Prairie Island Nuclear Generating Plant

Public Meeting
Pre-Application Discussion of
Spent Fuel Pool Criticality and Extended Power Uprate

December 8, 2010

Meeting Agenda

- Licensing Portion
- Technical Portion

Agenda – Licensing Portion

- Meeting Objectives
- Spent Fuel Pool Criticality (SFPC) Background
- SFPC Amendment Scope
- Extended Power Uprate (EPU) Amendment
- Basis for Concurrent Reviews
- Schedule
- Action Summary

Meeting Objectives – Licensing Portion

Pre-application discussion of SFPC amendment to:

- Establish viability of SFPC amendment concurrent review with Extended Power Uprate (EPU) amendment
- Discuss tentative schedules
- Obtain NRC feedback

SFPC Background

Analysis-of-Record

- Westinghouse WCAP-16517
  - NRC SER dated 2/5/2006
  - Allows enrichments up to 5 w/o U-235
  - In 2009, evaluated to address 422V+ fuel type
- Errors discovered in analysis (8/2010)

SFPC Amendment Scope

- Include EPU fuel assumptions
  - Gadolinium changes
  - Burnup profile changes
  - Coolant temperature increase
  - No enrichment changes
- Comport with Draft ISG DSS-ISG-2010-01
  - Justify any deviations from draft ISG

SFPC Amendment Scope

- Technical Specifications changes
  - TS LCO 3.7.17 and TS Design Features 4.3.1
    - New loading configurations
    - Credit for control rods
    - No fuel enrichment change
- Revised methodology
    - Described in the Technical Presentation
- Planned submittal in April 2011

EPU Amendment

- Discussed at Pre-Application Meeting 4/15/10
  - Typical EPU Scope
  - SFPC was not discussed
- Planned submittal April, 2011
  - Coincides with planned SFPC submittal

EPU Amendment

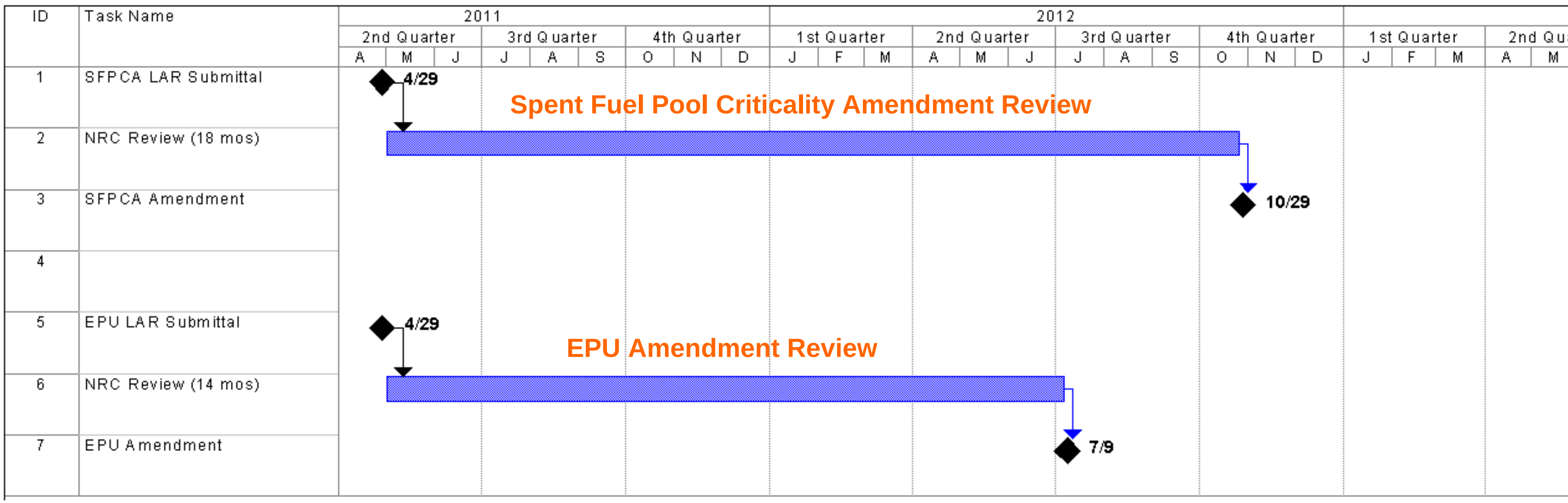
EPU submittal does not require SFPC analysis section

- RS-001 Section 2.8.6.2, Spent Fuel Storage only required when licensee requests approval for new fuel design
- No fuel design changes requested in the proposed EPU LAR
  - Previous approval of 422V+ heavy bundle design
  - Gadolinium changes may be made per Fuel Criteria Evaluation Process (FCEP)

Basis for Concurrent Reviews

- SFPC amendment approval does not depend on EPU amendment
  - SFPC analysis/amendment uses conservative projections of future core conditions to encompass core design variations
  - Assuming EPU fuel conditions does not authorize EPU operations
- EPU approval does not depend on SFPC amendment
  - RS-001 does not require SFPC description (no fuel change)
  - EPU implementation (mods, power increase) does not require SFPCA
  - Alternatives to discharging post-EPU burned fuel
- Reviews are independent
  - No overlap in affected Technical Specifications
  - Technical content is limited to spent fuel neutronics

Schedule


ID
Task Name
2011
2012
2nd Quarter
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4th Quarter
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4th Quarter
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A M J J A S O N D J F M A M J J A S O N D J F M A M
1 SFPCA LAR Submittal
2 NRC Review (18 mos)
3 SFPCA Amendment
4
5 EPU LAR Submittal
6 NRC Review (14 mos)
7 EPU Amendment
4/29
Spent Fuel Pool Criticality Amendment Review
10/29
4/29
EPU Amendment Review
7/9

Conclusion

- Basis for concurrent review
- Action summary

Action Summary

Break

Agenda – Technical Portion

- Objectives – Technical Portion
- Spent Fuel Pool Criticality (SFPC) Method
- Discussion
- Action Summary

Meeting Objectives – Technical Portion

- Objectives of the SFPC Analysis
- Methods to be used in the analysis
  - Changes from current analysis of record (AoR)
  - Depletion calculation inputs
  - Biases & uncertainties
  - Accidents & soluble boron
  - Interface conditions

Background:

- Licensing Basis
  - Comply with 10 CFR 70.24 per 10 CFR 50.68(a)
  - TS invoke criticality criteria of 10 CFR 50.68(b)(4)
    - Keff < 1.0 in unborated water
    - Keff ≤ 0.95 with soluble boron credit
- Configuration
  - One spent fuel pool shared between two units
  - One spent fuel rack design (no “regions”)
  - No credit for rack poison (no Boraflex credit)

SFPC Analysis Objectives

- Appropriate conservatism to meet current NRC expectations
  - Draft ISG conformance
  - Deviations itemized and discussed
- Provide operational flexibility
  - TS loading patterns to accommodate spent fuel projections and off load contingencies
  - Bound current and EPU fuel parameters

Changes from Current AoR

- Power: Assume EPU power 1811 MWth
- Peak Assembly Avg Power: 1.59 to 1.54
- Cycle Avg Boron: 800 ppm to 900 ppm
- Configurations: Increase from 3 to 5
- Fuel Type: No new fuel types

New SFP Configurations

Five (5) Configurations to be utilized

- (1) All-Cell configuration
- (2) 3x3 Configurations
  - Fresh center assembly w/ 4 wt% Gd_2O_3 rods
  - Uniform depletion, center assembly w/ RCCA
- (2) 2x2 Configurations
  - 3 depleted assembly, 1 empty cell
  - 2 depleted assembly, 1 empty cell, 1 fresh assembly

Depletion Calculation Inputs

- Depletion parameters will impact the isotopic inventory of depleted fuel
- Major depletion inputs include:
  - Axial burnup profile
  - Moderator temperature profile
  - Soluble boron concentration
  - Usage of burnable absorbers
  - Consideration of rodded operation

Axial Burnup and Temperature Profiles

- Axial profiles based on actual PINGP fuel management and operation history
- Over 10,000 axial burnup and temperature profiles sampled to develop limiting profiles

Limiting Burnup Profile Selection

- Depletion calculations based on ‘burnup bins’
  - Profiles sorted into bins of 0-18, 18-30, 30-38, 38-48, and > 48 GWD/MTU
  - Limiting burnup profiles for each bin will be selected by analyzing the axial profiles
  - A uniform burnup profile will also be evaluated for all burnups
  - For each burnup, the more reactive of the distributed or uniform shapes will be used

Temperature Profile Selection

- Temperature profiles based on assembly power distributions
- Limiting temperature profile in each burnup bin used in depletions
- Uniform burnup profile will have appropriate temperature profile associated with a burnup bin
- Fuel temperatures are based on bounding assembly power and flows

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Burnable Absorber Assumptions

- Gd_2O_3 (Gad) rods for reactivity control
- Different numbers of Gad rods will be reviewed and the most reactive poison loading will be selected
- Use of pyrex rods in early cycle operation will be addressed in depletion analysis for applicable enrichments

Draft ISG Depletion Consideration

- Draft ISG items 2b, 2c, 2d and 3a

  2b selection of depletion parameters

  2c selection of burnable absorber modeling

  2d rodded depletion

  3a axial burnup profile

- Each covered on ensuing slides

Draft ISG Section 2b

- Nominal values may not be appropriate, requests discussion of selected values
- Draft ISG acknowledges that some parameters cannot physically be maximized simultaneously
- PINGP analysis to use bounding and nominal parameters to generate a conservative isotopic inventory

Draft ISG Section 2c & 2d

- 2c – consider burnable absorber usage
  - Analysis will conservatively address burnable absorbers
- 2d – consider rodded depletion
  - No sustained rod insertion at PINGP full power
  - Unrodded operation is appropriate assumption

Draft ISG Section 3a

3a Select limiting axial burnup profile using NUREG-6801 or plant-specific

- Analysis will use site-specific burnup profiles; selecting profiles for each burnup bin to maximize reactivity
- An axially-uniform profile will be considered and used at those burnups where it is limiting

Biases and Uncertainties

- Biases and uncertainties included to ensure that normal variances and real deviations from analysis conditions are addressed
- The analysis will address:
  - Fuel & rack manufacturing tolerances
  - Uncertainties in code validation, depletion, burnup measurement, and fission product inventory
  - Pool temperature and code validation biases

Draft ISG – Biases & Uncertainties

- Draft ISG Sections 2a, 3b, and 4

  2a – Depletion uncertainty

  3b – Rack models

  4 – Code validation

Draft ISG Section 2a

- Use of the 5% decrement method for depletion uncertainty
  - Analysis to include the 5% decrement method to cover the areas that the Draft ISG deems appropriate
  - Analysis to account for uncertainty in fission products

Draft ISG Section 3b

- Modeling SFP racks including geometry and neutron absorbers
  - Analysis models SFP racks for geometry
  - No credit for rack neutron absorbers
  - Not impacted by absorber efficiency issues

Draft ISG Section 4

- Validation of codes
  - Code validation suite addresses Draft ISG
  - Code validation suite follows NUREG-6698 and includes the Haut Taux de Combustion (HTC) critical experiments

Accident Conditions & Soluble Boron

- Analyzed accidents
  - Misloaded fresh assembly
  - Loss of spent fuel pool cooling
  - Boron dilution
  - Seismic events
- All non-dilution events keff ≤ 0.95 at less than TS SFP boron concentration
- For dilution events, the boron concentrations to keep keff ≤ 0.95 under nominal conditions will be shown to be less than the credible dilution limit

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Accident Conditions & Soluble Boron

- Normal operation considered as precursor to an accident
- Analysis will consider normal operation scenarios

Interface Conditions

- Boundaries of fuel configurations and racks
- PINGP is one-region design
- No assumed gaps between rack modules
- No interfaces between regions or modules
- Interfaces between different fuel configurations will be considered

Interface Conditions

- Consider the maximum set of biases and uncertainties from the interfaces
- Analysis will incorporate biases and uncertainties based on the more reactive configuration

Conclusions

- SFP Criticality Analysis will:
  - Conservatively bound both current and proposed future operating conditions
  - Update the licensing basis methodology to current standards
  - Address NRC Staff concerns provided in the Draft ISG

Questions

- Q&A
- Action Items

Meeting Conclusions

- Basis for concurrent review
- Actions for planning SFPC-EPU submittals
- Appropriate SFPC Analysis Method
- Understanding NRC expectations

Action Summary

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