TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

July 17, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Applications of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391
		50-438
		50-439

Please refer to L. M. Mills's letter to you dated October 9, 1984 concerning piping design criteria for the Watts Bar and Bellefonte Nuclear Plants and to NRC's subsequent letter from Thomas M. Novak to H. G. Parris dated January 28, 1985 which concluded that TVA's submittal was not fully acceptable.

Enclosed is a revised submittal which addresses comments made in NRC January 28, 1985 letter and updates the wording to reflect subsequent issue of ASME Code Cases N-397 and N-411. Note that the Bellefonte and Watts Bar Nuclear Plants requests for variable damping and peak shifting have been combined in enclosure 1 and that enclosure 2 (use of multiple response spectra) has been changed to address NRC rules, which were given as an enclosure to NRC's January 28, 1985 letter.

If you have any questions, please get in touch with K. P. Parr at FTS 858-2682.

Very truly yours

TENNESSEE VALLEY AUTHORITY

J. A. Domer

J. A. Domer, Chief
Nuclear Licensing Branch

Sworn to and subscribed before me
this 17th day of July 1985

Paulette L. White

Notary Public
My Commission Expires 8-24-88

Enclosures
cc: See page 2

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Director of Nuclear Reactor Regulation July 17, 1985

cc: U.S. Nuclear Regulatory Commission (Enclosures)
Region II
Attn: Dr. J. Nelson Grace, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

ENCLOSURE 1

BELLEFONTE AND WATTS BAR NUCLEAR PLANTS
USE OF HIGHER VARIABLE DAMPING VALUES
AND AN ALTERNATE PEAK BROADENING TECHNIQUE
IN SEISMIC PIPING ANALYSIS

The following statements apply to variable damping and peak shifting:

1. TVA will use the variable damping in accordance with ASME Code Case N-411 and response spectrum shifting in accordance with ASME Code Case N-397 as discussed in our June 27, 1984 letter to the NRC for the seismic analyses of piping systems at both Bellefonte (BLN) and Watts Bar (WBN). These techniques will be implemented immediately unless directed otherwise by the NRC.

2. The proposed piping analysis changes will not be used for time history analyses until such time as its use is endorsed by the Pressure Vessel Research Committee (PVRC).

3. The proposed piping analysis changes are not limited to computer-modeled (rigorous) analyses but will also be applied for piping supported by criteria (alternate) analyses.

4. The design used for WBN includes a two-dimensional earthquake (the largest combination of vertical plus either horizontal component). The three dimensional earthquake (combination of the two horizontal plus vertical components per Regulatory Guide 1.92) was used for BLN.

5. At WBN, dynamic loads resulting from the design basis accident were generated by the spectral analysis method using 2-percent damping. TVA will use variable damping for any reevaluation or new designs where dynamic loads are evaluated by response spectra techniques.

USE OF HIGHER VARIABLE DAMPING
AND RESPONSE SPECTRA SHIFTING TECHNIQUES
FOR THE SEISMIC ANALYSIS OF PIPING SYSTEMS
AT TVA'S BLN AND WBN

TVA proposes to utilize the following two developments reported by the PVRC in any future seismic analysis of the piping at WBN and BLN. Use of these techniques will still produce conservative results for seismic analyses. These developments by PVRC (with TVA participating) have been submitted by PVRC to NRC for approval.

Variable Damping Values for Piping Analysis

The Task Group on Damping Values of the PVRC Technical Committee on Piping Systems has recently completed a review of a significant data base of damping tests. The results of the review clearly indicate the justification for increasing the present damping values for seismic design of nuclear power plant piping above those specified in Regulatory Guide 1.61, as was used for BLN and above the more conservative values used for WBN. Based upon their evaluations, the current recommendation of the Task Group members is that damping of 5 percent is acceptable to 10 hertz linearly decreasing to 2 percent at 20 hertz and held constant at 2 percent to 33 hertz. Recommendations are for both operating basis earthquake and safe shutdown earthquake and are independent of pipe diameter. This variable damping is as described in ASME Code Case N-411.

If, as a result of using the damping values in ASME Code Case N-411, piping supports are moved, modified or eliminated, the expected increased piping displacements due to greater piping flexibility will be checked to assure that they can be accommodated and that there will be no adverse interaction with adjacent structures, components and equipment.

The main steam lines at TVA's BLN were reanalyzed before the PVRC findings due to the revised seismic spectra for various buildings. The damping values used in the spectral analysis method were in accordance with NRC Regulatory Guide 1.61. The reanalysis resulted in overloading of several rigid and seismic pipe supports.

Based on the PVRC recommendations, TVA performed a second iteration on the analysis of main steam lines for BLN using the new damping values. The pipe support loads obtained by using these variable damping values (5 percent to 2 percent) were compared with those obtained by using standard damping values from Regulatory Guide 1.61. As a result of this comparison, it was discovered that fewer pipe supports exhibited significant load increase. Four rigid supports and ten dynamic snubbers, which were overloaded in the earlier analysis, did not overload in the later analysis using higher damping values. Elimination of redesign and installation work on these four supports and ten snubbers alone will result in savings in the range of $500,000.

Spectra Shifting

Regulatory Guide 1.122 recommends that the calculated dominant peaks of the floor response spectra be broadened to account for uncertainties in the structural frequencies owing to uncertainties in the material properties of the structure and soil and to approximations in the modeling techniques. This method of peak broadening is very conservative. An alternative method of broadening of the structural peaks as described in ASME Code Case N-397 can be based on a probabilistic approach. In the particular case where there is more than one piping frequency located within the frequency range of a widened spectrum peak, the floor spectrum curve may be more realistically applied in accordance with this code case.

It is obvious that the analysis utilizing peak shifting becomes cumbersome and less efficient for multiple support motion (multiple zones) and also if there is more than one peak within a defined frequency range of interest. It is TVA's intent to use the spectra shifting technique only if relief is required on a particular pipe support where substantial rework is determined to be required by the standard method.

Recommendations

The proposed recommendations have been accepted by the PVRC Task Group on Damping, the Technical Committee on Piping Systems, and the Steering Committee on Piping Systems. The proposals have been forwarded to NRC (reference 1) and considered by ASME (reference 2) for review and approval on a generic basis. Recently, these two issues have been officially recognized by the ASME as ASME Code Cases N-397 and N-411. NRC was represented on the PVRC committees. Dr. S. N. Hou and Dr. W. F. Anderson were on the Technical Committee on Piping Systems, Task Group on Damping, and R. J. Bosnak participated on the Steering Committee on Piping Systems. The response spectra peak shifting method has been accepted by NRC for inclusion in Standard Review Plan 3.9.2. The damping proposal has been accepted by NRC for use by Southern California Edison on San Onofre unit 1 (reference 3).

We believe that the changes proposed by PVRC for higher damping values and for an alternative to peak broadening are more realistic but still result in a conservative design. Such findings were substantiated by the Lawrence Livermore National Laboratory on three piping systems at Zion Nuclear Plant (reference 4). TVA plans to employ these two techniques in future analysis efforts for BLN and WBN.

References

1. Letter from L. J. Chockie, Chairman of PVRC, to N. J. Palladino, Chairman of NRC, dated June 9, 1983.

2. Minutes of the Special Working Group on Dynamic Analysis of ASME Section III, February 6, 1984.

3. Letter from Harold R. Denton, Director of the Office of Nuclear Reactor Regulation, to K. Baskin, Vice President Nuclear Engineering Licensing and Safety Department of Southern California Edison Company, dated February 8, 1984.

4. "Impact of Changes in Damping and Spectrum Peak Broadening on the Seismic Response of Piping Systems," NUREG/CR-3526, December 1983.

In response to NRC recommendations (reference) on the "Independent Support Motion Method":

a) For Inertial (or Dynamic) Components:

Recommendation

1) The responses of different support groups for each direction should be combined by the absolute sum method.

2) Modal and directional responses should be combined by the SRSS method without considering closely spaced frequencies.

TVA Response

1) We request concurrence with our present practice (used since 1981) of SRSS combination of responses from different support groups for statistically independent structures. On BLN, combination of different support groups by absolute sum is required if the structures cannot be established as statistically independent. Our position is supported by an internal study, ASME paper 81-WA-FV1-2, Kennedy in NUREG 1061, Brookhaven Report NUREG/CR3811, and Nuclear Engineering Paper, "Seismic Response of Structures by the Response Spectrum Method" (Bechtel, 1981).

2) In conjunction with the SRSS combination of the different support groups, we are combining modal responses by the NRC grouping method to account for closely spaced modes, which is more conservative than SRSS. Directional responses are combined by SRSS, which is in agreement with the recommendation.

Option

Our analysis handbooks will be changed to give the analyst the option of using the above recommendation.

Early Analysis

Some WBN and BLN analysis performed prior to 1981 utilized SRSS combination of different support groups for separate floors of the same structure; consequently, the FSAR has been written to account for this technique. Criteria has not allowed this practice since 1981. These analyses are being changed to utilize enveloped spectra or ABSUM when reanalyzed for other reasons.

b) For Pseudo-static Components - Seismic Anchor Movements (SAM):

Recommendation

1) For each group, the maximum absolute response should be calculated for each input direction, and these should then be combined by the absolute sum rule.

2) The directional responses should be combined by the SRSS rule.

TVA Response

1) We are in agreement.

2) We are in agreement.

c) For the Total Response:

Recommendation

Dynamic and pseudo-static responses should be combined by the SRSS rule.

TVA Response

For stress analysis, TVA is in agreement with the ASME Code which allows SAM to be added to secondary stresses. When SAM is added to secondary stress, it will generally not be combined with dynamic response. However, when it is combined, we are conservative as we are using the absolute sum method (ABSUM). For support loads, we are combining by ABSUM. We will change to SRSS with a computer program change at a later date.

d) High Frequency Modes:

Recommendation

Algebraic summation should be made for high frequency modes, and the resulting quantity should be combined with the response to lower frequency modes by the SRSS rule.

TVA Response

Our piping analysis program (TPIPE) is programmed to calculate rigid response static load cases for each of the x, y, and z directions and to screen the results against lower frequency dynamic load cases. The static loads generated are based on the entire mass. The consideration of high frequency modes to account for the nonparticipating (or missing mass) is a relatively new concept. It is being evaluated for possible incorporation into TPIPE.

For BLN, present procedures call for screening of load cases as described above, where the reference requires SRSS combination. However, it is our opinion that the existing analysis performed in this manner is acceptable based on the conservative masses used and by the relative size of the loads. If a dynamic analysis of a rigid area generates a load that is small compared to the rigid response load, the SRSS combination would provide a load negligibly larger than screening. Also, if the dynamic load is large, the rigid response load will likely be small, with the same results.

For WBN, the rigid response was evaluated for alternate analysis problems and for valves on piping attached to the steel containment vessel.

Reference

Thomas M. Novak's letter to H. G. Parris dated January 28, 1985.