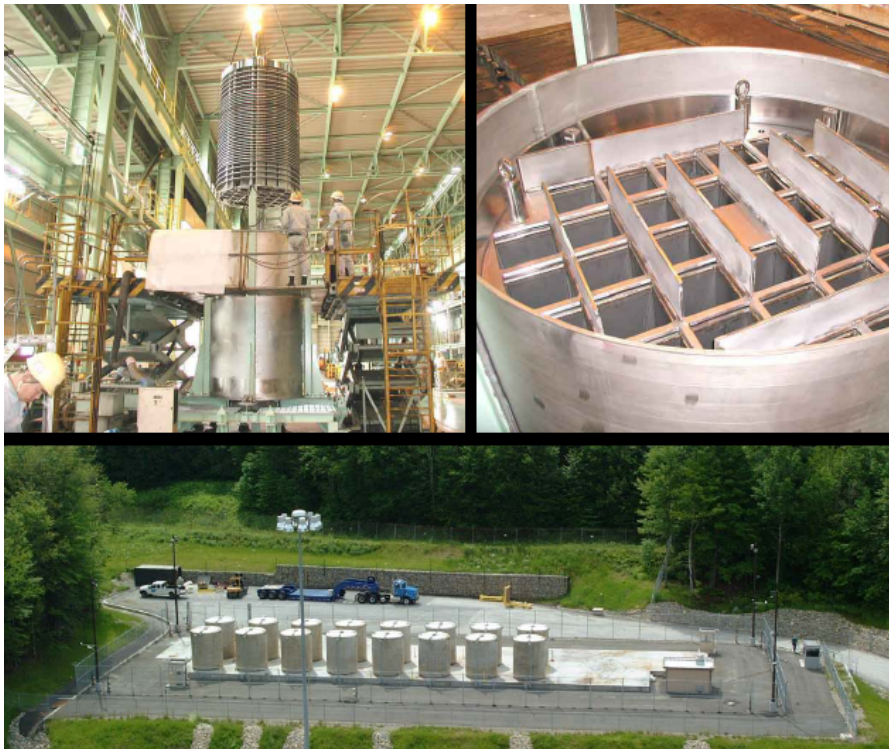
Overview of NAC-MPC Amendment Application Docket No. 72-1025



June 25, 2008

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Presentation Overview

- Introduction / Meeting Objectives
- Dairyland Power La Crosse BWR Project Schedule
- NAC-MPC Amendment
  - Structural and Thermal Evaluations
  - Nuclear Evaluations
- Licensing Considerations
- Questions

Introduction / Meeting Objectives

- Introduce DPC LACBWR spent fuel project
- Discuss LACBWR changes to the NAC-MPC system
- Address NAC's intended approach to nuclear, thermal, and structural evaluations, and licensing
  - Make as few licensing changes as possible
  - Major cask components will remain same
  - LACBWR spent fuel significantly colder than that licensed
  - Design basis calculations provide amendment bounding conditions

Dairyland Power Cooperative - La Crosse BWR Spent Fuel Storage Schedule

- LACBWR operation 1967 to 1987
- 1996-2006 limited dismantlement, including RPV removal
- 2007-2010:
  - ISFSI
  - 5 NAC-MPC systems
  - Loading campaign 3rd Quarter of 2010
- 2011 Full scale dismantlement and license termination plan development

MPC Amendment Schedule

- 72 Application
  - Pre-application meeting (Current meeting)
  - Pre-submittal meeting (October/November 2008)
  - Amendment request (December 2008)
  - Post-submittal meeting (January 2009)
  - Draft CoC (November 30, 2009)
- Schedule Drivers
  - DPC letter to NRC dated June 19, 2008
  - Decommissioning cost, weather challenges, staff, ALARA
- 71 CoC Amendment Application filed in 1st Quarter 2010

MPC-LACBWR Design Overview

- LACBWR—333 assemblies, 155 Allis-Chalmers and 178 Exxon
- LACBWR bounded by YR and CY
- 32 DFC capacity per canister / TSC (160 total)
- All AC assemblies in DFCs
- Five additional DFCs available

MPC-LACBWR Design Overview

- Actual MPC-YR transfer cask
- MPC VCC design with minor enhancements
- Tube and disk basket with design features and materials the same as MPC basket

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Amendment scope limited to expedite NRC's technical review, certification, and rulemaking

Structural and Thermal Evaluations for the NAC-MPC Amendment

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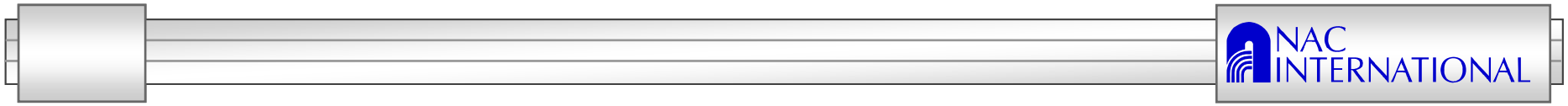


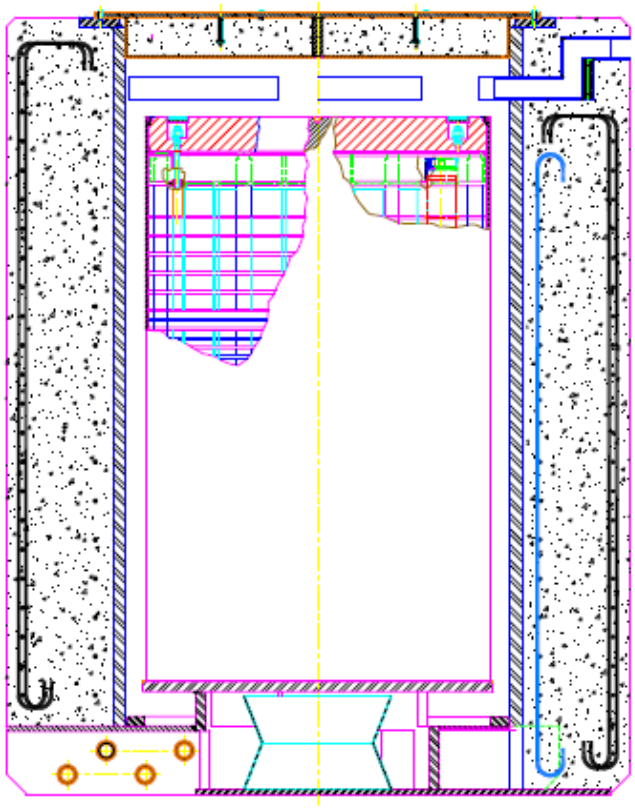
Structural Evaluation-Overview

- LACBWR will employ the existing YR transfer cask
- Bounding YR canister weight precludes the need for additional evaluation of transfer cask

	Yankee Rowe	LACBWR
Canister OD (in)	70.64	70.64
Canister length (in)	122.5	116.05
Lid thickness (in)	8	7
Liner ID (in)	79	79
VCC OD (in)	128	128
VCC length (in)	160	160
Liner thickness (in)	3.5	2.5
Number of assemblies	36	68
Assembly weight (lb)	850	390
Total fuel weight (lb)	30,600	30,680
Loaded canister weight	54,730	52,744

Structural Evaluation— Vertical Concrete Cask (VCC)

- LACBWR storage system will employ the existing YR concrete cask reinforcement / pedestal design
- YR heat load of 12.5 kW bounds the largest expected value of < 4 kW per canister-and bounds thermal stresses
- YR design basis calculations provide bounding conditions for LACBWR
  - Tornado missiles, seismic, 6-inch drop, extreme heat, air pad lift



No re-analysis of concrete cask

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LACBWR Canister Design

- Canister model will be combined with basket model to load the canister shell in tip over evaluation to comply with current license methodology
  - Multiple basket orientations considered

	Yankee Rowe	LACBWR
Canister OD (in)	70.64	70.64
Canister length (in)	122.5	116.05
Canister shell thickness (in)	0.625	0.50
Base plate thickness (in)	1.00	1.00
Canister material	Type 304L	Dual certified 304L 304
Lid thickness (in)	Two lids Structural: 3 Inner Shield: 5	Single lid 7
Lid Weld thickness (in)	0.875	0.50

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LACBWR Basket Design

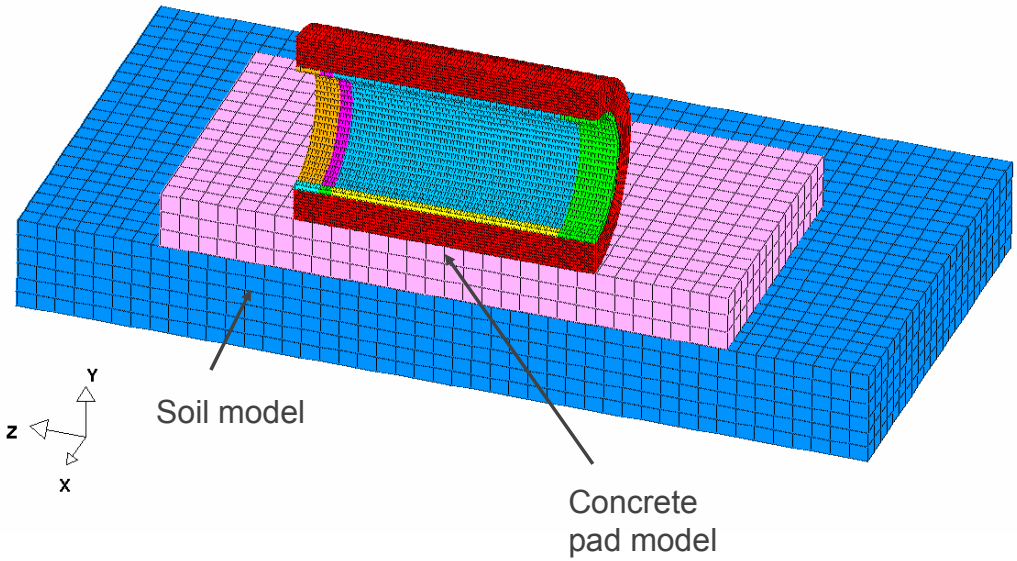
- Basket is tube and disk design (NAC-STC, NAC-MPC, NAC-UMS)
- LACBWR contains 32 over sized cells for damaged fuel cans
- Ultimate strength for 17-4 PH stainless steel is 135 ksi
- LACBWR loading is bounded by YR disk loading

	Yankee Rowe	LACBWR
Disk OD (in)	69.15	69.40
Disk material	17- 4 PH	17- 4 PH
Number of support disks	22	24
Support disk thickness (in)	0.50	0.625
Support disk pitch (in)	4.41	3.83
Cell size (in)	8.25	6.089
DFC cell size (in)	-	6.34
Number of DFC	-	32
Ligament thickness (in)	0.88	0.61
Load (lb) per disk per cell	38.6	18.8

Basket Analysis is Structural Focus of Amendment

Tip Over Evaluation

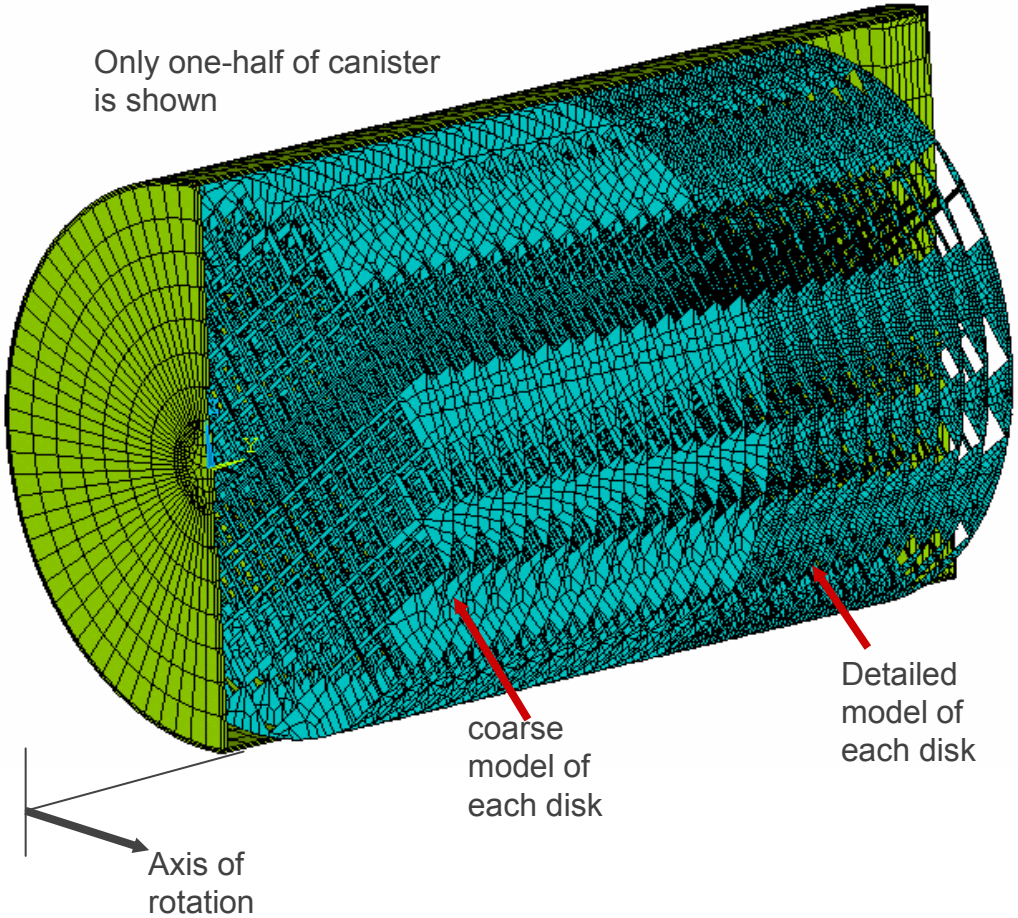
- Determination of peak accelerations will use MPC-CY LS-Dyna analysis methodology
- Soil properties will reflect LACBWR site
- Accelerations will be applied in a separate basket and canister evaluation



No New Methodologies

Basket and Canister Tip Over Evaluation

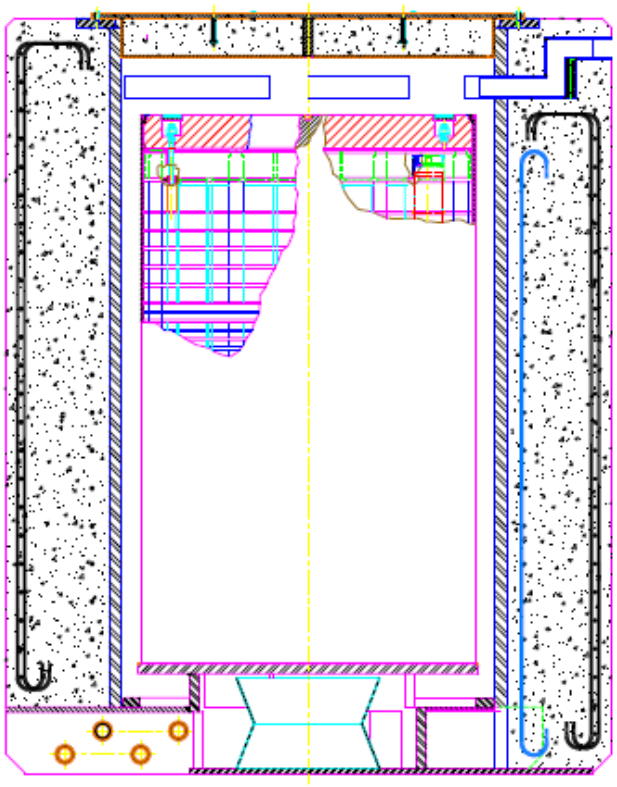
- ANSYS 3-D model of the full length basket and canister
- Acceleration applied by angular acceleration
- Full model captures loading condition of basket on the canister wall
- Canister is included in the model
- Multiple basket orientations are to be evaluated



New Methodology Used to Improve Accuracy

Thermal Evaluation Overview

- Maximum canister heat load < 4 kW (vs. 12 kW YR)
- Preliminary analysis results were performed without convection in the annulus region
  - Peak clad < 450°F
- Allowable temperature for stainless steel clad is 806°F
  - PNL-6189
  - EPRI TR-106440



Due to Low Heat Load, Credit for Convection Cooling Not Required

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Details of the Storage Condition Thermal Analysis

- Previous license amendments have used a series of effective properties (radiation & conduction)
  - For the BWR fuel assembly
  - For the damaged fuel can
  - For the neutron absorber
- LACBWR VCC thermal analysis model will use a 3-D model comprised of the fuel, damaged fuel can, basket, canister, and VCC
- Most significant heat load is the solar insolance

3-D ANSYS LACBWR Transfer Cask Model

- 3-D ANSYS canister-basket model will be used
- For the vacuum drying condition, the effective material properties for the fuel, neutron absorber and gaps will include the conductivity of helium
  - Minimum pressure of 10 Torr (13 millibar) > 1 millibar implies the gas has the same conductivity as gas with 1 bar pressure (Poling, Prausnitz, O'Connell, 2001)
- With maximum heat load, steady state conditions for vacuum drying and helium conditions will result in satisfactory clad and component temperatures
  - At 4.5 kW, YR transfer cask helium condition has a steady state temperature of 420°F

No Vacuum Drying Limits

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Nuclear Evaluations for the NAC-MPC Amendment

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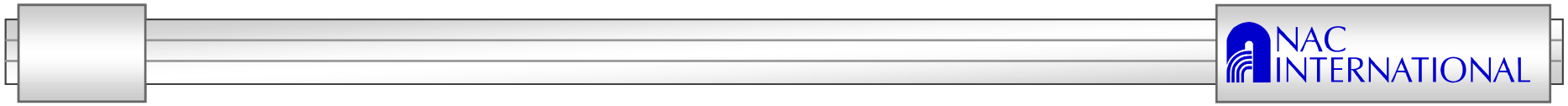

Shielding Analysis
Method

- Codes
  - MCNP5: 3-D Monte Carlo Evaluations
    - Continuous energy cross-sections – ENDF/B-VI libraries
    - Benchmarked to literature and against previous NAC cask models
  - SCALE 4.3: SAS2H Source Term Evaluations
    - 27-Group ENDF/B-IV libraries
  - SKYSHINE (NAC-CASC): Site Boundary Analysis
- Assemblies Grouped by Type: AC and Exxon

MPC Licensed Source Term Method
NRC Accepted Shielding Method

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Method (continued)

- Determine maximum system dose rates by:
  - Maximizing source for each fuel group by setting
    - Minimum cool time
    - Maximum burnup
    - Minimum enrichment
    - Maximum hardware source
- No channels or non-fuel hardware

Source Determination

- Overall source extremely low:
  - Maximum burnup – 22 GWd/MTU (low burnup fuel)
  - Minimum cool time – 23 years
  - Minimum enrichment – 3.12 wt% ^{235}U
- Licensing basis canister heat load < 4 kW
- As loaded heat load expected at 2-3 kW per canister

Source < ¼ MPC-YR Level
Low Source = Low Dose

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Shielding Evaluations

- Discrete shielding evaluations for storage and transfer casks with undamaged and damaged fuel
- Consider fuel debris
- Transfer cask evaluations for:
  - Dry system (bounding)
  - Wet system
- Storage cask always dry

Shielding Evaluations (continued)

- Shielding / radiation protection evaluations to be completed
  - Transfer cask occupational exposure
  - Storage cask occupational exposure
  - ISFSI dose (skyshine) calculations
    - Based on a 5 cask array
  - Cask and canister activation evaluations
  - Surface contamination release evaluation

Criticality Analysis

Method

- Code – MCNP5
  - ENDF-B/VI cross section set
- Analysis Steps
  - Construct detailed 3-D model
  - Most reactive basket configuration
  - Optimum moderator determination
  - Inclusion of damaged fuel
    - Including preferential flooding and optimum debris configuration

Revised Basket Requires Detailed Evaluation

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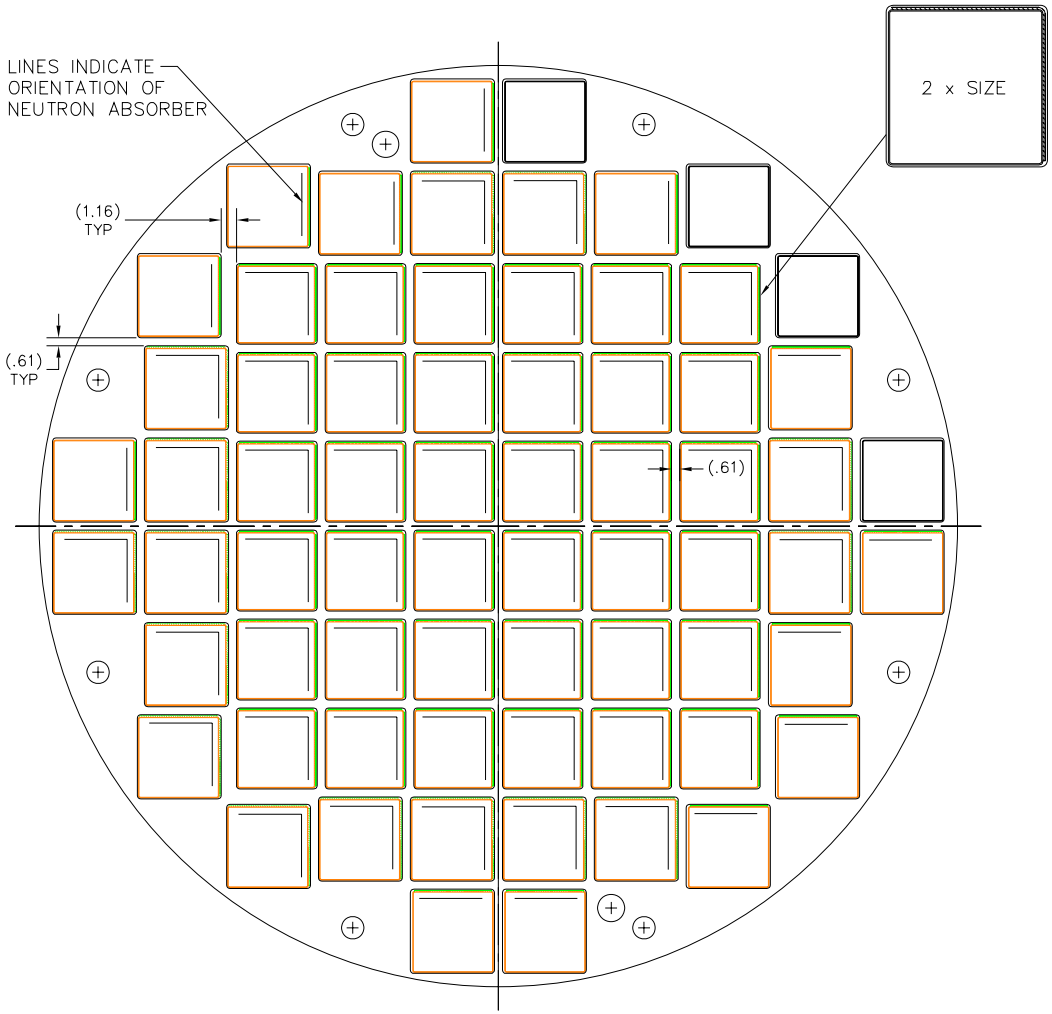
3-D Models

- Complete basket detail
- Simplified cask structure (primary shields modeled)
- Criticality control by flux traps in combination with fixed absorber panels
- Absorber panels are attached to outside of tubes
- Storage and transfer systems evaluated in vertical condition only
  - Transport to consider axial payload shift

LACBWR Basket Cross-Section



Assembly Information

- LACBWR used two primary steel clad assembly types
  - AC and Exxon
- Fuel information reviewed to set maximum enrichment / assembly configuration
- AC assemblies considered to be damaged
- Exxon assemblies undamaged
- Fuel characterization study to validate this licensing assumption

Steel Clad Low Reactivity Fuel

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Basket Tolerance and Shift

- Evaluated basket tolerances on primary system components
  - Fuel tube width and thickness
  - Absorber width and thickness
  - Disk opening location and size (maximum flux trap)
- Shifting evaluated for fuel assembly within tube and tubes within basket
- Components evaluated individually and in combination

Duplicate YR/CY Analysis Method for LACBWR

Optimum Moderator / Fuel Studies

- Determine maximum reactivity moderator in the canister, outside the cask, while considering preferential flooding of the damaged fuel canisters
- Evaluate maximum reactivity configuration of damaged fuel material in debris canister

Licensing Considerations for the NAC-MPC Amendment

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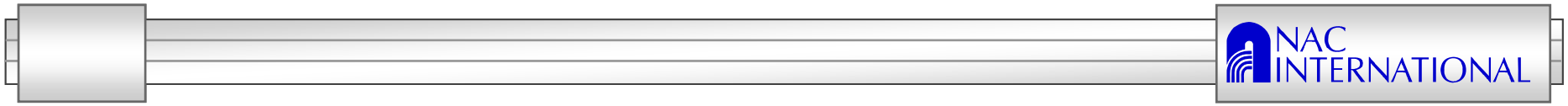

Licensing Summary
NAC Multi-Purpose Canister (NAC-MPC)

- Licensing Basis: CoC No. 1025, Amendment 5, July 24, 2007 and NAC-MPC FSAR, Revision 7
- LACBWR Amendment Request (FSAR Rev. MPC-08A) to be submitted in December 2008
- Desired draft CoC/SER date November 2009
- Desired draft final effective date for CoC 1025, Amendment 6 is March 2010
- DPC June 19 letter to NRC addressing importance of amendment schedule

Amendment Request to be Submitted in December 2008

- Electronic submittal planned
- NAC-MPC FSAR, with “Revision 08A” on all changed pages and rev bars added to mark changes/additions
- All chapters supplemented by MPC-LACBWR Appendix cross-referencing applicable information in base document text
- Upon approval, changes to be incorporated into NAC-MPC FSAR, Revision 8

Conclusion

- NAC is committed to the submission of a quality amendment
- NAC requests the NRC provide reviewers that have experience with the NAC-MPC or NAC-UMS systems
- NAC anticipates no RAIs because conservative nature of amendment relative to what is licensed
  - Only criticality and structural changes are significant to nuclear safety
  - Non-aggressive fuel
- RIS 2005-27-Rev. 1 would allow for a 7-month completion time (one – three disciplines) for NRC review

Questions?