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NTD-NRC-94-4127
May 17, 1994

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

Mr. William T. Russell, Director, Office of Nuclear Reactor Regulation

Subject: Additional information regarding Westinghouse methodology used for the analysis of steam generator tube support plate deflections during a postulated main steam line break and their relation to conditional tube burst probability.

Dear Mr. Russell:

Attached you will find additional clarifying information regarding methodology used by Westinghouse to perform the tube support plate deflection analysis for the voltage based tube plugging criteria. This material is being submitted to clarify assumptions used in the analysis of Westinghouse designed and built steam generators and to distinguish differences between domestic and French steam generator designs, which have a direct impact upon calculated plate deflections.

Also, this letter will serve to establish a formal Westinghouse position regarding tube support plate displacement analysis to be used in the evaluation of interim plugging criteria amendment requests and development of the NRC Generic Letter addressing the same subject. The calendar date of the Catawba submittal, which details the tube support plate analysis, results and applications, precedes the Charlotte NRC/EPRI/Utility meeting on Defect Specific Management, NDE Seminar, during which it is believed that a Westinghouse person stated that tube support plate displacement wasn't a necessary part of the criteria. Based on EPRI decisions, Westinghouse did not actively participate in this meeting. The EPRI repair criteria were developed assuming large TSP displacements and free span burst conditions. The Catawba submittal was the initial Westinghouse effort to establish limited TSP displacement as a basis for the repair criteria. These efforts are continuing as a major Westinghouse basis for establishing repair criteria for ODSCC at TSP intersections. It is the position of the Westinghouse Electric Corporation that the friction related assumptions used in the analysis are conservative, and the results of the deflection analysis for Model D3 and D4 steam generators support a negligible probability of tube burst under worst case thermal hydraulic conditions. With limited TSP displacement established by analysis and potentially supplemented by expanding a few plugged tubes at TSP intersections, Westinghouse believes the tube repair limits should approach that implemented in Belgium and France.

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If you or any of your staff have questions regarding generic assumptions or analysis methodology, please contact Dr. Thomas Pitterle, Westinghouse Nuclear Services Division, Waltz Mill Site, (412) 722-5090.

Very truly yours,

N. J. Liparulo, Manager
Nuclear Safety Regulatory and Licensing Activities

WKC/cld
Attachment

cc: E. Murphy
J. Strosnider
T. Sullivan

CIN332:WKC/051794

Dear Mr. Russell:

This letter is provided to clarify the historical Westinghouse position on the applicability of limited S/G TSP displacement analyses to reduce the potential for a S/G tube rupture in an SLB event. This topic is particularly applicable to the tube repair limit requirements for IPC/APC applications. It appears that there may have been some misunderstanding of the Westinghouse position on this topic, as related to the Braidwood Unit 1 IPC evaluation.

The Westinghouse positions on SLB TSP displacement analyses have been documented in WCAP report transmittals supporting IPC/APC submittals for Farley, Catawba-1 and Braidwood-1. No other correspondence to the NRC has been identified that conflicts with the WCAP reports. The WCAP submittals can be summarized as follows:

S/G Model 51: WCAP-12871 Revision 0, February 1991

The Model 51 SLB TSP displacement analyses, similar to all subsequent analyses described below, have been conservatively based on assumptions of aligned tubes with zero friction and a guillotine break at hot standby conditions. These assumptions lead to the largest TSP displacements. For a SLB at or near full power operating conditions, even with the zero friction assumption, the loads on the TSPs and resulting displacements are significantly less than for a SLB at hot standby conditions.

The analysis for the Westinghouse Model 51 S/Gs show maximum, local TSP displacements for some support plates that are too large to preclude a tube rupture if it is assumed that a throughwall crack is present having a length equal to the uncovered length of tubing. The lowest TSPs and most tube locations have, however, sufficiently limited displacements to reduce the tube burst probability at these locations to negligible levels. To avoid the complexity of tube location dependent repair limits, all IPC/APC submittals for Model 51 S/Gs and the EPRI repair criteria documents are based on the assumption of free span indications (no constraint provided by the TSPs).

Framatome analyses for the French Model 51 S/G design have shown sufficiently limited TSP displacements such that EdF does not consider free span burst as a basis for establishing repair criteria. The French Model 51 S/Gs have more tie-rods restraining TSP movement than most Westinghouse Model 51 S/Gs, and there are likely to be some differences in the methods of supporting the plates at the plate-to-wrapper interface. While Westinghouse has not reviewed the French analyses, there is no basis to question the differences between the French and Westinghouse analyses as the

results are very sensitive to the number of tie-rods and to the type of plate supports at the wrapper interface. This sensitivity is shown by the Westinghouse analysis results for the Model D3 and D4 S/Gs as described below. In addition, by expanding tubes which are going to be plugged into the TSPs, one can show similar acceptability for Model 51 S/Gs to that demonstrated by the French. A significant change in TSP displacement can be achieved by locking a small number of tubes to the TSPs, as discussed with the NRC for Braidwood-1.

S/G Model D3: WCAP-13494 Rev. 1, March 1993 and WCAP-13684 Revision 1, October 1993

The SLB TSP displacement analyses for the Catawba-1 Model D3 S/Gs show limited TSP displacements at all tube locations such that the probability of a tube rupture is negligibly small even for a SLB event at hot standby conditions. The principal reasons for the difference from the Model 51 results are the increased number of tie-rods in the Model D3 and, even more significantly, the differences in supports at the edges of the plates. For Model 51 S/Gs wedges at the plate edges are welded to the plates and provide no vertical restraint under the zero friction assumption. For the Catawba-1 Model D3 S/Gs, the wedges at the upper plates are welded to the wrapper and most plates have additional bar supports or welds at the edges of the plates. These differences in the TSP supports lead to the low SLB TSP displacements for Model D3 S/Gs.

S/G Model D4: WCAP-14046, April 1994

The Braidwood-1 SLB TSP displacement analysis results for Model D4 S/Gs are very similar to the Model D3 results except for the corners of two of the eight plates at the tube lane. A few tube locations at these plate corners have displacements that are sensitive to the assumed conditions and resulting loads for the SLB event. For a SLB at normal operating conditions, all displacements are sufficiently small such that the potential for a tube burst is negligible. Only under very conservative assumptions (SLB at hot standby conditions, low water level, coincident feedwater transient) are the TSP corner displacements significant for the Model D4 S/G. The principal reason for the differences in displacements for the Model D3 and D4 S/Gs is that the Model D3 has a bar constraint at the plate corners while the Model D4 does not have this constraint.

I hope that the above discussion clarifies the Westinghouse position on limited TSP displacement in a SLB event. Please call V. J. Esposito (412-722-5382) if we can provide further assistance on this important topic for APC repair limit considerations.