

NAC's Advances in the Storage and Transport of Radioactive Material

Edward Ketusky, Ph.D.
NAC Transportation Project Manager



The Skills and Experience to Deliver Nuclear Excellence

Updated 5/11/2023
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- Overview of NAC International
- NAC's storage and packaging focus
- NAC Optimus-L and –H
 - What makes the OPTIMUS family different



Wholly-owned subsidiary of
Hitachi Zosen USA since 2013
NAC Headquarters – Atlanta, GA

50+ Years in the Nuclear Industry -
Fuel Cycle Consulting and Used
Fuel Packaging and Transport

Fourteen (14) Nuclear
Fuel Cask Systems Licensed in
the U.S. and Abroad

U.S./Canada Leader in Used Fuel
Transportation –
NAC-LWT Fleet

More than 600 Storage
and Transport
Systems Delivered

Pioneers in Dry Storage
Ultra-High Capacity Systems
HLW Dry Storage, Prompt Defueling



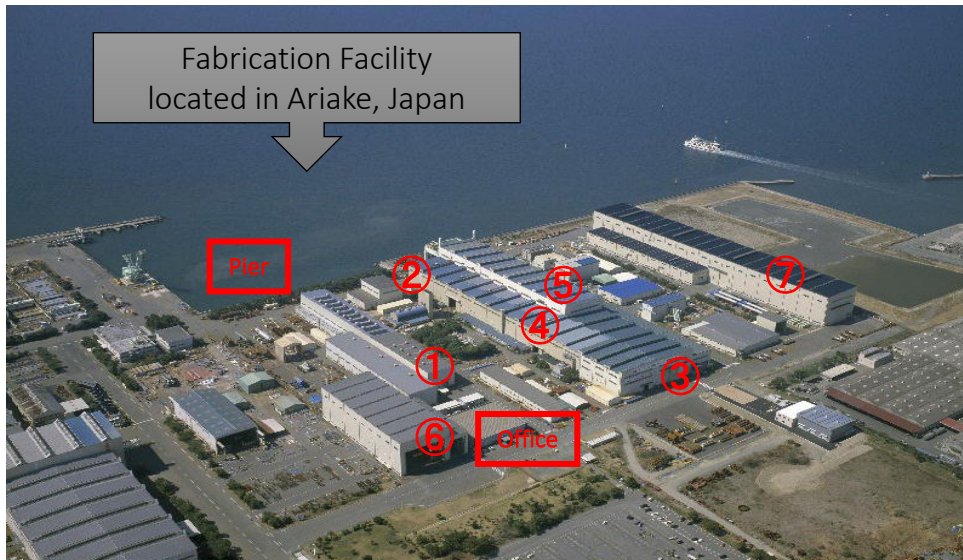
Teamed with WCS and Orano on the ISP Consolidated Interim Storage Facility

Supplier of Dry Storage Casks, Equipment and Services to U.S. DOE sites in West Valley and Hanford

Teaming with Deep Isolation to Develop Modern Nuclear Waste Disposal Solution



- NAC is a wholly owned subsidiary of Hitachi Zosen USA.
- \$3.5B in Sales and 8,800 employees (~70 NAC)
- Headquartered in Osaka and Tokyo with seven manufacturing facilities, eight branches overseas and 67 consolidated subsidiaries.
- Supplier of engineering and manufacturing of environmental systems, industrial plants, industrial machinery, process equipment, precision machinery, steel structure, construction machinery and disaster prevention systems
- Focuses on energy-from-waste, green energy field & social infrastructure / disaster prevention



- ① : Cask Shop
(15-100ton Crane)
- ② : Sub Assembly Shop
(5ton Crane)
- ③ : Machining Shop
(150ton Crane)
- ④ : Assembly Shop
(5-30ton Crane)
- ⑤ : Assembly Shop
(50-500ton Crane)
- ⑥ : Assembly Shop
(700ton Crane)
- ⑦ : Assembly Shop



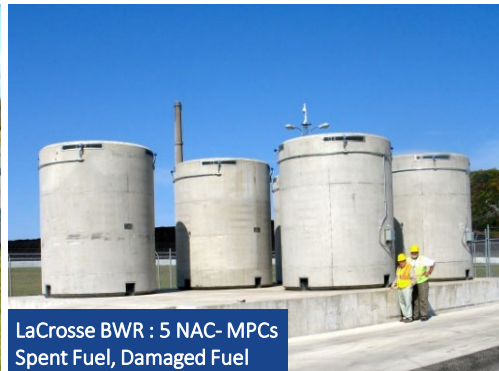
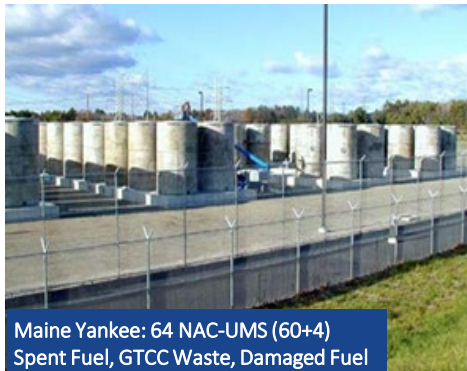
- Leading fabricator of casks and canister systems
- Delivered more than 720 Casks and Canisters since 1978
- Plant maximum capacity of 120 Canisters (~50 Casks per year)
- Currently fabricating MAGNASTOR canisters
- Recently completed transportation cask supply for NAC & Orano
- OSHA compliant and holds major QA certifications and ASME stamps for fabrication / inspections



Cask Designation	U.S. CoC Number or Docket Number	Amendment Number / Application
MAGNASTOR	72-1031	9/Storage
MAGNATRAN	71-9356	3/Transport
UMS	72-1015 71-9270	9/Storage 5/Transport
NAC-MPC	72-1025	8/Storage
NAC-STC	71-9235	23/Transport
NAC-LWT	71-9225 NRC 71-9225 DOE	72/Transport 13/Transport
OPTIMUS-L	71-9390	1/Transport
Newest Casks		
OPTIMUS-H	CNSC	1/Transport
Cask Under Development		
* OPTIMUS -Volunteer		



Nuclear Plant Defueling Excellence



- More than 600 cask systems delivered
- Only U.S. supplier currently providing dry storage technology both to commercial utilities and U.S. DOE



Duke McGuire: 28 NAC UMS & 38 MAGNASTOR Spent Fuel Systems
Duke McGuire currently has 38 MAGNASTOR systems delivered and 30 MAGNASTORs loaded to date.



Duke Catawba: 24 NAC UMS & 36 MAGNASTOR Spent Fuel Systems
Catawba currently has 36 MAGNASTOR systems delivered and 25 MAGNASTORs loaded to date.



APS: 152 NAC UMS & 11 MAGNASTOR Spent Fuel Systems. Transitioned to MAGNASTOR in 2018-2019. Currently 11 MAGNASTORs loaded



Taiwan - Spent Fuel
Chinshan - 25 NAC UMS
Kuosheng - 27 MAGNASTOR

MAGNASTOR

Vertical Concrete Cask



Canister & Basket



Transfer Cask



ISP Consolidated Interim Storage

- Participating with the Interim Storage Partners (ISP) team on CISF in Andrews County, Texas
- *U.S. NRC issued its license (SNM-2125) for the ISP CISF on September 13, 2021*
- Phase 1 of the project focused on shutdown / stranded sites and includes all three (3) NAC Dry Storage Technologies (MPC, UMS, MAGNASTOR).



NAC Remains Committed to
Consolidated Interim Storage

NAC SNF Canisters will have a home at ISP's CISF

West Valley – Vitrified Waste NAC STC Content



NAC-STC Cask Heavy Haul Transport



NAC-STC Specifications		NAC-STC Features:
Contents	Bare or Canistered SNF, GTCC and HLW	First and only modern NRC-licensed, rail-sized, dual-purpose cask routinely used in commercial shipments. Fleet of 12 Casks in Operation
Length:	Overall—193 in. Cavity—165 in.	
Diameter:	Overall—99 in. Cavity—71 in. Impact Limiters—124 in.	Meets all U.S. NRC, DOT and IAEA requirements
Weight:	Loaded—116 tons Empty—97 tons Transport—125 tons (with Impact Limiters)	Compatible with Crane Handling Capacity at Most Nuclear Power Plants

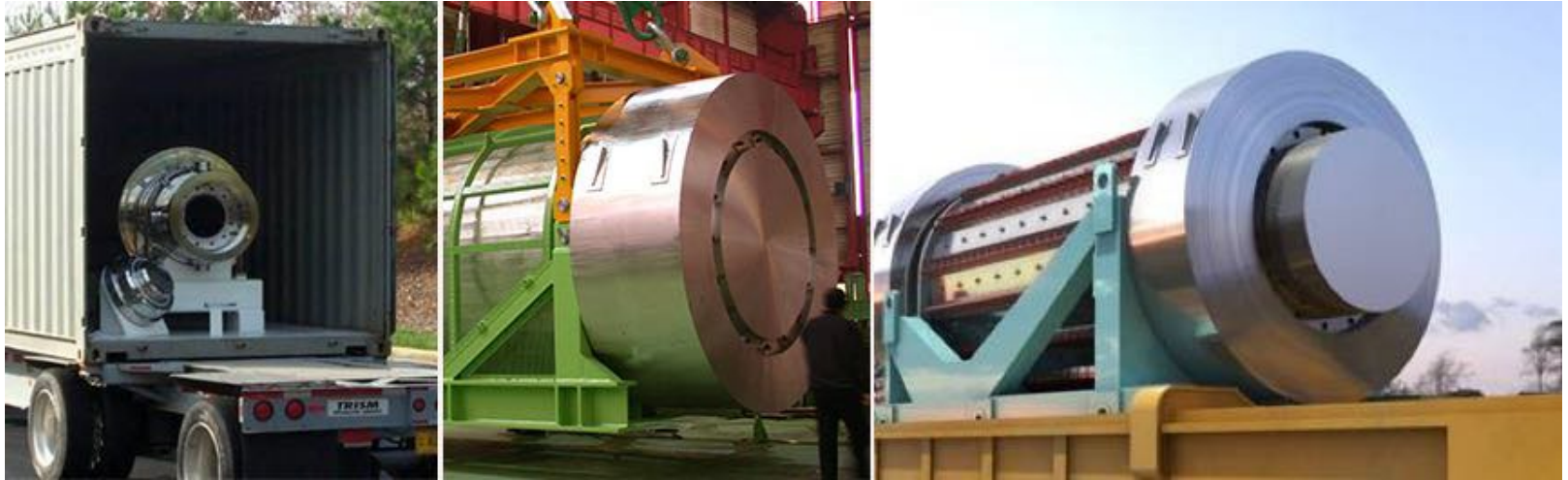


MAGNATRAN

- The MAGNATRAN is a larger rail cask variant to the licensed NAC-STC cask.
- Cask body length and internal diameter were increased to accommodate the higher-capacity MAGNASTOR TSC. Cavity dimensions are Ø72.25 inches by 192.5 inches long.
- Outside diameter of the cask has been maintained, allowing the use of the existing NAC-STC impact limiter design and avoiding any additional drop testing of MAGNATRAN
- Designed to more efficiently handle higher heat loads associated with the MAGNASTOR storage canisters, using 15 thermal fins mechanically attached to the cask body, captured by 30 encapsulated neutron shield components
- Contents: MAGNASTOR PWR/BWR/GTCC canisters
- Other potential contents: GTCC, HLW and others, DOE Vitrified Waste Canisters.



NAC -LWT



- NAC-LWT (legal weight truck) transport casks, NRC-licensed and endorsed by 50+ countries.
- Industry workhorse of spent nuclear fuel transportation casks and has been used for many types of solid and liquid wastes.
- The NAC-LWT is versatile – it can be loaded wet in a storage pool, or dry in hot-cell facilities or at facilities with small pools and limited crane capacities. The system is used for packaging research reactor spent fuel, nuclear power plant spent fuel assemblies and fuel rods, and other irradiated materials.



- **Currently, NAC-LWT only Type B cask licensed and deployed to ship HEU liquid wastes (7g U235/L)**

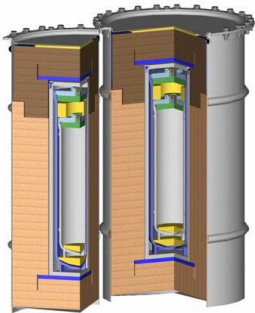
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Newest Casks		
OPTIMUS-H	CNSC	1/Transport
Cask Under Development		
* OPTIMUS -Volunteer		



Advancement: Developing The Optimus Family

Until recently, most Type B packages were either:

- Drum size packages or very large packages



Development of Optimus Family

- Versatile cost-effective Type B(U)F Packaging for Intermediate Level Waste, Transuranic (TRU) Waste, Low Enriched Uranium (LEU), High Assay LEU (HALEU), and Spent Fuel.
- Ships challenging waste, such as high activity sealed sources, over-packed containers with high heat loads, and aerosol cans with compresses or liquified gas propellant.
- Small light packages ideal for facilities with restricted access and/or low crane capacity.
- Use of same Cask Containment Vessel (CCV) design and Shield Insert Assemblies in both allow interchangeability and standardization in operations
- Easily reconfigured with Shield Inserts for contents requiring increased shielding.

Development of the Optimus Family

Currently has two versions: OPTIMUS-H and OPTIMUS-L. OPTIMUS-H is designed for high-activity contents: remote-handled transuranic waste (RH TRU) and spent fuel. OPTIMUS-L is designed for low-activity contents: contact-handled transuranic waste (CH TRU) and mixed low-level radioactive waste (MLLW).



Optimus Family

Safety features by design include:

- Designed to ASME Code Section III-NB and NF criteria
- Pressurization analysis, including non-compliant TRU waste
- Contingency combustion analysis, considering possible deflagration and detonation
- Up to 390 fissile grams equivalent (FGE) per drum for plutonium and uranium wastes



Up to 6 per legal weight truck limit



Up to 2 per legal weight truck limit

OPTIMUS® Product Comparison



Packaging Attribute	OPTIMUS®-H	OPTIMUS®-L
Package Designation	B(U)F	
Controls	Exclusive-Use or Nonexclusive-Use	
Cavity Size (in.)	Ø32.5 x 47.0 (fits 110 gallon drum)	
MNOP (psig)	100	
Outer Dimensions (in.)	Ø74 x 83	Ø49 x 70
Empty Weight (lb.)	24,700	6,050
Max. Content Weight (lb.)	7,300	3,150
Gross Weight (lb.)	~25,000 to 32,000	~6,500 to 9,200
Packages LWT Shipment	2	6

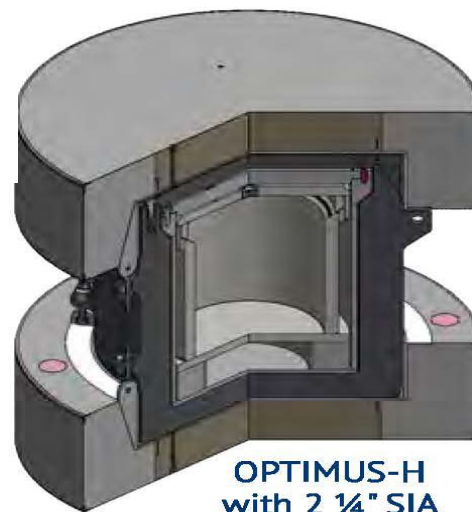


■ OPTIMUS®-H

■ OPTIMUS®-L

SIA	OPTIMUS-H	OPTIMUS-L
1"	✓	✓
2 ¼"	✓	✓
3 ¾"	✓	—

Large cavity and high payload weight limit allows OPTIMUS packaging to be reconfigured with Shield Insert Assemblies (SIAs), balancing weight and shielding constraints.

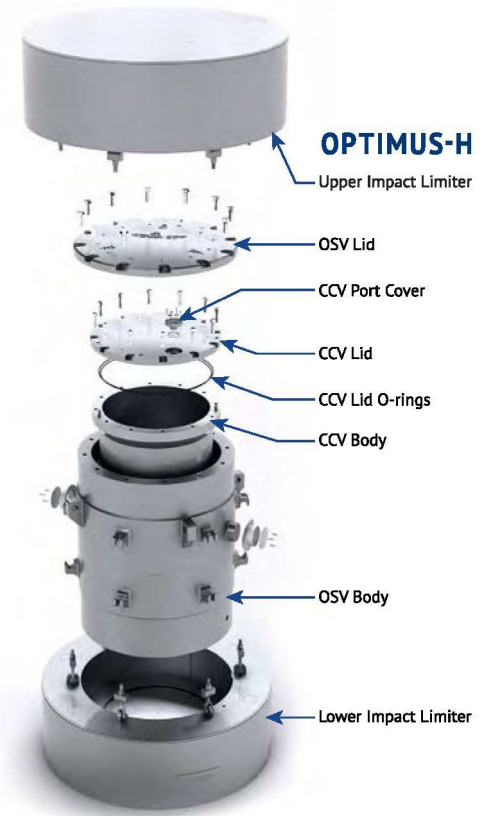


- Stainless steel containment vessel.
- Innovative bolted closure system to facilitate remote closure operations.
- Universal and compatible lifting and anchoring attachments.
- The CCV is designed to be interchangeable for use in both the OPTIMUS-L and OPTIMUS-H



Outer Shield Vessel

- Cost effective shield vessel to protect CCV.
- Simplified mechanical closure with weather seal.
- Integral trunnions, tie downs and attachment lugs for efficient handling.
- Integrated drain and monitoring port



Impact Limiter System

- Closed cell polyurethan foam encased in stainless steel.
- Swing-Bolt connections for quick installation/removal
- Integrated drain and monitoring port

PACKAGING ATTRIBUTE	OPTIMUS-H	OPTIMUS-L
Package Designation	B(U)F-96	
Controls	Exclusive Use	
Cavity Size (in.)	Ø32.5 x 47.0 (fits 110 Gallon Drum)	
MNOP (psig)	100	
Outer Dimensions (in.)	Ø74.2 x 83.2	Ø49.0 x 70.0
Empty Weight (lb.)	24,700	6,050
Maximum Content Weight (lb.)	7,300	3,150
Gross Weight (lb.)	~25,000 to 32,000	~6,500 to 9,200

- OPTIMUS®-L U.S. NRC CoC (USA/9390/B(U)F-96) issued December 2021
- OPTIMUS®-H application submitted to U.S. NRC December 2021 and NAC responded to NRC Information requests in August 2022
- OPTIMUS®-L Canadian CoC (CDN/2099/B(U)F-96) for Intermediate Level Waste (ILW) issued July 2020 and CoC Rev. 1 for Fissile Material (FM) issued August 2021. OPTIMUS®-H CoC (CDN/2098/B(U)F-96) for ILW issued August 2021 and CoC, Rev. 1 for FM and non-exclusive use issued August 2022
- OPTIMUS®-H Australian validation received in December 2021
- 26 OPTIMUS® packagings have been delivered and more are being currently fabricated.
- Significant opportunities to expand OPTIMUS applications globally.



Optimus Volunteer

- Seen as a solution to meeting many of the advanced reactor needs.
- Like the OPTIMUS-L, but much larger
 - Cavity length approx. 160"

Questions

Thanks!!

Edward Ketusky, Ph.D.

NAC Transportation Project Manager

eketusky@nacintl.com

404.268.5236