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AUTH.NAME AUTHOR AFFILIATION
MCDUFFIE,M.A. Carolina Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards minutes of 830201-03 meetings w/Mechanical Engineering Branch to respond to questions transmitted in 821222 ltr.Responses committing to FSAR change will be incorporated into future amend.

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Denton

CP&L

Carolina Power & Light Company

MAR 16 1983

SERIAL: LAP-83-63

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
MECHANICAL ENGINEERING BRANCH
FEBRUARY 1 - 3, 1983 MEETING MINUTES

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby transmits meeting minutes documenting the February 1-3, 1983 meeting with the Mechanical Engineering Branch (MEB). The purpose of the meeting was to respond to questions transmitted by the NRC Staff by letter dated December 22, 1982. The attached minutes are presented in a question-response format for clarity. Responses to all 45 MEB questions were provided and the status of each is listed below:

Closed	Closed Pending FSAR Change	Confirmatory	Open
210.3	210.01	210.19	210.07
210.4	210.02	210.20	210.16
210.5	210.06	210.32	210.33
210.13	210.08	210.36	210.34
210.14	210.09	210.45	210.35
210.17	210.10		210.40
210.18	210.11		210.44
210.21	210.12		
210.22	210.15		
210.24	210.23		
210.26	210.25		
210.27	210.28		
210.37	210.29		
210.41	210.30		
210.43	210.31		
	210.38		
	210.39		
	210.42		

B001

...tteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

For questions designated closed, it is CP&L's understanding that no additional information is required by the NRC Staff. For those responses committing to a Final Safety Analysis Report (FSAR) change, the changes will be incorporated into a future amendment. Those questions designated as confirmatory are awaiting NRC Staff review of information to be submitted or information previously submitted. Questions are designated open when no resolution with the Staff is possible at this time. Carolina Power & Light Company will further address these open items at a later date.

If you have any questions on these responses, please contact our staff.

Yours very truly,

M A McDuffie

M. A. McDuffie
Senior Vice President
Engineering & Construction

JHE/cfr (6324JHE)
Attachment

cc: Mr. N. Prasad Kadambi (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. Travis Payne (KUDZU)
Mr. Daniel F. Read (CHANGE/ELP)
Chapel Hill Public Library
Wake County Public Library
Mr. Wells Eddleman
Dr. Phyllis Lotchin
Ms. Patricia T. Newman
Mr. John D. Runkle
Dr. Richard D. Wilson
Mr. G. O. Bright (ASLB)
Dr. J. H. Carpenter (ASLB)
Mr. J. L. Kelley (ASLB)

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Yours very truly,

M. A. McDuffie
Senior Vice President
Engineering & Construction

JHW/cfr (5726JHS)
Attachment

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Mr. G. O. Bright (ASLB)
Dr. J. H. Carpenter (ASLB)
Mr. J. L. Kelley (ASLB)

Q 210.01 3.2.1.1, Table 3.2.1-1

What code was used in the design of reactor vessel internals? Why is there no quality group required for the reactor vessel internals?

RESPONSE:

As with other Westinghouse plants (e.g., Catawba, Watts Bar) of the same vintage which have previously been reviewed by the Mechanical Engineering Branch, the reactor internals for Shearon Harris were fabricated prior to implementation of sub-section NG of the ASME Code. However, the reactor internals were designed and fabricated consistent with the requirements of the ASME Code but do not have a specific code stress report or stamp. A footnote will be added to Table 3.2.1-1 to reflect the above stated design requirements implemented for the reactor internals.

In addition, per the operational QA program the reactor internals were identified as quality group B in accordance with Regulatory Guide 1.26.

Based upon the above, this item is closed pending an FSAR revision.

Q 210.02 3.2.1.1, Table 3.2.1-1, Pages 3.2.1-28, 29

Several waste processing system components that are identified safety class 3 are not seismic Category I. Explain this apparent inconsistency.

RESPONSE:

Westinghouse has supplied various components in the liquid and gaseous waste processing systems. As noted on Table 3.2.1-1, the reactor coolant drain tank pump, waste gas compressor, and hydrogen recombiner (catalytic) are non-nuclear safety components and, therefore, do not require seismic qualification. This classification is consistent with Regulatory Guide 1.143. However, based on contractual requirements with CP&L, Westinghouse designed and built these components to ASME Code Class 3 requirements. Additionally, these components were seismically qualified by analysis. Table 3.2.1-1 will be modified to reflect that these components have been seismically qualified.

It should also be noted that the gas decay tank has been seismically qualified as a Category I component. Therefore, Note 13 on Table 3.2.1-1 will be deleted and the gas decay tank identified as seismic Category I.

Based on the above information, this item is closed pending an FSAR revision.

Q 210.03 3.2.1.2, Page 3.2.1-2

Identify safety class 2 systems or components that are part of the reactor coolant pressure boundary.

RESPONSE:

Westinghouse utilizes the criteria in ANS 18.2a-1975 for defining the Class 1/Class 2 pressure boundary. Westinghouse does not provide any Class 2 components in the portion of systems defined in Class 1. One of the Class 1/Class 2 pressure boundary criteria concerns the use of flow limiting devices which would limit flow from a break in the RCS pressure boundary to a limit which could be made up by the normal charging system. Specifically, Westinghouse may use a 3/8" orifice to define the Class 1/Class 2 pressure boundary because a break downstream of a 3/8" orifice can be accommodated through the normal charging system. As such, components downstream of the 3/8" orifice will see RCS pressure but can be classified as Class 2. Typically, such components consist of small piping and valves (e.g., instrument lines).

Based upon the above discussion with the Staff, this item is closed.

Q 210.04 3.6.1.2.3, Page 3.6.1-2

Provide details of the portions of the safety injection system that you have excluded for break and through-wall leakage cracks by reason of not being normally pressurized.

RESPONSE:

The Safety Injection piping inside containment from the containment penetrations (M-17, M-20 and M-21) to the first check valves (ISI-V17SA, ISI-V230SB, ISI-V29SA, ISI-V63SA, ISI-V69SB, ISI-V75SA, ISI-V39SA, ISI-V45SB, ISI-51SA, ISI-V84SA, ISI-V90SB and ISI-V96SB) at the safety class break is not normally pressurized, and is therefore, excluded from break and through-wall crack evaluation.

This item is closed.

Q 210.05 3.6.1.2.4, Page 3.6.1-10

The criteria you have used for the effects of jet impingement forces is intended for postulating the effects of unrestrained whipping pipe. Provide justification for applying this criteria to the effects of jet impingement.

RESPONSE:

The forces imposed on a particular pipe segment and its restraining system which result from impact of a whipping pipe or from impingement of a jet issuing from the break of a pipe identical in nominal size and wall thickness as the whipping pipe are related. The internal energy of the particular pipe is converted to a fluid mass acceleration (the jet) which is counterbalanced by the whipping pipe inertia and piping restraint reaction forces after the impact. Since most of the energy of the whipping pipe is recovered at and post impact (where the jet thrust force is counterbalanced by the reaction forces in the restraints), while usually not all of the jet impingement energy is recovered because a pipe will not intercept the entire jet emanating from a pipe of equal nominal size, the force from an unrestrained whipping pipe on a pipe of same nominal size will generally be larger than the corresponding force due to jet impingement.

Since both the ANSI N176 standard and the SRP3.6.1 acknowledge that whipping pipes are considered incapable of damaging pipe of equal nominal size and equal or larger wall thickness, we feel that such criterion is equally justifiable for jet impingement.

Further confidence that this would indeed be justifiable was provided to us by our experience with dynamic analysis of piping systems subjected to jet impingement forces.

Such analyses would demonstrate that pipes which are restrained in accordance with design guidelines would not be adversely affected when impinged upon by jets issuing from pipes of equal nominal pipe size.

The following is an example that serves as illustration of why this is so.

The example chooses a 4 inch sched. 80 pipe carrying cold water at 1,275 psig. This pipe is assumed to break and the resulting jet is assumed to impinge upon an identical line located closer than the typical separation between lines. A distance of one pipe diameter is considered appropriate.

The maximum jet force is computed from:

$$F_J = k\, P_o\, A_b\, \frac{A_{target}}{A_{jet}}\, G$$

Where P_o is the operating pressure, A_b the break area, A_{target} the area of the jet intercepted by the target, A_{jet} the total area that the jet would have at the target location, and G is a shape factor which is related to the drag exerted by the jet. The factor k is a fluid coefficient which for cold fluids can be taken as 2.0. In this case we can conservatively assume that A_{target}/A_{jet} = .68. The shape factor in this instance equals 0.576 (from ANSI N176).

The force of the jet onto the other 4 inch sched. 80 pipe is therefore equal to about 11500 lb. We further assume that the target pipe is safety related and would therefore be seismically supported. The attached nemograph for restraint spacing indicates that straight spans of 4 inch sched. 80 pipe (constant k = 2450 to 3800 - see attached table) would be restrained every

9 to 11 feet. Presence of bends would further reduce the spacing. Since the boundary conditions of the span for the subsequent analysis is assumed to be simply supported, a spacing of 9 feet is used. Because of the closeness of the pipe, the full fluid force is not achieved until after the fluid has already impacted on the target, i.e., opening time of break (1 msec) is longer than time to reach target (0.5 msec). Thus the dynamic load factor of 2 may be applied to a force equal to $1\ P_o A_b \frac{A_{target}}{A_{jet}} G$ or the full force can be considered as statistically applied.

For that spacing, with the conservative assumption that the span is simply supported, a force of 11500 lbs placed at midspan would result in a maximum moment of about 3.1×10^5 in-lbs.

This moment is lower than 8.5% of the ultimate moment carrying capability of a 4 inch sched. 80 pipe. This moment is computed using Gerber's method[1] to be 372.8×10^5 in-lb and 387.27×10^5 in-lb for carbon steel and stainless steel pipes respectively (these values are confirmed by test). At this value movement strains are still low. In the worst case strains of 0.035% would occur. Such relatively small strains are indicative of the fact that the cross sectional area of the pipe would not be affected to the point that flow would be impaired. Naturally the pipe does retain its integrity.

A further note must be made. Besides the conservatisms inherent in the assumption of the target pipe being immediately adjacent to the jet origin, it is known that the modelling of the segment of affected pipe as a single span produces conservative results. Reference 2 demonstrated that inclusion of multispans reduces the computed moment significantly. For a multispan system the resulting moment would be below 70% of the ultimate moment (see attached example curves which demonstrate the conservatism of employing a single span model from the moment and reaction force standpoint as well as for the span lengths in question. The generic capability of the restraints to accept the resulting loads is not as easily demonstrated as the integrity and functionality of the pipe, since restraint design varies quite widely.

In general we found that the restraints are capable of accepting the loads. The best way of demonstrating this is by an example taken from Shearon Harris. This example happens to be for a 4 inch sched. 80 pipe so that comparisons of real occurences with the previously assumed arbitrary problem.

It is appropriate at this point to discuss and stress the fact that in Shearon Harris, the criterion that is being questioned eliminated only four jet impingement occurrences from approximately 200 interactions studied inside the containment. For these four cases three of the target pipes had the same size but twice the wall thickness. This explanation is given to stress the fact that in general the jet impingement from a pipe of same nominal size is not a design basis item. Rather the target pipe is examined for impingement by a jet from a larger pipe.

The specific Shearon Harris example is a jet from a broken line 3 AF4-1SA-1, labelled AT-AF-1-SA on drawing Sk. 2165-MNE-R-071 (Rev 6). The impacted line is 3AF4-95B-1. Using the methodology described in Section 3.6 of the FSAR, the force on the projected target is computed to be 2550 lbs. (This includes a dynamic amplification of 2.0)

Q 210.05 (Cont'd)

The separation distance between restraints in this instance is 6.5 feet. On this basis the maximum moment computed are a single simply supported span is about 49720 in-lbs. The maximum stress in the pipe will be about 11640 psi which is below allowable when combined with seismic stresses. Again the moment and the reaction forces are overestimated by employing a single span approach.

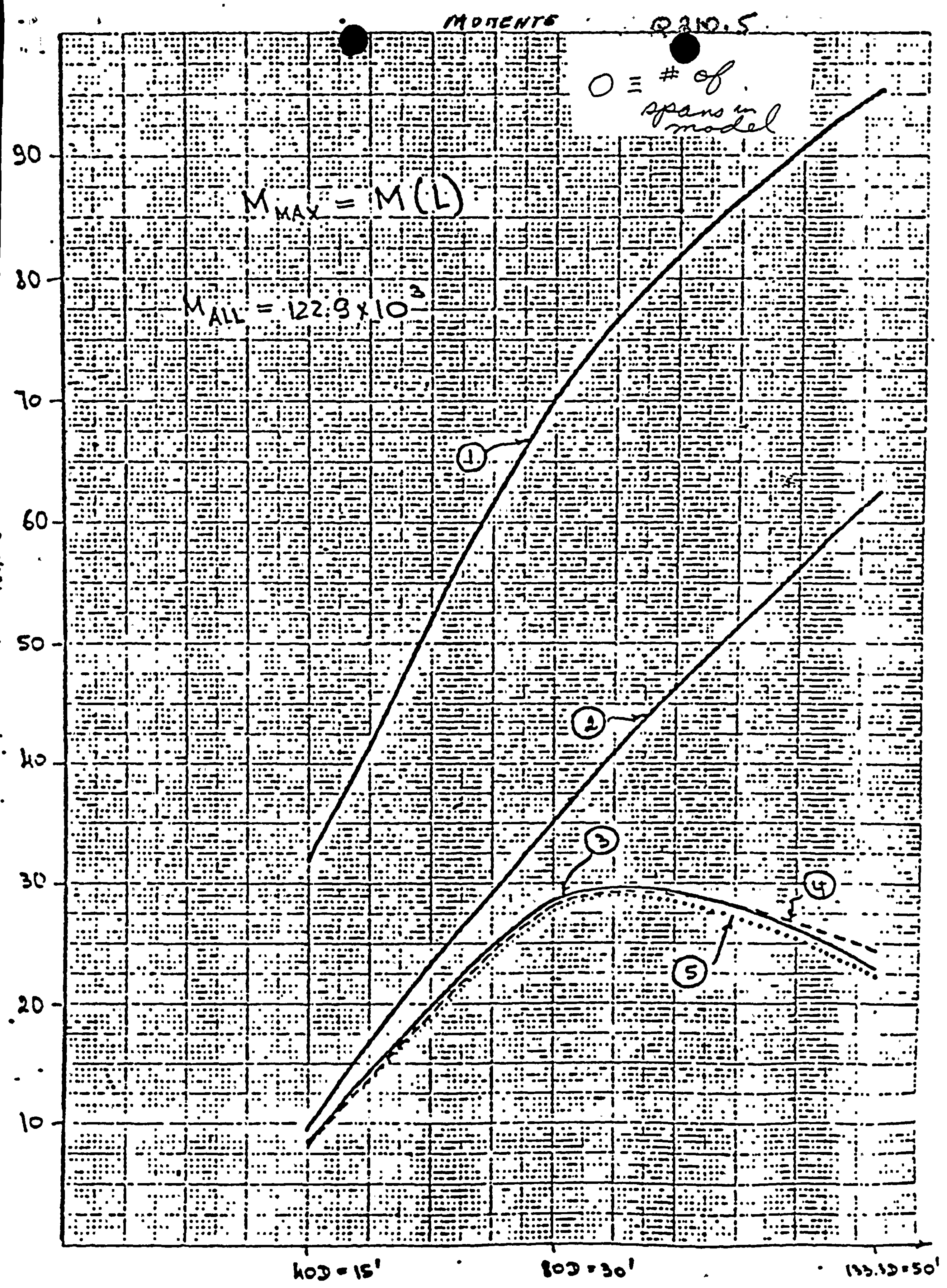
The reaction seen by the restraint will vary between 1330 and 2500 lbs depending on where the jet hits precisely. The two restraints that would be engaged are capable of accomodating this load. (One is a snubber rated at 1500 lbs, which can accomodate 2500 under emergency conditions, and the other is a stout frame capable of accommodating 2800 lbs under emergency loads. Each is eventually connected to embedded plates which are designed for 10,000 lbs.)

This item is considered closed.

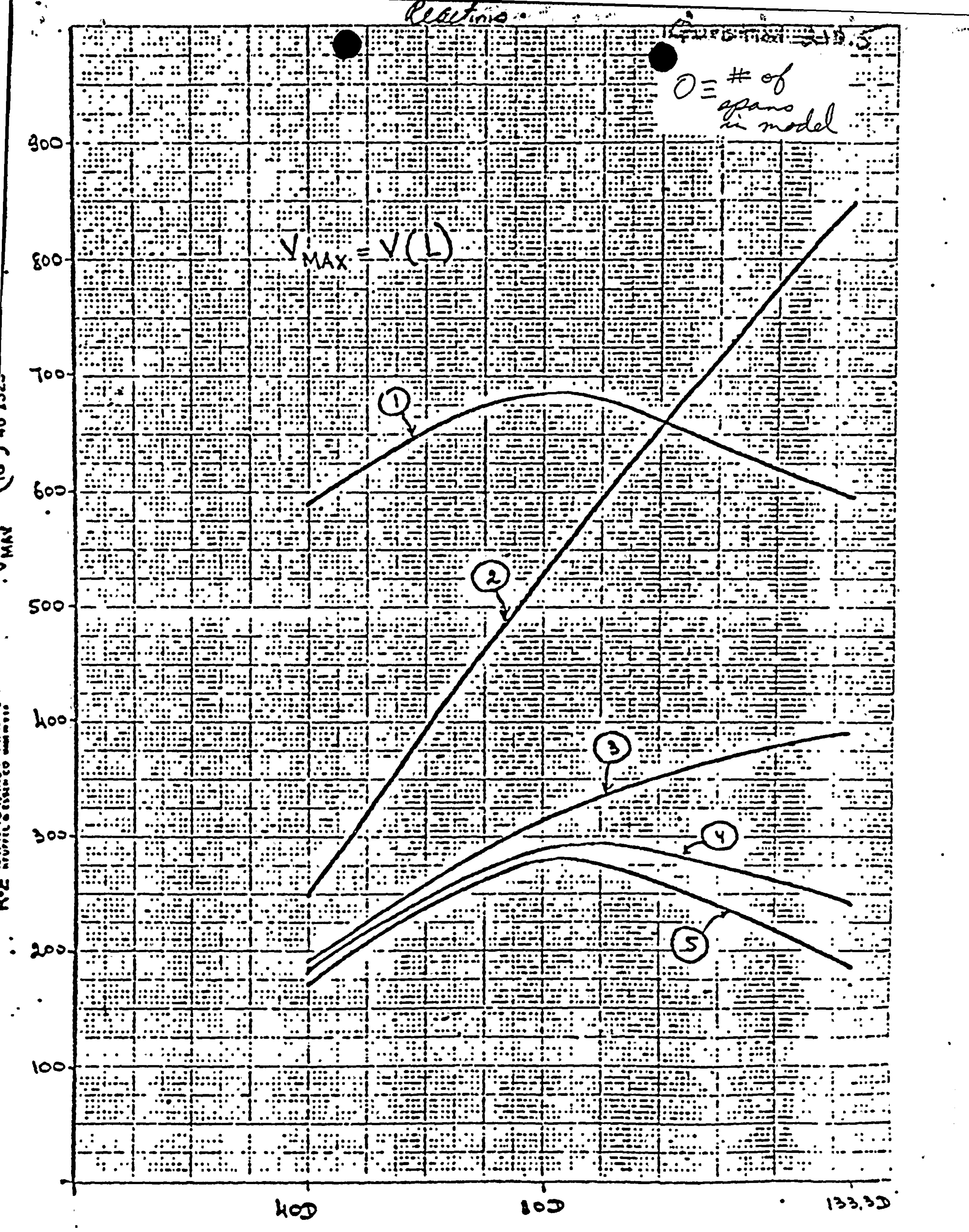
References

1 - Gerber T.L., "Plastic Deformation of Piping Due to Pipe Whip Loading", ASME Pressure Vessels and Piping Conference, Nuclear Matl. Div., June 1974.

2 - R. C. Iotti, G. Listvinsky, D. R. DeBoisblance "Dynamic Design of Piping Systems" 6th Conf. on Structural Mechanics in Reactor Technology, VOl. M 1981



MOMENTS
Q310.5
O ≡ # of spans in model
$M_{MAX} = M(L)$
$M_{ALL} = 122.9 \times 10^3$
90
80
70
60
50
40
30
20
10
1
2
3
4
5
40D = 15'
80D = 30'
133.3D = 50'

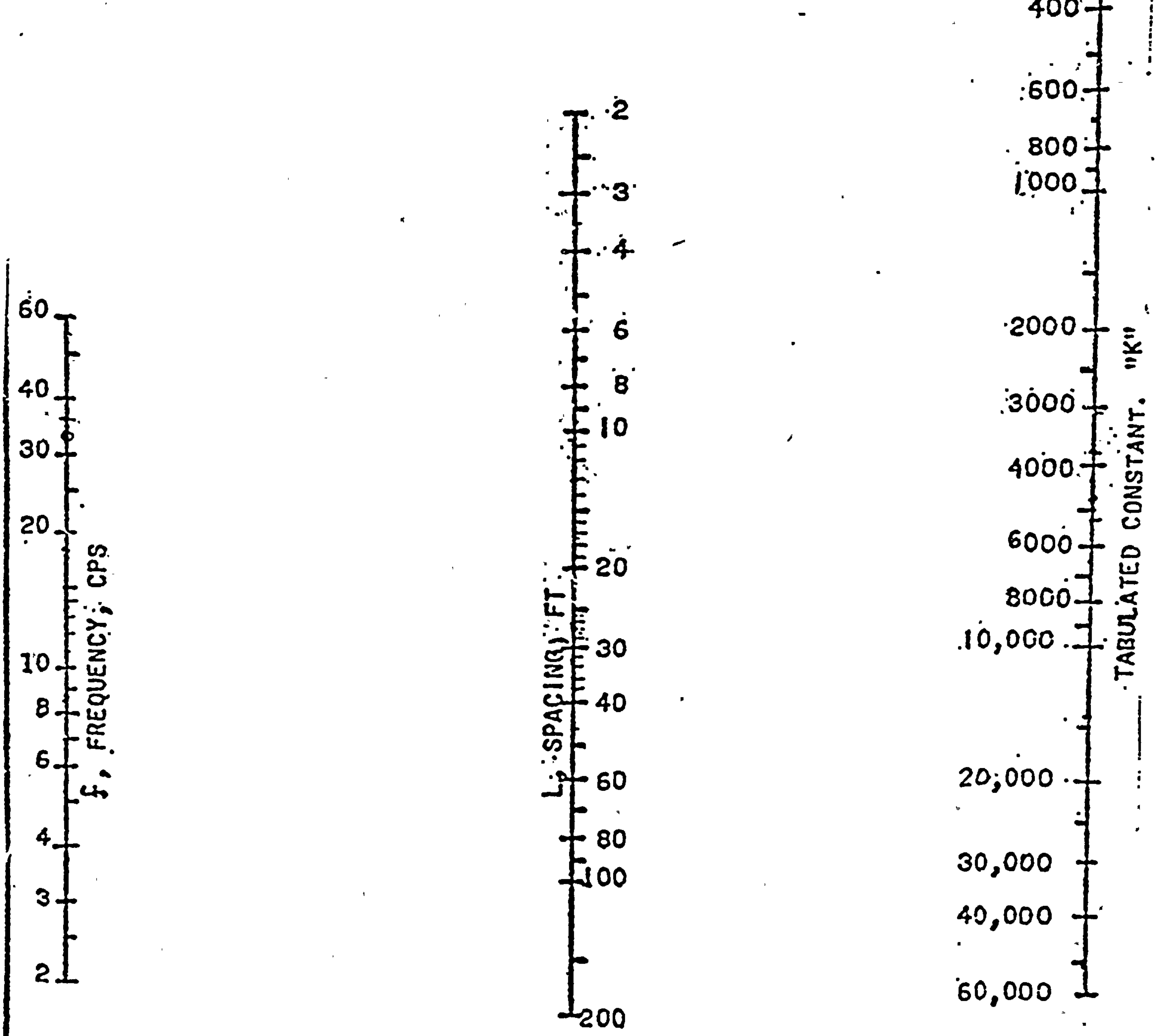


Relations
Question 3.5
O ≡ # of spans in model
$V_{MAX} = V(L)$
900
800
700
600
500
400
300
200
100
1
2
3
4
5
40D
80D
133.3D
V_{MAX}

Q210.5

NOMOGRAPH FOR SEISMIC RESTRAINT SPACING

SOLUTION OF $L = \sqrt{K/f}$



FOR USE WITH TABULATED VALUES OF THE CONSTANT "K" FOR SEISMIC RESTRAINT SPACING.

NOMOGRAPH FOR SEISMIC RESTRAINT SPACING

SEISMIC RESTRAINT SPACING — 4 IPS

VALUES OF CONSTANTS 'K'

SCHEDULE	10S	40(STD)	80(XS)	120	160	(XXS)
WALL THICKNESS, INS	.120	.237	.337	.438	.531	.674
UNIT WGTS, LBS/FT						
PIPE	5.614	10.791	14.985	19.004	22.511	27.544
PIPE + INS	10.274	15.451	19.645	23.664	27.171	32.204
PIPE + WATER	11.799	16.316	19.975	23.480	26.540	30.930
PIPE + WATER + INS	16.459	20.976	24.635	28.140	31.200	35.590
PIPE - S-S	3297	3213	3143	3074	3013	2923
S-F	5148	5016	4907	4800	4704	4564
F-F	7500	7308	7149	6993	6854	6649
PIPE + I - S-S	2437	2685	2745	2755	2743	2704
S-F	3805	4192	4285	4301	4282	4221
F-F	5544	6107	6244	6267	6239	6150
PIPE + W - S-S	2274	2613	2722	2766	2775	2759
S-F	3551	4079	4250	4318	4333	4307
F-F	5173	5943	6192	6291	6312	6275
PIPE + W + I - S-S	1926	2304	2451	2526	2560	2572
S-F	3006	3598	3827	3944	3996	4015
F-F	4380	5242	5575	5747	5822	5850

S-S Simply Supported at both Ends.
S-F Simply supported at one End; Fixed at other End.
F-F Fixed at both Ends

Q 210.06 3.6.1.3

Specify the assumed damage by an unrestrained whipping pipe to an impacted pipe of equal size with thinner wall thickness.

RESPONSE:

An unrestrained whipping pipe is considered capable of developing through-wall cracks in an impacted pipe of equal size with thinner wall thickness.

FSAR Section 3.6.1.3 will be modified to include the above information.

This item is closed pending an FSAR change.

Q 210.07 3.6.2.1.1.2, Page 3.6.2-1

Branch Technical Position MEB 3.1 requires that pipe rupture in Class 1 piping in areas other than containment penetration areas be postulated at:

(a) terminal ends.

(b) intermediate locations where the maximum stress range as calculated by Eq. (10) and either (12) or (13) exceeds 2.4 Sm.

(c) intermediate locations where the cumulative usage factor exceeds 0.1. Revise your ASME Section III Class 1 piping break postulation criteria to conform to this position.

RESPONSE:

The pipe break criteria used by Westinghouse for Class 1 lines outside the reactor coolant system was discussed. Current criteria in the FSAR are based on the 1975 version of MEB 3-1. Westinghouse does postulate breaks in Class 1 lines when the cumulative usage factor exceeds 0.1. Since Westinghouse uses the 1979 Summer Addenda of the ASME Code which deleted ΔT from consideration as a secondary stress, the Staff indicated that the pipe break criteria in the 1981 version of MEB 3-1 should be used. Westinghouse agreed to review the pipe break criteria for the Harris plant and justify the current criteria or commit to MEB 3-1 1981.

This item will remain open pending further Westinghouse review and agreement with the Staff on Class 1 pipe break criteria.

Q 210.08 3.6.2.1.1.2, Page 3.6.2-2

Clarify your position with respect to branch connections being considered terminal ends. What is meant by "two overlapped models?"

RESPONSE:

Westinghouse considers a branch connection to a main piping run a terminal end of the branch run. No exception is taken with respect to relative sizes.

Neither Westinghouse nor Ebasco use "overlapped models" in its analysis. Reference to overlapped models in FSAR Section 3.6.2.1.1.2. will be deleted.

Per the above discussion, this item is closed pending an FSAR revision.

Q 210.09 3.6.2.1.1.3, Page 3.6.2-2

It is the staff's position that breaks should be postulated at all terminal ends in ASME Class 2 and 3 piping, excluding piping in containment penetration areas, regardless of whether or not they are adjacent to the protective structure. Change your FSAR to conform to this criteria.

RESPONSE:

FSAR Section 3.6.2.1.1.3 will be revised accordingly.

This item is closed pending the FSAR change.

Q 210.10 3.6.2.1.2, Page 3.6.2-2

The break exclusion region for the main steam line should only extend to the inboard or outboard isolation valves. Modify your break criteria to include main steam piping between the outboard isolation valve and the first pipe rupture restraint.

RESPONSE:

See response to Question 210.11.

This item is closed pending an FSAR change.

Q 210.11 3.6.2.1.4, Page 3.6.2-5

Justify not evaluating pipe whip and jet impingement loads for main steam and feedwater lines in the steam tunnel.

RESPONSE:

As described in Section 3.6.2.1.2 and 3.6.2.1.4, the main steam piping in the steam tunnel is not subject to postulation of pipe breaks for the evaluation of the effects of pipe whip and jet impingement loads. The main steam piping in the steam tunnel is designated break-exclusion, (BEX) as described in Figure 3.6.2-1. Appendix 3.6.A, Tables 3.6.A-15 and 3.6.A-16 present the comparisons of the combined pipe stresses versus the required allowables for the main steam piping in the steam tunnel designated BEX.

The feedwater piping in the steam tunnel from the containment penetrations up to and including the feedwater check valve is similiarly designated BEX, and therefore, pipe breaks for the evaluation of the effects of pipe whip and jet impingement are not postulated. Appendix 3.6.A, Tables 3.6.A-17.1, .2, .3 and 3.6.A-18 present the comparisons of the combined pipe stresses versus the required allowables. The balance of the feedwater piping in the steam tunnel is designated non-nuclear Safety Seismic Category I. The routing is straight through the steam tunnel with no intermediate pipe fittings, welded attachments or valves. Consistent with MEB 3-1, paragraph B.1.C(2), pipe breaks need not be postulated.

FSAR Section 3.6.2.1.4 and Figure 3.6.2-1 will be modified to include a statement that a 100% volumetric inservice examination of all pipe welds in the break-exclusion area is conducted during each inspection interval as defined in IWA-2400, ASME Code, Section XI.

This item is closed pending an FSAR change.

Q 210.12 3.6.2.2

Insufficient detail for a complete review of your dynamic analysis of jet thrust exists. Provide information regarding your time-dependent function representation of the jet thrust force, your assumptions concerning rise time, and the time variation of the jet thrust forcing function's relation to pressure, enthalpy and volume of the fluid in any existing upstream reservoir.

RESPONSE:

The discussion of the Westinghouse method used to determine jet thrust from postulated breaks in the RCL piping was inadvertently left out of the FSAR. The attached write-up will be inserted in the FSAR on Page 3.6.2-9 immediately ahead of Section 3.6.2.2.2 in a future amendment. The procedures given for the calculation of jet thrust load are consistent with those given in ANS 58.2. These criteria have been reviewed and accepted by the Staff during MEB reviews for other plants.

For Ebasco scope, Time Dependent Jet Thrust Forcing Functions are calculated by use of RELAP-3 Program in conjunction with a proprietary post processor called CALPLOTF. Description of analytical methods with RELAP Program is given in Appendix C to ETR-1002 (Reference 3.6.2-4).

Pipe breaks are taken to be instanteous and therefore, no assumptions are made regarding rise time of the Jet Thrust Force.

FSAR Figures 3.6A-1 through 3.6A-28 will be revised appropriately.

This item is closed pending an FSAR revision.

Q 210.13 3.6.2.2.3, Page 3.6.2-9

In order for the staff to complete its review of FSAR Section 3.6.2, more detail of the methods used to perform piping dynamic analysis is required.

Specifically, the following information is required.

(1) The loading condition assumed prior to rupture.

(2) Methods employed to account for the effects of:

a. Mass inertia and stiffness
b. Impact and rebound
c. Elastic and inelastic deformation of piping
d. Support boundary conditions

(3) A representative mathematical model of the piping system or piping and restraint system.

(4) The analytical method of solution selected.

(5) Solutions for the most severe responses among the piping breaks analyzed.

(6) Solutions with demonstrable accuracy or justifiable conservatism. The extent of mathematical modeling and analysis should be governed by the method of analysis selected.

RESPONSE:

A detail description of methods used to perform piping dynamic analysis is given in Appendix C to ETR-1002 (Reference 3.6.2-4). Section 2.3 of the above describes typical models of piping

Q 210.13 (Cont'd)

with restraints and shows resulting responses of the piping and restraints.

This item is closed.

Q 210.14 3.6.2.3

Verify that all possible targets of unrestrained whipping pipes and jet impingement have been considered.

RESPONSE:

For the RCS, Westinghouse performs the jet impingement analysis and evaluates jets on Westinghouse-supplied equipment and supports. For jets from the RCS that could impact upon auxiliary equipment and piping, Westinghouse provides Ebasco with jet direction and expansion data. Ebasco takes this information and evaluates the impact on Class 1 piping and transmits any jet impingement loads on Class 1 piping to Westinghouse for incorporation into the Westinghouse Class 1 piping analysis.

For Ebasco scope, this information is provided in Section 3.6A.1.2 and 3.6A.2.2.

This item is closed.

Q 210.15 3.6.2.3.4.2, Page 3.6.2-16

It is the staff's position that jet expansion is not acceptable when used to evaluate jet impingement forces due to saturated water or subcooled water blowdown. Justify your jet expansion model for saturated water blowdown or change your FSAR to conform to the staff's position.

RESPONSE:

FSAR Section 3.6.2.3.4.2 will be modified to conform to the NRC's position.

This item is closed pending the FSAR change.

Q 210.16 3.6.2.5, Page 3.6.2-18

Justify the use of limited area circumferential or longitundinal breaks, provide a list showing where limited break areas have been postulated.

RESPONSE:

For the structural evaluation of the reactor coolant system Westinghouse assumes full double-ended breaks except at the reactor vessel nozzles. At this location a break opening area of 150 square inches is used. The break opening area is limited by the restraints at the reactor vessel nozzles. Westinghouse provides Ebasco with interface information to ensure that the Ebasco restraint design will limit the break opening area to a maximum of 150 square inches. Based on the Ebasco restraint design Westinghouse calculates actual break opening areas to confirm that interface requirements have been met. This information was not available at the meeting but will be provided to the Staff when available.

For Ebasco scope, limited area circumferential breaks are postulated only in the Main Steam System Inside Containment. (From containment penetration to SG). Limited area circumferential breaks in the Main Steam in justified since the displacement of the severed ends of the pipe is limited by pipe whip restraints.

A detailed dynamic analysis has been performed to show that the relative position of the two pipe ends remain within the bounds described in FSAR section 3.6.2.3.4.2. All limited area circumferential breaks are shown on Figure 3.6A-1. Limited area longitundinal breaks are not used.

This item is open, pending submittal of additional information on the traceability of the support details.

Q 210.17 3.6.2.5, Page 3.6.2-18

Provide details and examples of the analysis performed with respect to piping restraints.

RESPONSE:

The RCL pipe whip restraints are designed to the same limits as the primary equipment supports and thus remain elastic under faulted conditions. Westinghouse designs these restraints to NF limits defined in the ASME Code.

Examples and details of the Ebasco scope analyses performed for piping restraints were presented at the MEB meeting and were found to be acceptable.

Based on this discussion, this item is closed.

Q 210.18 3.6.2.5, Page 3.6.2-18

Provide details of dynamic testing performed to determine the energy dissipating capacity of crushable material used in pipe restraints. Verify that the allowable capacity is limited to 80% of the energy dissipating capacity determined by dynamic testing.

RESPONSE:

The energy dissipating capacity of the crushable material was based on static test results. The allowable design energy capacity was based on a maximum permissable crush of the compressible material of 50 percent of its original thickness. By specification the fabricator furnished the material so that the maximum thickness of the crushable material after being completely crushed to its maximum absorbing capacity shall not exceed 35 percent of its original thickness. Based on the foregoing the allowable capacity is limited to a maximum of 77 percent of the energy dissipating capacity determined by typical static test results.

This item is closed.

Q 210.19 3.6.2.5.1, Table 3.6.2-2

Provide primary-plus-secondary stress intensity ranges in the main reactor coolant loop fatigue analysis and also the cumulative usage factors for our review.

RESPONSE:

FSAR Table 3.6.2-2 which contains primary plus secondary stress intensity ranges and also cumulative usage factors is not completed. Completion of this table is contingent upon the performance of the as-build reconciliation of the RCS. Upon completion of the as-built reconciliation Table 3.6.2-2 will be provided.

This item will remain confirmatory until completion of NRC staff review of the revised FSAR table.

Q 210.20 3.6.2.5.2

Provide for our review a summary of the data developed to select postulated break locations for balance of plant piping. Include calculated stress intensities, cumulative usage factors, and the calculated primary-plus-secondary stress range.

RESPONSE:

Break locations for the RCS are outlined in Section 3.6 per WCAP-8082. Additional information for Class 1 piping relative to break locations will be provided to Ebasco for incorporation into the FSAR as requested by the Staff.

The FSAR will be revised to include complete summary information when it is available.

This item is confirmatory pending NRC Staff review of summary information to be submitted.

Q 210.21 3.7.3.1.1, Page 3.7.3-1

How have you determined "a sufficient number of degrees of freedom to closely simulate the dynamic behavior of the subsystems?"

RESPONSE:

For piping systems adequate mass points and corresponding dynamic degrees of freedom (each unrestrained mass point represents three degrees of freedom) are selected and distributed to provide for appropriate representation of the dynamic characteristics of the subsystem. As indicated in subsection 3.7.3.1.1.1, "the maximum spacing between mass points does not exceed one-half (1/2) of the distance for which the frequency of a simple support beam would be 20 cps. Furthermore, it is verified that the number of degrees of freedom considered in the analysis are equal to or more than twice the number of modes with frequencies less than 33 Hz." This approach assures that consideration of additional degrees of freedom would not result in more than a 10% increase in response and that the number of degrees of freedom are equal to at least twice the number of modes with frequencies less than 33 Hz.

This item is closed.

Q 210.22 3.7.3.1.1, Page 3.7.3-1

Define the term "significant modes" as you have applied it to seismic subsystem analysis.

RESPONSE:

Significant modes are all modes which contribute to the seismic response. These modes are further defined in FSAR Section 3.7.3.1.1.1.d and is repeated below:

> The modes are divided into two groups: the lower modes and higher "rigid" modes. The rigid modes are those whose natural frequencies lie outside the range where the support movement has significant energy. For earthquakes, this corresponds to frequencies above 33 Hz. Dynamic response analysis includes all modes below 33 Hz, however, additional calculations are made to account for all the rigid modes combined.

This item is closed.

Q 210.23 3.7.3.1.1, Page 3.7.3-1

What special devices have been used to eliminate the effects of relative displacements? Where have they been employed?

RESPONSE:

For piping systems, the most common special devices used in general to eliminate the effects of relative seismic displacements are expansion joints, flexible hoses, and ball joints. At this time, no special devices are being employed on Shearon Harris Unit 1 to eliminate these displacements.

Discussion of special devices will be removed from the FSAR. If any are utilized in the future a description of them will be incorporated into the FSAR.

This item is closed pending an FSAR change.

Q 210.24 3.7.3.5.1, Page 3.7.3-6

If the equivalent static load method is not used on piping systems where has it been used?

RESPONSE:

The equivalent static load method has been used for the analysis of cable trays, conduits, HVAC ducts and their supports.

This item is closed.

Q 210.25 3.7.3.8.1, Page 3.7.3.3-8

Further discussion of your approach to determining modal acceleration is required. It is not apparent from the material presented that the alternate response spectra are conservative.

RESPONSE:

Floor response spectra for seismic category I structures are determined from the in-structure acceleration time histories. The peaks of the floor response spectra are broadened plus or minus fifteen percent in frequency to account for variation of parameters, such as the material properties of the structure and soil, damping values, soil-structures interaction techniques. This is consistent with the example shown on Figure 1 of Regulatory Guide 1.122.

The alternate response spectra described in the FSAR will be modified per staff requests at the MEB meeting. The modifications to the spectra which comprise the alternate spectra technique are taken from a proposed draft revision to RG 1.122 contained in an NRC memorandum from Robert J. Bosnak to James P. Knight, dated January 27, 1983.

This item is closed pending an FSAR change.

Q 210.26 3.7.3.8.1.1, Page 3.7.3-9

Provide an example of your computer method analysis using the response spectra method of Section 3.7.3.1.1. Include a case in which the peak with the lowest period was used. Also provide an example of your frequency based static method. Justify the use of 70% of the period of the peak response as a cutoff criteria.

RESPONSE:

As stated in Section 3.7.3.8.1.1, three sample problems are presented in the FSAR which have been analyzed using both the response spectra method of Section 3.7.3.1.1, and the frequency based static method. The models of these systems are shown in Figures 3.7.3-2 through 3.7.3-5. The purpose of the comparision is to demonstrate that the static method is conservative.

Choice of 70% of the period of the peak response as a cutoff criteria is selected to assure that no resonance is present. The adequacy of this approach is demonstrated by the comparison of the sample problem results using both methods. The sample problems were selected to be representative of typical power plant piping systems.

It should be pointed out that 70% criterion is applied in such a manner that lowest period for which there is a significant response is chosen. Furthermore, in applying the participation factor of 1.5 the highest peak between zero and the first period of piping is taken.

The sample problems are formulated in a manner which encompasses the case where the peak with the lowest period is used. Therefore, no further examples are required.

This item is closed.

Q 210.27 3.7.3.9.1, Page 3.7.3-12

Stress in component supports due to differential seismic motion are not treated as secondary by ASME Subsection NF. Provide a basis for its acceptability.

RESPONSE:

Stresses due to differential seismic motion of primary component supports are treated as primary stresses in the reactor coolant system/component support analysis. Differential seismic motions are treated as secondary stresses on piping. This item was further discussed in Question 210.33.

Based upon the above, this item is closed.

Q 210.28 3.9.1.1, Page 3.9.1-1

Provide for our review the ASME Code service limits you have specified for transient loading conditions or load combinations with respect to Code Class 1 and CS components.

RESPONSE:

The stress limits and load combinaion criteria for Class 1 components, supports, and core support structures were discussed with respect to FSAR Tables 3.9.1-2 (Load Combinations) and Table 3.9.1-3 (stress limits). It was noted that Table 3.9.1-2 is also applicable to core support structures but that the procurement of these components predated ASME III Subsection NG. It was also noted that the procurement of the primary equipment supports predates Subsection NF but the stress criteria for these supports was in fact that of NF. Revised tables were presented to the Staff that, for load combinations, included core support structures (while deleting OBE from the design condition), and for stress criteria, explained that for Westinghouse designed supports Subsection NF was used for stress criteria only (no stress report or code stamp).

Additional discussion centered on the Class 1 scope split between Ebasco and Westinghouse. The scope was defined as follows:

Westinghouse

- Design, analysis, and procurement of primary components and supports;
- Analysis of Class 1 auxiliary lines including break location determination;
- Analysis of the reactor coolant loop piping including jet impingement analysis on primary components and supports;

Q 210.28 (Cont'd)

- Design and analysis of reactor coolant pipe whip restraints on the hot leg at the steam generator inlet elbow and all whip restraints on the crossover leg.

Ebasco

- Jet impingement loadings on Class 1 auxiliary lines including loop break jet loading using jet data (direction, expansion) provided by Westinghouse;

- Design of all Class 1 auxiliary piping supports (using Westinghouse loads);

- Design of primary shield wall pipe whip restraints (using Westinghouse loads).

Based on the above discussion and the attached revised tables, this item was closed pending an FSAR change.

Q 210.28 (Cont'd)

STRESS CRITERIA FOR ASME B&PV CODE, SECTION III
CLASS 1 COMPONENTS[a]

Design/Service Level	Vessels/Tanks	Piping	Pumps	Valves	Component[1] Supports
Design and service level A	ASME B&PV Code, Section III NB 3221, 3222	ASME B&PV Code, Section III NB 3652, 3653	ASME B&PV Code, Section III NB 3221, 3222	ASME B&PV Code, Section III NB 3520, 3525	ASME B&PV Code, Section III, Subsection NF NF 3221, 3222 NF 3231.1(a)
Service level B (UPSET)	ASME B&PV Code, Section III NB 3223	ASME B&PV Code, Section III NB 3654	ASME B&PV Code, Section III NB 3223	ASME B&PV Code, Section III NB 3525	ASME B&PV Code, Section III, Subsection NF NF 3223, 3231.1(a)
Service level C (Emergency)	ASME B&PV Code, Section III NB 3224	ASME B&PV Code, Section III NB 3655	ASME B&PV Code, Section III NB 3224	ASME B&PV Code, Section III NB 3526	ASME B&PV Code, Section III, Subsection NF NF 3224, 3231(b)
Service level D (Faulted)	ASME B&PV Code, Section III see paragraph 3.9.1.4 NB 3225	ASME B&PV Code, Section III see paragraph 3.9.1.4 NB 3656	ASME B&PV Code, Section III (No active class 1 pump used) NB 3225	(b)	ASME B&PV Code, Section III, Subsection NF see paragraph 3.9.1 NF 3225, 3231.1(c)

P_e, P_m, P_b, Q_T, C_p, S_n and S_m as defined by ASME B&PV Code, Section III

a. A test of the components may be performed in lieu of analysis.

Q 210.28 (Cont'd)

b. CLASS I VALVE SERVICE LEVEL D CRITERIA

ACTIVE	INACTIVE
Calculate Pm from Subsection NB3545.1 with Internal Pressure Ps = 1.25Ps	Calculate Pm from Subsection NB3545.1 with Internal Pressure Ps = 1.50 Ps
$Pm \leq 1.5Sm$	$Pm \leq 2.45Sm$ or $0.7Su$
Calculate Sn from Subsection NB3545.2 with	Calculate Sn from Subsection NB3545.2 with
Cp = 1.5	Cp = 1.5
Ps = 1.25Ps	Ps = 1.50Ps
Qt2 = 0	Qt2 = 0
Ped = 1.3X value of Ped from equations of 3545.2(b)(1)	Ped = 1.3X value of Ped from equations of 3545.2(b)(1)
$Sn \leq 3Sm$	$Sn \leq 3Sm$

(1) Subsection NF is used for stress criteria only. See FSAR Subsection 3.9.1.4.7

Q 210.28

LOADING COMBINATIONS FOR ASME CLASS 1 COMPONENTS,
COMPONENTS SUPPORTS, AND CORE SUPPORT STRUCTURES

Plant Classification	Design/Service Level	Loading Combination
Design		Design pressure, design temperature, deadweight
Normal	Service level A	Normal Condition transients, deadweight
Upset	Service level B	Upset condition transients, deadweight, OBE
Emergency	Service level C	Emergency condition transients, deadweight
Faulted	Service level D	Faulted condition transients, deadweight, SSE, pipe rupture loads

Q 210.29 3.9.1.2.2, Page 3.9.1-11

Specify cases where you have combined loads by algebraic addition.

RESPONSE:

Algebraic addition is used only in deriving the worst possible combined loads of the thermal expansion and dead weight conditions. These worst possible combined loads are then combined with seismic loads and other mechanical loads by absolute summation method in deriving restraint design loads.

FSAR Section 3.9.1.2.2 will be modified to state that only static loads are added algebraically.

This item closed pending an FSAR change.

Q 210.30 3.9.1.2.2, Page 3.9.1-11

NUREG/0800 requires that computer programs in analyses of seismic Category I Code and non-Code items have the following information provided to demonstrate their applicability and validity:

a. The author, source, dated version and facility.

b. A description and the extent and limitation of its application.

c. Solutions to a series of test problems which shall be demonstrated to be substantially similar to solutions obtained from any one of sources 1 through 4, and source 5:

   1. Hand calculations.

   2. Analytical results published in the literature.

   3. Acceptable experimental tests.

   4. By an MEB acceptable similar program.

   5. The benchmark problems prescribed in Report NUREG/CR-1677, "Piping Benchmark Problems."

Demonstrate compliance with these requirements and provide summary comparisons for the computer programs used in seismic Category I analyses.

RESPONSE:

All computer programs used in the design and analysis of Westinghouse-supplied equipment are listed in FSAR Section 3.9.1.2.1. All of these programs (with the exception of WECAN) are compiled in WCAP-8252 which has been reviewed and accepted by the Staff. The WECAN program is compiled in WCAP-8929 which is currently under review by Oak Ridge National Labs. As discussed in past MEB reviews (Catawba, Seabrook, etc.), Westinghouse does not list computer programs used in the design and analysis of vendor equipment but monitors their validity through QA procedures.

FSAR Section 3.9.1.2.2 will be modified to include the requested information for the computer program Pipestress 2010.

This item is closed pending this FSAR change.

Q 210.31 3.9.1.4.7, Page 3.9.1-15

Clarify your statement, "If plastic component analysis is used with elastic system analysis or with plastic system analysis, the deformations and displacements of the individual system members will be shown to be no larger than those which can be properly calculated by the analytical methods used for the system analysis."

RESPONSE:

The use of plastic component analysis with elastic or plastic system analysis was not used by Westinghouse for the Shearon Harris plant. This statement will be removed from the FSAR.

Per the above discussion and deletion of statement, this item is closed pending an FSAR change.

Q 210.32 3.9.2.1, Page 3.9.2-1

Your discussion of piping vibration and thermal expansion tests is too general. Provide specific acceptance criteria for piping vibration. Reactor coolant system transients must also include turbine stop valve closure and pressurizer pressure relief valve operation.

RESPONSE:

The discussion of piping vibration and thermal expansion tests is contained in FSAR Section 14.2.12.1.12. The FSAR will be amended in this section to include provisions for not exceeding endurance limits and to address dynamic operating transients. FSAR Section 3.9.2.1.1 will also be amended to include an additional reference to Section 14.2.12.1.12.

This item is confirmatory pending an FSAR revision and NRC staff review.

Q 210.33 3.9.2.3

Your discussion of seismic system analysis lacks sufficient information for the staff to complete their review. Information must be provided concerning the following:

(1) Consideration given to maximum relative displacements between supports.

(2) Procedures used to separate fundamental frequencies of components and equipment from the forcing frequencies of the support structure.

(3) Procedures for consideration of the three components of earthquake motion.

(4) Methods to consider differential piping support movements.

(5) Methods for seismic analysis of equipment and components supported at different elevations within a building or between different builldings with distinct inputs.

(6) Justification for the use of constant vertical static factors, if any.

(7) Procedures used to consider torsional effects due to eccentric masses.

(8) Methods used to analyze Category I buried piping, if any.

(9) Methodology to account for the seismic motion of non-Category I piping systems in the design of Category I piping.

Q 210.33 3.9.2.3 (Cont'd)

RESPONSE:

1. The Westinghouse time-history analysis of the reactor coolant system was discussed. It was noted that the maximum displacement between supports is considered in the analysis as primary stresses. The Ebasco input for this analysis consisted of the structural model of the containment and also the seismic motion of the base mat. Westinghouse added the reactor coolant system model and then developed acceleration time histories for the various attachment points of the NSSS. The computer code automatically generates the maximum displacements of these points and applies these displacements to the model.

The FSAR Section 3.7.3.9.2 should be modified to eliminate a reference to a static evaluation of the differential seismic movement of components interconnected between floors.

For Ebasco scope, information regarding item 1 is in Section 3.7.3.1.1 and is repeated below:

When the supports for a subsystem were all mounted at the same floor, the relative displacement among supports was not considered. This relative displacement was considered where the supports of the same subsystems were loaded at different floors.

For the case where the supports of the same subsystem were located in different buildings, the maximum relative displacements among the different supports were considered in the seismic dynamic analysis of the subsystem, unless special devices were used to eliminate the effect of relative displacements.

FSAR Section 3.7.3.1.1 will be modified concerning the following:

Relative displacements within a structure were assumed to be in phase relative to the mat. Relative displacements between structures were assumed to be totally out of phase. [The statement in this section which refers to the use of special devices will be deleted.]

2. The NSSS equipment is analyzed considering the effect of the equipment fundamental frequencies and the forcing frequencies of the supporting structure. Reference was made to FSAR Section 3.7.3.4.2 for a more detailed discussion.

For Ebasco scope, information regarding item 2 is in Section 3.7.3.4 and is repeated below:

3.7.3.4 Bases for Selection of Frequencies

Where feasible and practical, subsystems were designed to avoid the resonant frequency region of the supporting structure. Shifting of the subsystems away from the resonant region was achieved by modifying mass-stiffness characteristics.

Because of practical limitations, subsystems were, in some cases, designed in such a way that the frequencies fell into the resonant region of the supporting system. The amplified seismic response of the subsystem was then evaluated by a proper consideration of total modal contribution from all modes within the frequency range of 1 to 33 Hz as a minimum. In some cases, the modes with frequencies higher than 33 Hz were also included. See Section 3.7.3.1.

3. The three components of earthquake motion are combined by SRSS of the resultant unidirectional responses. Reference was made to FSAR Section 3.7.2.6B for a more detailed discussion.

For Ebasco scope, information regarding item 3 is in Sections 3.7.3.1.1, 3.7.3.6, 3.7.3.7 and 3.7.2.6A and is summarized below:

Modal responses were combined in the square root of the sum of the squares manner except for the responses of the closely spaced modes which were combined by the summation of the absolute values method. The latter were then combined with the responses of the remaining significant modes by the square root of the sum of the squares method. Closely spaced modes were ascertained utilizing the criterion of Regulatory Guide 1.92.

The seismic analysis of all Seismic Category I structures, systems, and components takes into consideration three orthogonal directions of seismic motions; two horizontal and one vertical. The maximum responses to each of the three components of motion are determined separately and combined by the square root of the sum of the squares (SRSS) method to obtain the total seismic responses in accordance with Regulatory Guide 1.92. The simultaneous application of time histories or linear summation of responses are not performed. The SRSS in mathematical form is:

Q 210.33 (Cont'd)

$$R_j = \pm \left[(R^2_{j1}) + (R^2_{j2} + R^2_{j3})\right]^{1/2}$$

in which R_j denotes the most probable response in the j-th direction, considering three-directional earthquake effects. R_{jk} (k - 1,2,3) denoted the response in the j-th direction resulted from the earthquake component in the k-th direction. The R can be displacements, velocities, accelerations, forces, moments, or stresses.

4. It was noted that Westinghouse does not have scope for the analysis of any piping between buildings. The Westinghouse Class 1 auxiliary piping analysis utilized a response spectrum that envelopes the response of each attachment point of the system under consideration. The effect of differential seismic motion of piping supports is considered to cause secondary stresses in the piping system. Reference was made to FSAR Section 3.7.3.8.2 for a more detailed discussion.

   Information regarding Ebasco scope is in Sections 3.7.3.9.1 and 3.7.3.9.2.

   FSAR Section 3.7.3.9.1 will be modified to clarify that the enveloped response spectrum is used.

5. Westinghouse does not have scope for any equipment or components supported between buildings. For equipment or components supported at different elevations within a building, Westinghouse uses response spectra that envelope the responses at each attachment point. Reference was made to FSAR Section 3.7.3.8.2 for a more detailed description.

Information regarding Ebasco scope is in Sections 3.7.3.9.1 and 3.7.3.9.2.

FSAR Section 3.7.3.9.1 will be modified to clarify that the enveloped response spectrum is used.

6. Westinghouse uses a vertical response spectra for Class 1 auxiliary piping analysis; vertical static factors are not used. Reference was made to FSAR Section 3.7.3.10.2.

   Information regarding Ebasco scope is in Section 3.7.3.10.1 and is repeated below:

   3.7.3.10.1 Balance of Plant Scope

   A single constant seismic vertical load factor was not used for the seismic design of seismic subsystem. The vertical load factor was determined from the analysis.

7. For piping in Westinghouse scope of analysis, rigid valves (i.e., valves with natural frequencies greater than 33 Hz) are included in the piping system model as lumped mass on rigid extended structures. If a valve is not rigid (one or more natural frequencies below 33 Hz), then a multimass dynamic model of the valve is developed for use in the piping system model. Reference was made to FSAR 3.7.3.11.2.

   Information regarding Ebasco scope is in Section 3.7.3.11.1 and is repeated below:

   3.7.3.11.1 Balance of Plant Scope

Torsional effects of all valves and other significant eccentric masses were included in the analysis of all Seismic Category I piping systems by taking into account the mass and eccentricity in the mathematical model.

8. Information regarding item 8 is in Section 3.7.3.12 and is repeated below:

   Ebasco's design procedure for seismic analysis of Seismic Category I buried piping was based upon Newmark's method (Reference 3.7.3-1) and Hetenyi's theory in beams on elastic foundations (Reference 3.7.3-2). The analysis procedure included calculation of stresses in the buried portion of the piping due to loads acting on the non buried portion of the piping inside the building (interaction effect), superimposed on the stresses due to various loads acting on the buried portion of the piping. The resultant stresses were within allowable stress criteria based on the applicable ASME Section III Code.

9. Item 9 remains open. The NRC does not accept the methodology used to account for seismic motion of non-category 1 piping on the design of category 1 piping. The NRC clarified that this does not apply to the Main Steam and Feedwater interface restraints which are acceptable.

Items 1 through 8 are closed pending FSAR changes and the addition of a reference to FSAR Section 3.7.3 in FSAR Section 3.9.2. Item 9 is open pending further discussions.

Q 210.34 3.9.3

Provide a discussion giving a more detailed justification to Regulatory Guide 1.48; Regulatory Positions C.6, C.7, C.8, and C.10.

RESPONSE:

The SHNPP position on Regulatory Guide 1.48 contained in FSAR Section 1.8 is presently under review and will be modified to reflect discussions at the MEB meeting.

Accordingly this item is open pending an FSAR change and NRC staff review.

Q 210.35 3.9.3.1

Your discussion of loading combinations, system operating transients, and stress limits lacks sufficient information for the staff to complete its review. Assurance must be provided that all operating categories should include plant events and service loading combinations required by Appendix A to Standard Review Plan 3.9.3. Provide appropriate service limits for Code Class 1, 2, and 3 and Class CS core support structures. Provide for our review your piping components functional capability program. Include ASME Code Section III allowable stress limits.

RESPONSE:

The loading combination and stress limits used for Class 1 components, supports, and core support structures are discussed in the response to Question 210.38.

The loading combinations and stress limits for Class 2 and 3 components were discussed. It was noted that pertinent information on loading combinations and stress limits for Class 2 and 3 components and supports is contained in the FSAR. Specifically, Table 3.9.3-1 provides loading combinations, Tables 3.9.3-2/3 provide stress limits for tanks (vessels), Tables 3.9.3-4/5 provide stress limits for pumps, Table 3.9.3-6 provides stress limits for valves and Section 3.9.3.4 defines the stress limits used for Class 2 and 3 supports.

The subject of functional capability of Class 1 piping outside the reactor coolant system was discussed. The Staff indicated that there were a number of criteria which were acceptable including the use of Level C limits from the Winter 1981 Addenda of the ASME Code for the faulted condition. Westinghouse indicated that they are using the Summer 1979 ASME Code faulted condition limits and considered these limits acceptable for assuring functional capability. Westinghouse agreed to review this item further and provide a more detailed position to the Staff.

This item will remain open pending resolution of the functional capability issue for Class 1 piping outside the RCS.

The following is a discussion of this item for the BOP scope:

Generically, the issue of functional capability for piping which is a passive component was unresolved until July 1981 because the NRC has not reached a conclusion as to what would be acceptable. In July 1981, the NRC issued NUREG-0800 which included SRP 3.9.3 and its Appendix A, the acceptance criteria adopted by the NRC for functional piping. Almost simultaneously, the NRC approved NEDO-21985 as an acceptable basis of demonstrating functional capability. Prior to the NRC's adoption of these criteria, essential system were considered operable if they met the pressure integrity considerations of the ASME code pursuant to Regulatory Guide 1.48. Specific calculations as to the total decrease in flow area required before functional capability was lost (i.e. the capability to deliver the amount of fluid necessary to shutdown the plant and/or mitigate the consequences of an accident) have been submitted on several dockets in support of this position.

Presently, functional capability is not a SHNPP requirement and, therefore, no commitment has been provided in the FSAR. This position is based upon the vintage of the requirements upon which SHNPP base licensing commitments were developed. SHNPP is not committed to either Appendix A of SRP 3.9.3, or to the NUREG-0800 version of SRP 3.9.3. In lieu of this document, SHNPP is committed to Regulatory Guide 1.48. Carolina Power & Light Company believes this position is consistent with the

NRC's position implemented on plants with CP docket dates prior to 7-1-78, (i.e. the approximate date of NRC's interim positions). The date of the Construction Permit for SHNPP is January 27, 1978.

For non-NSSS piping a measure of protection against loss of piping functional capability is provided for systems required to deliver flows under faulted plant conditions. This protection is afforded by specifying for these systems emergency level stress limits for primary piping loads. These low stress limits combined with the inherent conservatism of the design basis assure that gross deformations will not occur.

In addition, FSAR Section 3.9.3 will be revised to support the above position. Refer to the Response to Question 210.38 for Tables which show actual stress limits.

This item is open. The NRC staff accepted the above discussion for Class 2 and 3 carbon steel piping, but clearly stated that it will not accept this for Class 2 and 3 Stainless Steel piping due to lack of conservatism in Code requirements. The staff requires an analysis of stainless steel elbows on class 2 and 3 piping in essential systems in order to close this item. Carolina Power & Light Company will review the staff position and respond further at a later date.

Q 210.36 3.9.3.1

Provide faulted allowable stresses for bolts used in ASME Code components.

RESPONSE:

The service limits given in ASME III, Subsection NB-3230 for design and service levels A, B and C are used for the following Class 1 component bolts:

Reactor Vessel Studs
Steam Generator Manway Bolts
Pressurizer Manway Bolts
Reactor Coolant Pump Main Closure Bolts

The faulted condition service limit is not increased over the Level C service limits for the above bolts.

For Class 1, 2 and 3 valves and Class 2 and 3 auxiliary equipment, the maximum value of bolt stress averaged across the bolt cross section does not exceed two times the bolt design stress intensity which is equivalent to Level C limits.

For Class 1, 2 and 3 component supports, Westinghouse uses allowable bolt stresses specified in Code Case 1644. These limits are increased for the emergency condition according to the provisions of Appendix XVII-2110(a) of the ASME Code, Section III. For the faulted condition these limits are increased in accordance with the provisions of Appendix XVII-2100(a) and Appendix F-1370(a).

For Ebasco scope, only high strength bolting materials, as defined in ASME-III, NC/ND-3658.3, are used in the piping systems. The allowable stresses at 100°F are not less than 20,000 psi. The faulted service limit is based on equation (16) of NC/ND-3758.3.

The allowable faulted stress for bolting in Bergen-Paterson component standard supports is traced from ASME Section III Subsection NF, Para. NF 3231.1 (c) to Para. NF-1370 of Appendix F and limited or clarified by NRC Regulatory Guide 1.124 Rev. 1 dated January 1978.

The final result, in simple terms, is the percentage increase in normal allowable stress that may be applied for the faulted condition.

The example given is for A193 Grade B7 bolting material as follows:

NF-3231.1 (c) states that the rules of F-1370 of Appendix F may be applied to determine level D limits. F-1370 (a) allow an increase in normal load condition allowable stresses by a factor of $1.2 \times \frac{Sy}{Ft}$ but not to exceed a factor of $0.7 \times \frac{Su}{Ft}$ where F_t is the allowable tensile stress, and Su is the ultimate tensile stress at temperature.

Reg. Guide 1.124 states that the smaller factor of:

a. 2 or,

b. $1.167 \frac{Su}{Sy}$ if $Su \geq 1.2\ Sy$ or,

c. 1.4 if $Su \leq 1.2\ Sy$,

should be used where Su and Sy are component-support material properties at temperature.

Example: A 193 GB7 @ 650°F

Sy @ Temp = 83.0 where S_{ur} = Ult. @ Room

$Su = S_{ur} \cdot \frac{Sy}{Syr}$ Sy = Yield @ Temp.

S_{yr} = Min. Yield @ Room

$S_{ur} = 125, S_{yr} = 105$

$\therefore Su = 125 \times \frac{83}{105} = 98.8$

∴ Use 1.4 from option C above.

Normal allowable stress value at 650°F as derived from XVII - 2461.1 is:

$$F_{tb} = \frac{Su}{2.0} = \frac{98}{2} = 49.4$$

$$\frac{Su}{Sy} = \frac{98.8}{83} = 1.19 \text{ which is less than } 1.2$$

∴Faulted allowable stress = 49.4 x 1.4 = 69.1 Ksi

The example is given to demonstrate the analytical approach that would be used for bolting applications in component supports, however, because of the unique loading conditions on bolts in Bergen-Patterson applications on hanger products Bergen-Patterson product design department has elected to use physical testing to establish load ratings.

The following tabulation gives the allowable stress at normal and faulted conditions for the various bolting materials normally used:

Material	Min. Yield	Ultimate Tension	Sy @ Temp	Su @ Temp	Allowable Stress Normal	Allowable Stress Faulted
A307 GR B	37	58	26.1 @ 650°F	42.05 @ 650°F	21	39.2
SA 325	81	105	69.3 @ 400°F	89.8 @ 400°F	44.9	67.8

Q 210.36 (Cont'd)

Material	Min. Yield	Ultimate Tension	Sy @ Temp	Su @ Temp	Allowable Stress Normal	Allowable Stress Faulted
SA 574	135	170	106.4 @ 650°F	170 @ 650°F	85	159
SA 490	130	150	102.5 @ 650°F	150 @ 650°F	75	127.5
A 193 B7 $\leq$ 2 1/2"	105	125	83 @ 650°F	98.8 @ 650°F	49.4	69.1

All stress values = Ksi

All of the above pertains to component standard supports designed by analysis. For the Shearon Harris Project bolting used on structural frames is designed in accordance with AISC. Our practice is to limit bolt size selection to a maximum of 75 percent of the tabulated allowable loads with further reduction to 50 percent where prying action was considered to be a factor.

The Shearon Harris Project instructions direct that hangers/restraints be designed in accordance with 8 specified load combinations. In almost all cases, Equation 6 having Sx for the structural steel design criteria controls. Equation 8 which allows 1.5 Sx was found to be controlling equation in about a dozen cases.

Equation 6 which includes DBE, having a design criteria of Sx, may be considered as being conservative.

This item is considererd confirmatory pending NRC staff review.

Q 210.37 3.9.3.1, Table 3.9.3-8

Valve discs are considered part of the pressure boundary and as such should have allowable stress limits. Provide these limits for our review.

RESPONSE:

Valve discs are considered part of the pressure boundary by Westinghouse and thus uses ASME III Code allowable stress limits.

For Class 1 valves these limits are outlined on Table 3.9.1-3, "Stress Criteria for ASME Code, Section III Class 1 Components."

For Class 2 and 3 valves, these limits are outlined on Table 3.9.3-6, "Stress Criteria for ASME Code Class 2 and 3 NSSS-Supplied Active and Inactive Valves."

For Class 2 and 3 valves, stress limits are indicated in ASME Section III, Subsection NC, Table NC-3521-1 and FSAR Table 3.9.3-8. Note (3) of that ASME table indicates that "Design requirements listed in this table are not applicable to valve discs, steam, seat rings, or other parts of the valves which are contained within the confines of the body and bonnet."

NC-3512 Standard Design Rules of ASME refers to ANSI B16.5 for design requirements and pressure temperature ratings. ANSI B16.5 Appendix D requirements for pressure temperature ratings as follows: "Selection of gaskets, bolting, and in the case of valves, stems, discs and other parts subject to pressure and other loading must be consistent with pressure temperature rating."

Class 2 and 3 check and globe valve discs are considered pressure retaining parts. Table 1.7 of Appendix I of ASME

Q 210.37 (Cont'd)

Section III describes the allowable stress acceptance criteria for the pressure retaining parts.

This item is closed.

Q 210.38 3.9.3.1, Table 3.9.3-10, 3.9.3-11

The actual stress limits used should be clarified rather than a reference to the appropriate Code paragraph.

RESPONSE:

Refer to the attached tables 210.38-1 and 210.38-2 for the requested information. The FSAR will be revised to reflect this information.

This item is closed pending an FSAR change.

Table 210.38-1

STRESS CRITERIA FOR NON-NSSS SUPPLIED ASME CODE

CLASS 2 AND 3 PRESSURE VESSELS

Component	Condition	Stress Limits	S Allowable σ_m	$(\sigma_m$ or $\sigma_2) + \sigma_6$
Pressure Vessel (ASME III, Div. 1)	Design/Normal	ASME III, NC/ND-3300	1.0S	1.5S
	Upset	ASME III, NC/ND-3300	1.1S	1.65S
	Emergency	ASME III, NC/ND-3300	1.5S	1.8S
	Faulted	ASME III, NC/ND-3300	2.0S	2.4S
Pressure Vessel		Not Applicable (See Section 1.8, R-G. 1.48)		

Table 210.38-2

STRESS CRITERIA FOR NON-NSSS SUPPLIED ASME CODE

CLASS 2 AND 3 PIPING

Condition	Equation*	S Allowable
Design/Normal	(8)	$1.0S_h$
	(10)	S_A
	(11)	$S_h + S_A$
Upset	(9)	$1.2S_h$
	(10)	S_A
Emergency	(9)	$1.8S_h$
Faulted	(9)	$2.4S_h$

* Equations from ASME - III, Subsection NC/ND-3650, 1971 Edition through Summer 1973 Addenda.

Q 210.39 3.9.3.1.2.2, Appendix 3.9A-2

Define closely spaced modes as you have used them in Response Spectra Analysis.

RESPONSE:

Closely spaced modes were ascertained utilizing the criterion of Regulatory Guide 1.92, Rev. 1. FSAR Section 3.9.3.1.2.2 will be revised to include this information.

This item is closed pending an FSAR change.

Q 210.40 3.9.3.3

Identify any areas where the piping and support system for pressure relief devices uses hydraulic snubbers. Provide the snubbers performance characteristics, if any, for our review.

RESPONSE:

The only area where the hydraulic snubbers have been specified on a piping system for pressure relief devices is the Main Steam System.

The hydraulic snubbers are required by specifications to be designed, fabricated, examined and tested per the requirements of the ASME B&PV Code, Section III, Subsection NF.

The snubber performance characteristics for the specific mark numbers are as follows:

	MS-H-34	MS-H-41	SH-H-50
Snubber Bore (inch)	Pipe Snub 5	Pipe Snub 5	Pipe Snub 5
Level A Load (KIP)	46	48	44
Level D & B Load (KIP)	54	56	52
Bleed Rate @ D Load (in/min)	10-30	10-30	10-30
Valve Closure (in/min)	Not Applicable	Not Applicable	Not Applicable
Max Short Term Temp (°F)	300	300	300
Max Cont Oper Temp (°F)	225	225	225
Drag Force (KIP)	3	3	3
Side Loading Capacity	6g	6g	6g

The hydraulic snubbers are required to function under dynamic loads only and they are not required to function during any steady state condition.

This item is considered open pending staff review.

Q 210.41 3.9.3.3.1, Page 3.9.3-7

Confirm that pressure-relieving devices are spaced according to Regulatory Guide 1.67.

RESPONSE:

The pressure-relieving devices are spaced according to ASME B&PV Code, Section III, Subsection NB-3686.1 (c). In addition, the spacing follows the guidelines of ASME Code Case N40 (1569), and therefore, it complies with Regulatory Guide 1.67.

This item is closed.

Q 210.42 3.9.3.4.2, Table 3.9.3-1

Provide information showing where you have considered thermal stresses.

RESPONSE:

The effects of temperature are considered in two manners in the design and loading of Class 2 and 3 components. First, operating temperature conditions are considered in the selection of material used to manufacture the Class 2 and 3 component. Second, nozzle loadings resulting from thermal effects of attached piping are routinely taken into account per the loading combinations outlined on Table 3.9.3-1. In order to further clarify this, Westinghouse will add to the footnote on Table 3.9.3-1 that the thermal effects of attached piping were considered.

Per the above discussion, this item is closed pending an FSAR revision.

Q 210.43

Due to a long history of problems dealing with inoperable and incorrectly installed snubbers, and due to the potential safety significance of failed snubbers in safety related systems and components, it is requested that maintenance records for snubbers be documented as follows:

Pre-service Examination

A pre-service examination should be made on all snubbers listed in tables 3.7-4a and 3.7-4b of Standard Technical Specification 3/4.7.9. This examination should be made after snubber installation but not more than six months prior to initial system pre-operational testing, and should as a miniumum verify the following:

(1) There are no visible signs of damage or impaired operability as a result of storage, handling, or installation.

(2) The snubber location, orientation, position setting, and configuration (attachments, extensions, etc.) are according to design drawings and specifications.

(3) Snubbers are not seized, frozen or jammed.

(4) Adequate swing clearance is provided to allow snubber movement.

(5) If applicable, fluid is to the recommended level and is not leaking from the snubber system.

(6) Structural connections such as pins, fasteners and other connecting hardware such as lock nuts, tabs, wire, cotter pins are installed correctly.

If the period between the initial pre-service examination and initial system pre-operational test exceeds six months due to unexpected situations, re-examination of items 1, 4, and 5 shall be performed. Snubbers which are installed incorrectly or otherwise fail to meet the above requirements must be repaired or replaced and re-examined in accordance with the above criteria.

Pre-Operational Testing

During pre-operational testing, snubber thermal movements for systems whose operating temperature exceeds 250° F should be verified as follows:

(a) During initial system heatup and cooldown, at specified temperature intervals for any system which attains operating temperature, verify the snubber expected thermal movement.

(b) For those systems which do not attain operating temperature, verify via observation and/or calculation that the snubber will accomodate the projected thermal movement.

(c) Verify the snubber swing clearance at specified heatup and cooldown intervals. Any discrepancies or inconsistencies shall be evaluated for cause and corrected prior to proceeding to the next specified interval.

The above described operability program for snubbers should be included and documented by the pre-service inspection and pre-operational test programs.

Q 210.43 (Cont'd)

The pre-service inspection must be a prerequisite for the pre-operational testing of snubber thermal motion. This test program should be specified in Chapter 14 of the FSAR.

RESPONSE:

The described operability program for snubbers is discussed in FSAR Section 3.9.2.1.3.d.

This item is closed.

Q 210.44

There are several safety systems connected to the reactor coolant pressure boundary that have design pressure below the rated reactor coolant system (RCS) pressure. There are also some systems which are rated at full reactor pressure on the discharge side of pumps but have pump suction below RCS pressure. In order to protect these systems from RCS pressure, two or more isolation valves are placed in series to form the interface between the high pressure RCS and the low pressure systems. The leak tight integrity of these valves must be ensured by periodic leak testing to prevent exceeding the design pressure of the low pressure systems thus causing an intersystem LOCA.

Pressure iolation valves are required to be category A or AC per IWV-2000 and to meet the appropriate requirements of IWV-3420 of Section XI of the ASME Code except as discussed below.

Limiting Conditions for Operation (LCO) are required to be added to the technical specifications which will require corrective action i.e., shutdown or system isolation when the final approved leakage limits are not met. Also surveillance requirements, which will state the acceptable leak rate testing frequency, shall be provided in the technical specifications.

Periodic leak testing of each pressure isolation valve is required to be performed at least once per each refueling outage, after valve maintenance prior to return to service, and for systems rated at less than 50% of RCS design pressure each time the valve has moved from its fully closed position unless justification is given. The testing interval should average to be approximately one year. Leak testing should also be performed after all disturbances to the valves are complete, prior to reaching power operation following a refueling outage, maintenance and etc.

Q 210.44 (Cont'd)

The staff's present position on leak rate limiting conditions for operation must be equal to or less than 1 gallon per minute (GPM) for each valve to ensure the integrity of the valve, demonstrate the adequacy of the redundant pressure isolation function and give an indication of valve degradation over a finite period of time. Significant increases over this limiting value would be an indication of valve degradation from one test to another.

The Class 1 to Class 2 boundary will be considered the isolation point which must be protected by redundant isolation valves.

In cases where pressure isolation is provided by two valves, both will be independently leak tested. When three or more valves provide isolation, only two of the valves need to be leak tested.

Provide a list of all pressure isolation valves included in your testing program along with four sets of Piping and Instrument Diagrams which describe your reactor coolant system pressure isolation valves. Also discuss in detail how your leak testing program will conform to the above staff position.

RESPONSE:

A listing of all pressure isolation valves included in the testing program is contained in FSAR Section 3.9.6. This FSAR Section will be amended to include testing requirements which will later be incorporated into the Technical Specifications. Copies of drawing CAR 2165 G 809 showing RCS pressure isolation valves will be provided to the staff.

This item is open pending additional NRC review of the information to be submitted.

Q 210.45

Provide your complete program for the inservice testing of pumps and valves including any request for relief from ASME Section XI requirements.

RESPONSE:

The program for the inservice testing of pumps and valves including any requests for relief from ASME Section XI requirements is included as FSAR Section Appendix 3.9.D. This item is confirmatory pending additional staff review.

[illegible]