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Callaway Plant

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December 9, 2003

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

Ladies and Gentlemen: ULNRC-04926

Ameren UE

DOCKET NUMBER 50-483
UNION ELECTRIC COMPANY
CALLAWAY PLANT
APPLICATION OF PROPRIETARY
LEAK-BEFORE-BREAK (LBB) METHODOLOGY
REPORTS AND DRAFT REGULATORY GUIDE DG-1108

Reference: ULNRC-04868 dated June 27, 2003

In the letter referenced above, AmerenUE transmitted an application for amendment to Facility Operating License No. NPF-30 for the Callaway Plant. During the NRC review of that amendment application, several questions arose which were discussed during a meeting with NRC staff on November 12, 2003. The attachments to this letter provide the responses to those questions.

Westinghouse has determined that some of the information in the responses is proprietary, and is supported by an affidavit signed by Westinghouse, the owner of the information, that was submitted in the letter referenced above. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.790. Accordingly, it is respectfully requested that the information that is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR 2.790.

Correspondence with respect to the copyright or proprietary aspects of the items in the attached responses should reference CAW-03-1606 and be addressed to H.A. Sepp, Manager of Regulatory and Licensing Engineering, Westinghouse Electric Company, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

APO1

If you have any further questions on this amendment application, please contact us.

Very truly yours,

Keith D. Young

Keith D. Young
Manager-Regulatory Affairs

KDY/GBY/mlo

Attachment: 1) Responses to Requests for Additional Information (Proprietary)
2) Responses to Requests for Additional Information (Non-Proprietary)

STATE OF MISSOURI)
) SS
COUNTY OF CALLAWAY)

Keith D. Young, of lawful age, being first duly sworn upon oath says that he is Manager, Regulatory Affairs, for Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Keith D. Young
Keith D. Young
Manager, Regulatory Affairs

SUBSCRIBED and sworn to before me this 9th day of December, 2003.

TERRA E. COOK
Notary Public - Notary Seal
STATE OF MISSOURI
Callaway County
My Commission Expires May 13, 2006

Terra E. Cook

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RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION (NON-PROPRIETARY)

The following is a request for information on the three topical reports submitted for the leak before break (LBB) methodology in the application submitted June 27, 2003 (ULNRC-04868).

Surge Line

In accordance with Standard Review Plan (SRP) 3.6.3, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping," the following are questions related to the staff's review of Westinghouse topical report WCAP-15983-P, "Technical Justification for Eliminating Pressurizer Surge Line Rupture as the Structural Design Basis for the Callaway Nuclear Power Plant," dated February 2003.

Question 1:

Provide assurance that the internal loads used in the calculations were determined based on the as-built configuration of the surge line.

Response:

The internal loads used in the LBB analysis are based on the as-built configuration of the surge line.

Question 2:

Provide assurance that the wall thickness of all components of the surge line meets the minimum ASME Code, Section III, Class 1, wall thickness requirements.

Response:

All components of the surge line met the minimum ASME Code, Section III, Class 1, wall thickness requirements.

Question 3:

Discuss compliance with the snubber surveillance requirements of the Callaway Technical Requirements Manual (TRM) to provide assurance that snubber failure rate are acceptably low.

Response:

Callaway's snubber surveillance program is controlled per FSAR Section 16.7.2.1.1 (we do not have a TRM) and representative snubber samples are tested per the criteria defined therein to ensure that failure rates are acceptably low. Sixteen mechanical snubbers are currently in service within the referenced WCAP piping system boundaries for the Pressurizer Surge Line, 12" RHR lines and 10" Accumulator lines. Six of these have been functionally tested since initial plant operation and all have passed. Six others have been hand stroked during this period and all have passed. Two more of these sixteen snubbers are scheduled for functional testing during the next refueling outage. Our snubber surveillance program will continue to provide assurance that snubber failure rates are acceptably low, as required per NRC regulations.

Question 4:

Section 4.2 of the WCAP defines "TH" as the "Applicable Thermal Expansion Load (Normal or Stratified)." Provide clarification indicating if the "normal thermal expansion load" includes both axial and bending loads, and if the thermal stratification also includes axial and bending loads. Provide justification why normal and stratified thermal loads are not additive.

Response:

Normal thermal expansion loads include both axial and bending loads, and the thermal stratification loads also include axial and bending loads.

The "Applicable Thermal Expansion Load (Normal or Stratified)" designation means the given thermal conditions that apply to the case being evaluated. All thermal conditions analyzed included all of the applicable thermal loads and boundary conditions, including axial thermal expansion loads as well as any coincident thermal stratification loads. For example, in Table 4-2, Case A describes the normal operating case at 653°F, which accounts for the condition when the surge line is not stratified and is at a uniform temperature, with appropriate thermal displacements applied at the end boundaries. Case B describes another normal operating condition with stratification present. This case also accounts for the appropriate top and bottom temperatures in the surge line, reflecting the stratification differential as well as the expansion effects due to the temperature loads applied. This case also includes the appropriate thermal displacements applied at the end boundaries.

Question 5:

In Section 4.2 of the WCAP, the applied loads for crack stability analysis include loads due to seismic anchor motion (SAM) and the leak before break (LBB) margin is stated to be reduced to 1.0. SRP 3.6.3 indicates that the margin of 1.4 can be reduced to 1.0 if these loads are combined absolutely with the safe shutdown earthquake (SSE) load and the individual operating loads. Provide verification that the SAM loads were combined absolutely with the SSE and the operating loads, as specified in the SRP 3.6.3.

Response:

There is no seismic anchor motion loads due to SSE in the surge line because the surge line was coupled with the loop in the piping stress analysis.

Question 6:

In Table 4-2 of the WCAP, which shows Cases A through G for normal and faulted loading cases for LBB evaluations, provide the justification for not including normal thermal expansion loads in the load combination Case E.

Response:

All thermal conditions analyzed included all of the applicable thermal loads and boundary conditions, including axial thermal expansion loads as well as any coincident thermal stratification loads.

Case E also accounts for the appropriate top and bottom temperatures in the surge line, *reflecting the stratification differential as well as the expansion effects due to* the temperature loads applied. This case also includes the appropriate thermal displacements applied at the end boundaries.

Question 7:

For Node 3030 in Table 4-4 of the WCAP, which provides a summary of LBB loads and stresses, provide a table for Cases A through G of Table 4-2 showing the individual force and moment components due to pressure, deadweight, thermal expansion, thermal stratification, SSE inertia and SSE SAM.

Response:

a,c,e

Component	Fx(kips)	Mx(ft-kips)	My(ft-kips)	Mz(ft-kips)

* There is no SAM since the surge line was coupled with the loop in the piping stress analysis

Question 8:

In Section 4.5 of the WCAP, provide the minimum wall thickness at the weld counterbore used in the analysis.

Response:

The minimum wall thickness at the weld counterbore used in the analysis is 1.251 inches.

Question 9:

Provide the basis or a reference for Equation 5-3 in Section 5.2.2 of the WCAP.

Response:

The Equation 5-3 was developed by Westinghouse by using the Reference 5-2 (WCAP-15983-P Revision 0) as a basis.

Question 10:

In support of the statement in Section 5.2.3 of the WCAP that "The leak rates were calculated using the normal operating loads at the governing location identified in Section 4.0," provide a representative detailed leak rate calculation, including the calculation of the crack opening area, for the postulated through-wall circumferential crack at Node 3030.

Response:

Information for a representative leak rate calculation:

Node 3030 Case A:

Input Data:

Pipe outer diameter= 14.00 in, thickness=1.251 in, Pressure= 2250 psia, Temperature= 653°F, Axial force= 242351 lbs, Moment=1615950 in-lbs, E=25035000 psi, Yield stress= 27230 psi.

Leak rate calculation is an iterative process involving the use of Westinghouse proprietary computer codes. First the crack opening area was calculated for a circumferential through-wall crack length utilizing the NUREG/CR-3464 (Reference 5-3 of WCAP-15983-P Revision 0) method and the input data listed above. Using the resulting crack opening area, input data listed above, assumed leakage crack length and the method described in Section 5.2.2 of WCAP-15983-P Revision 0, leak rate was calculated. This process has to be repeated for various crack lengths to determine the crack length which will yield a leak rate of 10 gpm.

For NODE 3030 Case A, using the methodology described above, the results are: for a circumferential through-wall crack length of 3.89", the value of crack opening area is 0.02711 in^2 and the calculated leak rate is 10 gpm.

Question 11:

The fatigue crack growth analysis for the pressurizer surge line was performed at the same location where the maximum ASME Code, Section III, Class 1, cumulative usage factor was previously calculated under the effects of thermal stratification. Provide the specific location on the pressurizer surge line, and the value of the maximum cumulative usage factor used in the analysis.

Response:

The fatigue crack growth (FCG) analysis location is shown in Figure 6-1 of WCAP-15983-P, Revision 0.

The value of the maximum ASME Code, Section III, Class 1, cumulative usage factor previously calculated under the effects of thermal stratification is 0.4.

Question 12:

In Section 6.2 of the WCAP, the term "stress cuts" is used in the statement that "Fatigue crack growth analyses were carried out along five stress cuts...." Discuss what a "stress cut" is and provide an explanation of the manner in which it is used in the fatigue crack growth analyses.

Response:

Figure 6-2 of WCAP-15983-P shows the five locations (stress cuts) where the fatigue crack growth analyses were performed. A stress cut is an angular location on the cross-section of the pipe.

At each location stresses for each transient were obtained along with the number of cycles for input into the fatigue crack growth analyses.

Accumulator Lines

For WCAP-16019-P "Technical Justification for Eliminating 10" Accumulator Lines Rupture as the Structural Design Basis for the Callaway Nuclear Power Plant," the questions are the following.

Question 1:

Provide the ASME Code, Section III, Class 1, cumulative usage factors at Nodes 3020 (Accumulator Loop 2), 3120 (Accumulator Loop 2), and 3295 (Accumulator Loop 3).

Response:

The ASME Code, Section III, Class 1, cumulative fatigue usage near Node 3020 (Accumulator Loop 2) is [ ]^{a,c,e} and near Node 3120 (Accumulator Loop 2) is [ ]^{a,c,e}. At Node 3295 (Accumulator Loop 3) no ASME Code, Section III, Class 1, cumulative fatigue usage was calculated since it is located in the Class 2 portion of the line.

Question 2:

Provide assurance that the internal loads used in the calculations were determined based on the as-built configuration of the accumulator lines.

Response:

The loads used in the LBB analysis are based on the as-built configuration of the accumulator lines.

Question 3:

Provide assurance that the wall thicknesses of all components of the accumulator lines meet the minimum ASME Code, Section III, Class 1, wall thickness requirements.

Response:

All components of the accumulator lines met the minimum ASME Code, Section III, Class 1, wall thickness requirements.

Question 4:

Discuss compliance with the snubber surveillance requirements of the Callaway Technical Requirements Manual (TRM) to provide assurance that the snubber failure rate on the accumulator lines is acceptably low.

Response:

Callaway's snubber surveillance program is controlled per FSAR Section 16.7.2.1.1 (we do not have a TRM) and representative snubber samples are tested per the criteria defined therein to ensure that failure rates are acceptably low. Sixteen mechanical snubbers are currently in service within the referenced WCAP piping system boundaries for the Pressurizer Surge Line, 12" RHR lines and 10" Accumulator lines. Six of these have been functionally tested since initial plant operation and all have passed. Six others have been hand stroked during this period and all have passed. Two more of these sixteen snubbers are scheduled for functional testing during the next refueling outage. Our snubber surveillance program will continue to provide assurance that snubber failure rates are acceptably low, as required per NRC regulations.

Question 5:

In Section 4.2 of the WCAP, the applied loads for crack stability analysis include loads due to the safe shutdown earthquake (SSE). Provide verification that SSE loads include both inertia and seismic anchor motion loads, and that these are combined absolutely, as specified in the Standard Review Plan (SRP) 3.6.3.

Response:

There are no seismic anchor motion loads due to SSE in the accumulator lines because the accumulator lines were coupled with the loop in the piping stress analysis.

Question 6:

Provide detailed justification for not including operating basis earthquake (OBE) loads in the fatigue crack growth analysis

Response:

In the LBB analysis through-wall flaws are postulated and it was demonstrated that LBB conditions exist with ample margins for the Callaway accumulator lines. For the Fatigue Crack Growth (FCG) assessment, surface flaws were postulated and it was demonstrated that the postulated surface flaws will not grow through the wall considering the transients and cycles for the design life of the plant. Table 6-2 of WCAP-16019-P Revision 0 shows the results of the Fatigue Crack Growth (FCG) assessment. Even for the largest postulated flaw of 0.3 inch, this is about 33% of the wall thickness; results show that the growth is only about 10%. It was concluded that the flaw growth through the wall will not occur during the 40 year design life of the plant.

For the ASME Code, Section III, Class 1, cumulative usage factor calculations (see the response to question 1) the contribution from OBE was [ ]^{a,c,e} for Node 3020, which is small, and the contribution from OBE at Node 3120 was 0.00. It was judged that OBE would have a similar contribution on the FCG results. Therefore, OBE was not considered in the FCG assessment.

<u>RHR Lines</u>

For WCAP-16020-P "Technical Justification for Eliminating 12" Residual Heat Removal (RHR) Rupture as the Structural Design Basis for the Callaway Nuclear Power Plant," the questions are the following.

Question 1:

Provide the ASME Code, Section III, Class 1, cumulative usage factors at Nodes 3285 (RHR Line Loop 1) and 3020 (RHR Line Loop 4).

Response:

The ASME Code, Section III, Class 1, cumulative fatigue usage near Node 3285 (RHR Line Loop 1) is [ ]^{a,c,e} and near Node 3020 (RHR Line Loop 4) is [ ]^{a,c,e}.

Question 2:

Provide assurance that the internal loads used in the calculations were determined based on the as-built configuration of the residual heat removal (RHR) lines.

Response:

The loads used in the LBB analysis are based on the as-built configuration of the RHR lines.

Question 3:

Provide assurance that the wall thicknesses of all components of the RHR lines meet the minimum ASME Code, Section III, Class 1, wall thickness requirements.

Response:

All components of the RHR lines met the minimum ASME Code, Section III, Class 1, wall thickness requirements.

Question 4:

Discuss compliance with the snubber surveillance requirements of the Callaway TRM to provide assurance that snubber failure rate are acceptably low.

Response:

Callaway's snubber surveillance program is controlled per FSAR Section 16.7.2.1.1 (we do not have a TRM) and representative snubber samples are tested per the criteria defined therein to ensure that failure rates are acceptably low. Sixteen mechanical snubbers are currently in service within the referenced WCAP piping system boundaries for the Pressurizer Surge Line, 12" RHR lines and 10" Accumulator lines. Six of these have been functionally tested since initial plant operation and all have passed. Six others have been hand stroked during this period and all have passed. Two more of these sixteen snubbers are scheduled for functional testing during the next refueling outage. Our snubber surveillance program will continue to provide assurance that snubber failure rates are acceptably low, as required per NRC regulations.

Question 5:

In Paragraph 4.2, the applied loads for crack stability analysis include loads due to SSE. Provide verification that SSE loads include both inertia and seismic anchor motion loads, and that these are combined absolutely, as specified in the SRP 3.6.3.

Response:

There is no seismic anchor motion loads due to SSE in the RHR lines because the RHR lines were coupled with the loop in the piping stress analysis.

Question 6:

Provide detailed justification for not including OBE loads in the fatigue crack growth analysis

Response:

In the LBB analysis through-wall flaws are postulated and it was demonstrated that LBB conditions exist with ample margins for the Callaway RHR lines. For the Fatigue Crack Growth (FCG) assessment, surface flaws were postulated and it was demonstrated that the postulated surface flaws will not grow through the wall considering the transients and cycles for the design life of the plant. Table 6-2 of WCAP-16020-P Revision 0 shows the results of the Fatigue Crack Growth (FCG) assessment. Even for the largest postulated flaw of 0.35 inch, this is about 35% of the wall thickness; results show that the growth is only about 4%. It was concluded that the flaw growth through the wall will not occur during the 40 year design life of the plant.

For the ASME Code, Section III, Class 1, cumulative usage factor calculations (see the response to question 1) the contribution from OBE was 0.00 for Node 3285 and also 0.00 for Node 3020. It was judged that OBE would have a similar contribution on the FCG results. Therefore, OBE was not considered in the FCG assessment.

10/15/03 NRC question:

Discuss the rationale for not considering the potential effect of thermal stratification, cycling and striping (TASCS) in the horizontal sections of RHR and accumulator piping discussed in the subject WCAP topical reports (provided in the application dated June 27, 2003) due to potential leakage of hot fluids past the isolation valve or heat transfer across the isolation valve, including, in particular, the startup of the systems. The discussion should also address the contribution to thermal fatigue due to TASCS in the above cases and will the nodal location of maximum stress change as a result of the above. The reviewer does not believe a meeting is necessary because the request in the application is not a new request to the staff.

Response:

The following is the rationale for not considering the potential effect of thermal stratification, cycling and striping (TASCS) due to potential leakage of hot fluids past the valve or heat transfer across the valve in the horizontal sections of the RHR and accumulator piping. In particular, the startup of the systems is addressed.

Accumulator Piping:

The unisolable section of piping extending from the cold leg to the check valve is relatively short. This piping, including the horizontal section, will be at nearly the cold leg temperature due to turbulent penetration heating from the cold leg. Leakage from the cold leg is unlikely due to a second upstream check. Leakage would result in a rise in accumulator tank level and pressure, which would be detected. Heat transfer across the check valve is generally not significant with respect to structural considerations. Startup of the accumulator system would indicate a safety injection (accumulator blowdown). The higher flow rates preclude the possibility for stratification, as the line has full flow. The contribution to thermal fatigue due to TASCS is therefore negligible. The nodal location of maximum stress will not change.

RHR Piping:

The unisolable section of piping extending from the hot leg to the isolation valve is relatively short. This piping, including the horizontal section, will be at nearly the hot leg temperature due to turbulent penetration heating from the hot leg. Leakage, as at Genkai Unit 1 (see NRC Bulletin 88-08, Supplement 3), is possible if the isolation valve has a leakoff line. Callaway Plant has performed a modification to cap the subject leakoff line, therefore leakage is highly unlikely due to a second downstream isolation valve (which also has a capped leakoff line). Heat transfer across the isolation valve is generally not significant with respect to structural considerations. Startup of the RHR system generally occurs with the reactor coolant system much cooler and under significantly less pressure loading (approximately 350 F and about 440 psig) than for normal operating conditions (typically 618 F and 2235 psig). The higher RHR flow rates preclude the possibility for stratification, as the line has full flow. The contribution to thermal fatigue due to TASCS is therefore negligible. The nodal location of maximum stress will not change.

9/16/03 NRC question:

The following is an RAI for the license amendment request application dated June 27, 2003, related to an opening in the secondary shield wall.

On review of the Callaway drawings (in the FSAR and the additional drawing provided by the licensee to the NRC project manager), it has been identified that the proposed opening in the shield wall, which is depicted in drawing no. C-2S2977, may not be consistent with the following statement by the licensee on page 5, second paragraph, of Attachment 1 to the application:

"In order to preclude radiation streaming and dose resulting from creating the opening in the secondary shield cubicle wall, alternative shielding will be applied to the opening and access control entryway to limit radiation doses consistent with maintaining them as low as [is] reasonably achievable (ALARA)."

The alternative shielding indicated on the drawings does not appear to "preclude streaming" for the following reasons:

1. The shield does not cover the entire height of the opening. Approximately four square feet of opening is unshielded.

2. No shielding is provided on the top, or the deck, of the security cage to prevent radiation (penetrating the secondary shield wall opening at a up or down slant angle) from streaming into accessible spaces above and below the security cage.

3. The "alternative" lead shield that is included in the design will provide only approximately three orders of magnitude less shielding (one tenth thickness of lead versus about four tenth thicknesses of concrete).

Therefore, it is requested that the following be provided to clarify the application:

1. Explain how the alternative shielding is as effective as the original shield design,

or

2. a) Calculate the expected increase in radiation dose rates outside the secondary shield cubicle resulting from this modification.

2.b) Estimate the increase in dose expected for workers accessing these areas during periods of reactor shutdown and power operations and show that this is ALARA.

2.c) Verify that the modification does not create a very high radiation area, as defined in 10 Part 20, or describe the "additional measures" required by 10 CFR 20.1602.

Response:

First, our choice of words "in order to preclude radiation streaming" is incorrect. When we were in the development stage of this modification we were looking at using some kind of shield door rather than a labyrinth wall we are now proposing. The door would have "precluded streaming"; however, it would have weighed over 4000 pounds and was considered a personnel safety hazard to open and close it every time someone entered or exited the area. It was also our further concern that, because the door was so heavy, people would just leave it open during plant shutdown periods. With the door open we would have no shielding in the area just outside of the wall. During periods of plant shutdown, there could be several people working in the area which would have a higher dose than what is there before the modification. By using the labyrinth wall, sufficient shielding would be provided during plant shutdown periods to prevent this from occurring and also eliminate the personnel safety concern with handling a very heavy door.

The primary reason for cutting the access door is to make access to the sludge lance platform for all four steam generators and all four reactor coolant pumps faster, safer, and more efficient resulting in a lower total dose exposure to personnel. Currently, in order to get to the sludge lance platforms, one must enter the bio-shield area from the 2000 foot elevation, climb a ladder to the primary steam generator platform, then climb another ladder to the secondary platform. During Steam Generator or RCP Maintenance activities, access via the primary steam generator platform is not available due to high dose rates and contamination levels in the area forcing personnel to climb a temporary scaffold ladder to the platform. Extra dose is received installing and removing this access ladder as well as the additional time behind the bio-shield just to get to the sludge lance platform location. The door through the bio-shield wall coupled with the elevated walkway connecting the two sludge lance platforms will eliminate the need for this temporary ladder and access time.

During normal plant operations, we understand that dose rates in the affected zones will be higher than they are before the modification. The dose rates in the affected zone on the 2026 elevation will increase to about 67 mrem/hour during power operations with the labyrinth shield in place and will be insignificant during periods of plant shutdown. We also agree that the labyrinth shield wall was insufficient to cover the opening and would allow exposure to personnel in some areas of the affected zone. We will be increasing the height of the wall by 2'-0" to assure the doorway is covered. In addition, we will be adding approximately 12 inches to the bottom of the shield to provide shielding to feet and lower legs of personnel passing through the area. The area affected on the 2026 elevation of containment is small and there is no sensitive equipment in the area. The number of personnel passing through the area during power operations will be minimal and for very short durations.

The dose rates in the affected zone on the 2000 elevation will increase to about 188 mrem/hour during power operations. It is understood that this is a larger increase in dose rates; however; the area affected on the 2000 foot elevation of containment is very small and there is no sensitive equipment in the area. During power operations if personnel entered the affected area, they would do so just to pass through to gain access to equipment located beyond the zone that remains shielded. In addition, the number of personnel passing through the affected area during power operations will be minimal. Dose rates during plant shutdown will be insignificant because the source will be different (no N16 or Neutron).

The operating deck (2047'-6" elevation) is shielded by a 2'-0" thick concrete slab, coupled with the distance from the proposed opening, the increase in dose rate during power operations within the affected zone is only approximately 3 mrem/hour and is considered insignificant.

Conclusion:

Based on the above, total exposure to plant personnel will be reduced as a result of providing an access doorway through the secondary bio-shield wall at this location. The increase in dose rates in the affected areas will not result in the creation of a very high radiation area as defined in 10 Part 20 or 10 CFR 20.1602.