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SUBJECT: Forwards response to FSAR Question 110.43 in NRC 830803 ltr. Increased damping & seismic spectra resulting from finite element model utilized to produce Phase II refined loads for each of five sample anchor groups.

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Docket No. 50-397

Director, Nuclear Reactor Regulation
Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
SUPPLY SYSTEM RESPONSE TO
FSAR QUESTION 110.43

Reference: (a) Letter, A. Schwencer (NRC) to DW Mazur (SS), dated August 3, 1983, subject, "FSAR Questions 110.41, 110.42, 110.43 and 110.44"
(b) Letter, GD Bouchey (SS) to A. Schwencer (NRC), dated June 30, 1983, subject, "Confirmatory Issue No. 7 - Component Supports"

The Washington Public Power Supply System hereby provides a reply to FSAR Question 110.43 which was submitted as an attachment to reference (a) above. Our reply consists of this letter and one attachment.

If you have any questions or desire further information, please contact P. L. Powell, Manager, WNP-2 Licensing.

Very truly yours,

G. C. Sorensen, Acting Manager
Nuclear Safety and Regulatory Program

GCS:PWH:ch

Attachment: Attachment 1 - Response

cc: Mr. R. Auluck - NRC
Mr. W. S. Chin - BPA
Mr. A. D. Toth - NRC Resident Inspector

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FSAR Question 110.43

Paragraph 2.b.22 of the response to Question 110.40-2b states that the load definition for the sample supports was refined to reduce some of the known conservatisms in the analysis. Paragraphs 2.b.35 and 2.b.37 also state that some supports were reanalyzed to confirm design adequacy. These statements do not contain an acceptable response to Question 110.40-2b. Provide a quantitative discussion of how the inherent design conservatisms were applied to the reanalysis.

Supply System Response

FSAR Question 110.40-2 is also provided for purposes of continuity as follows:

2. Relative to the C-2808 contract:

   a. Of the 1500 rigid piping supports which are affected by the addition of thermal loads to the faulted condition loads, identify those that exceed the specified allowable stress limits and by what amount.

   b. For all supports identified in 2a above, justify the acceptability at the predicted stress. Such a justification could demonstrate that support failure does not occur even if the design limit is exceeded or could utilize inherent design conservatisms. If this justification includes the consideration of inherent design conservatisms, provide a quantitative discussion of how such conservatisms were applied to the analysis.

Supply System responses to FSAR Questions 110.40, 110.41, 110.42, 110.44 and the response to Safety Evaluation Report - Confirmatory Issue No. 7 all contain information relating to the design conservatisms addressed in FSAR Question 110.43. Page 4 of the response to FSAR Question 110.40 discussed the major conservatism which is seismic design criteria:

> ". . . . Phase II indicates the reduction of conservatisms from the original load definition; the major area of conservatism which was refined in this step was the seismic criteria. An analytical plant model being used in other areas of the plant was applied to these anchor group calculations with a resultant 20% average reduction in load; . . . . No further refinement of the load definition was pursued following acceptance of the entire sample . . . ."

The seismic design margin as well as other known conservatisms were discussed with NRC staff during the November 12, 1982, Bethesda meeting. The conservatisms which may be applicable in specific analysis are:

- seismic spectra
- 0.5% damping vs. 2%/3% (Reg. Guide 1.61)
- nominal upsizing of component support members
- support flexibility as opposed to rigid assumptions[7]
- thermal gaps in supports
- conservative design temperature
- standard support designs

The original plant piping design utilized a lumped mass plant model for defining seismic spectra. Virtually all of the initial piping loads were generated using this conservative model. A subsequent finite element model of the plant produced new seismic spectra, but was only used for the remaining piping design and in certain reanalysis. When these new spectra and increased damping are applied to a particular piping calculation, as in the five anchor group sample, the average load reduction is about 20%; the resultant loads for a few supports may however show slight increases.

In direct response to question 110.43, only the increased damping and the seismic spectra resulting from the finite element model were utilized to produce Phase II refined loads for each of the five sample anchor groups. The existing support load (known capacity) was then compared to the refined Phase II load, including thermal, as discussed in 2.b.27 through 2.b.34 of the response to FSAR Question 110.40. As a result, 25 support directions and 20 anchor directions were found to have an existing load (known capacity) less than the Phase II refined load.

The following table provides quantitative data regarding the refined Phase II support load versus the known capacity of the 25 supports following reanalysis:

Note: Footnotes are located at the end of this response.

Similarly, the existing anchor forces and moments were reviewed against refined Phase II loads. Due to the interaction of forces and moments in an anchor, an increase of any load or moment resulted in evaluation of the entire anchor. All twenty anchors were found acceptable. As stated above, existing design margin in the individual anchor designs was sufficient to demonstrate acceptability without additional load refinement. The following table provides quantitative data on each of the 20 anchor loads requiring review. Note that in many cases, the emergency loads (and respective allowable stresses) are the limiting condition which provides design margin for inclusion of thermal loads in the faulted combination.

Anchor Group No.	Data Point Number	Phase II Refined Faulted Load Combination	Calculated Support Capacity (Less than Code Allowables)
25	239Fx	12646	12045 (2)
25	239Mz	68983	65730 (2)
25	284Fx	3584	3220
25	250Fy (1)	15651	15178 (2)
25	250Mx	31935	31889 (2)
25	250My	37783	35502 (2)
25	250Mz (1)	68162	57079 (2)
28	4/29Fx (1)(3)	1699	1212
28	4/29Fy (1)(3)	2527	2011
28	4/29Fz (3)	1672	1382
28	4/29My (3)	2447	2403
28	48Fz (3)	738	520
28	48Mx	4649	3838 (2)
28	809Fx (1)(3)	1529	1266 (2)
28	809Fy (1)(3)	916	651 (2)
28	809Fz (1)(3)	1960	1362 (2)
28	809Mx (1)(3)	3087	2426 (2)
28	809Mz (1)(3)	2529	1953 (2)
36	1My (4)	5029	1515
36	500My (3)	802	223

(1) Load increase occurred during Phase II.
(2) Reflects emergency load without 20% increase.
(3) Anchor loads revised during evaluation period for other reasons.
(4) Anchor loads not reported during Phase I.
(5) 24 additional baseplates required evaluation.
(6) Loads without postscripts or "F" are pounds (force).
Loads with "M" postscripts are foot-pounds (moment).
(7) In-plane and out-of-plane rigidity are design considerations; in-plane deflection due to total normal load is limited to 1/16" outside containment and 1/64" inside containment.

Anchor Group No.	Data Point Number(5)	Phase II Refined Faulted Load Combination(6)	Calculated Support Capacity (Less than Code Allowables)
25	382	16405	15636
25	602	8520	7303
25	412	112	65
28	800z(1)	3777	2513
28	802y(1)	9632	8295
28	806x(1)	2835	1819
28	806y(1)	9025	7363
28	381z(1)	4280	3392
32	34x(1)	1866	1663
32	44x	455	450
32	67x	481	302
32	69x	563	465
36	1273	5487	5237
109/110	74x(1)	180	137
109/110	74y(1)	209	206
109/110	80x	361	126
109/110	80y	147	143
109/110	831 (83/84)x	439	200
109/110	88x	158	67
109/110	88y	217	170
109/110	931 (93/94)x	71	46
109/110	971 (98)x	184	180
109/110	1041 (104/105)x	131	91
109/110	1131 (113/114)z	70	53
109/110	153z	94	70

Each of the above supports was reviewed by the piping support group. The purpose of this review was to determine if the existing hardware was capable of carrying the Phase II load within all code and project criteria. No design conservatisms were removed in this review. As stated previously, all 25 supports were found acceptable by either inspection or reanalysis. The application of refined seismic spectra and the resultant Phase II loads should not be confused with the review of those supports addressed in the NRC question. The effort involved in obtaining additional load reduction after the initial Phase II refinement would have exceeded the effort required to individually review the scattered number of supports in the five anchor groups.