Enclosure 2
Non-Proprietary Meeting Handouts

TRANSNUCLEAR

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AREVA

Approach for Response to TN-40 Transport Application RAI
July 29, 2008

Transnuclear, Inc.

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Meeting Agenda

- *Introduction*
- *Discussion of Approach*
- *Criticality RAIs*
- *Schedule for Responses to RAIs*
- *Questions*

Introduction

- *TN's proposed approach to RAI responses for TN-40 Transport application for the Nuclear Analysis (Criticality and Shielding) will be discussed today*
- *Only significant RAIs requiring discussion of our proposed approach with the Staff are included in this Meeting*
- *The RAIs for the Shielding discipline do not appear to warrant a discussion in this Meeting and therefore only the Criticality RAIs will be discussed*
- *RAIs 6-4, 6-6 through 6-13, 6-30, and 6A-3 will be discussed in the non-proprietary portion of the meeting. RAIs 6-1, 6-2, 6-19, 6-20, 6-21, 6-26, 6-27, 6-28, 6-29, 6-32, 6-33, and 6-34 will be discussed in the proprietary portion of the meeting. RAIs 6-9 and 6-30 will be discussed in both the proprietary and non-proprietary portions of the meeting.*

Application for Prairie Island Nuclear Generating Plant Fuel Only

- *Current Application is for 14X14 Unconsolidated Intact PWR Fuel*
- *To Expedite NRC Approval, Only Prairie Island Specific Fuel will be Allowed*

Discussion of Parameters for Depletion

- *RAIs 6-6 through 6-13*
  - *All these RAIs relate to the use of the various depletion parameters utilized in the SAS2H depletion calculations. These parameters include, specific power, fuel temperature, moderator temperature, moderator density, presence of integral burnable absorber, BPRA loading history, control rod insertion history, soluble boron concentration and letdown.*

Discussion of Parameters for Depletion

- *Part 71 Transport License to apply only to Prairie Island fuel*
- *Prairie Island historical operating information will be submitted as part of the RAI response which contains the information requested, thereby providing the justification for the parameters employed in the SAS2H models*
- *Excerpts from this information are provided as part of this presentation*

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Discussion of Parameters for Depletion

- *Significant parameters / operating history details include*
  - *Reactor thermal power of 1650 MW. The specific power utilized in the calculations is conservative (25 MW Average per Assembly) as opposed to the actual – less than 14 MW Average per Assembly*
  - *An average fuel temperature of 901 K (corresponding to 1162 °F) is utilized in the depletion calculations*
  - *Average Moderator Temperature is 560 °F and Hot Leg Moderator Temperature is 590 °F. Additional depletion calculations are performed at the Hot Leg Temperature*
  - *The lowest Moderator Density (corresponding to the Hot Leg Temperature) of 0.705 gm/cm^3 is utilized to perform the additional depletion calculations*

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Discussion of Parameters for Depletion

- ***Burnable Poison Rod Assemblies (BPRAs)***
  - *The absorber material present in the BPRAs for Prairie Island is B_2O_3. The BPRAs consist of 4, 12 or 16 rodlets per assembly*
  - *A detailed history of the BPRA insertion for Prairie Island will be included in the RAI response submittal*
  - *Based on this BPRA insertion history, only four fuel assemblies had BPRAs inserted in two consecutive cycles – depletion calculations performed with BPRAs inserted throughout the depletion or at least two-thirds of the depletion are, therefore conservative*

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Discussion of Parameters for Depletion

- ***Integral Burnable Absorbers***
  - *The only integral burnnable absorber utilized at Prairie Island is based on Gadolinia (1.0 wt. % to 5.9 wt. %) mixed with lower enriched fuel in not more than 16 pins per fuel assembly. However, no credit is taken for either the lower enrichment of the fuel or the residual negative reactivity of the Gadolinia burnable absorber*
  - *Fuel assemblies with IFBA rods are not utilized at Prairie Island and therefore are not considered in the depletion models*

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Discussion of Parameters for Depletion

- **Control Rod Insertion**
  - *A detailed history of the Control Rod insertion for Prairie Island will be included in the RAI response submittal. Based on the information provided, it is clear that no significant control rod insertion activity occurred. A typical insertion profile is shown in Figure 1*
  - *Figure 2 shows an insertion profile for Cycle 1 where control rod insertion occurred. Based on the duration of insertion, the depletion of these fuel assemblies with control rods inserted is covered by those with BPRAs inserted for the entire cycle*

Figure 1: Typical Control Rod Insertion

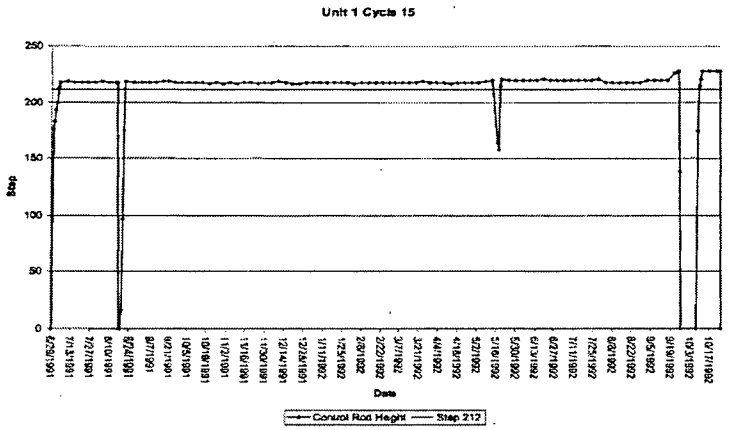

Figure 46
Unit 1 Cycle 15 Control Rod History

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Figure 2: Cycle 1 Control Rod Insertion

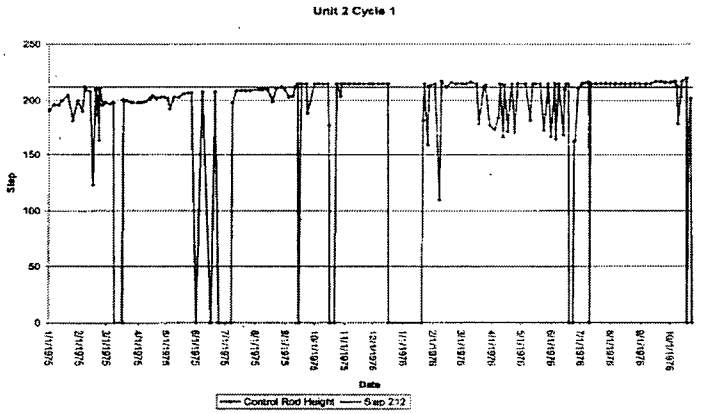

Figure 4B
Unit 2 Cycle 1 Control Rod History

Enclosure 3 to TN-E-26726

Discussion of Parameters for Depletion

- ***Soluble Boron Letdown***
  - *A detailed history of the Soluble Boron Letdown for Prairie Island will be included in the RAI response submittal. A typical letdown curve is shown in Figure 3*
  - *A UNIFORM soluble boron concentration of 600 ppm was utilized in the depletion calculations and demonstrated to be bounding for Prairie Island specific evaluations*
  - *More discussions on Boron letdown modeling is included in subsequent slides*

Figure 3: Typical Soluble Boron Letdown

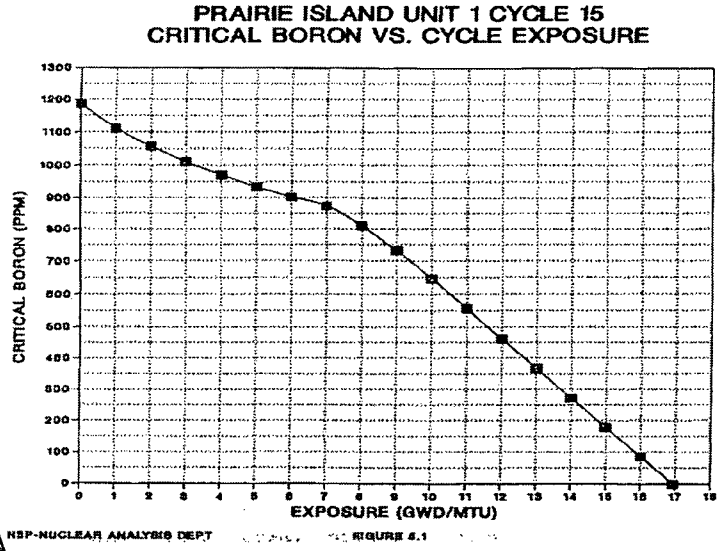

Figure 31
Unit 2 Cycle 15 Boron Letdown Curve

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Discussion of Parameters for Depletion

- *Axial Burnup Profile*
  - *The axial burnup profiles recommended by NUREG/CR-6801 (Reference [10] in the SAR) were directly utilized during depletion even though the Westinghouse 14x14 designs were not included because the fuel assemblies utilized are representative of the US PWR fuel assemblies*
  - *Burnup profile is a function of fuel height and the axial temperature change across the core (ΔTcore).*
  - *The axial profiles for each of the various fuel assembly design that were evaluated in Reference [10] were also shown to be similar to each other thereby providing additional assurance that these are representative.*
  - *Most importantly, the profiles that were recommended in Reference [10] represented the most conservative of all the profiles and are applicable to Prairie Island*

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Burnup Loading Curve

- *RAI 6-30*
  - *6-30: burnup loading curve*

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Burnup Loading Curve

- *A new, more refined, loading curve (shown in Figure 4) was developed based on new calculations – higher moderator temperature / lower moderator density*
- *Separate curves were developed for fuel assemblies depleted with and without BPRAs. No BPRAs were utilized in Prarie Island fuel assemblies for enrichment greater than 3.40 wt. % U-235*
- *BPRAs are not credited in the criticality analysis – neither for their absorption nor for their "water displacement" features*
- *Despite these conservative assumptions, the maximum calculated k-eff including all biases and uncertainties is 0.9335 which is approximately 4σ below the USL of 0.9370, demonstrating significant margins are still available.*

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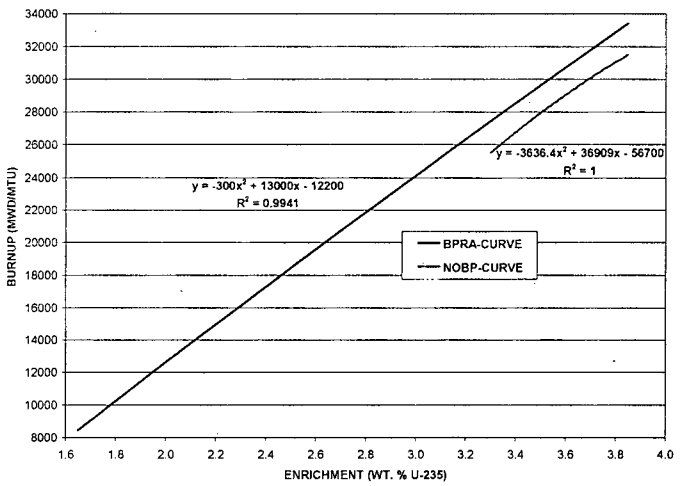
Figure 4: Burnup Loading Curve



Definition of Terms

- ***RAI 6-4: Equivalent Reload Assemblies***

  As this application is restricted to Prairie Island specific fuel, this term is not needed and the SAR will be modified to delete this term.

Assigned Burnup Loading Value

- *RAI 6A-3*
  - *6A-3: Accumulative uncertainties of fuel burnup records from cycle to cycle*

Assigned Burnup Loading Value

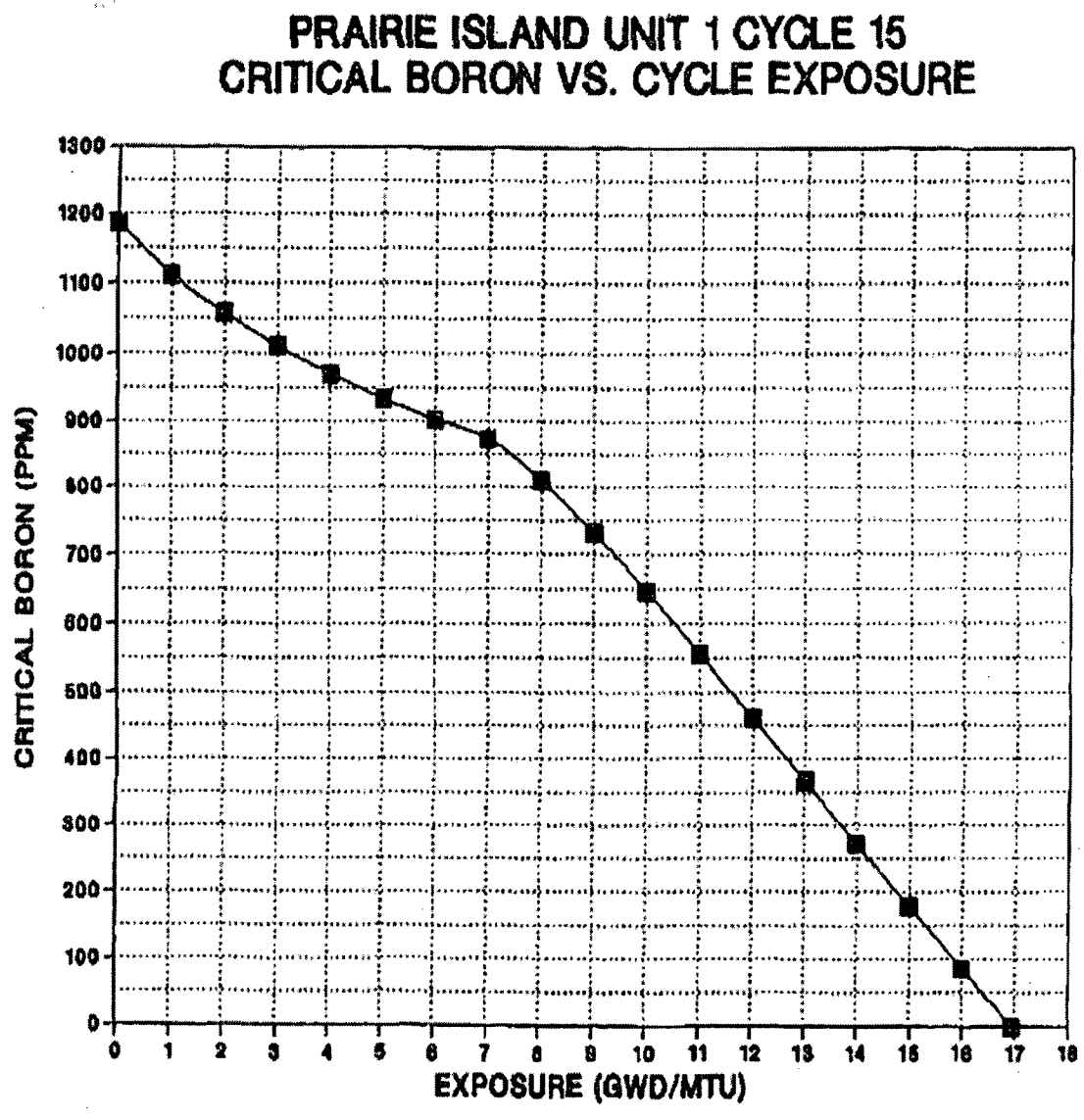
- *Individual assembly burnups are not utilized by the INCORE, DETECTOR, or FOLLOW codes to determine the individual fuel assembly burnup rates or the core burnup*
- *Thus the uncertainties in the calculated individual fuel assembly burnups do not accumulate from period to period or cycle to cycle*
- *Reducing the accumulative burnup by the 1.04 factor addresses the total burnup uncertainty over the lifetime of the fuel assembly*

RAI Response Schedule

- *TN plans to submit RAI responses by the revised due date of August 29, 2008*

Questions

Example of Boron Letdown Curve



NSP-NUCLEAR ANALYSIS DEPT FIGURE 5.1

Figure 31
Unit 2 Cycle 15 Boron Letdown Curve

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Example of RCCA Curve

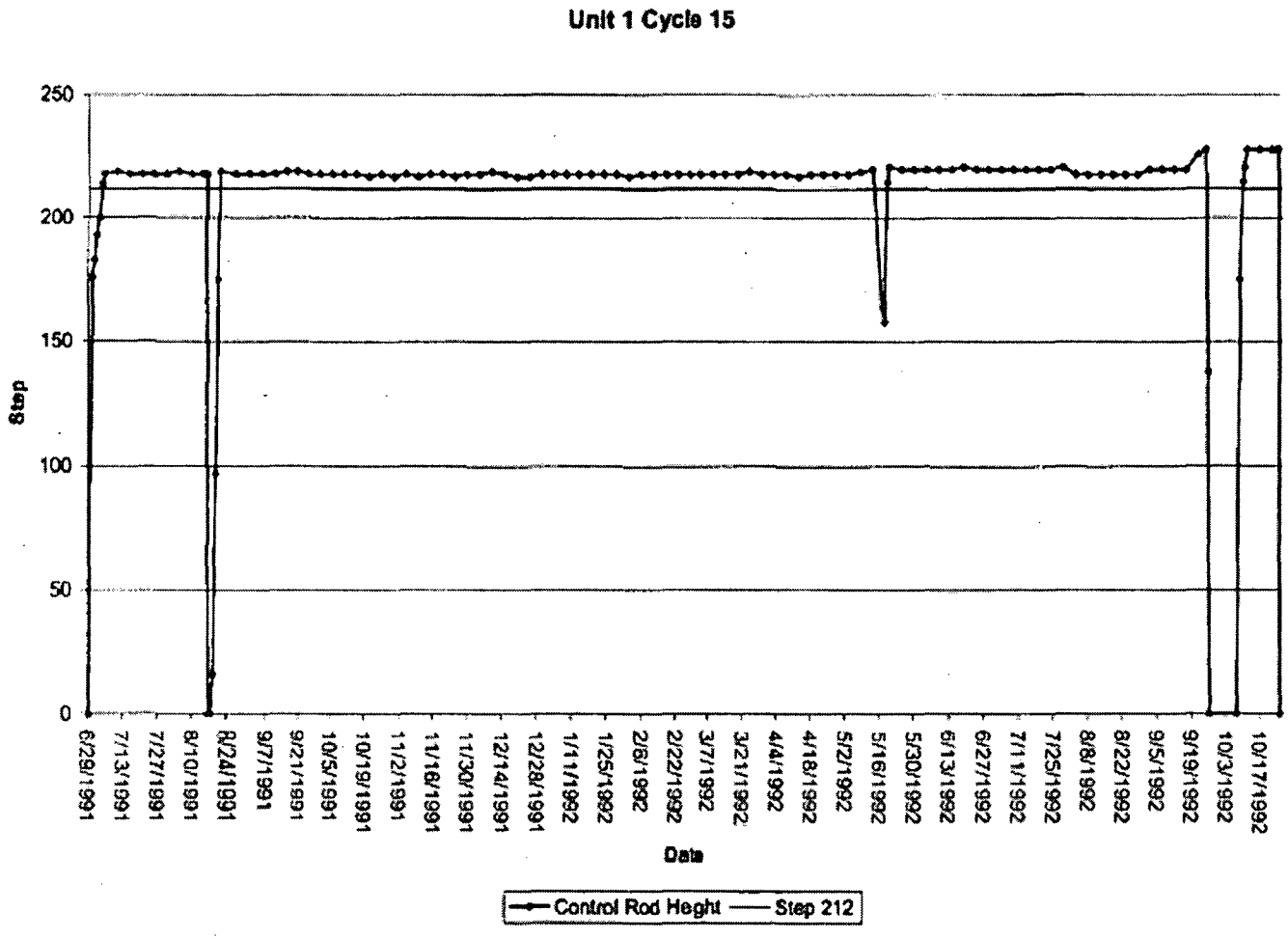

Figure 46
Unit 1 Cycle 15 Control Rod History

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Example of RCCA Curve

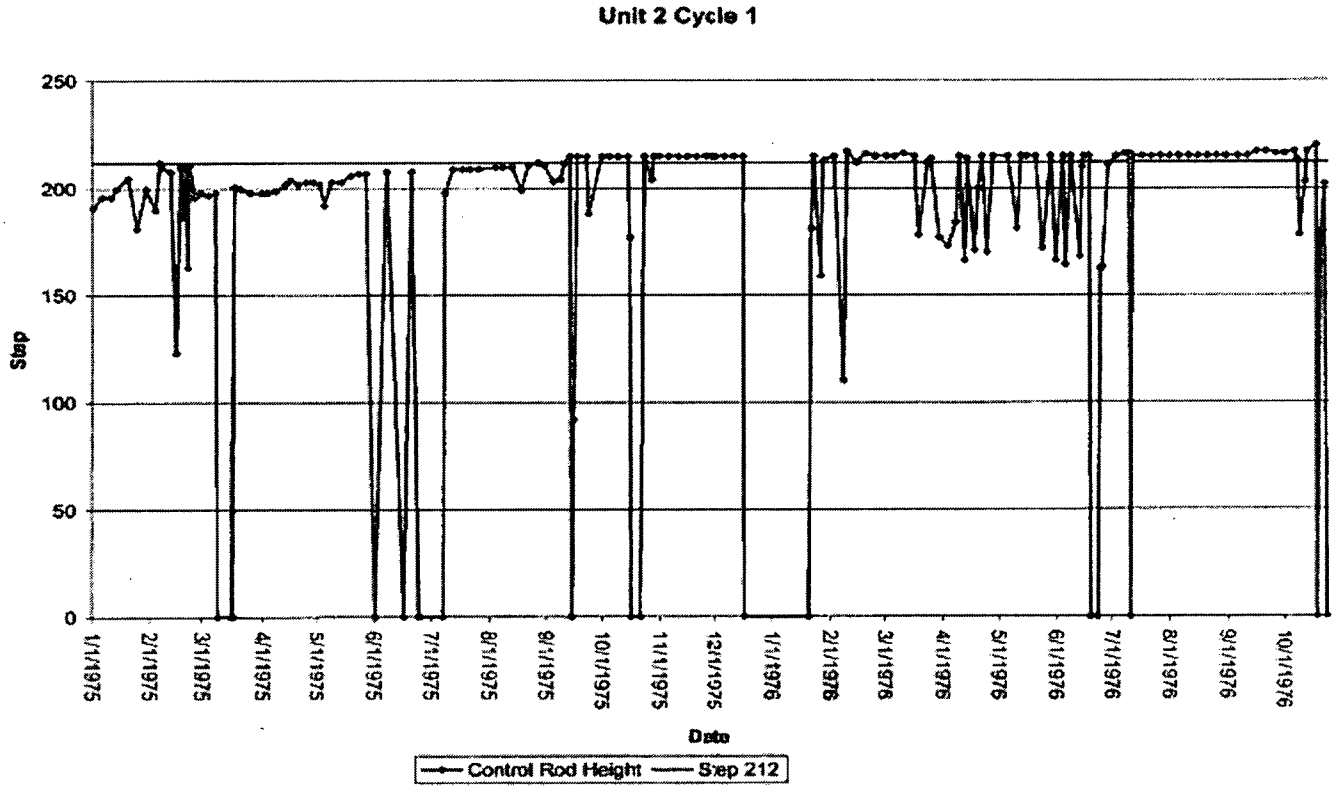

Figure 48
Unit 2 Cycle 1 Control Rod History

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Assigned Burnup Loading Value

- *RAIs 6A-1, and 6A-3*
  - *6A-1: Criticality Risk with misloaded assembly*
  - *6A-3: Accumulative uncertainties of fuel burnup records from cycle to cycle*

Assigned Burnup Loading Value

- *Risk of misloaded an assembly is reduced by requiring verification by two independent individuals that each fuel assembly to be loaded satisfies the loading requirements and assembly identity prior to insertion into cask.*
- *Prior to closure of cask, identity of each loaded fuel assembly is verified by two independent individuals*
- *Above approach is consistent with requirements in Prairie Island ISFSI License to address criticality risk of a misloaded assembly*
- *An additional measure of protection is provided by requiring 1800 ppm boron in pool water*

Assigned Burnup Loading Value

- *Individual assembly burnups are not utilized by the INCORE, DETECTOR, or FOLLOW codes to determine the individual fuel assembly burnup rates or the core burnup*
- *Thus the uncertainties in the calculated individual fuel assembly burnups do not accumulate from period to period or cycle to cycle.*
- *Reducing the accumulative burnup by the 1.04 factor addresses the total burnup uncertainty over the lifetime of the fuel assembly*