Luminant

Rafael Flores
Senior Vice President
& Chief Nuclear Officer
rafael.flores@Luminant.com

Luminant Power
P O Box 1002
6322 North FM 56
Glen Rose, TX 76043

T 254 897 5550
C 817 559 0403
F 254 897 6652

CP-200901038
Log # TXX- 09093

Ref. # 10CFR50.90

July 27, 2009

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION
DOCKET NOS. 50-445 AND 50-446
RESPONSE TO NRC STAFF EVALUATION AND BASIS FOR DENIAL OF LICENSE AMENDMENT REQUEST RE: REVISION TO THE TECHNICAL SPECIFICATION 3.7.17, "SPENT FUEL ASSEMBLY STORAGE"
(TAC NOS. MD8417 AND MD8418)

REFERENCE:

1. Letter logged TXX-07106 dated August 28, 2007 from Mike Blevins of Luminant Power to the NRC submitting License Amendment Request (LAR) 07-004.
2. Letter from Balwant Singal, Senior Project Manager of NRR to Mr. M. R. Blevins of Luminant Generation Company LLC dated November 14, 2007.
3. Letter from Michael T. Markley, Chief, Plant Licensing Branch IV of NRR to Mr. Rafael Flores of Luminant Generation Company LLC dated July 10, 2009.

Dear Sir or Madam:

Per Reference 1, Luminant Generation Company LLC (Luminant Power) requested changes to the Comanche Peak Steam Electric Station, herein referred to as Comanche Peak Nuclear Power Plant (CPNPP), Units 1 and 2 Operating Licenses and to Technical Specification 1.0, "USE AND APPLICATION" to revise Rated Thermal Power from 3458 MWT to 3612 MWT. As part of the request to increase rated thermal power, Luminant Power requested to revise Technical Specifications 3.7.17, "Spent Fuel Assembly Storage," for the spent fuel pool criticality analysis.

The proposed change was submitted to assure the Technical Specifications would remain conservative for the storage of spent fuel exposed to the higher licensed power levels of Comanche Peak Units 1 and 2. Per Reference 2, the NRC review of the above License Amendment Request was performed in two parts: a License Amendment Request to revise Rated Thermal Power and a License Amendment Request to revise Technical Specification 3.7.17 based on a revised spent fuel pool criticality analysis.

A001
NRR

On July 10, 2009, the NRC issued a letter providing a Safety Evaluation for the basis for denial of the License Amendment Request to revise the spent fuel pool criticality analysis and related Technical Specifications (Reference 3). Luminant Power has reviewed the NRC staff's Safety Evaluation and does not agree with the evaluation or with the conclusions reached in the evaluation. The more pertinent aspects of the evaluation with which Luminant Power disagrees are noted in the attachment to this letter. The attachment contains specific comments that may be categorized as follows:

- The NRC staff misunderstood the information provided;
- The NRC staff is imposing different standards than have been accepted in other recent safety evaluations without explanation or justification;
- The NRC staff failed to consider the information provided; and
- The NRC staff points to "potential non-conservatisms" without an identified basis for the concern.

As discussed with the NRC on July 23, 2009, Luminant Power believes, based on the comments provided in the attachment, sufficient technical detail has been provided to the NRC for the staff to complete the review and respectfully requests that the NRC staff reconsider the Safety Evaluation and continue to process the License Amendment Request.

In accordance with 10CFR50.91(b), Luminant Power is providing the State of Texas with a copy of this correspondence related to the proposed amendment.

This communication contains no new licensing basis commitments regarding Comanche Peak Units 1 and 2.

Should you have any questions, please contact Jimmy Seawright at (254) 897-0140.

I state under penalty of perjury that the foregoing is true and correct.

Executed on July 27, 2009.

Sincerely,

Luminant Generation Company LLC

Rafael Flores

By: Fred W. Madden

Fred W. Madden
Director, Oversight & Regulatory Affairs

Attachment

c - E. E. Collins, Region IV
B. K. Singal, NRR
Resident Inspectors, Comanche Peak

Alice Hamilton Rogers, P.E.
Inspection Unit Manager
Texas Department of State Health Services
Mail Code 1986
P. O. Box 149347
Austin TX 78714-9347

Luminant Power Response to NRC Staff Evaluation and Basis for Denial of License Amendment Request Re: Revision to the Technical Specification 3.7.17, "SPENT FUEL ASSEMBLY STORAGE"

NRC Safety Evaluation (item 1):
Pages 5 and 6, the NRC Safety Evaluation states:

> "The experiments used for validation are the same experiments Westinghouse has used to validate criticality codes in the past. The validation methodology submitted in WCAP-16827-P lacks key elements of a validation analysis. In particular, the area of applicability evaluation and trend analysis are not included. Consequently, more information is needed for the docketed validation to be considered complete...
> ...Using NUREG/CR-6698, the NRC staff concludes that the submittal lacks the necessary key elements of a validation analysis. Without these elements, there is insufficient information for the staff to determine whether or not the validations of the criticality codes used in this license amendment request are adequate."

Luminant Power Comment:
The 30 comparisons against experimental data presented in WCAP-16827-P also formed the basis for the validation of the SCALE code version 4.4a for the Beaver Valley Power Station (BVPS) Unit 2 analysis approved in March 2008. The Luminant Power analysis was submitted for review in August 2007, using the same 30 cases for validation of the SCALE code version 4.4 used at Comanche Peak. The BVPS SER (ML080730476, dated March 2008) states:

> "The experiments used for validation are the same experiments WEC has used to validate criticality codes in the past. The method used for validating the codes is the same as used in the past. There is a slight difference in results as previous analysis used SCALE-4.3, but the method of validation is the same. As documented in the Prairie Island (PI) safety evaluation (SE) and Vogtle SE, the NRC staff has previously accepted those experiments and methods."

Since the submittal of WCAP 16827-P (August of 2007), no further information has been requested with regards to the adequacy of the validation suite. Additional information justifying the applicability of the validation suite could have been provided had the need for this additional information been identified by the NRC.

NRC Safety Evaluation (item 2):
On page 6, the NRC Safety Evaluation states:

> "WCAP-16827-P, Addendum 1 (Reference 3), employs the following software: (1) SCALE5.1 and (2) PARAGON software. The substitution was made to ease the computational burden associated with the methods utilized in WCAP-16827-P. SCALE 5.1 and PARAGON are utilized as direct replacements for SCALE4.4 and PHOENIX-P, respectively. WCAP-16827-P, Addendum 1, indicates that a validation has been performed and lists a code bias and uncertainty. However, information regarding that validation was not provided. Therefore, the NRC staff could not evaluate the adequacy of the validation."
> ...
> "The licensee's RAI responses are largely silent on what code was used in the analysis... This results in an apparent mix and match of the different codes... The effect of the apparent mixing the two methods is not addressed."

Luminant Power Comment:
All calculations involving absolute reactivity determinations were performed using SCALE 4.4 to maintain consistency with the validation suite presented in WCAP-16827-P. Depletion calculations for Addendum 1 and RAI responses were performed using PARAGON and SCALE version 5.1 so that relative reactivity determinations could be presented in a short timeframe to support review of the License Amendment Request within the NRC staff's license amendment review schedule goals. SCALE version 5.1 was not used in absolute reactivity determinations, therefore no validation analysis of SCALE 5.1 was presented, but it had been performed prior to use in response to the RAIs. Consistent code versions were used for all relative reactivity determinations; hence, the two code versions were never mixed. Only the SCALE 4.4 code version was used to generate the required Technical Specification revisions.

Since the submittal of the RAI responses (completed in February 2009), no further information has been requested with regards to the SCALE code versions used in the RAI analyses.

NRC Safety Evaluation (item 3):
On page 6, the NRC Safety Evaluation states:

> "The response to RAI #17 recalculates the 'enrichment uncertainty,' 'burnup measurement uncertainty,' and 'depletion uncertainty' without the presence of soluble boron in the SFP."

Luminant Power Comment:
We believe that the NRC staff misunderstood the information provided. The enrichment uncertainty was not recalculated for the described condition without the presence of soluble boron in the spent fuel pool. The RAI response indicates that only depletion and burnup measurement uncertainties are treated.

NRC Safety Evaluation (item 4):
On page 6, the NRC Safety Evaluation states:

> "These recalculations are presumably performed with SCALE 5.1 and PARAGON, yet the SCALE 4.4 methodology bias and uncertainty along with the other biases and uncertainties determined with SCALE 4.4 are used in the Total Biases and Uncertainties. The effect of the apparent mixing [of] the two methods is not addressed."

Luminant Power Comment:
The NRC staff assumption is incorrect. No new SCALE or PARAGON calculations were performed to determine the magnitudes of the burnup measurement or depletion uncertainties. The results from the two SCALE code versions are never mixed; all absolute reactivity determinations are made in SCALE 4.4. As previously noted, SCALE 5.1 is used only for relative reactivity calculations.

NRC Safety Evaluation (item 5):
On page 7, the NRC Safety Evaluation states:

> "The 5 percent reactivity decrement has been used throughout the industry since the issuance of the Kopp Letter on August 19, 1998."

Luminant Power Comment:
It is noted that the NRC has accepted alternative approaches. For example, the NRC has accepted depletion uncertainties of both 0.5% and 1% Δk per 30,000 MWd/MTU used in calculations performed by Westinghouse for approved licensing actions after issuance of the Kopp Letter. The SFP criticality safety analyses for Ginna (ML003761578, dated December 2000), Diablo Canyon (ML022610080, dated September 2002), and Millstone Unit 2 (ML030910485, dated April 2003) all used 0.5% Δk per 30,000 MWd/MTU of burnup. The analysis for Vogtle (ML052420110, dated September 2005) used a depletion uncertainty of 1% Δk per 30,000 MWd/MTU of burnup.

<u>**NRC Safety Evaluation (item 6):**</u>
On page 7, the NRC Safety Evaluation states:

> "In its RAI response, the licensee indicated that a 'depletion uncertainty' using the '5 percent of the reactivity decrement' methodology is included in the rack-up of the biases and uncertainties for all of the storage configurations the licensee has requested to be incorporated in the TS. There was no information on what assumptions and input parameters were used in this portion of the analysis. If non-conservative core operating parameters or non-conservative axial burnup profiles were used in the analysis, then the 'depletion uncertainty' would be non-conservative. "

Luminant Power Comment:
As discussed in the response to RAI 17, the reactivity decrement is calculated by subtracting the target k_{eff} for each enrichment from the k_{eff} calculated with fresh fuel of that enrichment. This difference is then multiplied by 0.05 to determine the Δk_{eff} that is the depletion uncertainty. No depletion calculations are necessary to determine the magnitude of the depletion uncertainty as defined in the Kopp memo. As such, the core operating conditions and burnup profiles used in the analysis to determine absolute reactivity levels are not altered and are figured implicitly and correctly into the determination of the depletion uncertainty. Therefore, the necessary assumptions and input parameters were provided to support the analysis.

It should be noted that this same methodology of determining the depletion uncertainty was used in the approved spent fuel pool criticality analysis for the Prairie Island Nuclear Generating Plant (ML060250208, dated February 2006).

<u>**NRC Safety Evaluation (item 7):**</u>
On page 7, the NRC Safety Evaluation states:

> "For example, the axial burnup profile RAI [12] response, for the axial burnup profile used for the "4-out-of-4 with Axial Blankets" storage configuration, indicates there is a significant non-conservatism, depending on which axial burnup profile is used, but it is unclear which profile was used in this portion of the analysis. The NRC staff, therefore, concluded that there was insufficient information for the NRC staff to evaluate the values used in the analysis."

Luminant Power Comment:
As stated in the response to RAI 12, an additional reactivity bias was added to address the non-conservative burnup profile used for blanketed fuel in WCAP-16827. However, the burnup profile has no direct impact on the determination of depletion uncertainty as described in response to item 6 above.

The sum of biases and uncertainties is included in the response to RAI 17 for each configuration considered in the License Amendment Request as described below:

- The biases and uncertainties from WCAP-16827-P Tables 4-1, 4-6, and 4-7 are combined with the enrichment, depletion, and burnup measurement uncertainties presented as a function of enrichment in the tables in the response to RAI 17.
- The enrichment uncertainties are taken from Tables 4-8, 4-9, 4-14, 4-15, and 4-16 of WCAP-16827-P.
- The burnup shape biases presented in the response to RAI 12 for the "4-out-of-4 with Axial Blankets" are also added as part of the total sum of biases and uncertainties.

All of this information is included in either the original submittal or the RAI responses and provides the information necessary to evaluate the application of the 5% reactivity decrement depletion uncertainty.

<u>**NRC Safety Evaluation (item 8):**</u>
On page 8, the NRC Safety Evaluation states:

> "The NRC staff makes no evaluation of the 'burnup measurement uncertainty,'..."

Luminant Power Comment:
Information necessary to support the NRC staff's evaluation of the "burnup measurement uncertainty" was provided in Addendum 1 to WCAP-16827-P and also in the response to RAI 17. Since the submittal of the RAI responses (completed in February 2009), no further information has been requested with regard to the burnup measurement uncertainty used.

<u>**NRC Safety Evaluation (item 9):**</u>
On page 8, the NRC Safety Evaluation states:

> "Therefore, cases involving a distributed axial burnup profile at a burnup below 46 GWD/MTU are potentially non-conservative. NUREG/CR-6801 is generic, considering the axial burnup profiles for several fuel design types, therefore, allowing for a more specific analysis to show acceptable results. The licensee and its vendor attempted to do that in WCAP-16827-P, Addendum 1. The NRC staff had some concerns with that analysis. In particular, the analysis focused only on one enrichment in one storage configuration. "

Luminant Power Comment:
The most limiting burnup profiles present in the Comanche Peak spent fuel pools were used to demonstrate the conservatism of the burnup profile used in WCAP-16827. The intent of the response to RAI 10 was not to provide further justification for the information provided in Addendum 1, but to provide a completely alternate justification based on the same methods used and approved for BVPS Unit 2. The response to RAI 10 demonstrates that the results documented in WCAP-16827 are conservative for configurations containing unblanketed fuel assemblies.

<u>NRC Safety Evaluation (item 10):</u>
On page 9, the NRC Safety Evaluation states:

> "There is insufficient information that would enable the NRC staff to evaluate the site-specific axially distributed burnup profiles used in the RAI response."

Luminant Power Comment:
The following description was provided in the response to RAI 10 on the evaluation of different burnup profiles:

> "A review of end of cycle axial burnup profiles for unblanketed assemblies was performed using a three dimensional core simulator. All the CPSES burnup profiles were found to be well behaved. Potentially limiting axial burnup profiles were identified based on low burnup in the top three nodes of the fuel assembly. Justification of selecting limiting profiles based on the burnup of the top nodes was provided in the response to Question 11. Two limiting profiles were selected for evaluation. One burnup profile represents assembly average burnup through 30,000 MWd/MTU and the second profile for higher burnups."

This burnup shape selection methodology was used for the previously approved BVPS Unit 2 analysis. As indicated in the response to RAI 10, justification is provided in the response to RAI 11 to allow evaluation of the method for selecting limiting site-specific burnup profiles.

<u>NRC Safety Evaluation (item 11):</u>
On page 9, the NRC Safety Evaluation states:

> "Since this case study is limited to one enrichment, there is no information regarding applicability to lower enrichments."

Luminant Power Comment:
Section 4.1.2 of NUREG/CR-6801 specifically states that the end effect is relatively insensitive to initial enrichment. The limiting burnup profile was chosen from all unblanketed assemblies regardless of enrichment; all enrichments are bounded. Therefore, the information provided in RAI 10 using the maximum initial enrichment is sufficient.

<u>NRC Safety Evaluation (item 12):</u>
On page 9, the NRC Safety Evaluation states:

> "The Addendum appears to show a significant non-conservatism, and the RAI response showed a significant conservatism. Since information is lacking regarding the input parameters for either case, the NRC staff cannot determine whether or not the conservatism indicated in the RAI response is valid or not."

Luminant Power Comment:
The analysis provided in Addendum 1 indicates higher reactivity than that presented in WCAP-16827 because of the overly conservative burnup profiles which were used. No Comanche Peak specific profiles are included in the database used in NUREG/CR-6801, so the limiting Westinghouse NSSS burnup profiles were selected.

The analysis presented in the response to RAI 10, as discussed above, used only Comanche Peak specific burnup profiles, and is thus applicable and conservative.

The depletion conditions for the Addendum 1 analysis are provided in WCAP-16827-P, Addendum 1, Table 3.2. The text in section 3.2 also specifies that the conditions are:

> "representative of the uprate Comanche Peak Units 1 and 2 reactor cores."

The depletion conditions used in response to RAI 10 are shown to be conservative in the response to RAI 15 and are listed as:

> "All depletions were performed using the uprated power and temperature profiles documented in WCAP-16827."

NRC Safety Evaluation (item 13):
On page 10, the NRC Safety Evaluation states:

> "To address this issue [least conservative time of life] in the RAI response, the licensee limited the analysis."

Luminant Power Comment:
The analysis was limited to the specific fuel assembly axial zoning strategies which are present in the Comanche Peak spent fuel pools. The entire current inventory and all assemblies discharged from the core at currently licensed power levels are covered by this analysis.

NRC Safety Evaluation (item 14):
On page 10, the NRC Safety Evaluation states:

> "There is insufficient information that would enable the NRC staff to evaluate the site-specific axially distributed burnup profiles used in the RAI response."

Luminant Power Comment:
The response to RAI 12 provides the following descriptions of the methods used for evaluating various axial burnup profiles and is repeated below for convenience:

Natural Blankets

> A review of the axial burnup profiles generated by assemblies with natural blankets was performed and limiting profiles were selected on the basis of low relative burnups in the top three nodes. Further clarification of the veracity of this technique is provided in the response to RAI 11. Two limiting shapes were identified: one for assembly average burnups at or below 40,000 MWd/MTU and one above. At high burnups, the axial burnup profile tends to flatten as the higher reactivity of the less depleted fuel near the top of the core draws power upward. The limiting burnup profile for assemblies below 40,000 MWd/MTU burnup was generated by a once-burned assembly with slightly less than 19,000 MWd/MTU burnup. The limiting profile for high burnup assemblies was generated by a twice-burned assembly with a burnup slightly

greater than 42,000 MWd/MTU... Further justification for the use of the 4-zone model is also provided in the response to RAI 11.

2.0 w/o blankets

A review of the axial burnup profiles generated by assemblies with enriched blankets was performed and limiting profiles were selected on the basis of low relative burnups in the top three nodes. The profiles considered were end of cycle profiles from Unit 1 Cycles 10 – 14 and Unit 2 Cycles 8 – 11. Three limiting shapes were identified: one for assembly average burnups at or below 30,000 MWd/MTU, one for assembly average burnups between 30,000 and 45,000 MWd/MTU, and one for higher burnups. At high burnups, the axial burnup profile tends to flatten as the higher reactivity of the less depleted fuel near the top of the core draws power upward. The limiting burnup profile for assemblies below 30,000 MWd/MTU burnup was generated by a once-burned assembly with a 2.6 w/o blanket and slightly less than 17,000 MWd/MTU burnup. The results considering these 2.6 w/o blanket shapes at low burnup are presented below as part of the discussion of assemblies with 2.6 w/o blankets. The limiting profile for the middle burnup range was generated by a twice-burned assembly with a 2.0 w/o blanket and a burnup slightly under than 41,000 MWd/MTU. The higher burnup profile was generated by a twice-burned assembly with a 2.0 w/o blanket and a burnup of just over 45,000 MWd/MTU. The relative burnup profiles used for comparing the reactivity associated with these burnup profiles to the uniform profile used in WCAP-16827 were 7-zone models. The bottom nodes were used from the same assemblies selected based on low burnup in the top nodes. As was demonstrated in the response to RAI 11, the 7-zone model is slightly less conservative, but more realistic, than the 4-zone model.

2.6 w/o blankets

A review of the axial burnup profiles generated by assemblies with 2.6 w/o blankets was performed and limiting profiles were selected on the basis of low relative burnups in the top three nodes. The profiles considered were end of cycle profiles from Unit 1 Cycles 10 – 14 and Unit 2 Cycles 8 – 11. Two limiting shapes were identified: the worst case shape over all burnups and the most adverse profile that occurs above or not more than 10,000 MWd/MTU below the burnup limit for the enrichment of the assembly being considered. The worst case burnup profile is the low burnup profile discussed above. The most adverse shape near or in excess of the burnup limit comes from a thrice-burned 4.5 w/o assembly with 47,231 MWd/MTU burnup. The 4.5 w/o burnup limit, as determined from Table 5-2 of WCAP-16827, is 57,003 MWd/MTU. Some conservatism is included in this calculation by the use of this shape because the additional 9772 MWd/MTU burnup needed to make this assembly meet the requirements of this storage configuration would likely flatten the profile significantly. The 7-zone model was used for comparing the reactivity associated with these burnup profiles to the uniform profile used in WCAP-16827. The bottom nodes were used from the same assemblies selected based on low burnup in the top nodes. As was demonstrated in the response to RAI 11, the 7-zone model is slightly less conservative, but more realistic, than the 4-zone model.

As discussed previously, the above descriptions, combined with the response to RAI 11, provide sufficient information to evaluate the selection of limiting site-specific burnup profiles.

NRC Safety Evaluation (item 15):
On page 10, the NRC Safety Evaluation states:

> "The storage configuration in which the case study was performed in the "4-out-of-4 with Axial Blankets" storage configuration. While the RAI response evaluates the "3-out-of-4 with Axial Blankets" storage configuration for 2.6 w/o U^{235} blankets, no apparent case is made for the other blankets in the "3-out-of-4 with Axial Blankets" storage configuration."

Luminant Power Comment:
As was stated in WCAP-16827-P, Addendum 1, Section 3.6:

> "As storage configurations with fewer assemblies or reactivity-suppressing materials will exhibit a dampening effect on any reactivity differences due to the presence of axial blankets, this storage configuration is chosen to bound reactivity effects for all configurations with axial blankets."

The results presented for RAI 12 show that the burnup profile used in WCAP-16827 is more conservative at lower burnups. The lower burnup limits in the "3-out-of-4 with Axial Blankets" configuration make the burnup profile more conservative. Therefore, only areas for which margin could not be demonstrated for the "4-out-of-4 with Axial Blankets" configuration required explicit consideration for the "3-out-of-4 with Axial Blankets" configuration.

NRC Safety Evaluation (item 16):
On page 10, the NRC Safety Evaluation states:

> "The Addendum showed a significant non-conservatism, and the RAI response showed a significant conservatism. Since there is no information regarding the input parameters for either case, the NRC staff cannot determine whether or not the conservatism indicated in the RAI response is valid or not."

Luminant Power Comment:
The analysis provided in Addendum 1 indicates higher reactivity than that presented in WCAP-16827 because of the overly conservative burnup profile which was used. A burnup profile from an assembly with natural enrichment blankets was depleted assuming 2.6 w/o enriched blankets to conservatively bound the reactivity of the limiting discharged assembly.

The analysis presented in the response to RAI 12, as discussed above, used only Comanche Peak specific burnup profiles. The depletion calculations and spent fuel pool reactivity determinations were performed with consistent blanket enrichments. The analysis is thus applicable and conservative.

WCAP-16827-P, Addendum 1, Table 3-3 provides the axial enrichment, burnup, and temperature distributions used in the Addendum 1 analysis.

The conditions used in the RAI analysis are stated in the response to RAI 12 and repeated below for convenience:

Natural Blankets

A range of burnups from 25,000 MWd/MTU to 55,000 MWd/MTU was considered for both 4 and 5 w/o enrichment fuel with natural blankets. The maximum burnup was selected as 55,000 MWd/MTU because this is approximately the highest depletion reached by a fuel assembly with natural blankets at CPSES. Several significant conservatisms exist in these calculations.

The largest is the use of 1.0 w/o enrichment in the blankets instead of 0.72 w/o. The core operating conditions are also conservative. These depletions were performed assuming uprated core operating temperatures and power levels, as well as a constant soluble boron concentration of 1000 ppm. The average boron concentration for these older cycles was significantly lower, typically less than 700 ppm.

<u>2.0 w/o Blankets</u>

A series of depletion calculations were performed using these two axial burnup profiles to compare discharged assembly reactivity in the "4-out-of-4 with Axial Blankets" storage configuration to that predicted by the uniform burnup profile used in WCAP-16827. A range of burnups from 30,000 MWd/MTU to 51,000 MWd/MTU was considered for 4 w/o fuel and a burnup range of 30,000 MWd/MTU to 63,000 MWd/MTU was considered for 5 w/o fuel. These upper limits are rounded up from the limits documented in WCAP-16827. The depletion calculations were carried out using uprated core operating temperatures and power as well as a constant soluble boron concentration of 1000 ppm.

<u>2.6 w/o Blankets</u>

A series of depletion calculations were performed using these two axial burnup profiles to compare discharged assembly reactivity in the "4-out-of-4 with Axial Blankets" storage configuration to that predicted by the uniform burnup profile used in WCAP-16827. A range of burnups from 20,000 MWd/MTU to 55,000 MWd/MTU was considered for 4 w/o fuel and a burnup range of 20,000 MWd/MTU to 67,000 MWd/MTU was considered for 5 w/o fuel. These upper limits are discussed below. The depletion calculations were carried out using uprated core operating temperatures and power as well as a constant soluble boron concentration of 1000 ppm.

This information provides the details of the input parameters for both cases to demonstrate the differences in the analyses which lead to the different answers as well as the validity of the RAI response.

<u>**NRC Safety Evaluation (item 17):**</u>

On page 11, the NRC Safety Evaluation states:

> "However, the RAI responses determined that it was conservative to ignore the presence of Westinghouse Integral Fuel Burnable Absorbers (IFBAs) and Wet Annular Burnable Absorbers (WABAs). This conclusion is contradictory to that reached in NUREG/CR-6760, "Study of the Effect of Integral Burnable Absorbers for PWR Burnup Credit," dated March 2002 (Reference 15), and NUREG/CR-6761, "Parametric Study of the Effect of Burnable Poison Rods for PWR Burnup Credit," dated March 2002 (Reference 16), and other SFP licensing activities. Therefore, the NRC staff could not substantiate the basis for the licensee's conclusion."

Luminant Power Comment:

Several paragraphs of the response to RAI 15 are dedicated to describing the Comanche Peak specific justification for neglecting IFBA and WABA presence during depletion. The crux of the response is that depletion calculations modeling a constant cycle average boron concentration provide significant conservatism due to spectral hardening. This conservatism bounds depletion calculations modeling a realistic letdown curve with IFBA and WABA present in the fuel. The letdown curve used is provided in both tabular and graphical form, and a discussion is provided as to how it was generated and applied. The response to RAI 15 indicates that the average boron concentrations used range from 906 to 940 ppm. This value conservatively bounds the actual cycle average concentrations of 733 – 841 ppm provided in response to RAI 14.

The NUREG/CR-6760 and NUREG/CR-6761 analyses present limited case studies and are not applicable to Comanche Peak for several reasons: 1) incorrect fuel dimensions used in NUREG/CR-6760, 2) inappropriate IFBA loadings for the incorrect dimensions of the fuel, and 3) a non-conservative constant soluble boron concentration of 650 ppm used during depletion. The IFBA and WABA have a larger impact on the spectral hardening in the study because of this unrealistic, low boron concentration in the depletion calculations.

NRC Safety Evaluation (item 18):
On page 11, the NRC Safety Evaluation states:

> "The RAI response recalculates the 'enrichment uncertainty,' 'burnup measurement uncertainty,' and 'depletion uncertainty' assuming the presence of soluble boron in the SFP...
>
> - Other biases and uncertainties are not recalculated assuming the presence of soluble boron in the SFP. The NRC staff remains concerned about the effect that the large amount of soluble boron credited in the analysis will have on the temperature bias."

Luminant Power Comment:
We believe that the NRC staff misunderstood the information provided. All biases and uncertainties applicable to RAI 26 response were recalculated with soluble boron present, including the spent fuel pool temperature bias. The borated biases and uncertainties use the conservatively higher value from either 650 or 1600 ppm. These values were selected because they are near the soluble boron requirements reported in WCAP-16827. The response to RAI 26 states:

> "The biases and uncertainties considered in WCAP-16827-P were recalculated with soluble boron concentrations of approximately 650 ppm and 1600 ppm present to represent the concentrations necessary to maintain the appropriate margin to criticality for normal operation and accident scenarios. The limiting biases and uncertainties from the two borated scenarios were selected and appropriately combined to determine an enrichment-dependent, borated target k_{eff} for each unique configuration."

NRC Safety Evaluation (item 19):
On page 12, the NRC Safety Evaluation states:

> "There is insufficient information on what assumptions and input parameters were used in this portion of the analysis. If non-conservative core operating parameters were used in the depletion, then the 'depletion uncertainty' would be non-conservative. If non-conservative axial burnup profiles were used in the analysis, then the 'depletion uncertainty' would be non-conservative."

Luminant Power Comment:
The depletion uncertainty, as explained in the response to item 6, is independent of operating parameters and burnup profiles. The information provided was, therefore, sufficient to form the basis of an evaluation. The presence of soluble boron reduces the depletion uncertainty. The overall sum of biases and uncertainties will also be reduced because the depletion uncertainty is the largest contributor.

<u>NRC Safety Evaluation (item 20):</u>
On page 12, the NRC Safety Evaluation states:

> "As identified in the supplement (Reference 3) and the response to RAI #18 (Reference 5), there is a potential non-conservatism for neglecting fuel assembly grids when crediting soluble boron. This potential non-conservatism is not addressed in the licensee's soluble boron crediting analysis."

Luminant Power Comment:
The response to RAI 18 explicitly provides a conservative justification that the potential non-conservatism of neglecting grids has no impact on the conclusion of meeting 10 CFR 50.68 requirements. That justification is:

> "Assumptions for fresh 1.02 w/o 235U fuel are potentially non-conservative in that neglecting the grids can result in a less reactive assembly model than when grids are taken into account. However, potential non-conservatisms are overwhelmed by the first order effect of soluble boron lowering reactivity. In order to prove that fresh fuel still meets the requirements of 10CFR50.68, a very conservative determination of absolute reactivity will be made to show that keff is less than the 0.95 requirement. First, the sum of biases and uncertainties are increased by more than 20% to account for the presence of soluble boron. Both recent (Reference 5) and historical (Reference 6) evaluations have shown that soluble boron does not have a large positive impact on the sum of biases and uncertainties, so this assumption is extremely conservative. Second, the worst potential non-conservatism caused by neglecting grids reported in WCAP-16827-P, Addendum 1 is doubled. The boron concentration for this largest potential non-conservatism is 1800 ppm. These two terms can be added to the highest keff with identified potential non-conservatism, as shown below in Equation 1. This occurs at 200 ppm of soluble boron, and the corresponding keff is 0.90862 for fresh 1.02 w/o fuel. This results in a conservative estimate of keff equal to 0.94186. This result still satisfies the required limit of 0.95.
>
> $$k_{eff}^{cons} = k_{calc} + \Delta k_{B\&U} + \Delta k_{grids}$$
>
> Where:
> k_{eff}^{cons} is a conservative estimate of the absolute reactivity k_{calc} is the KENO calculated k_{eff} equal to 0.90862
> **$\Delta k_{B\&U}$ is the conservatively increased sum of biases and uncertainties, equal to 0.03 Δk_{eff}**
> Δk_{grids} is the conservatively doubled magnitude of potential non-conservatism caused by not modeling grids, equal to 0.00324"

Note 1: As demonstrated in the response to RAI 26, the sum of biases and uncertainties was 0.02890 Δk_{eff}, which is lower than the conservative estimate provided. This lowers the conservative estimate of k_{eff} to 0.94076.

Note 2: References 5 and 6 from the preceding quote are defined here. Reference 5 is the response for the Point Beach acceptance review questions (ML082630114, dated September 2008) which explicitly calculated borated biases and uncertainties. Reference 6 is part of the current licensing basis for Comanche Peak (ML003760081, dated April 2000) which presents the impact of boron concentration on mechanical uncertainties.

NRC Safety Evaluation (item 21):
On page 13, the NRC Safety Evaluation states:

> "The acceptance criteria used in the submittal compares the keff of the interface model, which includes radial leakage, with a storage configuration Target keff, which does not include radial leakage. This appears to prejudice the comparison in favor of the interface model, as it would be expected to have a lower keff than a model without axial leakage."

Luminant Power Comment:
The evaluations are performed in a model of all of Region II of the spent fuel pool for a single unit. As such, any credited radial leakage exists in the actual spent fuel pool. The effect of the radial leakage on the interface condition is insignificant more than one row in from the edges of the rack modules near the SFP walls. The use of infinite array models to determine the burnup limits provides a conservative reactivity determination by neglecting all radial leakage. The use of these models to determine biases and uncertainties is also conservative by maximizing the impact of each condition being considered. Fuel which meets these conservative limits in the infinite array models will inherently meet the reactivity requirements in the real, finite pool. The interface models therefore credit the actual state of the fuel.

Since the submittal of WCAP 16827-P (August of 2007), no further information has been requested with regards to the adequacy of the interface conditions. Additional information justifying the applicability of the models can be provided if necessary for the NRC staff review. This also applies to items 22 through 26 below.

NRC Safety Evaluation (item 22):
On page 13, the NRC Safety Evaluation states:

> "The acceptance criteria of using the largest Target keff of the two storage configuration sub-configurations used in the model also appears to prejudice the comparison in favor of the interface model. NUREG/CR-6683, "A Critical Review of the Practice of Equating the Reactivity of Spent Fuel to Fresh Fuel in Burnup Credit Criticality Safety Analyses for PWR Spent Fuel Pool Storage," dated September 2000 (Reference 17), indicates that the reactivity of the most reactive storage configuration will be reduced by the less reactive storage configuration, while the reactivity of the less reactive storage configuration will be increased. Therefore, the comparison should be with the less reactive storage sub-configuration. "

Luminant Power Comment:
The interface rows of the two configurations are tightly controlled, as specified in Section 4.5.1 of WCAP-16827-P. These conditions are required to meet the requirements of TS 3.7.17 requiring that all possible 2 by 2 matrices containing Region II cells meet the minimum requirements in the specification. The controls create a region comprised of the first row of each configuration that is less reactive, by inspection, than either of the two configurations being interfaced.

Considering the interface between the "3-out-of-4" and "4-out-of-4" storage configurations is illustrative. The empty cell from the "3-out-of-4" configuration is required to be in the interface row. This means that each 2 by 2 matrix that straddles the interface is in effect a "3-out-of-4" matrix. Two of the three assemblies, however, meet the burnup requirement for the "4-out-of-4" configuration and are considerably less reactive than the requirement to be allowed in the "3-out-of-4" configuration. It is thus physically impossible for the interface configuration to have higher reactivity than the complete configuration on either side of it. The figure given below graphically depicts this by showing the minimum assembly burnups allowed in the interface. The configuration created at the interface rows is highlighted.

48156		48156		79019	79019	79019
48156	48156	48156	48156	79019	79019	79019

The computational result cannot be lower than the lower target k_{eff} of the two configurations being considered in a particular case. This is because portions of that configuration separated from the interface rows will be neutronically indistinguishable from an infinite array of that configuration. No mechanism exists to further suppress reactivity in the computational model. Therefore, the comparison is with the more reactive storage configuration.

<u>NRC Safety Evaluation (item 23):</u>
On page 13, the NRC Safety Evaluation states:

> "The two sub-configurations used in the interface model are not justified sufficiently, as to whether or not they create bounding conditions. In keeping with NUREG/CR-6683, the bounding cases would likely involve the maximum Target keff sub-configuration from one storage configuration and the minimum Target keff sub-configuration from a different storage configuration."

Luminant Power Comment:
All configurations considered in the License Amendment Request have the same absolute reactivity when accounting for all applicable biases and uncertainties. There is, therefore, no large mismatch in reactivities of adjacent configurations in the analysis. Furthermore, because fresh fuel is never used to represent depleted fuel, the concern of using isotopics at conditions that are not applicable is eliminated.

<u>NRC Safety Evaluation (item 24):</u>
On page 13, the NRC Safety Evaluation states:

> "There is insufficient information that indicates whether or not other modeling changes exist that would prejudice the comparison in favor of the interface model (i.e., it is not stated which storage configuration is in the one module and which is in eight), and it is not stated whether or not intra-module spacing is included."

Luminant Power Comment:
The results of the calculation may be slightly impacted by the relative positions of the configurations being evaluated. The conclusions are still valid, however, as long as the interface requirements are satisfied. The information that is relevant to evaluation of the configuration interfaces is provided in the description of the full pool model in Section 4.5 of WCAP-16827.

Evaluation of interface configurations were all performed using a full pool model, which is described in Section 4.5 of WCAP-16827. Intra-module separation distances are also addressed in this section:

> "The rack modules are conservatively positioned such that the outer faces are touching. This is a conservative assumption relative to the minimum intra-module separation distances specified in Reference 14. The racks are separated from the spent fuel pool walls by the minimum distance. The overall pool dimensions are determined by maintaining these minimum required separations."

NRC Safety Evaluation (item 25):
On page 13, the NRC Safety Evaluation states:

> "The interface issue does not appear to have been reexamined with the revised burnup/enrichment combinations and Target keff values from the responses to other RAIs."

Luminant Power Comment:
The changes to target k_{eff} values made as a result of RAI responses impact only depleted conditions. The fresh target k_{eff} values therefore have not changed and remain applicable. Furthermore, the increased burnup limits precisely offset any reduction in target k_{eff} identified for depleted conditions. This ensures that the depleted fuel maintains the margin identified in WCAP-16827 in the interface models.

NRC Safety Evaluation (item 26):
On page 13, the NRC Safety Evaluation states:

> "The introduction of sub-configurations within a storage configuration also introduces the interface question within a storage configuration."

Luminant Power Comment:
No storage configuration submitted in this License Amendment Request has any unique "sub-configurations." Each storage configuration is a 2x2 array, and therefore cannot be further divided into sub-configurations. The larger arrays used in the configuration-to-configuration analysis support the concept that the interface restrictions used provide reactivity control in the real pool. Concerns related to fresh fuel equivalencing have been addressed above in noting that the specific target k_{eff} values are determined for the conditions of fresh fuel present. The intentional lowering of reactivity at the interface will also preclude one configuration from driving up reactivity in a neighboring configuration.

Submittals related to this license amendment request:

M. Blevins, Luminant Power, to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, License Amendment Request (LAR) 07-004, Revision to the Operating License and Technical Specification 1.0, "Use and Application" and 3.7.17, "Spent Fuel Assembly Storage" to Revise Rated Thermal Power from 3458 MWT to 3612 MWT," dated August 28, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML072490131).

Contained original analysis report, WCAP-16827

M. Blevins, Luminant Power, to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, Supplement to License Amendment Request (LAR) 07-004, Revision to the Technical Specifications for Spent Fuel Pool Criticality (TAC Nos. MD8417 and MD8418)," TXX-08087, dated June 30, 2008 (ADAMS Accession No. ML082610284).

Contained Addendum 1 to WCAP-16827

M. Blevins, Luminant Power, to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, Response to Request for Additional Information Regarding Spent Fuel Pool Criticality License Amendment Request (TAC Nos. MD8417 and MD8418)," TXX-08148, dated December 11, 2008 (ADAMS Accession No. ML083570151).

Contained responses to RAIs 1, 3, 6, 7, 8, 9, 11, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 27, 29, 30, 31, and 32

M. Blevins, Luminant Power, to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, Response to Request for Additional Information Regarding Spent Fuel Pool Criticality License Amendment Request (TAC Nos. MD8417 and MD8418)," TXX-09001, dated January 22, 2009 (ADAMS Accession No. ML090700442).

Contained responses to RAIs 10, 12, 17, and 28

M. Blevins, Luminant Power, to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, "Response to Request for Additional Information Regarding Spent Fuel Pool Criticality License Amendment Request (TAC Nos. MD8417 and MD8418)," TXX-09032, dated February 17, 2009 (ADAMS Accession No. ML090630241).

Contained response to RAI 26

NOTE: RAIs 2, 4, and 5 were deleted in the original NRC request for additional information issued to Comanche Peak on November 19, 2009.