NAC International Presents:

NAC's MAGNASTOR® System: The Next Generation of Advanced Spent Fuel Storage for the U.S.

ISSF2010

International Seminar on Interim Storage of Spent Fuel

Sponsors: CRIEPI and IAEA

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NAC's MAGNASTOR System: The Next Generation of Advanced Spent Fuel Storage for the U.S.

Topics

- NAC International Background
- Overview of the MAGNASTOR System
- Development of the MAGNASTOR System
- Advanced Features of the MAGNASTOR System
- Deployment of the MAGNASTOR System
- Questions and Discussion

NAC International Background

NAC Background and History

- NAC was founded in 1968
- NAC is a provider of global nuclear fuel cycle services and products:
  - Spent Fuel Management and Storage Technology
  - Spent Fuel Transportation Systems and Services
  - Worldwide Nuclear Consulting
  - U.S. Department of Energy (DOE), Government Agency Support
- NAC is Owned by the United States Enrichment Corporation, Inc. (USEC)
- NAC Headquarters located in Norcross, Georgia, USA
- Other NAC Offices - Tokyo, London, and Moscow

MAGNASTOR

NAC International Overview
Proven Nuclear System and Service Solutions

Norcross

Tokyo

London

Moscow

Consulting	Transportation Services	Projects/Engineering
Recognized Authority on Nuclear Fuel Cycle	More than 3,600 Cask Movements Over 6 Million Miles	Numerous Spent Fuel Technologies Licensed
Nuclear Fuel Database Management	Cask Services at Sites	More than 300 Storage and Transport Systems Delivered

Over Forty Years of Nuclear System and Service Solutions Experience

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Dry Spent Fuel Storage Experience









NAC Dry Storage System Experience: Totals

- 422 Ordered
- 296 Delivered
- 247 Loaded

Development of the MAGNASTOR System

NAC MAGNASTOR Casks Constructed at the McGuire Nuclear Station

Background: Why U.S. Utilities Prefer Multipurpose Canister Systems (MCS)

- Concrete-based, MCS technology gives more flexibility for uncertainty about storage duration, location, transport, or disposal
- Provides storage containment, criticality control and much of the thermal function in one element (canister)
- Shielding, physical protection and some thermal functions are provided by the overpacks (casks)
- The canister becomes the “contained” waste form, not individual fuel assemblies; allows easier movement of waste, less facility support for whatever occurs in the future.
- MCS allows significantly fewer transport casks, which are relatively much more expensive than concrete storage casks

MCS Acceptance by U.S. Utilities

- U.S. utilities very strong advocates of concrete MCS
- NAC believes this support principally driven by:
  - large uncertainties about spent fuel disposition
  - extensive flexibility provided by MCS designs
  - very reasonable MCS cost for large flexibility
- Concrete MCS technology has equal safety to metal casks, meets all regulations, is proven in performance
- NAC's MAGNASTOR System was developed to provide utilities MCS flexibility at even lower cost per assembly

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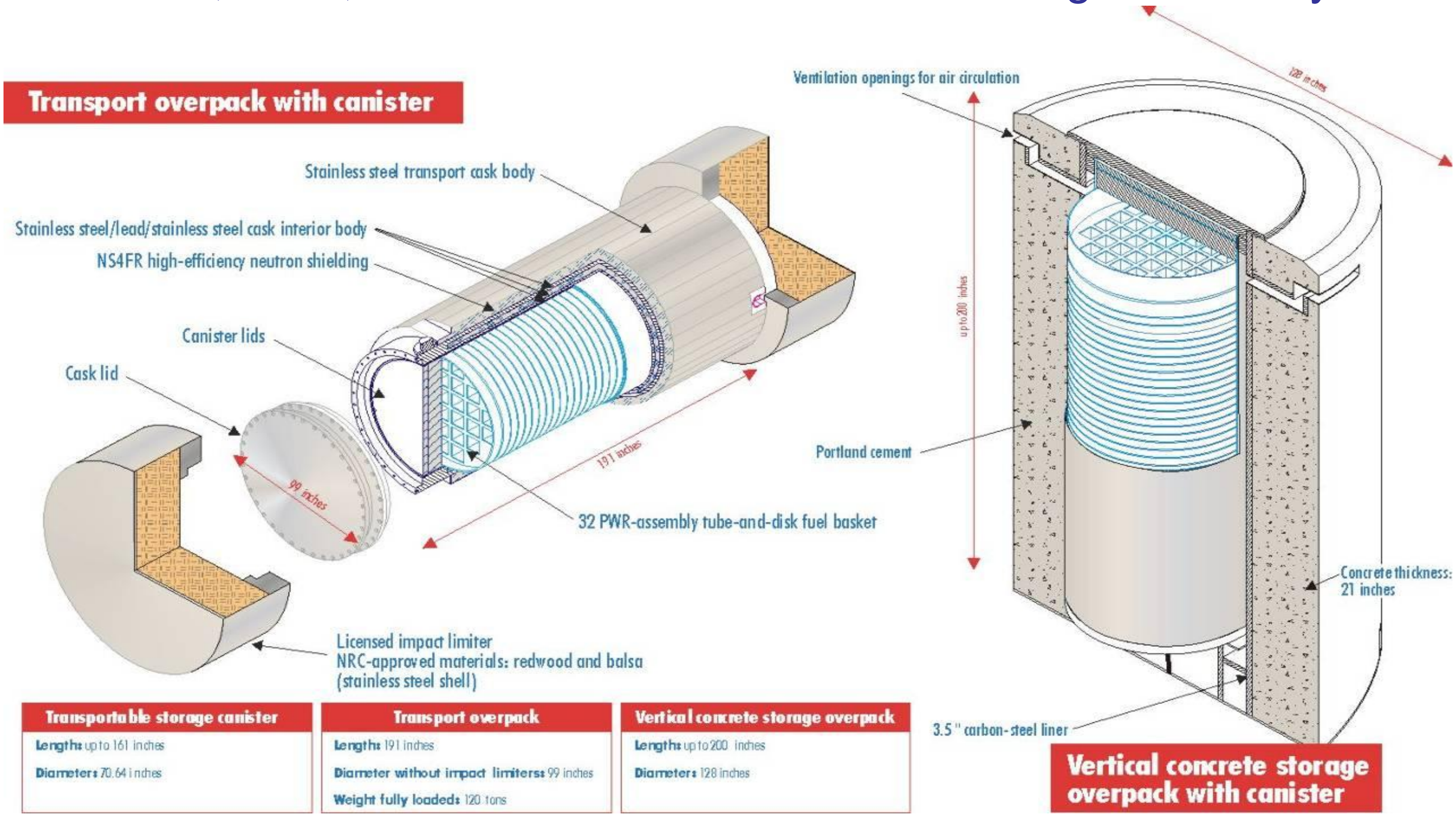
Typical NAC MCS

NAC's MPC, UMS, and MAGNASTOR MCS technologies are very similar



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Lessons Learned to Achieve Better Performance and Economics with MAGNASTOR

Based on NAC's extensive experience with UMS and MPC, several important lessons learned include:

- High capacity drives system safety, performance and economics; if possible, take advantage of larger plant capabilities to handle high capacity systems
- Higher density fuel storage can reduce dose rates and onsite/offsite exposures *per assembly stored*
- Final mechanical assembly of key components is more efficient, with better schedules and lower risk
- Simplified operations reduce time, cost, and dose

MAGNASTOR System Development Strategy

- Higher capacity with minimal volume increase
- Simple basket and cask design for ease of fabrication
- Utilize proven UMS and MPC technology, where it makes sense
- Incorporate customers on design review team for collection and integration of lessons learned and best practices
- Work with several fabricators early to integrate and develop efficient fabrication and construction methods into design
- Use full scale prototypes and lead component assemblies to refine fabrication methods and determine real cost

MAGNASTOR Basket Fabrication Projects

- NAC partial basket fabrication project at GEH in Pittsburgh
  – completed 12/2005
- NAC basket fabrication project at HMC in Japan
  – completed 12/2006
- NAC, Ceradyne & GEH fabricated first deliverable MAGNASTOR basket applying full QA
  – completed 6/2009
- Others in process

U.S. MAGNASTOR System Summary

- Concrete storage system, with dual purpose canister
- System capacity: 87 BWR or 37 PWR assemblies
- System thermal capacity: BWR 33 kW; PWR 35.5 kW
- Loaded weight:161 tons (146.4 Mt) on storage pad
- Basket: developed cell, mechanical final assembly
- Canister redundant closure design: single lid, seal ring
- Transfer cask operations lift: <115 tons (104.5 Mt)
- Enhanced canister draining, drying features

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MAGNASTOR System Design Parameters

Fuel Specific Data		PWR / BWR
Maximum Assembly Capacity		37 / 87
Thermal Capacity	(Storage)	35.5 kW / 33 kW, maximum (40 kW Design Basis)
	(Transport)	23KW / 22 kW, maximum (Initial License)
Fuel Cool Time	(Storage)	4 years, minimum
	(Transport)	To meet maximum heat load limits
Fuel Initial Enrichment		5.0 w/o / 4.5 w/o, U^{235} maximum
Fuel Burn-Up (Assembly Average)		60 / 60 GWD/ MTU maximum
Key System Parameters		
VCC Length:	Standard Cask	225 inches
	Segmented Body	204 / 194.5 inches (MAG-E)
VCC Outer Diameter		136 inches
Canister Cavity Length		Type 1 – 173 inches
		Type 2 – 180 inches
Internal Cavity Diameter		71 inches
Overall Canister Length		Type 1 – 185 inches /181 inches MAG-E
		Type 2 – 192 inches
Canister Shell Thickness		0.5 inches
Maximum Weight on Crane Hook (Transfer Cask loaded)		114.25 tons / 114.75 tons
Concrete Cask Maximum Weight on Storage Pad		160 tons / 161 tons

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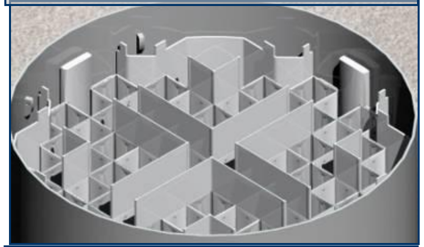
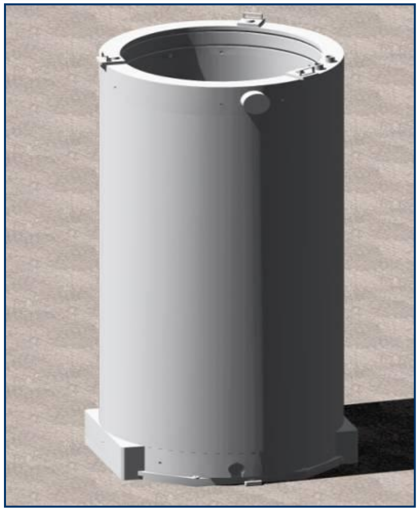
MAGNASTOR System Hardware

Vertical Concrete Cask (VCC)

Canister and Basket

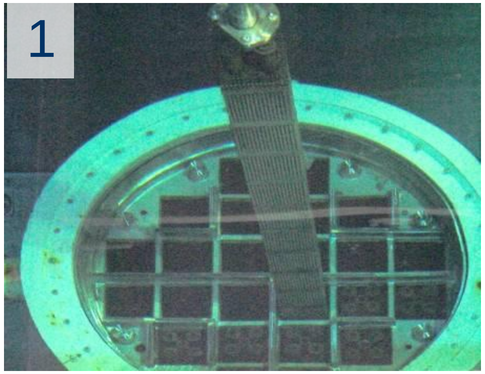


Transfer Cask



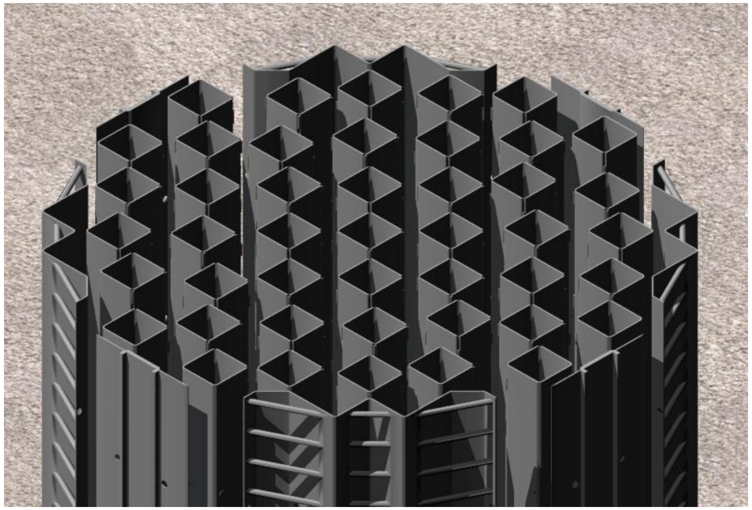
MAGNASTOR Operations

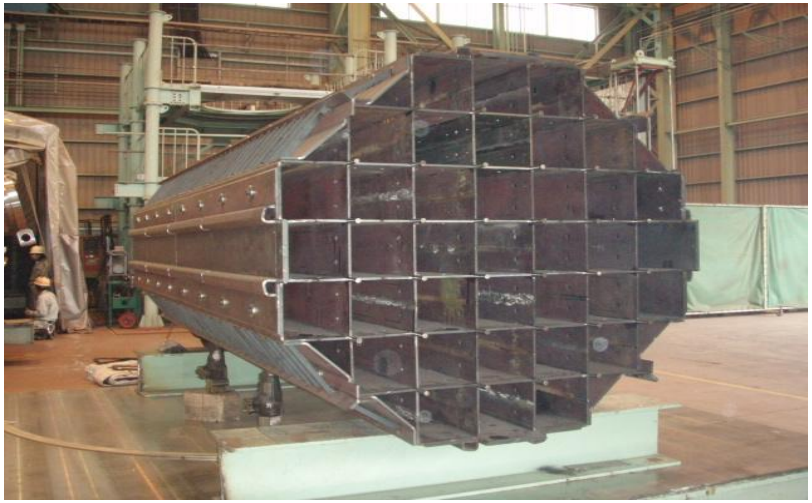
1. **Canister in MTC is loaded in the pool**
2. **Canister is welded, drained and vacuum dried**
3. **MTC (with loaded canister) is transferred to VCC**
4. **VCC /canister is transferred to the pad**



This is virtually the same process in use at all U.S. plants with MCS now.

Development and Licensing Summary





- Capacity: 87 BWR, 37 PWR assemblies
- Incorporates lessons-learned from industry multi-purpose system and transport cask fleet experience
- MAGNASTOR Final Rule and CoC were effective on Feb 4, 2009

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Advanced Features of the MAGNASTOR System

NAC Technology at the Largest Spent Fuel Dry Storage Facility at the Largest Nuclear Plant Site in the U.S., Palo Verde Nuclear Generating Station (PVNGS) Outside Phoenix, Arizona

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Advanced Features of the MAGNASTOR System

Transportable Storage Canister

- Developed cell basket – many fewer tubes than storage cells
- High strength basket material: smaller ODs, lighter system weight
- Closure for improved shielding, less welding/examination time
- Improved draining and drying design
- Unique in-pool closure approach for very low doses

Vertical Concrete Cask

- Variable liner/concrete thickness for extraordinary shielding
- Unique vertical lift design: lift lugs or air pallets
- Layered defense-in-depth against beyond-design-basis events

Transport Cask

- New, tested impact limiter design – accident loads < 60g
- Unique, patented neutron shield, conductive heat removal system

Deployment of the MAGNASTOR System

NAC Spent Fuel System Customers: Procurements and Systems Loaded

Customer	Technology Selected	Purchased Systems	Delivered Systems	Loaded Systems
Dominion - Surry	ST	2	2	2
China Nuclear EIC	STC	2	2	2
Yankee Atomic - Rowe	MPC	16	16	16
Connecticut Yankee	MPC	43	43	43
Dairyland Power - Lacrosse	MPC	5	0	0
Maine Yankee	UMS	64	64	64
APS – Palo Verde	UMS	104	84	78
Duke Energy - McGuire	UMS	28	28	28
Duke Energy - Catawba	UMS	24	24	16
License to INER, ROC	UMS	25	[25 Canisters]	0
Duke Energy - McGuire	MAGNASTOR	20	[8 VCCs]	0
Duke Energy - Catawba	MAGNASTOR	24	0	0
Zion*Solutions* - Zion	MAGNASTOR	65	0	0
Totals (Through 18OCT2010)		422	296	249

QUESTIONS AND DISCUSSION

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