UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 19, 2008

Mr. M. R. Blevins
Executive Vice President
& Chief Nuclear Officer
Luminant Generation Company LLC
ATTN: Regulatory Affairs
P. O. Box 1002
Glen Rose, TX 76043

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION REGARDING SPENT FUEL POOL CRITICALITY LICENSE AMENDMENT REQUEST (TAC NOS. MD8417 AND MD8418)

Dear Mr. Blevins:

By letter dated August 28, 2007, and supplemented by letter dated June 30, 2008, Luminant Generation Company LLC (the licensee) requested changes to the Technical Specifications for the Comanche Peak Steam Electric Station, Units 1 and 2, spent fuel pool (SFP) storage requirements. On April 24, 2008, the licensee and the U.S. Nuclear Regulatory Commission (NRC) staff held a teleconference discussing the items to be covered in the supplement.

The NRC staff has reviewed the information provided in the application and determined that additional information is needed in order to complete the evaluation. This request for additional information (RAI) was discussed with the licensee on November 13, 2008. Based on discussions with Jimmy Seawright on November 28, 2008, it was agreed that responses to all the RAI questions, except for questions 10, 12, 17, 26, and 28 will be provided by December 12, 2008. Responses to RAI questions 10, 12, 17, 26, and 28 will be provided by January 16, 2009.

If you have any questions, please contact me at 301-415-3016.

Sincerely,

Balwant K. Singal

Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-445 and 50-446

Enclosure:
As stated

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REQUEST FOR ADDITIONAL INFORMATION REGARDING

LUMINANT GENERATION COMPANY LLC

LICENSE AMENDMENT REQUEST

TO REVISE SPENT FUEL STORAGE CONFIGURATIONS

COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2

DOCKET NOS. 50-445 AND 50-446

BACKGROUND

By letter dated August 28, 2007 (Reference 1), Luminant Generation Company LLC (the licensee) requested changes to the Technical Specifications (TSs) for the Comanche Peak Steam Electric Station (CPSES), Units 1 and 2 spent fuel pool (SFP) storage requirements. On April 24, 2008, the licensee and the U.S. Nuclear Regulatory Commission (NRC) staff held a teleconference to discuss the items to be covered in the supplement. The licensee provided the supplemental information by letter dated June 30, 2008 (Reference 2).

Currently, fresh fuel with a maximum 5.0 weight percent (w/o) enrichment may be stored without restriction, with respect to criticality, in the Region I portion of the SFP. That will not change with this license amendment request (LAR). This LAR would modify the CPSES, Units 1 and 2 SFP storage requirements in the Region II portion of the SFP. Currently, fresh and depleted fuel assemblies storage is restricted in Region II. Those restrictions are identified in Figures 3.7.17-1 through 3.7.17-4 in TS 3.7.17, "Spent Fuel Assembly Storage." This LAR would modify the existing figures in TS 3.7.17 and add two new figures.

The technical justification for the request is provided in WCAP-16827-P, Enclosure 3 of Reference 1, and WCAP-16827-P, Addendum 1, Enclosure 1 of Reference 2. The technical justification includes analyses of nine different 2x2 SFP storage cell arrays identified as "storage configurations: '4-out-of-4,' '4-out-of-4 with Axial Blankets,' '4-out-of-4 with 1 RCCA,' '4-out-of-4 with 2 RCCAs,' '4-out-of-4 with 2 RackSavers and Axial Blankets,' '4-out-of-4 with 3 RackSavers and Axial Blankets,' '3-out-of-4,' '3-out-of-4 with Axial Blankets,' and '2-out-of-4.'"" However, the CPSES, Units 1 and 2 proposed TS (Attachments 4, 5, 6, and 7 of Reference 1) only include the "4-out-of-4," "4-out-of-4 with Axial Blankets," "3-out-of-4," "3-out-of-4 with Axial Blankets," and "3-out-of-4" storage configurations. The TS contain an additional storage configuration "1-out-of-4" which is not addressed in either WCAP-16827-P or WCAP-16827-P, Addendum 1. The CPSES, Units 1 and 2 LAR does not include the storage configurations crediting rod cluster control assemblies (RCCAs) or RackSavers in the proposed TS. Therefore, the staff's review only considers the storage configurations that are currently in the CPSES, Units 1 and 2 TS or those being proposed as changes to the CPSES, Units 1 and 2 TS: "4-out-of-4," "4-out-of-4 with Axial Blankets," "3-out-of-4," "3-out-of-4 with Axial Blankets," "2-out-of-4," and "1-out-of-4" storage configurations.

REGULATORY BASES

General Design Criterion 62, "Prevention of criticality in fuel storage and handling," in Title 10 of the *Code of Federal Regulations* (10 CFR), Appendix A to Part 50 requires:

> Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations.

10 CFR 50.68(b)(1) requires:

> Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water.

10 CFR 50.68(b)(4) requires:

> If no credit for soluble boron is taken, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water. If credit is taken for soluble boron, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water.

10 CFR 50.36(c)(4), "Design feature," requires:

> Design features to be included are those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered in categories described in paragraphs (c) (1), (2), and (3) of this section.

REQUEST FOR ADDITIONAL INFORMATION

The NRC staff requests responses to the following questions in order to continue its review of the CPSES, Units 1 and 2 SFP LAR:

1. The current CPSES, Units 1 and 2 TS 4.3.1.1 requires "keff < 1.0 when fully flooded with unborated water which includes an allowance for uncertainties as described in Section 4.3 of the FSAR [Final Safety Analysis Report]" and "keff ≤ 0.95 if fully flooded with water borated to 800 ppm [parts per million], which includes an allowance for uncertainties as described in Section 4.3 of the FSAR." It appears that the proposed change to TS 3.7.17 (Reference 1) would create a technical discrepancy with TS 4.3.1. Please provide clarification and the revised TS pages to ensure that there is no discrepancy, if you agree.

2. Deleted.

3. The proposed change to TS 3.7.17 and WCAP-16828-P does not appear to uniquely consider the "4-out-of-4 with Axial Blankets" and "3-out-of-4 with Axial Blankets" storage configurations in the interface portion of the analysis. The analysis appears to assume that they are identical to the "4-out-of-4" and "3-out-of-4" storage configurations. Yet the reactivity at the interface of these storage configurations will be different than the "4-out-of-4" and "3-out-of-4" interface with the storage configurations. What is the reactivity effect of explicitly modeling the "4-out-of-4 with Axial Blankets" and "3-out-of-4 with Axial Blankets" storage configurations in interface situations?

4. Deleted.

5. Deleted.

6. Several of the figures in the proposed change to TS 3.7.17 (Reference 1) indicate a burnup well in excess of the current maximum licensed burnup. It appears that for some of the figures in the proposed change to TS 3.7.17, simulations with a burnup in excess of the current maximum licensed burnup were used to derive the figure (even though the figure itself does not indicate a burnup in excess of the current maximum licensed burnup). Please explain the following:

   a. The reason for its acceptability.

   b. The basis and justification for using the computer codes well in excess of the current maximum licensed burnup.

7. The current TS Figure 3.7.17-1 indicates that a 5.0 w/o enriched fuel assembly with zero Pu^{241} decay time requires approximately 63 gigawatt days per metric ton unit (GWD/MTU) of burnup to be stored in a "4-out-of-4" storage configuration in Region II. The proposed TS Figure 3.7.17-1 indicates that a 5.0 w/o enriched fuel assembly with zero Pu^{241} decay time requires approximately 76 GWD/MTU of burnup to be stored in a "4-out-of-4" storage configuration in Region II. Please explain the reason for this large difference.

8. The current and proposed TS figures for the "3-out-of-4" storage configuration in Region II show an increase in required burnup. Please explain the reason for this large difference.

9. The current and proposed TS figures for the "2-out-of-4" storage configuration in Region II show a significant decrease in required burnup. Please explain what has changed to warrant this large difference.

10. The axial burnup profile used in WCAP-16827-P is indicated by NUREG/CR-6801 (Reference 4) to be non-conservative for burnups below 46 GWD/MTU, while WCAP-16827-P used this profile exclusively for any case involving a distributed axial burnup profile. Therefore, every case involving a distributed axial burnup profile at a burnup below 46 GWD/MTU is potentially

non-conservative. NUREG/CR-6801 is generic, considering the axial burnup profiles for several fuel design types, therefore opening the potential for a more specific analysis to show acceptable results. The licensee and its vendor attempted to do that in WCAP-16827, Addendum 1. However, the staff finds that analysis insufficient for the following reasons:

a. WCAP-16827, Addendum 1 states, "The reactivity effects due to axial burnup profile for burnups less than 46 GWd/MTU are only applicable at low enrichments, since higher enrichments require greater than 46 GWd/MTU of burnup for acceptable storage. Therefore, fuel assemblies of 2.4 w/o ^{235}U enrichment are investigated to determine the reactivity effects of a limiting burnup profile." However, not a single 3.0 w/o ^{235}U burnup credited in WCAP-16827-P equals or exceeds 46 GWD/MTU. Most 4.0 w/o ^{235}U burnup levels credited in WCAP-16827-P do not equal or exceed 46 GWD/MTU. Additionally, a large number of the simulations performed to determine the amount of burnup to be credited for the 4.0 w/o ^{235}U and 5.0 w/o ^{235}U enrichment levels were performed at burnups below 46 GWD/MTU.

b. WCAP-16827, Addendum 1 states, "To properly justify the conservatism of the axial burnup profile [...]^{a,c} considered in the original (Reference 1 [of WCAP-16827, Addendum 1]) analysis, a thorough analysis of axial burnup profiles from the database of Reference 8 [of WCAP-16827, Addendum 1] is conducted. The database of Reference 8 [of WCAP-16827, Addendum 1] contains thousands of axial burnup profiles from several reactors, and reactor types, around the world. Since the lattice design, and the reactor type in which it is irradiated, influences the axial burnup profile of fuel assemblies, only axial burnup profiles from Westinghouse 17x17 fuel assemblies, identical to that utilized at Comanche Peak Units 1 and 2, are considered in this investigation. Furthermore, only the limiting axial burnup profiles from this assembly design are considered. The limiting axial burnup profile is chosen based on the relative burnup of the top two nodes. Fuel assemblies from the database are audited, and the assembly with the minimum relative burnup in the top two nodes is chosen to represent the limiting axial burnup profile for a given burnup range." Mere comparison of the relative burnup in the top two nodes is not how the limiting profile was determined in DOE/RW-0472 (Reference 5) or NUREG/CR-6801; therefore, the NRC staff is unsure how this method adequately determines the limiting profile from the limited Westinghouse 17x17 population of profiles used at each burnup increment. NUREG/CR-6801, Appendix A, Axial Discretization and Boundary Conditions, indicates that more than the top two nodes are important for determining the "end effect." Additionally, NUREG/CR-6801 states, "...that often a very small secondary peak is observed at the other end of the fuel rod, due to the reduced burnup at that end as well." To put "very small" in context, NUREG/CR-6801 considers 0.005 Δkeff to be small. Since WCAP-16827-P reserves an analytical margin of 0.005 Δkeff, in this context, a "very small" impact is worth determining.

Therefore, the staff finds this method for determining the limiting profile to be insufficient.

c. WCAP-16827, Addendum 1 states, "The limiting fuel representations described above are simulated at 2.4 w/o ^{235}U in the "4-out-of-4" storage configuration model from Reference 1. As storage configurations with fewer assemblies or reactivity-suppressing materials will exhibit a dampening effect on any reactivity differences due to axial burnup profiles, this storage configuration is chosen to bound reactivity effects for all configurations." While the "4-out-of-4" storage configuration may be bounding with respect to the other storage configurations, that does not mean the result for those storage configurations will be zero. It appears that WCAP-16827, Addendum 1 has not determined the effect on those storage configurations.

d. In the simulations of 2.4 w/o ^{235}U in the "4-out-of-4" storage configuration, WCAP-16827, Addendum 1 selects "limiting" Westinghouse 17x17 axial burnup profiles from the database used in the DOE Topical Report (Reference 5) and NUREG/CR-6801. However, when only the Westinghouse 17x17 axial burnup profiles are considered, the population is significantly reduced. Additionally, there is no evidence to support the idea that these are or were limiting Westinghouse 17x17 axial burnup profiles. Also, there is no CPSES, Units 1 and 2 site-specific justification for using the selected profiles. Therefore, the staff believes there is currently insufficient information to conclude that the profiles used in the simulations are limiting.

e. The simulations of 2.4 w/o ^{235}U in the "4-out-of-4" storage configuration in WCAP-16827, Addendum 1 are represented in Figure 3-5. Figure 3-5 shows increasing non-conservatism with decreasing burnup. However, the simulations only go down to a burnup of 30 GWD/MTU while the 2.0 w/o ^{235}U burnup credited in the "4-out-of-4" storage configuration goes down to 18 GWD/MTU and the simulations used to determine that credit go down to 15 GWD/MTU. This indicates that the WCAP-16827-P, Addendum 1 stated "...maximum reactivity increase observed..." is probably not the maximum reactivity increase.

f. WCAP-16827, Addendum 1 espouses applying the reactivity increase from the simulations as an uncertainty to 2.0 w/o ^{235}U total Uncertainty and Bias. However, the staff does not believe the manner in which the axial burnup profile is used warrants it being treated as an uncertainty.

Therefore, the staff requests the licensee determine the effect of using appropriate axial burnup profiles and that the burnup/enrichment loading curves be adjusted accordingly.

11. WCAP-16827-P uses four nodes to represent the axial burnup profile in most storage configurations. The storage configurations that contain an RCCA are

modeled with seven nodes. Note this review does not consider the storage configurations with RCCAs, as they are not part of the licensee's request. NUREG/CR-6801 does not specify the number of nodes to be used, but indicates 10 is too few and more than 18 is not necessary. However, NUREG/CR-6801 uses nodes of uniform size whereas WCAP-16827-P uses three small nodes to represent the top of the fuel assembly and one large node to represent the rest. During the April 24, 2008, teleconference, the licensee indicated the supplement would provide information to justify the four-node model. WCAP-16827, Addendum 1 does contain a discussion on nodalization, however, it is uncertain how this discussion justifies the four-node model. Therefore, the staff requests the following information.

a. WCAP-16827, Addendum 1, Figures 3-10 through 3-18 appear to be comparisons of CPSES, Units 1 and 2 core simulator axial burnup profiles and a WCAP-16827-P profile. Please explain the background behind the core simulator axial burnup profiles. Please also explain why they are appropriate for comparison and what they represent.

b. Please explain why the figures in WCAP-16827, Addendum 1, while attempting to justify the four-node model, are actually compared to a seven-node model.

c. Please explain how the comparisons in those figures show that the four-node model is able to model the reactivity with sufficient precision and how this comparison would change with different axial burnup profiles.

The staff requests the licensee provide quantitative evidence that the four-zone nodalization adequately captures the "end effect" vis-à-vis a more detailed nodalization.

12. WCAP-16827-P uses a uniform burnup profile to model fuel assemblies with axially blanketed fuel. With respect to representing the burnup profile of an assembly with axial blankets, the staff is unaware of any generic analysis that would support definitive conclusions. NUREG/CR-6801 does state in its conclusion that, "...the axial blankets have significantly lower enrichment than the central region, the end effect for assemblies with axial blankets is typically very small or negative. Furthermore, the lower the initial enrichment of the axial blankets is with respect to the higher enrichment central region, the lower is the end effect." To put "very small" in context, NUREG/CR-6801 considers 0.005 Δkeff to be small. Since WCAP-16827-P reserves an analytical margin of 0.005 Δkeff, in this context a "very small" impact is worth determining. WCAP-16827, Addendum 1 provides some information about this item. WCAP-16827, Addendum 1 provides a comparison between a uniform profile and a limiting axial profile selected from profiles of actual blanketed fuel assemblies from recent CPSES, Units 1 and 2 cores. However, the staff finds that analysis insufficient for the following reasons:

a. The criteria for selecting the "limiting axial profile" was based on the relative burnup in the top two nodes, the same as was described in question 10b. The staff has the same concerns regarding this method for selecting the limiting axial profile in this instance as discussed in question 10b. Additionally, since the top zone is an axial blanket, the presence of axial blankets would seem to make it less likely that using the top two zones as the criteria would identify the limiting profile.

b. WCAP-16827, Addendum 1 states, "...the representation is most conservative at 35 GWd/MTU, reaching a maximum reactivity difference of 1893 ± 41 percent millirho (pcm) Δkeff (1 pcm = 10-5). The least conservative time of life is at 60 GWd/MTU when the reactivity difference is 361 ± 39 pcm Δkeff." The comparison is provided in Figure 3-19. Figure 3-19 shows the "least conservative time of life" to be a negative difference, which is a non-conservative rather than a less conservative resultant. Figure 3-19 also indicates the non-conservatism becomes larger with increasing burnup. Since the "4-out-of-4 with Axial Blankets" storage configuration credits 62,662 megawatt days per metric ton unit (MWD/MTU) of burnup for 5.0 w/o enriched U^{235} with zero Pu^{241} decay time, this point is non-conservative by an amount that is reasonably expected to exceed the WCAP-16827-P reserved analytical margin of 0.005 Δkeff. Therefore, the "4-out-of-4 with Axial Blankets" storage configuration does not appear to meet the requirements of 10 CFR 50.68 based on this consideration alone. Additionally, as that point is used to determine a second order polynomial for controlling the burnup/enrichment loading curve for the "4-out-of-4 with Axial Blankets" storage configuration for zero Pu^{241} decay time, that equation is non-conservative by some amount. As other simulations in the "4-out-of-4 with Axial Blankets" storage configuration determinations use burnup levels at or above 60 GWD/MTU, those are also non-conservative by some amount.

c. While the above discussion utilizes information provided by the licensee, given the way an axially blanketed fuel assembly is modeled in WCAP-16827-P, the manner in which the distributed profile is determined in WCAP-16827-P, Addendum 1, and the lack of information as to whether or not a single distributed profile was used for all burnup levels, the staff is uncertain as whether or not the depiction in WCAP-16827, Addendum 1 Figure 3-19 accurately represents the margin (positive or negative), associated with modeling an axially blanketed fuel assembly with a uniform profile.

d. Other than indicating the comparison was made using a uniform axially distributed profile in the "4-out-of-4 with Axial Blankets" storage configuration, virtually no information was provided concerning the simulations performed to make the comparison. (The staff believes that the indication in WCAP-16827-P, Addendum 1 that its simulations were made with the "4-out-of-4" storage configuration instead of the "4-out-of-4 with Axial Blankets" storage configuration is a typographical error.)

e. By comparing WCAP-16827-P, Table 4-18 and WCAP-16827, Addendum 1 Figure 3-19, the staff believes the comparison in WCAP-16827, Addendum 1 is made using 5.0 w/o enriched fuel assemblies.

(i) Given that as the case, there appears to be an unexplained 1500 pcm Δkeff difference between the U^{235} 5.0 w/o enriched with 60 GWD/MTU burnup values in WCAP-16827-P Table 4-18 and WCAP-16827, Addendum 1 Figure 3-19. The difference is such that if the WCAP-16827-P Table 4-18 value were used, the amount of non-conservatism at 60 GWD/MTU burnup would be approximately 1900 pcm rather than the 361 pcm indicated by WCAP-16827-P, Addendum 1.

(ii) Since the dampening effect on the "end effect" caused by the presence of axial blankets is believed to decrease as the delta between the nominal enrichment and the blanket enrichment decreases, comparisons similar to those performed in WCAP-16827, Addendum 1 should show lower peaks and earlier transition to negative margin for lower enrichments. Therefore, the lower enrichments credited in the "4-out-of-4 with Axial Blankets" storage configuration may also have significant non-conservatisms.

f. While the "4-out-of-4" storage configuration may be bounding with respect to the other storage configurations, that does not mean the result for those storage configurations will be zero. It appears that WCAP-16827, Addendum 1 made no effort to determine the effect on those storage configurations.

Therefore, the staff requests the licensee determine the effect of using appropriate axial burnup profiles and that the burnup/enrichment loading curves be adjusted accordingly.

13. WCAP-16827-P characterized the core operating parameters it used as "...conservative temperature profiles for Comanche Peak Units 1 and 2 at uprated conditions. The use of uprated conditions for depletion calculations – with increased power, moderator temperatures and fuel temperatures – lead to increased reactivity determinations at any given burnup relative to fuel irradiated in the core prior to the uprate. The fuel temperatures for each axial zone are calculated based on a representative fuel temperature correlation while the moderator temperatures are based on a linear relationship with axial position." The staff finds this analysis insufficient for the following reasons:

a. When the staff compared the core exit temperature used in WCAP-16827-P with the core exit temperature information contained in the CPSES, Units 1 and 2 stretch power uprate (SPU) information in WCAP-16840-P Table 2.8.3-1 (Enclosure 1 to Reference 1), it appears that WCAP-16827-P was using the nominal post-SPU core exit temperature rather than a conservative post-SPU core exit temperature. A conservative temperature profile would require the use of the maximum core exit temperature as indicated by NUREG/CR-6665, "Review and Prioritization of Technical Issues Related to Burnup Credit for LWR Fuel," (Reference 7). While WCAP-16840-P Table 2.8.3-1 indicates the post-SPU nominal core exit temperature exceeds the pre-SPU nominal core exit temperature, there is no indication that the post-SPU nominal temperature exceeds the pre-SPU maximum core exit temperature. During the April 24, 2008, teleconference, the staff stated that use of the nominal post-SPU core exit temperature was not considered conservative. WCAP-16827, Addendum 1 contains a section on core depletion. However, the new information provided is not significantly different from the information in WCAP-16827-P. NUREG/CR-6665 estimates the reactivity effect of the depletion moderator temperature to be 90 pcm/degree Kelvin. A 10 degrees Fahrenheit (°F) difference between the nominal core exit temperature and maximum core exit temperature is likely to result in an approximate increase in keff of 0.0045, essentially enough to eliminate the 0.005 Δkeff analytical margin reserved in WCAP-16827-P. Therefore, the staff finds the potential magnitude of the non-conservatism to be such that it would preclude a reasonable assurance conclusion that the licensee meets the regulatory requirements in 10 CFR 50.68.

b. The use of the uprated power is not conservative with respect to pre-uprate assemblies. According to NUREG/CR-6665, "Calculations with both actinide and fission product credit show a trend for conservative prediction of fuel reactivity worth when fuel is burned at lower specific power for a longer period of time for a given burnup. The magnitude of the conservatism increases with increasing burnup." Therefore, the use of the higher specific power associated with the uprate would be non-conservative with respect to the effect power history has on the assembly's final reactivity. Therefore, the staff requests the licensee determine the effect of using appropriate power, moderator/fuel temperature on all storage configurations, and that the burnup/enrichment loading curves be adjusted accordingly.

14. What are the CPSES, Units 1 and 2 cycle-average soluble boron concentrations?

15. In addition to power, moderator/fuel temperature, and soluble boron concentration, the licensee is also requested to address the other core depletion parameters indicated in NUREG/CR-6665.

16. WCAP-16827-P states, "The design parameters of the Westinghouse and Siemens 17x17 STD and OFA fuel assembly types are summarized in Table 3-5. Illustrations of these designs are contained in Figure 3-4 and Figure 3-5. Simulations are performed for each storage configuration in this analysis to determine the fuel assembly combinations that produce the highest reactivity." Please clarify if the determination was made before or after all biases and uncertainties were applied.

17. In the August 19, 2008, L. Kopp memorandum (Reference 8), the NRC staff provided guidance for determining the burnup uncertainty: "A reactivity uncertainty due to uncertainty in the fuel depletion calculations should be developed and combined with other calculational uncertainties. In the absence of any other determination of the depletion uncertainty, an uncertainty equal to 5 percent of the reactivity decrement to the burnup of interest is an acceptable assumption." The 5 percent reactivity decrement has been used throughout the industry since the issuance of the Kopp memorandum. Rather than use the 5 percent reactivity decrement as the burnup uncertainty, the WCAP-16827-P analysis used a 5 percent decrease in the burnup of interest. In actuality, the methodology performs a simulation at three different burnup levels and fits that data with a second order polynomial. The methodology then takes the derivative of that polynomial to find the equation for the line tangent to the curve at the point of the burnup being credited and then uses that equation to find a Δkeff from a Δburnup. The Δburnup is set equal to 5 percent of the burnup being credited. This Δkeff is then applied as the Burnup Uncertainty. The staff found this methodology unacceptable for the February 5, 2006, Prairie Island SFP criticality amendment (Reference 9) and the March 27, 2008, Beaver Valley criticality amendment (Reference 10). During the April 24, 2008, teleconference, the staff indicated to the licensee that use of this methodology for calculating the Burnup Uncertainty had been previously rejected by the staff. The licensee's vendor indicated that they had additional information that had not yet been supplied to the staff and the new information would allow the staff to accept the alternative methodology. The staff informed the licensee that approval of the new information supporting the alternate methodology would be precedent setting and take additional time. Despite the assurances that new information would be provided in the supplement, the information concerning the Burnup Uncertainty in WCAP-16827, Addendum 1 is virtually identical to the information the vendor provided for the Beaver Valley criticality amendment. The staff finds this information to be insufficient. Therefore, the staff requests the licensee provide a revised analysis that determines and applies the Burnup Uncertainty in accordance with staff guidance. Since the CPSES, Units 1 and 2 analysis credits such large amounts of burnup, the staff does not believe there is sufficient analytical margin to accommodate the increase in Burnup Uncertainty. Therefore, the staff requests the burnup/enrichment loading curves be adjusted accordingly.

18. WCAP-16827-P makes an assumption not to model the fuel assembly spacer grids stating, "No credit is taken for spacer grids or spacer sleeves." The staff requested the licensee to justify that this assumption remained conservative in

modern analysis during April 24, 2008, teleconference. The licensee agreed that the supplement would contain to justify this information. WCAP-16827, Addendum 1 provides information for two scenarios in the "4-out-of-4" storage configuration. One is for very low enriched fuel with no burnup (1.02 w/o ^{235}U with 0 burnup), both with and without grids. The other is maximum enrichment with very high burnup (5.0 w/o ^{235}U with 75 GWD/MTU burnup), both with and without grids. WCAP-16827, Addendum 1 claims these scenarios are bounding for all other storage configurations and burnup/enrichment combinations. With regard to this analysis, the staff requests the following additional information:

a. Provide additional details regarding the parameters used in the simulations that were performed.

b. The staff has noted a difference between the zero soluble boron starting point on WCAP-16827, Addendum 1 Figure 3-7 for the 5.0 w/o ^{235}U with 75 GWD/MTU burnup without grids and the WCAP-16827-P Table 4-17 value for 5.0 w/o ^{235}U with 75 GWD/MTU burnup and zero ^{241}Pu decay (also without grids) of approximately 5000 pcm. Please explain the differences between the simulations in WCAP-16827-P and WCAP-16827, Addendum 1 that result in this large difference. Explain how those differences affect the conclusions reached in WCAP-16827-P and WCAP-16827-P, Addendum 1. Please also explain why the difference does not manifest itself for the 1.02 w/o ^{235}U with 0 burnup scenario.

c. WCAP-16827, Addendum 1 indicates that the 1.02 w/o ^{235}U with 0 burnup scenario in the "4-out-of-4" storage configuration results in the largest non-conservatism. While the "4-out-of-4" storage configuration may be bounding with respect to the other storage configurations, that does not mean the result for those storage configurations will be zero. It appears that WCAP-16827, Addendum 1 made no effort to determine the effect on those storage configurations. As WCAP-16827-P and WCAP-16827, Addendum 1 indicate CPSES, Units 1 and 2 require in excess of 1600 ppm of soluble boron to meet the regulatory requirements the staff considers the determination of this bias to be important. In order to ensure compliance with the regulation, the licensee should develop and apply an appropriate bias for each storage configuration. The licensee is requested to provide the information used to develop and apply the bias. CPSES, Units 1 and 2 have used several different fuel designs; please indicate which fuel design was used as the basis for the grids and how this fuel design is limiting.

19. WCAP-16827-P makes an assumption not to model Boraflex wrapper material present in the CPSES, Unit 2 Region II SFP. Although the Boraflex was never installed, the wrapper material is present. WCAP-16827, Addendum 1 provides information to validate that assumption. WCAP-16827, Addendum 1 provides information for two scenarios in the "4-out-of-4" storage configuration. One is for very low enriched fuel with no burnup (1.02 w/o ^{235}U with 0 burnup). The other is

maximum enrichment with very high burnup (5.0 w/o ^{235}U with 75 GWD/MTU burnup). WCAP-16827, Addendum 1 claims these scenarios are bounding for all other storage configurations and burnup/enrichment combinations. Information provided in WCAP-16827, Addendum 1 indicates there is a large amount of conservatism associated with this assumption at zero soluble boron concentrations, and that the conservatism decreases with increasing soluble boron concentration. The staff has noted a difference between the zero soluble boron starting point on WCAP-16827, Addendum 1, Figure 3-9 for the 5.0 w/o ^{235}U with 75 GWD/MTU burnup without grids and the WCAP-16827-P Table 4-17 value for 5.0 w/o ^{235}U with 75 GWD/MTU burnup and zero ^{241}Pu decay (also without grids) of approximately 5000 pcm. Please explain the differences between the simulations in WCAP-16827-P and WCAP-16827, Addendum 1 that result in this large difference. Please also explain how those differences affect the conclusions reached in WCAP-16827-P and WCAP-16827-P, Addendum 1 and why the difference does not manifest itself for the 1.02 w/o ^{235}U with 0 burnup scenario.

20. With regard to the oversized inspection cell, WCAP-16827-P states, "An empty row of storage cells is included in all adjacent locations, including diagonal cells. The surrounding storage locations in the model contain STD fuel assemblies at the maximum permissible enrichment for the "4-out-of-4" storage configuration." This appears to require the oversized inspection cells to be bordered by a complete row of empty cells. This requirement is not captured in the proposed CPSES, Units 1 and 2 TS. Please provide a revised TS pages to capture this requirement.

21. WCAP-16827-P does not establish uncertainties for the UO_2 density manufacturing tolerances or dishing and chamfering. Rather WCAP-16827-P models a set density and all fuel pellets are modeled as full right circular cylinders. WCAP-16827, Addendum 1 provides additional information that indicates the set density is above the nominal density plus tolerances. WCAP-16827, Addendum 1 provides additional information that indicates the nominal dishing and chamfering for CPSES, Units 1 and 2 fuel. WCAP-16827, Addendum 1 claims these assumptions are conservative due to the additional fissile material they provide. However, that rationale ignores the potential for self-shielding. A review of past submittals, which determined a UO_2 density uncertainty (References 11, 12, and 13), indicate the Δkeff between the nominal case and perturbed case with increased UO_2 density can be less than the KENO case uncertainty, and when the KENO case uncertainty is applied to determine a margin that margin may be negative. Please state how the CPSES, Units 1 and 2 analyses are crediting the "margin" associated with UO_2 density and dishing and chamfering.

22. WCAP-16827-P does consider uncertainties for the fuel assembly manufacturing tolerances associated with pellet diameter, cladding thickness, and enrichment, but does not establish uncertainties for fuel rod pitch or the guide tubes. Please state why reactivity uncertainties were not considered for these manufacturing tolerances.

23. WCAP-16827-P also establishes an uncertainty for eccentric positioning of fuel assemblies in the storage cells. That uncertainty is established by simulations "...performed to investigate the effect of off-center position of the fuel assemblies for each of the fuel assembly storage configurations. These simulations positioned the assemblies as close as possible in four adjacent storage cells and at intermediate positions in between."

    a. Moving the assemblies closer together in the center of the model moves them further away from the boundary. In determining this uncertainty each storage configuration is modeled as infinitely repeating 2x2 arrays with periodic boundary conditions. Therefore, as the distance to the modeled 2x2 array boundary increases, the distance to the next fuel assembly is being doubled effectively opening the intra-array gap and producing a potentially negative reactivity effect that may not actually be present. Please state how the results of the eccentric position uncertainty would change if fuel assemblies surrounding the 2x2 array were held in the nominal position.

    b. No eccentric positioning uncertainty is listed for the "4-out-of-4," "4-out-of-4 with Axial Blankets," "3-out-of-4," or "3-out-of-4 with Axial Blankets," storage configurations, thus indicating the analysis did not find a statically significant resultant. Please state if the simulations performed in the analysis considered both the presence and absence of axial blankets in reaching the conclusion that there was not a statistically significant resultant.

24. The reactivity uncertainties established in WCAP-16827-P are based on perturbations of the minimum allowed fresh fuel in a given storage configuration. In some storage configurations there is a large range between the minimum allowed fresh fuel and the maximum allowed enrichment/burnup combination. For example, the minimum allowed fresh fuel in the "4-out-of-4" storage configuration is 1.02 w/o ^{235}U while the maximum allowed enrichment/burnup combination is 5.0 w/o ^{235}U with 75,729 MWD/MTU burnup.

    a. What assurance is there that the uncertainties do not change over the range covered by the storage configurations?

    b. If burnup is considered, how might decay time affect the uncertainties?

25. The reactivity uncertainties established in WCAP-16827-P are based on perturbations of the minimum allowed fresh fuel in a given storage configuration. The "4-out-of-4" and "4-out-of-4 with Axial Blankets" storage configurations, with the exception of the burnup uncertainty, use the same "rackup" of biases and uncertainties. Similarly, the "3-out-of-4" and "3-out-of-4 with Axial Blankets" storage configurations, with the exception of the burnup uncertainty, share the same "rackup" of biases and uncertainties.

a. Please explain why the presence of axial blankets does not affect the enrichment uncertainty.

b. What assurance is there that the other uncertainties do not change with the presence axial blankets?

26. In determining the soluble boron requirements for CPSES, Units 1 and 2, WCAP-16827-P states, "...soluble boron credit methodology utilized here is identical to that followed in Reference 1." Reference 1 is Reference 14 herein. However, it does not appear to be true. While there are some similarities between what was done in WCAP-16827-P and Reference 14, they certainly are not identical and there are enough significant differences such that the Reference 14 is not an appropriate precedent for what was done in WCAP-16827-P. WCAP-16827-P determined the soluble boron requirements for the "4-out-of-4" storage configuration using 5.0 w/o enriched fuel assembly with 75,759 MWD/MTU of burnup. An implicit assumption is that this storage configuration with this burnup/enrichment is limiting with respect to all other storage configurations and burnup/enrichment combinations within WCAP-16827-P. Rather than an infinite array of "4-out-of-4" storage configurations, the soluble boron credit methodology is modeled as the SFP Region II full of "4-out-of-4" storage configurations. The WCAP-16827-P soluble boron credit methodology determines the keff of the model at eleven points ranging from 0 ppm to 1024 ppm. A Δkeff term is determined for the ten soluble boron amounts with respect to 0 ppm. The Δkeff terms are fit to a second order polynomial with respect to soluble boron concentration. That polynomial is used to individually find the soluble boron concentration to accommodate three separate Δkeff factors. Those factors are 0.05 Δkeff, a Δkeff for uncertainties, and the Δkeff required to offset the largest reactivity increase due to worst case accident/abnormal conditions. The soluble boron required to maintain the SFP keff less than 0.95 under nominal conditions is the summation of the first two factors. The licensee must be able to demonstrate the ability to detect and terminate an SFP boron dilution event before reaching this soluble boron concentration. This value is typically located in the Design Features section of the Technical Specifications. The soluble boron required to maintain the SFP keff less than 0.95 under accident/abnormal conditions is the summation of all three. This value is typically the basis for an SFP minimum soluble boron concentration limiting condition for operation (LCO). The first factor in the WCAP-16827-P soluble boron methodology has several implicit assumptions. One is that the storage configuration is already at a keff less than 1.0. A second is that the total "rackup" of biases and uncertainties is unchanged by the presence of soluble boron in the moderator. The second factor includes a "depletion uncertainty" and a "burnup measurement uncertainty." The "burnup measurement uncertainty" is identical to that used previously. The "depletion uncertainty" is a new item, used only in the soluble boron credit determination. The third factor accounts for accident/abnormal conditions. The staff previously identified several non-conservative aspects of this methodology. Those were discussed with the licensee during April 24, 2008, conference call. WCAP-16827-P, Addendum 1 provided some additional information regarding

the soluble boron credit methodology. It indicates that the above soluble boron credit methodology was applied to each storage configuration, but ultimately simulations were performed with soluble boron present with the biases and uncertainties applied afterward. The WCAP-16827-P, Addendum 1 method indicates that > 1900 ppm of soluble boron is required to maintain keff ≤ 0.95 under all conditions, as compared to the 1600 ppm indicated by WCAP-16827-P. WCAP-16827-P, Addendum 1 also indicates that the "2-out-of-4" storage configuration requires a higher soluble boron concentration rather than the "4-out-of-4" storage configuration, as was assumed in WCAP-16827-P. To further evaluate the soluble boron credit requirements for CPSES, Units 1 and 2, the licensee is requested to provide the following information. (Note storage configurations crediting RCCA or RackSavers are not included in this request for additional information.)

a. WCAP-16827-P, Addendum 1 continues to assume the biases and uncertainties are unaffected by the presence of a large amount of soluble boron. What effect does the presence of 1600 ppm and 1900 ppm of soluble boron have on the biases and uncertainties?

b. The analysis states that increased temperature induced a negative reactivity effect. Was that determination made with or without soluble boron present in the SFP?

c. WCAP-16827-P, Addendum 1 discusses additional simulations that were performed to support the analysis, which differed from the WCAP-16827-P methodology, and provides the keff results in Table 3-4. Please provide a description of those simulations. Include the parameters used and any modeling differences with respect to WCAP-16827-P. Also, clarify if the results stated in Table 3-4 are for 1600 ppm or 1900 ppm of soluble boron.

d. WCAP-16827-P, Addendum 1 discusses the results of the simulations performed on two storage configurations. One contains two RCCAs; the other is the "2-out-of-4" storage configuration, which resulted in the largest soluble boron requirement. The biases and uncertainties for each are handled differently. Please state the reasons.

    (i) The discussion of the "2-out-of-4" storage configuration applies the "standard" biases and uncertainties from WCAP-16827-P, Table 4-16 and the "burnup measurement uncertainty" from WCAP-16827-P, Table 4-16, but does not apply the "depletion uncertainty." Also, should a "depletion uncertainty" be applied, it is likely that any remaining reserved analytical margin would be completely eroded. Please justify.

e. WCAP-16827-P, Addendum 1 indicates that > 1900 ppm of soluble boron is required to maintain keff ≤ 0.95 under all conditions. As CPSES, Units 1 and 2 TS 4.3.1.1.c lists the amount of soluble boron required to maintain keff ≤ 0.95 under nominal conditions, what is the amount of soluble boron required to maintain keff ≤ 0.95 under nominal conditions using the methodology of WCAP-16827-P, Addendum 1? If necessary, provide a revised TS proposal that incorporates this value.

f. WCAP-16827-P, Addendum 1 credits a portion of the 0.005 Δkeff reserved analytical margin to offset the amount of soluble boron required above 1900 ppm. 1900 ppm is close to the CPSES, Units 1 and 2, TS 3.7.16 minimum SFP soluble boron requirement of 2000 ppm. Please describe the process used to determine that SFP is at the proper soluble boron concentration.

27. WCAP-16827-P assumed the "4-out-of-4" storage configuration as bounding for all other storage configurations in its soluble boron crediting methodology. The assumption was proven invalid in WCAP-16827-P, Addendum 1. WCAP-16827-P, Addendum 1 repeatedly used the "4-out-of-4" storage configuration as bounding for all other storage configurations. The staff requests quantitative evidence that the "4-out-of-4" storage configuration is indeed bounding for all other storage configurations were it is used as such.

28. Please state why the "depletion uncertainty" is not applied to the unborated portion of the analysis.

29. Please state how the "1-out-of-4" storage configuration currently in the CPSES, Units 1 and 2, TS is affected by the proposed changes.

30. Describe the process used to determine that fuel assemblies have attained proper burnup for storage in the burnup dependent racks.

31. Describe the process used to control movement of items within the SFP.

32. Describe how this LAR affects CPSES, Units 1 and 2's B.5.b commitments.

REFERENCES

1. Mike Blevins, Luminant Generation Company LLC, letter to U.S. Nuclear Regulatory Commission, "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).

2. Mike Blevins, Luminant Generation Company LLC, letter to U.S. Nuclear Regulatory Commission, "Supplement to License Amendment Request (LAR) 07-004, Revision to the Technical Specifications for Spent Fuel Pool Criticality (TAC Nos. MD8417 and MD8418)," dated June 30, 2008 (ADAMS Accession No. ML082610284).

3. NOT USED.

4. U.S. Nuclear Regulatory Commission, "Recommendations for Addressing Axial Burnup in PWR Burnup Credit Analysis," NUREG/CR-6801, March 2003 (ADAMS Accession No. ML031110292).

5. U.S. Department of Energy, "Topical Report on Actinide-Only Burnup Credit for PWR Spent Fuel Packages," DOE/RW-0472, Revision 2, September 1998.

6. NOT USED.

7. U.S. Nuclear Regulatory Commission, "Review and Prioritization of Technical Issues Related to Burnup Credit for LWR Fuel," NUREG/CR-6665, February 2000 (ADAMS Accession No. ML003688150).

8. U.S. Nuclear Regulatory Commission Memorandum from L. Kopp to T. Collins, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants," dated August 19, 1998 (ADAMS Accession No. ML003728001).

9. Mahesh L. Chawla, U.S. Nuclear Regulatory Commission, letter to Thomas J. Palmisano, Nuclear Management Company, LLC, "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Issuance of Amendments RE: 'Spent Fuel Pool Storage' (TAC Nos. MC5811 and MC5812)." dated February 5, 2006 (ADAMS Accession No. ML060250208).

10. Nadiyah S. Morgan, U.S. Nuclear Regulatory Commission, letter to Peter P. Sena III, Beaver Valley Power Station, "Beaver Valley Power Station, Unit No. 2 – Issuance of Amendment RE: 'Incorporation of the Results of a New Spent Fuel Pool Criticality Analysis,' (TAC No. MD2378)," dated March 27, 2008 (ADAMS Accession No. ML080730476).

11. Joseph M. Solymossy, Nuclear Management Company, LLC, letter to U.S. Nuclear Regulatory Commission, "License Amendment Request (LAR) to Revise the Spent Fuel Pool Criticality Analyses and Technical Specifications (TS) 3.7.17, 'Spent Fuel Storage' and 4.3, 'Fuel Storage'," dated February 1, 2005 (ADAMS Accession No. ML050330138).

12. Robert C. Mecredy, Rochester Gas and Electric Corporation, letter to U.S. Nuclear Regulatory Commission, "Application for Amendment to Facility Operating License, Credit for Soluble Boron in Spent Fuel Pool, Rochester Gas and Electric Corporation, R.E. Ginna Nuclear Power Plant," dated March 8, 2000 (ADAMS Accession No. ML003691703).

13. Jeffrey T. Gasser, Southern Nuclear Operating Company, Inc., letter to U.S. Nuclear Regulatory Commission, "Vogtle Electric Generating Plant Request to Revise Technical Specifications to Reflect Updated Spent Fuel Rack Criticality Analyses for Units 1 and 2," dated August 13, 2004 (ADAMS Accession No. ML042320393).

14. Guy S. Vissing, U.S. Nuclear Regulatory Commission to Dr. Robert C. Mecredy, Rochester Gas and Electric Corporation, "R. E. Ginna Nuclear Power Plant – Amendment Re: Revision to the Storage Configuration Requirements Within the Existing Storage Racks and Taking Credit for a Limited Amount of Soluble Boron (TAC No. MA8443), dated December 7, 2000 (ADAMS Accession No. ML003761578).

November 19, 2008

Mr. M. R. Blevins
Executive Vice President
& Chief Nuclear Officer
Luminant Generation Company LLC
ATTN: Regulatory Affairs
P. O. Box 1002
Glen Rose, TX 76043

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION REGARDING SPENT FUEL POOL CRITICALITY LICENSE AMENDMENT REQUEST (TAC NOS. MD8417 AND MD8418)

Dear Mr. Blevins:

By letter dated August 28, 2007, and supplemented by letter dated June 30, 2008, Luminant Generation Company LLC (the licensee) requested changes to the Technical Specifications for the Comanche Peak Steam Electric Station, Units 1 and 2, spent fuel pool (SFP) storage requirements. On April 24, 2008, the licensee and the U.S. Nuclear Regulatory Commission (NRC) staff held a teleconference discussing the items to be covered in the supplement.

The NRC staff has reviewed the information provided in the application and determined that additional information is needed in order to complete the evaluation. This request for additional information (RAI) was discussed with the licensee on November 13, 2008. Based on discussions with Jimmy Seawright on November 28, 2008, it was agreed that responses to all the RAI questions, except for questions 10, 12, 17, 26, and 28 will be provided by December 12, 2008. Responses to RAI questions 10, 12, 17, 26, and 28 will be provided by January 16, 2009.

If you have any questions, please contact me at 301-415-3016.

Sincerely,
/RA/

Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-445 and 50-446

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As stated

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ADAMS Accession No. ML083120002 *RAI memo dated 10/23/08

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