Monticello Nuclear Generating Plant (MNGP)

Fuel Storage Criticality Safety Analysis (CSA)
Pre-Application Public Meeting
January 17, 2012

Agenda

- Objectives
- Background
- Schedule
- License Amendment Request (LAR)
  - Scope
  - Content
  - ISG Compliance
- Summary of Actions

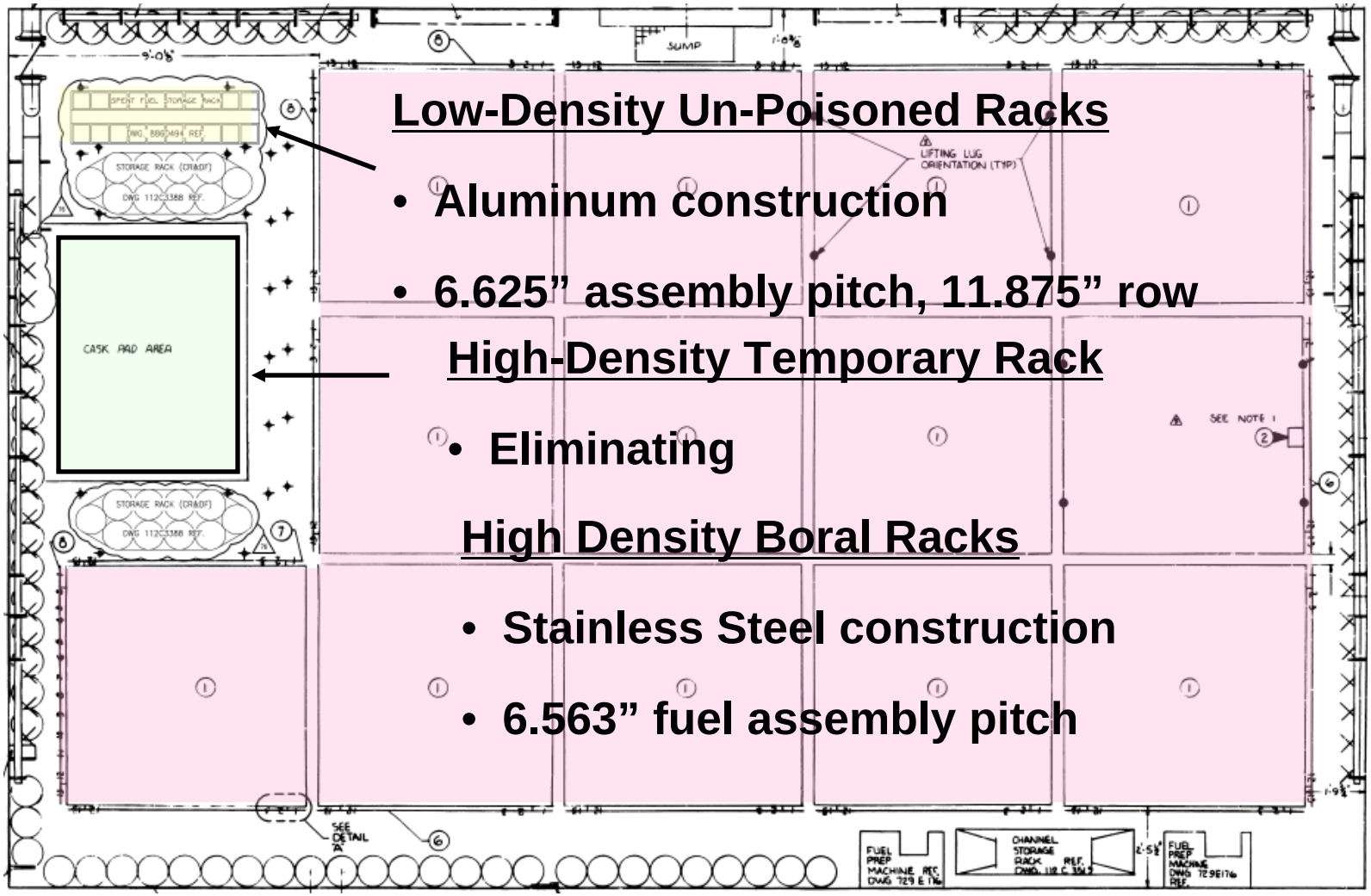
Meeting Objectives

- Agreement on LAR content
- Agreement on schedule targets
  - Concurrent review with Areva Transition LAR
- NRC feedback
  - LAR content
  - Analysis methods
- Actions

LAR Objectives

1. Address Areva ATRIUM 10XM fuel type
2. Adopt Areva CSA methodology
3. Improve analysis to meet NRC expectations
4. Address legacy issues

Background – Spent Fuel Pool



Low-Density Un-Poisoned Racks

- **Aluminum construction**
- **6.625” assembly pitch, 11.875” row**

High-Density Temporary Rack

- **Eliminating**

High Density Boral Racks

- **Stainless Steel construction**
- **6.563” fuel assembly pitch**

Background – Areva Fuel Transition

- Transition to Areva ATRIUM-10XM (2015)
  - Previously-licensed fuel at other plants
  - Areva new long-term fuel supplier for MNGP
  - Add fuel type to fuel storage CSA
- Transition to Areva safety analysis
  - 14-month review time for Areva Transition LAR
  - 2-year review time for Areva CSA

Background – LAR Scope

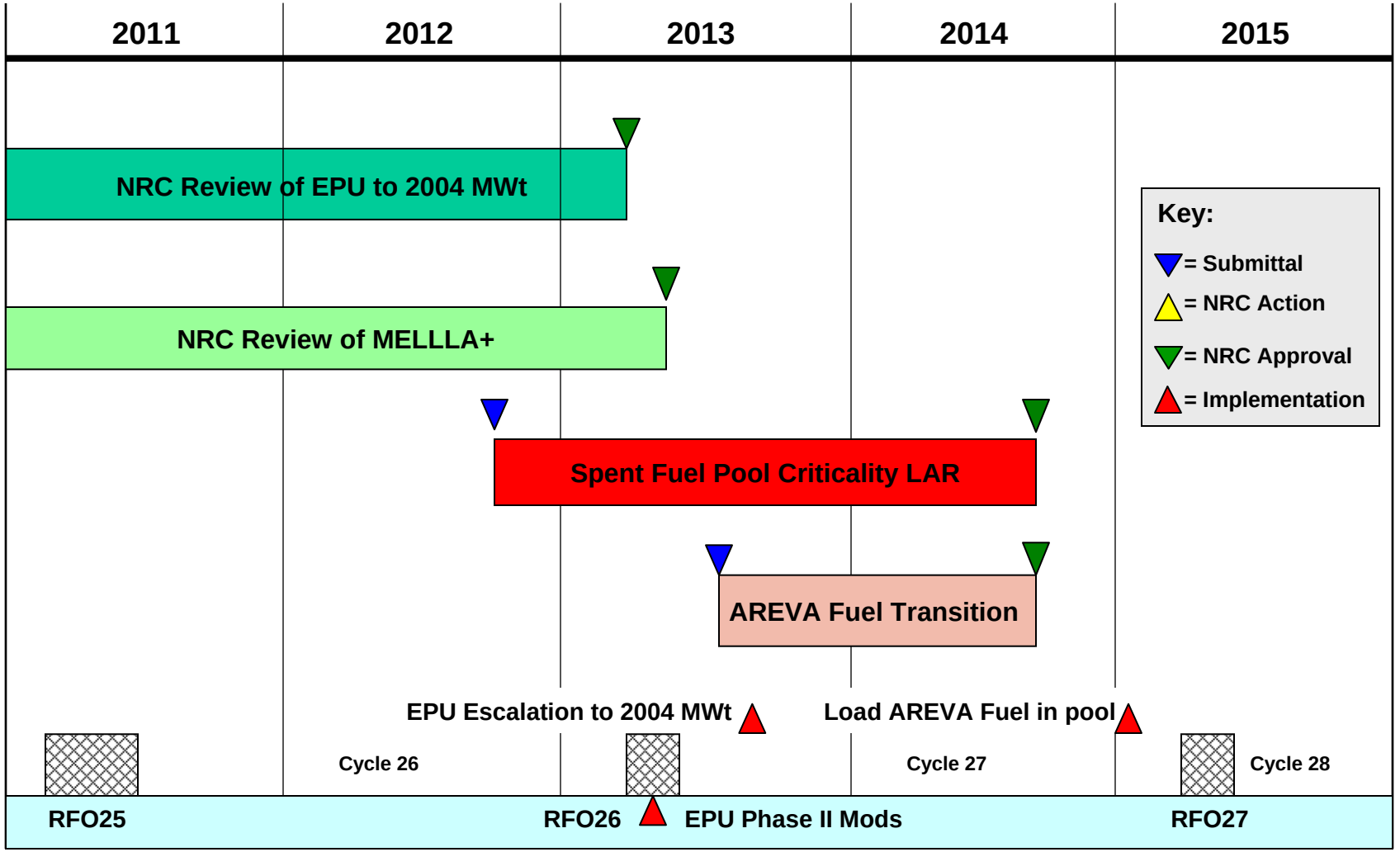
- CSA methodology – new for MNGP
  - Previously-approved methods
  - Align with Interim Staff Guidance (ISG)
- Some administrative changes, clarifications

Background – LAR Scope

No Complicating Factors:

- No significant change in fuel design
- No credit for rack inserts
- No rerack, no rack design changes
- No burnup credit
- No Boraflex
- No new SFP loading restrictions
- No New Fuel Vault analysis

Schedule – Related LARs



Schedule – Concurrent Reviews

- CSA amendment does not depend on Fuel Transition amendment
- Fuel Transition does not depend on CSA amendment
- Reviews are independent

LAR Scope – Proposed Changes

- Revised Criticality Safety Analysis for SFP
- Technical Specification (TS) Changes
- Operating License clarification

LAR Scope – Other Evaluations

- SFP cooling
  - Expect no change to fuel assembly decay heat
  - Expect no change to fuel assembly flow channel
- SFP structural seismic qualification
  - ATRIUM-10XM bounded by legacy fuel weight
- Material effects of new fuel type
  - ATRIUM-10XM uses no new materials

LAR Content

- Cover letter
- Enclosure 1 (justification of changes)
- Enclosure 2 (TS changes)
- Enclosure 3 (TS Bases markup – info only)
- Enclosure 4, 5, 6 Analysis
  - QA product, audited
- No new commitments

LAR – License Changes

- OL Condition 2.B.2 Clarification
  - Broad statement to define fuel quantity limit
  - Reconcile it with current licensing basis, Part 72
- TS Design Feature 4.3.1.1 (SFP)
  - Eliminate core k-infinity as a limit for SFP
  - Revised description of fuel to include ATRIUM
  - Eliminate description of 8x8 temporary rack
  - Align low-density rack criterion to 50.68

LAR – Proposed Changes

- TS Design Feature 4.3.1.2 (NFV)
  - Prohibit loading the NFV
- TS Design Feature 4.3.3
  - Reduce SFP capacity by 64 assemblies based on elimination of the 8x8 temporary rack
  - Reduce SFP capacity by 20 additional assemblies (legacy contingency)

CSA Acceptance Criteria

- Acceptance criteria per 10 CFR 50.68(b)

Normal and Accident conditions:

- $k_{95/95} \leq 0.95$ for unborated conditions

CSA Methods

- Follows NRC guidance DSS-ISG-2010-01
- Performed under Areva's QA program
- Precedent (2011)

CSA Methods - General

- Define an ATRIUM 10XM reference bounding fuel assembly
  - More reactive (lifetime maximum basis) than all previous MNGP fuel designs (including assembly modifications)
  - Uses Areva's standard moderator void dependent in-core depletion method
  - Depletes U-235 and gadolinium, builds in plutonium and fission products
  - Reactivity comparisons performed using spent fuel pool model (in-rack) conditions

CSA Methods – General (continued)

- Define a reactivity equivalent assembly at beginning of life conditions
  - Same geometry, but no integral neutron absorbers
  - More reactive than the reference bounding assembly and associated uncertainties
  - Reactivity comparisons performed using spent fuel pool model (in-rack) and limiting moderator temperature conditions

CSA Methods – ISG Compliance

- IV.1.a, Limiting Fuel Assembly
  - ATRIUM 10XM RBL is more reactive than legacy fuel designs
- IV.2.a, Depletion Uncertainty
  - Defined and conservatively applied
- IV.2.d, Rodded Operation
  - Sensitivity shows unrodded operation is limiting

CSA Methods – ISG Compliance

- IV.3.b.ii Neutron Absorber Efficiency
  - Minimum Boron-10 Areal density
- IV.3.b.iii Neutron Absorber Degradation
  - Conservative representation of blistering
- IV.3.c, Rack Interfaces
  - Multiple rack types will be evaluated

CSA Methods – ISG Compliance

- IV.3.d, Normal Conditions
  - Normal fuel handling configurations
  - Orientation variations in the racks
- IV.3.e, Accident Conditions
  - Standard credible accident scenarios
  - Limiting event – missing Boral plate

CSA Methods – ISG Compliance

- IV.4.a.i, Criticality Code Validation – HTC
  - HTC benchmarks not used because REBOL used
- IV.4.c.i, Variance about the mean
  - Performed per NUREG-6698
- IV.4.d, Lumped fission products
  - Lumped fission products not credited in RBLs
- IV.4.e, Code-to-Code Comparisons
  - Use comparisons to KENO results as one method to quantify CASMO-4 uncertainty

CSA Methods – ISG Compliance

- IV.5.a, Precedents
  - CSA methods
  - TS k-infinity change

Summary of Actions

- Xcel Actions
  - Points of Emphasis for LAR content
- NRC Actions


Xcel Energy®

TS Markup – Spent Fuel

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. ~~Fuel assemblies having a maximum k-infinity of 1.33 in the normal reactor core configuration at cold conditions~~;

b. $k_{eff} \leq 0.95$ for high density fuel racks and low density fuel racks if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 10.2.1 of the USAR;

c. ~~keff ≤ 0.90 for original fuel rack if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 10.2.1 of the USAR~~; and

d. A nominal 6.563 inch center to center distance between fuel assemblies placed in the 13 x 13 high density storage racks~~, a nominal 6.625 inch center to center distance between fuel assemblies placed in the 8 x 8 high density storage rack,~~ and a nominal 6.625 inch center to center distance between fuel assemblies placed in the original storage rack, and a two inch gap between the high density racks and the original rack.

TS Markup – New Fuel

4.3.1.2 The new fuel storage racks shall not be used for fuel storage. The new fuel shall be stored in the spent fuel storage racks. ~~The new fuel storage racks are designed and shall be maintained with:~~

~~a. Fuel assemblies having a maximum k-infinity of 1.31 in the normal reactor core configuration at cold conditions;~~

~~b. $k_{eff} \leq 0.90$ if dry;~~

~~c. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 10.2.1 of the USAR;~~

~~d. $k_{eff} \leq 0.98$ under optimum moderator conditions, which includes an allowance for uncertainties as described in Section 10.2.1 of the USAR; and~~

~~e. A minimum 6.5 inch center to center distance between fuel assemblies placed in storage racks within a row and a minimum 10 inch center to center distance between fuel assemblies placed in storage racks between rows.~~

TS Markup – SFP Capacity

4.3.3 Capacity

The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than ~~2301~~ 2217 fuel assemblies.

Renewed OL Clarification

B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses: . . .

2. Pursuant to the Act and 10 CFR Part 70, NSPM to receive, possess, and use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operations, as described in the Final Safety Analysis Report, as supplemented and amended, and the licensee's filings dated August 16, 1974 (those portions dealing with handling of reactor fuel) and August 17, 1977 (those portions dealing with fuel assembly storage capacity)

Points to clarify for this license condition:

- Invokes USAR: SFP capacity 2301 assemblies
- Invokes 1977 “filing”: SFP capacity at that time < 2301 assemblies
- Does not invoke TS 4.2.1: Additional 484 assemblies in core
- Does not invoke Independent Spent Fuel Storage Installation
  - Unlimited amount of storage under 10 CFR 72 General License