



# **MAGNASTOR Amd. 8 Overview Presentation**

**NRC Docket No.: 72-1031**

**June 29, 2017**



# Objectives and Outline

- Objective
  - Describe contents of MAGNASTOR Amendment 8 application to facilitate NRC review
- Outline
  - Scope of Amendment Request
  - Preferential Loading Pattern
  - Safety Analyses
  - Schedule/Amendment Need Date
  - Summary & Questions

## Scope of Amendment Request

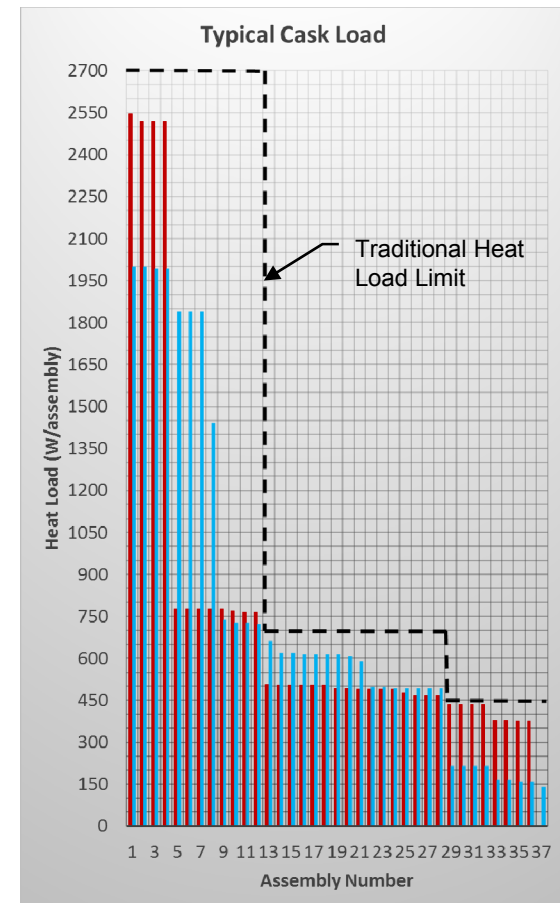
- Scope limited to addition of the PWR DF2 system intended for use at Fort Calhoun Station (FCS)
  - Component designs same as existing designs, but shortened for FCS fuel to minimize weight on hook (more to follow)
    - FCS crane capacity is 106 tons
  - Safety analyses use the same methodologies as previous FSAR revisions
  - Alternate 3-zone preferential loading pattern will allow entire FCS fuel inventory to be placed into dry storage within 2.5 years after reactor shutdown
  - Non-fuel hardware expanded to cover FCS inventory

# Scope of Amendment Request

System Component	New Designator	Summary of Design Changes
Basket	PWR DF2	Same as PWR DF basket with length reduced by 11.5"
DFC	DFC	Same top and bottom end details as existing PWR DFC with length reduced to fit within PWR DF2 cavity
TSC	TSC5	Same top and bottom end details as TSC2 with cavity length reduced by 11.5"
MTC	MTC3	Same top and bottom end details as MTC2 with following modifications to the side wall: <ul style="list-style-type: none"><li>• Shorter by 11.5" (removed from sidewall)</li><li>• Inner shell thickness reduced by 1/4"</li><li>• Neutron shield thickness increased by 1/4"</li></ul>
VCC	CC6	Same top and bottom end details as CC4 with 11.5" removed from concrete shell

# Alternate 3-Zone Preferential Loading Pattern

- Traditional preferential loading patterns
  - Limit maximum FA heat load in each zone
  - Zone and basket heat load limits based on all cells at maximum assembly heat loads
  - Not typical of actual cask loads
- New preferential loading pattern expands specification to include:
  - Loading sequence (high-to-load heat load)
  - Maximum SF heat load in zone
  - Maximum total heat load in zone
  - Maximum total canister heat load
  - Other requirements

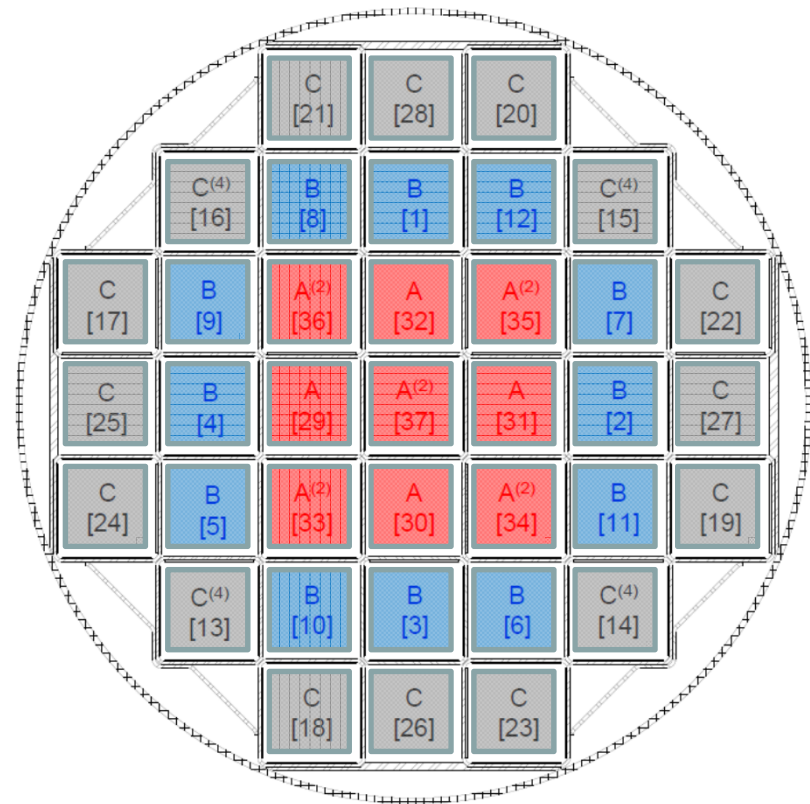


# Alternate 3-Zone Preferential Loading Pattern

Zone Description	Designator	Maximum Heat Load <sup>(1)</sup> (W/assy)	# Assemblies	Maximum Total Zone Heat Load (W)
Inner Zone	A	450	9	3,800
Middle Zone	B <sup>(3)</sup>	2,700	12	22,000
Outer Zone	C	700	16	10,000
Total	---	---	37	30,000

**Notes:**

- (1) Sort SFA in descending order by assembly heat load and load per the [sequence numbers] shown in Figure B2-2, Alternate Three-Zone.
- (2) Indicated cells may remain empty. SFAs must be loaded in all other cell locations.
- (3) No two adjacent SFAs in Zone B may have a combined heat load exceeding 4,100 watts.
- (4) DF is permitted in DFCs in the locations indicated in Figure B2-2. Heat loads for DF in these locations need not be in sequential order with the heat loads of other SFAs, as required by Note 1, but shall meet all other preferential loading instructions.

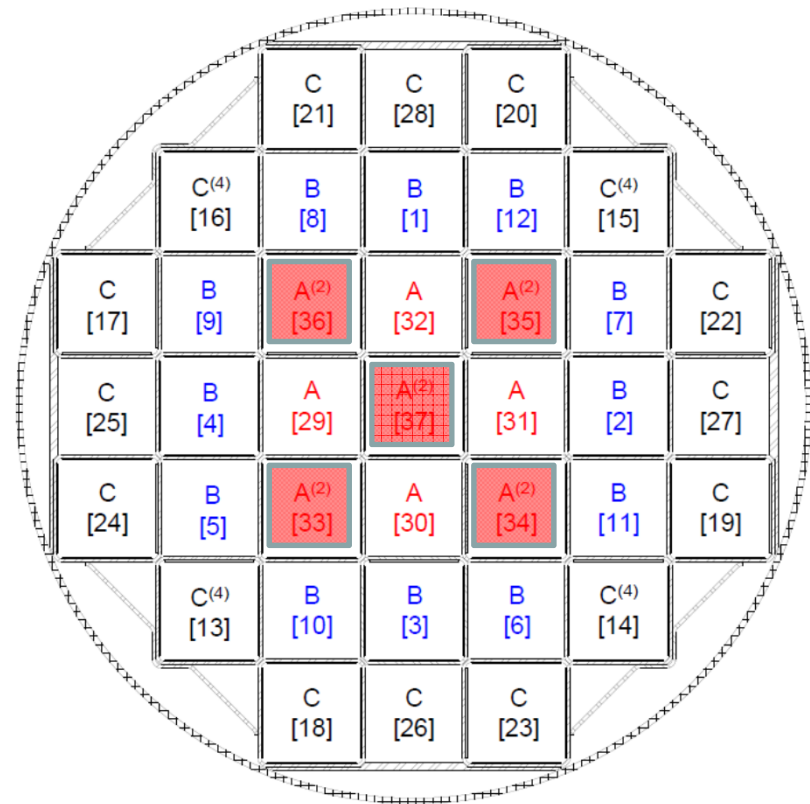


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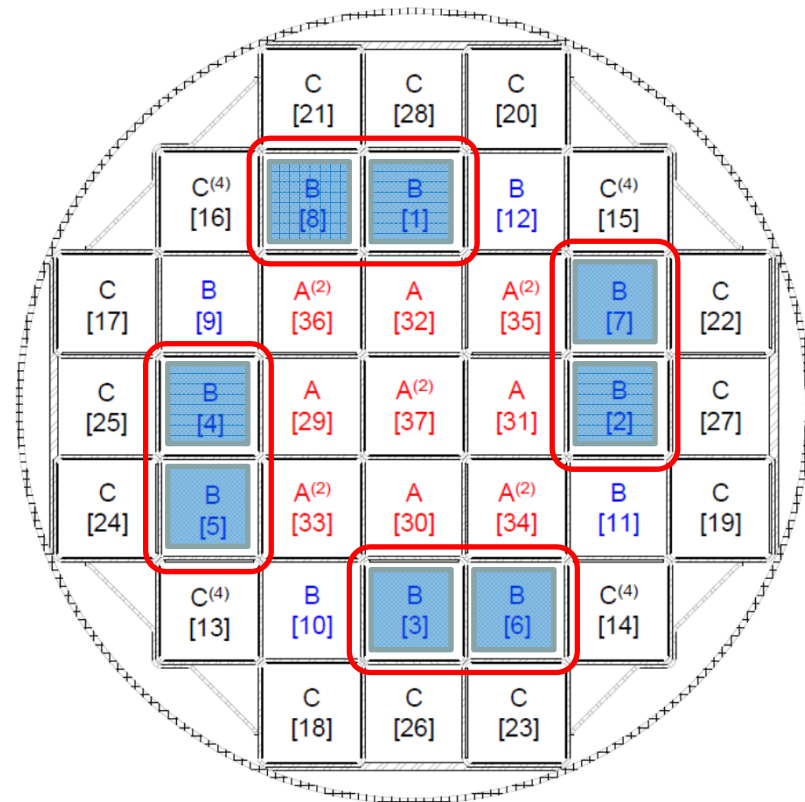


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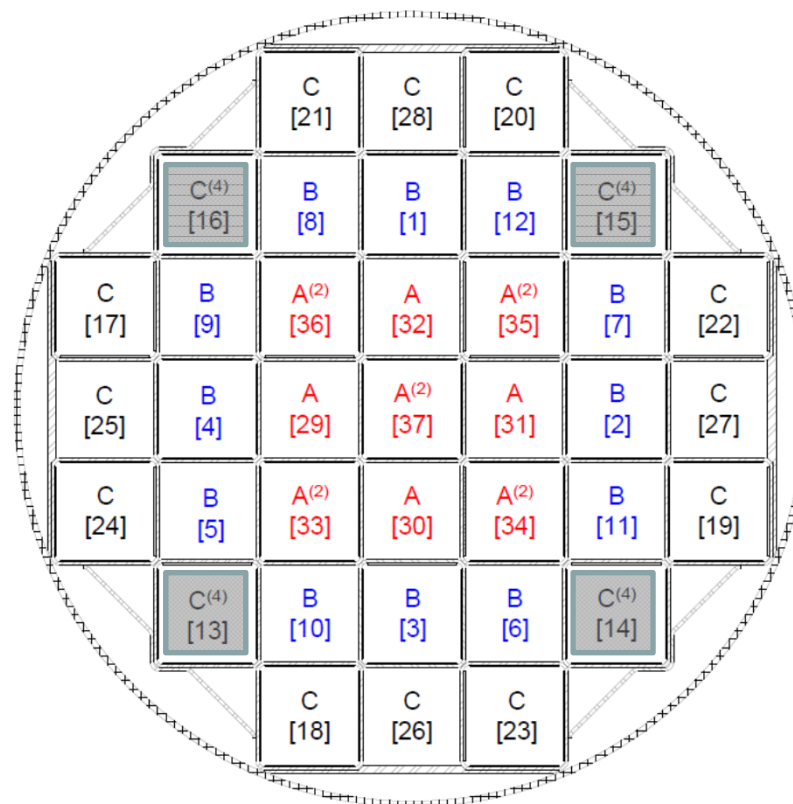


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## Safety Analyses - Structural

- CC6 - Bounded by existing analyses for all normal, O/N and accident conditions
  - CC6 has same top and bottom end details and wall construction as CC4 but is shorter, lighter and has a lower C.G.
  - Peak temperatures and thermal gradients bounded by existing structural analysis
- TSC5 - Bounded by existing analyses for all normal, O/N and accident conditions
  - TSC5 same as TSC2, but shorter and has lighter contents
  - TSC5 peak temperatures and thermal gradients bounded by existing structural analysis

# Safety Analyses - Structural

- PWR DF2 Basket
  - All normal, O/N, and accident load conditions determined to be bounded by existing analyses
    - Same design as PWR DF basket, only shorter and lighter
    - FCS fuel weight and line load lower than those for PWR DF basket
  - New thermal stress evaluation performed using bounding temperature profile for alternate 3-zone preferential loading pattern
    - Lower basket peak temperature, but different profile
    - Thermal stresses shown to be bounded by existing analysis

# Safety Analyses - Structural

- MTC3
  - New FEA vertical lift analysis of MTC3
    - Same FEA model with ½-inch thick inner shell
    - Results show FS > 6 on yield and 10 on ultimate
  - Other load conditions bounded by previous analyses
    - MTC3 and TSC5 weight less than configurations included in previous analyses

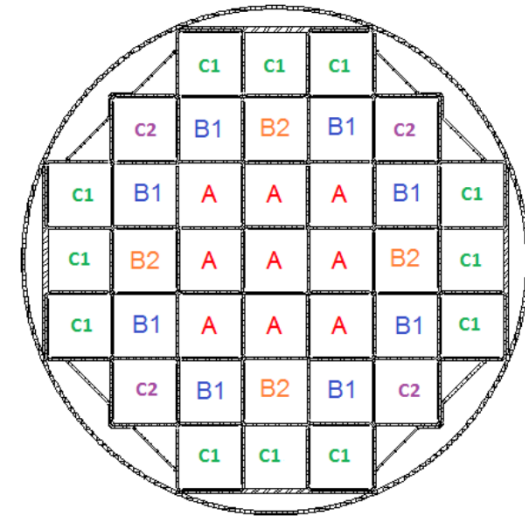
# Safety Analyses - Thermal

- Section 4.10 added for thermal evaluation of PWR DF2
  - Uniform load plus 5 possible heat load patterns evaluated
  - Uses same methodology as Section 4.4
  - Storage Conditions (Section 4.10.1)
    - Maximum temperatures for all normal, O/N and accident conditions shown to be bounded by previous analyses
  - Transfer Conditions (Section 4.10.2)
    - Maximum temperatures for H<sub>2</sub>O and helium phases w/ R-ACWS (100°F @ 60 gpm) much lower than normal storage conditions
    - Transient times reduced to maintain large thermal margins
      - 1<sup>st</sup> vacuum drying -  $T_{\max} = 662^{\circ}\text{F}$  at 16-hours
      - Helium backfill -  $T_{\max} = 421^{\circ}\text{F}$  at 24-hours
      - 2<sup>nd</sup> Vacuum drying cycle -  $T_{\max} = 662^{\circ}\text{F}$  at 11-hours
      - TSC transfer -  $T_{\max} = 712^{\circ}\text{F}$  at 22-hours

# Safety Analyses - Shielding

- Bounding 4-zone preferential loading pattern used for shielding evaluation

- Zone A – 9x 450W SFAs
- Zone B1 – 4x 2,700W SFAs
- Zone B2 – 8x 2,050W SFAs
- Zone C1 – 12x 700W SFAs
- Zone C2 (DFC locations) – 4x 700W SFAs
- Total heat load = 42,458 watts (vs. 30 kW)



- Non-fuel hardware evaluated

- SS rods – 1 SFA each in Zones A, B1, and B2, 10 rods per SFA, 45 GWd/MTU burnup
- Thimble plugs – all SFA in Zones B1 and B2, 180 GWd/MTU exposure, bounding mass (W14x14)
- HFRA – 1 FA each in Zones A, B1, B2, and C, 20 replacement hafnium rods and SS clad at 25 GWd/MTU
- CEAs – 9 FAs in Zone A at 180 GWd/MTU

## Safety Analyses - Shielding

- CC6 Dose Rates
  - Lower on top, higher on side, lower at site boundary
- MTC3 Dose Rates
  - Lower than MTC2 dose rates on top, side and bottom
  - Occupational dose results remain bounding
- Non-fuel Hardware Components
  - Minor localized increases in dose rates
  - Does not significant affect occupational dose

## Safety Analyses - Criticality

- No new analyses – same as existing criticality evaluation for CE14H1 assembly type



## Schedule

- CoC amendment needed in 10/18 (15 months) to support FCS decommissioning schedule
  - 9 months to complete technical review
  - 6 months for direct-final rulemaking
- Similar amendment for KPS completed in 16 months including delays resulting from administrative issues

## Summary

- Scope of MAGNASTOR Amendment 9 limited to the addition of the PWR DF2 system for CE 14x14 FCS fuel
  - Shorter versions of existing components – no new design features introduced
  - Same conservative analysis methodologies as those used in previous FSAR (to facilitate NRC review)
  - New preferential loading pattern (similar to KPS) to allow entire FCS inventory to be loaded at 2.5 years after shutdown
  - Non-fuel hardware expanded to cover FCS inventory
- CoC amendment needed in 10/18 to support FCS decommissioning schedule

**QUESTIONS?**