PMComanchePeakPEm Resource

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Cc: ComanchePeakCOL Resource; Ward, William
Subject: Comanche Peak RCOL Section 9.2.5 - RAI Number 121
Attachments: RAI 3762 (RAI 121).doc

The NRC staff has identified that additional information is needed to continue its review of the combined license application. The NRC staff's request for additional information (RAI) is contained in the attachment. Luminant is requested to inform the NRC staff if a conference call is needed.

The response to this RAI is due within 35 calendar days of October 9, 2009

Note: If changes are needed to the safety analysis report, the NRC staff requests that the RAI response include the proposed changes.

thanks,

Stephen Monarque
U. S. Nuclear Regulatory Commission
NRO/DNRL/NMIP
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Hearing Identifier: ComanchePeak_COL_Public
Email Number: 685

Mail Envelope Properties (9C2386A0C0BC584684916F7A0482B6CA04A84FE1F1)

Subject: Comanche Peak RCOL Section 9.2.5 - RAI Number 121
Sent Date: 10/9/2009 11:08:50 AM
Received Date: 10/9/2009 11:08:53 AM
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Post Office: HQCLSTR02.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	650	10/9/2009 11:08:53 AM
RAI 3762 (RAI 121).doc	87034	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information (RAI) No. 3762

RAI Number 121

10/9/2009

Comanche Peak Units 3 and 4
Luminant Generation Company, LLC.
Docket No. 52-034 and 52-035
SRP Section: 09.02.05 - Ultimate Heat Sink
Application Section: 9.2.5

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

09.02.05-1

The ultimate heat sink (UHS) must be designed to quality standards commensurate with the safety functions to be performed in accordance with the requirements of 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 1. Section 3.2 of the Comanche Peak combined license (COL) Final Safety Analysis Report (FSAR) incorporates by reference Section 3.2.2 of the US-APWR DCD, which requires quality standards to be specified for structures, systems, and components (SSCs) based on safety importance and other considerations. The NRC staff found that the UHS description and designations are incomplete with respect to the following items:

- The description provided in FSAR Section 9.2.5 does not clearly indicate which components and control, alarm, and indication functions are safety-related versus those that are not safety-related, so appropriate designations can be confirmed. Also, the cooling tower structure and components (including materials that are used) are not described and appropriate designations and standards are not specified, such as for the cooling tower structure itself, drift eliminators, film fills, risers, water distribution system/piping and valves (including nozzles), and fan vibration monitors.

- FSAR Table 3D-201 indicates that the operational duration for the UHS basin water level and temperature instruments is only two weeks. This is not consistent with the long-term performance criteria that are specified in Regulatory Guide 1.27, 'Ultimate Heat Sink,' Revision 2 (January 1976) and this relatively short operational duration needs to be explained and justified.

Therefore, the applicant is requested to provide additional information to address these items and revise the FSAR, as necessary to adequately reflect this information.

09.02.05-2

The ultimate heat sink (UHS) must be designed to quality standards commensurate with the safety functions to be performed in accordance with GDC 1 requirements. As specified by Section 3.2.1.1.2 of the DCD and FSAR Section 3.2, non-safety-related parts of the UHS should be designated as Seismic Category II if a failure under seismic loading conditions could prevent or reduce the functional capability of a safety-related SSC. The NRC staff found that insufficient information was provided in FSAR Section 9.2.5 to determine if the seismic designation for non-safety-related parts of the UHS is appropriate. Therefore, the applicant is requested to provide additional information to address this item and revise the FSAR, as necessary to adequately reflect this information.

09.02.05-3

The ultimate heat sink (UHS) must be capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, and external missiles without loss of capability to perform its safety functions with and without off-site power available in accordance with the requirements of GDC 2. Because the cooling towers are located in relatively close proximity to each other, the following concerns were identified:

- Missiles from a single tornado can impact the exposed parts of multiple cooling tower basins and cause damage to the cementitious membrane.

- The low pressure created by a tornado vortex could impact all of the cooling tower fans as well as the water inventory that is contained in the exposed areas of the cooling tower basins.

Therefore, the applicant is requested to provide additional information to address these items and revise the FSAR, as necessary to adequately reflect this information.

09.02.05-4

The UHS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. The UHS description and piping and instrumentation diagram (P&ID) were reviewed to assess the design adequacy of the UHS for performing its heat removal functions. However, the NRC staff found that some of the descriptive information that was provided for the UHS is confusing, incomplete, inaccurate, or inconsistent. In order for the NRC staff to complete this assessment, the applicant is requested to address the following items and revise the FSAR, as appropriate to reflect this information:

- Much of the information related to the UHS that is discussed in other parts of the FSAR has not been included in the description provided in FSAR Section 9.2.5. Consequently, the description of the UHS design basis that is provided in FSAR Section 9.2.5 is incomplete. For example, information related to the UHS that is listed in FSAR Section 1.2.1.7.1, "General Plant Arrangement," such as "The UHS is designed and constructed as a safety-related structure, to the requirements of seismic category I, as defined in RG 1.29," should be included in the description provided in FSAR Section 9.2.5.

- FSAR Section 9.2.5 indicates that the cooling tower basins are of uniform depth, whereas FSAR Section 3.8.4 indicates that the pump wells are deeper than the rest of the basin. This needs to be clarified, as well as which depth is the point of reference for specifying the nominal water level in the basin.

- The system description does not specify if the cooling tower fans are single speed or multiple speed units, and what air flow rate is required.

- The system description and P&ID do not fully describe where all indications are displayed (e.g., local, remote panel, control room), and what instruments provide input to a process computer and/or have alarm and automatic actuation functions.

- The P&ID indicates that overflow protection for the basin is provided by a spillway or drain line, but this is not described in FSAR Section 9.2.5, and design specifications, size requirements, and other design details are not provided.

- FSAR Section 9.2.5 indicates that the power supplies for the transfer pumps are provided by alternate trains from the train associated with its respective cooling tower. For example, the transfer pump for the A Train can be powered by the C or D trains depending on the breaker alignment. However, the FSAR does not indicate if this logic also applies to the transfer pump valves and indications.

- FSAR Figures 1.2-206, Section E1-E1, and 1.2-210, Section D2-D2, show the transfer pump discharge pipe going into different essential service water (ESW) tunnel compartments; whereas, the description in FSAR Section 9.2.5 and Figure 9.2.5-201 indicate that there is only one common transfer pump discharge/transfer pipe such that only one of the compartments would be used.

- FSAR Table 3.7.1-3R, Note 5, indicates that the mat for the cooling tower basin supports one UHS basin with two pools; whereas, the description in FSAR Section 9.2.5 indicates that each basin has only one pool.

- FSAR Section 9.2.5 and other FSAR sections do not specifically state that the cooling towers are Seismic Category 1, and there is no discussion explaining how the seismic qualification of the cooling towers will be established.

09.02.05-5

The UHS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. The capability of the UHS as described in FSAR Section 9.2.5 was reviewed by the NRC staff to assess the adequacy of the UHS for performing its heat removal functions. However, the NRC staff found that the FSAR description did not demonstrate adequate performance of the UHS for the most limiting conditions. As such, the applicant is requested to address the following items in this regard and revise the FSAR, accordingly to reflect this information:

- The analysis assumes that the starting water temperature in the cooling tower basin is 95 °F, which is the maximum temperature that is allowed for ESWS operation. There is no discussion of how the temperature in the basin will trend to confirm that 95 °F is not exceeded, and there is no recognition and confirmation that the heat transfer rate is sufficient to achieve cold shutdown conditions within 36 hours as required by Technical Specification requirements and specified in the review criteria established in NUREG-0800, Standard Review Plan (SRP) Section 5.4.7.

- The analysis is based on a wet bulb temperature of 80 °F (includes 2 °F margin), but Table 2.0-1R shows that the most limiting wet bulb temperature for heat removal is 83 °F. The applicant used an average temperature that was based on the worst 30-day historical record, which is inappropriate for establishing the worst-case conditions for heat removal because it is not bounding and will not demonstrate that the maximum allowed ESWS supply temperature will not be exceeded. Additionally, Table 2.0-1R indicates that temperature peaks that are less than two hours in duration are excluded, but no explanation or justification was provided for this exception. If peak temperatures that are less than two hours in duration can cause the UHS temperature limit to be exceeded, they can not be excluded from consideration in Table 2.0-1R.

- Table 9.2.5-201 shows that the design heat load of each cooling tower is 1.96×10^8 Btu/hr, which does not provide any excess margin in performance capability to allow for cooling tower fouling and degradation, the effects of other cooling towers and nearby structures, and analytical uncertainties that exist. The cooling tower design heat load needs to be justified accordingly, showing that the heat removal capability is sufficient to handle the maximum heat load and to establishing cold shutdown conditions within 36 hours (per Technical Specification requirements and the guidance in SRP Section 5.4.7) without exceeding a basin temperature of 95 °F. Additionally, Table 9.2.5-201 should also list the design air flow that is required and corresponding fan speeds, as well as the cooling tower design approach temperature that corresponds to the most limiting conditions that are assumed, taking into consideration the maximum amount of cooling tower fouling and degradation that is allowed over the life of the plant and other factors that apply.

- The water inventory analysis was not adequately explained and justified. For example, the assumptions that give the maximum evaporation and water loss rates are different from those that are limiting for heat removal. Unlike the heat removal analysis, the most limiting temperature assumptions that apply for inventory assessment can be based on the most limiting 30 day historical record. However, the factors that are used for drift and evaporation need to be justified based upon site-specific conditions and cooling tower design specifications, and how they relate to the factors that are assumed. Additionally, other water loss considerations must be addressed as well, such as natural evaporation and wind loss from the exposed parts of the basins, blowdown, seepage, and ESWS leakage.

09.02.05-6

The UHS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. The capability of the UHS as described in FSAR Section 9.2.5 was reviewed by the NRC staff to assess the adequacy of the UHS for performing its heat removal functions. In order to assure a 30-day inventory of water for the UHS, transfer pumps are provided for each cooling tower basin so water can be transferred from the basin of an inoperable cooling tower to those that are operable. However, the transfer pumps share a common header for transferring the water between basins, and potential failures of the header were not addressed. Also, the transfer pumps are designed to provide 800 gallons per minute, but this was not compared with the maximum makeup rate that is needed to demonstrate that the available flow rate is adequate. The applicant is requested to address these considerations and revise the FSAR as appropriate to reflect this information.

09.02.05-7

The UHS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. The capability of the UHS as described in FSAR Section 9.2.5 was reviewed by the NRC staff to assess the adequacy of the UHS for performing its heat removal functions. In order to assure a 30-day inventory of water for the UHS, the water level in the cooling tower basins must be sufficient to satisfy the minimum net positive suction head (NPSH) requirements of the transfer pumps. However, the NPSH requirement for the transfer pumps is not specified and FSAR Section 9.2.5 did not describe how the UHS design will assure that the NPSH requirement for the transfer pumps is satisfied (including consideration of vortex formation) and how much excess margin is provided by the UHS design for the most limiting assumptions. Consequently, the applicant is requested to provide additional information in FSAR Section 9.2.5 to specify what the minimum NPSH requirement is for the transfer pumps and explain how this minimum NPSH requirement is satisfied by the system design when taking vortex formation into consideration, and how much excess margin is available for the most limiting case.

09.02.05-8

The UHS must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. The capability of the UHS as described in FSAR Section 9.2.5 was reviewed by the NRC staff to assess the adequacy of the UHS for performing its heat removal functions. The NRC staff found that FSAR Section 9.2.5 does not address low temperature operation of the UHS, including (for example) the effects of freezing temperatures and ice formation on the cooling tower spray nozzles, fill material (especially for cooling towers that are in standby), basins (including membrane), and ESWS operation. Cooling tower designs typically include a bypass flow path for maintaining the basin water temperature above freezing and to support low temperature operation of the ESWS. However, the NRC staff noted that this capability is not provided for the Comanche Peak cooling towers. Consequently, the applicant is requested to revise FSAR Section 9.2.5 to describe low temperature operation and the effects of ice formation on the UHS.

09.02.05-9

The UHS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. Since the cooling tower spray nozzles are located at an elevation that is well above the cooling tower basin water level, there is a potential for the risers in standby loops to drain and create a large void in the supply piping to the cooling tower spray headers. If this occurs, an automatic actuation of the standby UHS trains could result in a waterhammer. Any loop seals in the spray headers and the supply piping that are caused by component design or piping configuration would tend to result in a much more severe waterhammer event. The UHS description does not adequately consider and address waterhammer vulnerabilities (such as this) in FSAR Section 9.2.5 and (to the extent that waterhammer is a valid consideration) does not explain how system design features, operating procedures, and periodic surveillance testing provide adequate assurance that the UHS safety functions will not be compromised by waterhammer events. Consequently, the applicant is requested to provide additional information to address waterhammer vulnerabilities that apply to the UHS and revise the FSAR needs as appropriate to reflect this information. Also, if system valves are relied upon to prevent excessive back-leakage, the UHS description in the FSAR needs to fully explain and justify the maximum amount of back-leakage that is allowed, and specify the leakage acceptance criteria that will be established in the in-service testing program for these valves and the basis for this determination.

09.02.05-10

The UHS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. Over time, debris such as spalled concrete, spray nozzles, and objects that are introduced by the makeup water source have accumulated in the cooling tower water basins at some operating nuclear power plants. These objects can be drawn into the suctions of pumps that are in the cooling tower basin and pose a hazard for pump operation. Typically, screens are provided to protect pump suctions from this sort of hazard. The NRC staff noted that there is no discussion in FSAR Section 9.2.5 to explain how the transfer pump suctions are protected from the intrusion of debris and how much distance from the bottom of the pump well is needed to allow for silt accumulation such that pump performance is not impacted. Therefore, the applicant is requested to provide additional information in FSAR Section 9.2.5 as appropriate to address this consideration.

09.02.05-11

The UHS must be capable of removing heat from SSCs important to safety during normal operating and accident conditions over the life of the plant in accordance with the requirements of GDC 44. FSAR Section 9.2.5 indicates that the makeup water source for the cooling tower basins is Lake Granbury. Lake water can cause silt accumulation and the introduction of fish, clams, algae, grass, and other aquatic organisms and biofouling agents. These things can degrade the operation of ESWS pumps, heat exchangers, and UHS transfer pumps; cause clogging of spray nozzles and fill material; and ultimately degrade the capability of the ESWS and UHS to remove heat. While chemical treatment can address corrosion and biofouling issues to some extent, it does not address all of the problems that can occur. Therefore, the applicant is requested to provide additional information in FSAR Section 9.2.5 to address these considerations.

09.02.05-12

The UHS must be designed so that periodic inspections of piping and components can be performed to assure that the integrity and capability of the system will be maintained over time in accordance with the requirements of GDC 45. The NRC staff finds the design to be acceptable, if the FSAR describes inspection program requirements that will be implemented are considered to be adequate for this purpose. FSAR Section 9.2.5.4 indicates that periodic inspection of mechanical cooling tower components, including fans, motors, and reducing gears will be performed in accordance with manufacturer's recommendations and is part of the monitoring that is required in Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment." The NRC staff considers the information that was provided to be incomplete in that it does not specify programmatic requirements and procedural controls that will be implemented for performing inspections; it does not describe the extent and nature of inspections that will be conducted; it does not include all of the UHS-related structures and components, such as the tower structure, basin (general condition and silt buildup), ESWS tunnel (general area inspections), fill material, and spray nozzles; industry experience was not considered and addressed; and specific provisions of GL 89-13 are not described. Therefore, the applicant is requested to provide additional information in FSAR Section 9.2.5 to address these considerations.

09.02.05-13

The UHS must be designed so that periodic pressure and functional testing of components can be performed to assure the structural and leak tight integrity of system components, the operability and performance of active components, and the operability of the system as a whole and performance of the full operational sequences that are necessary for accomplishing the UHS safety functions in accordance with the requirements of GDC 46. The NRC staff finds the design to be acceptable, if the FSAR describes pressure and functional test program requirements that will be implemented and are considered to be adequate for this purpose. FSAR Section 9.2.5.4 indicates that periodic testing of mechanical cooling tower components, including fans, motors, and reducing gears will be performed in accordance with manufacturer's recommendations and is part of the monitoring that is required in Generic Letter 89-13. The NRC staff considers the information that was provided to be incomplete in that it does not specify programmatic requirements and procedural controls that will be implemented for performing tests, it does not describe the extent and nature of tests that will be performed; it does not include all of the UHS-related components, such as spray nozzles, transfer pumps and headers; industry experience was not considered and addressed; periodic functional testing of the cooling tower is not specified to confirm adequate performance; and specific provisions of GL 89-13 are not described. Therefore, the applicant is requested to provide additional information in FSAR Section 9.2.5 to address these considerations.

09.02.05-14

Technical Specification (TS) 3.7.9, "Ultimate Heat Sink (UHS)," provides limiting conditions for operation (LCO) and surveillance requirements (SR) for the UHS. The NRC staff reviewed UHS design and operational requirements that are specified to confirm that they are adequately reflected in the proposed TS requirements and to assure that the TS Bases are reflective of the TS requirements that are proposed and the UHS description that is provided in FSAR Section 9.2.5. Based on a review of the proposed TS requirements, the NRC staff requests the applicant address the following items and revise TS 3.7.9 as appropriate:

- Proposed SR 3.7.9.1 requires operators to verify that the required UHS basin water level is ≥ 2,850,000 gallons. While this may be the minimum amount of water that is required, the requirement should be expressed in terms that the operators can verify, such as a level in the cooling tower basin.

- Proposed SR 3.7.9.2 requires operators to verify that water temperature of the UHS is ≤ 95 °F. Because the maximum allowed temperature for the ESWS is 95 °F, analyses would have to demonstrate that this temperature will not be exceeded during the most limiting safe shutdown transient conditions. If the water temperature is already at 95 °F at the start of the safe shutdown transient, it is doubtful that the temperature can be maintained below this value unless the normal operating heat loads exceed the limiting heat loads that exist for the safe shutdown transient. Usually, the maximum allowed temperature in the basin must be limited to something less than the maximum allowed ESWS temperature to accommodate the limiting safe shutdown heat loads without exceeding the ESWS temperature limit.

- Proposed SR 3.7.9.3 requires operators to operate each cooling tower fan for ≥ 15 minutes, but no requirement is specified to monitor vibration as discussed in FSAR Section 9.2.5.

- There is no SR to verify that the blowdown valves isolate on an actual or simulated actuation signal.

- Page B 3.7.9-2, under "Applicable Safety Analyses" and "LCO," the bases indicate that the operating limits are based on the worst case LOCA. Contrary to this, FSAR Section 9.2.5 indicates that the limiting heat load is based on the safe shutdown transient while the limiting inventory is based on the worst case LOCA.

09.02.05-15

Tier 1 of the US-APWR DCD specifies a safety significant interface requirement in Section 3.2 for the UHS that COL applicants must address by preparing site-specific ITAAC. The COL applicant proposed ITAAC for the Comanche Peak UHS in Part 10 of the COL application. The balance-of-plant areas are included in Appendix A.1 of Part 10, and the ITAAC are specified in Table A.1-1. Based on a review of the Comanche Peak ITAAC that are proposed for balance-of-plant areas, the NRC staff requests the applicant address the following items and revise the proposed ITAAC as appropriate to reflect this information:

- The listing of seismic category 1 equipment on Table A.1-2 does not include the cooling tower structure and related equipment, such as fill material, risers and spray piping, spray nozzles, drift eliminators, and so forth. The cooling tower and related components are safety-related and must satisfy seismic category 1 specifications in order to be credited for LOCA mitigation.

- Item 7 requires tests and analyses of the as-built system to be performed to demonstrate adequate heat removal capability. Because ITAAC must be completed before fuel load, an explanation is needed for how the specified test will be performed to account for limiting conditions, and how enough heat will be generated to perform tests that are sufficient for this purpose. Similarly, an explanation is needed for how the analyses will be completed based on the test data that is obtained to ensure conservative results.

- Important design features did not have corresponding ITAAC, such as placement of tornado missile barriers relative to components that are being protected, routing of transfer piping to confirm protection from tornado missiles, application of cementitious membrane on basin inner surfaces to prevent seepage, location of basin "mostly below grade," the fire barrier between transfer pumps and ESWS pumps; alternate power supplies for transfer pumps from respective cooling tower trains, tornado missile protection for pumps from outside missiles, depth of pump well as well as depth of ESWS and transfer pump suctions (sufficient to allow for silt buildup without impacting capability); and transfer pump design flow rate.

09.02.05-16

The US-APWR DCD established COL information items to specify supplemental information that is needed in order to describe the UHS that is chosen for a particular site. In reviewing the information that was provided by the applicant to address these COL Information Items, the NRC staff noted that in the following two cases the supplemental information that was provided by the COL applicant appears to involve departures from the US-APWR DCD design basis information and these changes to the DCD need to be addressed and reflected in the COL application accordingly:

- CP COL 9.2(18) replaced the eighth bullet of the second paragraph in DCD Tier 2 Section 9.2.5.1 which eliminated the following design bases information: "The most severe meteorological condition is based upon 30 years maximum historical conditions of dry and wet bulb temperatures." This change to the US-APWR design basis appears to be a departure and the COL applicant is requested to provide a justification accordingly.

- CP COL 9.2(21) changed the 6th paragraph under DCD Tier 2 Section 9.2.5.2 to eliminate "The blowdown discharge is provided as a check point for monitoring and neutralizing chemistry of ESW discharges to the environment." This change to the US-APWR design basis appears to be a departure and the applicant is requested to provide a justification accordingly.