -68F are licensed for transport within the HI-STAR overpack under Certificate of Compliance 71-9261, Revision 8, which expires on March 31, 2014.

The Multi-Purpose Canister (Continued)

Specifications[14,16]

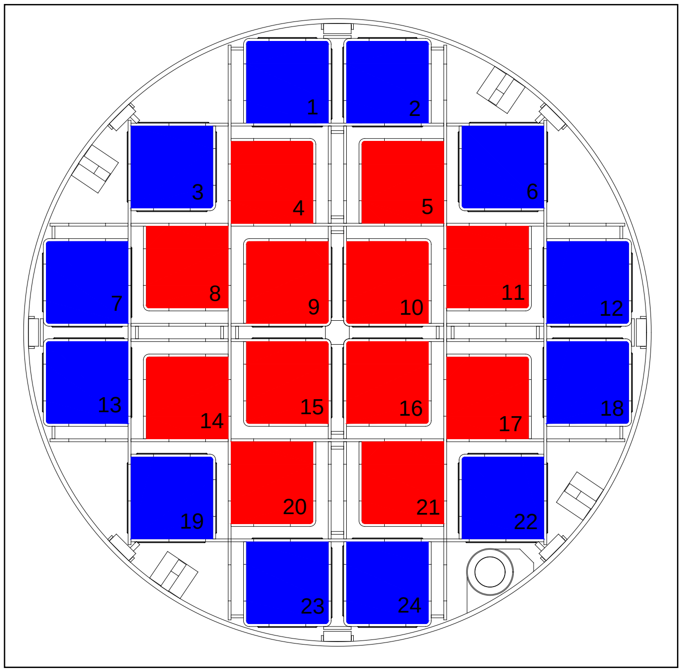
Attribute	Type of Multi-Purpose Canister
	MPC-HB*
a. Capacity (intact assemblies)	80 BWR
b. Weight (lb)	
Empty	27,000
Loaded	59,000
c. Thermal	
Design Heat Rejection (kW)	
HI-STAR Storage	2.0
HI-STAR Transport	2.0
Max. Per Assy. Heat Load (kW)	
HI-STAR Storage	0.05
HI-STAR Transport	0.05
Avg. Burnup per Assembly (GWD/MTU)	
HI-STAR Storage	23 (greater than 29 yrs. cooled)
HI-STAR Transport	23 (greater than 29 yrs. cooled)
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	114.7
Cavity Length	106
Cross Section	68.5
Wall Thickness	0.5
Lid Thickness	9.5
Bottom Thickness	2.5
Basket Length	N/A (Proprietary)
f. Materials of Construction	
Canister Body	SS
Basket	SS/Boral/Al
Shield Plugs	SS
g. Cavity Atmosphere	He
h. Maximum Leak Rate (atm-cm^3/sec)	5 x 10^{-6}

N/A denotes Not Available
*MPC-HB is licensed specifically for Humboldt Bay used fuel in the HI-STAR HB

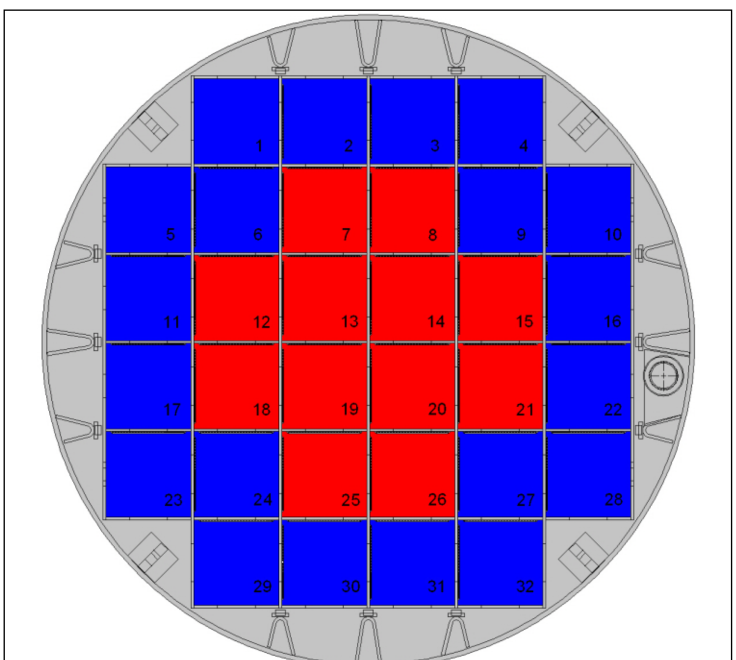
Licensing Status

The MPC-HB is licensed for storage within the HI-STAR HB overpack under NRC Storage Material License SNM-2514, Humboldt Bay site-specific ISFSI, which expires on November 7, 2025. The MPC-HB is licensed for transport within the HI-STAR HB overpack under Certificate of Compliance 71-9261, Revision 8, which expires on March 31, 2014.

The Multi-Purpose Canister (Continued)



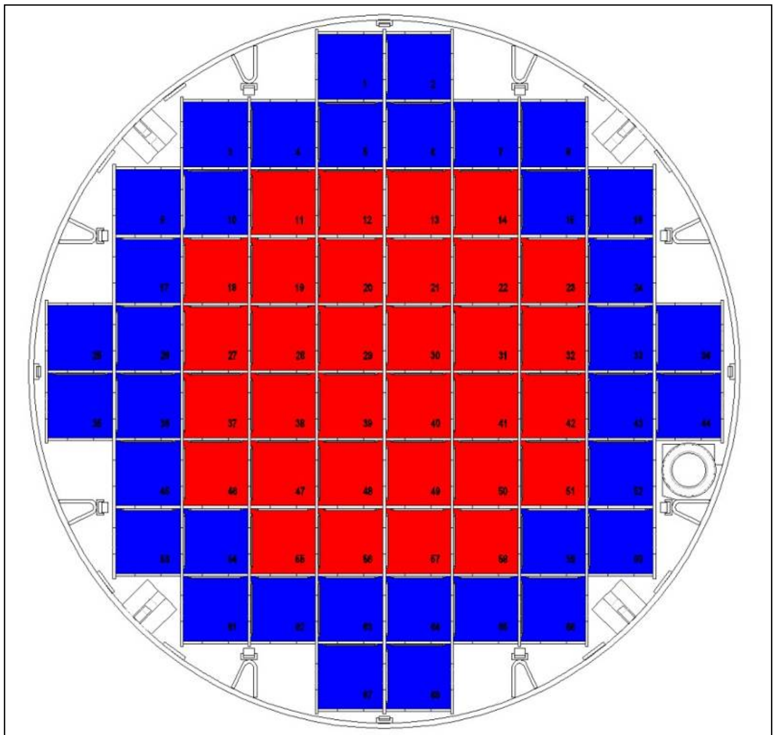
Cross-Section of MPC-24 Showing Regionalized Loading



Cross-Section of MPC-32 Showing Regionalized Loading

HI-STAR 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

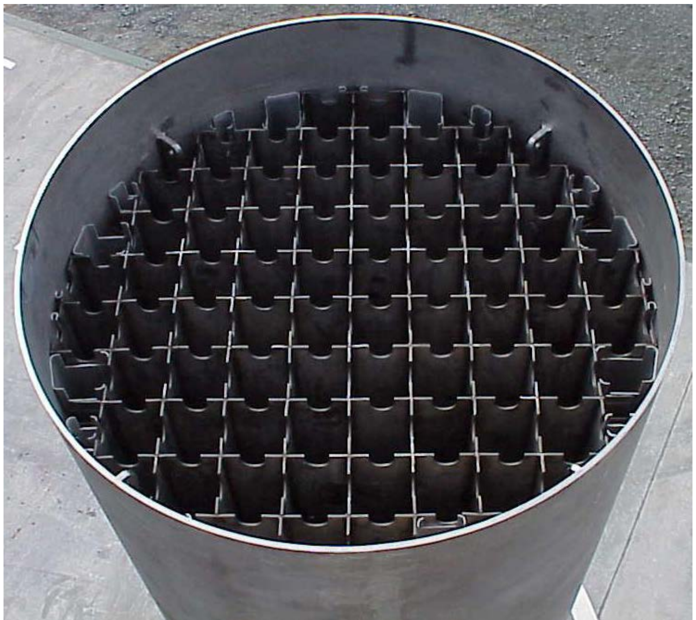
The Multi-Purpose Canister (Continued)



Cross-Section of MPC-68 Showing Regionalized Loading

- ■ Represents Older (Lower Dose) Fuel Assemblies
- ■ Represents Younger (Higher Dose) Fuel Assemblies

The Multi-Purpose Canister (Continued)



Top View of the MPC-68

HI-STAR 100 USED FUEL STORAGE AND TRANSPORT SYSTEM

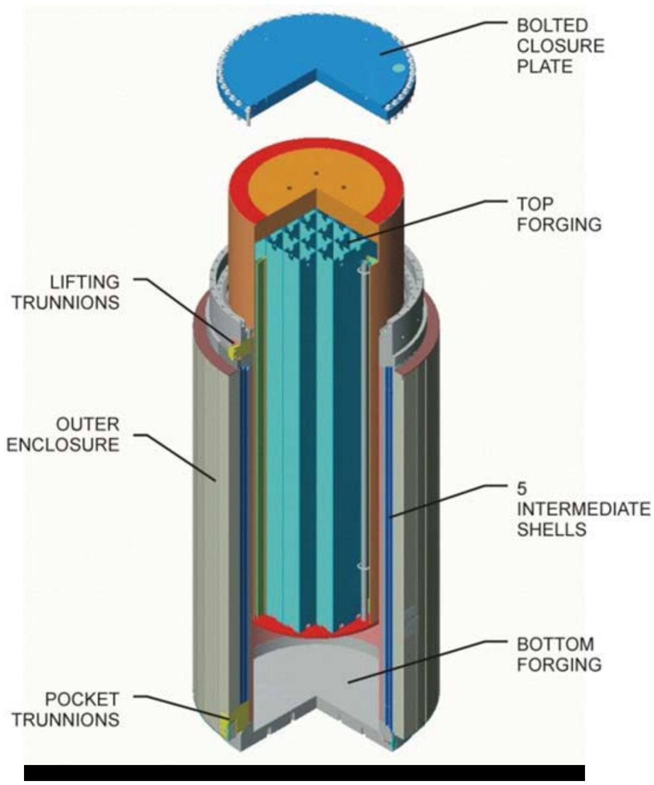
HI-STAR 100 Storage/Transport Overpack

Description

The HI-STAR 100 is a heavy-walled steel cylindrical cask licensed for the storage and transport of MPCs. The overpack containment boundary is formed by a steel inner shell welded at the bottom to a bottom plate and, at the top, to a heavy top flange with a bolted closure plate. The containment boundary forms an internal cylindrical cavity for housing the MPC.

The outer surface of the overpack inner shell is buttressed with intermediate shells of gamma shielding. Besides serving as an effective gamma shield, these layers provide additional strength to the overpack to resist puncture or penetration. Radial channels, filled with neutron shielding, are vertically welded to the outermost intermediate shell and act as fins for improved heat conduction.

The exposed steel surfaces (except seal seating surfaces) of the overpack and the intermediate shell layers are coated to prevent corrosion. Lifting trunnions are attached to the overpack top flange for lifting and rotating the cask body between vertical and horizontal positions.



Cut-Away View of HI-STAR 100

HI-STAR 100 Storage/Transport Overpack (Continued)

Specifications[14,15,16]

Attribute	HI-STAR 100 Storage/Transport Overpack	HI-STAR 100HB* Storage/Transport Overpack
a. Capacity (MPC)	1	1
b. Maximum Weight (lb)		
Empty, w/o Impact Limiters	153,710	102,200
Impact Limiters (2)	26,000	26,000
Loaded w/ MPC-24 (w/Impact Limiters)	272,622	n/a
Loaded w/ MPC-24E, -24EF (w/Impact Limiters)	275,316	n/a
Loaded w/ MPC-32 (w/Impact Limiters)	279,893	n/a
Loaded w/ MPC-68, -68F (w/Impact Limiters)	277,299	n/a
Loaded w/ MPC-HB (w/Impact Limiters)	n/a	187,200
c. Shape	Cylindrical	Cylindrical
d. Dimensions (in)		
Overall Length	203.1	128.0
Overall Cross Section	96.0	96.0
Cavity Length	191.1	115.0
Cavity Cross Section	68.8	68.8
Wall Thickness	13.6	13.6
Lid Thickness	6.0	6.0
Bottom Thickness	12.0	12.0
e. Neutron Shield (in)		
Side Thickness	4.44	4.44
Lid Thickness	n/a	n/a
Bottom Thickness	n/a	n/a
f. Materials of Construction		
Cask Body	Steel	Steel
Neutron Shield	Holtite	Holtite
g. Outside Surface Dose (mrem/hr)	<1000 @ surface, <200 (contact) , <10 (at 2m)	<1000 @ surface, <200 (contact) , <10 (at 2m)
h. Maximum Leak Rate (atm-cm^3/sec)	4.3×10^{-6}	4.3×10^{-6}

n/a denotes not applicable
N/A denotes Not Available
*HI-STAR 100HB is licensed specifically for Humboldt Bay used fuel

Licensing Status

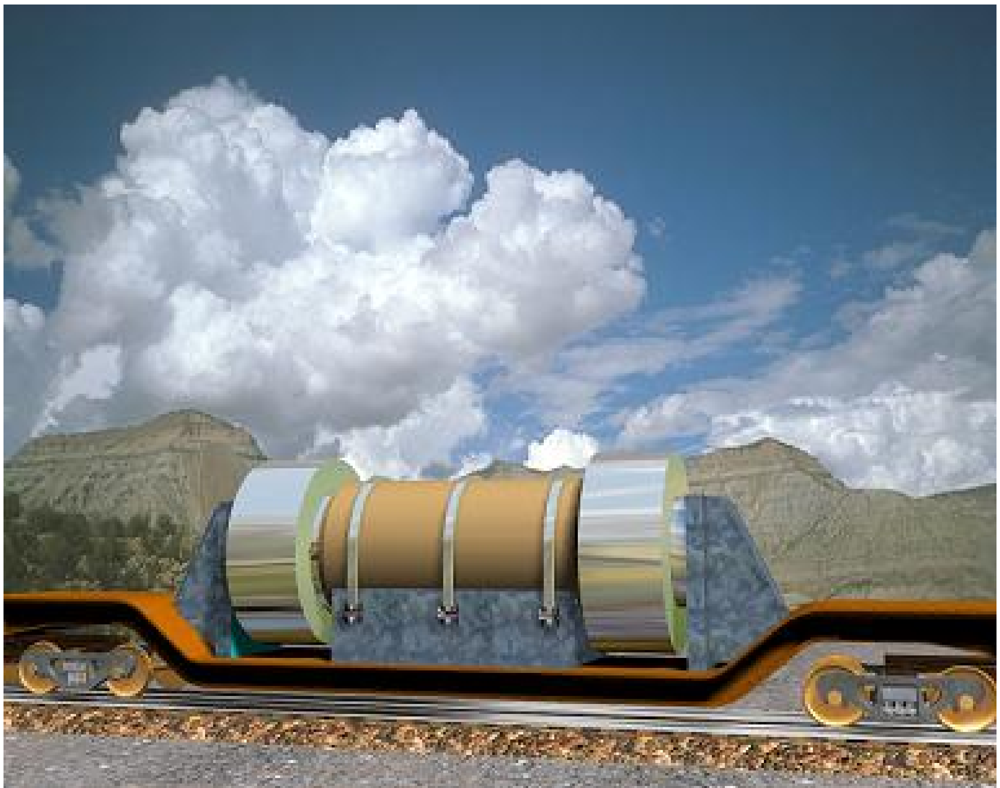
The HI-STAR 100 overpack is licensed for storage under Certificate of Compliance 72-1008, Amendment 2, which expires on October 4, 2019. The HI-STAR 100 overpack is licensed for transport under Certificate of Compliance 71-9261, Revision 8, which expires on March 30, 2014. The HI-STAR 100HB overpack is licensed for storage under NRC Storage Material License SNM-2514, Humboldt Bay site-specific ISFSI (subterranean configuration), which expires on November 7, 2025. The HI-STAR 100HB overpack is licensed for transport under Certificate of Compliance 71-9261, Revision 8, which expires on March 30, 2014.

Extent of Commercial Use

Twelve HI-STAR 100 casks are currently loaded and in interim storage at domestic NPPs. The HI-STAR 100 has not been used to transport used fuel in the U.S. (as of publication date).

HI-STAR 100 Storage/Transport Overpack (Continued)

HI-STAR 100 Overpacks in Interim Storage at a Domestic ISFSI



HI-STAR 100 Overpack with Impact Limiters

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HI-STAR 190 USED FUEL STORAGE AND TRANSPORT SYSTEM

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Introduction

The HI-STAR 190 storage and transport system, currently being developed by Holtec International, is the next-generation high capacity MPC system for the dry storage and off-site transport of used nuclear fuel. The HI-STAR 190 system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the MPC concept, is comprised of the following components:

- Multi-Purpose Canisters (MPC)
- HI-STAR 190 Storage/Transport Overpack.

The HI-STAR 190 storage/transport overpack serves the dual purpose of on-site storage and off-site transport of used nuclear fuel. In the storage application, the HI-STAR overpack is loaded with an MPC containing used fuel and placed on an aboveground ISFSI storage pad. In the transportation mode, the HI-STAR overpack is loaded on a rail car and impact limiters are attached prior to off-site transport of the overpack.

The HI-STAR 190 system is fully compatible with the MPCs licensed for storage in the HI-STORM FW system (MPC-37 (PWR fuel) and MPC-89 (BWR Fuel). The HI-STAR 190 system's ability to both store and transport used nuclear fuel eliminates repackaging of the MPC's and/or fuel assemblies.

The following table illustrates the compatibility among the components of the HI-STAR 190 storage and transport systems.

HI-STAR 190 STORAGE AND TRANSPORT SYSTEM

System	HI-STAR 190 (Under Development)	HI-STAR 190 (Under Development)
Function	Storage & Transport	Storage & Transport
Fuel Type	PWR	BWR
MPC	MPC-37	MPC-89
Storage Cask/Module	HI-STAR 190	HI-STAR 190
Transfer Cask	n/a	n/a
Transport Cask	HI-STAR 190	HI-STAR 190

n/a denotes not applicable

This section describes each component of the system, starting with the Multi-Purpose Canister.

HI-STAR 190 USED FUEL STORAGE AND TRANSPORT SYSTEM

The Multi-Purpose Canister

Description

The MPC is a welded, cylindrical, stainless steel canister that maintains the vertical configuration of the used nuclear fuel and is the confinement boundary between the fuel and the environment while permanently enclosing the used fuel assemblies for storage or transport. The MPCs that will be included in the license application for use in the HI-STAR 190 storage and transport system are the MPC-37 (PWR fuel) and MPC-89 (BWR fuel). The outer diameter of the MPC and HI-STAR 190 overpack remains unchanged for either of the MPC configurations.

The sealed canister consists of a honeycombed fuel basket and a cylindrical canister shell, the MPC Enclosure Vessel. Metamic™-HT is the licensed neutron absorber and the structural material for the HI-STAR 190 MPC fuel basket. The honeycombed fuel baskets provide criticality control, structural support, and heat removal features. Once loaded with used fuel and sealed, the MPC is placed in the HI-STAR 190 storage and transport overpack. One MPC is loaded per HI-STAR 190 overpack.

The HI-STAR 190 system utilizes the MPC-37 and MPC-89 designs to accommodate storage and transport of varying contents. See the HI-STORM FW Used Fuel Storage and Transport section for the description and specification details regarding the MPC-37 and MPC-89.

The Multi-Purpose Canister (Continued)

Specifications

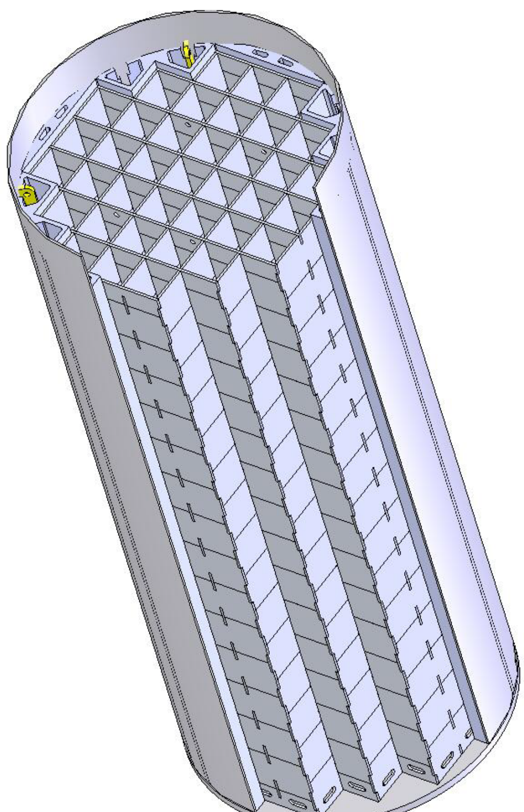
HI-STAR 190 is currently under development, see the HI-STORM FW Used Fuel Storage and Transport System section for MPC-37 and MPC-89 specifications.

Licensing Status

The MPC-37 and MPC-89 are not currently licensed for storage or transport in the HI-STAR 190 overpack – the initial submittal to the U.S. Nuclear Regulation Commission for HI-STAR 190 system is currently scheduled to occur by the end of 2013.

The Multi-Purpose Canister (Continued)

Metamic™-HT Basket



MPC-37 Schematic

Holtec International

HI-STAR 190 USED FUEL STORAGE AND TRANSPORT SYSTEM

HI-STAR 190 Storage/Transport Overpack

Description

The HI-STAR 190 is a heavy-walled steel cylindrical cask licensed for the storage and transport of MPCs. The HI-STAR 190 system physically contains the used nuclear fuel within an inert, isolated environment during transfer, storage, and transport operations. The HI-STAR 190 overpack provides a physical barrier to protect the MPCs under Design Basis threats and Beyond Design Basis threats. The overpack provides protection against release of radionuclides and is designed to passively remove heat generated from the stored fuel.

Specifications

Attribute	HI-STAR 190 Storage/Transport Overpack*
a. Capacity (MPC)	1
b. Weight (lb)	
Empty	N/A
Loaded w/ MPC-37	N/A
Loaded w/ MPC-89	N/A
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length	N/A
Overall Cross Section	N/A
Cavity Length	N/A
Cavity Cross Section	N/A
Wall Thickness	N/A
Lid Thickness	N/A
Bottom Thickness	N/A
e. Neutron Shield (in)	
Side Thickness	N/A
Lid Thickness	N/A
Bottom Thickness	N/A
f. Materials of Construction	
Cask Body	N/A
Neutron Shield	N/A
g. Outside Surface Dose (mrem/hr)	N/A
h. Maximum Leak Rate (atm-cm^3/sec)	N/A

N/A denotes Not Available
*HI-STAR 190 Storage/Transport Overpack is currently under development

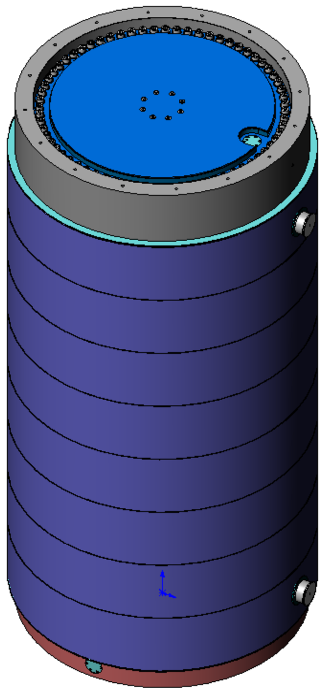
Licensing Status

The HI-STAR 190 storage/transport system is not currently licensed – the initial submittal to the U.S. Nuclear Regulatory Commission for HI-STAR 190 is currently scheduled to occur by the end of 2013.

Extent of Commercial Use

The HI-STAR 190 storage and transport system is not currently in use.

HI-STAR 190 Storage/Transport Overpack (Continued)



HI-STAR 190 Storage & Transport Overpack (Conceptual Rendering)

NAC-MPC USED FUEL STORAGE AND TRANSPORT SYSTEM

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC-MPC system, designed and built by NAC International, is a storage and transport system that provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the Multi-Purpose Canister (MPC) concept, is comprised of the following components:

- Transportable Storage Canisters (TSC)
- Vertical Concrete Cask (VCC)
- Transfer Cask
- NAC-STC Transport Cask

The NAC-MPC concept is to load nuclear fuel into a canister and then handle the canister as a distinct unit until disposal or final packaging for disposal in a geologic repository. From a high level operational standpoint, the NAC-MPC is similar to other MPC systems.

To load a system for storage, an empty TSC is placed within the transfer cask. The canister and annulus are then filled with water and lowered into the fuel pool. Used fuel assemblies are loaded into the canister and a crane is used to place the shield lid in the top of the canister. The transfer cask is moved to the decontamination area and the shield lid is welded to the canister. A suction pump is used to drain water from the canister and the canister is then vacuum dried and backfilled with helium. The vent and drain port covers are welded to the shield lid and the structural lid is then installed and welded to the canister.

With the VCC located on a heavy-haul trailer or on the floor of the work area, a transfer adapter is placed upon the top of the concrete cask. The loaded transfer cask is raised and positioned in the transfer adapter on top of the concrete cask. Using a crane, the canister is lifted slightly to take the canister weight off of the transfer cask bottom doors. Using the hydraulic system, the bottom doors are opened and the canister is lowered using the crane. The transfer cask is removed, the shield plug is installed above the canister, and the concrete cask lid is installed. The loaded concrete cask is then transported to the storage pad.

The NAC-MPC system uses the NAC-STC overpack for off-site transportation of TSCs. The NAC-STC can also be used for the transportation of directly-loaded, intact PWR fuel assemblies.

This section describes each component of the system, starting with the TSCs.

NAC-MPC USED FUEL STORAGE AND TRANSPORT SYSTEM

Transportable Storage Canisters

Description

The TSC consists of a cylindrical stainless steel shell with welded bottom plate, shield lid, structural lid, and a fuel basket. The TSC provides heat transfer paths, criticality control, and structural support. One TSC is loaded per vertical concrete cask.

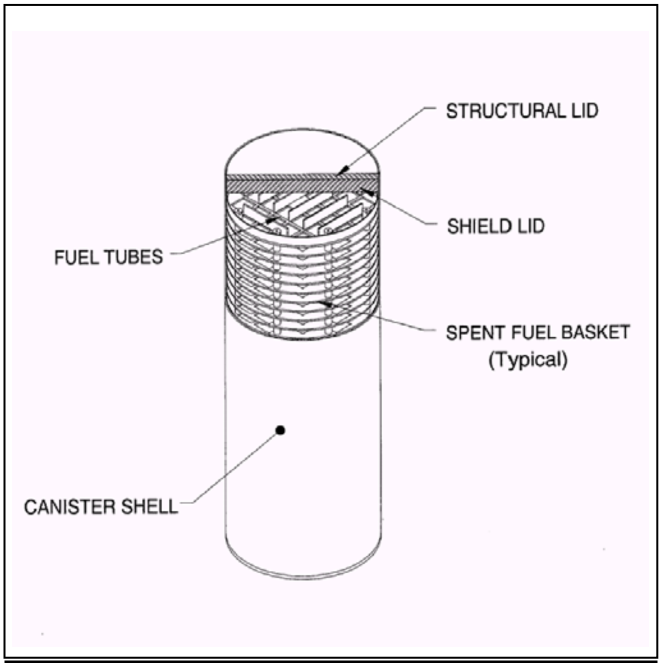
Specifications[17,18]

Attribute	Type of Transportable Storage Canister		
	DPC/Yankee-MPC	CY-MPC, 24 Assy	CY-MPC, 26 Assy
a. Capacity (intact assemblies)	68 BWR/36 PWR	24 PWR	26 PWR
b. Maximum Weight (lb)			
Empty	24,130	30,509	30,721
Loaded	54,730	62,909	65,821
c. Thermal			
Design Heat Rejection (kW)	12.5	16.2 stor/15.7 trans	17.5 stor/17.0 trans
Max. Per Assy. Heat Load (kW)	0.347	0.674 stor/0.654 trans	0.84 stor/0.654 trans
Maximum Burnup (GWD/MTU)	36	43	43
d. Shape	Cylindrical	Cylindrical	Cylindrical
e. Dimensions (in)			
Overall Length	122.5	151.75	151.75
Cross Section	70.64	70.64	70.64
Wall Thickness	0.625	0.625	0.625
Lid Thickness	8.0	8.0	8.0
Bottom Thickness	1.0	1.75	1.75
Basket Length	112.8	141.3	141.3
f. Materials of Construction			
Canister Body	SS	SS	SS
Basket	SS/Boral/Al	SS/Boral/Al	SS/Boral/Al
Shield Plugs	SS	SS	SS
g. Cavity Atmosphere	He	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	$\leq 2 \times 10^{-7}$	$\leq 2 \times 10^{-7}$	$\leq 2 \times 10^{-7}$

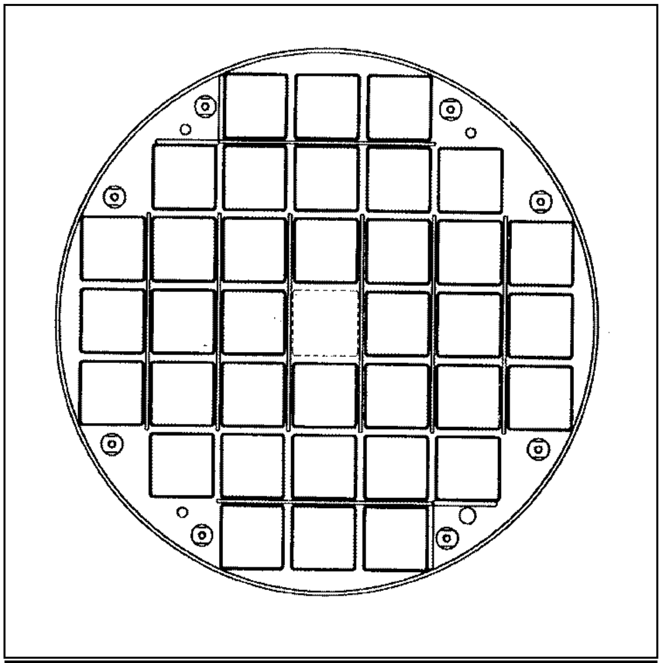
Licensing Status

The DPC-MPC, Yankee-MPC and CY-MPCs have been approved for storage within a VCC under Certificate of Compliance 72-1025, Amendment 3, which expires on April 10, 2020. The DPC-MPC, Yankee-MPC and CY-MPCs have been approved for transport within the NAC-STC transport cask under Certificate of Compliance 71-9235, Revision 12, which expires May 31, 2014.

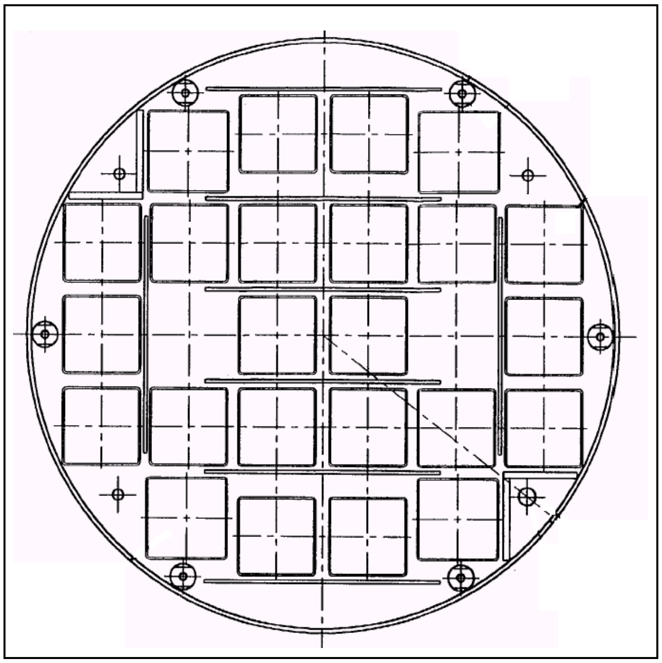
Transportable Storage Canisters (Continued)



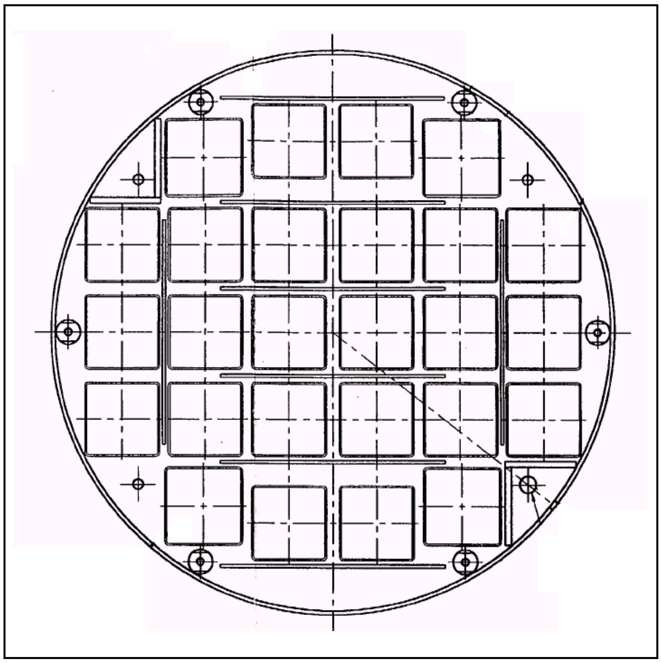
Typical Canister Assembly



Yankee-MPC Basket, Cross-Section

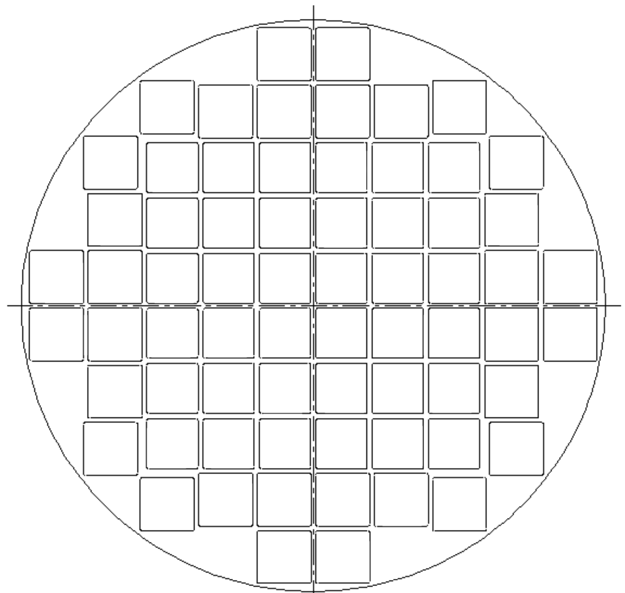


CY-MPC 24 Assembly Basket, Cross-Section



CY-MPC 26 Assembly Basket, Cross-Section

Transportable Storage Canisters (Continued)



DPC-MPC 68 BWR Assembly Basket, Cross-Section

NAC-MPC USED FUEL STORAGE AND TRANSPORT SYSTEM

Vertical Concrete Casks

Description

The VCC is the storage overpack for the TSC and provides structural support, shielding, protection from environmental conditions, and natural convection cooling of the TSC during storage. The VCC is a reinforced concrete structure with a carbon steel inner liner. It contains an annular air passage with inlet and outlet vents to allow for natural air circulation around the TSC.

Specifications[17,18]

Attribute	Type of Vertical Concrete Cask	
	DPC/Yankee-MPC	**CY-MPC**
a. Capacity (MPC)	1	1
b. Weight (lb)		
Empty (nominal)	151,364	185,950
Loaded	206,094	251,771
c. Shape	Cylindrical	Cylindrical
d. Dimensions (in)		
Overall Length	160	190.6
Overall Cross Section	128	128
Cavity Cross Section	79.0	79.0
Wall Thickness	24.5	24.5
Top Shield Plug	5.13	6.125
Lid Thickness	1.50	1.50
e. Neutron Shield (in)		
Side Thickness	n/a	n/a
Lid Thickness	1.0	2.0
Bottom Thickness	n/a	n/a
f. Materials of Construction		
Cask Body	Concrete/CS	Concrete/CS
Neutron Shield, Radial	n/a	n/a
Neutron Shield, Lid	NS-4-FR	NS-4-FR
g. Outside Surface Dose (mrem/hr)	<50 Side, <55 Top	<170 Side, <100 Top
h. Maximum Leak Rate (atm-cm^3/sec)	Per TSC	Per TSC

n/a denotes not applicable

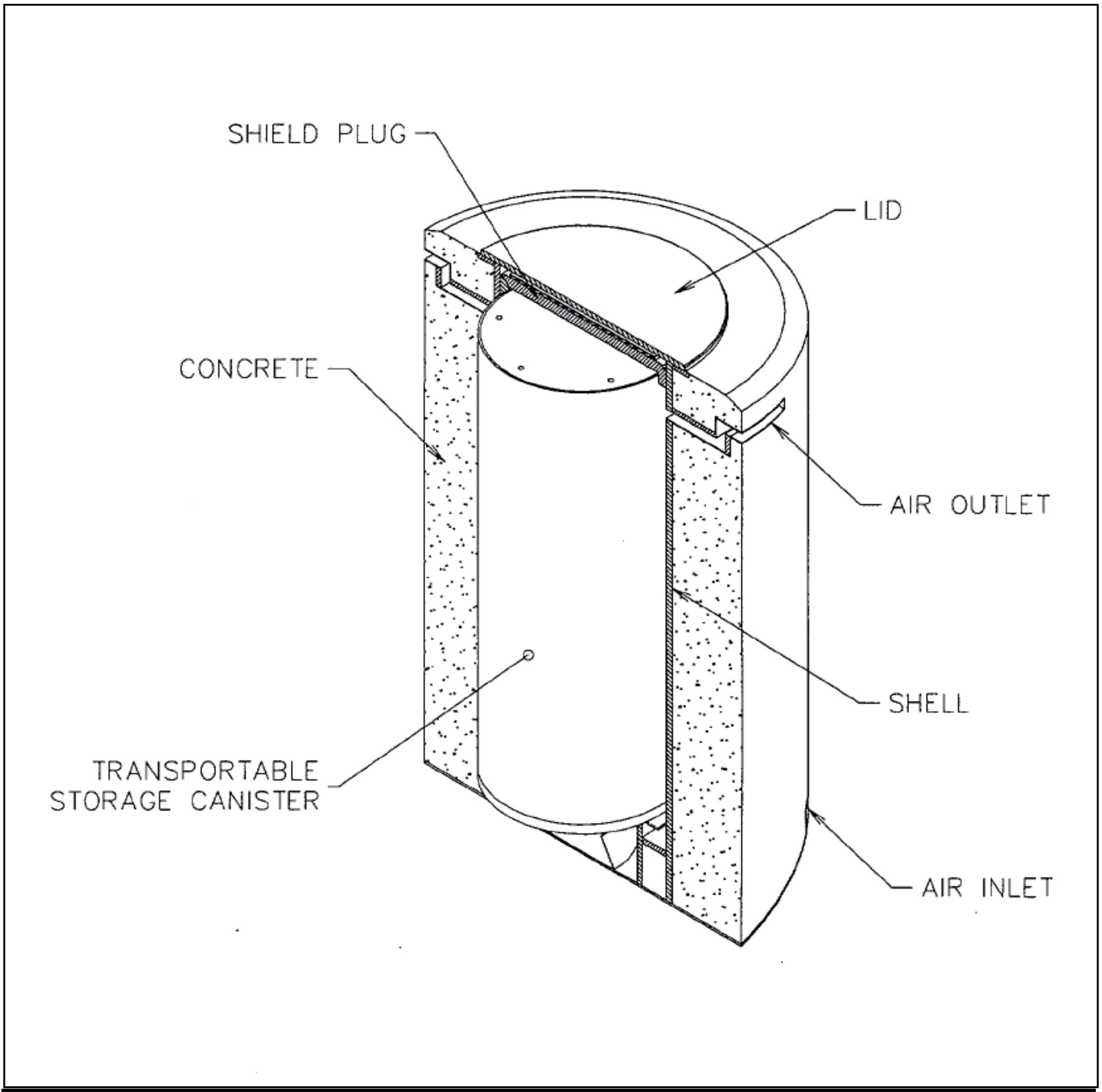
Licensing Status

The DPC-MPC, Yankee-MPC and CY-MPC vertical concrete casks have been approved for storage under Certificate of Compliance 72-1025, Amendment 3, which expires on April 10, 2020.

Extent of Commercial Use

Sixteen VCCs have been loaded at Yankee Atomic Power's Yankee Rowe Plant (of which one is loaded with GTCC), 43 have been loaded at Connecticut Yankee's Haddam Neck NPP (of which three are loaded with GTCC), and 5 have been loaded at Dairyland Power's LaCrosse NPP.

Vertical Concrete Casks (Continued)



Vertical Concrete Cask (VCC) Cross-Section

NAC-MPC USED FUEL STORAGE AND TRANSPORT SYSTEM

On-Site Transfer Casks

Description

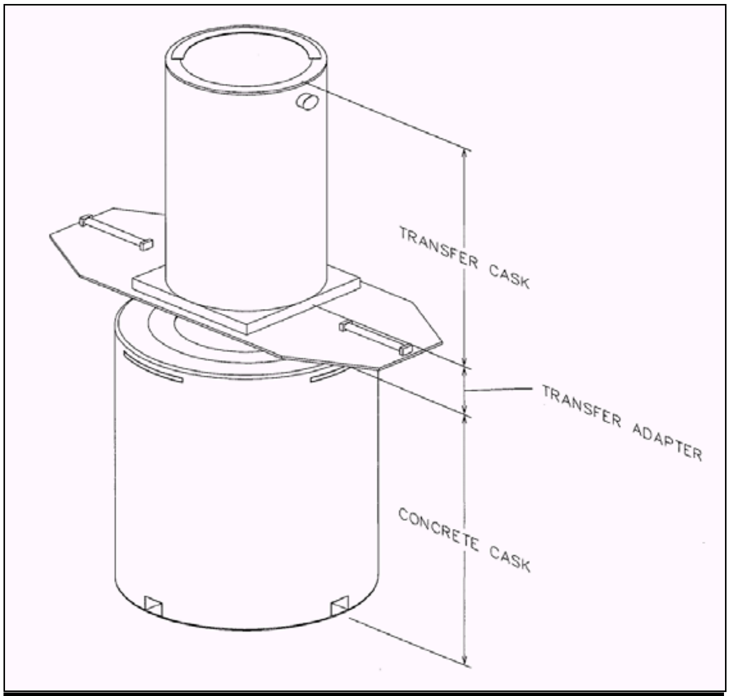
The transfer cask is used for transfer operations within the Used Fuel Pool Building and for transfer operations to/from the VCC. The cylindrical multi-walled transfer cask has a bolted top retaining ring to prevent a loaded canister from being inadvertently removed through the top of the transfer cask. Retractable bottom shield doors are used during unloading operations.

Specifications[17,18]

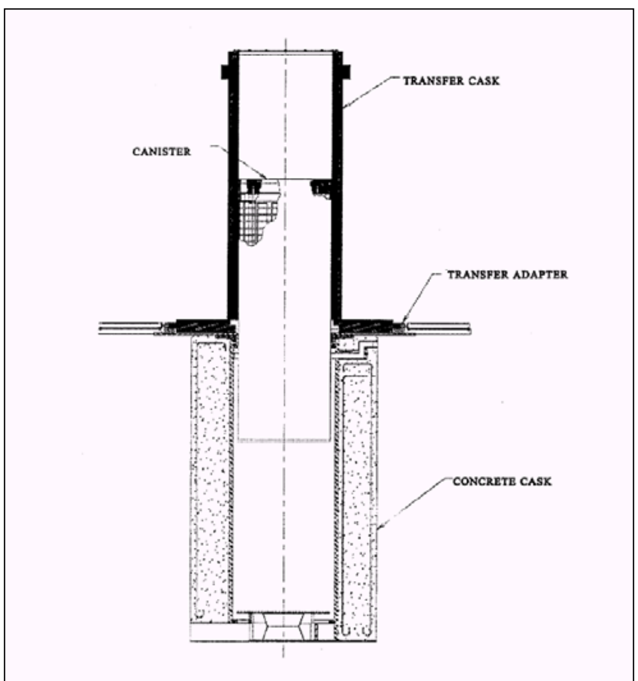
Attribute	Type of Metal On-Site Transfer Casks	
	DPC/Yankee-MPC	**CY-MPC**
a. Capacity (MPC)	1	1
b. Weight (lb)		
Empty	80,743	106,894
Loaded	135,473	172,708
c. Shape	Cylindrical	Cylindrical
d. Dimensions (in)		
Overall Length	133.38	162.88
Overall Cross Section	86.5	89.0
Cavity Length	123.5	153.0
Cavity Cross Section	71.5	71.5
Wall Thickness	7.5	8.75
Retaining Ring Thickness	0.75	0.8
Bottom Thickness	9.5	9.5
e. Neutron Shield (in)		
Side Thickness	2.0	2.75
Lid Thickness	n/a	n/a
Bottom Thickness	n/a	n/a
f. Materials of Construction		
Cask Body	CS/Pb	CS/Pb
Neutron Shield	NS-4-FR	NS-4-FR
g. Outside Surface Dose (mrem/hr)	<200 side	<300 side

n/a denotes not applicable

On-Site Transfer Casks (Continued)



On-Site Transfer Cask w/ Concrete Cask



On-Site Transfer Cask w/ Concrete Cask

NAC-STC Transport Cask

Description

The NAC-STC is a steel-lead-steel multiwall cask licensed for the storage and transport of TSCs and directly-loaded intact PWR assemblies. The NAC-STC closure design provides dual lids for transport and storage operations as well as protection of the vent and drain ports located within the inner lid. Both lids are installed during transport and storage. The NAC-MPC storage system utilizes the NAC-STC transport cask for off-site transportation of the TSCs.

Specifications[17,18,19,20]

Attribute	NAC-STC Transport Cask
a. Capacity	1 TSC or 26 directly loaded PWR assys
b. Weight (lb)	
Empty	175,970
Impact Limiters (2-DPC/Yankee-MPC)	18,590
Impact Limiters (2-CY-MPC 24 & 26)	12,797
Loaded, DPC/Yankee-MPC (w/Impact Limiters)	249,290
Loaded, CY-MPC 24 Assembly Basket (w/Impact Limiters)	251,676
Loaded, CY-MPC 26 Assembly Basket (w/Impact Limiters)	254,588
Loaded, Direct-Loaded Basket (w/Impact Limiters)	249,520
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length w/o Impact Limiter	193
Overall Cross Section, w/o Impact Limiters	99
Cavity Length	165
Cavity Diameter	71
Wall Thickness	14.0
Inner Lid Thickness	9.0
Outer Lid Thickness	5.25
Bottom Thickness	13.65
Thickness of Canister Spacers	As Required
e. Neutron Shield (in)	
Side Thickness	5.5
Lid Thickness	2.0
Bottom Thickness	2.0
f. Materials of Construction	
Cask Body	SS/Pb
Neutron Shielding	NS-4-FR
g. Cavity Atmosphere	He
h. Outside Surface Dose (mrem/hr)	<1000 @ surface, <200 (contact) , <10 (at 2m)
i. Maximum Leak Rate (atm- cm^3/sec)	$\leq 2 \times 10^{-7}$ Metallic seals / $\leq 4.1 \times 10^{-5}$ Viton seals

Licensing Status

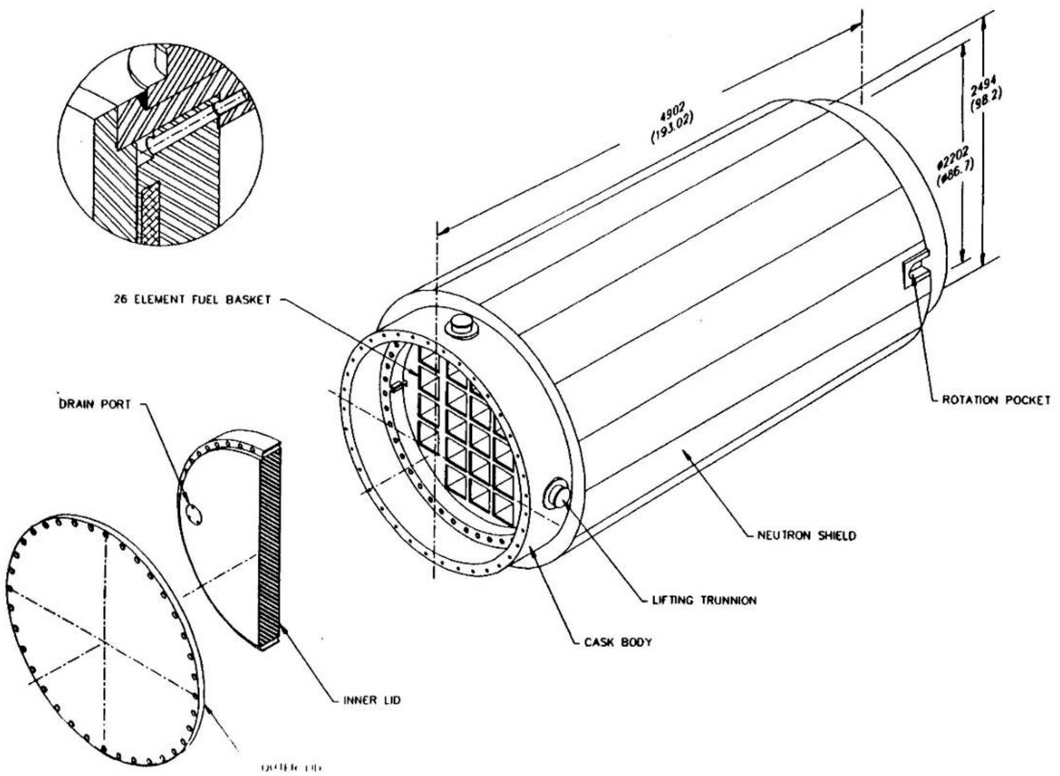
The NAC-STC is licensed for transport under Certificate of Compliance 71-9235, Revision 12, which expires on May 31, 2014.

NAC-MPC USED FUEL STORAGE AND TRANSPORT SYSTEM

NAC-STC Transport Cask (Continued)

Extent of Commercial Use

NAC-STC casks are not currently in use in the U.S. Internationally, two (2) NAC-STC casks are in operation, transporting used fuel from a nuclear power plant to an away-from-reactor storage facility, using the directly loaded basket design for 26 PWR assemblies.



NAC-STC Shipping Cask

NAC-UMS USED FUEL STORAGE AND TRANSPORT SYSTEM

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC Universal MPC System (UMS), designed and built by NAC International, is a storage and transport system that provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the MPC concept, is comprised of the following components:

- Transportable Storage Canisters (TSC)
- Vertical Concrete Cask (VCC)
- On-Site Transfer Cask
- Universal Transport Cask

Like other MPC systems, used nuclear fuel is placed into a canister and transferred into a concrete overpack via a transfer cask. When fuel is to be moved off-site, the canister is transferred into a transport cask.

The NAC-UMS concept is unique in that it provides 5 types of standardized canisters, vertical concrete casks, and on-site transfer casks. These 5 types of equipment are of different lengths to accommodate 3 classes of PWR and 2 classes of BWR fuel assemblies. Since the system would ultimately transport the TSCs off-site (to another storage facility or geologic repository), the TSCs are designed for transport conditions, which are more robust than storage only conditions.

To load a system for storage, an empty TSC is placed within the transfer cask. The canister and annulus are then filled with water and lowered into the fuel pool. Used fuel assemblies are loaded into the canister and a crane is used to place the shield lid in the top of the canister. The transfer cask is moved to the decontamination area and the shield lid is welded to the canister. A suction pump is used to drain water from the canister and the canister is then vacuum dried and backfilled with helium. The vent and drain port covers are welded to the shield lid and the structural lid is then installed and welded to the canister.

The NAC-UMS system uses the NAC-UMS transport cask for off-site transportation of TSCs.

This section describes each component of the system, starting with the TSCs.

NAC International

NAC-UMS USED FUEL STORAGE AND TRANSPORT SYSTEM

Transportable Storage Canisters

Description

The Transportable Storage Canister (TSC) is a cylindrical, stainless steel canister that provides confinement and contains the fuel basket structure. The fuel basket provides criticality control, structural support, and heat removal features. One TSC is loaded per storage or transport overpack. The various classes of TSCs vary in basket and canister lengths.

Specifications[21,23]

Attribute	Type of Transportable Storage Canister		
	Class 1	Class 2	Class 3
a. Capacity (intact assemblies)	24 PWR	24 PWR	24 PWR
b. Weight (lb)			
Empty	32,900	34,400	35,200
Loaded	70,600	72,900	70,800
c. Thermal			
Design Heat Rejection (kW)	23.0 stor/20.0 trans	23.0 stor/20.0 trans	23.0 stor/20.0 trans
Maximum Per Assy Heat Load (kW)	0.96 stor/0.83 trans	0.96 stor/0.83 trans	0.96 stor/0.83 trans
Maximum Burnup (GWD/MTU)	60.0	60.0	60.0
d. Shape	Cylindrical	Cylindrical	Cylindrical
e. Dimensions (in)			
Overall Length	175.1	184.2	191.8
Cavity Length	163.3	172.4	180.0
Cross Section	67.1	67.1	67.1
Wall Thickness	0.625	0.625	0.625
Lid Thickness	10	10	10
Bottom Thickness	1.75	1.75	1.75
Basket Length	162.6	171.7	179.3
f. Materials of Construction			
Canister Body	SS	SS	SS
Basket	SS/Al/Boral	SS/Al/Boral	SS/Al/Boral
Shield Plugs	SS	SS	SS
g. Cavity Atmosphere	He	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	$\leq 2 \times 10^{-7}$	$\leq 2 \times 10^{-7}$	$\leq 2 \times 10^{-7}$

Transportable Storage Canisters (Continued)

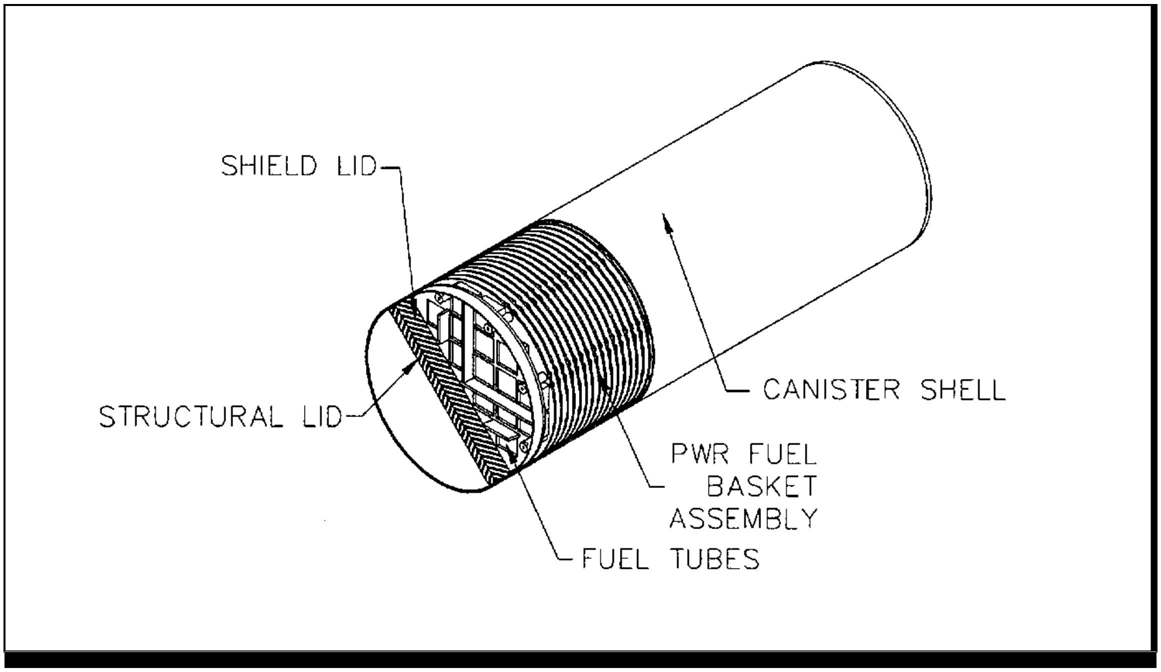
Attribute	Type of Transportable Storage Canister	
	Class 4	**Class 5**
a. Capacity (intact assemblies)	56 BWR	56 BWR
b. Weight (lb)		
Empty	35,600	36,200
Loaded	75,000	75,600
c. Thermal		
Design Heat Rejection (kW)	23.0 stor/16.0 trans	23.0 stor/16.0 trans
Maximum Per Assy Heat Load (kW)	0.41 stor/0.29 trans	0.41 stor/0.29 trans
Maximum Burnup (GWD/MTU)	60.0	60.0
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	185.6	190.4
Cavity Length	173.8	178.6
Cross Section	67.1	67.1
Wall Thickness	0.625	0.625
Lid Thickness	10	10
Bottom Thickness	1.75	1.75
Basket Length	173.1	177.9
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/CS/Boral/Al	SS/CS/Boral/Al
Shield Plugs	SS	SS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	$\leq 2 \times 10^{-7}$	$\leq 2 \times 10^{-7}$

Licensing Status

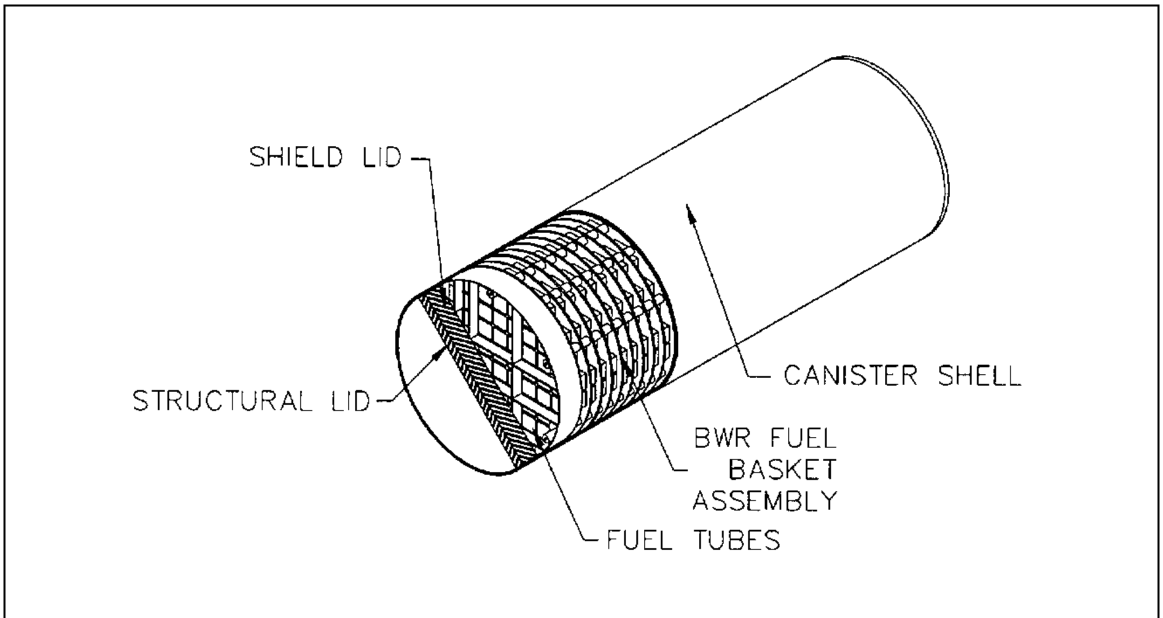
Class 1, 2, 3, 4, and 5 transportable storage canisters have been licensed for storage under Certificate of Compliance 72-1015, Amendment 3, which expires on November 20, 2020. The canisters are licensed for transport under Certificate of Compliance 71-9270, Revision 4, which expires on October 31, 2017.

NAC-UMS USED FUEL STORAGE AND TRANSPORT SYSTEM

Transportable Storage Canisters (Continued)



NAC-UMS Transportable Storage Canister, Typical PWR Configuration



NAC-UMS Transportable Storage Canister, Typical BWR Configuration

Vertical Concrete Casks

Description

The Vertical Concrete Cask (VCC) is a steel and concrete cylindrical vessel that stores the TSC vertically. The cask is ventilated using internal airflow paths which remove decay heat by natural circulation around the TSC wall. There are five separate classes of casks to accommodate TSCs of different lengths.

Specifications[21,23]

Attribute	Type of Vertical Concrete Cask		
	Class 1	**Class 2**	**Class 3**
a. Capacity (Canister)	1	1	1
b. Weight (lb)			
Empty	223,500	232,300	239,700
Loaded	294,100	305,100	310,400
c. Shape	Cylindrical	Cylindrical	Cylindrical
d. Dimensions (in)			
Overall Length	209.2	218.3	225.9
Overall Cross Section	136.0	136.0	136.0
Cavity Cross Section	74.5	74.5	74.5
Wall Thickness	30.75	30.75	30.75
Top Shield Plug	5.125	5.125	5.125
Lid Thickness	1.5	1.5	1.5
e. Neutron Shield (in)			
Side Thickness	n/a	n/a	n/a
Lid Thickness	1.0	1.0	1.0
f. Materials of Construction			
Cask Body	Concrete/Steel	Concrete/Steel	Concrete/Steel
Neutron Shield, Shield Plug	NS-4-FR	NS-4-FR	NS-4-FR
g. Outside Surface Dose, Side (mrem/hr)	<50 Side / <50 Top	<50 Side / <50 Top	<50 Side / <50 Top

n/a denotes not applicable

Vertical Concrete Casks (Continued)

Attribute	Type of Vertical Concrete Casks	
	Class 4	**Class 5**
a. Capacity (Canister)	1	1
b. Weight (lb)		
Empty	233,700	238,400
Loaded	308,700	313,900
c. Shape	Cylindrical	Cylindrical
d. Dimensions (in)		
Overall Length	219.7	224.5
Overall Cross Section	136.0	136.0
Cavity Length	N/A	N/A
Cavity Cross Section	74.5	74.5
Wall Thickness	30.75	30.75
Top Shield Plug	5.125	5.125
Lid Thickness	1.5	1.5
e. Neutron Shield (in)		
Side Thickness	n/a	n/a
Lid Thickness	1.0	1.0
f. Materials of Construction		
Cask Body	Concrete/Steel	Concrete/Steel
Neutron Shield, Shield Plug	NS-4-FR	NS-4-FR
g. Outside Surface Dose, Side (mrem/hr)	<50 Side / <50 Top	<50 Side / <50 Top

N/A denotes Not Available
n/a denotes not applicable

Licensing Status

Class 1, 2, 3, 4, and 5 VCCs have been licensed for storage under Certificate of Compliance 72-1015, Amendment 3, which expires on November 20, 2020.

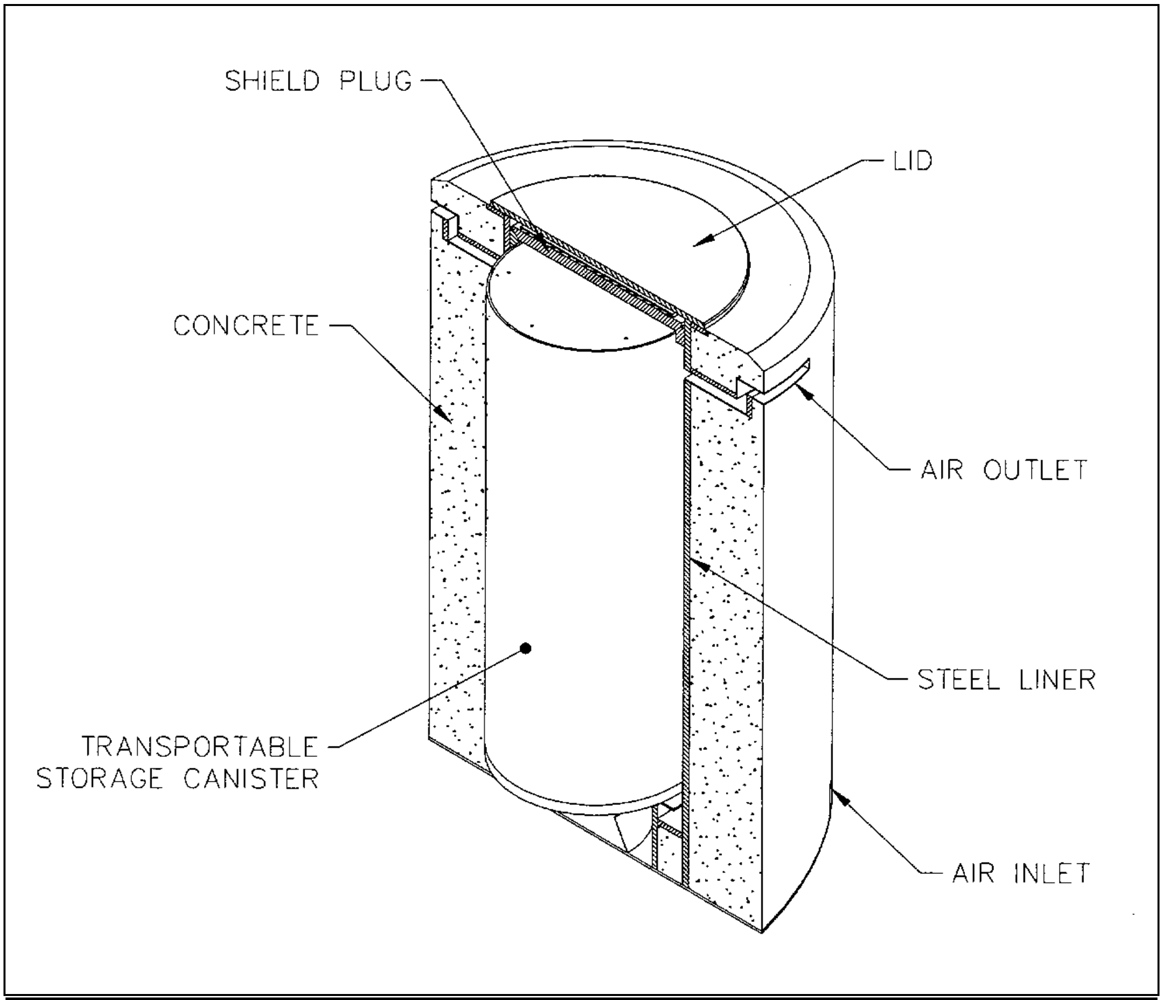
Extent of Commercial Use

Twenty-eight systems have been loaded at Duke Energy's McGuire NPP, 64 systems have been loaded at Maine Yankee Atomic Power's Maine Yankee Plant (of which 4 are loaded with GTCC), and 24 systems have been loaded at Duke Energy's Catawba NPP.

One hundred one systems have been loaded at Arizona Public Service's Palo Verde Plant. A total of 134 systems have been purchased by APS.

Internationally, 24 BWR systems are ordered and in fabrication for the Chin Shan NPP, Taiwan.

Vertical Concrete Casks (Continued)



Vertical Concrete Cask (VCC) Cross-Section

On-Site Transfer Casks

Description

The transfer cask is used for transfer operations within the Used Fuel Pool Building and for transfer operations to/from the VCC. The cylindrical multi-walled transfer cask has a bolted top retaining ring to prevent a loaded canister from being inadvertently removed through the top of the transfer cask. Retractable bottom shield doors are used during unloading operations.

Specifications[21,23]

Attribute	Type of Metal On-Site Transfer Cask		
	Class 1	**Class 2**	**Class 3**
a. Capacity (MPC)	1	1	1
b. Weight (lb)			
Empty	112,300	117,300	121,500
Loaded	182,900	190,100	192,200
c. Shape	Cylindrical	Cylindrical	Cylindrical
d. Dimensions (in)			
Overall Length	187.8	196.9	204.5
Overall Cross Section	85.3	85.3	85.3
Cavity Length	177.3	186.4	194.0
Cavity Cross Section	67.8	67.8	67.8
Wall Thickness	8.75	8.75	8.75
Lid Thickness	0.75	0.75	0.75
Bottom Thickness	9.0	9.0	9.0
e. Neutron Shield (in)			
Side Thickness	2.75	2.75	2.75
Lid Thickness	n/a	n/a	n/a
Bottom Thickness	1.5	1.5	1.5
f. Materials of Construction			
Cask Body	CS/Pb	CS/Pb	CS/Pb
Neutron Shield	NS-4-FR	NS-4-FR	NS-4-FR
g. Outside Surface Dose (mrem/hr)	ALARA	ALARA	ALARA

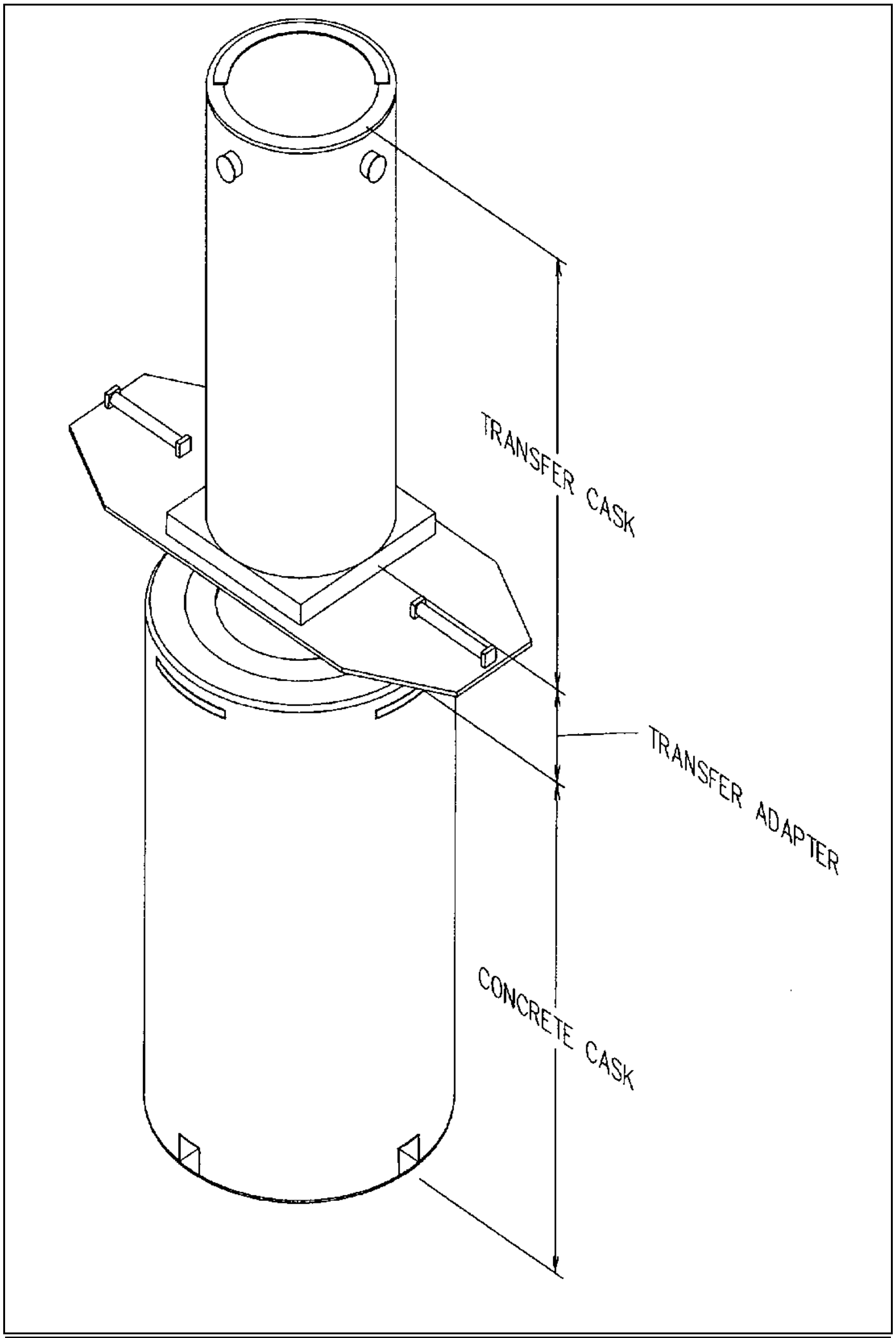
n/a denotes not applicable

On-Site Transfer Casks (Continued)

Attribute	Type of Metal On-Site Transfer Cask	
	Class 4	Class 5
a. Capacity (MPC)	1	1
b. Weight (lb)		
Empty	118,000	120,700
Loaded	193,000	196,200
c. Shape	Cylindrical	Cylindrical
d. Dimensions (in)		
Overall Length	198.3	203.1
Overall Cross Section	85.3	85.3
Cavity Length	187.8	192.6
Cavity Cross Section	67.8	67.8
Wall Thickness	8.75	8.75
Lid Thickness	0.75	0.75
Bottom Thickness	9.0	9.0
e. Neutron Shield (in)		
Side Thickness	2.75	2.75
Lid Thickness	n/a	n/a
Bottom Thickness	1.5	1.5
f. Materials of Construction		
Cask Body	CS/Pb	CS/Pb
Neutron Shield	NS-4-FR	NS-4-FR
g. Outside Surface Dose (mrem/hr)	ALARA	ALARA

n/a denotes not applicable

On-Site Transfer Casks (Continued)



On-Site Transfer Cask w/Concrete Cask

Universal Transport Cask

Description

The Universal Transport Cask is a steel-lead-steel multiwall cask licensed for the transport of TSCs. The cask closure design utilizes a single closure lid. The cask is loaded using the on-site transfer cask eliminating the need to handle the TSCs in the reactor pool prior to shipment off-site.

Specifications[21,22,23]

Attribute	Universal Transport Cask
a. Capacity (Canister)	1
b. Weight (lb)	
Empty (w/o Impact Limiters)	159,898
Impact Limiters (2 – approx.)	18,900
Loaded w/ spacer, Class 1 Canister (w/Impact Limiters)	250,009
Loaded w/ spacer, Class 2 Canister (w/Impact Limiters)	251,492
Loaded w/ spacer, Class 3 Canister (w/Impact Limiters)	248,373
Loaded w/ spacer, Class 4 Canister (w/Impact Limiters)	255,022
Loaded w/ spacer, Class 5 Canister (w/Impact Limiters)	254,004
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length w/ Impact Limiters	273.3
Overall Length w/o Impact Limiters	209.3
Overall Cross Section w/ Impact Limiters	124.0
Overall Cross Section w/o Impact Limiters	92.9
Cavity Length	192.5
Cavity Cross Section	67.6
Cask Lid	6.5
Cask Bottom	10.3
e. Neutron Shield Thickness (in)	
Radial	5.15
Lid Thickness	n/a
Bottom Thickness	1.0
f. Materials of Construction	
Cask Body	SS/Pb
Neutron Shield	NS-4-FR
Impact Limiters	Redwood/Balsa/SS
g. Calculated Total Dose Rates (mrem/hr)	<1000 @ surface, <200 (contact) , <10 (at 2m)
h. Maximum Leak Rate (atm- cm^3/sec)	$\leq 6.5 \times 10^{-6}$
i. Cask Cavity Atmosphere	He

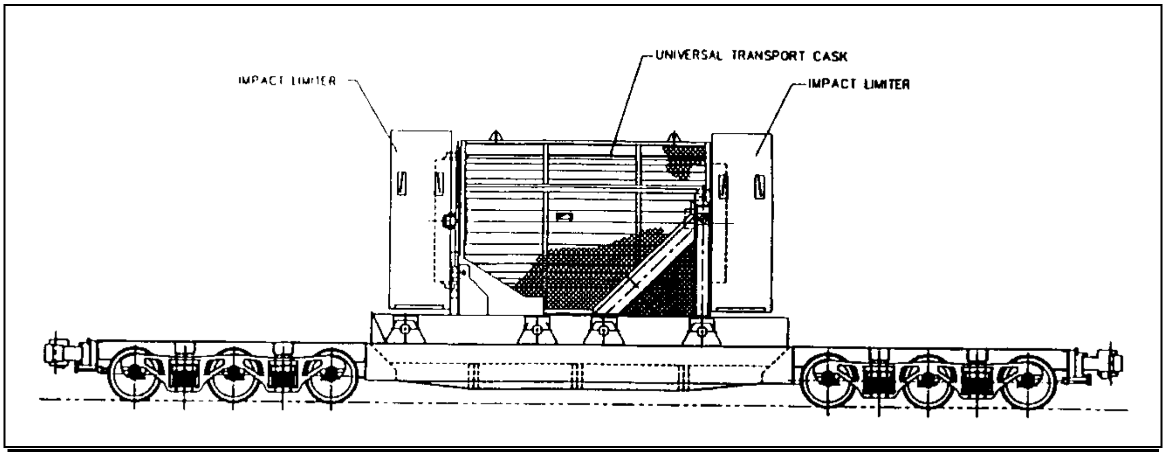
n/a denotes not applicable

Licensing Status

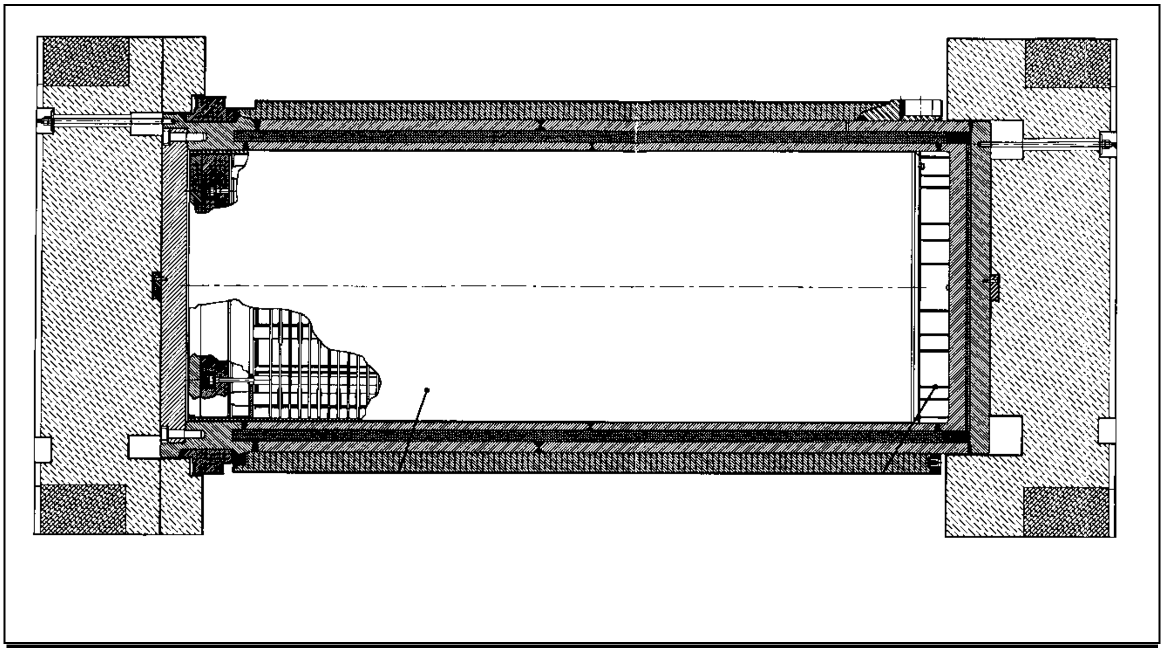
The NAC-UMS transport cask is licensed for transport under Certificate of Compliance 71-9270, Revision 4, which expires on October 31, 2017.

NAC-UMS USED FUEL STORAGE AND TRANSPORT SYSTEM

Universal Transport Cask (Continued)



Universal Transport Cask, Transport Configuration



Universal Transport Cask, Elevation View

NAC-MAGNASTOR USED FUEL STORAGE AND TRANSPORT SYSTEM

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC Modular, Advanced Generation, Nuclear All-Purpose Storage (MAGNASTOR) System is a new generation of canister-based multiple purpose technology for storage and transport of used nuclear fuel. It provides confinement, radiation shielding, structural integrity, criticality control, and heat removal from the fuel. The system is comprised of the following components:

- Transportable Storage Canisters (TSC)
- Vertical Concrete Cask (VCC)
- On-Site MAGNASTOR Transfer Cask (MTC)
- MAGNASTOR Transport Cask (MAGNATRAN)

Like other MPC systems, used nuclear fuel is placed into a canister and transferred into a concrete storage overpack via a transfer cask. When fuel is transported off-site, the canister is transferred from the concrete storage overpack into a transfer cask, and subsequently is transferred from the transfer cask into a transport cask.

The MAGNASTOR System accepts up to 37 PWR or 87 BWR fuel assemblies, and includes two different length TSCs to accommodate both PWR and BWR fuel. Moreover, both the MTCs and the VCCs have fixed lengths so that they can accommodate TSCs of both lengths.

To load a system for storage, an empty TSC is placed within the transfer cask. The canister and annulus are then filled with water and lowered into the fuel pool. Used fuel assemblies are loaded into the canister and a crane is used to place the closure lid into the top of the canister. The transfer cask is moved to the decontamination area and the closure lid is welded to the canister shell. Helium blowdown and suction pump are used to drain water from the canister and the canister is then vacuum dried and backfilled with helium. The vent and drain port cover plates and closure lid ring are then installed and welded to the canister lid and shell.

With the VCC located on a heavy-haul trailer or on the floor of the work area, a transfer adapter is placed upon the top of the concrete cask. The loaded transfer cask is raised and lowered into the adaptor plate on top of the concrete cask. Using a crane, the canister is lifted slightly to take the canister weight off of the transfer cask bottom doors. Using the hydraulic system, the bottom doors are opened and the canister is lowered using the crane. The transfer cask is removed and the concrete cask lid is installed. The loaded concrete cask is then transported to the storage pad.

This section describes each component of the system, starting with the TSCs.

NAC-MAGNASTOR USED FUEL STORAGE AND TRANSPORT SYSTEM

Transportable Storage Canisters

Description

The Transportable Storage Canister (TSC) is a cylindrical, stainless steel canister that provides confinement and contains the fuel basket structure. The TSC has a stainless steel closure lid. The fuel basket provides criticality control, structural support, and heat removal features. One TSC is loaded per storage or transport cask. PWR and BWR canisters are identical with the exception of the fuel basket configuration and length.

Specifications[24,25]

Attribute	Transportable Storage Canister[a]
a. Capacity (intact assemblies)	37/87 (PWR/BWR)
b. Weight (lb)	
Empty	40,000/42,000
Loaded	102,500/103,500
c. Thermal	
Design Heat Rejection (kW)	35.5/33.0
Max. Fuel Clad Temperature (^{o}F)	752
Maximum Burnup (GWD/MTU)	60.0
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	184.8/191.8
Cavity Length	N/A
Cross Section	71
Wall Thickness	0.5
Lid Thickness	9
Bottom Thickness	2.75
Basket Length	172.5/179.5
Basket Cross Section	69.8
f. Materials of Construction	
Canister Body	SS
Basket	Nickel-Plated CS/SS
Shield Lid	SS
g. Cavity Atmosphere	He
h. Maximum Leak Rate (atm-cm^3/sec)	$\leq 2 \times 10^{-7}$

[a]PWR/BWR
N/A denotes Not Available;

Licensing Status

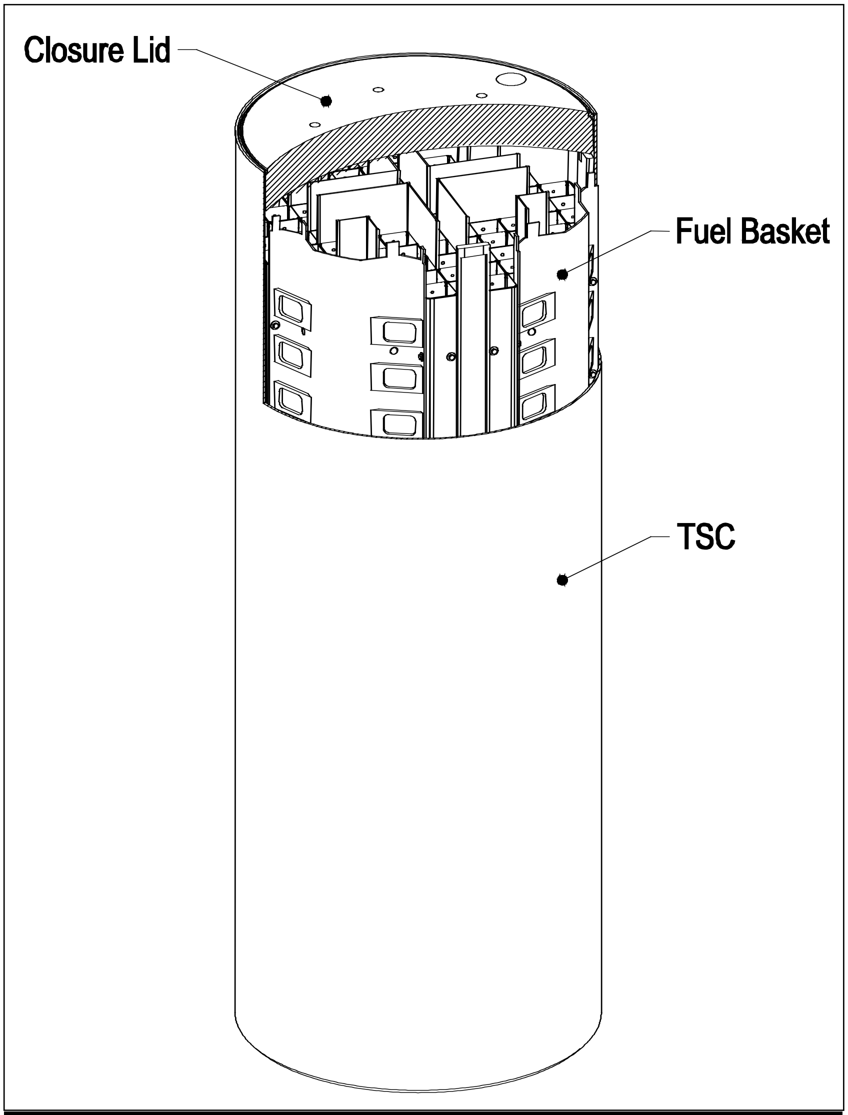
The NAC MAGNASTOR System has been approved for storage under the Certificate of Compliance 72-1031, which expires on February 4, 2029.

Extent of Commercial Use

Twenty systems ordered for Duke Energy’s McGuire NPP, 24 systems ordered and 1 system loaded at Duke Energy’s Catawba NPP, and 61 ordered for Zion*Solutions*.

Internationally, 27 BWR systems are ordered and in fabrication for the Kuosheng NPP, Taiwan.

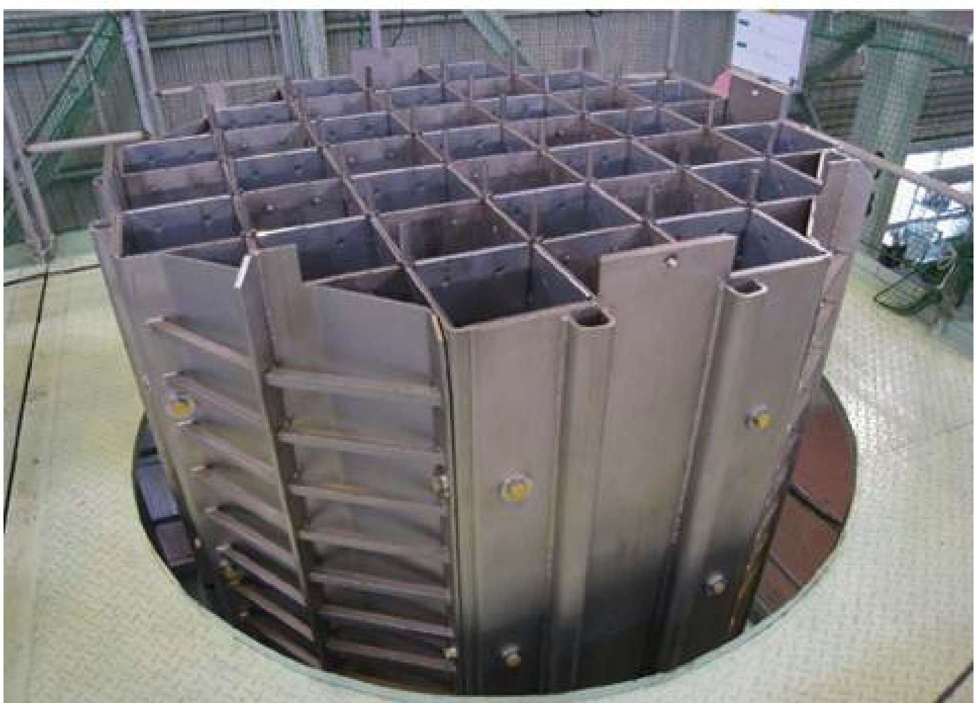
Transportable Storage Canisters (Continued)



Transportable Storage Canister and Basket

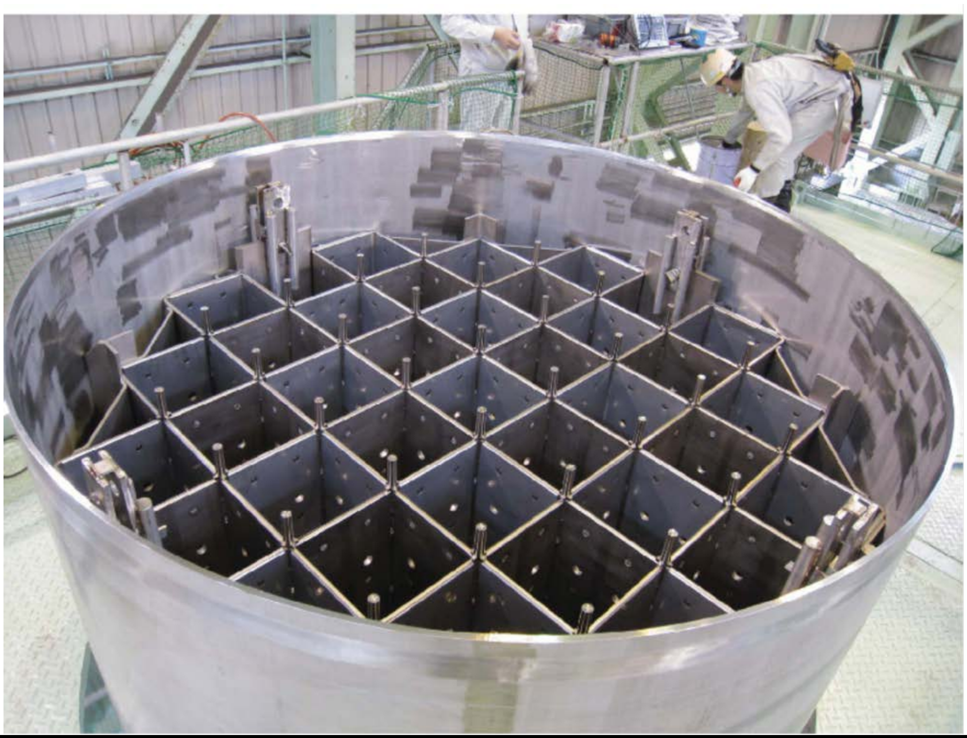
Transportable Storage Canisters (Continued)

87 BWR Assembly Basket



37 PWR Assembly Basket

Transportable Storage Canisters (Continued)



PWR Basket Inserted in the TSC

NAC-MAGNASTOR USED FUEL STORAGE AND TRANSPORT SYSTEM

Vertical Concrete Casks

Description

The Vertical Concrete Cask (VCC) is a reinforced concrete structure with a structural steel inner liner and base that stores the TSC vertically. The cask body provides an annular air passage to allow the natural circulation of air around the TSC to remove the decay heat from the contents. The lower air inlets and upper air outlets are steel-lined penetrations in the concrete cask body. Each air inlet/outlet is covered with a screen. The inlet plenum directs the air upward and around the pedestal that supports the TSC. Decay heat is transferred from the fuel assemblies to the TSC wall by conduction, convection, and radiation. Heat is removed by conduction and convection from the TSC shell to the air flowing upward through the annular air passage and exhausting out through the air outlets.

Specifications[24,25]

Attribute	Vertical Concrete Cask
a. Capacity (TSC)	1
b. Weight (lb)	
Empty	219,000
Loaded (PWR/BWR)	321,500/322,500
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length	≤ 225.3.
Overall Cross Section	136
Cavity Cross Section	79.5
Wall Thickness	28.25
Lid Thickness	6.75
e. Materials of Construction	
Cask Body	Concrete
Lid	Concrete/CS
f. Outside Surface Dose, Side (mrem/hr)	N/A

N/A denotes Not Available

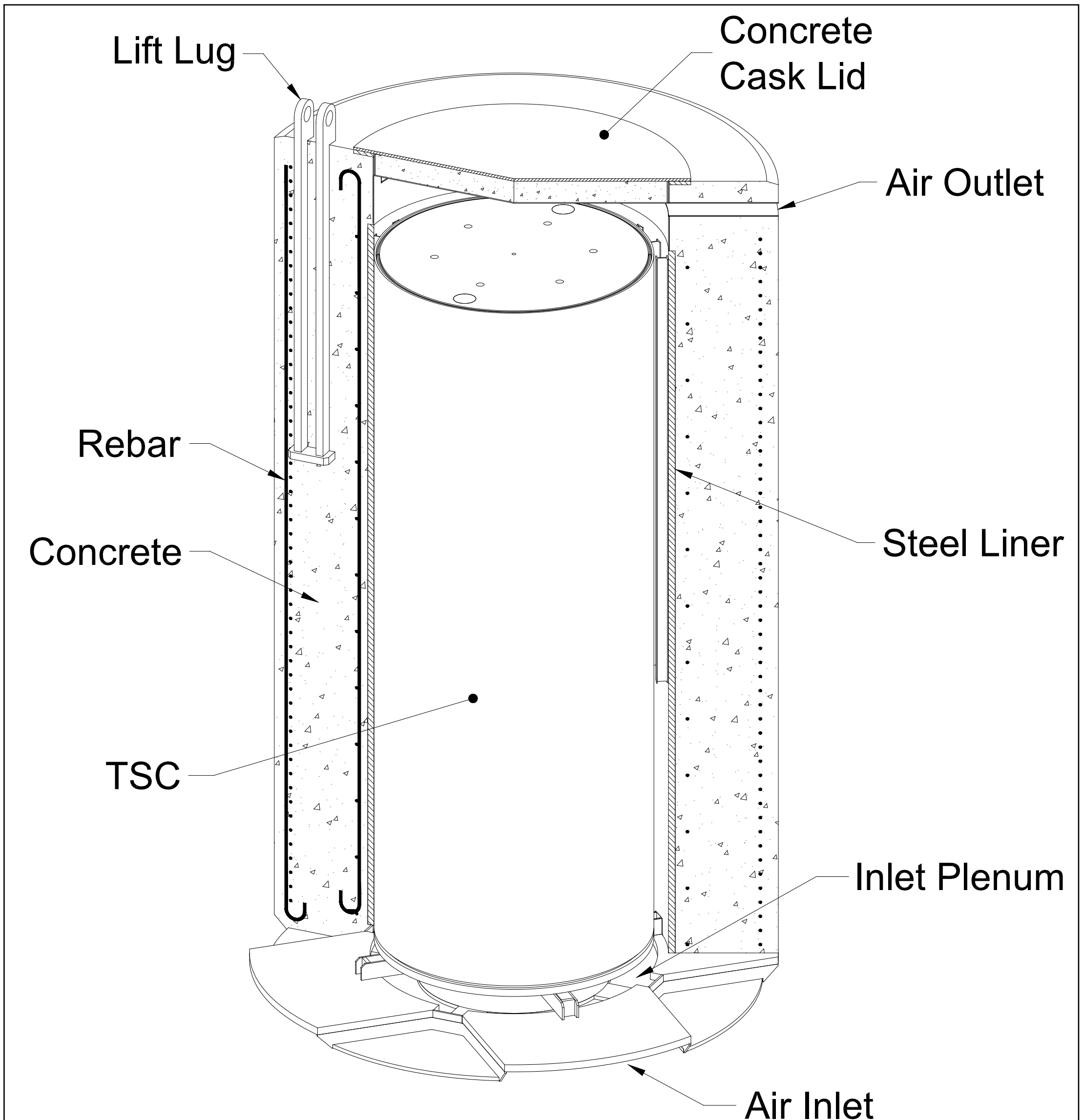
Licensing Status

The NAC MAGNASTOR System has been approved for storage under the Certificate of Compliance 72-1031, which expires on February 4, 2029.

Extent of Commercial Use

Twenty VCCs delivered to Duke Energy’s McGuire NPP, 24 VCCs delivered to Duke Energy’s Catawba NPP, and 65 VCCs delivered to Zion*Solutions*.

Vertical Concrete Casks (Continued)



Vertical Concrete Cask Cross-Section

On-Site Transfer Casks

Description

The MAGNASTOR Transfer Cask (MTC) is used for transfer operations within the Used Fuel Pool Building and for transfer operations to/from the VCC. The MTC is a low alloy steel cask that is equipped with shield doors so that a TSC can be lowered from the MTC into a VCC, or removed from the VCC and loaded into a transport cask.

Specifications[24,25]

Attribute	Transfer Cask[a]
a. Capacity (TSC)	1
b. Weight (lb)	
Empty	108,500
Loaded	212,00/213,000
c Shape	Cylindrical
d. Dimensions (in)	
Overall Length	215/222 est.
Overall Cross Section	88
Cavity Length	189/196 est.
Cavity Cross Section	73
Wall Thickness	7.45
Lid Thickness	14
Bottom Thickness	12
e. Neutron Shield (in.)	
Side Thickness	2.25
Lid Thickness	N/A
Bottom Thickness	N/A
f. Materials of Construction	
Cask Body	Steel
Neutron Shield	NS-4-FR
g. Outside Surface Dose (mrem/hr)	N/A

[a]PWR/BWR
N/A denotes Not Available

Licensing Status

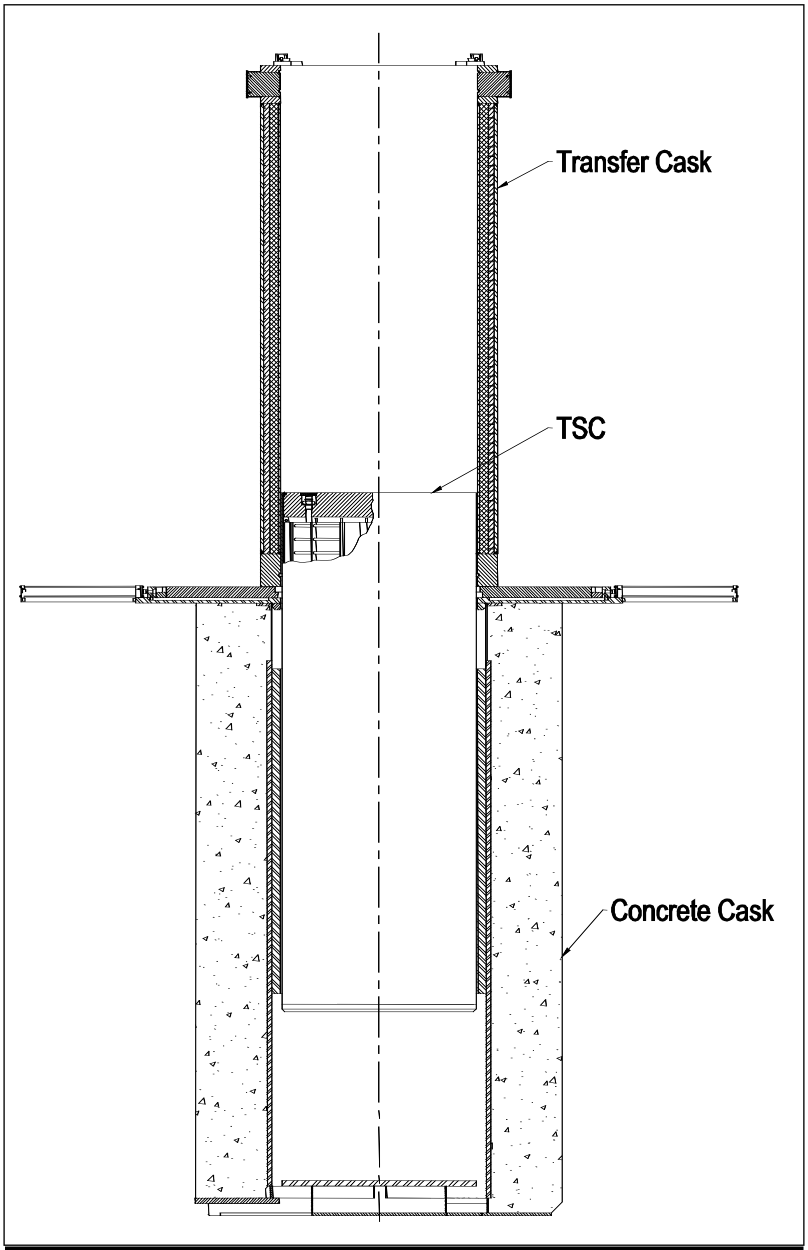
The NAC MAGNASTOR system has been approved for use for storage under the Certificate of Compliance 72-1031 which expires on February 4, 2029.

Extent of Commercial Use

One MTC has been delivered to Duke Energy's McGuire NPP, 1 MTC delivered to Duke Energy's Catawba NPP, and 2 MTCs delivered to Zion*Solutions*.

Internationally, 27 BWR MAGNASTOR systems have been ordered and are in fabrication (including one MTC) for Kuosheng NPP, Taiwan.

On-Site Transfer Casks (Continued)



On-Site TSC Transfer from Transfer Cask to Concrete Storage Cask

NAC-MAGNASTOR USED FUEL STORAGE AND TRANSPORT SYSTEM

MAGNATRAN Transport Cask

Description

The MAGNATRAN transport cask system is based on the licensed NAC-STC and NAC-UMS transport casks. The cask body length and internal diameter were increased to accommodate the higher capacity MAGNASTOR TSC. The outside diameter of the cask has been maintained, allowing the use of the existing NAC-STC impact limiter design, thereby avoiding any additional drop testing of MAGNATRAN. The MAGNATRAN transport cask is designed to more efficiently deal with higher heat loads associated with the MAGNASTOR TSC without excessively long cooling times. The MAGNATRAN cask is also designed and will be certified for the transport of greater than Class C waste. It also meets all of 10 CFR 71 requirements.

The major components of the MAGNATRAN transport cask system include a multi-walled construction consisting of shells of stainless steel/lead/stainless steel with a single closure lid. Attached to the body is a series of thermal fins and encapsulated NS-4-FR neutron shield material, a patented design for improved shielding and thermal performance of the neutron shield.

The body of the MAGNATRAN is a smooth right-circular cylinder of multi-walled construction consisting of a stainless steel inner shell, lead layer, and an outer stainless steel shell. Mechanically attached to the cask body are 15 thermal fins captured by 30 encapsulated neutron shield components.

MAGNATRAN Transport Cask

Specifications[24,25,26]

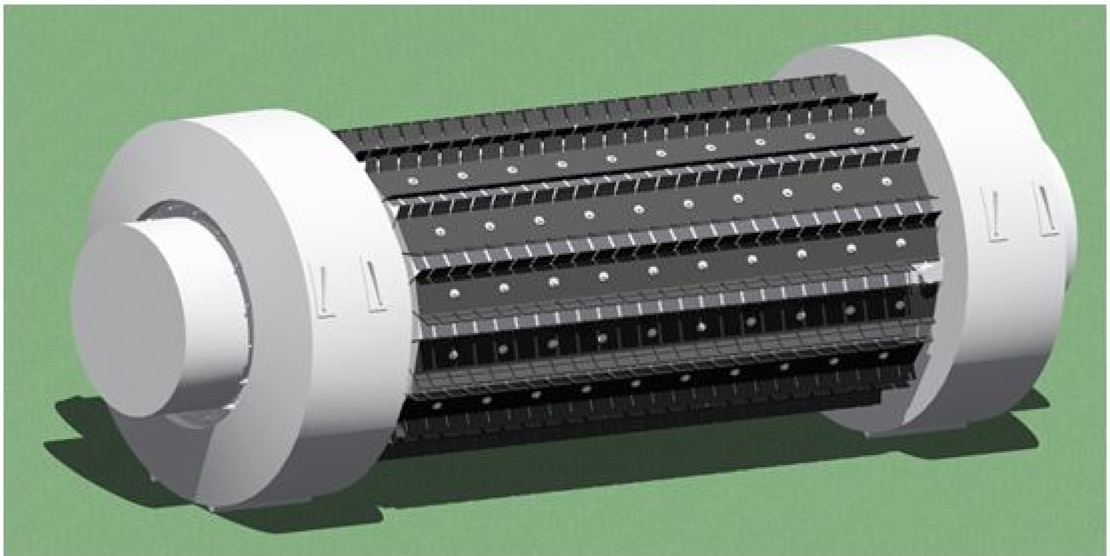
Attribute	MAGNATRAN Transport Cask
a. Capacity (Canister)	1 TSC
b. Weight (lb)	
Empty	205,000
Loaded	320,000
Loaded w/ impact limiters	350,000
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length w/ Impact Limiters	326
Overall Length w/o Impact Limiters	236
Overall Cross Section w/ Impact Limiters	128
Overall Cross Section w/o Impact Limiters	99.5 across neutron shield/110 across cooling fins
Cavity Length	192.5
Cavity Cross Section	72.25
Cask Lid	7.75
Cask Bottom	13.65
e. Neutron Shield Thickness (in)	
Radial	5.3/6.0
Cask Lid	n/a
Cask Bottom	n/a
f. Materials of Construction	
Cask Body	SS/Pb
Neutron Shield	NS-4-FR
Impact Limiters	Redwood and balsa wood
g. Calculated Total Dose Rates (mrem/hr)	<1000 @ surface, <200 (contact) , <10 (at 2m)
h. Maximum Leak Rate (atm- cm^3/sec)	1×10^{-7}
i. Cask Cavity Atmosphere	He

n/a denotes not applicable

Licensing Status

The MAGNATRAN Safety Analysis Report is currently under review (Docket No. 71-9356) by the NRC.

MAGNATRAN Transport Cask



MAGNATRAN Transport Cask

NUHOMS® USED FUEL STORAGE AND TRANSPORT SYSTEM

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The NUHOMS® storage system, designed and built by Transnuclear, is a storage and transport system which provides confinement, radiation shielding, structural integrity, criticality control, and heat removal for used nuclear fuel. The system, based upon the Multi-Purpose Canister (MPC) concept, is comprised of the following components:

- Dry Shielded Canisters (DSC)
- Transfer Cask
- Horizontal Storage Module (HSM)
- Transportation Cask

To load a system for storage, an empty DSC is placed within the transfer cask, which is then lowered into the used fuel pool. The used fuel assemblies are loaded into the DSC, a shield plug is installed, and the transfer cask is removed from the pool. The cask is placed in the cask decontamination area where sealing, draining, drying, and helium backfilling operations are performed. The cask is moved onto a transport trailer in the plant's fuel/reactor building and towed to the independent spent fuel storage installation (ISFSI). At the ISFSI location, the loaded transfer cask is aligned with the HSM and the DSC is pushed out of the transfer cask into the HSM using a hydraulic ram.

NUHOMS® Dry Shielded Canister

Description

The DSC consists of a cylindrical stainless steel shell with welded top and bottom cover plates forming a containment boundary. Within the DSCs are baskets that provide heat transfer paths, criticality control, and structural support. One DSC is loaded per concrete module.

The following DSCs are currently available for the NUHOMS® system.

Type of DSC[a]	Capacity
NUHOMS®-24 PS	24 PWR assemblies
NUHOMS®-24 PL	24 PWR assemblies
NUHOMS®-24 PHBS	24 PWR assemblies[b]
NUHOMS®-24 PHBL	24 PWR assemblies[c]
NUHOMS®-24 PTH-S	24 PWR assemblies
NUHOMS®-24 PTH-L	24 PWR assemblies
NUHOMS®-24 PTH-LC	24 PWR assemblies
NUHOMS®-24PT2S	24 PWR assemblies
NUHOMS®-24PT2L	24 PWR assemblies
NUHOMS®-24PT4	24 PWR assemblies
NUHOMS®-32 PT-S100	32 PWR assemblies
NUHOMS®-32 PT-S125	32 PWR assemblies
NUHOMS®-32 PT-L100	32 PWR assemblies
NUHOMS®-32 PT-L125	32 PWR assemblies
NUHOMS®-32PTH	32 PWR assemblies
NUHOMS®-32PTH1	32 PWR assemblies
NUHOMS®-32PTH1-S	32 PWR assemblies
NUHOMS®-32PTH1-M	32 PWR assemblies
NUHOMS®-32PTH1-L	32 PWR assemblies
NUHOMS®-32PTH2	32 PWR assemblies[e]
NUHOMS®-37PTH	37 PWR assemblies[d]
NUHOMS® FO-DSC	24 PWR assemblies
NUHOMS® FC-DSC	24 PWR assemblies with components
NUHOMS® FF-DSC	13 PWR damaged assemblies
NUHOMS®-24PT1	24 PWR assemblies with UO_2 or MOX fuel
NUHOMS®-52B	52 BWR assemblies
NUHOMS®-61BT	61 BWR assemblies
NUHOMS®-61BTH	61 BWR assemblies
NUHOMS®-69BTH	69 BWR assemblies[d]
NUHOMS®-12T	12 TMI-2 fuel debris canisters
NUHOMS®-07P	7 PWR

[a] "T" denotes transportable; "H" denotes high burnup contents; "S" denotes short cavity configuration; "L" denotes long cavity configuration.
[b] Same as 24PS except that the 24PHBS can accept high burnup fuel, and the outer top plate has a test port and plug to allow for testing to a condition of "leak tight" per ANSI 14.5-1997.
[c] Same as 24PL except for modifications listed in a, above.
[d] Proposed in Certificate of Compliance 72-1004, Amendment 13, currently under NRC review.
[e] Proposed in Certificate of Compliance 72-1029, Amendment 3, currently under NRC review.

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -24PS	**NUHOMS® -24PL**
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Weight (lb)		
Empty	37,761	35,426
Loaded	78,128	75,794
c. Thermal		
Design Heat Rejection (kW)	24	24
Maximum Per Assy Heat Load (kW)	1.0	1.0
Maximum Burnup (GWD/MTU)	45	45
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.29	186.29
Cross Section	67.19	67.19
Cavity Length	167	173
Wall Thickness	0.625	0.625
f. Materials of Construction		
Canister Body	SS	SS
Basket	Steel	Steel
Shield Plugs	CS	SS/Pb
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-4}	1 x 10^{-4}
i. Transport Cask	Not Licensed for Transport	Not Licensed for Transport

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -24PHBS	**NUHOMS® -24PHBL**
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Weight (lb)		
Empty	37,761	35,426
Loaded	78,128	75,794
c. Thermal		
Design Heat Rejection (kW)	24	24
Maximum Per Assy Heat Load (kW)	1.3	1.3
Maximum Burnup (GWD/MTU)	55	55
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.17	186.17
Cross Section	67.19	67.19
Cavity Length	167	173
Wall Thickness	0.625	0.625
f. Materials of Construction		
Canister Body	SS	SS
Basket	Steel	Steel
Shield Plugs	CS	SS/Pb
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-7}	1×10^{-7}
i. Transport Cask	Not Licensed for Transport	Not Licensed for Transport

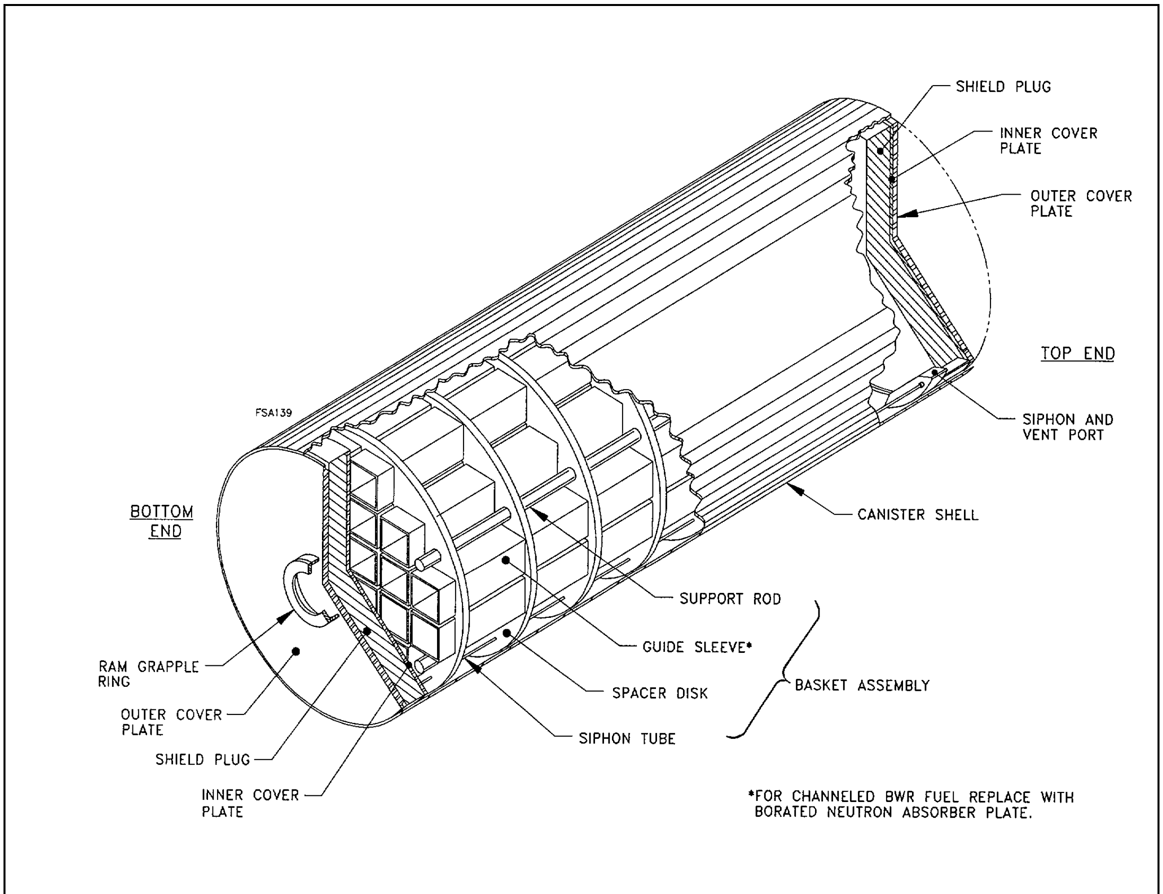
Licensing Status

The NUHOMS®-24PS, -24PL, -24PHBS, and -24PHBL canisters are included within Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015.

Extent of Commercial Use (as of March 2013)

- 84 NUHOMS®-24P DSCs have been loaded at Duke Energy’s Oconee NPP.
- 48 NUHOMS®-24P DSCs have been loaded at Constellation’s Calvert Cliffs NPP under site specific license SNM-2505.
- 3 NUHOMS®–24P DSCs have been loaded at FirstEnergy’s Davis-Besse NPP.
- 22 NUHOMS®-24PT have been loaded at SMUD’s Rancho Seco NPP.
- 43 NUHOMS®-24PHB DSCs have been loaded at Duke Energy’s Oconee NPP.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-24P and -24PHB DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,33,34]

Attribute	Type of Dry Shielded Canister		
	NUHOMS® -24PTH-S	**NUHOMS® -24PTH-L**	**NUHOMS® -24PTH-LC**
a. Capacity (intact assemblies)	24 PWR	24 PWR	24 PWR
b. Maximum Weight (lb)			
Empty	52,000	53,300	49,100
Loaded	92,400	93,700	89,500
c. Thermal			
Design Heat Rejection (kW)	40.8	40.8	24
Maximum Per Assy Heat Load (kW)	2.0	2.0	1.5
Maximum Burnup (GWD/MTU)	62	62	62
d. Shape	Cylindrical	Cylindrical	Cylindrical
e. Dimensions (in)			
Overall Length	186.55	192.55	186.55
Cross Section	67.19	67.19	67.19
Cavity Length	169.6	175.6	173.28
Wall Thickness	0.5	0.5	0.5
f. Materials of Construction			
Canister Body	SS	SS	SS
Basket	Steel/B-Al/Al	Steel/B-Al/Al	Steel/B-Al/Al
Shield Plugs	Steel/Pb	Steel/Pb	Steel/Pb
g. Cavity Atmosphere	He	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-7}	1×10^{-7}	1×10^{-7}
i. Transport Cask	NUHOMS®-MP197HB*	NUHOMS®-MP197HB*	NUHOMS®-MP197HB*

*Proposed under Certificate of Compliance 71-9302, Revision 6, currently under NRC review.

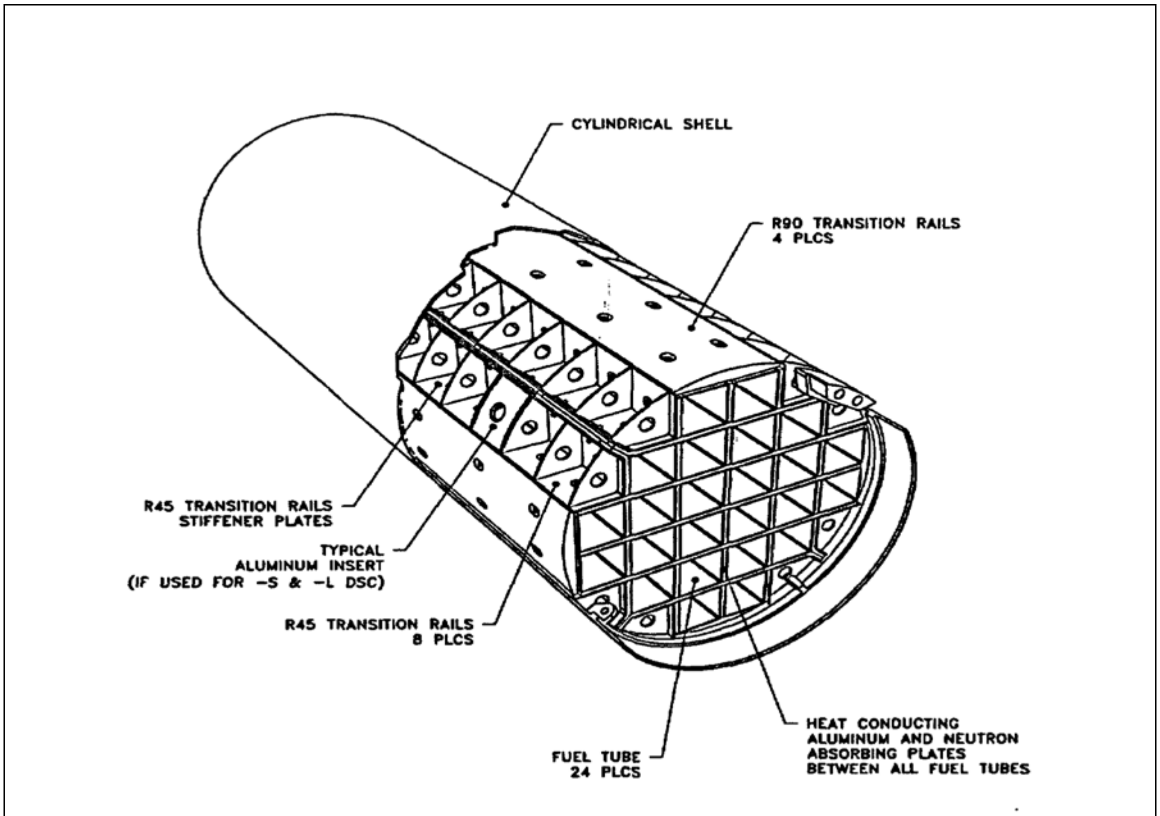
Licensing Status

The NUHOMS®-24PTH-S, -24PTH-L, and –24PTH-LC canisters are included within Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015

Extent of Commercial Use (as of March 2013).

- 13 NUHOMS®-24PTH DSCs have been loaded at Entergy's Palisades NPP.
- 14 NUHOMS®-24PTH DSCs have been loaded at Progress Energy's H.B. Robinson NPP.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-24PTH DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -24PT2S	**NUHOMS® -24PT2L**
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Weight (lb)		
Empty	43,951	41,600
Loaded	84,319	81,968
c. Thermal		
Design Heat Rejection (kW)	24	24
Maximum Per Assy Heat Load (kW)	1.0	1.0
Maximum Burnup (GWD/MTU)	45	45
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.5	186.5
Cross Section	67.19	67.19
Cavity Length	166.94	172.94
Wall Thickness	0.625	0.625
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/Boral	SS/Boral
Shield Plugs	Steel	Steel/Pb
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-4}	1×10^{-4}
i. Transport Cask	Not Licensed for Transport	Not Licensed for Transport

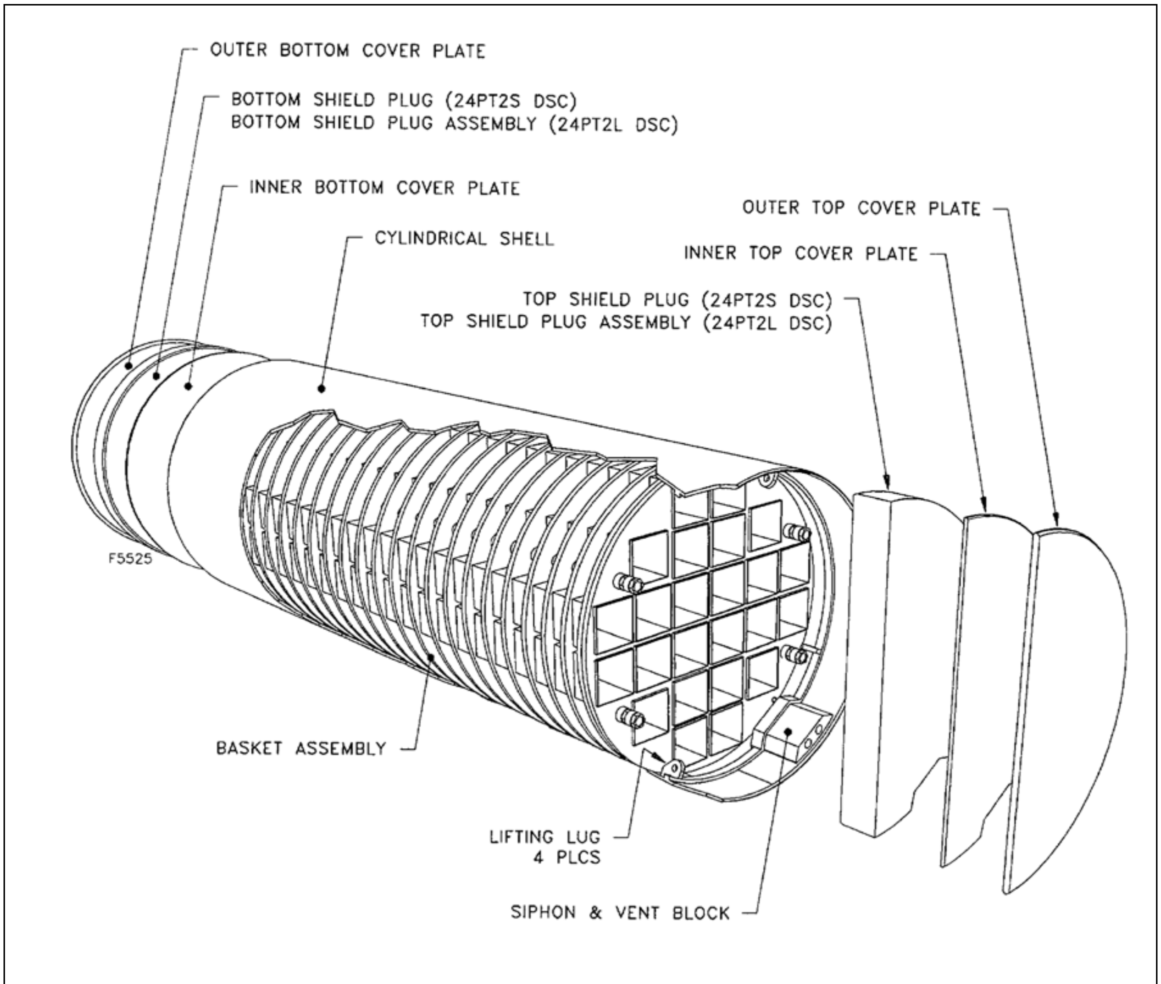
Licensing Status

The NUHOMS®-24PT2S and -24PT2L canisters are included within Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015.

Extent of Commercial Use (as of March 2013)

No NUHOMS®-24PT2 DSCs have been loaded at this time.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-24PT2 DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,33,34]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -32PT-S100	**NUHOMS® -32PT-S125**
a. Capacity (intact assemblies)	32 PWR	32 PWR
b. Weight (lb)		
Empty	44,470	46,570
Loaded	88,150	100,380
c. Thermal		
Design Heat Rejection (kW)	24	24
Maximum Per Assy Heat Load (kW)	1.2	1.2
Maximum Burnup (GWD/MTU)	45	45
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.55	186.55
Cross Section	67.19	67.19
Cavity Length	169.6	167.1
Wall Thickness	0.50	0.50
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/B-Al/Al	SS/B-Al/Al
Shield Plugs	Steel	Steel
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-7}	1×10^{-7}
i. Transport Cask	NUHOMS®-MP197HB*	NUHOMS®-MP197HB*

*Proposed under Certificate of Compliance 71-9302, Revision 6, currently under NRC review.

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,33,34]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -32PT-L100	**NUHOMS® -32PT-L125**
a. Capacity (intact assemblies)	32 PWR	32 PWR
b. Weight (lb)		
Empty	45,460	47,560
Loaded	89,140	101,380
c. Thermal		
Design Heat Rejection (kW)	24	24
Maximum Per Assy Heat Load (kW)	1.2	1.2
Maximum Burnup (GWD/MTU)	45	45
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	192.55	192.55
Cross Section	67.19	67.19
Cavity Length	175.6	173.1
Wall Thickness	0.50	0.50
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/B-Al/Al	SS/B-Al/Al
Shield Plugs	Steel	Steel
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-7}	1×10^{-7}
i. Transport Cask	NUHOMS®-MP197HB*	NUHOMS®-MP197HB*

*Proposed under Certificate of Compliance 71-9302, Revision 6, currently under NRC review.

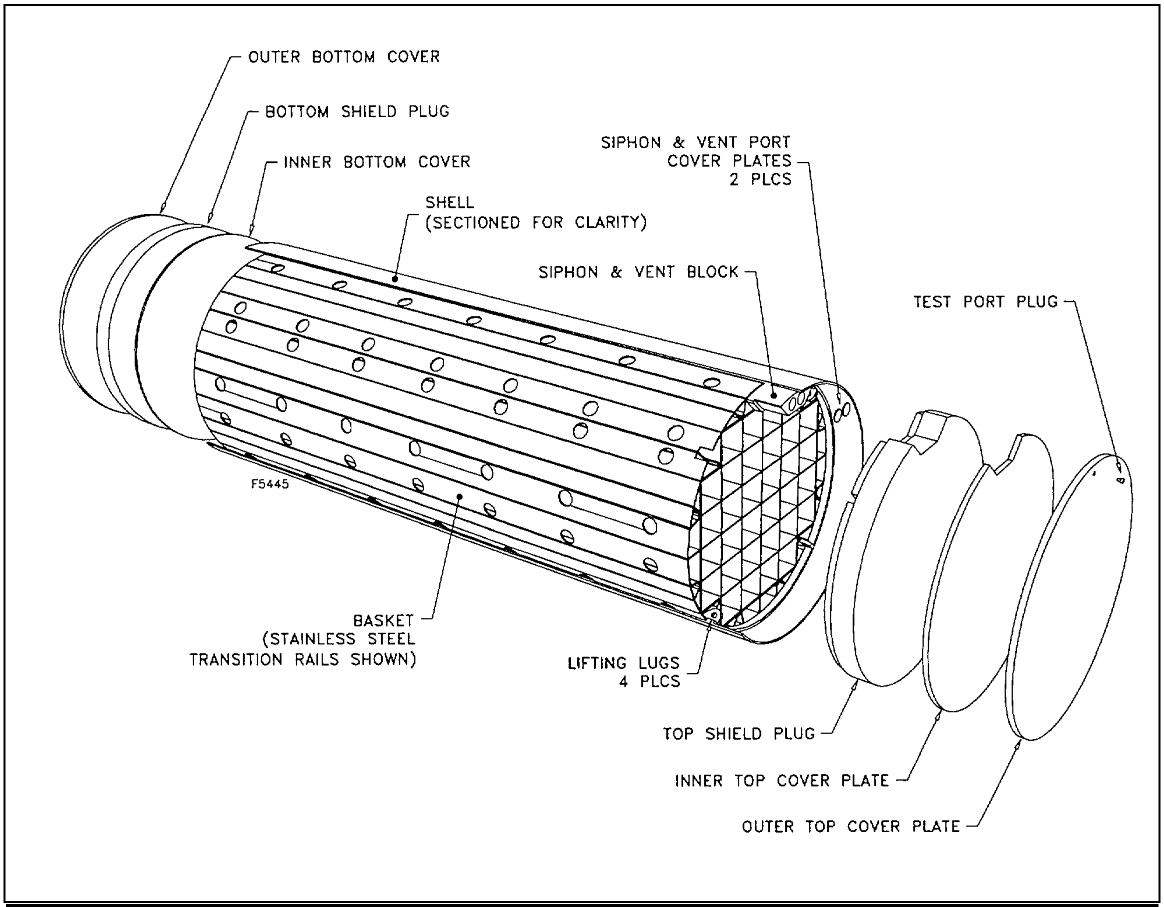
Licensing Status

The NUHOMS®-32PT canisters are included within Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015.

Extent of Commercial Use (as of March 2013)

- 18 NUHOMS®-32PT DSCs have been loaded at Dominion’s Millstone NPP.
- 8 NUHOMS®-32PT DSCs have been loaded at Dominion’s Kewaunee NPP.
- 10 NUHOMS®-32PT DSCs have been loaded at Omaha Public Power District’s Fort Calhoun NPP.
- 6 NUHOMS®-32PT DSCs have been loaded at Constellation’s Ginna NPP.
- 11 NUHOMS®-32PT DSCs have been loaded at Entergy’s Palisades NPP.
- 32 NUHOMS®-32PT DSCs have been loaded at NextEra Energy’s Point Beach NPP.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-32PT DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,29,30,33,34]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -32PTH NUHOMS® -32PTH Type 1	**NUHOMS® -32PTH1-S-M-L**
a. Capacity (intact assemblies)	32 PWR	32 PWR
b. Weight (lb)		
Empty	58,000	58,000
Loaded	108,850	108,850
c. Thermal		
Design Heat Rejection (kW)	34.8	40.8
Maximum Per Assy Heat Load (kW)	1.2	1.5
Maximum Burnup (GWD/MTU)	60	62
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	193.0	185.75/193/198.5
Cross Section	69.75	69.75
Cavity Length	171.63	164.5/172.0/181.5
Wall Thickness	0.5	0.5
f. Materials of Construction		
Canister Body	SS	SS
Basket	SS/B-Al/Boral/MMC	SS/B-Al/Boral/MMC
Shield Plugs	Steel	Steel
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-7}	1 x 10^{-7}
i. Transport Cask	NUHOMS®-MP197HB*	NUHOMS®-MP197HB*

*Proposed under Certificate of Compliance 71-9302, Revision 6, currently under NRC review.

Licensing Status

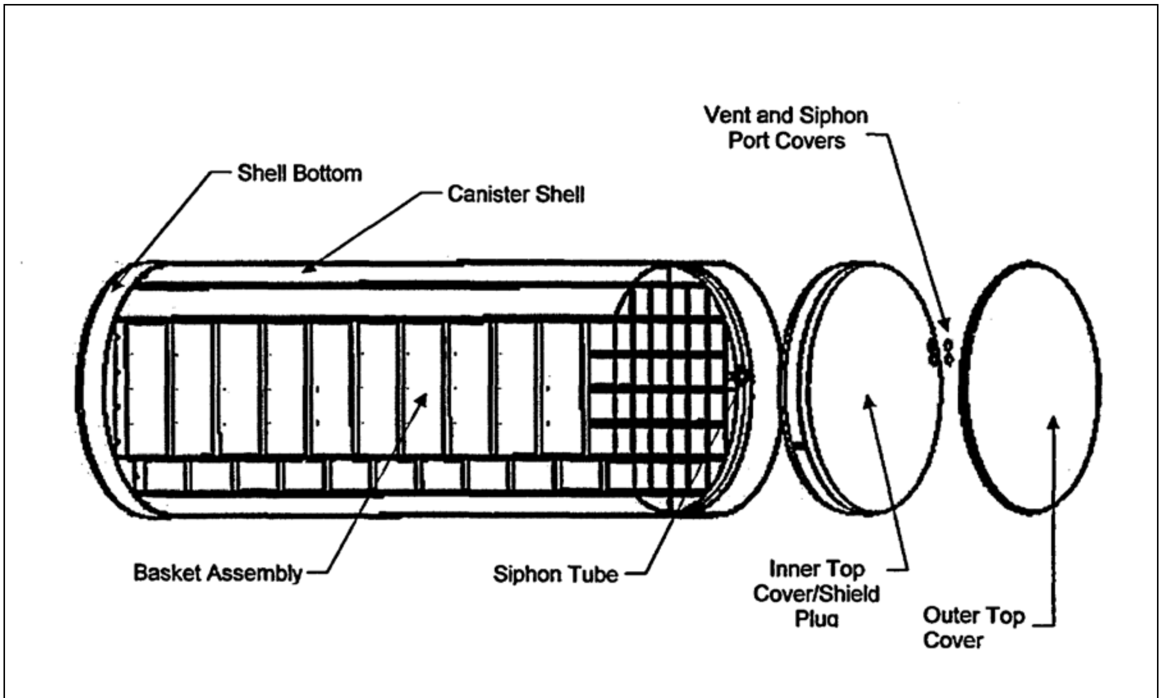
The NUHOMS®-32PTH and NUHOMS®-32PTH Type 1 canisters are included within Certificate of Compliance 72-1030, Amendment 1, which expires on January 10, 2027.

The NUHOMS®-32PTH -S-M-L canisters are included within Certificate of Compliance 72-1004, Amendment 9, which expires on January 23, 2015.

Extent of Commercial Use (as of March 2013)

- 22 NUHOMS®-32PTH DSCs have been loaded at Dominion's Surry NPP.
- 13 NUHOMS®-32PTH DSCs have been loaded at Dominion's North Anna NPP.
- 18 NUHOMS®-32PTH DSCs have been loaded at Florida Power & Light's Turkey Point NPP.
- 14 NUHOMS®-32PTH DSCs have been loaded at Florida Power & Light's St. Lucie NPP.
- 6 NUHOMS®-32PTH DSCs have been loaded at NextEra Energy's Seabrook NPP.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-32PTH DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[31]

Attribute	Type of Dry Shielded Canister
	NUHOMS® -32PTH2
a. Capacity (intact assemblies)	32 PWR
b. Weight (lb)	
Empty	56,170
Loaded	110,000
c. Thermal	
Design Heat Rejection (kW)	37.2
Maximum Per Assy Heat Load (kW)	1.5
Maximum Burnup (GWD/MTU)	62.5
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	198.5 max
Cross Section	69.75
Cavity Length	178.65 min
Wall Thickness	0.63
f. Materials of Construction	
Canister Body	SS
Basket	SS/Al/MMC
Shield Plugs	Steel
g. Cavity Atmosphere	He
h. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-7}
i. Transport Cask	Will be included in MP197HB in future revisions.

Licensing Status

The NUHOMS®-32PTH2 system is included in Amendment 3 to Certificate of Compliance 72-1029, Advanced Standardized NUHOMS® System, which is currently under NRC review.

Extent of Commercial Use (as of March 2013)

No NUHOMS®-32PTH2 DSCs have been loaded at this time.

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,33,34]

Attribute	Type of Dry Shielded Canister
	NUHOMS® -37PTH-S/37PTH-M
a. Capacity (intact assemblies)	37 PWR / 37 PWR
b. Weight (lb)	
Empty	46,400/47,700
Loaded	108,100/109,300
c. Thermal	
Design Heat Rejection (kW)	30.0
Maximum Per Assy Heat Load (kW)	1.2
Maximum Burnup (GWD/MTU)	62
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	182.00 max / 189.25 max
Cross Section	69.75
Cavity Length	164.38 min / 171.63 min
Wall Thickness	0.5
f. Materials of Construction	
Canister Body	SS
Basket	SS/B-Al/Boral/MMC
Shield Plugs	Steel
g. Cavity Atmosphere	He
h. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-7}
i. Transport Cask	NUHOMS®-MP197HB*

*Proposed under Certificate of Compliance 71-9302, Revision 6, currently under NRC review.

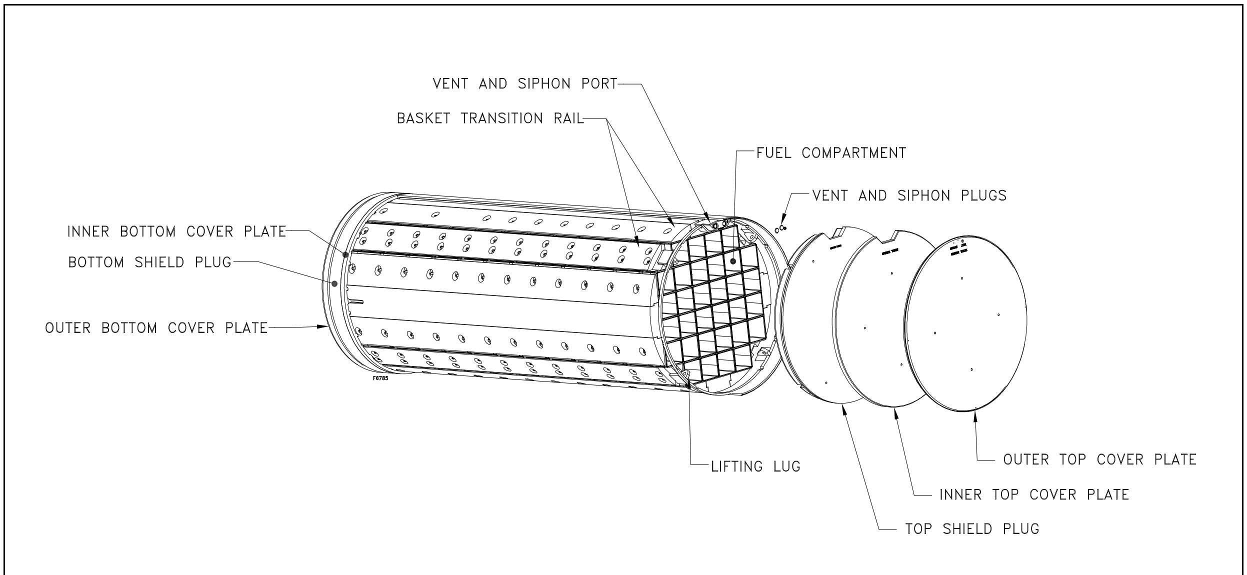
Licensing Status

The NUHOMS®-37PTH system is included in Amendment 13 to Certificate of Compliance 72-1004, Standardized NUHOMS® System, which is currently under NRC review.

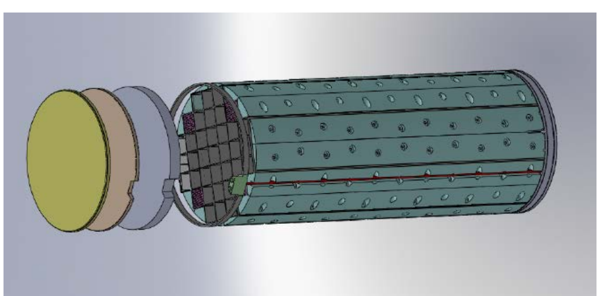
Extent of Commercial Use (as of March 2013)

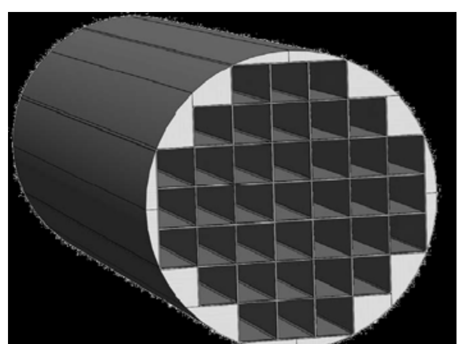
No NUHOMS®-37PTH DSCs have been loaded at this time.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-32PTH2 DSC





NUHOMS®-32PTH2 DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[32,35]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® FO-DSC	NUHOMS® FC-DSC
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Weight (lb)		
Empty	43,890	41,230
Loaded	80,710	81,120
c. Thermal		
Design Heat Rejection (kW)	13.5	13.5
Maximum Per Assy Heat Load (kW)	0.764	0.764
Maximum Burnup (GWD/MTU)	40	40
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.2	186.2
Cross Section	67.19	67.19
Cavity Length	167	173
Wall Thickness	0.625	0.625
f. Materials of Construction		
Canister Body	SS	SS
Basket	CS/Al-B Sheets	CS/Al-B Sheets
Shield Plugs	CS	Steel/Pb
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	N/A	N/A
i. Transport Cask	NUHOMS®-MP187	NUHOMS®-MP187

N/A denotes Not Available

NUHOMS® Dry Shielded Canister (Continued)

Specifications[32,35]

Attribute	Type of Dry Shielded Canister
	NUHOMS® FF-DSC
a. Capacity (intact assemblies)	13 PWR
b. Weight (lb)	
Empty	48,220
Loaded	74,900
c. Thermal	
Design Heat Rejection (kW)	9.93
Maximum Per Assy Heat Load (kW)	0.764
Maximum Burnup (GWD/MTU)	40
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	186.2
Cross Section	67.19
Cavity Length	173
Wall Thickness	0.625
f. Materials of Construction	
Canister Body	SS
Basket	CS Discs/Stainless Cans
Shield Plugs	Steel/Pb
g. Cavity Atmosphere	He
h. Maximum Leak Rate (atm-cm^3/sec)	N/A
i. Transport Cask	NUHOMS®-MP187

N/A denotes Not Available

Licensing Status

The NUHOMS® FO-DSC, FC-DSC, and FF-DSC canisters are licensed for storage at Rancho Seco Nuclear Generating Station under Site-Specific license SNM-2510. The NUHOMS® FO-DSC, FC-DSC, and FF-DSC canisters are licensed for transport under Certificate of Compliance 71-9255.

Extent of Commercial Use (as of March 2013)

Two NUHOMS® FO-DSCs, 18 NUHOMS® FC-DSCs, and 1 NUHOMS® FF-DSC are licensed and in use for used nuclear fuel storage at the Rancho Seco Nuclear Generating Station.

Comments

The NUHOMS® FO-DSC and FC-DSCs are designed for 24 intact PWR assemblies with and without control components, respectively. The NUHOMS® FF-DSC can accommodate 13 damaged fuel assemblies without control components, each contained within a failed fuel can.

NUHOMS® Dry Shielded Canister (Continued)

Specifications[31,32]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -24PT1	**NUHOMS® -24PT4**
a. Capacity (intact assemblies)	24 PWR	24 PWR
b. Weight (lb)		
Empty	46,700	47,450
Loaded	78,400	85,000
c. Thermal		
Design Heat Rejection (kW)	14	24
Maximum Per Assy Heat Load (kW)	0.583	1.26
Maximum Burnup (GWD/MTU)	45	60
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.5	196.3
Cross Section	67.19	67.2
Cavity Length	167.0	180.2
Wall Thickness	0.625	0.53
f. Materials of Construction		
Canister Body	SS	SS
Basket	CS/Boron plates	Steel/Boral
Shield Plugs	CS	SS/Pb
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-7}	ANSI N14.5-1997
i. Transport Cask	NUHOMS®-MP187	NUHOMS®-MP197

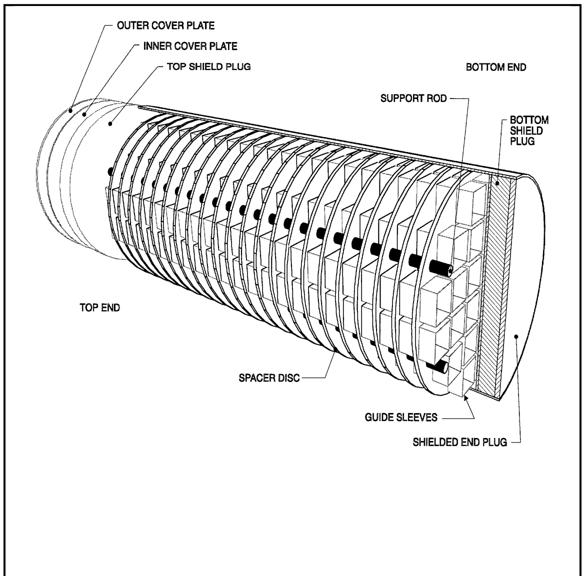
Licensing Status

The NUHOMS®-24PT1 and -24PT4 canisters are licensed for storage with the Standardized Advanced NUHOMS® System under Certificate of Compliance 72-1029, Amendment 1, which expires February 5, 2023. The NUHOMS®-24PT1 DSC is licensed for transport under Certification of Compliance 71-9255, Revision 10, which expires on November 30, 2013.

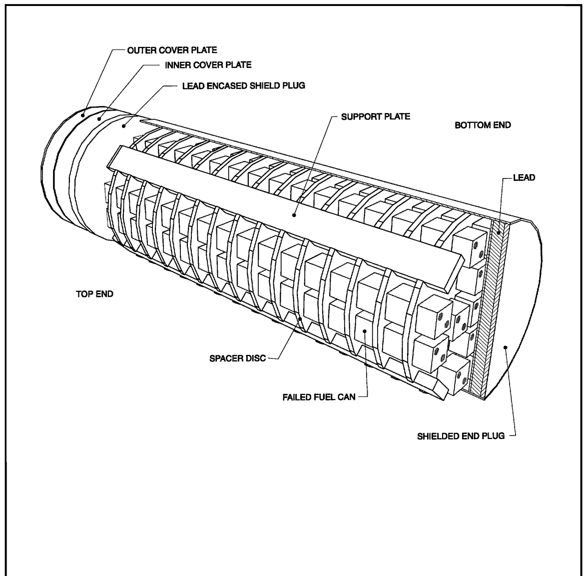
Extent of Commercial Use (as of March 2013)

- 18 NUHOMS®-24PT1 DSCs have been loaded at Southern California's Edison's San Onofre NPP.
- 33 NUHOMS®-24PT4 DSCs have been loaded at Southern California's Edison's San Onofre NPP.

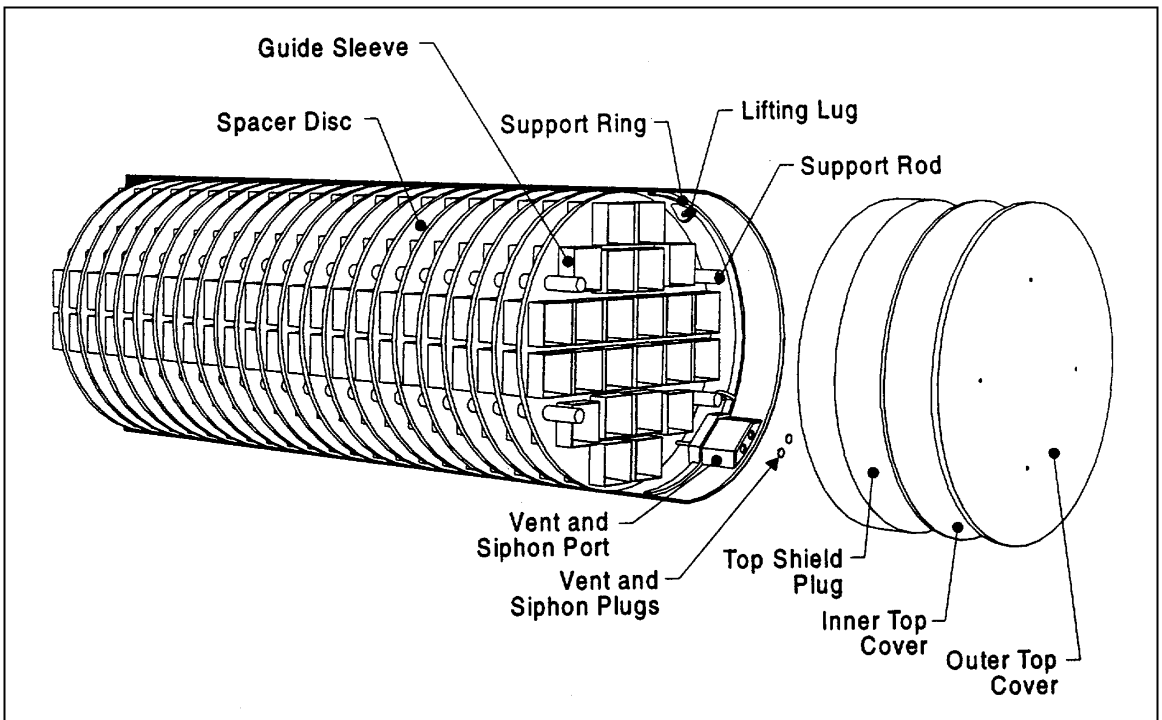
NUHOMS® Dry Shielded Canister (Continued)



NUHOMS® FO-DSC and FC-DSC

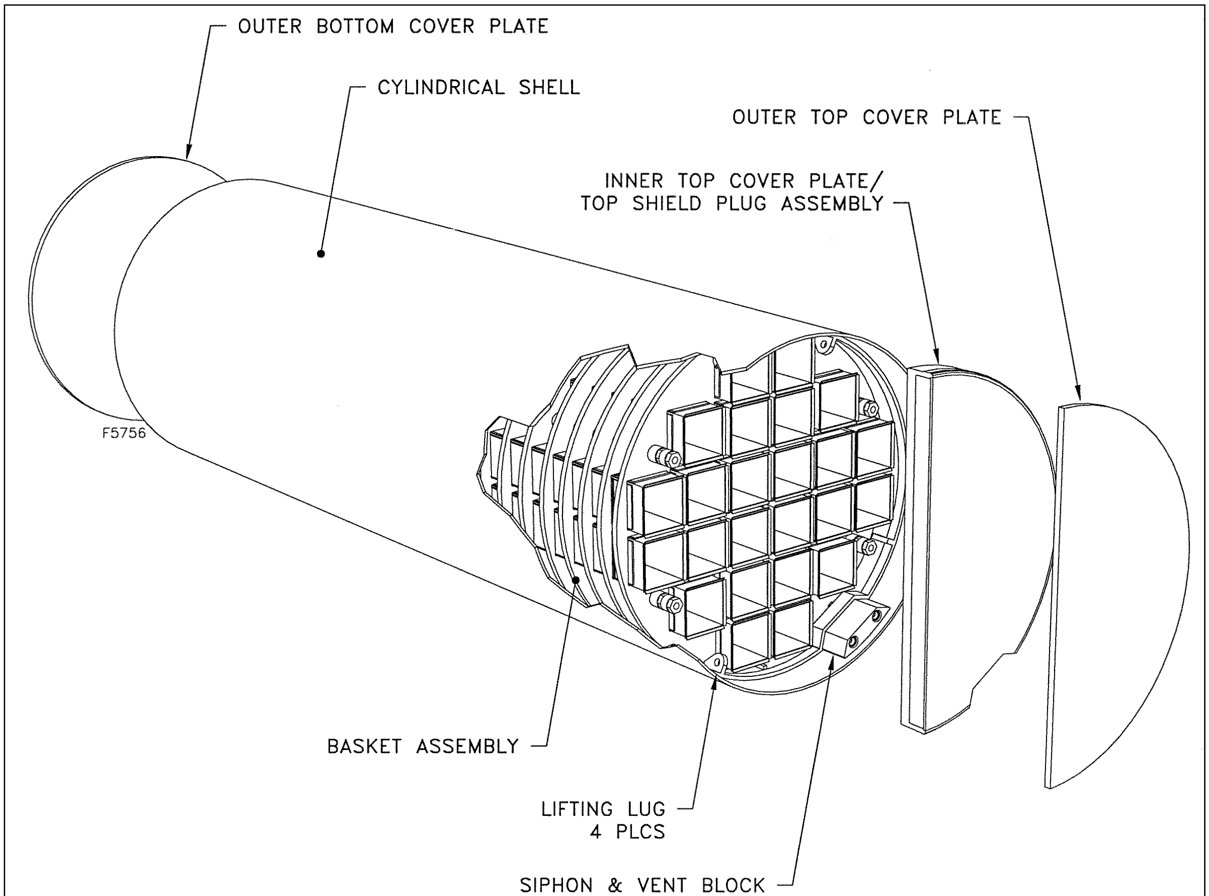


NUHOMS® FF-DSC



NUHOMS®-24PT1 DSC

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-24PT4 DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,33,34]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -52B	**NUHOMS® -61BT**
a. Capacity (intact assemblies)	52 BWR	61 BWR
b. Weight (lb)		
Empty	37,225	45,390
Loaded	74,925	88,390
c. Thermal		
Design Heat Rejection (kW)	19.24	18.3 stor /15.89 trans
Maximum Per Assy Heat Load (kW)	0.37	0.30 stor / 0.26 trans
Maximum Burnup (GWD/MTU)	35	40
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	196.0	195.92
Cross Section	67.19	67.25
Cavity Length	177.5	179.5
Wall Thickness	0.625	0.500
f. Materials of Construction		
Canister Body	SS	SS
Basket	CS/B-SS	CS/B-Al/Al
Shield Plugs	CS	CS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-4}	1 x 10^{-7}
i. Transport Cask	Not Licensed for Transport	NUHOMS®-MP197 NUHOMS®-MP197HB

Licensing Status

The NUHOMS®-52B and -61BT canisters are licensed for storage with the Standardized NUHOMS® System under Certificate of Compliance 72-1004, Amendment 10, which expires on January23, 2015. The NUHOMS®-61BT canister is licensed for transport under Certificate of Compliance 71-9302, Revision 5, which expires on August 31, 2014.

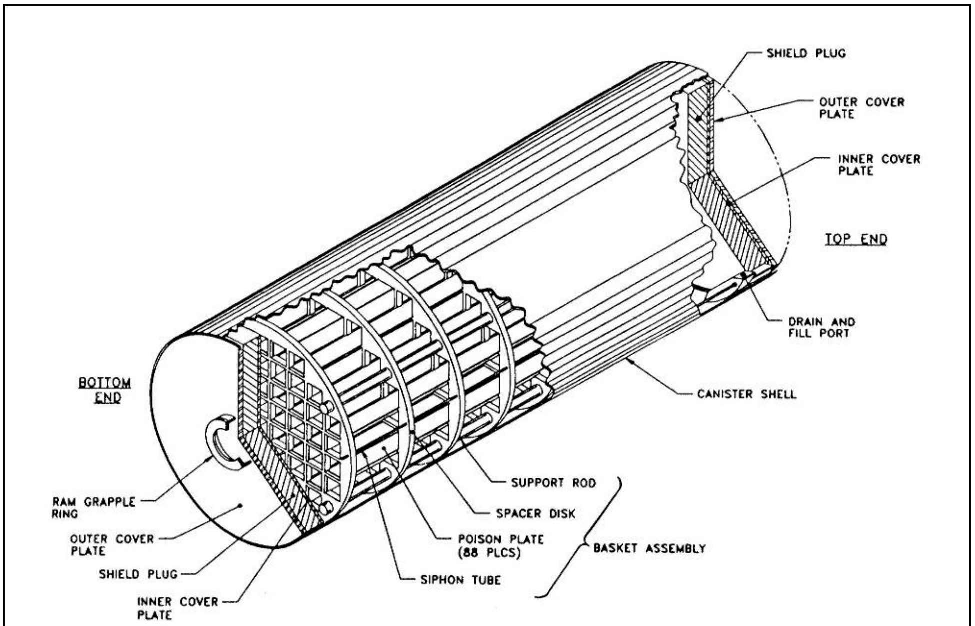
Extent of Commercial Use (as of March 2013)

- 27 NUHOMS®-52B DSCs have been loaded at Pennsylvania Power & Light's (PPL) Susquehanna NPP.
- 44 NUHOMS®-61BT DSCs have been loaded at PPL's Susquehanna NPP.
- 23 NUHOMS®-61BT DSCs have been loaded at Exelon's Oyster Creek NPP.
- 20 NUHOMS®-61BT DSCs have been loaded at NextEra Energy's Duane Arnold NPP.
- 19 NUHOMS®-61BT DSCs have been loaded at Exelon's Limerick NPP.
- 10 NUHOMS®-61BT DSCs have been loaded at Northern States Power's Monticello NPP.
- 8 NUHOMS®-61BT DSCs have been loaded at Nebraska Public Power District's Cooper NPP.
- 6 NUHOMS®-61BT DSCs have been loaded at Constellation's Nine Mile Point NPP.

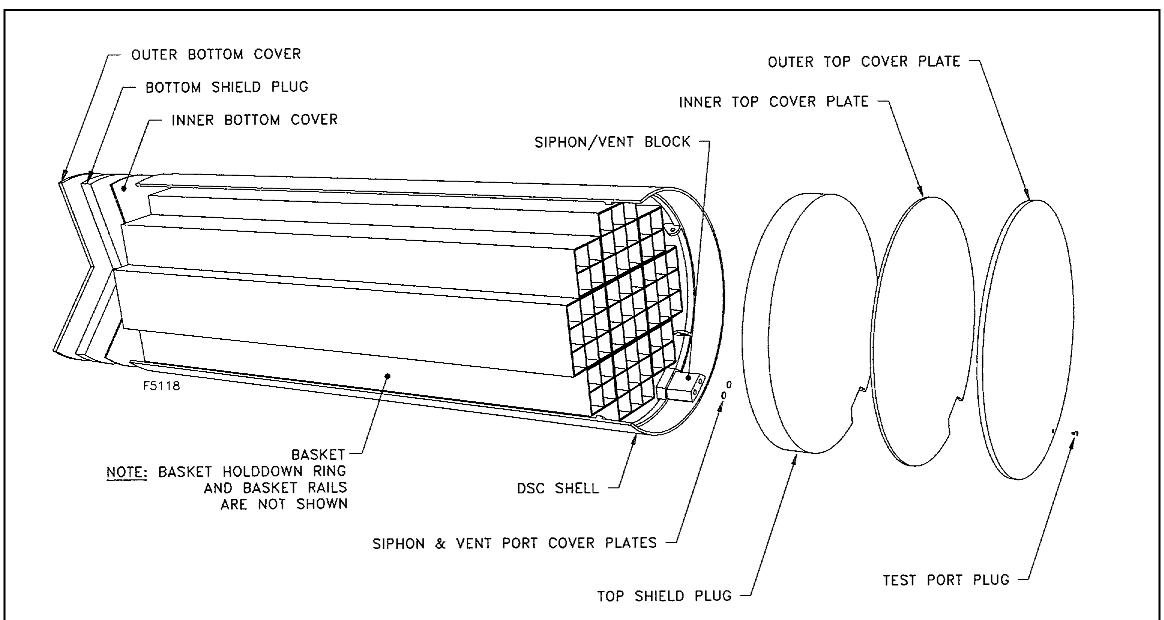
Comments

The NUHOMS®-61BT canister is licensed for storage at a total heat load of 18.3 kW. It is licensed for transport at a lower total heat load of 15.9 kW.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-52B DSC



NUHOMS®-61BT DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[27,28,33,34]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -61BTH	**NUHOMS® -69BTH**
a. Capacity (intact assemblies)	61 BWR	69 BWR
b. Weight (lb)		
Empty	50,120	57,000
Loaded	93,120	106,000
c. Thermal		
Design Heat Rejection (kW)	31.2	26 to 32
Maximum Per Assy Heat Load (kW)	0.37	0.7
Maximum Burnup (GWD/MTU)	62 storage – 45 transport*	45 transport*
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	196.0	196.0
Cross Section	67.0	69.75
Cavity Length	179.5	179.0
Wall Thickness	0.500	0.500
f. Materials of Construction		
Canister Body	SS	SS
Basket	CS/B-Al/MMC/Boral/Al	CS/B-Al/MMC/Boral/Al
Shield Plugs	CS	CS
g. Cavity Atmosphere	He	He
h. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-4}	1×10^{-7}
i. Transport Cask	NUHOMS®-MP197 NUHOMS®-MP197HB	NUHOMS®-MP197 NUHOMS®-MP197HB

*Average burnup.

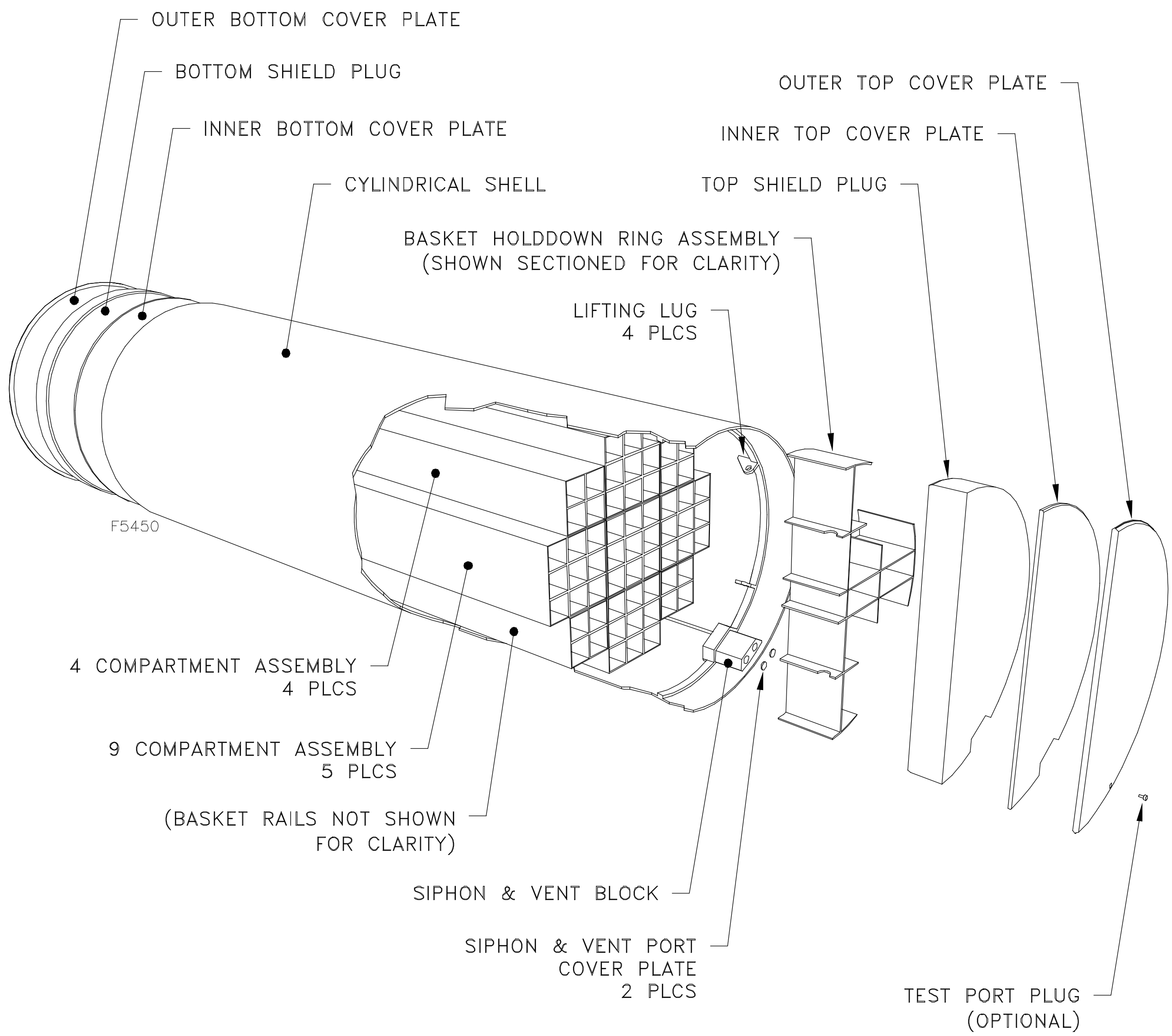
Licensing Status

The NUHOMS®-61BTH canisters are licensed for storage with the Standardized NUHOMS® System under Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015. The NUHOMS®-61BTH canister is licensed for transport under Certificate of Compliance 71-9302, Revision 5, which expires on August 31, 2017 (Maximum Burnup 40 GWd/MTU). The NUHOMS®-69BTH canister is licensed for transport under Certificate of Compliance 71-9302, Revision 5, which expires on August 31, 2017 (Maximum Burnup 40 GWd/MTU).

Extent of Commercial Use (as of March 2013)

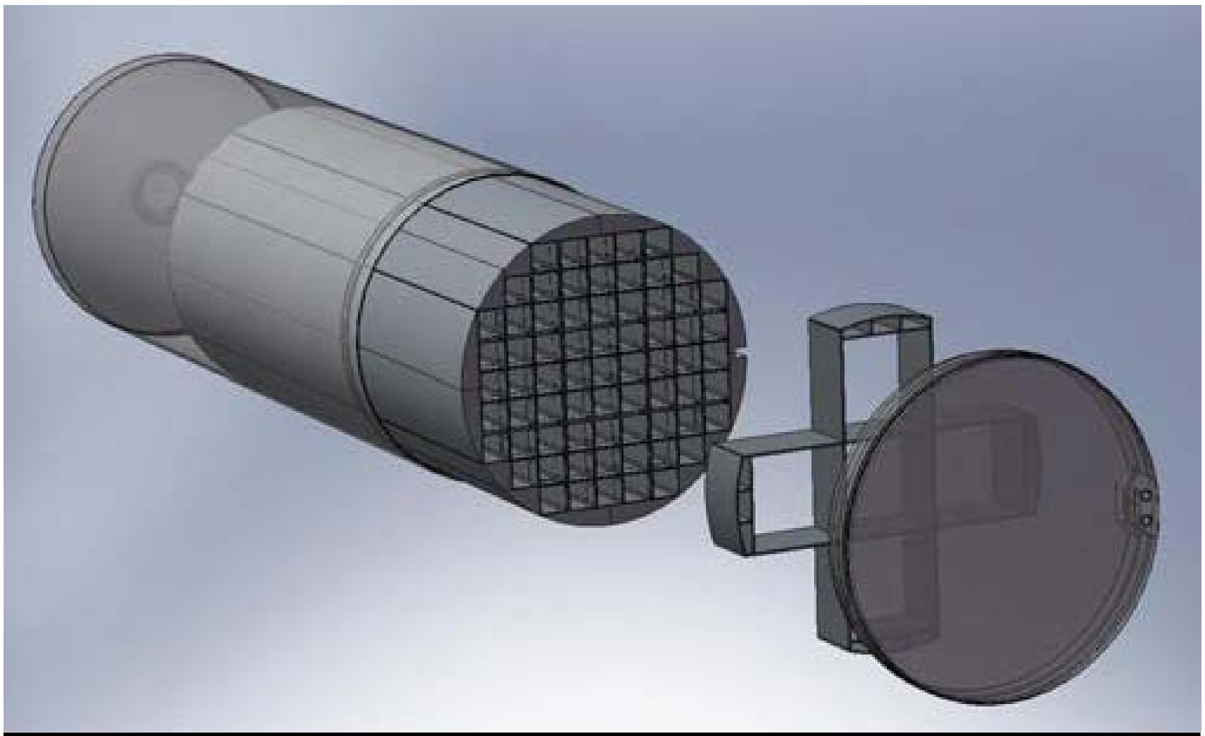
Twelve NUHOMS®-61BTH DSCs have been loaded at Duke Energy's Brunswick NPP. The NUHOMS®-61BTH DSCs are also in use at Exelon's Oyster Creek.

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-61BTH DSC

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-69BTH DSC

NUHOMS® Dry Shielded Canister (Continued)

Specifications[36,37]

Attribute	Type of Dry Shielded Canister	
	NUHOMS® -12T	**NUHOMS® -07P**
a. Capacity (intact assemblies)	12 TMI-2 fuel debris canisters	7 PWR
b. Weight (lb)		
Empty	N/A	N/A
Loaded	<70,000	22,000
c. Thermal		
Design Heat Rejection (kW)	0.86	7.0
Maximum Fuel Clad Temp. (^oF)	N/A	<716
Maximum Burnup (GWD/MTU)	3.2	N/A
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	163.5	179
Cross Section	67.2	37
Cavity Length	151	163.5
Wall Thickness	0.625	0.50
f. Materials of Construction		
Canister Body	CS	SS
Basket	CS	SS/Al-B
Shield Plugs	CS	Pb
g. Cavity Atmosphere	Air	He
h. Maximum Leak Rate (atm-cm^3/sec)	N/A	1×10^{-4}
i. Transport Cask	MP-187	Not licensed for transport

N/A denotes Not Available

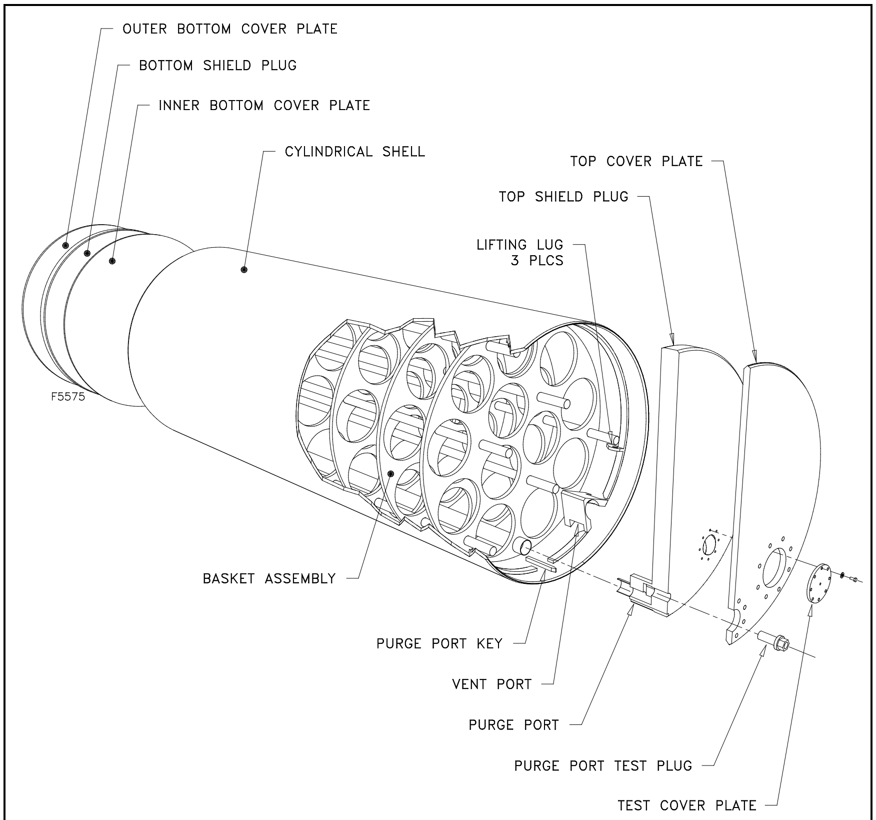
Licensing Status

The NUHOMS® -07P used fuel storage system is licensed under site specific license SNM-2502 for use at Duke Energy's H. B. Robinson NPP. On March 19, 1999, the NRC issued SNM-2508 for the storage of TMI-2 fuel debris using the NUHOMS®-12T used fuel storage system at DOE's INL site.

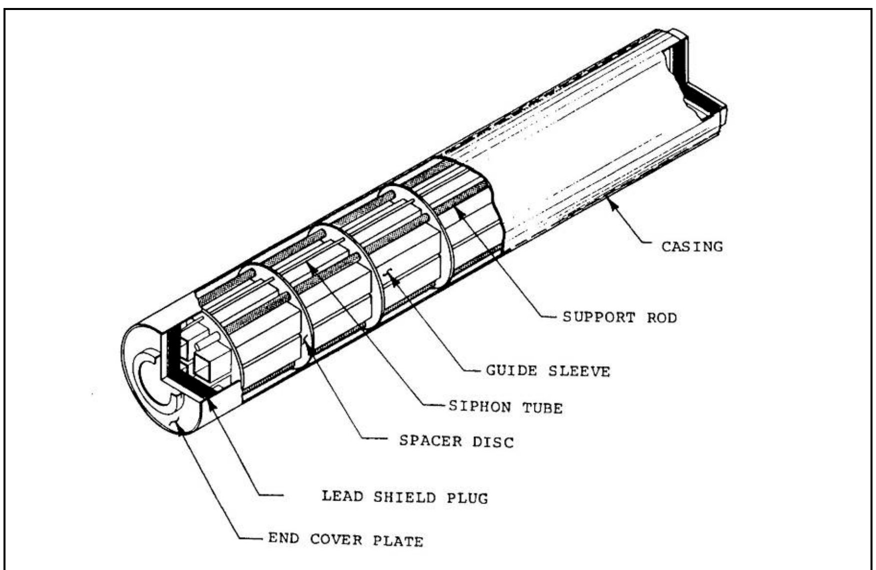
Extent of Commercial Use (as of March 2013)

- 8 NUHOMS® -07Ps were delivered and loaded at Duke Energy's H.B. Robinson NPP.
- DOE-ID has completed the transfer and loading of all 29 NUHOMS®-12T DSCs at the INL, storing a total of 345 TMI-2 canisters

NUHOMS® Dry Shielded Canister (Continued)



NUHOMS®-12T DSC



NUHOMS®-07P DSC

NUHOMS® Transfer Casks

Description

The transfer cask is used for transfer operations within the Used Fuel Pool Building and for transfer operations to/from the HSM. The transfer cask is a cylindrical vessel with a bottom end closure assembly and a bolted top cover plate. Upper and lower trunnions are used for rotation, lifting, and support during the transfer to the ISFSI.

Specifications[27,28,29,30,31]

Attribute	Type of Transfer Cask				
	OS197 / OS197H / OS197FC	OS187H	Standardized	OS197L	OS200
a. Capacity (DSC)	1 DSC	1 DSC	1 DSC	1 DSC	1 DSC
b. Maximum Weight (lb)					
Empty Weight, w/o Collar	111,250	119,920	107,091	62,000	130,300
Empty Weight, with Collar	N/A	N/A	113,501	N/A	N/A
c. Shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical
d. Dimensions (in)					
Overall Length, w/o Collar	N/A	197.1	N/A	207.22	211
Overall Length, with Collar	N/A	N/A	N/A	N/A	N/A
Nominal Cross Section	N/A	92.2	85.25	80.36	92.11
Cavity Length	196.75	186	196.75	197.75	199.25
Cavity Cross Section	68	70.5	68	68	70.5
e. Neutron Shield Thickness (in)	3.0	5.0	3.0	3.0	4.93
f. Materials of Construction					
Cask Body	SS/Pb	SS/Pb	SS/Pb	SS	SS
Neutron Shield	Clean Water	Demineralized (Demin) Water	Clean Water	Clean Water	Demin Water
g. Outside Surface Dose (mrem/hr)	ALARA	ALARA	ALARA	ALARA	ALARA

N/A denotes Not Available

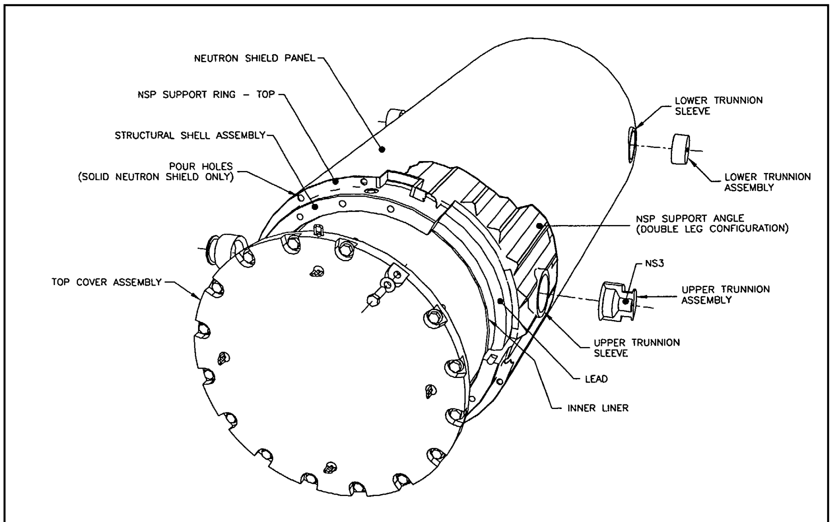
Licensing Status

The OS197, OS197H, and Standardized Transfer Casks are licensed for on-site transfer under Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015. The OS197 is also licensed for on-site transfer under Certificate of Compliance 72-1029, Amendment 0, which expires on February 5, 2023. The OS187H is used with the Certificate of Compliance 72-1030, the NUHOMS®-HD storage system. The OS200 is licensed for on-site transfer under Certificate of Compliance 72-1004, Amendment 10, which expires on January 23, 2015. The OS197L is proposed in Certificate of Compliance 72-1004, Amendment 11, currently under NRC review.

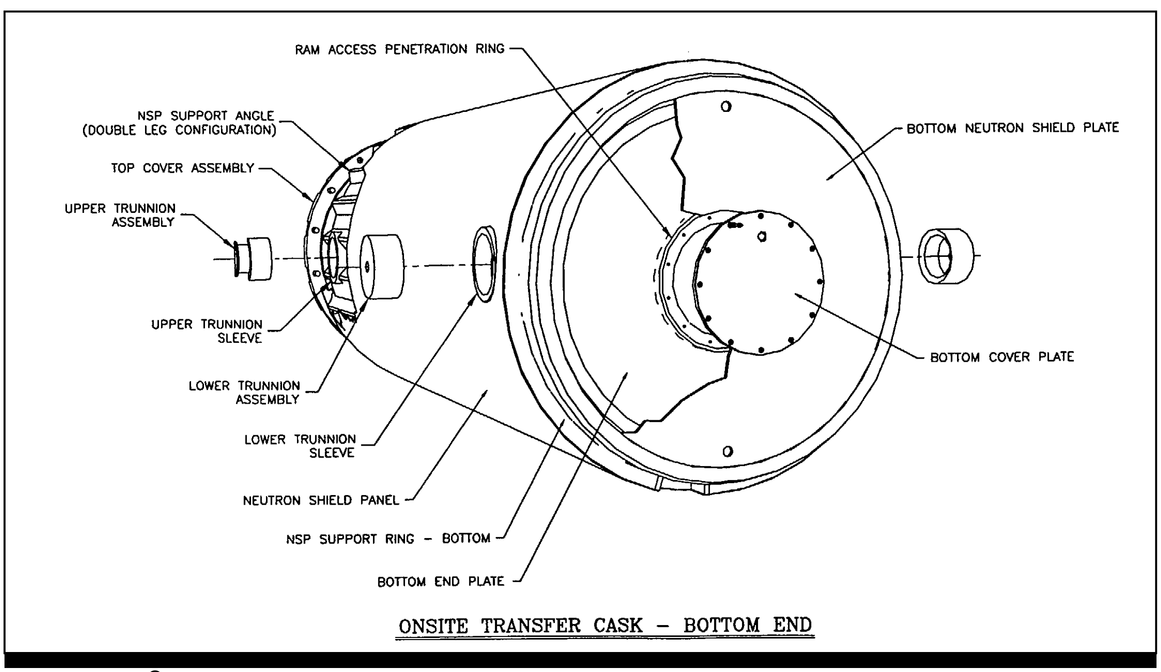
NUHOMS® Transfer Casks (Continued)

Comments

To accommodate BWR fuel in the standardized transfer cask, a cask collar is used which extends the cavity length by 10 inches. The OS197 transfer casks have a cavity length that can accept BWR fuel without a collar. To accommodate PWR fuel, the OS197 transfer casks use a spacer within the cavity.



NUHOMS® Onsite Transfer Cask – Top End



NUHOMS® Onsite Transfer Cask – Bottom End

NUHOMS® Transport Casks

Description

Two transport casks have been licensed for the off-site transport of loaded DSCs originating from either the used fuel pool or from storage within a HSM. These transport casks also have the capability to be used as on-site transfer casks between the fuel pool and the storage pad. Both casks are similar in design and consist of concentric stainless steel-lead-stainless steel cylindrical shells with neutron shielding provided by borated polyester resin.

Specifications[32,33,34]

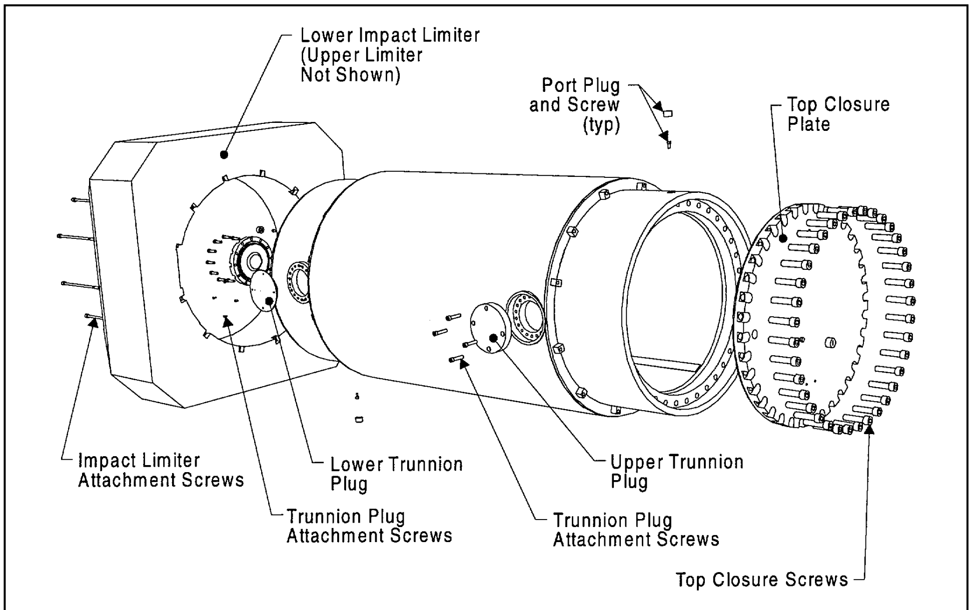
Attribute	Type of Transport Cask		
	NUHOMS® -MP187	**NUHOMS® -MP197**	**NUHOMS® -MP197HB**
a. Capacity (DSC)	1 NUHOMS® FO-DSC, FC-DSC, FF-DSC, or -24PT1 DSC	1 NUHOMS®-61BT DSC	1 NUHOMS®-61BT -61BTH, -69BTH, or -24PT4 DSC
b. Weight (lb)			
Empty Cask w/o Impact Limiters	158,600	148,840	154,000
Impact Limiters	31,600	27,870	25,000 (including thermal shield and attachments)
Cask w/ Impact Limiters, NUHOMS FO-DSC	270,900	n/a	n/a
Cask w/ Impact Limiters, NUHOMS FC-DSC	271,300	n/a	n/a
Cask w/ Impact Limiters, NUHOMS FF-DSC	265,100	n/a	n/a
Cask w/ Impact Limiters, NUHOMS-24PT1 DSC	268,800	n/a	n/a
Cask w/ Impact Limiters, NUHOMS-61BT DSC	n/a	265,100	267,390
c. Shape	Cylindrical	Cylindrical	Cylindrical
d. Dimensions (in)			
Overall Length w/o impact limiters	201.5	208	210.25
Overall Length w/ impact limiters	308	281.25	271.25
Overall Cross Section w/o impact limiters	92.5	91.5	97.5
Overall Cross Section w/ impact limiters	126.75	122	126
Cavity Length	187	197	199.25
Cavity Cross Section	68	68	70.5/68 with internal sleeve
Lid Thickness	6.5	4.5	4.5
Bottom Thickness	8.0	6.5	6.5
e. Neutron Shield Thickness (in)	4.5	4.5	6.25
f. Materials of Construction			
Cask Body	SS/Pb	SS/Pb	SS/Pb
Neutron Shield	Hydrogenous Neutron Absorbing Material	Hydrogenous Neutron Absorbing Material	Hydrogenous Neutron Absorbing Material
Impact Limiters	SS/Polyurethane Foam/Al Honeycomb	SS/Balsa/Redwood	SS/Balsa/Redwood
Cask Seals	Metallic O-Rings	Fluorocarbon O-Rings	Fluorocarbon O-Rings
g. Cask Cavity Atmosphere	Air	He	He
h. Outside Surface Dose (mrem/hr)	<1000 @ package surface, <200 @ vehicle edge <10 @ 2m	<1000 @ package surface, <200 @ vehicle edge <10 @ 2m	1000 @ package surface, <200 @ vehicle edge <10 @ 2m
i. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-7}	1 x 10^{-7}	1 x 10^{-7}

n/a denotes not applicable

NUHOMS® Transport Casks (Continued)

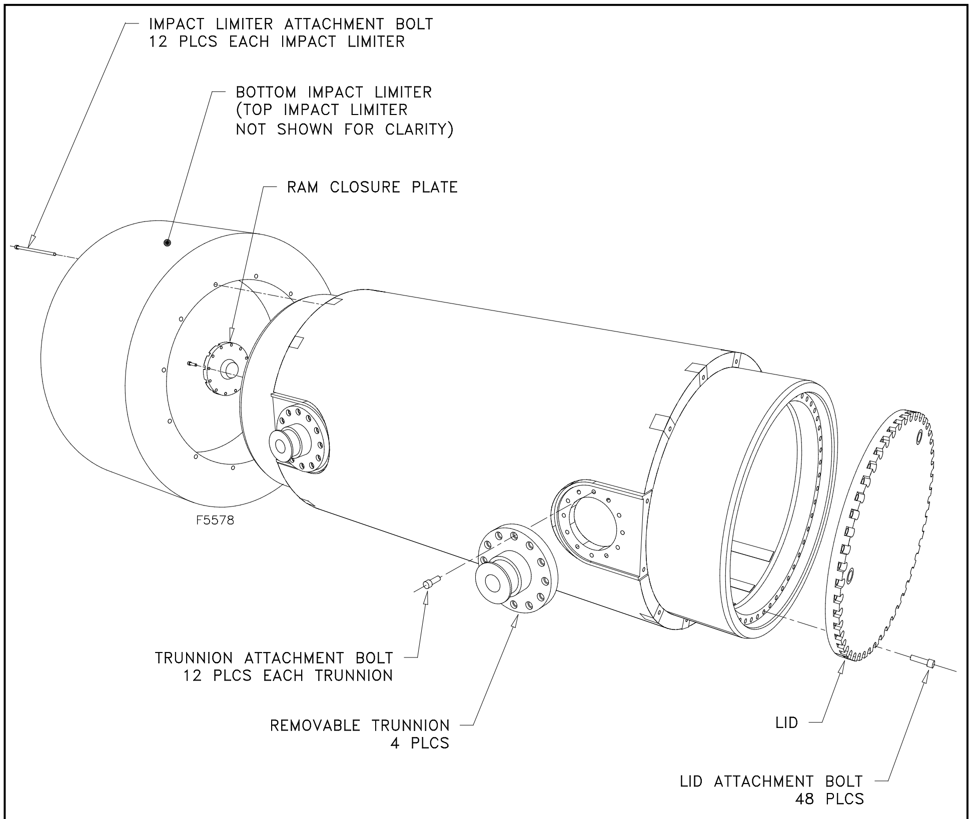
Licensing Status

The MP187 is licensed for transport under Certificate of Compliance 71-9255, Revision 10, which expires on November 30, 2013. The MP197 is licensed for transport under Certificate of Compliance 71-9302, Revision 5, which expires on August 31, 2017. The MP197HB is licensed for transport under Certificate of Compliance 71-9302, Revision 5, which expires on August 31, 2017 (burnup up to 40 GWd/MTU for NUHOMS®-61BT, -61BTH, and, -69BTH, and 45 GWd/MTU for NUHOMS®-24PT4). The MP187 transportation cask cannot be fabricated until the CoC is updated from a -85 certificate to a -96 certificate.



NUHOMS®-MP187 Transport Cask

NUHOMS® Transport Casks (Continued)



NUHOMS®-MP197 Transport Cask

NUHOMS® USED FUEL STORAGE AND TRANSPORT SYSTEM

NUHOMS® Horizontal Storage Modules

Description

The HSM is a reinforced concrete unit that stores the DSC horizontally with penetrations located at the top and bottom for airflow. The DSC Support Structure, a structural steel frame with rails, is installed in the HSM to support the DSC within the HSM and to provide for sliding the DSC into and out of the module.

Specifications[1]

Attribute	Type of Horizontal Storage Module	
	HSM Model 80	**HSM Model 102**
a. Capacity (DSC)	1 per unit	1 per unit
b. HSM Dimensions		
Length	19' (PWR) / 19'10" (BWR)	19' (PWR) / 19'10" (BWR)
Height	15'	15'
Width	9'8"	9'8"
c. Materials of Construction	Concrete/Steel	Concrete/Steel
d. Outside Surface Dose (mrem/hr)	ALARA	ALARA

Attribute	Type of Horizontal Storage Module	
	HSM-H/HS	**Advanced HSM**
a. Capacity (DSC)	1 per unit	1 per unit
b. HSM Dimensions		
Length	20'8"	19'7"
Height	18'6"	20'7"
Width	9'8"	8'5"
c. Materials of Construction	Concrete/Steel	Concrete/Steel
d. Outside Surface Dose (mrem/hr)	ALARA	ALARA

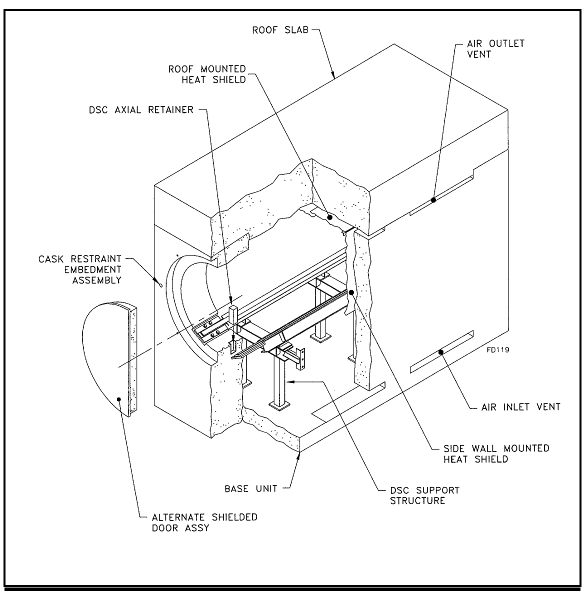
NUHOMS® Horizontal Storage Modules (Continued)

Specifications[1,31]

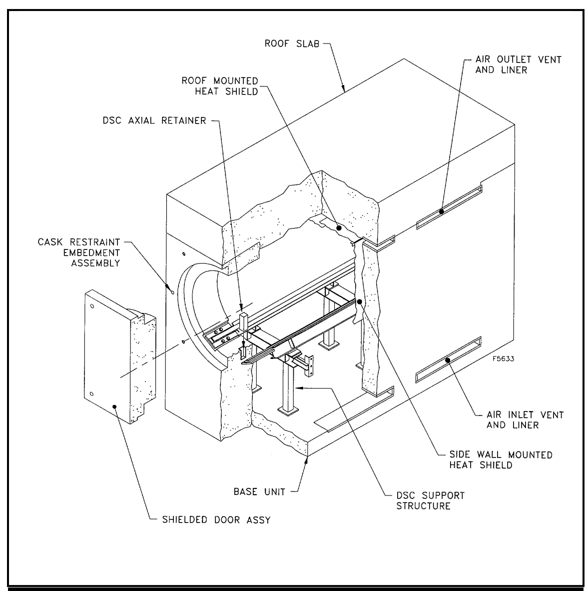
Attribute	Type of Horizontal Storage Module
	Advanced HSM-HS*
a. Capacity (DSC)	1 per unit
b. HSM Dimensions	
Length	20’8”
Height	18’6”
Width	9’8”
c. Materials of Construction	Concrete/Steel
d. Outside Surface Dose (mrem/hr)	ALARA

*The Advanced HSM-HS is proposed in Amendment 3 of Certificate of Compliance 72-1029, currently under NRC review.

Attribute	Type of Horizontal Storage Module	
	NUHOMS-07P HSM	**NUHOMS-12T HSM**
a. Capacity (DSC)	1 per unit	1 per unit
b. HSM Dimensions		
Length	19’5”	18’2”
Height	12’	14’6”
Width	5’7”	10’3”
c. Materials of Construction	Concrete/Steel	Concrete/Steel
d. Outside Surface Dose (mrem/hr)	ALARA	ALARA

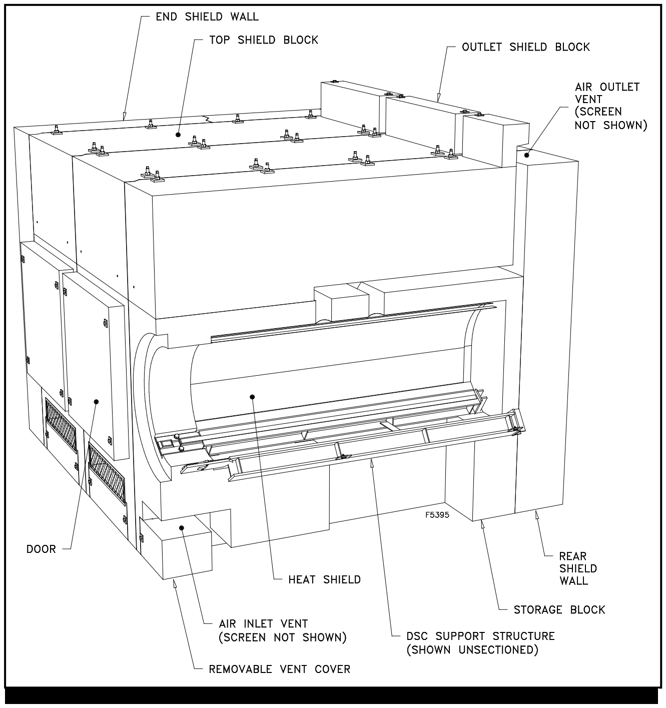


NUHOMS® HSM Model 80

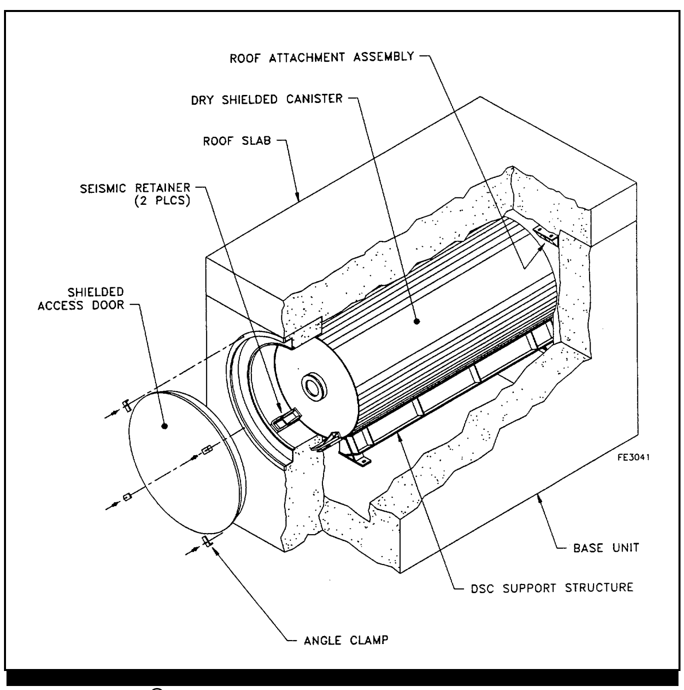


NUHOMS® HSM Model 102

NUHOMS® Horizontal Storage Modules (Continued)

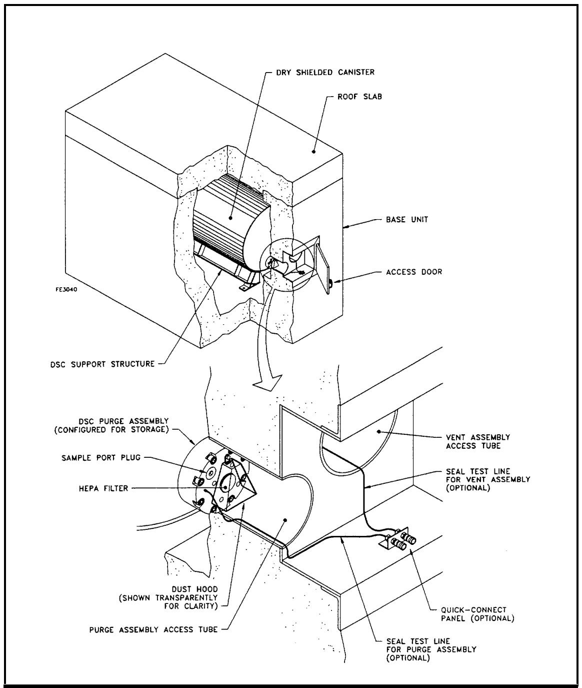


NUHOMS® Advanced HSM

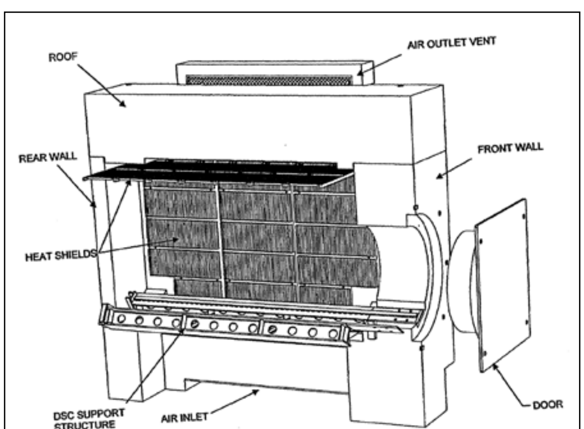


NUHOMS®-07P HSM

NUHOMS® Horizontal Storage Modules (Continued)



NUHOMS®-12T HSM



NUHOMS® HSM-H

NON-CANISTERED STORAGE-ONLY AND DUAL-PURPOSE CASKS

The storage-only and dual-purpose casks that are described in the following pages have the capability to accept bare used fuel assemblies for storage and transport. The attributes of these metal casks have been summarized in Table 4 of the Introduction. Casks that can accept large multiple assembly canisters have been described previously under the section “Canistered Storage/Transport Systems”.

Some of the storage-only casks that are contained in this section may be licensed for transport, in some instances, under specific limiting conditions.

This section describes nine casks that are licensed for use in the U.S.:

(1) CASTOR® V/21 Storage Cask
(2) CASTOR® X/33 Storage Cask
(3) NAC I28 S/T Storage and Transport Cask
(4) REA-2023 Storage Cask
(5) TN-24 Storage Casks
(6) TN-32 Storage Casks
(7) TN-40 Storage and Transport Casks
(8) TN-68 Storage and Transport Cask
(9) MC-10 Storage Cask

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CASTOR® V/21 STORAGE CASK

Contact:
GNS Gesellschaft für Nuklear-Service mbH
Tel: 0201/109-1828
www.gns.de

Introduction

The GNS CASTOR® V/21 cask is a nodular cast iron shielded cask which has the capacity to store 21 PWR used nuclear fuel assemblies. It was designed for both storage and transport of used nuclear fuel, but has only been approved for storage in the U.S. The NRC had previously refused to approve nodular cask iron casks for transport in the U.S. because of brittle fracture concerns. However, the cask is in full compliance with IAEA standards for transportation.

Description

The cask body is formed by casting the sides and bottom in one piece of ductile cast iron in nodular graphite form. The nodular cast iron provides the gamma shielding, and the polyethylene rods inserted into two concentric rows of axial holes drilled into the side walls of the cask provide the neutron shielding. Heat removal is facilitated by circumferential fins on the cask surface. The cask inner cavity is plated with nickel. The cask inner cavity contains a borated stainless steel basket. The CASTOR® V/21 cask is closed with a multiple lid system consisting of both a primary and secondary lid machined from stainless steel, and multiple elastomer and metal seals for each lid.

Like all metal storage casks, the CASTOR® V/21 is loaded and unloaded in the used fuel pool of a reactor site.

CASTOR® V/21 STORAGE CASK

Specifications[38]

Attribute	CASTOR® V/21
a. Capacity (assemblies)	21 PWR
b. Weight (lb)	
Empty	204,000
Loaded	234,000
c. Thermal	
Design Heat Rejection (kW)	21
Maximum Fuel Clad Temp. (^{o}F)	665/688 (vertical/horizontal)
Maximum Burnup (GWD/MTU)	35
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	192.4
Overall Cross Section	93.9
Cavity Length	163.5
Cavity Cross Section	60.1
Wall Thickness w/o fins	14.9
Cooling Fin Length	3.8
Lid Thickness	15.0
Bottom Thickness	18.1
Basket Length	161.8
Basket Cross Section	60.0
f. Neutron Shield (in)	
Number of Rods	132
Rod Diameter	2.4
Lid Thickness	N/A
Bottom Thickness	13.8
g. Materials of Construction	
Cask Body	Ductile Cast Iron (Ni-Plated Cavity)
Basket	SS/Borated SS
Neutron Shield	Polyethylene
h. Number of Cooling Fins	73
i. Cavity Atmosphere	He
j. Outside Surface Dose (mrem/hr)	20/200 (avg/max)
k. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

N/A denotes Not Available

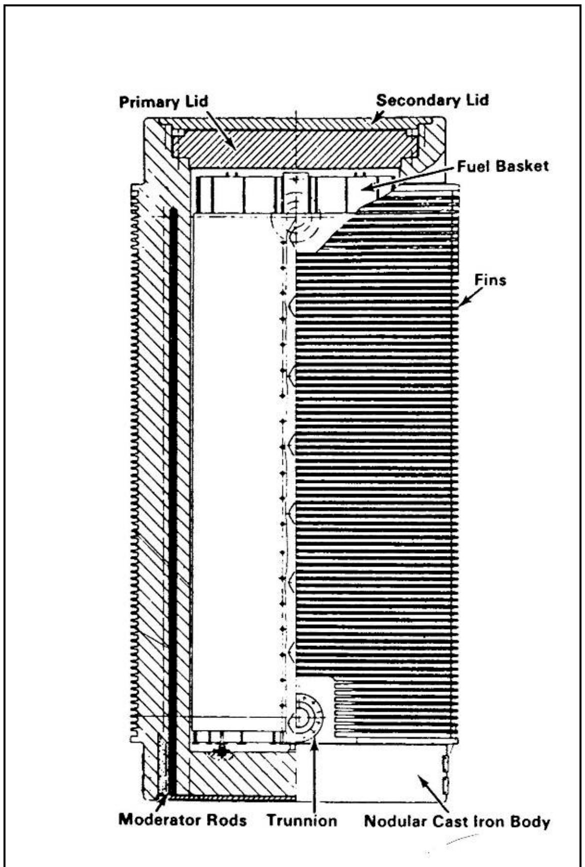
Licensing Status

The CASTOR® V/21 is licensed for storage under site-specific license SNM-2501, which expires July 31, 2046. The CASTOR V/21 is not licensed for transport in the U.S.

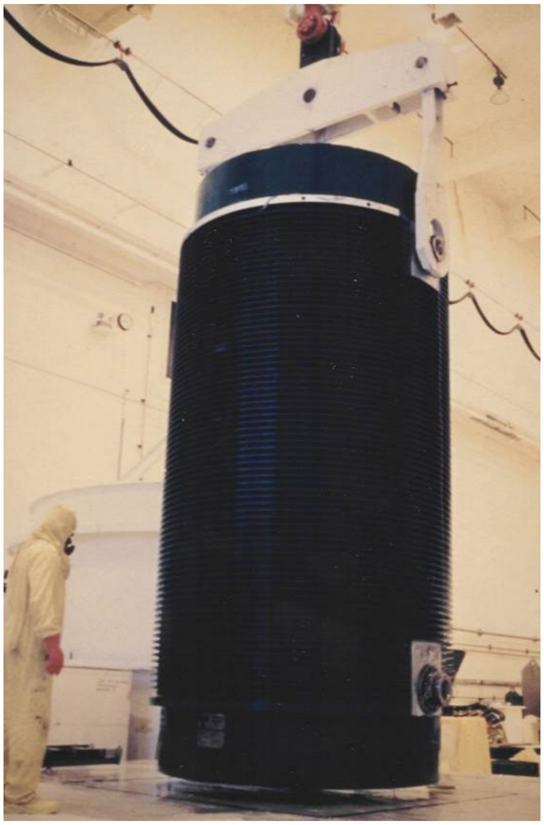
Extent of Commercial Use

Twenty-five CASTOR® V/21 casks are in use at Dominion's Surry NPP, and one cask is at the DOE's Idaho National Laboratory.

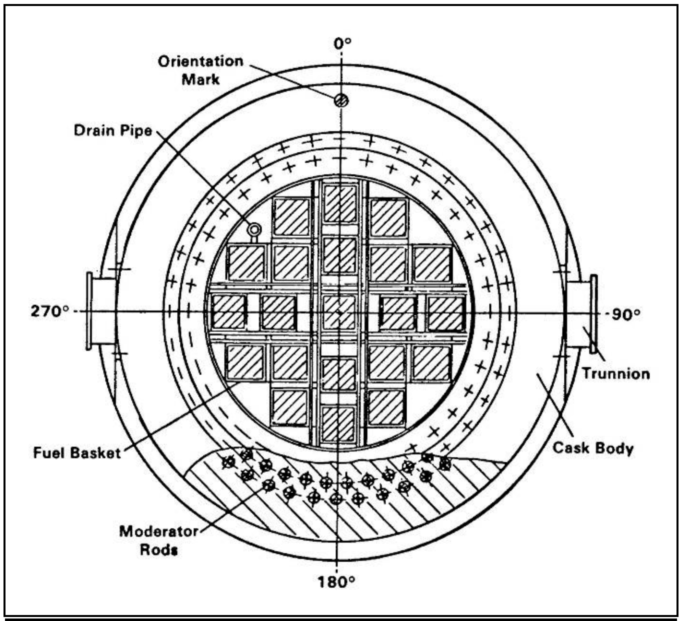
CASTOR® V/21 STORAGE CASK



CASTOR® V/21 Elevation View

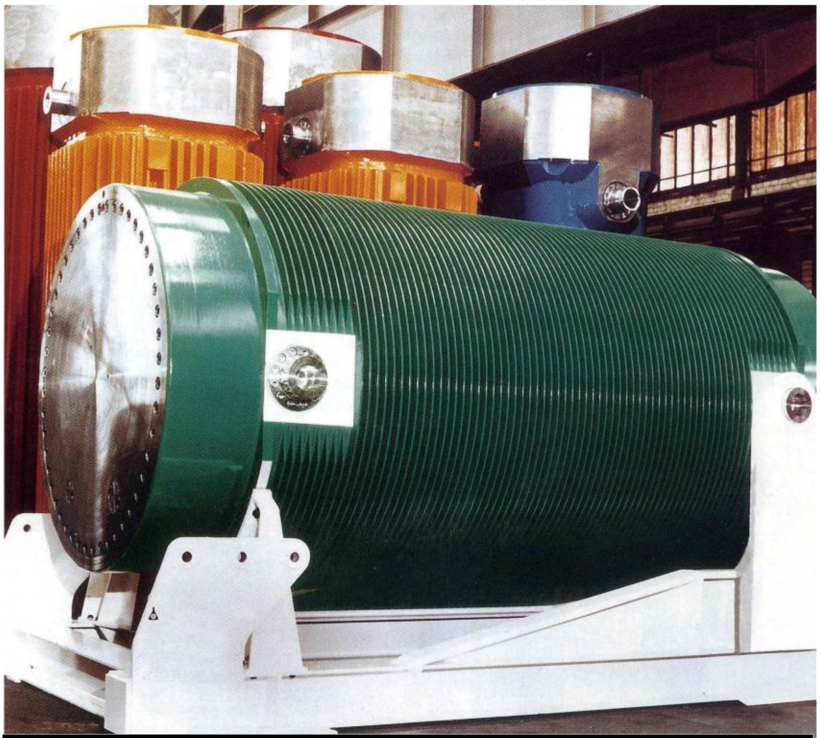


CASTOR® V/21



CASTOR® V/21 Cross-Section

CASTOR® V/21 STORAGE CASK



CASTOR® V/21

CASTOR® X/33 STORAGE CASK

Contact:
GNS Gesellschaft für Nuklear-Service mbH
Tel: 0201/109-1828
www.gns.de

Introduction

The GNS CASTOR® X/33 cask is a ductile cast iron shielded cask which has the capacity to store 33 PWR used nuclear fuel assemblies.

Description

The CASTOR® X/33 cask body is formed by casting the sides and bottom in one piece of ductile cast iron in nodular graphite form. The ductile cast iron provides the gamma shielding, and the polyethylene rods inserted into two concentric rows of axial holes drilled into the side walls of the cask provide the neutron shielding. Heat removal is facilitated by circumferential fins on the cask surface. The cask inner cavity is plated with nickel. The cask inner cavity contains a borated stainless steel basket. The CASTOR® X/33 cask is closed with a multiple lid system consisting of both a primary and secondary lid machined from stainless steel, and multiple elastomer and metal seals for each lid.

Like all metal storage casks, the CASTOR® X/33 is loaded and unloaded in the used fuel pool of a reactor site.

CASTOR® X/33 STORAGE CASK

Specifications[38]

Attribute	CASTOR® X/33
a. Capacity (assemblies)	33 PWR
b. Weight (lb)	
Empty	168,000
Loaded	212,000
c. Thermal	
Design Heat Rejection (kW)	16.6
Maximum Fuel Clad Temp. (^{o}F)	N/A
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	189.0
Overall Cross Section	94.5
Cavity Length	161.4
Cavity Cross Section	70.0
Wall Thickness, w/o Fins	12.2
Cooling Fin Length	None
Lid Thickness	15.0
Bottom Thickness	12.6
Basket Length	159.4
Basket Cross Section	N/A
f. Neutron Shield	
Number of Rods	72
Rod Diameter (in)	2.4
Lid Thickness (in)	None
Bottom Thickness (in)	None
g. Materials of Construction	
Cask Body	Ductile Cast Iron (Ni-Plated Cavity)
Basket	SS/Borated SS
Neutron Shield Rods	Polyethylene
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Outside Surface Dose (mrem/hr)	20/200 (avg./max.)
k. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

N/A denotes Not Available

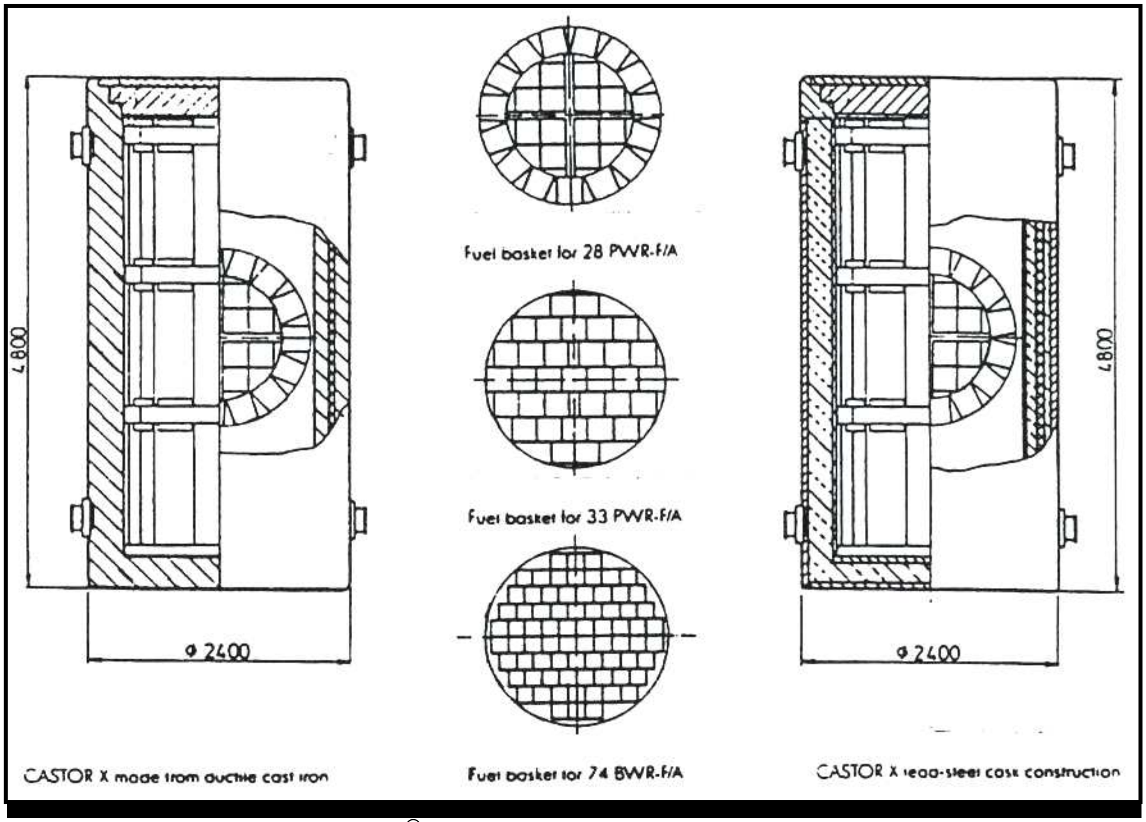
Licensing Status

The CASTOR® X/33 is licensed for storage under site-specific license SNM-2501 for use at Dominion's Surry ISFSI. The NRC approved the Topical Safety Analysis Report for storage, under 10 CFR 72, in April 1994.

Extent of Commercial Use

One CASTOR® X/33 cask is in use at Dominion's Surry NPP.

CASTOR® X/33 STORAGE CASK



Cross Section of CASTOR® X/33

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NAC I28 S/T STORAGE AND TRANSPORT CASK

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC I28 S/T cask is a metal cask that is designed for the storage and transport of 28 PWR used fuel assemblies. The cask is licensed for storage-only use in the U.S. No application requesting authorization for transport has been submitted. A slightly modified version of the cask can be used to store and transport canisters of consolidated fuel rods (see information under the NAC C28 S/T cask, Appendix A).

Description

The NAC I28 S/T cask is a multi-walled cylinder with the outside wall consisting of 2.68-inch thick stainless steel, the inside wall consisting of 1.53-inch thick stainless steel, and the space between them filled with 3.2 inches of lead. A 7-inch thick solid neutron shield encased in 0.25 inches of stainless steel is attached to the outside wall. The bottom and the lid are also made of lead encased in stainless steel, and a neutron shield cap is placed on the top of the cask after fuel loading. The lid is sealed with metallic O-rings. The 28 fuel cavities consist of square aluminum tubes which are held together by aluminum castings. Boral sheets are attached to the outside of the tubes for criticality prevention.

Like all metal storage casks, the NAC I28 S/T cask is loaded and unloaded in the used fuel pool of a reactor site.

NAC I28 S/T STORAGE AND TRANSPORT CASK

Specifications[38]

Attribute	NAC I28 S/T
a. Capacity (assemblies)	28 PWR
b. Weight (lb)	
Empty	166,000
Loaded	206,000
c. Thermal	
Design Heat Rejection (kW)	17.4
Maximum Fuel Clad Temp. (^{o}F)	679
Maximum Burnup (GWD/MTU)	35
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	181.3
Overall Cross Section	94.0
Cavity Length	165.0
Cavity Cross Section	64.8
Wall Thickness	14.6
Lid Thickness	8.5
Bottom Thickness	8.8
Basket Length	155.0
Basket Cross Section	64.5
f. Neutron Shield (in)	
Side Thickness	7.0
Lid Thickness	2.0
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/Pb
Basket	Cask Al Grid/Al Storage Cells/Boral Plates
Neutron Shield	GESC NS4FR
h. Number of Cooling Fins	24 (within neutron shield)
i. Cavity Atmosphere	He
j. Cavity Pressure (psia)	30
k. Outside Surface Dose (mrem/hr)	<100
l. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-6}

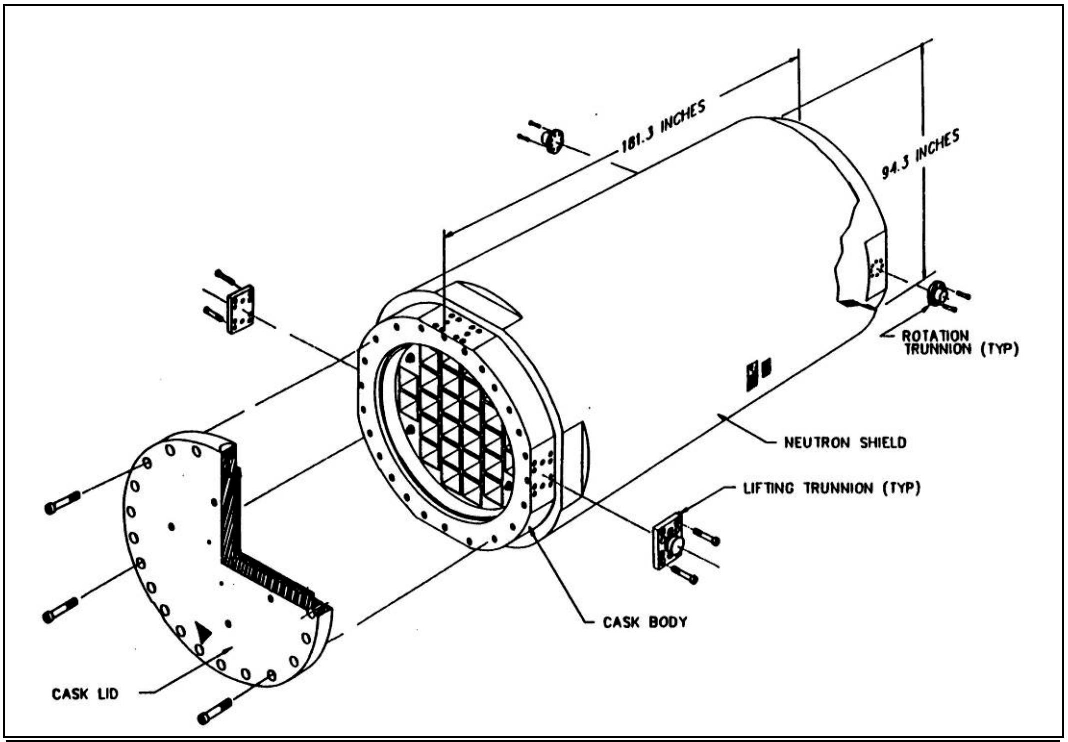
Licensing Status

The NAC I28 S/T is licensed by the NRC for storage under site-specific license SNM-2501 for use at Dominion's Surry NPP. The NRC approved the TSAR for storage, under 10 CFR 72, in February 1990.

Extent of Commercial Use

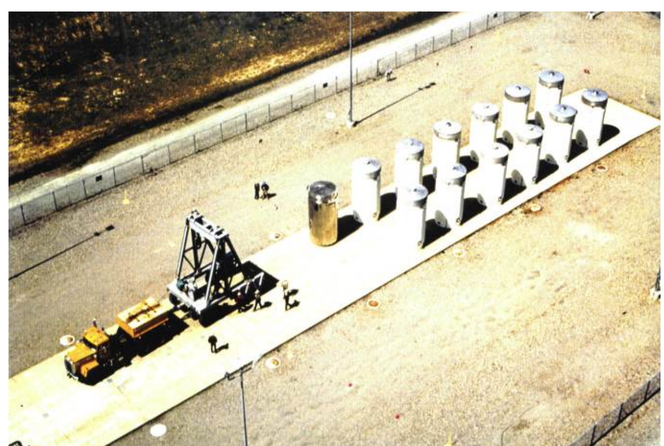
Two NAC I28 S/T casks are in use at Dominion's Surry NPP.

NAC I28 S/T STORAGE AND TRANSPORT CASK



NAC S/T Series Used Fuel Storage Cask

NAC I28 S/T Used Fuel Storage Cask



NAC I28 S/T Used Fuel Storage Cask in Place at Surry Nuclear Power Plant ISFSI

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Ridihalgh Eggers & Associates

REA-2023 STORAGE CASK

Contact:
U. S. Department of Energy
Idaho National Laboratory
www.inl.gov

Introduction

The REA-2023 cask, designed by Ridihalgh, Eggers & Associates, Inc., is a metal cask designed to accommodate 24 PWR or 52 BWR used fuel assemblies. It was the first dry metal storage cask built in the U.S. It was never licensed by NRC, but is used for demonstration purposes by DOE.

Description

The REA-2023 cask consists of a cask body (sides, bottom, and lid), and a fuel basket. The cask body consists of a 0.75 inch thick cavity shell of stainless steel which, together with an outer cylindrical shell of 2 inch thick stainless steel, sandwiches 4.25 inches of lead shielding. A six-inch thick neutron shield of borated 50/50 ethylene glycol solution surrounds the outer shell. The cavity bottom plate and outer bottom plate are two inch thick stainless steel that sandwich a layer of lead that is 3.25 inches thick. The primary cover consists of bottom and top plates of 1.0 and 2.0 inch thick stainless steel that encases a 3 inch thick layer of lead. Sealing of the cover is made by two silicon O-rings. The secondary cover is a 2 inch thick plate that is welded around its periphery.

The fuel basket is fabricated in 4 sections, each having thirteen 6-inch square compartments fabricated of stainless steel clad Boral. The outer boundary of each section, and an internal lid, are constructed of 0.25 inch copper plate. The other boundary of the basket sections are fitted into the cask such that contact is made between the cask and the basket. This is done to facilitate conduction of heat to the inner wall of the cask.

Like all metal storage casks, the REA-2023 cask is loaded and unloaded in the used fuel pool of a reactor site.

Specifications[39]

Attribute	REA-2023	
a. Capacity (assemblies)	24 PWR/52 BWR	
b. Weight (lb)		
Empty	168,000	
Loaded on Storage Pad	196,000	
c. Thermal		
Design Heat Rejection (kW)	24 (PWR), 20.8 (BWR)	
Maximum Fuel Clad Temp. (^{o}F)	482	
Maximum Burnup (GWD/MTU)	33	
d. Shape	Cylindrical	
e. Dimensions (in)	**PWR**	**BWR**
Overall Length	182.0	192.6
Overall Cross Section	93.0	87.6
Cavity Length	166.7	177.2
Cavity Cross Section	66.0	61.0
Wall Thickness	13.5	13.25
Lid Thickness	8.0	8.0
Bottom Thickness	7.25	7.25
Basket Length	N/A	N/A
f. Neutron Shield (in)		
Side Thickness	6.0 (6.25 with cover)	
Lid Thickness	None	
Bottom Thickness	None	
g. Materials of Construction		
Cask Body	SS/Pb	
Basket	SS/Boral	
Neutron Shield	Glycol/Water	
h. Number of Cooling Fins	None	
i. Cavity Atmosphere	He	
j. Outside Surface Dose (mrem/hr)	<20	
k. Maximum Leak Rate (atm-cm^3/sec)	N/A	

N/A means Not Available

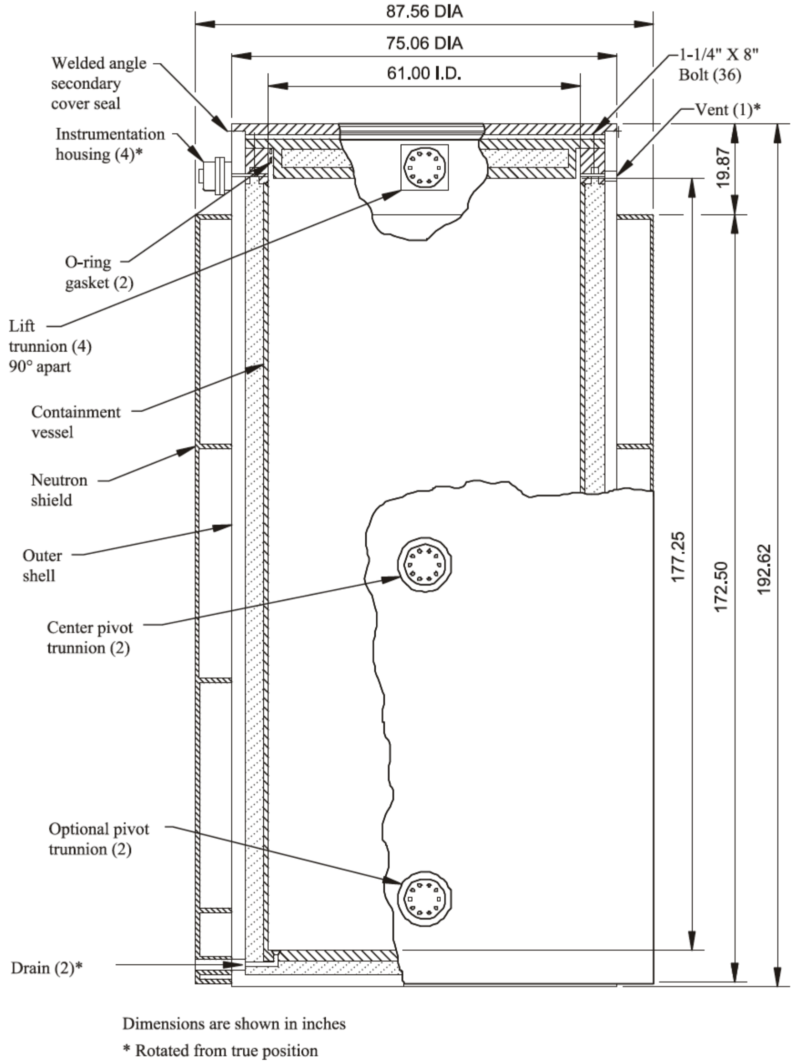
Licensing Status

The Topical Safety Analysis Report (TSAR) for storage was submitted to the NRC. The TSAR was withdrawn from review prior to NRC approval.

Extent of Commercial Use

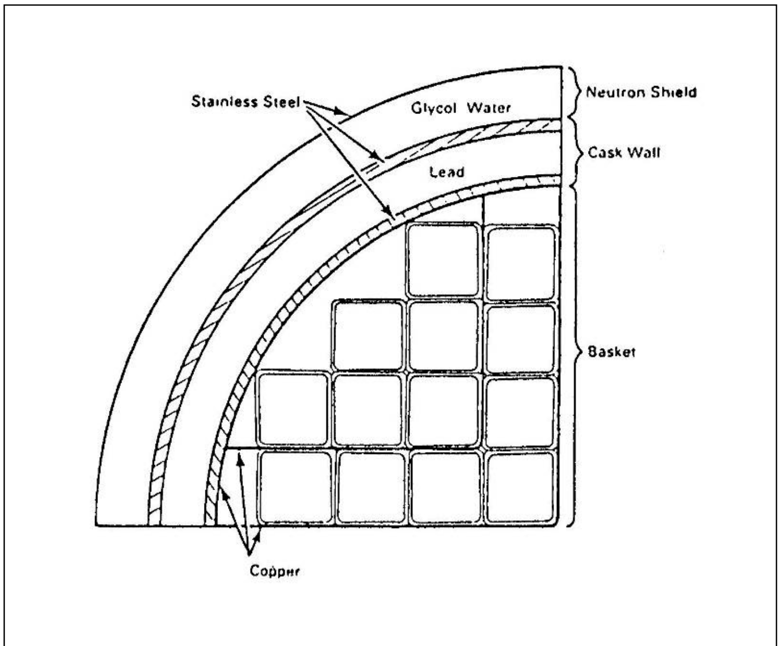
One REA-2023 was procured by DOE and used in a demonstration program at GE Morris. The cask is loaded with legacy materials from a variety of DOE research programs and is maintained under DOE regulatory authority at the Idaho National Laboratory.

REA-2023 STORAGE CASK

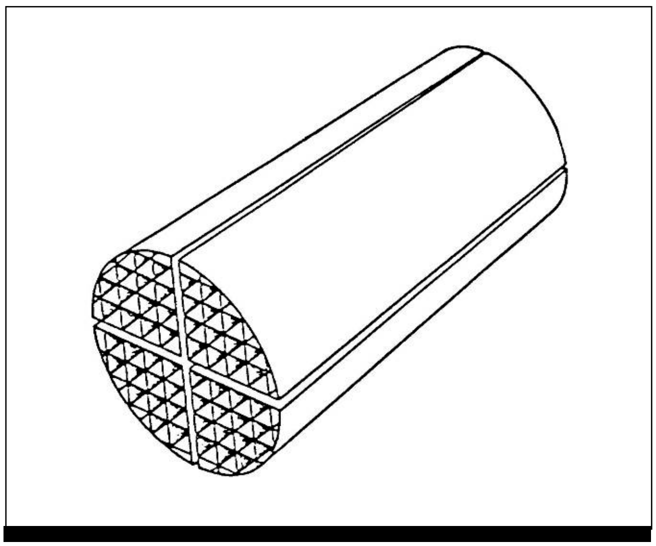


REA-2023 BWR Used Fuel Storage Cask

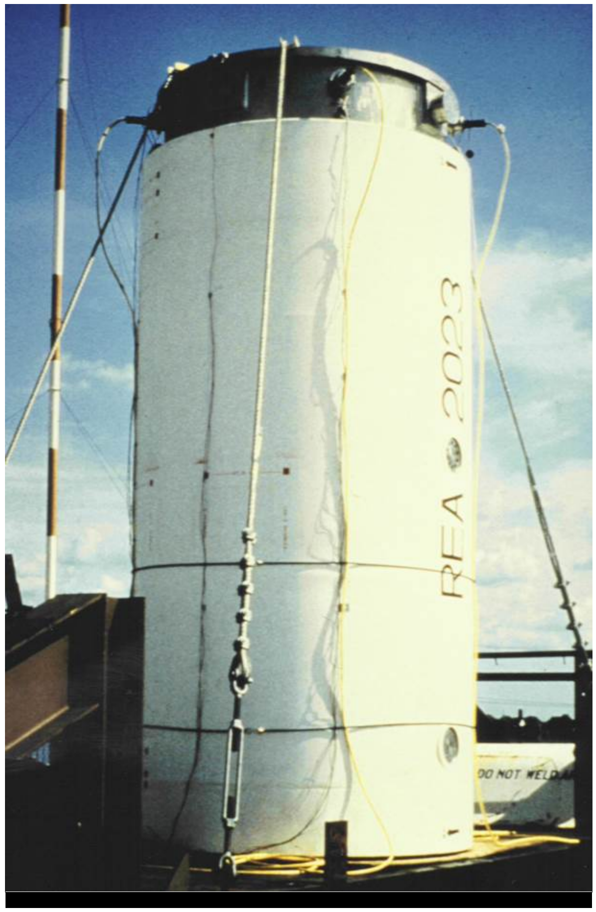
REA-2023 STORAGE CASK



REA-2023 Cross-Section View



REA-2023 52 Assembly BWR Basket



REA-2023 Storage Cask

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TN-24 STORAGE CASKS

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-24 and TN-24P casks are part of a family of TN-24 forged metal storage casks for used nuclear fuel that are in use in the U.S. and Europe. TN-24 and TN-24P casks differ in a number of respects – including the design heat rejection capability and maximum fuel clad temperature, the size of the cask cavity, and a number of other features. However, both can store 24 PWR assemblies. The TN-24 cask has been licensed for use in the U.S. only for storage. The only TN-24P in use in the U.S. today is at the Idaho National Laboratory, where it is used for demonstration purposes.

Description

The TN-24 cask body is a cylinder made of SA-350, Grade LF3 forged steel with a wall thickness of 9.75 inches. The bottom of the cask is 10 to 11-inches thick forged steel welded to the cylinder wall. The top of the cask is sealed by a lid that is 11.5 inches thick. The lid employs a double barrier seal system with two metallic O-rings. A neutron shield (5 to 6 inches thick) consisting of a borated polymer material encased in stainless steel, is attached to the outer wall of the cask body forging. The fuel basket is made of 0.433 inch thick copper plated stainless steel plates formed into 8.7 inch square cavities.

Like all metal storage casks, the TN-24 and TN-24P casks are loaded and unloaded in the used fuel pool of a reactor site.

TN-24 STORAGE CASKS

Specifications[40]

Attribute	TN-24	TN-24P
a. Capacity (assemblies)	24 PWR	24 PWR
b. Weight (lb)		
Empty	166,000	166,000
Loaded	226,000	226,000
c. Thermal		
Design Heat Rejection (kW)	24	20.6/20.5 (vertical/horizontal)
Maximum Fuel Clad Temp. (^{o}F)	706	429/436 (vertical/horizontal)
Maximum Burnup (GWD/MTU)	35	35 (vertical/horizontal)
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	186.8	199.3
Overall Cross Section	92.4	89.8
Cavity Length	163.25	163.4
Cavity Cross Section	57.25	57.3
Wall Thickness, w/o fins	9.5	16.25
Lid Thickness	10.5	15.4 (24.9 w/protective cover)
Bottom Thickness	10.25	11.0
Basket Length	162.0	162.2
Basket Cross Section	57	N/A
Thickness of Basket Spacers	0.4	0.4
f. Neutron Shield (in)		
Side Thickness	5.38	4.2
Lid Thickness	2.75	4.2
Bottom Thickness	N/A	N/A
g. Materials of Construction		
Cask Body	SA350, Grade LF3 CS (Forged)	Forged Steel
Basket	Boron SS w/Copper Plate	Al/B
Neutron Shield	Polyester Resin	Polyethylene Resin (sides); Granular Polypropylene (lid)
h. Number of Cooling Fins	None	44 (within neutron shield)
i. Cavity Atmosphere	He	He
j. Cavity Pressure (psia)	33.9 (initial)	N/A
k. Outside Surface Dose, Side (mrem/hr)	<60	<100
l. Maximum Leak Rate (atm-cm^3/sec)	6.5 x 10^{-7}	6.5 x 10^{-7}

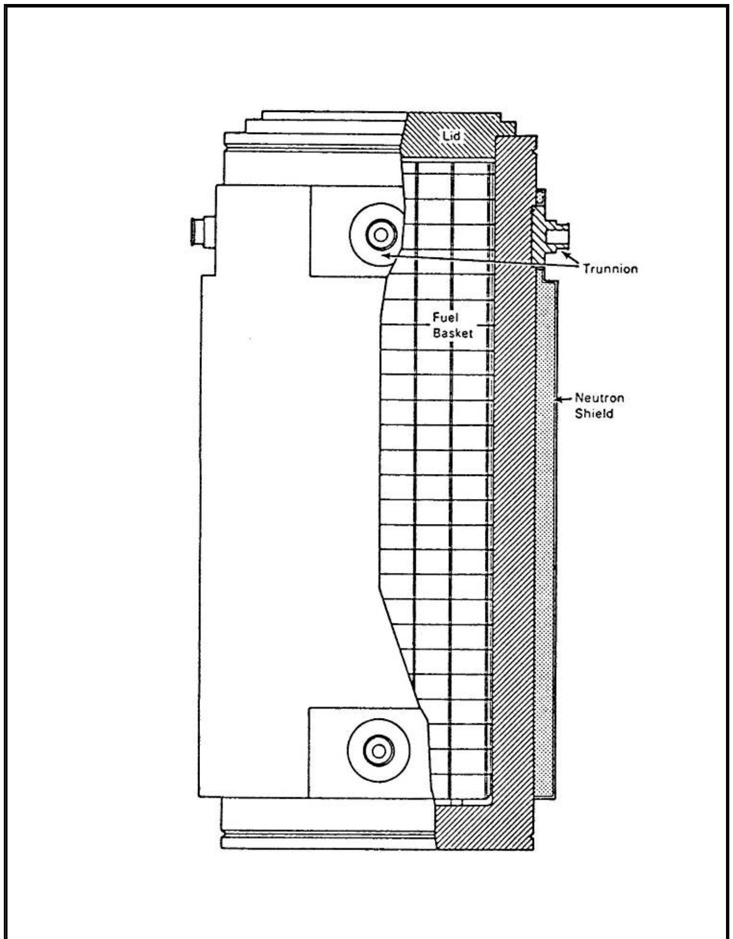
N/A denotes Not Available

Licensing Status

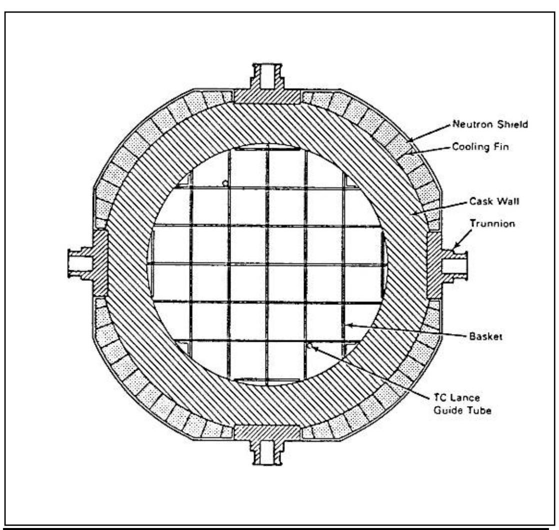
The TN-24 is a licensed storage cask under Certificate of Compliance 72-1005, which expires on November 30, 2013.

Extent of Commercial Use

One TN-24P cask is in use at DOE’s Idaho National Laboratory.



TN-24 Used Fuel Storage Cask



TN-24P Cross-Section

Photograph of TN-24P Used Fuel Storage Cask

TN-32 STORAGE CASKS

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-32 casks are metal storage casks designed for storage of 32 PWR used fuel assemblies. This cask has been licensed only for storage use in the U.S.

Description

The TN-32 casks consist of a cask body (sides, bottom, and lid), a fuel basket, and a protective cover. The cask body consists of a containment vessel surrounded by a gamma shield in the form of layers of carbon steel, all of which are surrounded by a neutron shield and outer shell. The containment vessel consists of the cask's inner shell which is a welded carbon steel cylinder with an integrally welded carbon steel bottom closure, a welded flange forging at the top of the inner shell, and a flanged and bolted carbon steel lid with bolts and inner metallic seals. The cask cavity surfaces are sprayed with metallic aluminum for corrosion protection. The gamma shield, which completely encloses the containment vessel inner shell and bottom closure, consists of a multi-layer carbon steel body welded to the bottom plate and to the closure flange. Gamma shielding is also welded to the inside of the containment lid. Neutron shielding is provided by a borated polyester resin cast into long aluminum containers and arrayed within a steel shell to surround the gamma shield on the cylindrical sides of the cask. A 4-inch thick disc of polypropylene encased in a 0.25-inch steel shell is attached to the cask lid to provide neutron shielding in the top of the cask.

During storage, a protective cover is placed over the cask lid to provide weather protection to the lid, overpressure tank, and pressure monitoring equipment. Two alternative configurations of the TN-32 are also licensed. The TN-32A has a lid with an inner shield plate of 4.88 inch thickness as opposed to the 6 inch thickness for the standard TN-32 design which increases the cavity length to 164.38 inches. The top neutron shielding is increased so that the top of the TN-32A cask has the same amount of shielding as the standard TN-32 design. The second alternative configuration, the TN-32B, is identical to the standard TN-32 except that the top lifting trunnions are designed as single failure proof.

The basket structure consists of an assembly of stainless steel cells, joined by fusion welding and separated by aluminum and poison plates which form a sandwich-type panel. The dimensions of each cell compartment are 8.70 x 8.70 inches.

Like all metal storage casks, the TN-32 casks are loaded and unloaded in the used fuel pool of a reactor site.

TN-32 STORAGE CASKS

Specifications[41,42]

Attribute	TN-32
a. Capacity (assemblies)	32 PWR
b. Weight (lb)	
Empty (TN-32/TN-32A/TN-32B)	184,600/184,800/184,800
Loaded on Storage Pad (TN-32/TN-32A/TN-32B)	231,000/231,200/231,200
c. Thermal	
Design Heat Rejection (kW)	32.7
Maximum Fuel Clad Temp. (^{o}F)	565
Maximum Burnup (GWD/MTU)	40
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	184.0
Overall Length with protective cover	201.88
Overall Cross Section	97.75
Cavity Length (TN-32/TN-32A/TN-32B)	163.25 / 164.38 / 163.25
Cavity Cross Section	68.75
Lid Thickness (TN-32/TN-32A/TN-32B)	10.5 / 9.38 / 10.5
Wall Thickness	9.5
Bottom Thickness	10.25
Basket Length	160.0
f. Neutron Shield (in)	
Side Thickness	4.5
Lid Thickness	4.0
Bottom Thickness	N/A
g. Materials of Construction	
Cask Body	CS Containment Barrier with Multi-Layer CS Shielding
Basket	SS/Borated Al/Al
Radial Neutron Shield	Borated Polyester Resin
Lid Neutron Shield	Polypropylene
h. Number of Cooling Fins	N/A
i. Cavity Atmosphere	He
j. Outside Surface Dose (mrem/hr)	<100
k. Maximum Leak Rate (atm-cm^3/sec)	6.5×10^{-7}

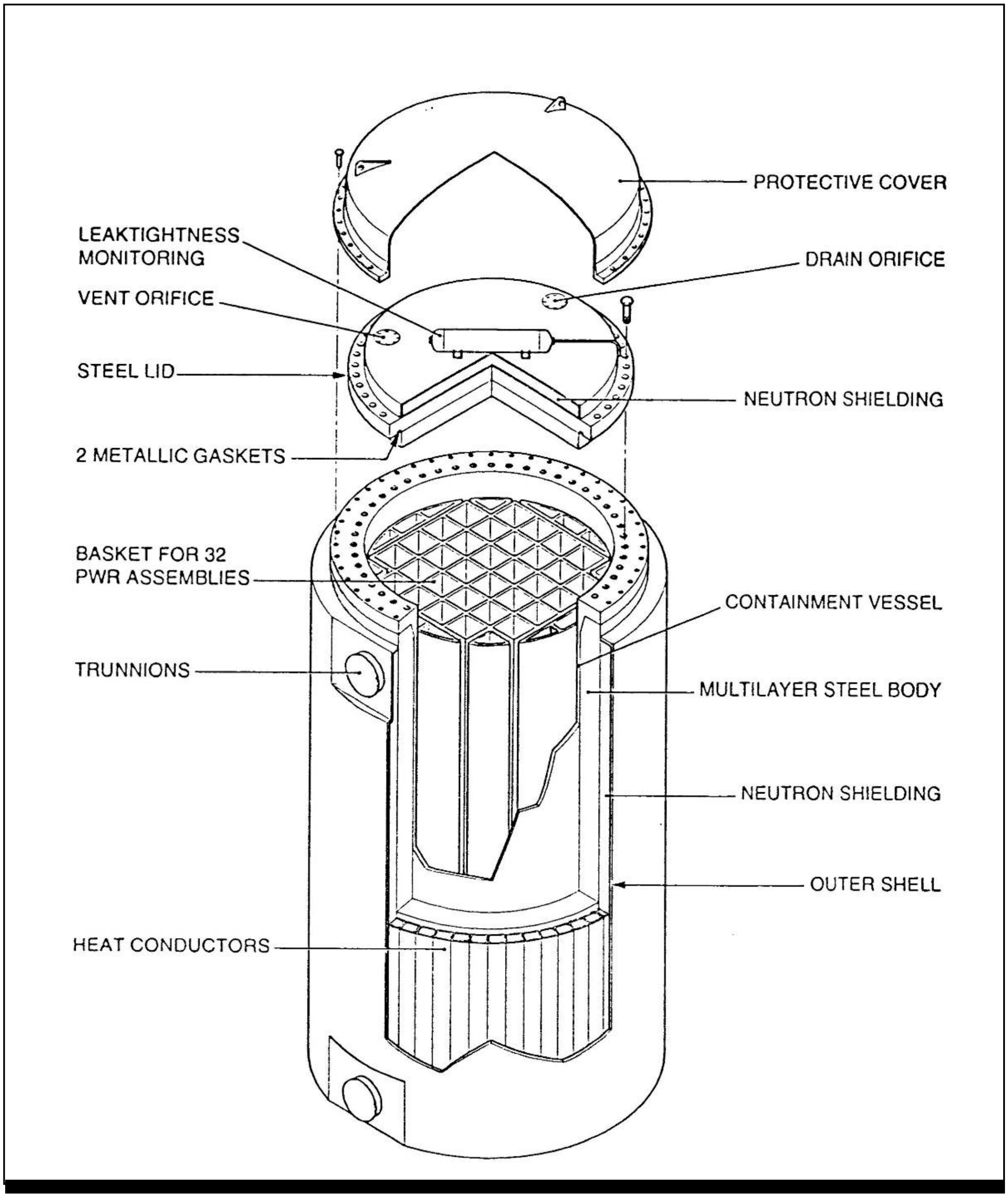
N/A denotes Not Available

Licensing Status

The TN-32 cask is a NRC licensed storage cask under storage Certificate of Compliance 72-1021, Amendment 1, which expires on April 19, 2020.

Extent of Commercial Use

As of March 2013, 26 TN-32 casks have been loaded at Dominion Virginia Power's Surry NPP (SNM-2501); 27 TN-32 casks have been loaded at Dominion's North Anna NPP (SNM-2507); and 10 TN-32 casks have been loaded at Duke Energy's McGuire NPP.



TN-32 Used Fuel Storage Cask

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TN-40 STORAGE AND TRANSPORT CASKS

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Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-40 cask is a metal storage cask designed for storage of 40 PWR used fuel assemblies from Xcel Energy's Prairie Island Plant. The TN-40 cask, except for the TN-40HT cask, is licensed in the U.S. for storage and transport. The TN-40HT is licensed only for storage use.

Description

The TN-40 cask consists of a cask body (sides, bottom, and lid), a fuel basket, and a protective cover. The cask body consists of a containment vessel surrounded by a gamma shield of carbon steel, all of which are surrounded by a neutron shield and outer shell. The containment vessel consists of the cask's inner shell which is a welded carbon steel cylinder with an integrally welded carbon steel bottom closure, a welded flange forging at the top of the inner shell, and a flanged and bolted carbon steel lid with bolts and inner metallic seals. The cask cavity surfaces have a sprayed metallic coating of Zn/Al for corrosion protection. The gamma shield, which completely encloses the containment vessel inner shell and bottom closure, consists of a carbon steel cylinder welded to the bottom plate and to the closure flange. Gamma shielding is also welded to the inside of the containment lid. Neutron shielding is provided by a borated polyester resin cast into long aluminum containers and arrayed within a steel shell to surround the gamma shield on the cylindrical sides of the cask. A disc of polypropylene is attached to the cask lid to provide neutron shielding in the top of the cask. During storage, a protective cover is placed over the cask lid to provide weather protection to the lid, overpressure tank, and pressure monitoring equipment.

The basket structure consists of an assembly of 40 stainless steel cells, joined by fusion welding and separated by aluminum and poison plates which form a sandwich-type panel. The dimensions of each cell compartment are 8.05 x 8.05 inches.

Conversion of a loaded TN-40 from a storage configuration to a transport configuration requires replacement of the seals, installation of higher strength lid closure bolts, and installation of a spacer between the cask lid and the payload. This conversion would like require the TN-40 cask to be placed back in the fuel pool.

Like all metal storage casks, the TN-40 casks are loaded and unloaded in the used fuel pool of a reactor site.

Transnuclear Inc.

TN-40 STORAGE AND TRANSPORT CASKS

Specifications[43,44,45]

Attribute	TN-40	TN-40HT
a. Capacity (assemblies)	40 PWR	40 PWR
b. Weight (lb)		
Empty	164,600	189,343
Loaded on Storage Pad	226,000	242,343
Loaded (Transport w/Impact Limiters)	271,500	N/A
c. Thermal		
Design Heat Rejection (kW)	27	32
Maximum Fuel Clad Temp. (^{o}F)	602	680
Maximum Burnup (GWD/MTU)	45	60
d. Shape	Cylindrical	Cylindrical
e. Dimensions (in)		
Overall Length	175.0	170.0
Overall Length with Protective Cover	202.0	199.6
Overall Cross Section	99.52	101.0
Cavity Length	163.0	163.0
Cavity Cross Section	72.0	72.0
Wall Thickness	9.50	8.75
Lid Thickness	10.5	10.0
Bottom Thickness	10.25	8.75
Basket Length	160.0	160.0
Basket Cross Section	N/A	71.70
Thickness of Basket Spacers	1.25	Proprietary
f. Neutron Shield (in)		
Side Thickness	4.26	5
Lid Thickness	4.5	5
Bottom Thickness	N/A	5
g. Materials of Construction		
Cask Body	CS	CS
Basket	SS/Borated Al/Al	SS/Al/neutron absorber plates
Neutron Shield	Borated Polyethylene Resin (sides) Borated Polypropylene (lid)	Borated Polyethylene Resin
h. Number of Cooling Fins	None	None
i. Cavity Atmosphere	He	He
j. Outside Surface Dose (mrem/hr)	< 100	< 100
k. Maximum Leak Rate (atm-cm^3/sec)	1×10^{-5}	1×10^{-5}

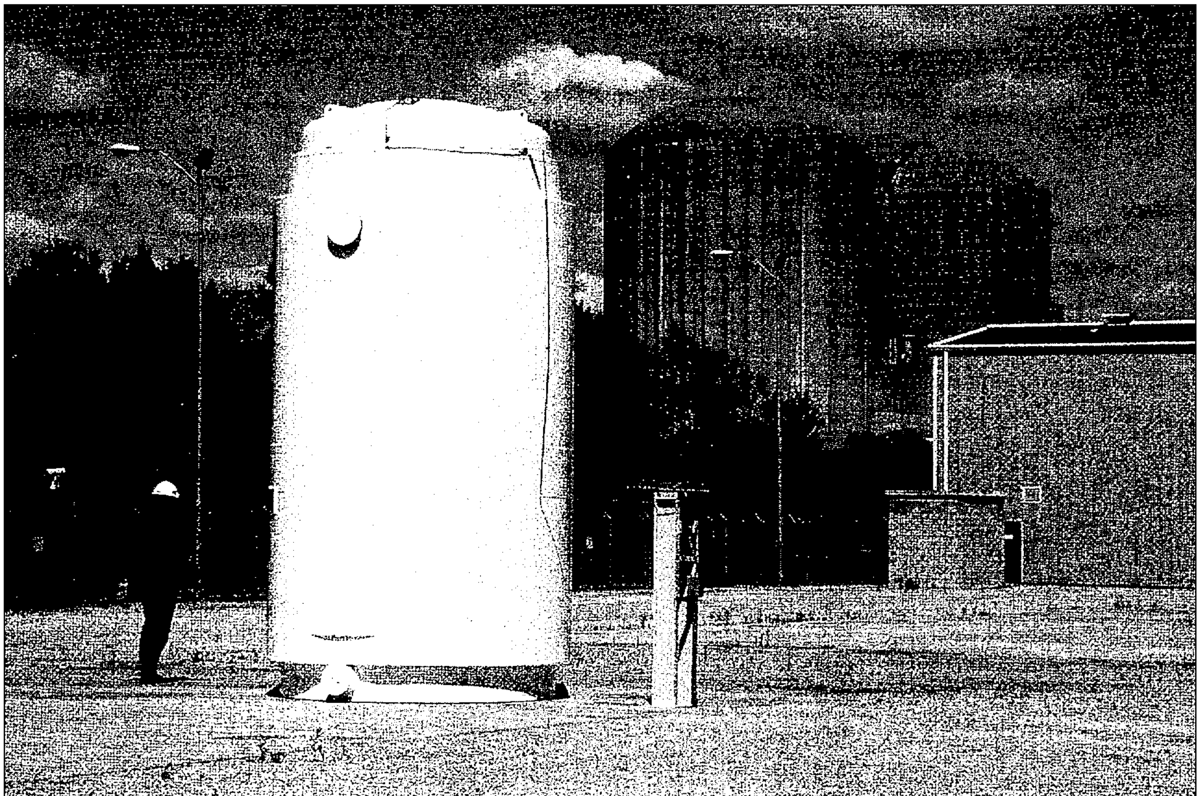
N/A means Not Available

Licensing Status

The TN-40 cask is currently licensed for storage of Xcel Energy's Prairie Island Nuclear Generating Plant used fuel under a plant-specific license, SNM-2506 (including the TN-40HT model which is authorized for storage of high burnup fuel). SNM-2506 renewal application in under NRC review as of the date of this report. The TN-40 cask is licensed for transport in the U.S. under transport Certificate of Compliance 71-9313, Revision 0, which expires on June 30, 2016. The TN-40HT model is not licensed for transport at this time.

Extent of Commercial Use

Twenty-nine TN-40 casks have been loaded at Xcel Energy's Prairie Island Nuclear Generating Plant.



TN-40 Storage Cask

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TN-68 STORAGE AND TRANSPORT CASK

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-68 cask is a metal cask designed for storage and transport of 68 BWR used fuel assemblies. This cask has been licensed in the U.S. for both storage and transport.

Description

The TN-68 cask consists of a cask body (sides, bottom, and lid), a fuel basket, and a protective cover. The cask body consists of a containment vessel surrounded by a gamma shield of carbon steel, all of which are surrounded by a neutron shield and outer shell. The containment vessel consists of the cask's inner shell which is a welded carbon steel cylinder with an integrally welded carbon steel bottom closure, a welded flange forging at the top of the inner shell, and a flanged and bolted carbon steel lid with bolts and inner metallic seals. The cask cavity surfaces are uncoated. The gamma shield, which completely encloses the containment vessel inner shell and bottom closure, consists of a carbon steel cylinder welded to the bottom plate and to the closure flange. Gamma shielding is also welded to the inside of the containment lid. Neutron shielding is provided by a borated polyester resin cast into long aluminum containers and arrayed within a steel shell to surround the gamma shield on the cylindrical sides of the cask. A 4-inch thick disc of polypropylene is attached to the cask lid to provide neutron shielding in the top of the cask. During storage, a protective cover is placed over the cask lid to provide weather protection to the lid, overpressure tank, and pressure monitoring equipment.

The basket structure consists of an assembly of 68 stainless steel cells, joined by fusion welding to stainless steel plates. Above and below the plates are slotted borated aluminum or B_4C/aluminum metal matrix composite plates which form an egg-crate structure. The dimensions of each cell compartment are 6.0 x 6.0 inches.

Like all metal storage casks, the TN-68 casks are loaded and unloaded in the used fuel pool of a reactor site.

TN-68 STORAGE AND TRANSPORT CASK

Specifications[46,47,48]

Attribute	TN-68
a. Capacity (assemblies)	68 BWR
b. Weight (lb)	
Empty	192,100
Loaded on Storage Pad	230,000
Loaded (Transport w/Impact Limiters)	272,000
c. Thermal	
Design Heat Rejection (kW)	21.2
Maximum Fuel Clad Temp. (^oF)	502 storage/490 transport
Maximum Burnup (GWD/MTU)	40
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	197.25
Overall Length with Protective Cover	215.0
Overall Length with Impact Limiters	271.0
Overall Cross Section w/o Impact Limiters	98.0
Cross Section of Impact Limiters	144.0
Cavity Length	178.0
Cavity Cross Section	69.5
Wall Thickness	7.5
Lid Thickness	9.5
Bottom Thickness	9.75
Basket Length	164.0
f. Neutron Shield (in)	
Side Thickness	6.0
Lid Thickness	4.0
Bottom Thickness	N/A
g. Materials of Construction	
Cask Body	CS
Basket	SS/Borated Al/Al
Radial Neutron Shield	Borated Polyester Resin
Lid Neutron Shield	Polypropylene
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Outside Surface Dose (mrem/hr)	<100
k. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-5}

N/A means Not Available

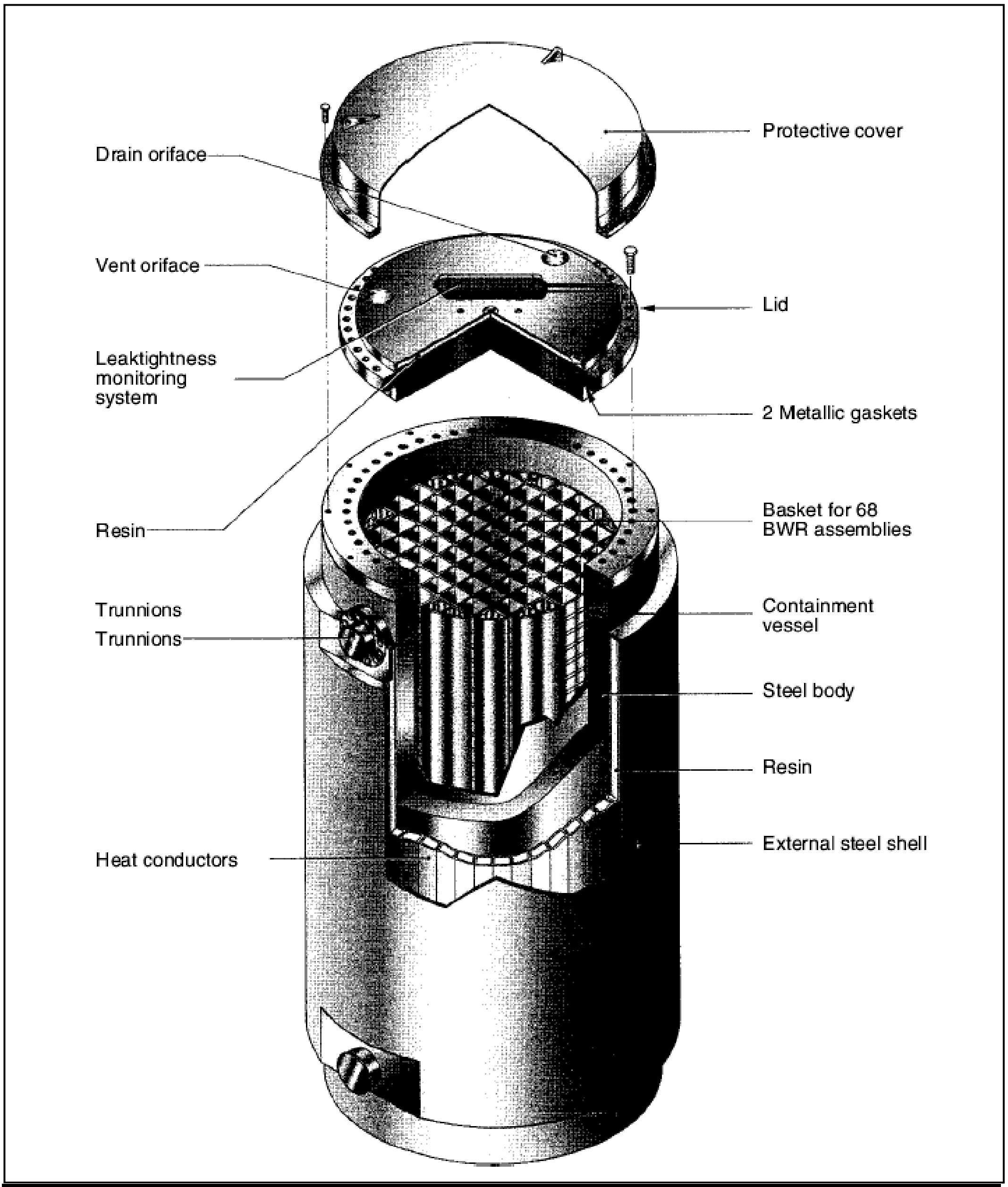
Licensing Status

The TN-68 cask is licensed for storage in the U.S. under storage Certificate of Compliance 72-1027, Amendment 1, which expires on May 28, 2020. The TN-68 cask is licensed for transport in the U.S. under transport Certificate of Compliance 71-9293, Revision 3, which expires on February 29, 2016. The TN-68 transport cask cannot be fabricated until the CoC is updated from a -85 certificate to a -96 certificate.

Extent of Commercial Use

Fifty-nine TN-68 casks have been loaded at Exelon’s Peach Bottom NPP.

TN-68 STORAGE AND TRANSPORT CASK



TN-68 Storage/Transport Cask

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MC-10 STORAGE CASK

Contact:
U. S. Department of Energy
Idaho National Laboratory
www.inl.gov

Introduction

The Westinghouse MC-10 is a metal storage cask that has a capacity for storing up to 24 PWR or 49 BWR used nuclear fuel assemblies. It was one of the early storage casks developed, and is still in use at Dominion's Surry NPP. It was also involved in dry storage demonstration projects at the U.S. Department of Energy's Idaho National Laboratory (INL).

Description

The MC-10 cask is a forged steel container with an integrally welded forged steel bottom, which together with the lid, provide the necessary gamma shielding. A neutron shield surrounds the forged steel body. The removal of heat from the contents of the cask is facilitated by twenty-four nickel-plated longitudinal fins that project from the outside of the forged shell, through the neutron shield, and into the surrounding air. The cask inner cavity contains a basket consisting of a grid and storage cells. The cask closure consists of a shield plug, a primary cover, a neutron shield and a seal cover.

Like all metal storage casks, the MC-10 is loaded and unloaded in the used fuel pool of a reactor site.

MC-10 STORAGE CASK

Specifications[38]

Attribute	MC-10
a. Capacity (assemblies)	24 PWR/49 BWR
b. Weight (lb)	
Empty	205,600
Loaded	239,600
c. Thermal	
Design Heat Rejection (kW)	13.5
Maximum Fuel Clad Temp. (^{o}F)	636
Maximum Burnup (GWD/MTU)	35
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	188.0
Overall Cross Section	107.3
Cavity Length	162.6
Cavity Cross Section	68.0
Wall Thickness, w/o Fins	13.1
Cooling Fin Length	12.5
Lid Thickness	8.5
Bottom Thickness	10.0
Basket Length	N/A
Basket Cross Section	N/A
Thickness of Basket Spacers	0.75
f. Neutron Shield (in)	
Side Thickness	3.1
Lid Thickness	2.5
Bottom Thickness	2.5
g. Materials of Construction	
Cask Body	Low Alloy/Forged Steel
Basket	SS Grid/SS Storage Cells/Boral Plates
Neutron Shield	BISCO NS-3
h. Number of Cooling Fins	24
i. Cavity Atmosphere	He
j. Cavity Pressure (psia)	35
k. Outside Surface Dose (mrem/hr)	<100
l. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-10}

N/A denotes Not Available

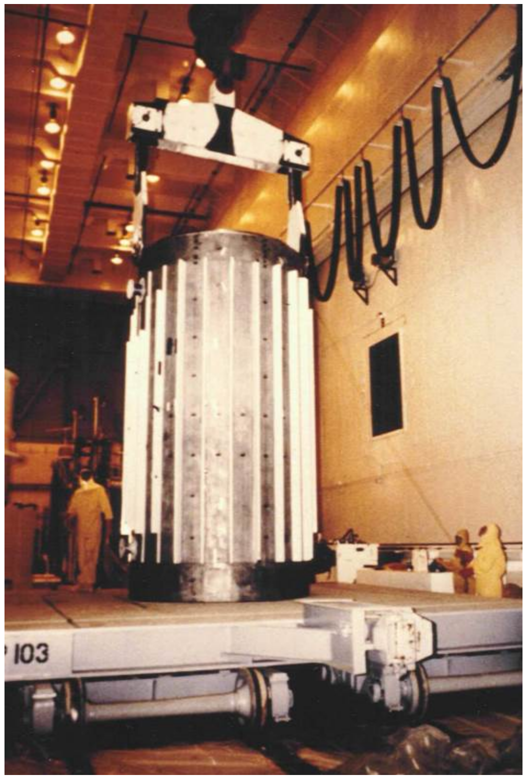
Licensing Status

The MC-10 cask's Certificate of Compliance 72-1001 expired on August 17, 2010.

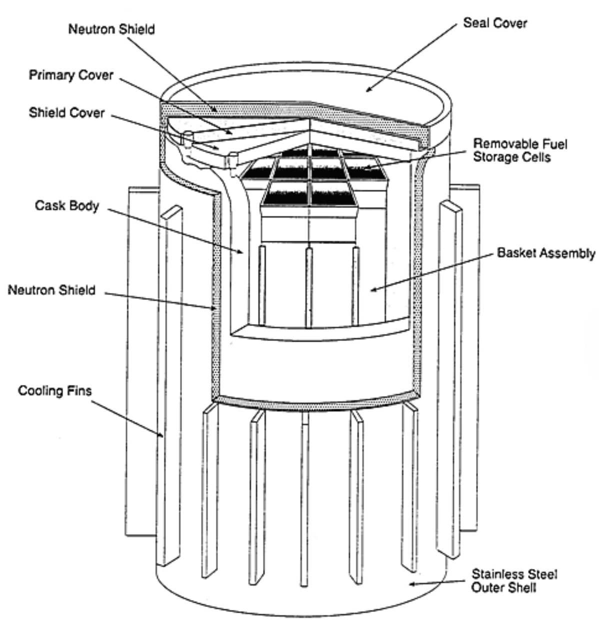
Extent of Commercial Use

One MC-10 cask is in use at INL and one is in use at Dominion's Surry NPP under a site-specific license (SNM-2501).

MC-10 STORAGE CASK



MC-10 Attached to Crane



MC-10 Containment Vessel Cross-Section

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CANISTER-BASED AND NON-CANISTERED TRANSPORT CASKS

The transport casks that are described in the following pages have the capability to ship bare used fuel assemblies, or canisters containing used fuel assemblies. The attributes of these casks have been summarized in Table 6 of the Introduction. Dual-purpose casks (storage/transport) that can accept large multiple-purpose canisters have been described previously under the section "Canistered Storage/Transport Systems".

This section describes six casks that are licensed for use in the U.S.:

(1) GA-4 Legal Weight Truck Transport Cask
(2) HI-STAR 60 Transport Cask
(3) HI-STAR180 Transport Cask
(4) NAC-LWT Legal Weight Truck Transport Cask
(5) TN FSV Legal Weight Truck Transport Cask
(6) TN-LC Transport Cask

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GA-4 LEGAL WEIGHT TRUCK TRANSPORT CASK

Contact:
General Atomics
Tel: (858) 455-3155
www.ga.com

Introduction

The GA-4 legal weight truck transport cask is a stainless steel-encased depleted uranium shielded cask for transporting four (4) PWR used nuclear fuel assemblies. The cask, along with its transport trailer, is designed to provide the greatest practical payload capacity for PWR used nuclear fuel with a gross vehicle weight that does not exceed the Federal limit of 80,000 lbs. for semi tractor-trailer trucks operated on U.S. and Interstate designated highways. Although the design holds a current Certificate of Compliance issued by the NRC, no GA-4 casks have been constructed. The cask consists of:

- Steel-depleted uranium-steel cask body with steel bottom and closure lid
- Non-removable metal cruciform basket with fixed neutron poisons
- Hydrogenous neutron shield
- Removable aluminum honeycomb impact limiters

The GA-4 legal weight truck transport cask is designed and licensed by General Atomics.

Description

The GA-4 cask assembly includes the cask body, closure (including bolts), and impact limiters. The cask's cavity cross-section is square. The square cavity, which is lined with stainless steel, is sectioned into four equal quadrants by a welded-in-place cruciform basket – one quadrant for each of four PWR fuel assemblies. B_4C pellets inserted and sealed into the cruciform basket limit the K_{eff} of used nuclear fuel contents of the cask. The cavity shell is surrounded by a depleted uranium metal shield. The cross-section of the outside boundary of the depleted uranium and enclosing steel shell is a square with rounded corners. The steel and depleted uranium gamma shield and structure is surrounded by the neutron shield (proprietary design). The bottom of the cask is a solid stainless steel forging. The stainless steel cask lid is recessed into the end flange of the cask's body and is held in place by 12 Inconel bolts. Closure seals are ethylene-polypropylene O-rings. The cask's end impact limiters are removable and are constructed from aluminum honeycomb.

GA-4 LEGAL WEIGHT TRUCK TRANSPORT CASK

Specifications[49]

Attribute	GA-4 Legal Weight Truck Transport Cask
a. Capacity (assemblies)	4 PWR
b. Weight (lb)	
Empty (w/o Impact Limiters)	48,352
Impact Limiters (2)	4,000
Loaded (w/ Impact Limiters)	55,000
c. Thermal	
Design Heat Rejection (kw)	2.47
Maximum Fuel Clad Temp. (^oF)	445
Maximum Burnup (GWD/MTU)	35 @ 10 year cooled or 45 @ 15 year cooled
d. Shape	Rounded Square
e. Dimensions (in)	
Overall Length w/o Impact Limiters	187.76
Overall Length w/Impact Limiters	234.0
Overall Cross Section w/o Impact Limiters	39.75/48.31 including trunnions
Overall Cross Section w/ Impact Limiters	90
Cavity Length	167.25
Cavity Cross Section, Corner to Corner	25.68
Cavity Cross Section, Side to Side	18.16
Fuel Compartment	8.8
Wall Thickness w/o Neutron Shield	4.58
Lid Thickness	11
Bottom Thickness	9.5
Basket Length	166.6
Thickness of Basket Spacers	0.61
f-+. Neutron Shield (in)	
Side Thickness	N/A (Proprietary)
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/DU
Basket	SS/B_4C
Neutron Shielding	N/A (Proprietary)
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Outside Surface Dose (mrem/hr)	<200 (contact), <10 @ 2m
k. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7} (air), 1.96×10^{-7} (He)

N/A denotes Not Available

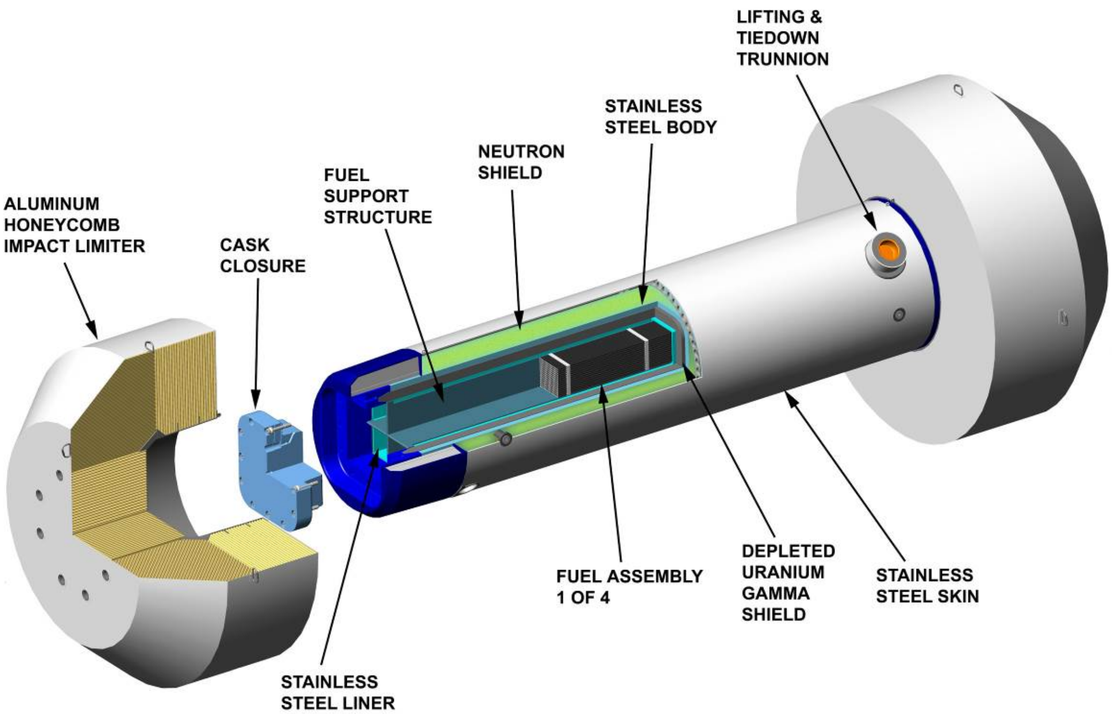
Licensing Status

The GA-4 legal weight truck transport cask is a licensed transportation cask under Certificate of Compliance 71-9226, Revision 3, which expires on October 31, 2013. The GA-4 transport cask cannot be fabricated until the CoC is updated from a -85 certificate to a -96 certificate.

Extent of Commercial Use

No GA-4 casks have been fabricated. GA has performed additional burnup credit calculations which would significantly extend the capability of the cask, but the decision was made not to apply for a revision to the CoC as of the date of this report.

GA-4 LEGAL WEIGHT TRUCK TRANSPORT CASK



GA-4 Used Fuel Transport Cask, Exploded View

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HI-STAR 60 TRANSPORT CASK

Contact:
Holtec International
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Fax: (856) 797-0909
www.holtecinternational.com

Introduction

The HI-STAR 60 (Holtec International Storage, Transport & Repository) package is Holtec's licensed transport package for off-site transport of PWR (15x15) fuel assemblies. The HI-STAR 60 metal cask is designed to hold the PWR used fuel assemblies in a thermally conductive fuel basket. The fuel basket provides the criticality control and the packaging body (cask) provides the confinement boundary, helium retention boundary, moderator exclusion boundary, gamma and neutron radiation shielding, and heat rejection capability. The HI-STAR 60 package is designed for transport by either rail or road. The transport package consists of:

- HI-STAR 60 metal cask
- Fuel basket (F-12)
- Removable honeycomb impact limiters
- Personnel Barrier

The HI-STAR 60 package is designed for transport by rail or road according to the provisions of 10 CFR 71, but is not a truck weight cask according to definitions of legal-weight truck (LWT) or over-weight truck (OWT). The HI-STAR 60 package may be shipped by road as long as the shipment is in compliance with applicable 10CFR71 and 49CFR requirements (as indicated by 10 CFR 71.5), other relevant DOT requirements, and local authority requirements. For shipments over public roads, special permissions would be required and route options would be limited. In practice, shipment in the U.S. by rail is more feasible.

Description

The HI-STAR 60 cask is a multi-layer steel cylinder with a welded base-plate and bolted lid (closure plate). The inner shell of the cask forms an internal cylindrical cavity for housing the fuel basket. The outer surface of the cask inner shell is buttressed with intermediate steel shell for radiation shielding. The cask closure plate incorporates a dual O-ring design to ensure its containment function. The containment system consists of the cask inner shell, bottom plate, top flange, top closure plate, top closure inner O-ring seal, vent port plug and seal, and drain port plug and seal.

The fuel basket, designated F-12 for the transport of 12 PWR fuel assemblies, is a fully welded, stainless steel, honeycomb structure and features flux traps between some, but not all cells.

The HI-STAR 60 transport package is fitted with two impact limiters fabricated of aluminum honeycomb crush material completely enclosed by an all-welded austenitic stainless steel skin. Both impact limiters are attached to the cask with sixteen (16) bolts.

The personnel barrier is used to provide a physical barrier to prevent manual access to thermally hot areas of the cask when configured for transportation. The personnel barrier is a sturdy cage type construction, supported by an internal or external support structure.

Specifications[50]

Attribute	HI-STAR 60 Transport Cask
a. Capacity (assemblies)	12 (15x15 PWR)
b. Weight (lb)	
Empty (Nominal w/o Impact Limiters)	142,350
Impact Limiters (2)	N/A
Loaded (Gross w/ Impact Limiters)	164,000
c. Thermal	
Design Heat Rejection (kW)	10.5
Maximum Burnup (GWD/MTU)	45
Minimum Cooling Time (yr)	5
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/ Impact Limiters	274.37
Overall Cross Section	75.75
Cavity Length	158.94
Cavity Cross Section	42.52
Wall Thickness	11.10
Lid Thickness	9.92
Bottom Thickness	8.07
f. Neutron Shield (in)	
Side Thickness	N/A
Lid Thickness	N/A
Bottom Thickness	N/A
g. Materials of Construction	
Cask Body	Steel
Neutron Shielding	Holtite-A
Fuel Basket	Metamic™
h. Cavity Atmosphere	He
i. Outside Surface Dose (mrem/hr)	<100
j. Maximum Leak Rate (atm-cm^3/sec)	N/A

N/A denotes Not Available (Proprietary)

Licensing Status

The HI-STAR 60 package is licensed for transport under Certificate of Compliance 71-9336, Revision 0, which expires on May 31, 2014. The system is licensed as a Type B(U)F-96 Transport Package in accordance with TS-R-1[2] and 10 CFR 71 regulations.

Extent of Commercial Use

The HI-STAR 60 transport package is currently not in use in the U.S. Holtec is under contract to provide the HI-STAR 60 transport package to an international utility.

HI-STAR 60 Containment and Top/Bottom Forgings during Fabrication at the Holtec Manufacturing Division

HI-STAR 60 Impact Limiters

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HI-STAR 180 TRANSPORT CASK

Contact:
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www.holtecinternational.com

Introduction

The HI-STAR 180 (Holtec International Storage, Transport & Repository) package is Holtec's licensed transport package for off-site transport of undamaged, moderate burnup and high burnup, PWR (14x14) fuel assemblies. The HI-STAR 180 metal cask is designed to hold the PWR used fuel assemblies in a thermally conductive fuel basket. The fuel basket provides the criticality control and the packaging body (cask) provides the confinement boundary, helium retention boundary, moderator exclusion boundary, gamma and neutron radiation shielding, and heat rejection capability. The HI-STAR 180 package is designed for transport by either rail or road. The transport package consists of:

- HI-STAR 180 metal cask
- Interchangeable fuel baskets (F-32 & F-37)
- Removable honeycomb impact limiters

The HI-STAR 180 package is designed for transport by rail or road according to the provisions of 10 CFR 71, but is not a truck weight cask according to definitions of legal-weight truck (LWT) or over-weight truck (OWT). The HI-STAR 180 package may be shipped by road as long as the shipment is in compliance with applicable 10CFR71 and 49CFR requirements (as indicated by 10 CFR 71.5), other relevant DOT requirements, and local authority requirements. For shipments over public roads, special permissions would be required and route options would be limited. In practice, shipment in the U.S. by rail is more feasible.

Description

The HI-STAR 180 metal cask consists of a monolithic cylinder configured from several short annular shield cylinders, holding Holtite-B neutron shielding material, which are stacked on top of each other to provide full-length gamma and neutron shielding. The containment boundary is formed by cryogenic steel inner shell welded at the bottom to a nickel steel baseplate (containment baseplate) and at the top to a machined nickel steel forging (containment closure flange). The cask closure system includes two independent closure lids, each equipped with two concentric annular metallic seals. Each lid is bolted independently to the containment closure flange.

Metamic™-HT, a metal matrix composite of aluminum and boron carbide, is the principal constituent material of the fuel basket, both as a structural material and neutron absorber material. Two interchangeable fuel basket models, designated F-32 and F-37, contain either 32 or 37 PWR fuel assemblies respectively, in regionalized and uniform loading patterns. The fuel basket features a honeycomb structure and flux traps between some, but not all cells.

The HI-STAR 180 package is fitted with two impact limiters fabricated of aluminum honeycomb crush material completely enclosed by an all-welded austenitic steel skin. Both impact limiters are attached to the cask with sixteen (16) bolts.

HI-STAR 180 TRANSPORT CASK

Specifications[51]

Attribute	HI-STAR 180 Transport Cask
a. Capacity (assemblies)	32/37 (14x14 PWR)
b. Weight (lb)	
Empty (F-37 Fuel Basket, Nominal, w/o Impact Limiters)	262,350
Impact Limiters (2)	N/A
Loaded (F-37 Fuel Basket, Gross, w/Impact Limiters)	308,647
c. Thermal	
Design Heat Rejection (kW)	32
Maximum Burnup (GWD/MTU)	66
Minimum Cooling Time (yr)	3 (F-32 Fuel Basket) 4 (F-37 Fuel Basket)
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/ Impact Limiters	285.04
Overall Cross Section	106.30
Cavity Length	174.37
Cavity Cross Section	72.83
Wall Thickness	N/A
Inner Lid Thickness	N/A
Outer Lid Thickness	N/A
Bottom Thickness	N/A
f. Neutron Shield (in)	
Side Thickness	N/A
Lid Thickness	N/A
Bottom Thickness	N/A
g. Materials of Construction	
Cask Body	Steel
Neutron Shielding	Holtite-B
Fuel Basket	Metamic™-HT
h. Cavity Atmosphere	He
i. Outside Surface Dose (mrem/hr)	N/A
j. Maximum Leak Rate (atm-cm^3/sec)	N/A

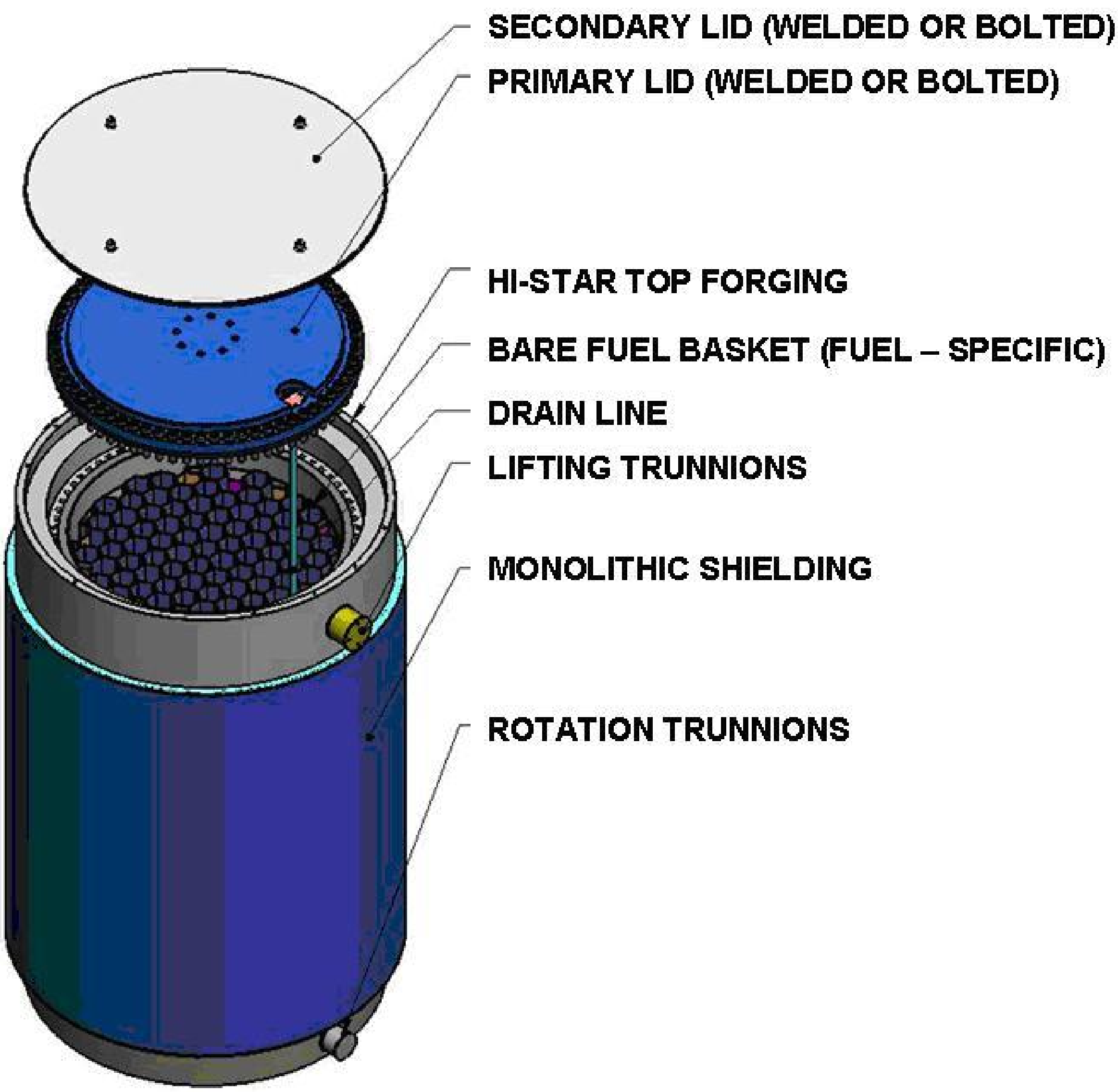
N/A denotes Not Available (Proprietary)

Licensing Status

The HI-STAR 180 package is licensed for transport under Certificate of Compliance 71-9325, Revision 0, which expires on October 31, 2014. The system is licensed as a Type B(U)F-96 Transport Package in accordance with TS-R-1[2] and 10 CFR 71 regulations.

Extent of Commercial Use

The HI-STAR 180 transport package is not currently in use in the U.S.



HI-STAR 180 Transport Package

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NAC-LWT LEGAL WEIGHT TRUCK TRANSPORT CASK

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC-LWT cask is a stainless steel and lead shielded cask with a surrounding water-ethylene glycol neutron shield. The cask, which has capacity to ship 1 PWR or 2 BWR used nuclear fuel assemblies, is designed to be transported using legal-weight trucks having a fully loaded gross vehicle weight that does not exceed 80,000 lbs. The cask consists of:

- Steel-lead-steel cask body with steel bottom and closure lid
- Removable metal PWR and BWR baskets
- Water/ethylene glycol neutron shield
- Impact limiters

Eight (8) NAC-LWT casks are currently owned and licensed by NAC International.

Description

The NAC-LWT cask assembly includes the cylindrical cask body, and closure (including bolts). The top and bottom of the cask are protected from impact by aluminum honeycomb removable impact limiters. The cask's cavity, which is lined with stainless steel, contains a removable basket – one basket type for 2 BWR fuel assemblies and one for 1 PWR fuel assembly. The cavity shell is surrounded by a lead shield. Outside the lead is a stainless steel shell. The steel and lead gamma shield and structure is surrounded by a neutron shield tank having an external stainless steel shell and containing a mixture of water and ethylene glycol, which is the neutron shield. The bottom and lid of the cask are stainless steel forgings. The cask lid is held in place by twelve (12) bolts. Metallic and Teflon O-ring seals are used between the lid and the cask body.

NAC-LWT LEGAL WEIGHT TRUCK TRANSPORT CASK

Specifications[52]

Attribute	NAC-LWT Transport Cask
a. Capacity (assemblies)	1 PWR/2 BWR/Other research reactor fuel types
b. Weight (lb)	
Empty (w/o Impact Limiters)	48,000
Impact Limiters (2)	2,855
Loaded (w/ Impact Limiters)	51,200
c. Thermal	
Design Heat Rejection (kW)	2.5
Maximum Fuel Clad Temp. (^oF)	653
Operating Temperature (^oF)	228 (cask radial surface; max.)
Maximum Burnup (GWD/MTU)	35
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/o Impact Limiters	199.8
Overall Length w/Impact Limiters	231.8
Overall Cross Section w/o Impact Limiters	44.2
Overall Cross Section w/ Impact Limiters	65.3
Cavity Length	177.9
Cavity Cross Section	13.375
Inner Wall Thickness	0.75
Lead Shield Wall Thickness	5.75
Outer Shell Wall Thickness	1.20
Lid Thickness	11.3
Bottom Thickness	10.5
Basket Length	178.0
Basket Cross Section	13.3
f. Neutron Shield (in)	
Neutron Shield Tank Thickness	5.0
Neutron Shield Wall Thickness	0.25
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/Pb
Basket	SS
Neutron Shielding	Borated Water/Ethylene Glycol
h. Cavity Atmosphere	He
i. Outside Surface Dose (mrem/hr)	<100
j. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

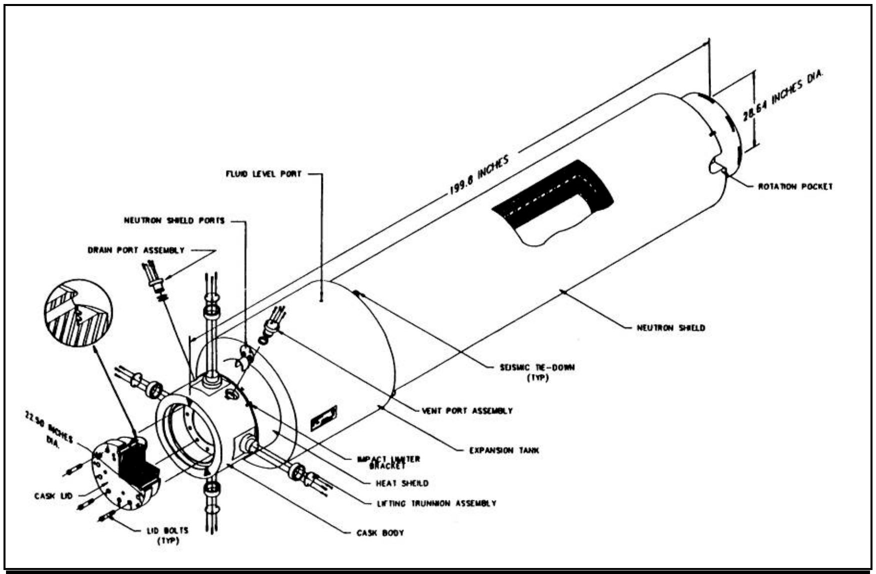
Licensing Status

The NAC-LWT cask is a licensed transport cask under Certificate of Compliance 71-9225, Revision 58, which expires on February 28, 2015.

Extent of Commercial Use

NAC-LWT casks have been used extensively to transport foreign research reactor used nuclear fuel and high burnup LWR fuel rods. Shipments have been made by rail, truck and maritime vessels.

NAC-LWT LEGAL WEIGHT TRUCK TRANSPORT CASK



NAC-LWT Legal Weight Truck Transport Cask

NAC-LWT Legal Weight Truck Transport Cask

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TN FSV LEGAL WEIGHT TRUCK TRANSPORT CASK

Contact:
James Kaylor
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James.Kaylor@icp.doe.gov

Introduction

The TN FSV cask is a steel and lead shielded transport cask for transporting irradiated nuclear fuel by legal-weight truck. The cask was designed and licensed by Transnuclear Inc. for Public Service Company of Colorado. It has three transport configurations: one configuration for transporting irradiated Fort St. Vrain (FSV) high-temperature gas cooled reactor (HTGR) fuel elements; a second configuration for transporting irradiated fuel parts and intact irradiated Peach Bottom Unit 1 fuel elements within an secondary containment vessel; and a third configuration for transporting intact, irradiated PWR fuel rods. The cask consists of:

- Steel/lead/steel cask body and stainless steel lid
- Impact limiters

Description

The TN FSV Cask was intended for truck transport of 6 hexagonal-shaped FSV HTGR fuel elements contained in a sealed, cylindrical stainless steel canister. The cask, with the “Oak Ridge Basket” installed can also be used to ship canisters containing irradiated Peach Bottom Unit 1 (PB-1) fuel or irradiated nuclear fuel parts. Intact PWR fuel pins can be shipped using a shielded basket designed for the cask. The construction of the cask body is stainless steel inner and outer cylindrical shells encasing a lead shield. A stainless steel thermal shield covers the cylindrical side of the cask’s body. The bottom and lid are solid stainless steel. The lid consists of a 2.5-inch thick stainless steel plate fully recessed and bolted into the cask top flange. When transporting irradiated FSV fuel elements, a depleted uranium shield plug can be used. The “Oak Ridge Basket” provides neutron absorbers and structural support plates for 5 canisters containing PB-1 irradiated fuel or irradiated nuclear fuel parts. Up to seven PWR fuel rods can be shipped when using the PWR fuel basket. Irradiated guide tubes may also be transported using this basket. Lifting trunnions are located near the top (lid) end and rotation trunnions near the cask bottom. The cask lid is sealed with two O-rings.

TN FSV LEGAL WEIGHT TRUCK TRANSPORT CASK

Specifications[53]

Attribute	TN FSV Transport Cask
a. Capacity (assemblies)	6 HTGR/7 PWR
b. Weight (lb)	
Empty (w/o Impact Limiters)	42,000
Impact Limiters (2)	N/A
Loaded (w/ Impact Limiters)	47,000
c. Thermal	
Design Heat Rejection (kW)	0.36 (FSV Fuel and PWR fuel)
Maximum Burnup (GWD/MTU)	70 - 73 FSV Fuel/Up to 80 PWR fuel
Minimum Cooling Time (yr)	4.4 (FSV Fuel) 27 (Peach Bottom Fuel)\ 15 (Oak Ridge Canisters) 0.5 to 4.1 (PWR fuel, time is a function of kgU/rod and burnup)
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/ Impact Limiters	247
Overall Cross Section	31
Cavity Length	199
Cavity Cross Section	18
Wall Thickness	6.5
Lid Thickness	2.5
Bottom Thickness	5.5
f. Neutron Shield (in)	
Side Thickness	None
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/Pb
Neutron Shielding	None
h. Cavity Atmosphere	N/A
i. Outside Surface Dose (mrem/hr)	N/A
j. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

N/A denotes Not Available

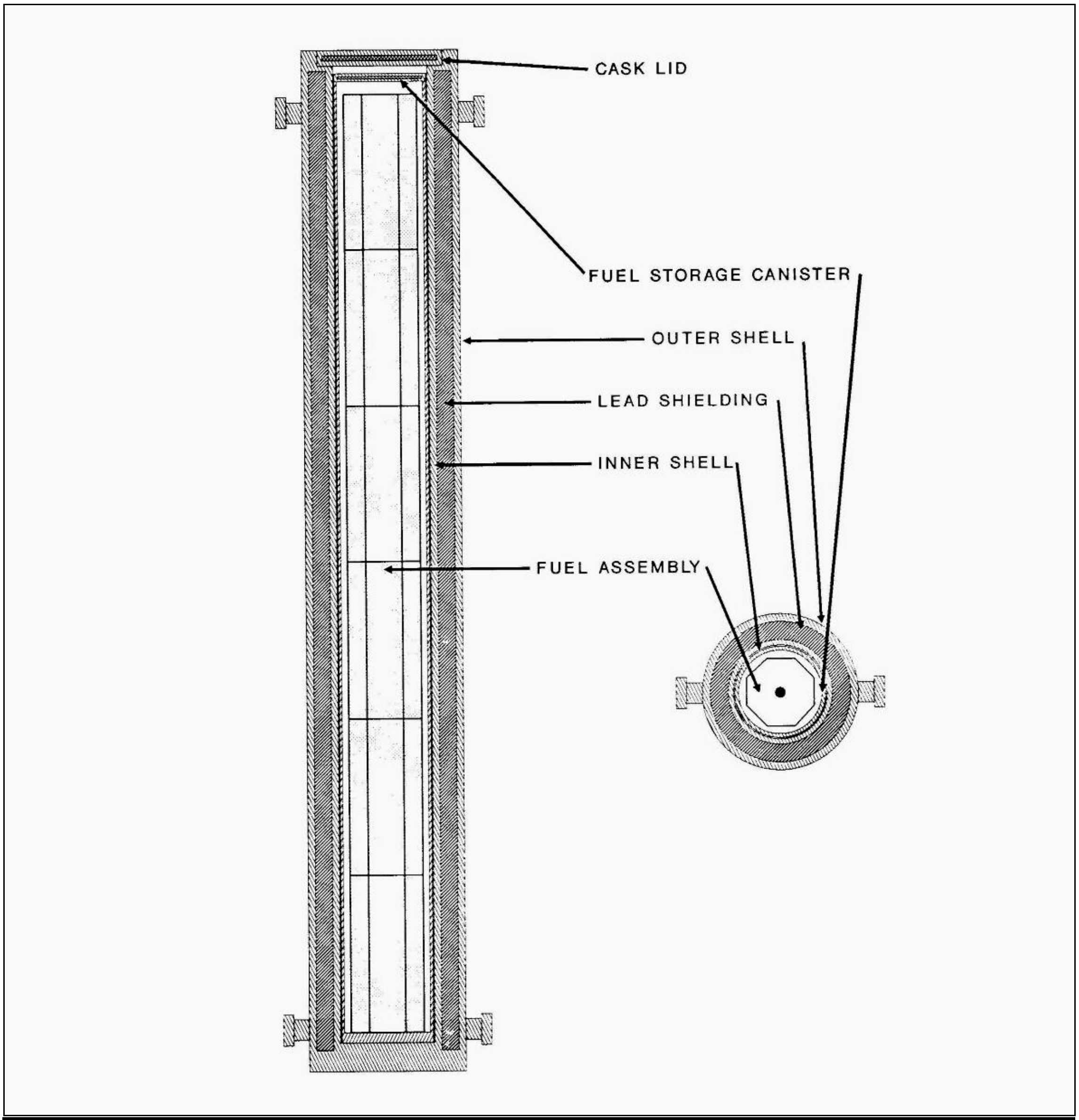
Licensing Status

The TN FSV cask is a licensed transportation cask under Certificate of Compliance 71-9253, Revision 12, which expires on June 30, 2014.

Extent of Commercial Use

To date, TN FSV casks have seen limited use. The two casks now owned by the DOE are located at the Idaho National Laboratory.

TN FSV LEGAL WEIGHT TRUCK TRANSPORT CASK



TN FSV Legal Weight Truck Transport Cask

TN FSV LEGAL WEIGHT TRUCK TRANSPORT CASK

TN FSV Legal Weight Truck Transport Cask

TN-LC TRANSPORT CASK

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-LC is designed for exclusive-use transportation of irradiated test, research, and commercial reactor fuel in either a closed transport vehicle or an ISO container. The cask consists of:

- Payload basket
- Shielded body
- Shielded closure lid and top and bottom impact limiters
- Stainless steel or aluminum spacers to limit axial movement of the payload

Description

There are four basket designs available for use with the TN-LC transport cask:

1. TN-LC-NRUX for National Research Universal Reactor and National Research Experimental Reactor fuel assemblies, (NRU or NRX Mk I),
2. TN-LC-MTR for Material Test Reactor fuel assemblies,
3. TN-LC-TRIGA for Training, Research and Isotope, General Atomics (TRIGA) reactor fuel assemblies, and,
4. TN-LC-1FA for Pressurized Water Reactor and Boiling Water Reactor fuel assemblies or fuel pins. The fuel pin basket also accommodates Mixed Oxide (MOX) and Evolutionary Pressurized Reactor (EPR) fuel pins.

The packaging body is a right circular cylinder composed of top and bottom end flange forgings connected by inner and outer shells. Lead shielding is placed between the two cylindrical shells in the bottom end assembly, and in the lid. Neutron shielding, composed of borated resin compound inserted into twenty aluminum shield boxes, is set between the outer shell and a stainless steel outer sheet.

Two removable trunnions are bolted to the packaging body using eight bolts for each trunnion. Two pocket trunnions in the bottom flange are used for rotating the package and may be used for horizontal package lifting. Impact limiters consisting of balsa and redwood blocks encased in stainless steel shells, are attached to each end of the packaging during shipment, each with eight bolts.

The TN-LC transport package is compatible with fuel pool loading/unloading at nuclear power plants, research reactors, reprocessing facilities, and hot cells at several national labs and research institutions.

Contents may include 1 PWR assembly, 1 BWR assembly, up to 25 PWR or BWR fuel rods in a 25 pin can basket, up to 26 NRU fuel assemblies, up to 26 NRX fuel assemblies, up to 54 MTR fuel assemblies, or up to 180 TRIGA fuel elements.

TN-LC TRANSPORT CASK

Specifications[54]

Attribute	TN-LC Transport Cask
a. Weight (lb)	
Empty (w/o Impact Limiters)	43,900
Impact Limiters (2)	3,000
Loaded (w/ Impact Limiters)	51,000
c. Thermal	
Design Heat Rejection (kW)	0.39 (NRUX), 1.5 (MTR), 1.5 (TRIGA), 3.0 (1 PWR assembly), 2.0 (1 BWR assembly), 3.0 (MOX 25 pin can w/ up to 25 rods) – 1.98 (MOX 25 pin can w/ up to 9 rods)
Maximum Burnup (GWD/MTU unless noted otherwise)	≤ 80% depletion of initial U^{235} mass (NRUX) 0.660 (MTR) 0.450 (TRIGA Element ID t-04) 62.0 (PWR assembly and BWR assembly) 90.0 (25PWR/EPR, 9PWR/EPR, 25BWR, 9 BWR fuel rods 62.0 (MOX fuel rods)
Minimum Cooling Time (yr)	10 (NRU and NRX) 2.02 (MTR Type A or Type C; See table 3 in CoC) 1.09 (TRIGA T-01; See tables 6 & 7 in CoC) 10 (PWR assembly and BWR assembly), 10 (25 PWR/EPR, 9PWR/EPR 25BWR, 9 BWR: fuel rods), 10 (MOX fuel rods)
c. Shape	Cylindrical
d. Dimensions (in)	
Overall Length w/ Impact Limiters	230
Overall Cross Section w/o Impact Limiters	38.50
Cavity Length	182.50
Cavity Cross Section	18
Cask body Outer shell Thickness	1.5
Cask body Inner shell Thickness	1.0
Lid Thickness	7.5
Bottom Thickness	7.5
e. Gamma Shield (in)	
Lead gamma shield thickness	3.50
f. Neutron Shield (in)	
Neutron shield thickness	3.75
g. Materials of Construction	
Cask Body	SS/Pb
Neutron Shielding	Borated resin compound
h. Cavity Atmosphere	Helium
i. Outside Surface Dose (mrem/hr)	<200
j. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

Licensing Status

The TN-LC cask is a licensed transportation cask under Certificate of Compliance 71-9358, Revision 0, which expires on December 31, 2017.

Extent of Commercial Use

Fabrication of the TN-LC transport cask is under way and the delivery of the first TN-LC is expected in early 2015.

TN-LC TRANSPORT CASK

TN-LC Transport Cask

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REFERENCES

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APPENDIX A
CASKS FORMERLY LICENSED IN THE U.S. AND UNLICENSED CASKS OF U.S. ORIGIN

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INTRODUCTION

This appendix contains data sheets on U.S. casks that were included in JAI-582, "*Shipping and Storage Cask Data For Commercial Spent Nuclear Fuel*," originally published by JAI Corporation in March 2005, but which now have expired licenses. In addition, this appendix includes one cask of U.S. origin (the GA-9) that was designed but never licensed.

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FSV-1 LEGAL WEIGHT TRUCK TRANSPORT CASK

Contact:
General Atomics
Tel: (858) 455-3155
www.ga.com

Introduction

The FSV-1 cask is a stainless steel-encased depleted uranium shielded legal-weight truck transport cask. The cask was originally designed to transport Ft. St. Vrain (FSV) high temperature gas cooled reactor (HTGR) used fuel elements. There are two FSV-1 casks. The cask consists of:

- Steel-depleted uranium-steel cask body and inner and outer lids
- Closure-end impact limiter

Description

The FSV-1 cask, which was originally designed by General Atomics Corporation, was intended for truck transport of 6 hexagonal-shaped FSV HTGR fuel elements contained in a sealed, cylindrical stainless steel canister. The construction of the cask body is stainless steel inner and outer cylindrical shells encasing a depleted uranium metallic shield. The bottom of the cask is solid stainless steel. The cask cavity is closed using two lids. The outer cask lid consists of a 3.75-inch thick stainless steel plate and a 2.25-inch thick depleted uranium shield. An inner lid is a stainless steel shell containing depleted uranium 4.15-inches thick. Lifting trunnions, welded to the cylindrical external shell, are located near the top (lid) end. Rotation trunnions are located near the cask bottom. When used to transport FSV HTGR used nuclear fuel, the FSV-1 cask is equipped with an impact limiter on the top (closure) end. The cask cavity is sealed using silicone elastomeric seal rings one located between the outer lid and cask body and another between the inner lid and inner cask body.

FSV-1 LEGAL WEIGHT TRUCK TRANSPORT CASK

Specifications

Attribute	FSV-1 Transport Cask
a. Capacity (assemblies)	6 HTGR
b. Weight (lb)	
Empty	43,200
Loaded	47,600
c. Thermal	
Design Heat Rejection (kW)	4.1
Maximum Fuel Clad Temp. (^{o}F)	N/A
Maximum Burnup (GWD/MTU)	N/A
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/o Impact Limiter	208
Overall Cross Section	28
Cavity Length	187.6
Cavity Cross Section	17.7
Wall Thickness	5.15
Lid Thickness	10.15
Bottom thickness	10.2
f. Neutron Shield (in)	None
g. Materials of Construction	
Cask Body	SS/DU
h. Cavity Atmosphere	N/A
i. Outside Surface Dose (mrem/hr)	N/A
j. Maximum Leak Rate (atm-cm^3/sec)	1.0 x 10^{-6}

N/A denotes Not Available

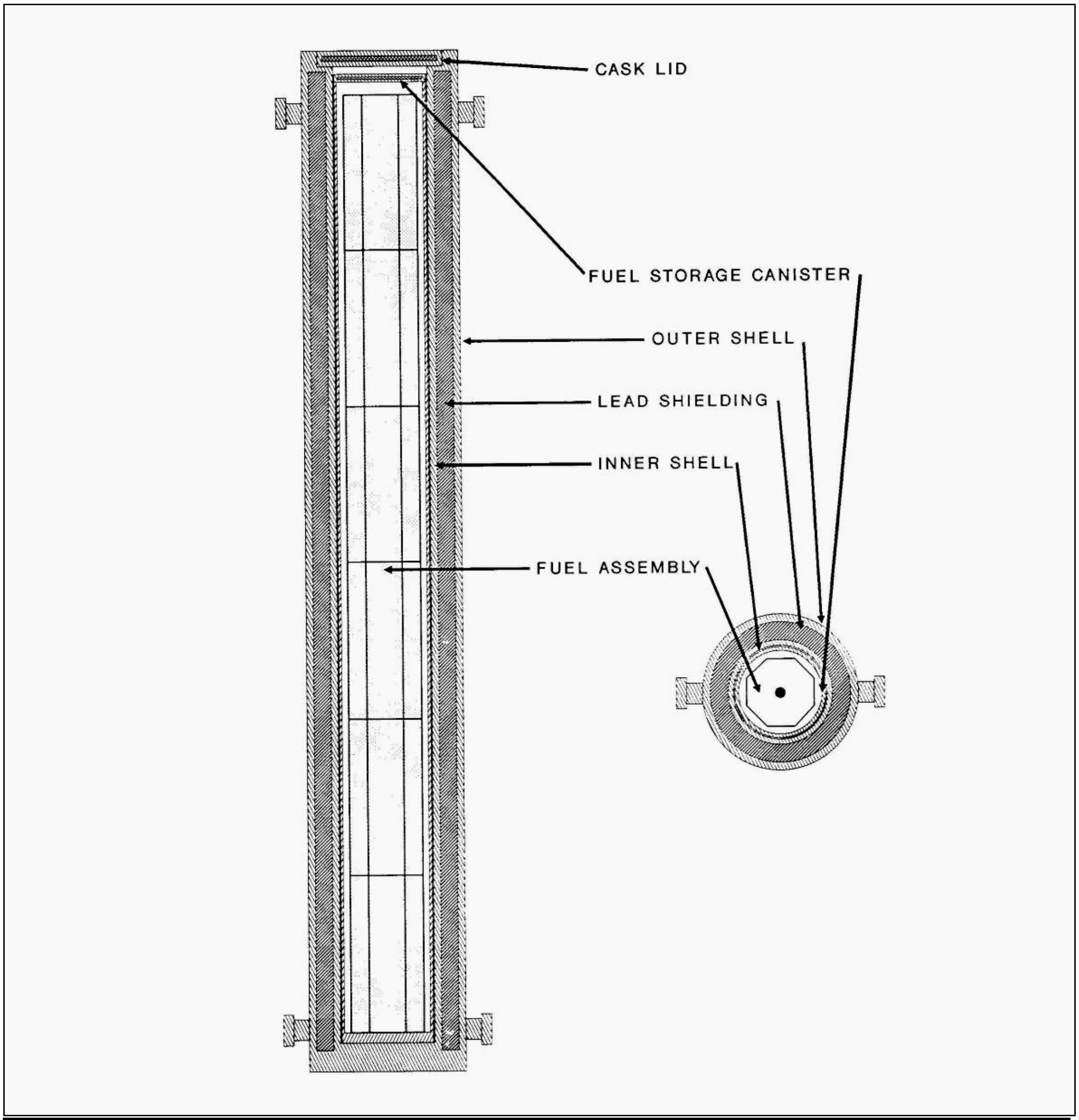
Licensing Status

The FSV-1 cask was a licensed transport cask under Certificate of Compliance 71-6346, Revision 28, which expired on May 31, 2006. A restriction in the Certificate of Compliance states that use of FSV-1 packages fabricated after August 31, 1986 is not authorized.

Extent of Commercial Use

FSV-1 casks have seen limited use following being placed into service in the 1970s.

FSV-1 LEGAL WEIGHT TRUCK TRANSPORT CASK



GA FSV-1 Legal Weight Truck Transport Cask

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GA-9 TRANSPORT CASK

Contact:
General Atomics
Tel: (858) 455-3155
www.ga.com

Introduction

The GA-9 legal weight truck transport cask is a stainless steel-encased depleted uranium shielded cask for transporting nine BWR used nuclear fuel assemblies. The cask, along with its transport trailer, is designed to provide the greatest practical payload capacity for BWR used nuclear fuel with a gross vehicle weight that does not exceed the Federal limit of 80,000 lbs for semi tractor-trailer trucks operated on U.S. and Interstate designated highways. Although the design has been completed, application has not been made to the U.S. Nuclear Regulatory Commission for a current Certificate of Compliance. The cask consists of:

- Steel-depleted uranium-steel cask body with steel bottom and closure lid
- Removable metal cruciform basket with fixed neutron poisons
- Thermoplastic neutron shield
- Removable aluminum honeycomb impact limiters

The GA-9 legal weight truck transport cask was designed by General Atomics.

Description

The GA-9 cask assembly includes the cask body, closure (including bolts), and impact limiters. The cask's cavity cross-section is square. The square cavity, which is lined with stainless steel, is sectioned into nine equal compartments by a removable cruciform basket – one compartment for each of nine BWR fuel assemblies. B_4C pellets inserted and sealed into the cruciform basket limit the K_{eff} of used nuclear fuel contents of the cask. The cavity shell is surrounded by a depleted uranium metal shield. The cross-section of the outside boundary of the depleted uranium and enclosing steel shell is a square with rounded corners. The steel and depleted uranium gamma shield and structure is surrounded by a thermoplastic neutron shield. The bottom of the cask is a solid stainless steel forging. The stainless steel cask lid is recessed into the end flange of the cask's body and is held in place by 12 Inconel bolts. Closure seals are ethylene-polypropylene O-rings. The cask's end impact limiters are removable and are constructed from aluminum honeycomb.

General Atomics

GA-9 TRANSPORT CASK

Specifications

Attribute	GA-9 Legal Weight Truck Transport Cask
a. Capacity (assemblies)	9 BWR
b. Weight (lb)	
Empty	47,300
Loaded	54,000
c. Thermal	
Design Heat Rejection (kW)	2.12
Maximum Fuel Clad Temp. (^{o}F)	445
Maximum Burnup (GWD/MTU)	35 @ 10 years cooled
d. Shape	Rounded Square
e. Dimensions (in)	
Overall Length w/o Impact Limiters	198.3
Overall Length w/Impact Limiters	244.5
Overall Cross Section w/o Impact Limiters	39.75/46.66 including trunnions
Overall Cross Section w/ Impact Limiters	90
Cavity Length	178
Cavity Cross Section, Corner to Corner	25.68
Cavity Cross Section, Side to Side	18.16
Fuel Compartment	5.76
Wall Thickness w/o Neutron Shield	4.48
Lid Thickness	10.8
Bottom Thickness	9.5
f. Neutron Shield (in)	
Side Thickness	4.5 (max)
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/DU
Basket	SS/B_4C
Neutron Shielding	N/A
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Outside Surface Dose (mrem/hr)	<200 (contact), <10 @ 2m
k. Maximum Leak Rate (atm-cm^3/sec)	1.0 x 10^{-7} (air), 1.96 x 10^{-7} (He)

N/A denotes Not Available

Licensing Status

Application has not been made to the U.S. Nuclear Regulatory Commission for a Certificate of Compliance for the GA-9 legal weight truck transport cask.

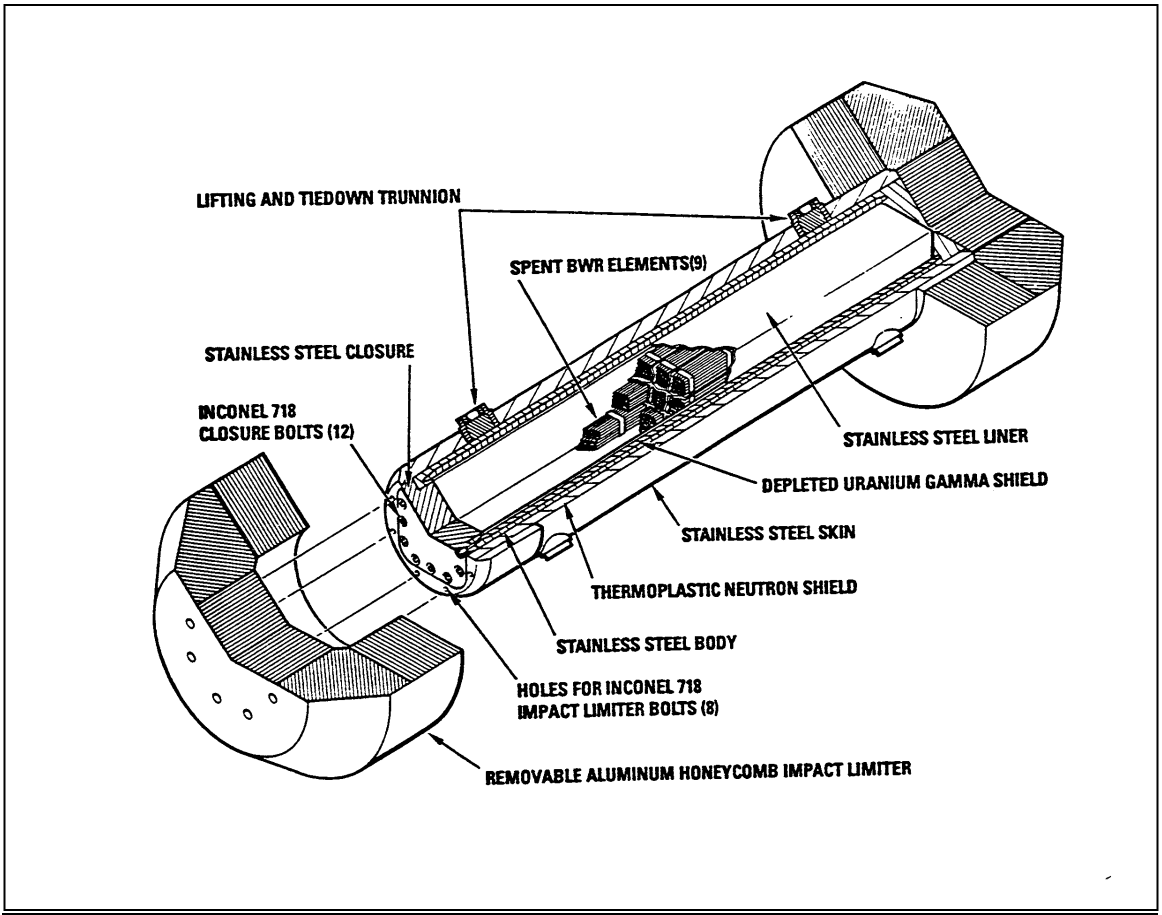
Extent of Commercial Use

None. No GA-9 casks have been constructed.

Comments

The GA-9 cask can use a 4-element basket to handle PWR fuel between 167 and 178 inches in length.

GA-9 TRANSPORT CASK



GA-9 Used Fuel Transport Cask, Exploded View

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General Electric

IF-300 TRANSPORT CASK

Contact:
Unknown

Introduction

The IF-300 cask is a stainless steel-encased depleted uranium shielded cask for transporting seven PWR or seventeen BWR used nuclear fuel assemblies. The cask, along with its transport skid was designed and licensed by General Electric Company in 1974 to transport used nuclear fuel from reactors to its planned Morris, Illinois nuclear fuel reprocessing plant. The 70-ton cask on its transport skid was designed to be transported in unrestricted interchange (maximum loaded railcar weight of 263,000 lb.) general rail service. The cask consists of:

- Steel-depleted uranium-steel cask body with steel bottom and closure lid
- Removable metal cruciform basket with fixed neutron poisons
- Water/ethylene glycol neutron shield
- Transport skid

Description

The IF-300 cask assembly includes the cylindrical cask body, and closure (including bolts). Impact limiting metal fins are incorporated into the lid and bottom of the cask. The cask's cavity, which is lined with stainless steel, contains a removable cruciform basket with equal-sized compartments for fuel assemblies – 17 for BWR or 7 for PWR fuel assemblies. B_4C pellets inserted and sealed in rods in the basket structure limit the K_{eff} of used nuclear fuel contents of the cask. The cavity shell is surrounded by a depleted uranium metal shield. Outside the depleted uranium is a stainless steel shell. The steel and depleted uranium gamma shield and structure is surrounded by a neutron shield tank having a corrugated external stainless steel shell containing a mixture of water and ethylene glycol, which is the neutron shield. The bottom and lid of the cask have depleted uranium shielding encased in stainless steel. The cask lid is held in place by 32 bolt-studs. Metallic O-ring seals are used between the lid to the cask body.

IF-300 TRANSPORT CASK

Specifications

Attribute	IF-300 Transport Cask
a. Capacity (assemblies)	7 PWR/18 BWR (17 channeled BWR) 1 NUHOMS®-07P DSC
b. Weight (lb)	
Empty	130,000
Loaded	140,000
c. Thermal	
Design Heat Rejection (kW)	11.7
Maximum Fuel Clad Temp. (^oF)	325
Maximum Burnup (GWD/MTU)	35
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	210
Overall Cross Section	64
Cavity Length	180.25
Cavity Cross Section	37.5
Wall Thickness w/o Fins	6.125
Lid Thickness	2.5 SS/3.0 DU
Bottom Thickness	N/A
f. Number of Cooling Fins	N/A (radial concentric)
g. Neutron Shield (in)	
Neutron Shield Tank Thickness	4.5 (min)
Lid Thickness	None
Bottom Thickness	None
h. Materials of Construction	
Cask Body	SS/DU
Basket	SS/B_4C
Neutron Shielding	Water/Ethylene Glycol
i. Cavity Atmosphere	He, Ar, or N_2 @ 1 atm
j. Outside Surface Dose (mrem/hr)	<200
k. Maximum Leak Rate (atm-cm^3/sec)	N/A

N/A denotes Not Available

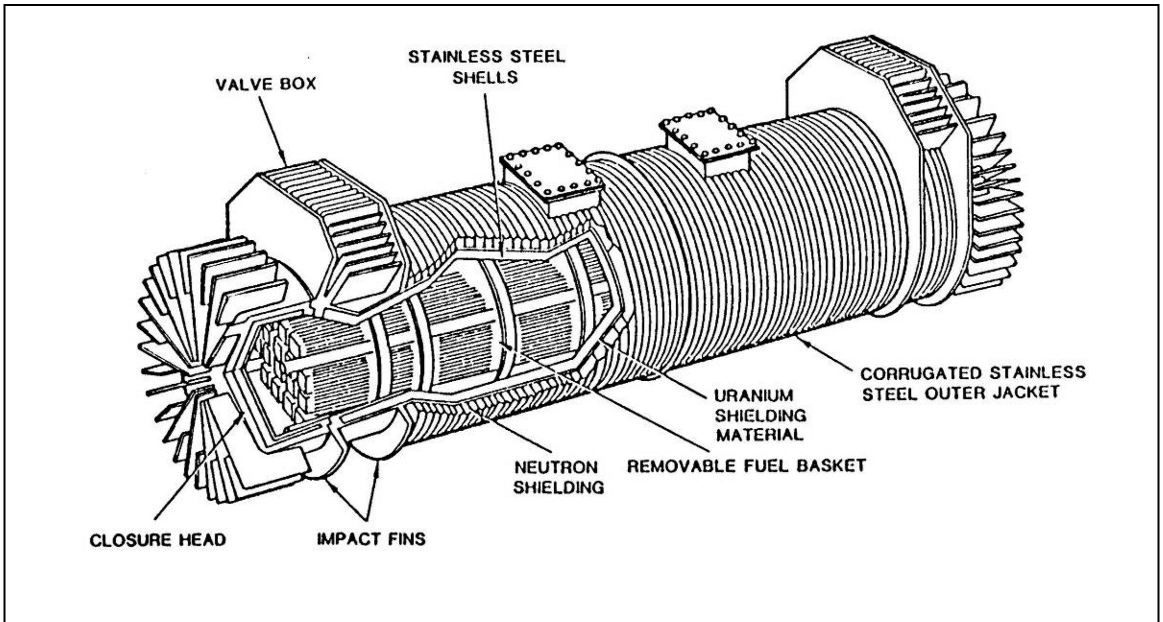
Licensing Status

The IF-300 cask was a licensed transport cask under Certificate of Compliance 71-9001, Revision 39, which expired on October 1, 2008. The certificate is non-renewable.

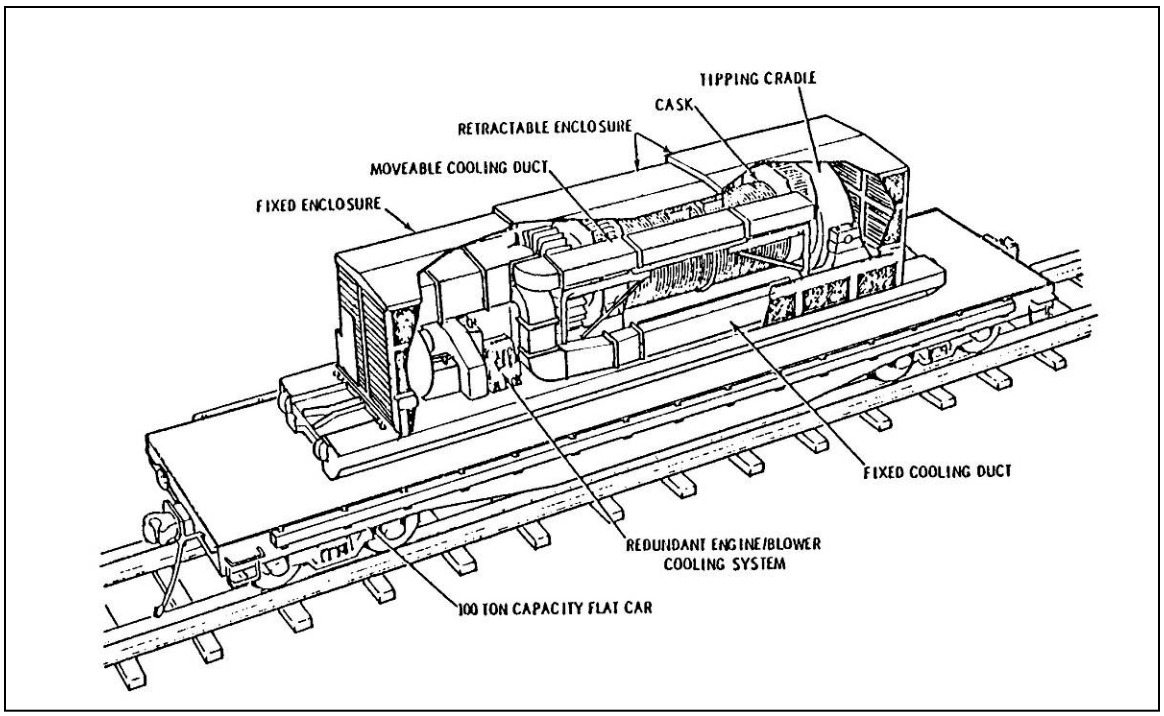
Extent of Commercial Use

None.

IF-300 TRANSPORT CASK



IF-300 Rail Transport Cask



IF-300 Rail Transport System

IF-300 TRANSPORT CASK

IF-300 Rail Transport System

NAC I26 S/T STORAGE AND TRANSPORT CASK

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC I26 S/T cask is a metal cask that is designed for the storage and transport of 26 PWR used fuel assemblies. This cask has been licensed for use in the U.S. only for storage applications. No application for use of the cask in transport applications was ever submitted.

One NAC I26 S/T cask has been fabricated for use at the Almaraz Nuclear Power Station in Spain.

Description

The NAC I26 S/T cask is a multi-walled cylinder with the outside wall consisting of 2.63-inch thick stainless steel, the inside wall consisting of 1.5-inch thick stainless steel, and the space between them filled with 3.2 inches of lead. A 7-inch thick solid neutron shield encased in 0.25 inches of stainless steel is attached to the outside wall. The bottom and the lid are also made of lead encased in stainless steel, and a neutron shield cap is placed on the top of the cask after fuel loading. The lid is sealed with metallic O-rings. The 26 fuel cavities consist of square aluminum tubes which are held together by aluminum and stainless steel spacers and tie bars. Boral sheets are attached to the outside of the tubes for criticality prevention.

Like all metal storage casks, the NAC I26 S/T cask is loaded and unloaded in the used fuel pool of a reactor site.

Specifications

Attribute	NAC I26 S/T
a. Capacity (assemblies)	26 PWR
b. Weight (lb)	
Empty	162,200
Loaded	200,000
c. Thermal	
Design Heat Rejection (kW)	26
Maximum Fuel Clad Temp. (^{o}F)	679
Maximum Burnup (GWD/MTU)	35
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	181.3
Overall Cross Section	94.0
Cavity Length	165.0
Cavity Cross Section	64.8
Wall Thickness	14.6
Lid Thickness	8.5
Bottom Thickness	8.8
Basket Length	155.0
Basket Cross Section	64.5
f. Neutron Shield (in)	
Side Thickness	7.0
Lid Thickness	2.0
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/Pb
Basket	Al & SS Grid/Al Storage Cells/Boral Plates
Neutron Shield	GESC NS4FR
h. Number of Cooling Fins	24 (within neutron shield)
i. Cavity Atmosphere	He
j. Cavity Pressure (psia)	30
k. Outside Surface Dose (mrem/hr)	<100
l. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-6}

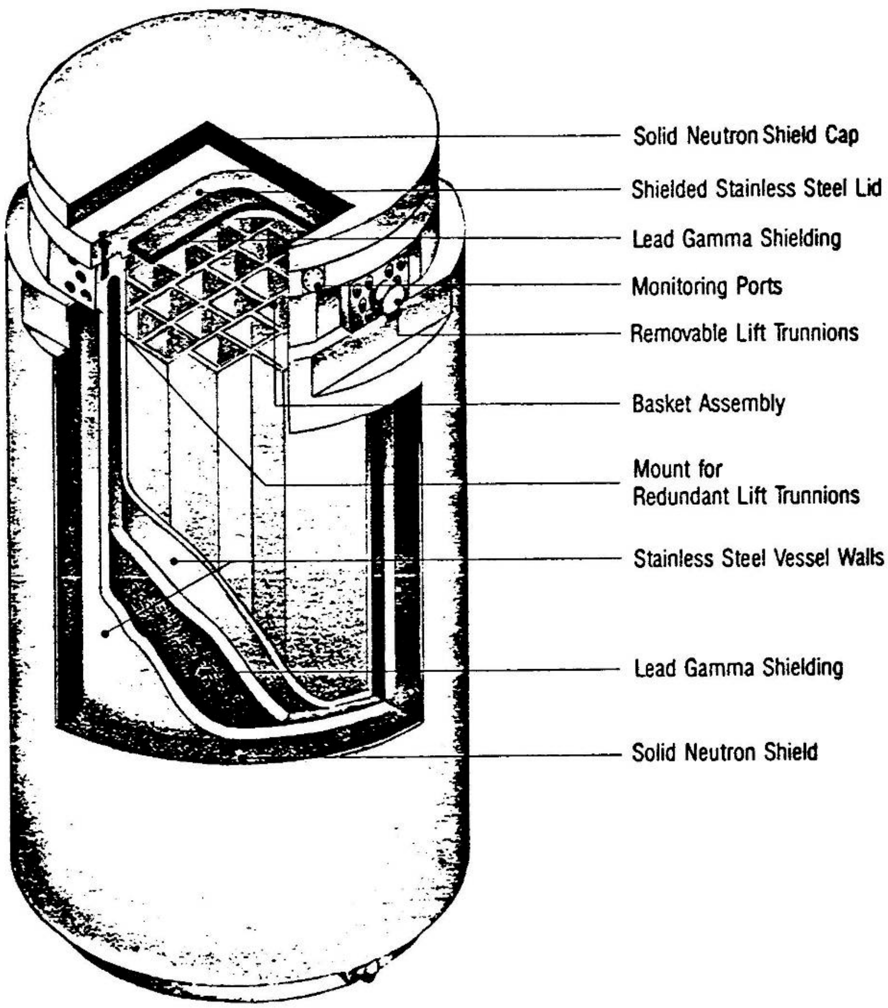
Licensing Status

The NAC-I26 S/T was a NRC licensed storage cask under Certificate of Compliance 72-1002 which expired on August 31, 2010.

Extent of Commercial Use

One cask was fabricated for use at the Almaraz Nuclear Station in Spain.

NAC I26 S/T STORAGE AND TRANSPORT CASK



NAC-I26 S/T Used Fuel Storage Cask

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NAC C28 S/T STORAGE AND TRANSPORT CASK

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NAC C28 S/T cask is a metal cask that is designed for the storage and transport of irradiated PWR fuel rods contained in canisters, with the fuel rods from 2 PWR assemblies being contained in each canister. The cask has a capacity to hold 28 canisters of consolidated fuel rods (equal to the rods of 56 PWR assemblies). This cask is a modification of the NAC I28 S/T cask – to be able to accommodate consolidated fuel rods specifically. This cask has been licensed for use in the U.S. only for storage applications. No application for use of the cask in transport applications was ever submitted.

None of these casks have been built to date, primarily because no U.S. utility is planning to disassemble used fuel assemblies and consolidate the resulting fuel rods and non-fuel bearing components.

Description

The NAC C28 S/T cask is a multi-walled cylinder with the outside wall consisting of 2.68-inch thick stainless steel, the inside wall consisting of 1.53-inch thick stainless steel, and the space between them filled with 3.2 inches of lead. A 7-inch thick solid neutron shield encased in 0.25 inches of stainless steel is attached to the outside wall. The bottom and the lid are also made of lead encased in stainless steel, and a neutron shield cap is placed on the top of the cask after fuel loading. The lid is sealed with metallic O-rings. The 28 fuel cavities consist of square aluminum tubes which are held together by aluminum castings. Boral sheets are attached to the outside of the tubes for criticality prevention.

Like all metal storage casks, the NAC C28 S/T cask is loaded and unloaded in the used fuel pool of a reactor site.

NAC C28 S/T STORAGE AND TRANSPORT CASK

Specifications

Attribute	NAC C28 S/T
a. Capacity (canisters)	28 (containing the irradiated fuel rods from 56 PWR assemblies)
b. Weight (lb)	
Empty	166,000
Loaded	230,000
c. Thermal	
Design Heat Rejection (kW)	20 (consolidated assemblies)
Maximum Fuel Clad Temp. (^{o}F)	679 (consolidated assemblies)
Maximum Burnup (GWD/MTU)	35 (consolidated assemblies)
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	181.3
Overall Cross Section	94.0
Cavity Length	165.0
Cavity Cross Section	64.8
Wall Thickness	14.6
Lid Thickness	8.5
Bottom Thickness	8.8
Basket Length	155.0
Basket Cross Section	64.5
f. Neutron Shield (in)	
Side Thickness	7.0
Lid Thickness	2.0
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/Pb
Basket	Cask Al Grid/Al Storage Cells/Boral Plates
Neutron Shield	GESC NS4FR
h. Number of Cooling Fins	24 (within neutron shield)
i. Cavity Atmosphere	He
j. Cavity Pressure (psia)	30
k. Outside Surface Dose (mrem/hr)	<100
l. Maximum Leak Rate (atm-cm^3/sec)	1 x 10^{-6}

Licensing Status

The NAC-C28 S/T storage cask license is currently expired and no longer in use.

Extent of Commercial Use

None.

NLI 1/2 LEGAL WEIGHT TRUCK TRANSPORT CASK

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NLI 1/2 cask is a stainless steel, lead, and depleted uranium shielded cask with a surrounding water-ethylene glycol neutron shield. The cask, which has capacity to transport 1 PWR or 2 BWR used nuclear fuel assemblies, was designed to be transported using legal-weight trucks having a fully loaded gross vehicle weight that does not exceed 80,000 lbs. The cask consists of:

- Steel-depleted uranium-lead-steel cask body with steel bottom and outer closure lid and composite steel-depleted uranium inner lid
- Removable aluminum and stainless steel PWR and BWR baskets
- Water/ethylene glycol neutron shield
- Impact limiters

Five NLI 1/2 casks are currently owned and licensed by NAC International.

Description

The NLI 1/2 cask assembly includes the cylindrical cask body, and a two-lid closure. The top and bottom of the cask are protected from impact by stainless steel-clad balsa wood-filled removable impact limiters. The cask's cavity, which is lined with stainless steel, contains a removable cruciform basket – one basket type for 2 BWR fuel assemblies and one for 1 PWR fuel assembly. The cavity shell is surrounded by a depleted uranium and lead shield. A stainless steel shell encases the depleted uranium/lead gamma shield. The gamma shield and structure is surrounded by a neutron shield tank having an external stainless steel shell and containing a mixture of water and ethylene glycol (which is the neutron shield). Stainless steel forgings form the bottom and closure ends of the cask. The cask's inner lid is held in place by 12 bolts and the outer lid is held in place by 8 bolts. A metallic O-ring seals the inner lid to the cask's cavity and a Teflon O-ring is used to seal the outer lid to the cask body's top forging.

NLI 1/2 LEGAL WEIGHT TRUCK TRANSPORT CASK

Specifications

Attribute	NLI 1/2 Transport Cask
a. Capacity	
Intact Assemblies	1 PWR/2 BWR
Consolidated Fuel Rods	2 PWR/4 BWR
b. Weight (lb)	
Empty	44,600
Loaded	46,200
c. Thermal	
Design Heat Rejection (kW)	10.6 (intact assys) 10.6 (consolidated assys)
Maximum Fuel Clad Temp. (^{o}F)	900 (intact assys) 1,009 (consolidated assys)
Maximum Burnup (GWD/MTU)	56 (PWR intact assys) 34 (BWR intact assys) 40 (consolidated assys)
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	195.25
Overall Cross Section	47.125
Cavity Length	178.0
Cavity Cross Section	13.375
Inner Wall Thickness	0.5
Lead Shield Wall Thickness	2.125
Depleted U Wall Thickness	2.75
Outer Shell Wall Thickness	0.875
Inner Container Wall Thickness	0.25
Lid Thickness	6.5 (inner lid), 4.4 (outer lid)
Bottom Thickness	14.5
Basket Length	173.0
Basket Cross Section	13.3
f. Neutron Shield (in)	
Neutron Shield Tank Thickness	5.25
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SS/Pb/DU
Basket	SS and Al
Neutron Shielding	Water/Ethylene Glycol
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Cavity Pressure (psig)	132 (max.)
k. Outside Surface Dose (mrem/hr)	53 (max.)
l. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

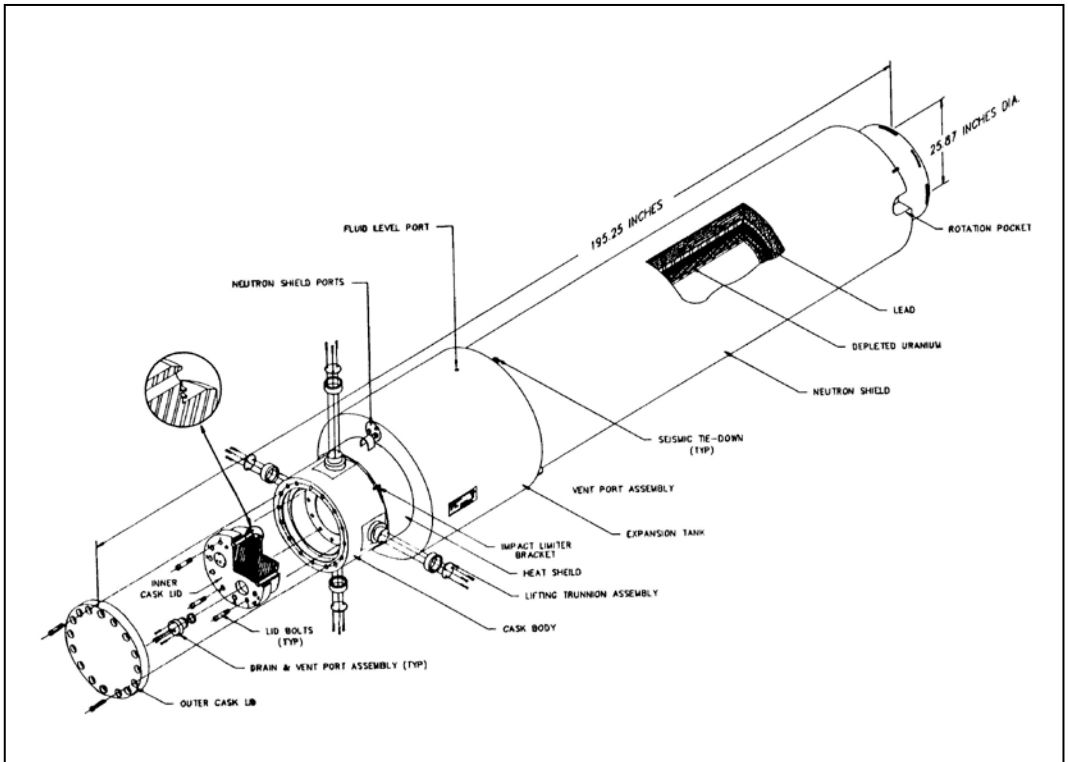
Licensing Status

The NLI 1/2 cask was a licensed transport cask under Certificate of Compliance 71-9010, Revision 40, which expired on April 30, 2006.

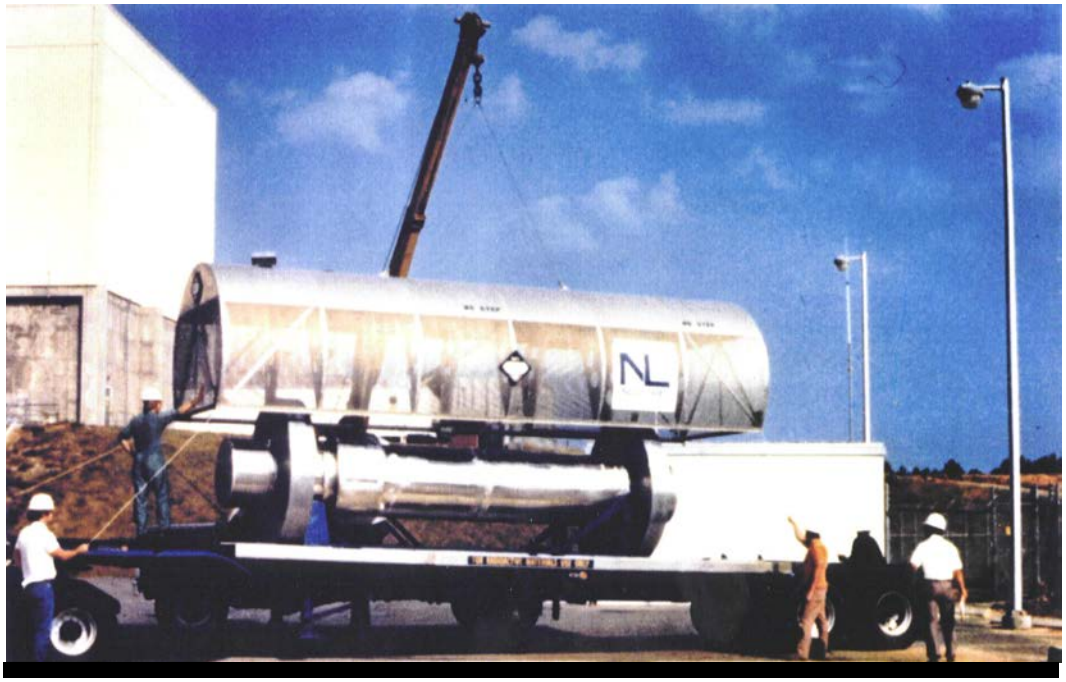
NLI 1/2 LEGAL WEIGHT TRUCK TRANSPORT CASK

Extent of Commercial Use

No longer in use. NLI 1/2 casks have interchangeable cavity baskets for BWR and PWR fuel. Five casks have been fabricated. The casks have been used to transport foreign research reactor used nuclear fuel and high burnup LWR fuel. Shipments have been made on maritime vessels and by truck.



NLI-1/2 Legal Weight Truck Transport Cask



NLI-1/2 Legal Weight Truck Transport Cask

NLI 10/24 RAIL TRANSPORT CASK

Contact:
NAC International
Tel: (770) 447-1144
Fax: (770) 447-1797
www.nacintl.com

Introduction

The NLI 10/24 cask is a stainless steel and lead shielded cask with a surrounding water-ethylene glycol neutron shield. The cask, which has capacity to transport 10 PWR or 24 BWR used nuclear fuel assemblies, was designed for transport by rail. The cask consists of:

- Steel-lead-steel cask body with steel bottom and outer closure lid and steel inner lid
- Removable aluminum and silver-indium-cadmium PWR and BWR baskets
- Water/ethylene glycol neutron shield
- Impact limiters

Two incompletely configured NLI 10/24 casks were designed and owned by NAC International.

Description

The major components of an NLI 10/24 cask assembly includes the cylindrical cask body, two-lid closure (including bolts), removable BWR and PWR baskets, NLIX railcars, impact limiters, and auxiliary cooling systems. The top and bottom of the cask are protected from impact by stainless steel-clad balsa wood-filled removable impact limiters. The cask's cavity, which is lined by a stainless steel shell, contains a removable cruciform basket – one basket type for 24 BWR fuel assemblies and one for 10 PWR fuel assembly. The cavity shell is surrounded by a lead shield. A stainless steel outer shell encases the lead. The gamma shield and structure is surrounded by a neutron shield tank having an external stainless steel shell and containing a mixture of water and ethylene glycol, which is the neutron shield. Stainless steel forgings form the bottom and closure ends of the cask. A metallic O-ring seals the inner lid to the cask's cavity and a Viton or silicone O-ring is used to seal the outer lid to the cask body's top forging.

Specifications

Attribute	NLI 10/24 Transport Cask
a. Capacity (assemblies)	10 PWR/24 BWR
b. Weight (lb)	
Empty	178,000
Loaded	194,000
c. Thermal	
Design Heat Rejection (kW)	70.0
Maximum Burnup (GWD/MTU)	35.5 PWR/29.7 BWR
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	204.5
Overall Cross Section	88.0
Cavity Length	179.5
Cavity Cross Section	45.0
Inner Wall Thickness	0.75
Lead Shield Wall Thickness	6.0
Outer Shell Wall Thickness	2.0
Lid Thickness	9.0 (inner) lid, 2.5 (outer lid)
Bottom Thickness	12.5
f. Neutron Shield (in)	
Neutron Shield Tank Thickness	9.75
Lid Thickness	3.0
Bottom Thickness	3.75
g. Materials of Construction	
Cask Body	SS/Pb
Basket	Al Lined with Ag-In-Cd Plates in SS
Neutron Shielding, Sides	Water/Ethylene Glycol
Neutron Shielding, Ends	Ricorad
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Cavity Pressure (psig)	23.1 (normal); 500 (max.)
k. Normal Operation Temperature (^{o}F)	
Outer Surface	227
Inner Seal	268
Basket	451 (max.)
Fuel Assembly	690 (avg.)
l. Outside Surface Dose (mrem/hr)	<200
m. Maximum Leak Rate (atm-cm^3/sec)	1.0 x 10^{-7}

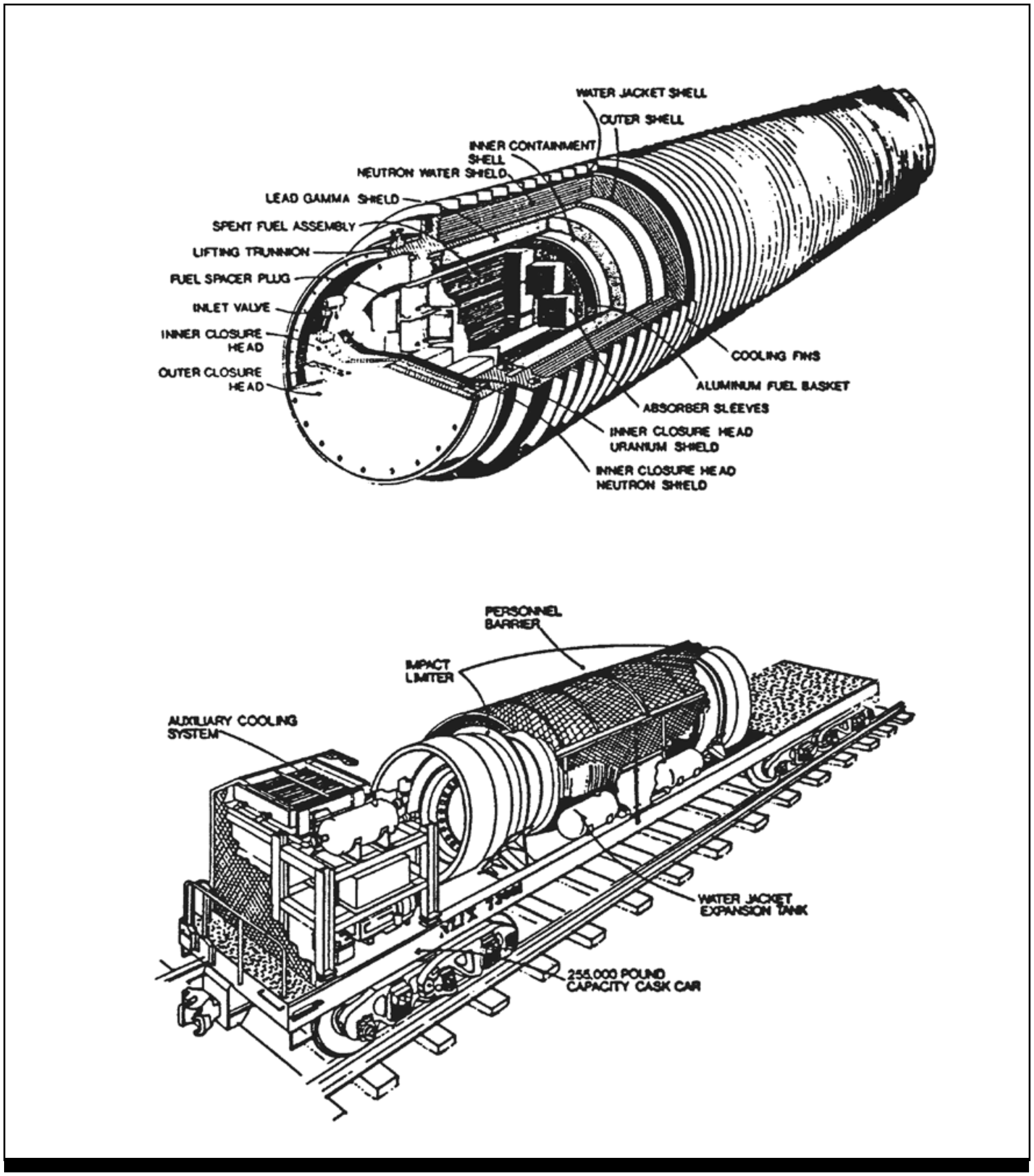
Licensing Status

The NLI 10/24 cask was a licensed transport cask under Certificate of Compliance 71-9023, Revision 9, which expired on July 31, 2008.

NLI 10/24 RAIL TRANSPORT CASK

Extent of Commercial Use

None. NLI 10/24 casks have interchangeable cavity baskets for BWR and PWR fuel. One cask was fully constructed and configured for use; construction of the second cask was stopped before completion. In the late 70's, the aluminum and silver-indium-cadmium baskets for the casks were removed to recover silver. The certificate of compliance issued by NRC stated that "fabrication of new packages or major packaging components, including the fuel basket, is not authorized." NLI 10/24 casks have not been used to transport used nuclear fuel or other radioactive material. The certificate of compliance authorized rail mode of transport only.



NLI-10/24 Rail Transport Cask

NLI-10/24 Rail Transport Cask

125-B TMI-2 CORE AND FUEL DEBRIS RAIL TRANSPORT CASK

Contact:
Kevin Streeper
Tel: (208-521-3282
Fax: (208) 533-3904
Kevin.Streeper@icp.doe.gov

Introduction

The NuPac 125-B cask is a stainless steel and lead shielded transport cask. The cask was designed for the U.S. Department of Energy (DOE) to transport dewatered core and fuel debris from the Three Mile Island Unit 2 reactor. There are three 125-B casks, all owned by the DOE. The cask consists of:

- TMI core and fuel debris canister-basket
- Steel-lead-steel cask body
- Impact limiters

The 125-B cask was designed and licensed by Nuclear Packaging, Inc. (NuPac) of Tacoma, Washington.

Description

The 125-B cask uses a hub and spoke, canister-basket (inner vessel) providing 7 cylindrical cells (hub cell and 6 spoke cells) for canisters containing dewatered core and fuel debris from the TMI-2 reactor. The canister basket, with its bolted lid and O-ring seals in place, provides primary containment. The construction of the cask body/shield is stainless steel, lead, stainless steel with a bolted secondary closure, O-ring seals, thermal protection shell, external lifting and tie-down trunnions, and large enclosing impact limiters on the cask's ends. The 125-B cask was designed to be transported by rail.

125-B TMI-2 CORE AND FUEL DEBRIS RAIL TRANSPORT CASK

Specifications

Attribute	125-B Cask
a. Capacity	
Canisters	7 canisters containing dewatered TMI core or fuel debris
Maximum Weight (lb/canister)	2,940
b. Weight (lb)	
Empty, w/o lid	88,900
Loaded	181,500
c. Thermal	
Design Heat Rejection (kW)	0.1 max per canister
Maximum Burnup (GWd/MTU)	3.165
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/Impact Limiters	279.5
Overall Length w/o Impact Limiters	207.5
Overall Diameter w/Impact Limiters	120.0
Overall Diameter w/o Impact Limiters	65.5
Cavity Length	192.5
Cavity Diameter	51.25
Lid Thickness, Outer	7.5
Bottom Thickness	7.5
Inner Vessel Length	192.0
Inner Vessel Canister Cavity Length	151.0
Inner Vessel Diameter	50.25
Inner Vessel Wall Thickness	1.0
Inner Vessel Bottom Plate Thickness	2.0
Inner Vessel Lid Thickness	5.0
Inner Vessel Shield Plug Length	10.0
Canister Impact Limiter Length (est.)	24.0
Canister Cavity Diameter	14.5
f. Number of Cooling Fins	None
g. Materials of Construction	
Cask Body	SS/Pb/SS
Cask Bottom and Lid	SS
Inner Vessel Structure	SS
Neutron Absorber/Moderator	Unspecified Solid
Shield Plugs	SS
Impact Limiters	Closed Cell Polyurethane Foam Clad w/ 0.125 SS
h. Cavity Atmosphere	Ar, N_2, or He
i. Cavity Pressure (absolute)	1 Atmosphere
j. Outside Surface Dose (mrem/hr)	<100
k. Maximum Leak Rate (atm-cm^3/sec)	1.0×10^{-7}

Licensing Status

The 125-B cask was a licensed transportation cask under Certificate of Compliance 71-9200, Revision 10, which expired on February 23, 2010.

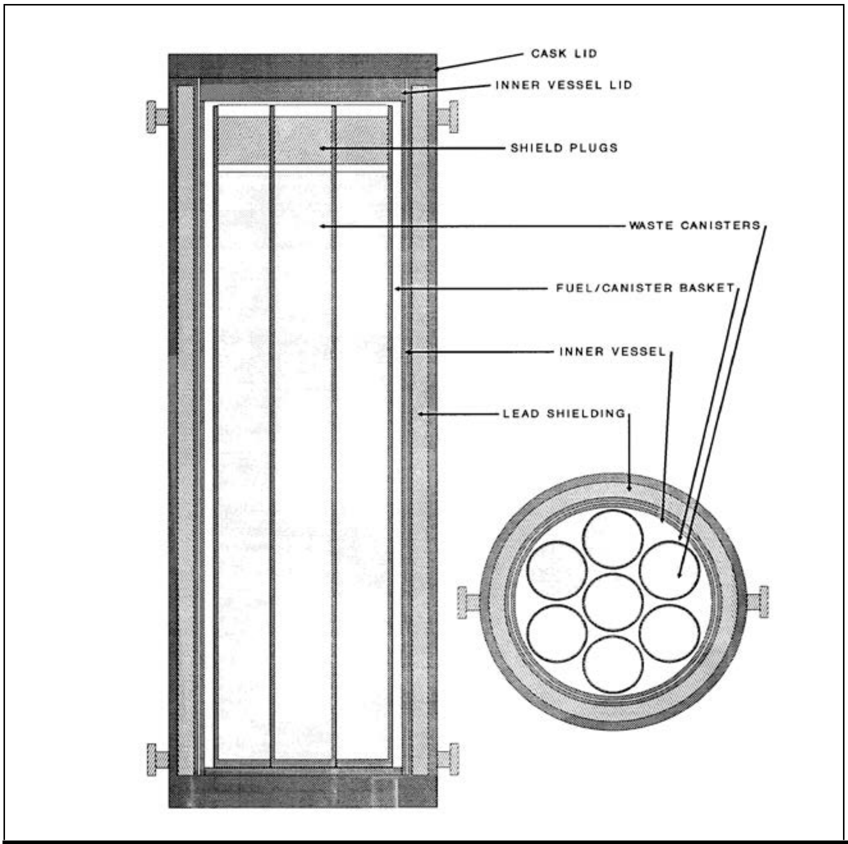
Nuclear Packaging, Inc.

125-B TMI-2 CORE AND FUEL DEBRIS RAIL TRANSPORT CASK

Extent of Commercial Use

There are three 125-B casks. The casks were used from 1989 until 1991 to transport canisters containing core and fuel debris from the Three Mile Island Unit 2 reactor plant to the Idaho National Laboratory.

125-B TMI-2 Core and Fuel Debris Rail Transport Cask



Sectional View of the 125-B TMI-2 Core and Fuel Debris Rail Transport Cask

TN-REG STORAGE AND TRANSPORT CASK

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-REG cask is a metal storage and transport cask designed to accommodate 40 PWR used fuel assemblies that were used at the R. E. Ginna Plant. The cask is a modification of the TN-24 cask design. It was designed specifically for transporting R.E. Ginna used fuel from the West Valley (NY) Demonstration Project of DOE to the DOE Idaho National Laboratory. Only one such cask has been built and used in the U.S., and it was used only for the one-time transport of 40 PWR assemblies as aforementioned.

Description

The TN-REG cask body is a cylinder made of SA-350, Grade LF3 forged steel with a wall thickness of 9.25 inches. The bottom of the cask is 8.25 inches thick forged steel welded to the cylinder wall. The top of the cask is sealed by a lid that is 8.5 inches thick. The lid is bolted to the cask and is sealed with a Viton O-ring, with a second metallic O-ring provided to leak test to Viton O-ring. The fuel basket is constructed of borated stainless steel. The fuel basket has forty 8.05 inch square compartments for the used fuel assemblies. Each fuel cell has a top and bottom end cap to confine damaged fuel. The impact limiters are made of balsa-redwood that is encased in steel.

TN-REG STORAGE AND TRANSPORT CASK

Specifications

Attribute	TN-REG
a. Capacity (assemblies)	40 PWR
b. Weight (lb)	
Empty	181,000
Loaded on Storage Pad	233,200
c. Thermal	
Design Heat Rejection (kW)	4.16
Maximum Fuel Clad Temp. (^{o}F)	716
Maximum Burnup (GWD/MTU)	15
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	180.0
Overall Length w/ Impact Limiters	234.0
Overall Cross Section w/o Impact Limiters	90.25
Overall Cross Section w/ Impact Limiters	131.0
Cavity Length	163.25
Cavity Cross Section	71.75
Wall Thickness	9.25
Lid Thickness	8.5
Bottom Thickness	8.25
Basket Length	162.0
Basket Cross Section	N/A
Thickness of Basket Spacers	N/A
f. Neutron Shield (in)	
Side Thickness	None
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SA-350, Grade LF3 CS (Forged)
Basket	Borated SS
Neutron Shield	None
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Cavity Pressure (psig)	100
k. Outside Surface Dose (mrem/hr)	N/A
l. Maximum Leak Rate (atm-cm^3/sec)	1.66×10^{-4}

N/A means Not Available.

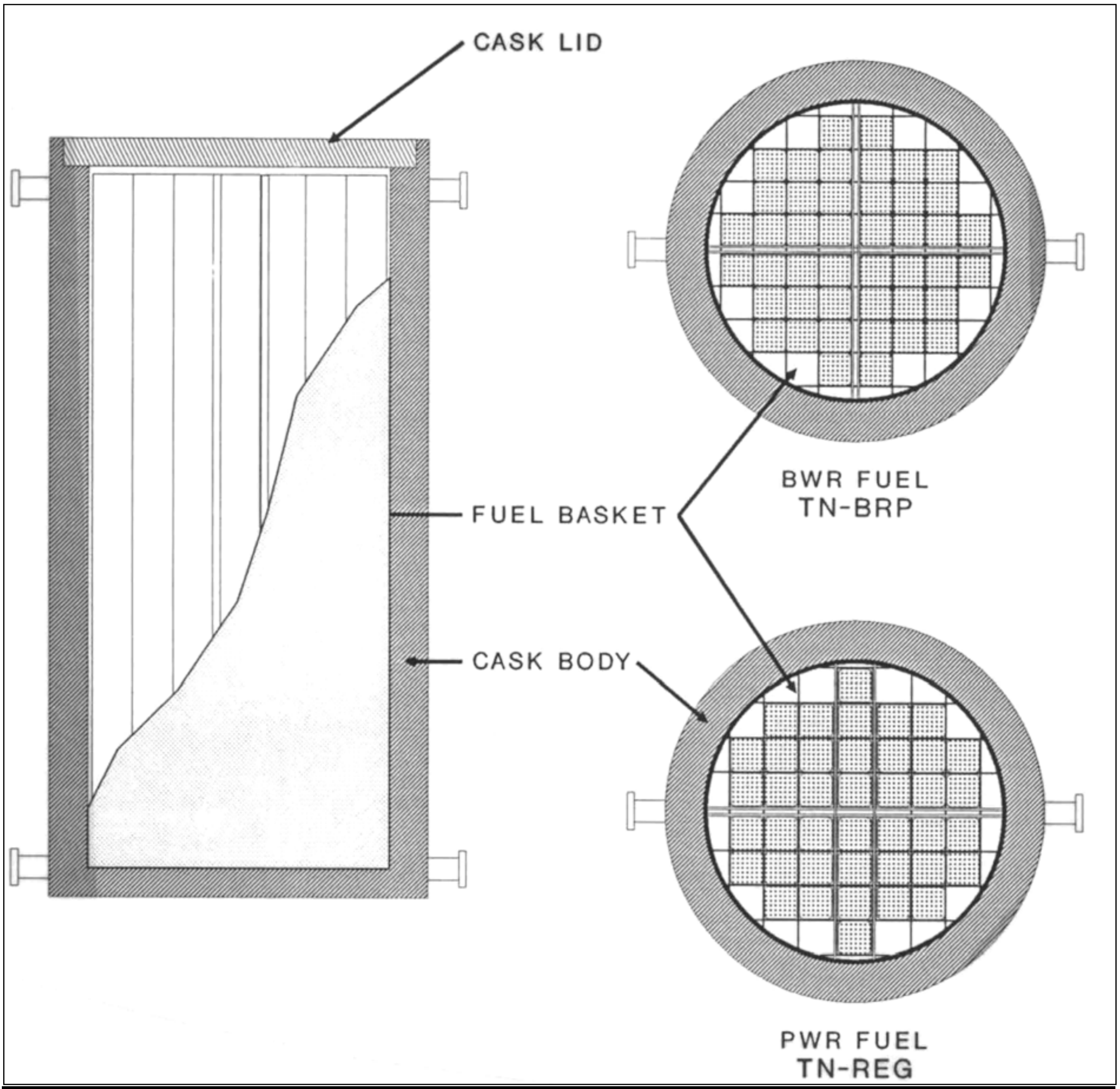
Licensing Status

The TN-REG cask was licensed for transport in the U.S. under transport Certificate of Compliance 71-9206. Specifically, the cask was authorized for such use on a one-time basis, with the Certificate of Compliance to expire immediately upon completion of transport of 40 PWR used fuel assemblies from West Valley, NY to the Idaho National Laboratory, or May 31, 2005, whichever occurred first. (The Certificate of Compliance was terminated on August 20, 2004). The Certificate of Compliance also required that 38 of the 40 assemblies contain either a burnable poison assembly or a control rod assembly, but allowed the transport of damaged fuel as approved contents. No license for use of the TN-REG cask for storage was applied for from NRC since the safety aspects of storage at West Valley and the Idaho National Laboratory were evaluated and permitted by DOE.

TN-REG STORAGE AND TRANSPORT CASK

Extent of Commercial Use

Only a single TN-REG cask has been used, since the basket was specifically designed for the used fuel of the R. E. Ginna Plant that was on inventory in the used fuel pool of the West Valley Plant – which formerly supported reprocessing operations there. The cask is now located at the DOE Idaho National Laboratory.



TN-REG and TN-BRP Transport Cask

TN-BRP and TN-REG Storage/Transport Cask

TN-BRP STORAGE AND TRANSPORT CASK

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-BRP cask is a metal storage and transport cask designed to accommodate 85 BWR used fuel assemblies that were used at the Consumers Power Big Rock Point Plant. The cask is a modification of the TN-24 cask design. It was designed specifically for transporting Big Rock Point used fuel from the West Valley (NY) Demonstration Project of DOE to the DOE Idaho National Laboratory. Only one such cask has been built and used in the U.S., and it was used only for the one-time transport of 85 BWR assemblies as aforementioned.

Description

The TN-BRP cask body is a cylinder made of SA-350, Grade LF3 forged steel with a wall thickness of 9.62 inches. The bottom of the cask is 9.75 inches thick forged steel welded to the cylinder wall. The top of the cask is sealed by a lid that is 9.75 inches thick. The lid is bolted to the cask and is sealed with a Viton O-ring, with a second metallic O-ring provided to leak test to Viton O-ring. The fuel basket is constructed of borated stainless steel. The fuel basket has forty-four 6.8 inch square compartments for the used fuel assemblies; two BWR assemblies can fit into each cavity, end to end (i.e., double-stacked). Each fuel cell has a top and bottom end cap to confine damaged fuel. The impact limiters are made of balsa-redwood that is encased in steel.

Specifications

Attribute	TN-BRP
a. Capacity (assemblies)	85 BWR
b. Weight (lb)	
Empty	179,600
Loaded on Storage Pad	222,700
c. Thermal	
Design Heat Rejection (kW)	6.39
Maximum Fuel Clad Temp. (^{o}F)	716
Maximum Burnup (GWD/MTU)	25
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length	190.5
Overall Length w/ Impact Limiters	244.5
Overall Cross Section w/o Impact Limiters	83.25
Overall Cross Section w/ Impact Limiters	131.0
Cavity Length	171.0
Cavity Cross Section	64.0
Wall Thickness	9.62
Lid Thickness	9.75
Bottom Thickness	9.75
Basket Length	170.0
Basket Cross Section	N/A
Thickness of Basket Spacers	N/A
f. Neutron Shield (in)	
Side Thickness	None
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	SA-350, Grade LF3 CS (Forged)
Basket	Borated SS
Neutron Shield	None
h. Number of Cooling Fins	None
i. Cavity Atmosphere	He
j. Cavity Pressure (psig)	100
k. Outside Surface Dose (mrem/hr)	N/A
l. Maximum Leak Rate (atm-cm^3/sec)	1.68×10^{-2}

N/A means Not Available

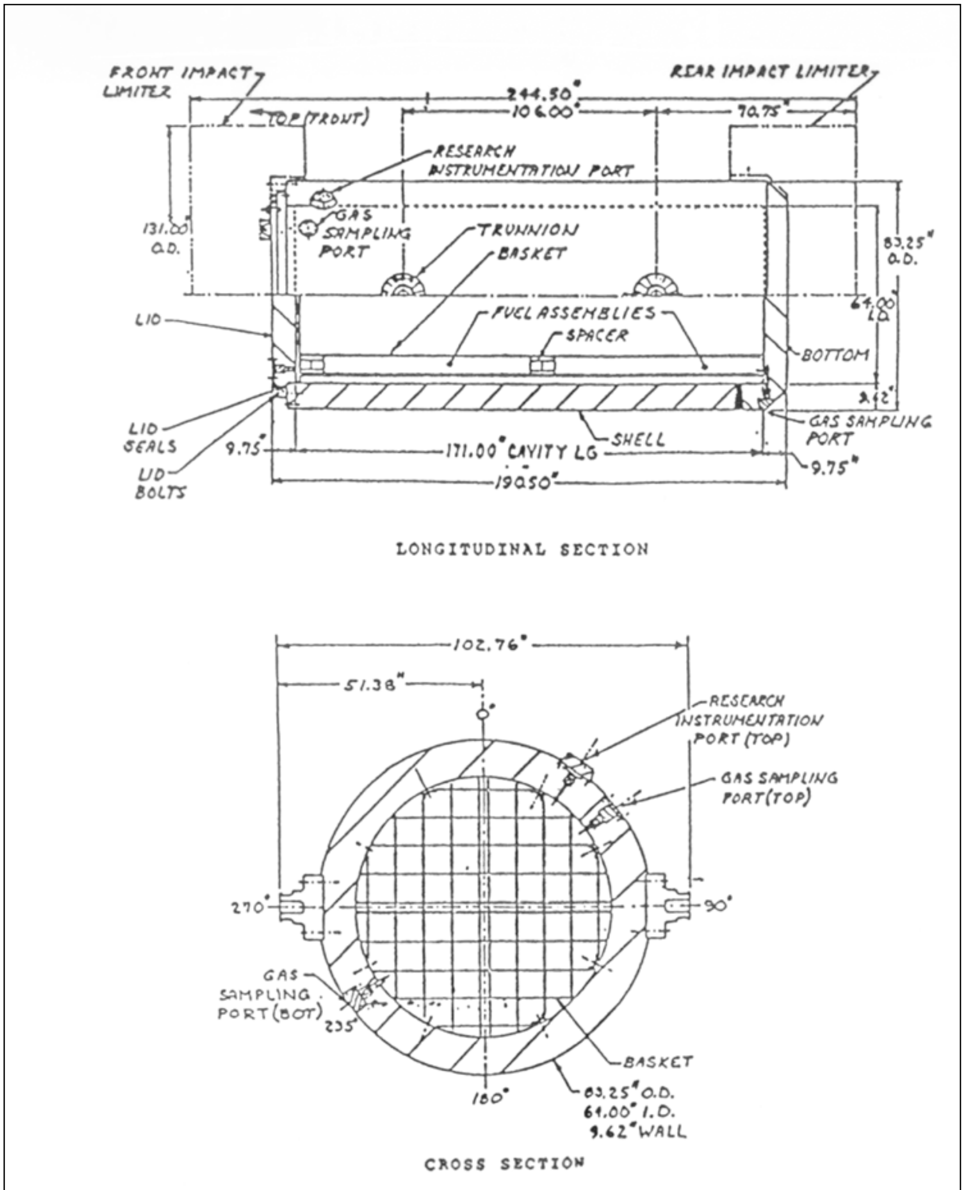
Licensing Status

The TN-BRP cask was licensed for transport in the U.S. under transport Certificate of Compliance 71-9202. Specifically, the cask was authorized for such use on a one-time basis, with the Certificate of Compliance to expire immediately upon completion of transport of 85 BWR used fuel assemblies from West Valley, NY to the Idaho National Laboratory, or June 30, 2004, whichever occurred first. The Certificate of Compliance also allowed the transport of damaged fuel as approved contents. No license for use of the TN-BRP cask for storage was applied for from NRC since the safety aspects of storage at West Valley and the Idaho National Laboratory were evaluated and permitted by DOE.

TN-BRP STORAGE AND TRANSPORT CASK

Extent of Commercial Use

Only a single TN-BRP cask has been used, since the basket was specifically designed for the used fuel of the Big Rock Point Plant that was on inventory in the used fuel pool of the West Valley Plant – which formerly supported reprocessing operations there. The cask is now located at the Idaho National Laboratory.



TN-BRP Storage/Transport Cask

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TN-8/TN-8L OVERWEIGHT TRUCK TRANSPORT CASK

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-8 cask is a lead, steel, and resin shielded irradiated fuel transport cask. The cask, which has a capacity to transport 3 PWR used nuclear fuel assemblies, was designed to transport used nuclear fuel with a high thermal output (12 kW/assembly) by overweight truck. The cask consists of:

- Steel-lead cask body
- Resin neutron shield
- Copper cooling fins
- Impact limiters

Two TN-8 casks are currently owned by Transnuclear Inc. and two more are owned by their parent company in France.

Description

The TN-8 cask assembly includes 3 square stainless steel pressure vessels each of which provide a cavity for the containment of a used fuel assembly. These pressure vessels are placed together in a triangular pattern and surrounded by 5.3 inches of lead. The lead is surrounded by 1 inch of steel, and then by 5.9 inches of resin (neutron shield). The pressure vessels are loaded and then sealed, thus making them both the non-removable cask basket as well as the main containment boundary for the casks. Radial copper fins are welded to the steel shell surrounding the lead shielding, and extent through the resin neutron shield. The lid is a welded stainless steel shell containing lead and resin shielding. The pressure vessels are closed and sealed by 16 bolts and two silicone rubber or Viton O-rings set within recessed grooves in the top flange. The ends of the cask are surrounded by impact limiters that consist of stainless steel shells filled with balsa wood.

The lid of the cask may be replaced with a modified lid which increases the cavity length to 171.7 inches or to 173 inches with the lid plate removed.

TN-8/TN-8L OVERWEIGHT TRUCK TRANSPORT CASK

Specifications

Attribute	TN-8 / TN-8L Transport Cask
a. Capacity (assemblies)	3 PWR
b. Weight (lb)	
Empty	73,800
Loaded	78,600
c. Thermal	
Design Heat Rejection (kW)	35.5/23.7
Maximum Fuel Clad Temp. (^{o}F)	N/A
Maximum Burnup (GWD/MTU)	38.0
d. Shape	Pear Shaped – Nearly Cylindrical
e. Dimensions (in)	
Overall Length w/ Impact Limiters	217.5
Overall Length w/o Impact Limiters	188.5
Overall Cross Section	67.5
Cavity Length	168.0
Cavity Cross Section	Irregular
Wall Thickness w/o Fins	13.3
Cooling Fin Length	13.8
Lid Thickness	12.0
Bottom Thickness	12.0
Basket Length	168.0
Basket Cross Section	Irregular
f. Neutron Shield (in)	
Side Thickness	7.28
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	Steel/Pb
Basket	SS/B_4C-Cu Plates
Neutron Shielding	Solid Borated Polyester Resin
h. Number of Cooling Fins	~20,000
i. Cavity Atmosphere	He
j. Cavity Pressure (psia)	14.7
k. Outside Surface Dose (mrem/hr)	<2 @ 2m
l. Maximum Leak Rate (atm-cm^3/sec)	6.5×10^{-7}

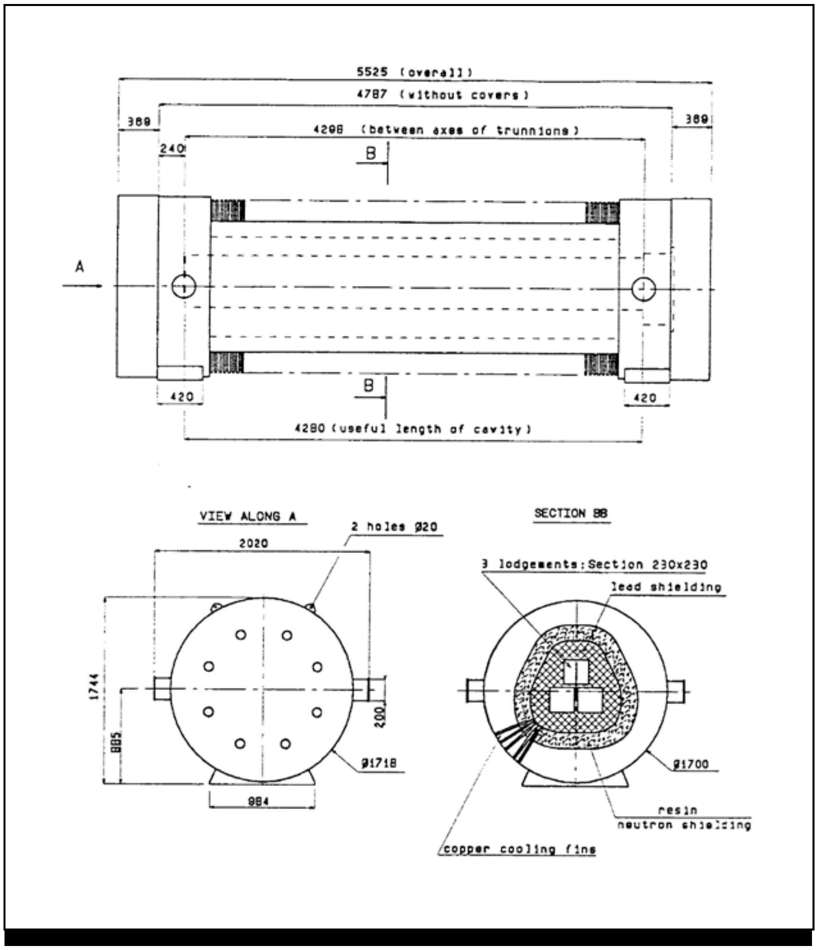
N/A denotes Not Available

Licensing Status

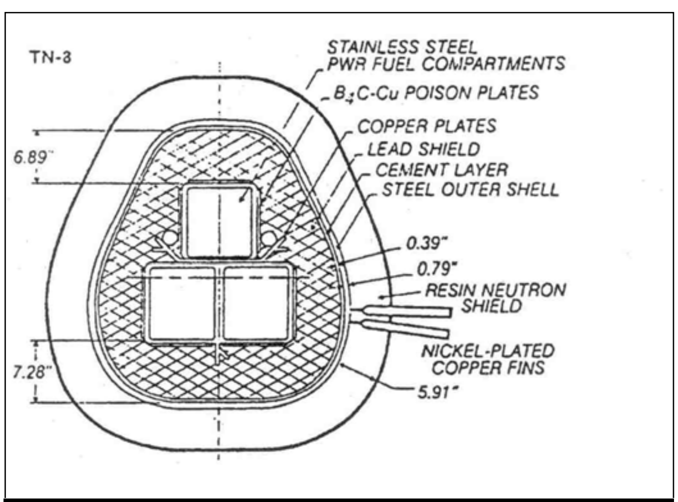
The TN-8 and TN-8L casks were licensed for transport under Certificate of Compliance 71-9015 which expired on May 31, 2006.

Extent of Commercial Use

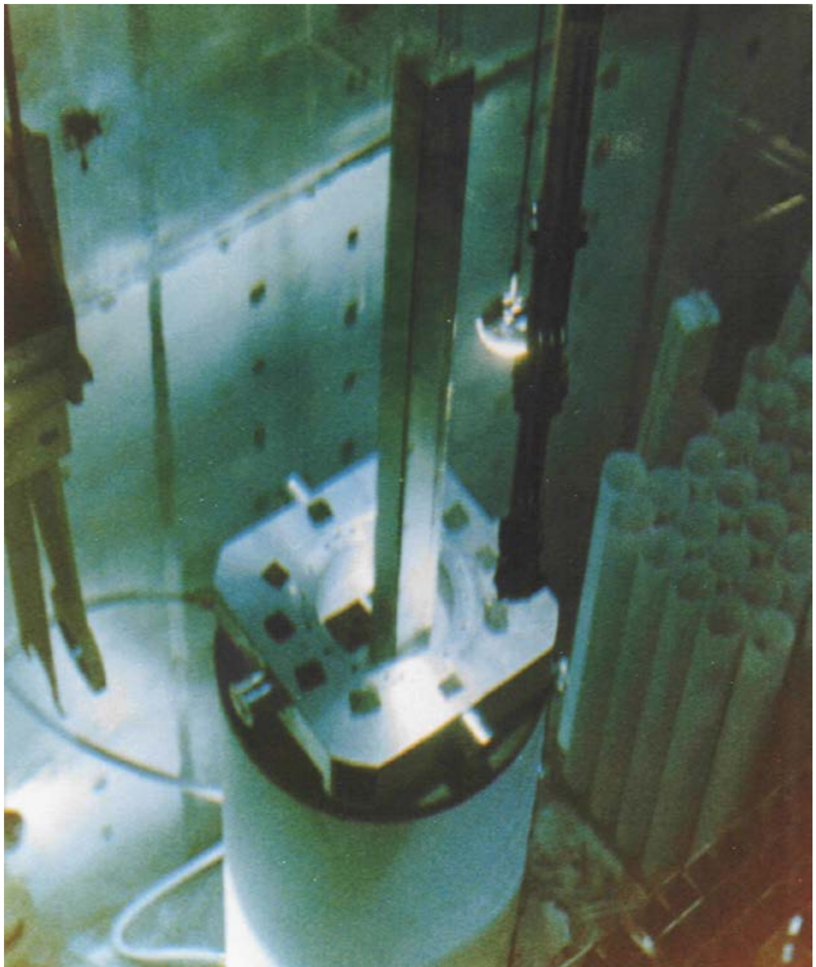
None. Two TN-8L casks are available in the U.S. and two TN-8 casks are used in Europe.



TN-8 Used Fuel Transport Cask



TN-8 Used Fuel Cask Cross-Section



TN-8 Used Fuel Cask During Loading

TN-9 OVERWEIGHT TRUCK TRANSPORT CASK

Contact:
Transnuclear Inc.
Tel: (410) 910-6880
Fax: (410) 910-6902
www.transnuclear.com

Introduction

The TN-9 cask is a lead, steel, and resin shielded irradiated fuel transport cask. The cask, which has a capacity to transport 7 BWR used nuclear fuel assemblies, was designed to transport used nuclear fuel with a high thermal output (3.5 kW/assembly) by overweight truck. The cask consists of:

- Steel-lead cask body
- Resin neutron shield
- Copper cooling fins
- Impact limiters

One TN-9 cask is currently owned by Transnuclear Inc. and one is owned by Exelon.

Description

The TN-9 cask assembly includes 3 rectangular stainless steel pressure vessels each of which provide a cavity for the containment of used fuel assemblies – two pressure vessels containing 2 BWR assemblies each, and one pressure vessel containing 3 BWR assemblies. These pressure vessels are placed so that three assemblies are end to end with two assemblies placed on either side – to form a near circular pattern. They are surrounded by 5.0 inches of lead, 1 inch of steel, and 5.9 inches of resin (neutron shield). The pressure vessels are loaded and then sealed, thus making them both the non-removable cask basket as well as the main containment boundary for the casks. Radial copper fins are welded to the steel shell surrounding the lead shielding, and extent through the resin neutron shield. The lid is a welded stainless steel shell containing lead and resin shielding. The pressure vessels are closed and sealed by 16 bolts and two silicone rubber or Viton O-rings set within recessed grooves in the top flange. The ends of the cask are surrounded by impact limiters that consist of stainless steel shells filled with balsa wood.

TN-9 OVERWEIGHT TRUCK TRANSPORT CASK

Specifications

Attribute	TN-9 Transport Cask
a. Capacity (assemblies)	7 BWR
b. Weight (lb)	
Empty	73,600
Loaded	78,200
c. Thermal	
Design Heat Rejection (kW)	24.5
Maximum Fuel Clad Temp. (^{o}F)	N/A
Maximum Burnup (GWD/MTU)	36.5
d. Shape	Cylindrical
e. Dimensions (in)	
Overall Length w/ Impact Limiters	N/A
Overall Length w/o Impact Limiters	200.0
Overall Cross Section	66.0
Cavity Length	178.0
Cavity Cross Section	Irregular
Wall Thickness w/o Fins	14.4
Cooling Fin Length	13.8
Lid Thickness	11.0
Bottom Thickness	11.0
Basket Length	178.0
Basket Cross Section	Irregular
f. Neutron Shield (in)	
Side Thickness	6.89
Lid Thickness	None
Bottom Thickness	None
g. Materials of Construction	
Cask Body	Steel/Pb
Basket	SS/B_4C-Cu Plates
Neutron Shielding	Solid Borated Polyester Resin
h. Number of Cooling Fins	N/A
i. Cavity Atmosphere	He
j. Cavity Pressure (psia)	14.7
k. Outside Surface Dose (mrem/hr)	<2 @ 2m
l. Maximum Leak Rate (atm-cm^3/sec)	6.5 x 10^{-7}

N/A denotes Not Available

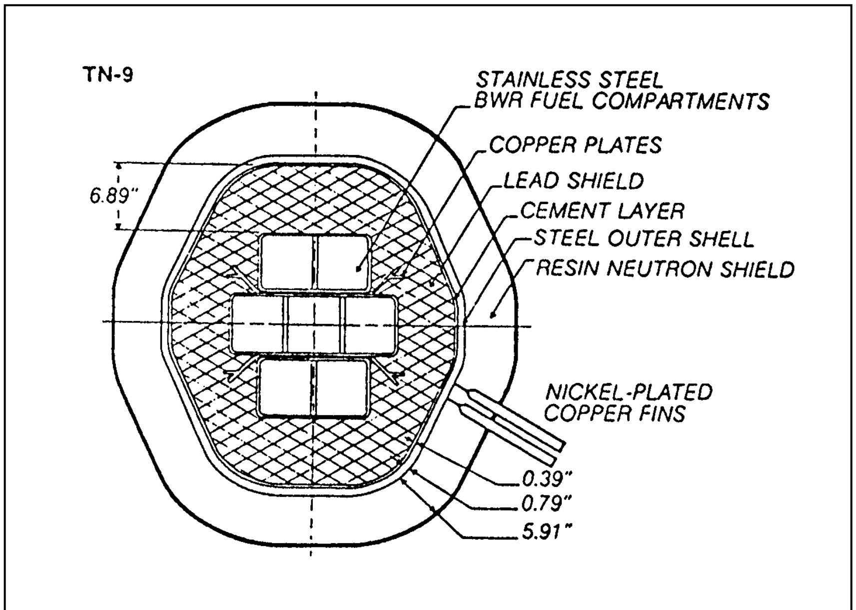
Licensing Status

The TN-9 cask was licensed for transport under Certificate of Compliance 71-9016, which expired on May 31, 2006.

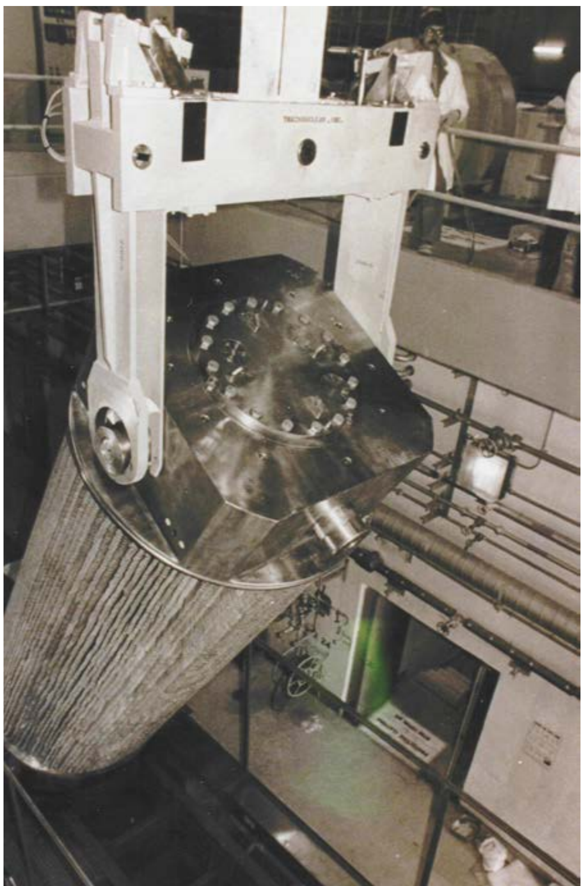
Extent of Commercial Use

None. Two TN-9 casks are available in the U.S.

TN-9 OVERWEIGHT TRUCK TRANSPORT CASK



TN-9 Used Fuel Shipping Cask, Cross-Section



TN-9 Used Fuel Cask

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