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SUBJECT: Forwards response to NRC 861202 request for addl info re piping stress analysis damping values, including util response to NRC comments, proposed revs to FSAR & util 700605 ltr transmitting seismic spectra info.

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United States Nuclear Regulatory Commission
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
PIPING STRESS ANALYSIS DAMPING VALUES

Reference:
1. Carolina Power & Light Company Letter No. NLS-85-457, dated April 24, 1986
2. United States Nuclear Regulatory Commission Letter, dated December 2, 1986

Gentlemen:

Carolina Power & Light Company (CP&L), by submittal of Reference 1, requested approval to utilize the damping curve developed by the Pressure Vessel Research Council (PVRC) in ASME Code Case N-411. This letter is in response to the request for additional information and commitments identified by Reference 2. The FSAR changes and accompanying commitments have been restructured from the original submittal. To avoid possible confusion, this letter supersedes the previous submittal in its entirety.

Specifically, reference to Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants" has been removed. The existing HBR2 design basis employs the more restrictive damping values specified in FSAR Section 3.7.2.2 "Damping Factors" and Table 3.7.2-1. An additional change from the previous submittal is the omission of the use of the N-411 damping values for seismic analysis of Operating Basis Earthquake (OBE) event. Since HBR2 does not have OBE Seismic Response Spectrum Curves, Code Case N-411 could not be used for these analyses and reference to it could possibly create confusion.

The existing FSAR criteria for piping analyses and the proposed PVRC damping with the upgraded criteria are considered as valid options for pipe stress analyses and modification work at Robinson. When performing analyses, the damping values taken from the curve presented in Code Case N-411 are only to be used with the upgraded criteria, not with the original FSAR criteria. That is, no analysis will combine damping values and criteria which are not consistent.

CP&L's response to each specific NRC comment is provided in Attachment 1. Proposed revisions to the affected FSAR tables and text as well as the new PVRC damping curve figure are provided in Attachment 2. Engineering practices to check for adequate clearances, support/structure load carrying capacity, and to confirm acceptable acceleration values are not separately identified within the FSAR since these practices are applicable to all piping analysis design efforts. Implementation of the proposed FSAR revisions shown in Attachment 2 will close out all commitments made within this submittal.

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FEB 16 1987

To facilitate review, a copy of our June 5, 1970 letter transmitting the HBR2 current seismic spectra has been included as Attachment 3.

Should you have any questions regarding this request, please contact Mr. Sherwood R. Zimmerman at (919) 836-6264.

Yours very truly,

A. B. Cutter - Vice President
Nuclear Engineering & Licensing

ABC/MDM/kts (5123MDM)

Attachments

cc: Dr. J. Nelson Grace (NRC-RII)
Mr. H. Krug (NRC Resident Inspector - RNP)
Mr. G. Requa (NRC)

ATTACHMENT 1

NRC COMMENT #1 The damping values specified in Code Case N-411 may be used only in those analyses where current seismic spectra and procedures have been employed. The 0.1g and 0.2g Housner spectrums which are identified in Figures 2.5.2-2 and 2.5.2-3 of the H. B. Robinson, Unit 2 Updated FSAR cannot be considered as "current".

CP&L RESPONSE The damping values specified in Code Case N-411 will only be used in analyses in which current seismic spectra and procedures are employed for dynamic piping analysis. These current seismic spectra were previously provided to the NRC in CP&L letter dated June 5, 1970 (Attachment 3).

NRC COMMENT #2 For equipment other than piping, the damping values specified in Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants", should be used.

CP&L RESPONSE The damping values specified in Code Case N-411 will only be used for piping stress analysis. For equipment other than piping, the damping values specified in FSAR Table 3.7.2-1 shall be maintained. These values are more restrictive than those provided in Regulatory Guide 1.61.

NRC COMMENT #3 These damping values are not appropriate for analyzing the dynamic response of piping systems using supports designed to dissipate energy by yielding (i.e., the design of which is covered by Code Case N-420).

CP&L RESPONSE The damping values specified in Code Case N-411 will not be used for analyzing the dynamic response of piping systems using supports designed to dissipate energy by yielding.

NRC COMMENT #4 These damping values are not applicable to piping in which stress corrosion cracking has occurred unless a case-specific evaluation is made and is reviewed by the NRC staff.

CP&L RESPONSE The damping values specified in Code Case N-411 will not be used for analyzing piping in which stress corrosion cracking has occurred unless a case-specific evaluation is made and is provided to the NRC staff for review.

NRC COMMENT #5 The damping values specified in Code Case N-411 may be used only in analyses which assume an upper bound envelope of the individual response spectra for all support locations to calculate maximum inertial responses of multiple-supported items.

CP&L RESPONSE The damping values specified in Code Case N-411 will be used only in analyses which assume an upper bound envelope of the individual response spectra for all support locations to calculate maximum inertial responses of multiple-supported systems.

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NRC COMMENT #6 Where predicted maximum piping displacements using Code Case N-411 criteria exceed the current design calculations by an amount greater than acceptable tolerance levels, a physical verification of the availability of adequate clearance with adjacent structures, equipment and components must be performed. For equipment mounted on piping such as valves with extended structures, proper account must be taken for both rotation and translation in arriving at the predicted maximum displacement at the extreme ends of pipe mounted equipment.

CP&L RESPONSE This requirement is standard engineering practice and performed for all piping analyses whether or not Code Case N-411 is applied. Such a review will continue to be performed.

NRC COMMENT #7 It must be verified that the operability qualification level of pipe mounted equipment is not exceeded by the predicted response using Code Case N-411.

CP&L RESPONSE This requirement is standard engineering practice and performed for all piping analyses whether or not Code Case N-411 is applied. Such a review will continue to be performed.

NRC COMMENT #8 Where the existing design loads of piping supports are exceeded by the new loads predicted by the use of Code Case N-411, it must be verified that the new loads do not exceed the design capacity of the supports.

CP&L RESPONSE This requirement is standard engineering practice and performed for all piping analyses whether or not Code Case N-411 is applied. Such a review will continue to be performed.

NRC COMMENT #9 It must be verified that the cumulative effect of the changes of loads on piping supports that are in turn supported by a structural element of a building, such as walls, slabs, beams and columns, does not exceed the load carrying capacity of the affected structural element.

CP&L RESPONSE This requirement is standard engineering practice and performed for all piping analyses whether or not Code Case N-411 is applied. Such a review will continue to be performed.

NRC COMMENT #10 The FSAR and other applicable documents must be amended to identify the licensee's request for the application of Code Case N-411 and the staff's approval of the request. The application of Code Case N-411 shall be described in the FSAR and a commitment shall be included in the FSAR to maintain in the licensee's engineering records a current list and individual files of all pipe stress packages reanalyzed using Code Case N-411.

CP&L RESPONSE The FSAR and other applicable documents will be amended at the next scheduled update to specifically address the commitments associated with the application and approval for use of Code Case N-411. A commitment will be include in the FSAR to specifically reference use of Code Case N-411 for each pipe stress package using these damping values.

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ATTACHMENT 2

PROPOSED FSAR REVISION

(5123MDM/mmh)

Restraints were added to these systems to change their fundamental frequency such that it fell outside the building fundamental frequency band.

3.7.3.2.7.2 Systems Analyzed by the Simplified Method

As described above, the design basis for systems analyzed by the simplified method was that restraints and supports were placed at close enough intervals so that seismic stresses would not exceed 5000 psi for the OBE and 10,000 psi for the DBE. An evaluation was performed for this method in a manner similar to that described in Section 3.2.3.2.7.1.

3.7.3.2.8 Valve Evaluation - Effects Of Valve Operators

For systems originally analyzed by the computer method, the stress levels at all applicable valve locations were increased as described in Reference 3.7.3-1 to account for the effect of the offset mass of the valve operators. Thus, by including the total stress (i.e., stress due to valve operators and normal piping stresses) in the evaluation described in Section 3.7.3.2.7, the potential effect of resonance was determined.

For systems analyzed by the simplified method, an overall evaluation was performed utilizing the information from Reference 3.7.3-1. For this evaluation the worst stress condition (i.e., for a 2 in. valve) was assumed to apply in all cases.

As a result of the investigation of the effect on Class I piping due to valve operator offset weight (Reference 3.7.3-1) it was concluded that supports were required for the operators on valves less than 2 in. diameter. Therefore, supports were provided to meet the following criteria:

a) Supports were provided at the valve body or operator in such a manner that the offset weight effect is essentially eliminated

b) The support accepts all valve operator load when considering the appropriate seismic loading at the valve location.

3.7.3.2.9 Systems Analyzed by Dynamic Methods

As initiated by response to IE Bulletin 79-14, the DBE dynamic analysis for safety-related piping systems incorporates the following techniques:

a) The DBE response spectrum curves (.5 percent damping) are broadened plus and minus ten percent.

b) The inclusion of closely spaced modes follow the guidelines of NRC Regulatory Guide 1.92.

c) The cutoff frequency is 33 Hertz.

d) The participation of mass in the rigid range is included.

e) A 3D earthquake is formed using the SRSS method.

f) The vertical response spectrum is taken as 2/3 of the building ground response curve.

g) In some cases multi-level excitation (different response spectra for different restraints) is used.

3.7.3.2.9.1 Code Case N-411 Optional Damping Values

The damping values given in Figure 3.7.2-7 may be used as an option only if the following criteria are applied in addition to those previously listed in 3.7.3.2.9.

a) A response spectrum analysis is performed and not a time history analysis.

b) The alternate damping values will be used only for piping.

c) The alternate damping values will not be used to analyze piping systems using supports designed to dissipate energy by yielding.

d) The alternate damping values will not be used in conjunction with multi-level excitation.

e) The alternate damping valves will not be used in analyzing piping systems in which stress corrosion cracking has occurred.

f) Application of these damping values will be separately identified in each calculation

3.7.3.3 Class I Equipment

The purpose of this section is to identify the procedure used in the seismic design of Class I equipment to assure that the seismic requirements were met.

3.7.3.3.1 Seismic Criteria

Seismic requirements and design adequacy were determined as follow:

a) The horizontal seismic accelerations used were equal to or greater than the accelerations that occur at the equipment location (i.e., at the proper building elevation) as determined from the building dynamic analysis for the DBE

b) The vertical seismic accelerations used were 2/3 of the value selected for horizontal acceleration

c) The vertical and horizontal accelerations were assumed to act simultaneously

International Atomic Energy Agency (IAEA) Panel on "Aseismic Design and Testing of Nuclear Facilities," held in Tokyo, Japan in June 1967, and the Word Conference on Earthquake Engineering held in Santiago, Chile, in January, 1969.

The model analysis was performed utilizing the same damping factors for each mode.

The optional damping values for piping in Table 3.7.2-1 and Figure 3.7.2-7 may be used if the criteria in 3.7.3.2.9.1 is followed.

3.7.2.3 Dynamic Characteristics of Structures Inside Containment

The dynamic characteristics of the concrete inner structures are:

a) Periods of vibration (including rocking)

T_1 = 0.166 sec
T_2 = 0.046 sec
T_3 = 0.018 sec
T_4 = 0.006 sec

b) Absolute accelerations

	0.1g Earthquake	0.2g Earthquake
El 275 (operating floor)	0.3g	0.44g
El 251 (intermediate floor)	0.14g	0.23g
El 226 (base mat)	0.1g	0.2g

c) Relative Displacement

	0.1g Earthquake	0.2g Earthquake
El 275 (operating floor)	.0007 inches	.001 inches
El 251 (intermediate floor)	.0003 inches	.00048 inches

The dynamic analysis for the internal concrete structure of the reactor containment was performed by the Modal Analysis Method using average damping factors for all modes of vibration, including rocking. The damping factors used were 2 percent of critical for the operational basis earthquake (OBE) (design, 0.1g) and 5 percent for the design basis earthquake (DBE) (hypothetical, 0.2g).

The concrete inner structure was analyzed as a free standing cantilever beam having no structural connection to the reactor containment above the foundation mat. The effect of the containment structure on the vibration of the concrete inner structure was considered in the multi-mass model by including the mass moment of inertia of the containment with that of the foundation mat to account for its contribution to foundation rocking.

TABLE 3.7.2-1

DAMPING FACTORS

Component	Percent of Critical Damping
Containment Structure	2.0
Concrete Support Structure of Reactor Vessel	2.0
Steel Assemblies:	
(a) Bolted or Riveted	2.5
(b) Welded	1.0
Vital Piping Systems	0.5*
Concrete Structures Above Ground:	
(a) Shear Wall	5.0
(b) Rigid Frame	5.0

* For final reconciliation of pipe stress analysis, piping system backfits, or new piping damping values as define in ASME Code Case N-411 (Figure 3.7.2-7) may be utilized for ~~both OBE and~~ DBE.

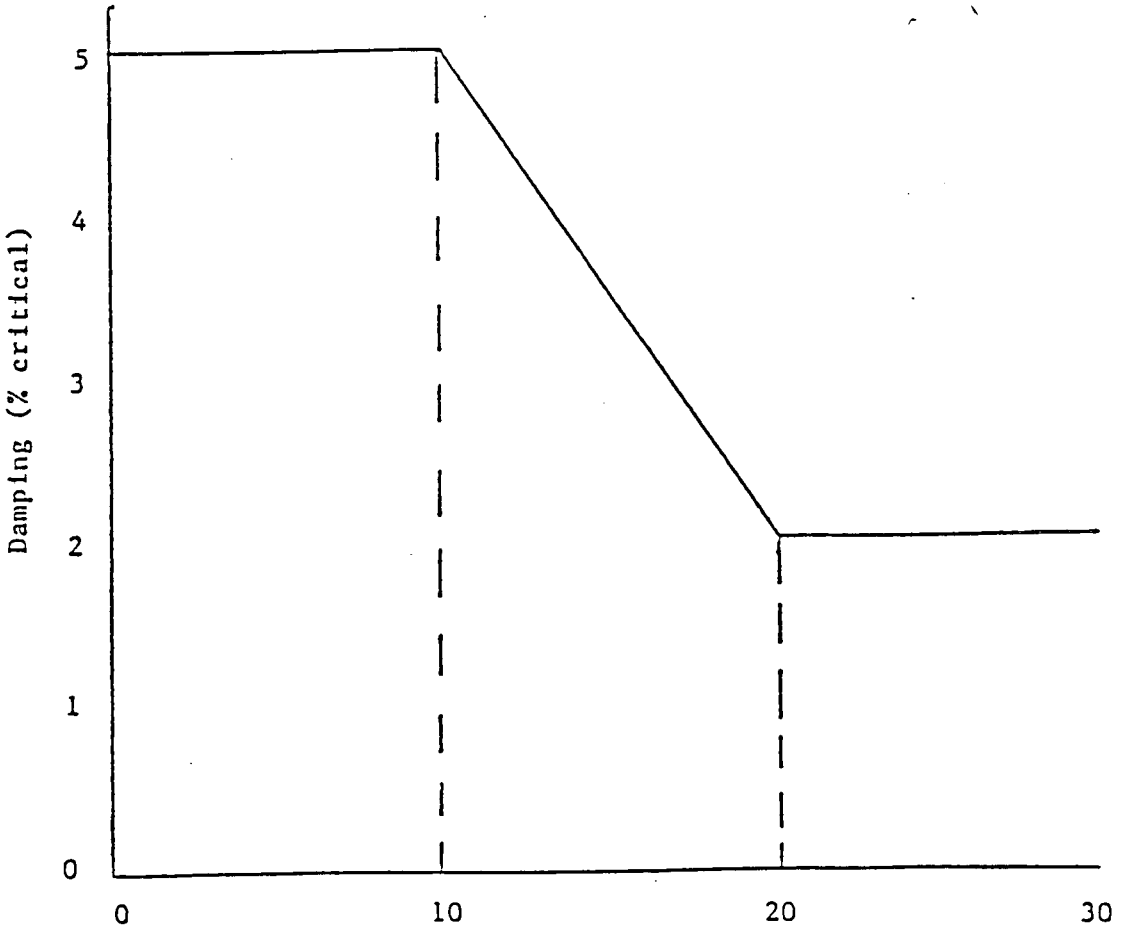

Figure 3.7.2-7

Damping Value for Seismic Analysis of Piping

(Applicable to DBE, Independent of Pipe Diameter)

ATTACHMENT 3

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