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June 1, 1988

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, DC 20555

Dear Sir:

Subject: Oyster Creek Nuclear Generating Station
Docket No. 50-219
Mark I Long Term Program - NUREG 0661

During NRC inspection 88-15, conducted at the Oyster Creek plant from May 23, 1988 through May 27, 1988, the inspectors identified several overstress conditions in the Torus attached piping analysis section of the Plant Unique Analysis (PUA) performed pursuant to NUREG 0661. Although NRC reviewed and approved the PUA consisting of MPR reports MPR 733, MPR-734 and MPR-772, the latest supplement (MPR-S99) was not reviewed since these changes were evaluated by GPU Nuclear (GPUN) pursuant to 10CFR50.59. During the inspection, the results of the 10CFR50.59 evaluation were questioned. As a result of a telecon between GPUN and the NRC staff, it was agreed to provide a more rigorous discussion of these overstressed conditions.

In discussions with the NRC inspectors and both Region I and NRR staff, GPUN explained the overstress conditions were acceptable due to the conservatism inherent in the analysis technique and the relatively low magnitude of overstress calculated (maximum 8%). The basis of this determination was the previous acceptability of similar occurrences in the NRC's evaluation (SER dated January 13, 1984) of the PUA for Oyster Creek. Enclosure 1 provides a more detailed discussion of the overstress conditions and the result of GPUN's evaluation of the concerns raised during the inspection.

The purpose of the Mark I Containment Long Term Program (NUREG 0661) is to re-establish the originally intended design safety margins (safety-to-failure factor of 3 to 4) following the identification of loading factor hich were not considered in the original design basis. This condition was ntified as a Generic Unresolved Safety Issue (USI A-7). Section 1.2 of NUREG-0661 provides a discussion of the Mark I Short Term Program which resulted in NUREG 0408 "Mark I Containment Short-Term Program Safety Evaluation Report." This report concluded that Mark I Containments provided adequate safety margin (safety-to-failure factor of 2) to justify continued operation of the plant pending completion of the more detailed analysis and upgrade to the intended standards as required in the Long Term Program. Based on this report the NRC granted exemptions relating to the structural factor of safety requirements of 10CFR50.55(a). These exemptions have been extended for

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Oyster Creek by NRC letters dated December 29, 1981, January 19, 1982, and October 6, 1986, with the last letter directly referencing Torus attached piping.

Currently, the Oyster Creek plant is required by Confirmatory Order to meet the requirements of NUREG 0661 and the Oyster Creek PUA prior to restart from the Cycle 12R refueling outage. In view of the existing exemptions to 10CFR50.55(a), the existing structure satisfies the safety-to-failure factor of 2 criteria of the short term program. The continued operation of the Oyster Creek plant does not represent an undue risk to the health and safety of the public as determined in NUREG 0408 and further determined in the aforementioned extensions to the exemptions granted by the NRC for the Oyster Creek plant.

The specific overstress conditions identified may not be in literal compliance with NUREG 0661 Long Term Program criteria, however, GPUN believes the intent of the criteria are met. While GPUN agrees that resolution of the concerns relating to the overstress conditions identified during the inspection must be accomplished, this situation does not adversely effect the present continued safe operation of the Oyster Creek plant.

If you should have any questions please contact Mr. Paul Czaya, Licensing Engineer at (201)316-7975.

Very truly yours,

E. E. Fitzpatrick
Vice President and Director
Oyster Creek

EEF/GB/dmd (0075A)
Enclosures

cc: Mr. William T. Russell, Administrator
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NRC Resident Inspector
Oyster Creek Nuclear Generating Station

Enclosure 1

EVALUATION OF CALCULATED OVERSTRESS LOCATIONS

Background:

NRC Inspection 88-15 was conducted at the Oyster Creek plant from May 23, 1988 through May 27, 1988. The objective of this inspection was to review the modifications performed to satisfy the requirements of the Mark I Containment Long Term program (NUREG 0661). The inspectors noted several calculated overstress conditions contained in a supplement to the Torus attached piping PUAR. This supplement (MPR 999) describes the reanalysis performed on some of the piping systems attached to the suppression chamber as a result of subsequent changes to the piping and support arrangements from those described in MPR 734. MPR 734 comprised the original PUAR for Torus attached piping. The NRC staff documented the acceptability of the analytical techniques employed and the resultant stresses calculated in an SER dated January 13, 1984, "Mark I Containment Long Term Program - Structural Review." The latest supplement (MPR 999) has not been submitted to the NRC Staff for review. The external Torus attached piping modifications were completed in the fall of 1987. The Torus major modifications were completed during the Cycle 10R refueling outage during 1983-1984. One remaining Long Term Program modification is the upgrade of Torus bulk temperature measurement capability which will be completed during the next (Cycle 12R) refueling outage. Mark I containment vacuum breakers are no longer considered part of the Long Term Program via Generic Letter 83-02. However, remaining vacuum breaker modifications will be completed during the 12R outage.

Discussion:

Application of SRSS Load Combination Method for Mark I Analysis

A question raised by the NRC concerned the applicability of using square-root-sums-of-squares (SRSS) load combination methodology, for Oyster Creek torus-attached piping analyses. Although the original combination methodology for torus-attached piping analyses, documented in Oyster Creek PUA Reference 2 used absolute sum load combination, SRSS was subsequently approved generically by the NRC for Mark I use by Reference 4. Accordingly, the reanalysis documented in Reference 1 utilized the SRSS methodolgy. The SRSS analyses in the Reference 1 utilized the SRSS methodolgy. The SRSS analyses in the Reference 1 were performed in accordance with the guidelines stipulated in Reference 4 and thus is in accordance with NRC approved Mark I analysis methodology.

Conservatism in Response Specturm Analyses Method

The response spectrum analyses method as stated in Reference 3 imposes significant conservatism in the dynamic analysis results as compared to more accurate time history methods. The conservatism is a generally recognized consequence of the response spectrum analysis methodology and has been attributed to the conservative methods used to generate response spectra. Reference 5 discusses this relationship in detail. This reference indicated a mean factor of conservatism of 25% due to this effect. The Franklin Institute Mark I Technical Evaluation Report for the Oyster Creek torus attached piping PUA (Reference 6) also noted that response spectra methods nave shown up to 30% higher response than time-history analysis.

Table 1 of Attachment 1 shows a comparable degree of conservatism introduced by the response spectrum method for Mark I loads on a specific torus attached piping line (the SRV discharge line). At least 21%, and in many cases significantly greater conservatism can be seen. The following section discusses the basis for concluding that similar results could be expected for the nitrogen purge and containment spray test return branch connections.

Comparison of Piping System and Loading Characteristics

Factors which affect the response spectrum methods' degree of conservatism are the numbers of significant and participating modes, number and direction of excitation points and the shape of the response spectrum loading. As shown in Table 2 of Attachment 1 the two lines which have calculated stresses which exceed the Mark I criteria slightly (containment spray test return and nitrogen purge) have a large number of participating modes (19 and 14 respectively). The number of participating modes which fall in the range of peak LOCA loading response is 4 for the nitrogen purge line and 9 for the containment spray test return line as compared to 11 modes for the SRV discharge piping. Based on this evaluation there are sufficient modes in the peak response area for each of the lines to expect that time history method would result in significant reduction in calculated response.

The response spectra characteristics for typical DBA Condensation Oscillation and Pool Swell Loads applied to the SRV Discharge Piping and Vacuum Relief Piping (to which the Nitrogen Purge and Containment Spray Test Return lines are connected) have similar dynamic characteristics as documented in Attachment 2.

Also as shown in Table 2 of Attachment 1 all of the lines have a number of independent response input points and excitation degrees of freedom. As a result it is expected that the conservatism introduced by the response spectrum method due to this effect would be comparable.

Effect of Large Stress Intensification Factor

The evaluation of the branch connections in MPR-999 employed the local stress intensification factors (SIF) which are permitted by the ASME Code for Class 2 and 3 piping analysis. For the reduced outlet branch fittings to which these lines connect, the Code equations result in an effective SIF of approximately 4. Our experience shows that a more detailed evaluation (e.g., using finite element methods) can reduce the magnitude of the SIF from those obtained using the simplified Code formulas. A small change (i.e., 10%) in the SIF using the more rigorous approach would be reasonable to expect. The effect all by itself would then be sufficient to enable these branch connections to satisfy the Mark I criteria.

Influences of Mark I Loadings a Final Result

A detailed review was performed to assess the amount of reduction required in the Mark I loading response to satisfy the Mark I stress acceptance criteria. As shown in Table 3 of Attachment 1 the reduction in Mark I load responses required to show that Mark I acceptance criteria are satisfied are 7% less.

Conclusion

Based upon the conservatisms inherent in the analytical techniques utilized in the calculation of piping stresses as well as the conservatism in the suppression pool dynamic loads, as stated in the NRC SER dated January 13, 1984 "Mark I Containment Long Term Program - Pool Dynamic Loads," GPUN believes that good engineering judgement was prudently applied to the evaluation of calculated stresses for the nitrogen purge and containment spray test return lines. It is reasonable to conclude that explicit satisfaction of the Mark I criteria for these two lines would be achievable using more rigorous analysis methods than employed in MPR-999. Therefore, it is GPUN's position that the intent of the criteria in NUREG 0661 is met and the continued operation of the Oyster Creek plant is justified and poses no risk to the health and safety of the public and plant personnel.

References

1. MPR Letter dated December 23, 1987, forwarding MPR-999, "Oyster Creek Nuclear Generating Station, Mark I Containment Long-Term Program, Plant Unique Analysis Report, Torus Attached Piping, Addendum to MPR-734," December 1987.

2. MPR-734, "Oyster Creek Nuclear Generating Station, Mark I Containment Long-Term Program, Plant Unique Analysis Report, Torus Attached Piping," August 1982.

3. MPR Letter dated May 27, 1988, Subject: Oyster Creek Nuclear Generating Station Torus Attached Piping," August 1982.

4. NRC Letter dated March 10, 1983, forwarding SER entitled "Safety Evaluation by the Office of Nuclear Reactor Regulation for Acceptability of the SRSS Method for Combining Dynamic Responses in Mark I Piping System," dated March 10, 1983.

5. "Uncertainty and Conservatism in the Seismic Analysis and Design of Nuclear Facility," American Society of Civil Engineers, 1986.

6. Technical Evaluation Report, "Audit for Mark I Containment Long-Term Program - Structural Analysis for Operating Reactors," August 30, 1983.

Attachment 1

Comparison of Response and Dynamic Characteristics of Three Oyster Creek Torus Attached Piping Lines to Mark I Dynamic Loading Conditions

1. Table 1: Effect of Analysis Method on SRV Piping System Response to Mark I Loadings

2. Table 2: Comparison of Mark I Dynamic Loadings and Piping Dynamic Response for Several Torus Attached Piping Systems

3. Table 3: Summary of Projected Dynamic Response Reductions Required to Demonstrate Satisfaction of Mark I Program Stress Criteria for Two Reducing Outlet Tee Fittings

Table 1

Effect of Analysis Method
on SRV Piping System Response to Mark I Loadings

	Mark I Hydrodynamic Loading					
	Pool Swell			Condensation Oscillation		
Location	Response Spectrum (Kips)	Harmonic (Time History) (Kips)	Reduction %	Response Spectrum (Kips)	Harmonic (Time History) (Kips)	Reduction %
S1	3.36	1.98	41	6.03	4.04	33
S2	8.26	2.57	69	20.2	3.59	82
S3	3.34	0.50	85	6.32	2.03	68
S5	3.49	1.34	62	5.71	4.52	21
H4	0.02	~0	--	0.04	~0	--
H5	0.0	~0	--	0.0	~0	--
Hanger	0.03	~0	--	0.03	~0	--
		Average Reduction	64%			51%

From: MPR Letter Report Dated August 2, 1985

Table 2

Comparison of Mark I Dynamic
Loadings and Piping Dynamic Response for
Several Torus Attached Piping Systems

Item	SRV Discharge Line (South Header)	Containment Spray Test Return South Line and Vacuum Relief Assembly B	Nitrogen Purge Line and Torus-to-Reactor Building Vacuum Relief Assembly
A. Piping Response Characteristics			
. Line Size	12 and 14 inch	6 and 18 inch	8 and 20 inch
. Participating Modes	22	19	14
. Modes in Peak DBACO Response Range (See Note 2)	11	(See Note 1)	4
. Modes in peak PSW Response Range (See Note 2)	11	9	(See Note 1)
. Distance from Torus Response Point	40 to 88 feet	18 to 51 feet	63 feet
B. Mark I Loading Characteristics			
. Independent Response Input Points	2	2	1
. Excitation Degrees of Freedom	4	6	3

Notes:

1. These loadings met the Mark I criteria and need no further evaluati--
2. Mark I loads shown in Enclosure 2.

Table 3

SUMMARY OF PROJECTED DYNAMIC RESPONSE REDUCTIONS REQUIRED TO DEMONSTRATE SATISFACTION OF MARK I PROGRAM STRESS CRITERIA FOR TWO REDUCING OUTLET TEE FITTINGS

Fitting and Branch Line	Limiting Mark I Load Combination	Applicable Mark I Program Stress Criteria	(Note 2) Mark I Piping Results Reported In MPR-999	Reduction in Mark I Dynamic Load Response Needed to Satisfy Mark I Program Stress Criteria
6" X 18" Tee on Containment Spray Test Return Line (Branch line to Torus to Drywell Vacuum Relief Assembly B)	Ib: P+DW+SRV(NOC) +EQ(S)	27,000	27,900 (Exceeds criteria by 3.3%)	None (See Note 1)
	II: P+DW+PSW+SRV(DBA) +EQ(S)	36,000	36,600 (Exceeds criteria by 1.7%)	Less than 4% Reduction in calculated pool swell (PSW) response required to satisfy criteria.
6" X 20" Tee on Nitrogen Purge (Branch line connected to Torus to Reactor Building Vacuum Relief Assembly)	III: P+DW+DBA/CO +EQ(O)	36,000	38,700 (Exceeds criteria by 7.5%)	Less than 8% Reduction in calculated DBA condensation oscillation (DBA/CO) response required to satisfy criteria.

NOTES:

1. For convenience, the analyses in MPR-999 conservatively included seismic anchor motion stresses in the total stress results for Combination Ib: N+EQ(S)+SRV(NOC) under Class 2 piping analysis "Equation 9." These anchor motion stresses need not be included in the "Equation 9" evaluation. We have determined that by removing the anchor motion stresses from this evaluation and combining the anchor motion stresses in "Equation 11," Combination Ib would satisfy the Mark I acceptance criteria. Thus no reduction in torus dynamic loads is required for this load combination.

2. Stresses due to torus hydrodynamic loads are based upon SRSS of modal stresses. Stresses based upon an algebraic sum of modal stresses are not yet available.

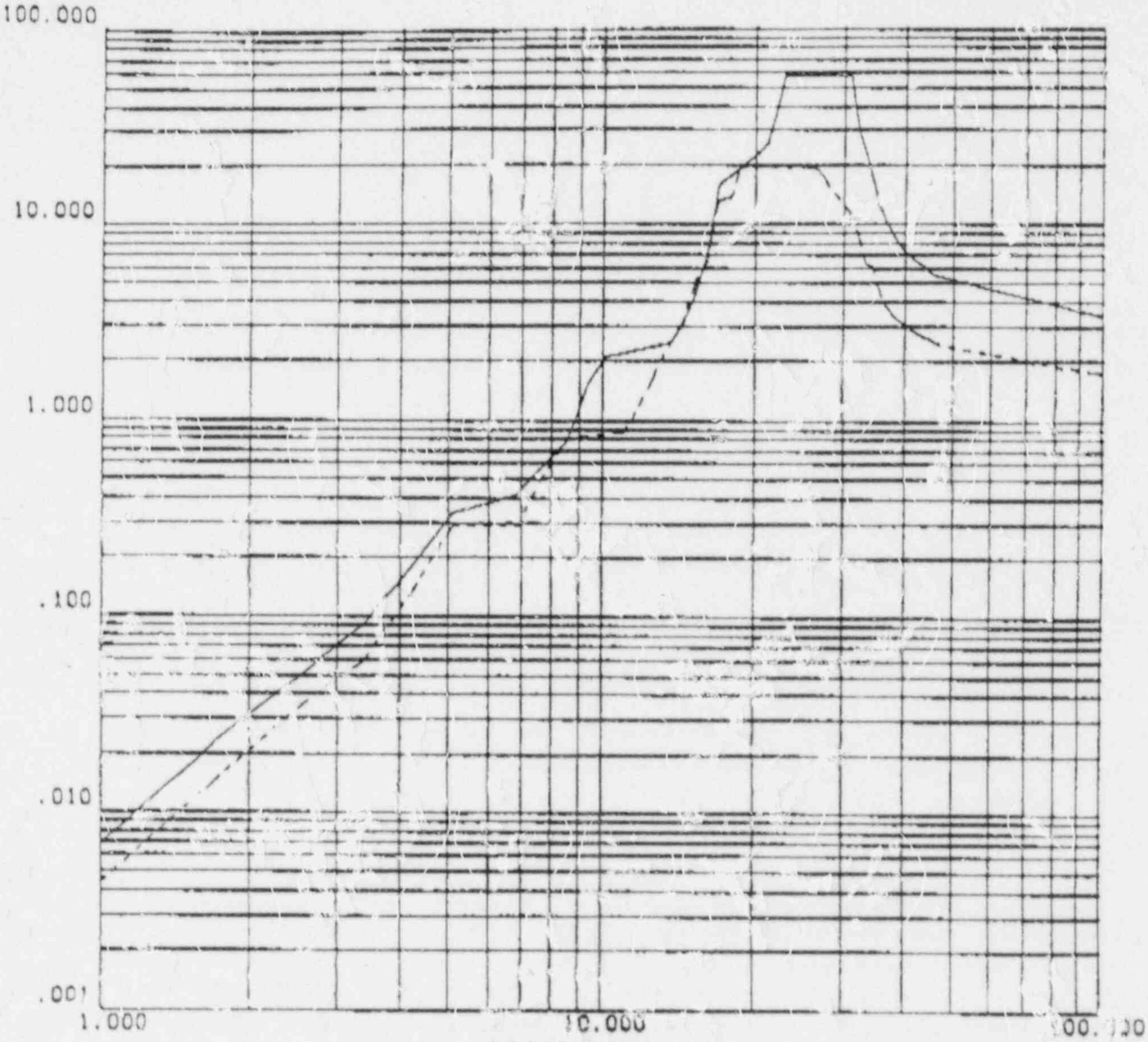
Typical Mark I Loadings for Oyster Creek Torus Attached Piping

This enclosure documents two typical Mark I piping loadings for Oyster Creek Torus attached piping. The table below documents the applicability of these loads to several piping systems and notes significant dynamic characteristics. The table and the attached figures show comparable dynamic Mark I loading functions for the SRV and Vacuum relief piping systems to which the nitrogen purge line and containment spray return line are connected.

Load	Applicability	Dynamic Characteristic
Figure 18 - DBA Condensation Oscillation (Node 1330)	SRV Line	Flat topped spectra with peak response from 20 to 30+ Hertz
Figure 15 - DBA Condensation Oscillation (Node 301)	Vacuum Breakers (Nitrogen purge line connection)	Flat topped spectra with peak response from 20 to 30+ Hertz
Figure 3.1-40 - DBA Pool Swell (Node 1330)	SRV Line	Flat topped spectra with peak response from 15 to 25 Hertz
Figure 3.1-36 - DBA Pool Swell (Node 1245)	Vacuum Breakers (Containment spray test return line connection)	Flat topped spectra with peak response from 15 to 30+ Hertz

FIGURE 18

OYSTER CREEK NUCLEAR GENERATING STATION
MODIFIED COUPLED TORUS/VENT SYSTEM EVALUATION
DBA C.O. ALTERNATE 2 - RESPONSE SPECTRA COMPARISON
MAIN SRV NODE 2329 (1330) RAD. DOF 2 (ANSYS 170)



MIN Y= 6.79X10^{-03} AT X= 1.000 MAX Y= 52.447 AT X= 22.950
DATA FROM 040CON9N1 2 PERCENT DAMPING

MIN Y= 4.45X10^{-03} AT X= 1.000 MAX Y= 19.616 AT X= 18.700
DATA FROM 040CON6N3 2 PERCENT DAMPING

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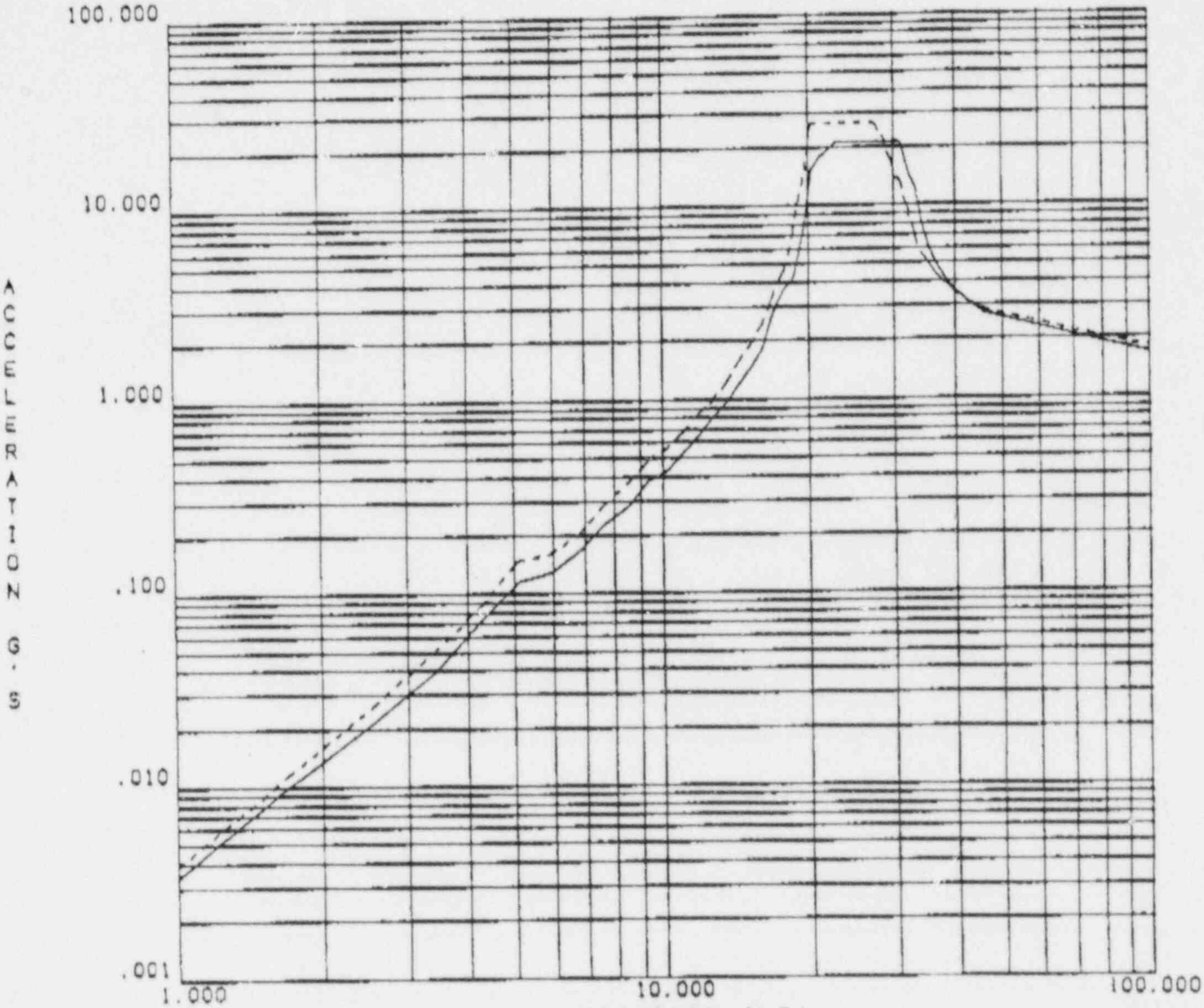
FIGURE 15

OYSTER CREEK NUCLEAR GENERATING STATION
MODIFIED COUPLED TORUS/VENT SYSTEM EVALUATION
DBA C.O. ALTERNATE 2 - RESPONSE SPECTRA COMPARISON
VACUUM BREAKER NODE 738 (301) RAD. DOF 3(ANSYS 1)



MIN Y= 3.37×10^{-03} AT X= 1.000 MAX Y= 21.168 AT X= 22.950
DATA FROM 040CON9N1 2 PERCENT DAMPING

MIN Y= 3.94×10^{-03} AT X= 1.000 MAX Y= 26.746 AT X= 20.400
DATA FROM 040CON6N3 2 PERCENT DAMPING

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FIGURE 3.:-40

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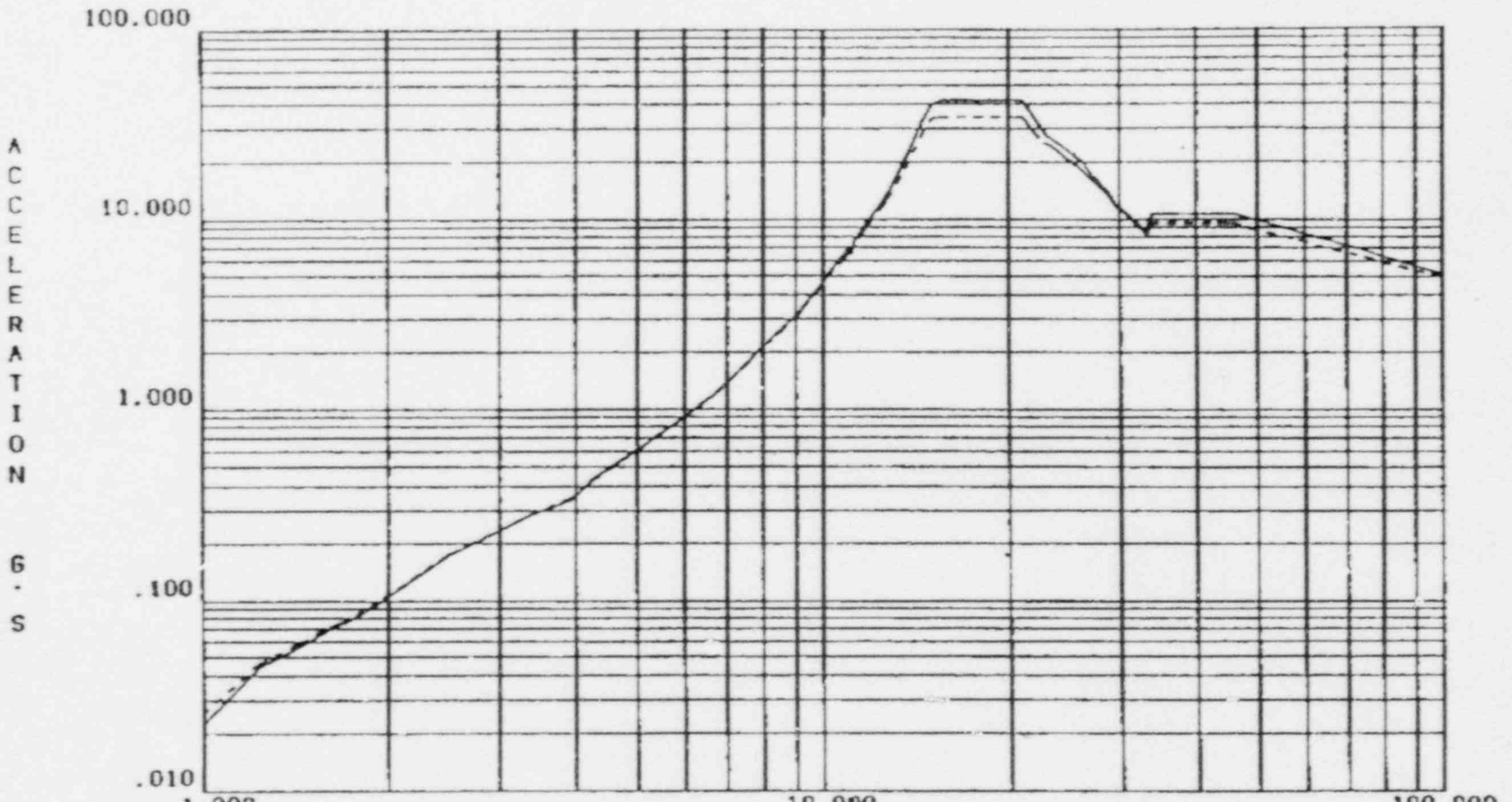
OYSTER CREEK NUCLEAR GENERATING STATION
COUPLED TORUS/VENT SYSTEM EVALUATION
DBA POOL SWELL - 4.06 FT DC SUBMRG, 0 DELTA P (040PSW6A1)
RESPONSE SPECTRA FOR PIPING ATTACHED TO VENT SYSTEM
MAIN SRV NODE 1329/1330(ANSYS 170) RADIAL (Z) TRANSLATION



——— MIN Y= 2.22×10^{-02} AT X= 1.000 MAX Y= 41.645 AT X= 15.538 2 PERCENT DAMPING
------ MIN Y= 2.55×10^{-02} AT X= 1.000 MAX Y= 34.443 AT X= 15.538 3 PERCENT DAMPING

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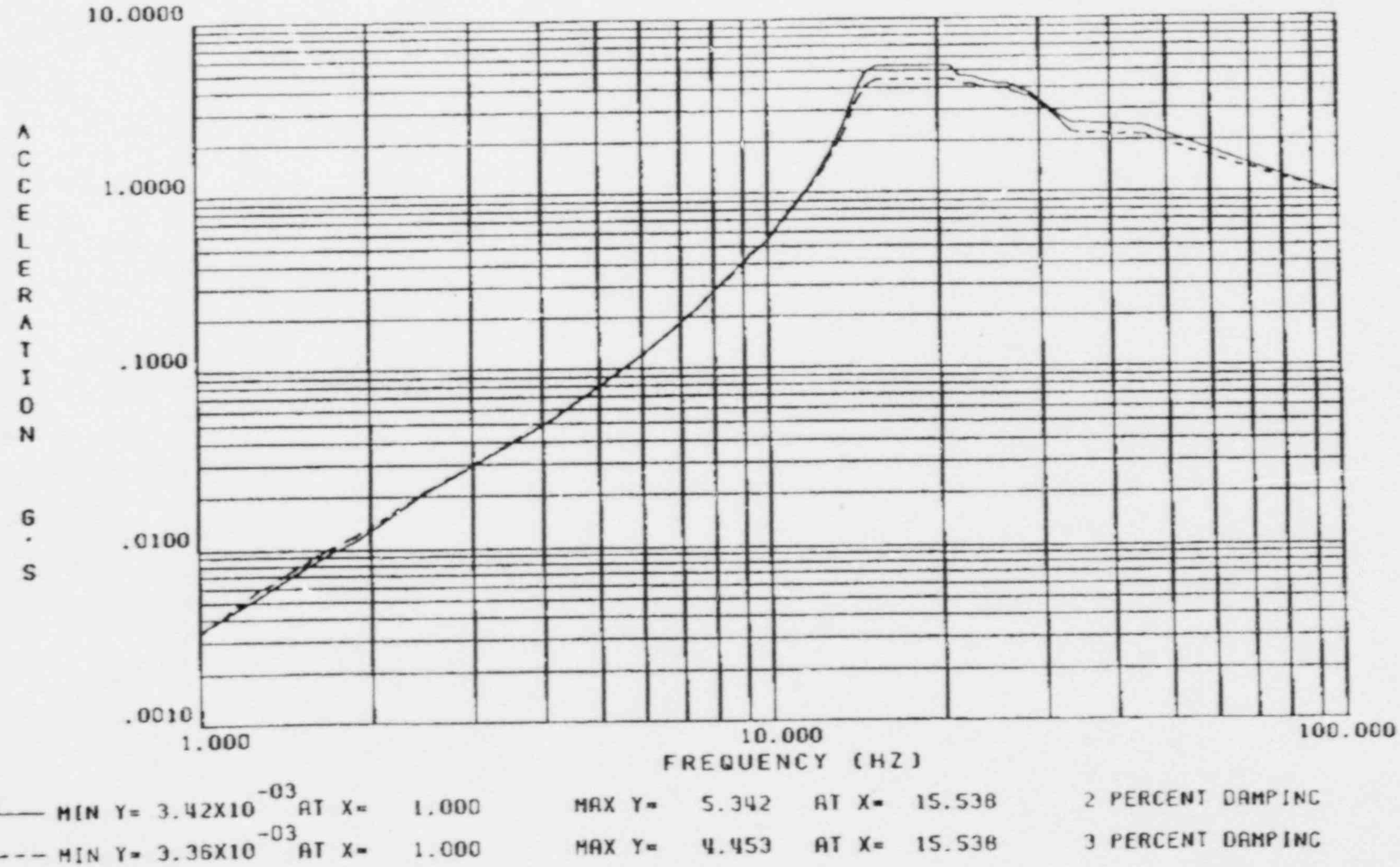
FIGURE 3.1-36

OYSTER CREEK NUCLEAR GENERATING STATION
COUPLED TORUS/VENT SYSTEM EVALUATION
DBA POOL SWELL - 4.06 FT DC SUBMRG, 0 DELTA P (040PSW6A1)
RESPONSE SPECTRA FOR PIPING ATTACHED TO VENT SYSTEM
VACUUM BREAKER NODE 1245(ANSYS 27) RADIAL (X) TRANSLATION



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