ASEA BROWN BOVERI

February 25, 1992
LD-92-030

Docket No. 52-002

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: Response to NRC Requests for Additional Information

Reference: Letter, Structural and Geosciences Branch RAIs, T. V. Wambach (NRC) to E. H. Kennedy (C-E), dated September 26, 1991

Dear Sirs:

The Reference requested additional information for the NRC staff review of the Combustion Engineering Standard Safety Analysis Report - Design Certification (CESSAR-DC). Enclosure I to this letter provides our responses to RAIs 220.9, 230.6, and 230.8.

In addition, Enclosure II contains revised responses to RAIs 220., 410.102a, 500.25(b), and Question 1 (Task Action Plan Item B-17).

Should you have any questions on the enclosed material, please contact me or Mr. Stan Ritterbusch of my staff at (203) 285-5206.

Very truly yours,

COMBUSTION ENGINEERING, INC.

C. B. Brinkman
Acting Director
Nuclear Systems Licensing

gdh/lw
Enclosures: As Stated

cc: J. Trotter (EPRI)
T. Wambach (NRC)

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Enclosure I to
LD-92-030

RESPONSE TO NRC REQUESTS FOR ADDITIONAL INFORMATION
STRUCTURAL AND GEOSCIENCES BRANCH

Question 220.9

Section 3.7.1.2 - Figures 3.7-25 through 3.7-27 are for damping values of 5 percent. To show the appropriateness of these time histories, provide and discuss similar figures for other damping values that will be used in the design of all Category I structures, systems, and components.

Response 220.9

The synthetic time histories H1, H2 and V were generated by obtaining a reasonably conservative envelope to the target smooth spectrum at a spectral damping ratio of 5 percent. The response spectra calculated for these synthetic time histories are presented in CESSAR-DC Figs. 3.7-25 through 3.7-27. The procedure used to obtain the synthetic time histories and the frequencies at which spectral ordinates were calculated are summarized in the response to RAI 220.8.

The spectral ordinates of the target smooth spectrum were estimated for spectral damping ratios other than 5 percent using, as a basis, the spectral amplification factors recommended by Newmark and Hall (1982). The following median and 84th percentile factors were proposed by Newmark and Hall:

Spectral Region	Cumulative Probability, %	Equation for Amplification Factors
Acceleration	84.1 (one sigma)	$4.38 - 1.04\,Ln(\beta)$*
Velocity		$3.38 - 0.67\,Ln(\beta)$
Displacement		$2.73 - 0.45\,Ln(\beta)$
Acceleration	50 (median)	$3.21 - 0.68\,Ln(\beta)$
Velocity		2.3 41 $Ln(\beta)$
Displacement		$1.82 - 0.27\,Ln(\beta)$

* β is spectral damping in percent

The above equations were used as follows: (i) the spectral amplification factor for a given spectral damping ratio was divided by that for β = 5 percent to obtain an "adjustment factor" for the given spectral damping ratio; and (ii) the adjustment factor was then multiplied by the spectral ordinates of the target smooth spectrum (for β = 5 percent) to obtain the spectral ordinates of the target smooth spectrum at the desired spectral damping ratio. The adjustment factors were calculated for both the median and the 84th percentile amplification factors; as expected the two sets of adjustment factors were very close (differences were no more than about 6%). For the reasons outlined in response to RAI 230.4, the adjustment factors based on the median amplification factors were used herein to obtain spectral ordinates for the target smooth spectrum at spectral damping ratios of 1, 2 and 7 percent in addition to those that had been developed for 5 percent damping.

The adjustment factors calculated using the above equations are as follows:

Spectral Region	Frequency Range, f in Hz	Adjustment Factor for a spectral damping ratio of							
		1 percent		2 percent		5 percent		7 percent	
		*	**	*	**	*	**	*	**
Acceleration	$f \geq 3.4$	1.517	1.619	1.295	1.352	1	1	0.892	0.871
Velocity	$0.5 < f < 3.4$	1.400	1.468	1.228	1.267	1	1	0.916	0.902
Displacement	$f \leq 0.5$	1.314	1.361	1.179	1.206	1	1	0.934	0.925

* based on ratio of median spectral amplification factors

** based on ratio of 84th percentile spectral amplification factors

Note that Newmark and Hall (1982) suggested the use of the above equations for the horizontal components of earthquake ground motions. For simplicity, the same equations were considered appropriate to obtain adjustment factors (ie, ratios) for the vertical component as well.

Finally, the spectral ordinates for damping ratios of 1, 2,5 and 7 percent were calculated for the synthetic time histories, H1, H2 and V and these were compared with the target smooth spectrum for the appropriate damping ratio. These comparisons are provided herein in Figs. 1a through 3d.

Figure 1a shows the comparison for H1 at a damping ratio of 1 percent, Fig. 1b is a similar comparison at a damping ratio of 2 percent, Fig. 1c is for a damping ratio of 5 percent and Fig. 1d is for a damping ratio of 7 percent. Corresponding comparisons are presented in Figs. 2a, 2b, 2c and 2d for H2 and in Figs. 3a, 3b, 3c and 3d for the vertical synthetic time history, V.

The results shown in Figs. 1a through 3d indicate: (i) the spectral ordinates of the synthetic time histories provide a reasonably conservative envelope to the target smooth spectrum at damping ratios from 1 to 7 percent for the frequencies of interest; and (ii) the amount of conservatism increases with decreasing damping.

RAI 220.9

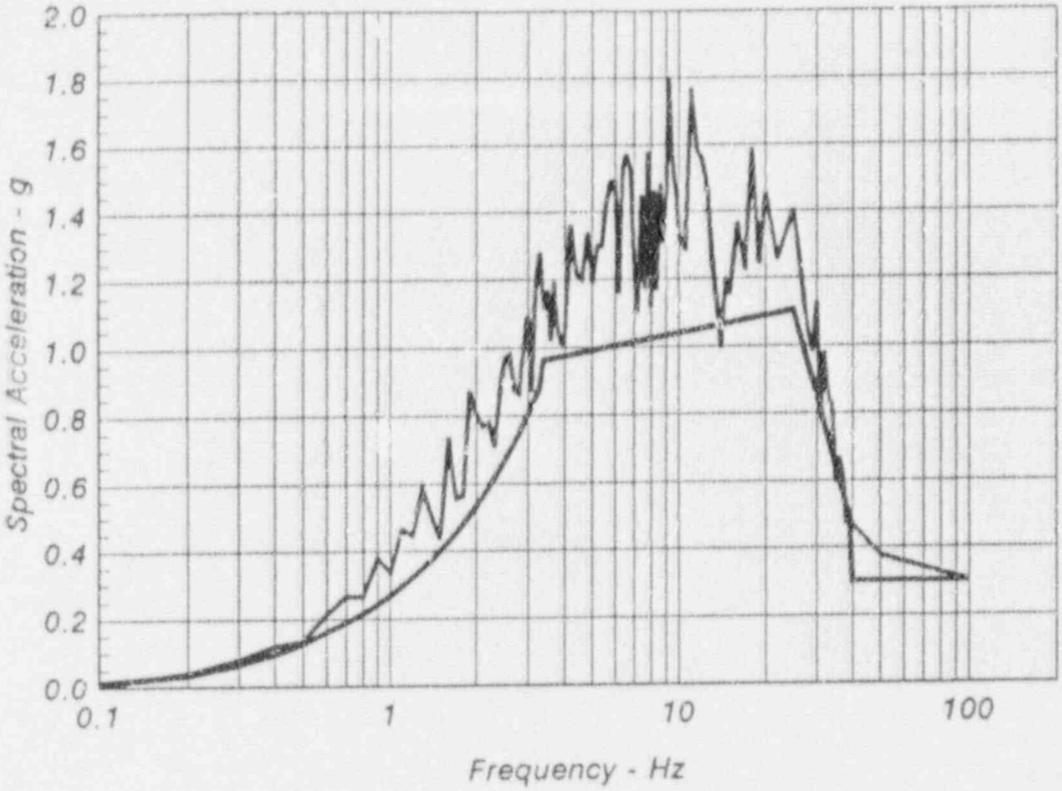


Fig. 1a Spectral Acceleration for Target Spectrum and for Synthetic Time History H1 -- Spectral Damping = 0.01

O-220.9 - 1

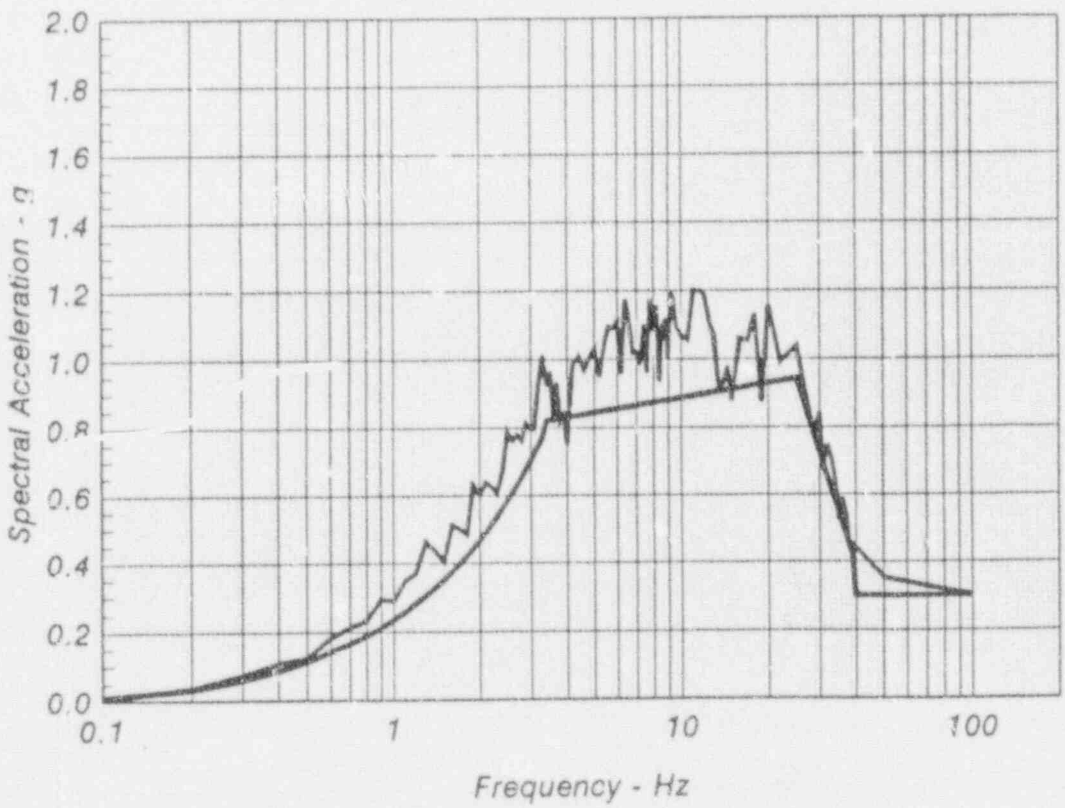


Fig. 1b Spectral Acceleration for Target Spectrum and for Synthetic Time History H1 -- Spectral Damping = 0.02

O-220.9 - 2

RAI 220.9

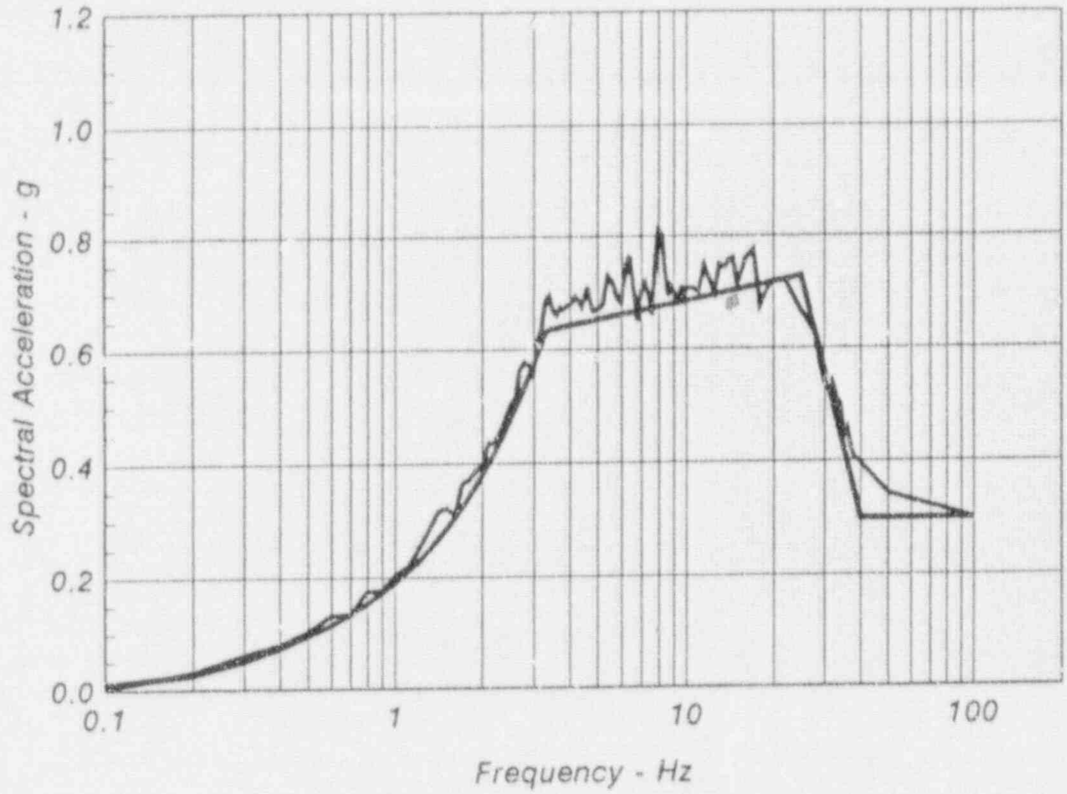


Fig. 1c Spectral Acceleration for Target Spectrum and for Synthetic Time History H1 -- Spectral Damping = 0.05

Q-220.9 - 3

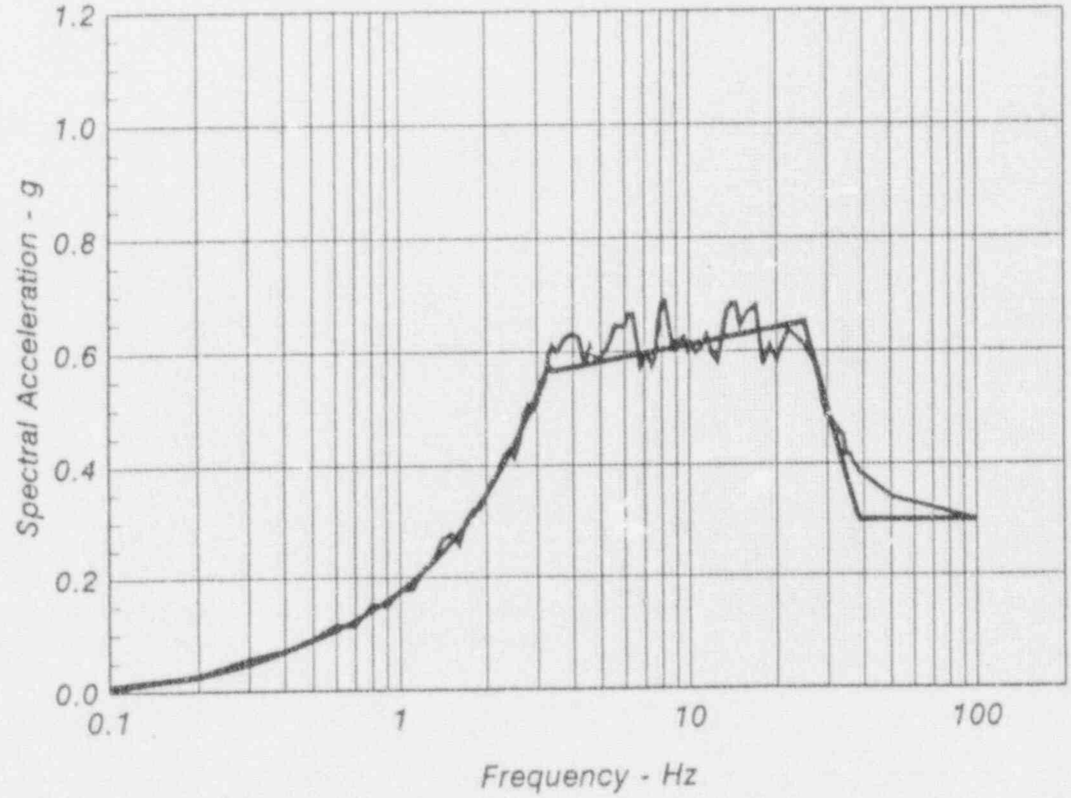


Fig. 1d Spectral Acceleration for Target Spectrum and for Synthetic Time History H1 -- Spectral Damping = 0.07

Q-220.9 - 4

RAI 220.9

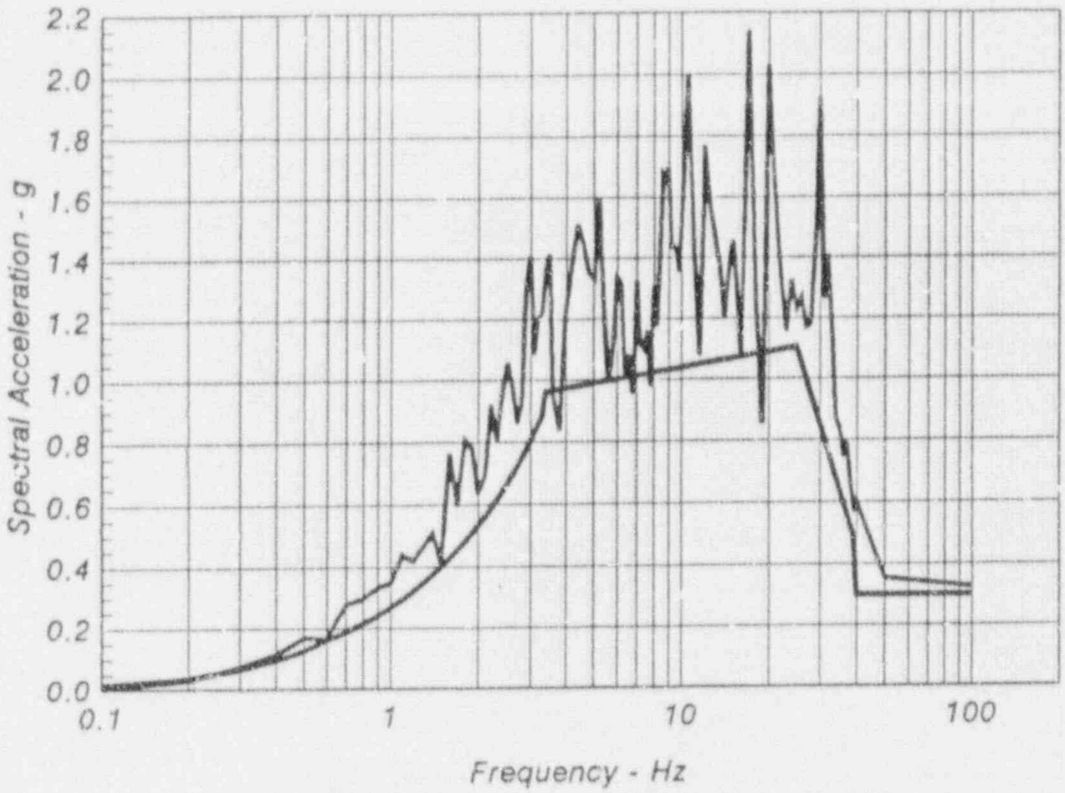


Fig. 2a Spectral Acceleration for Target Spectrum and for Synthetic Time History H2 -- Spectral Damping = 0.01

Q-220.9 - 5

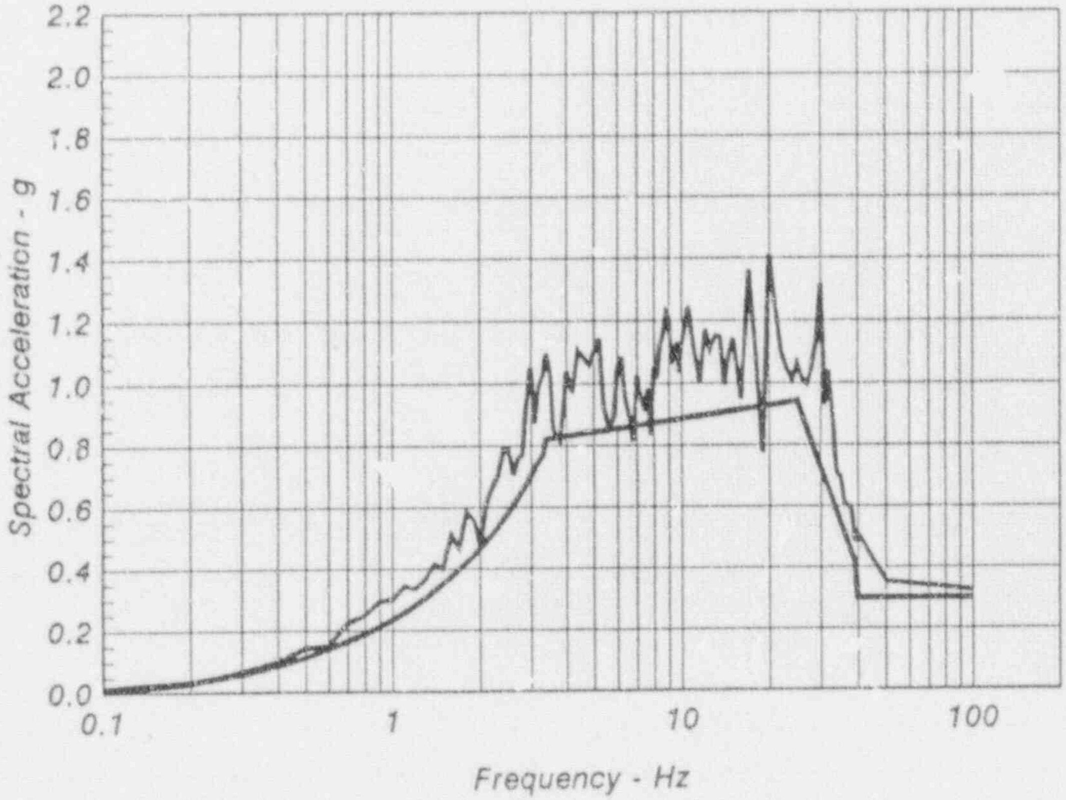


Fig. 2b Spectral Acceleration for Target Spectrum and for Synthetic Time History H2 -- Spectral Damping = 0.02

Q-220.9 - 6

RAI 220.9

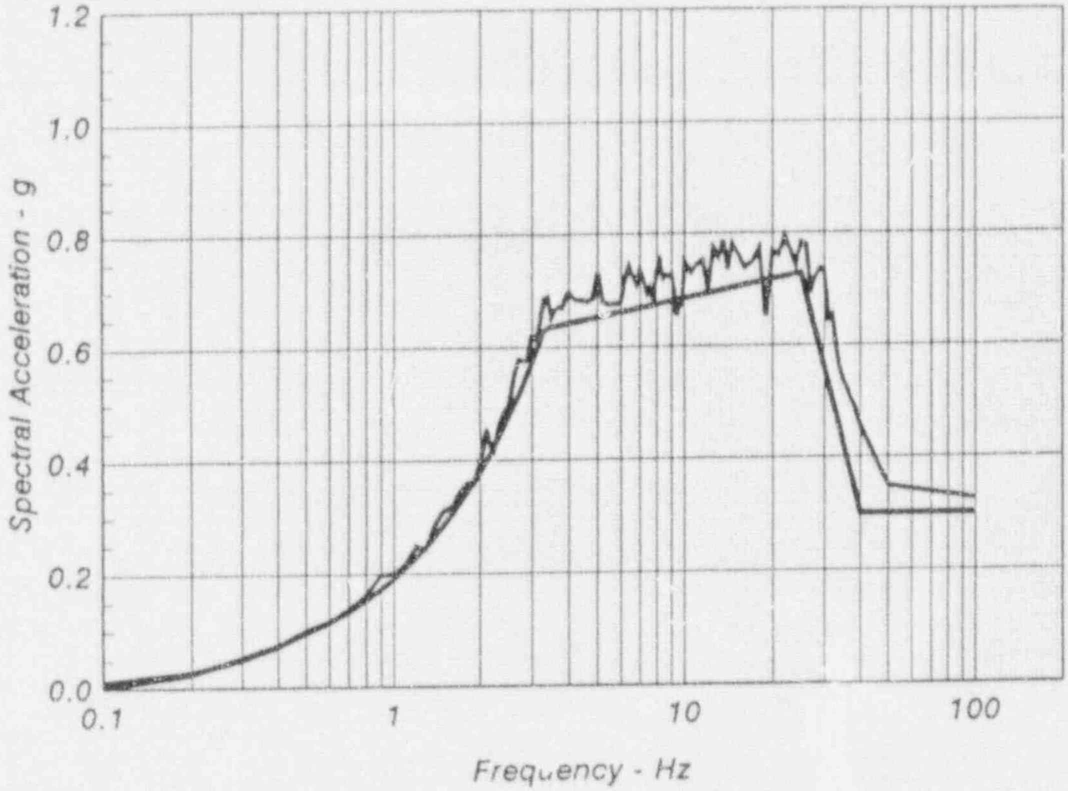


Fig. 2c Spectral Acceleration for Target Spectrum and for Synthetic Time History H2 -- Spectral Damping = 0.05

Q-220.9 - 7

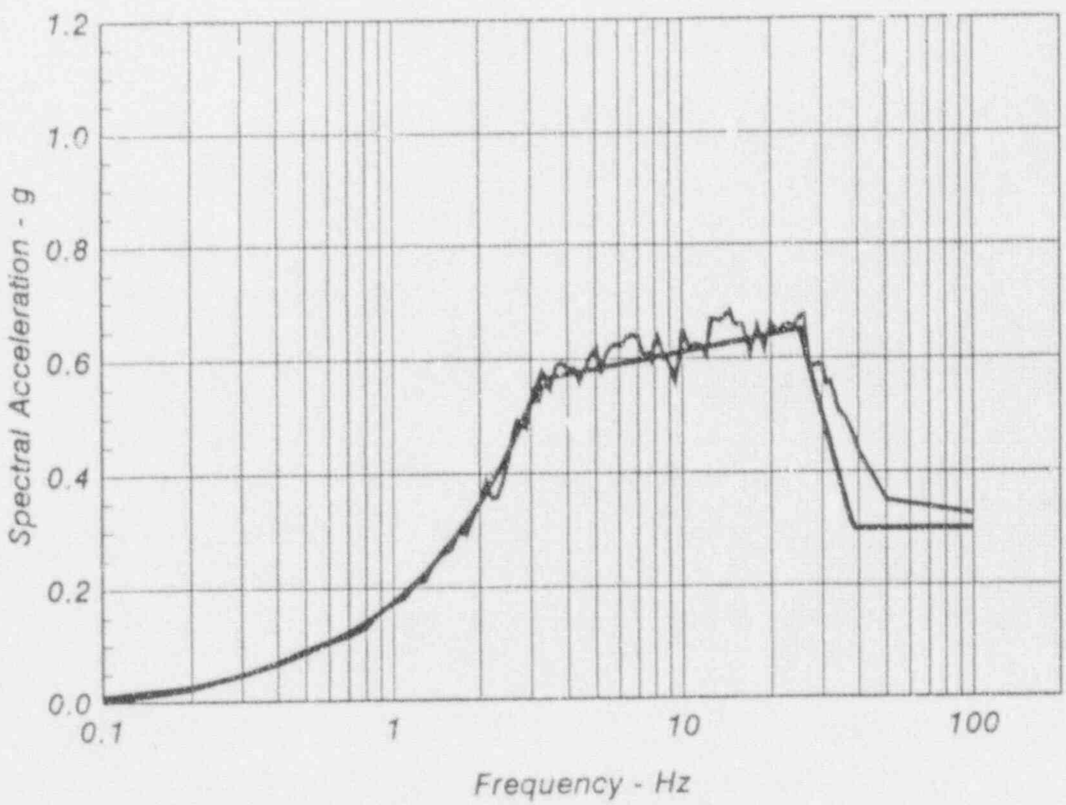


Fig. 2d Spectral Acceleration for Target Spectrum and for Synthetic Time History H2 -- Spectral Damping = 0.07

Q-220.9 - 8

RAI 220.9

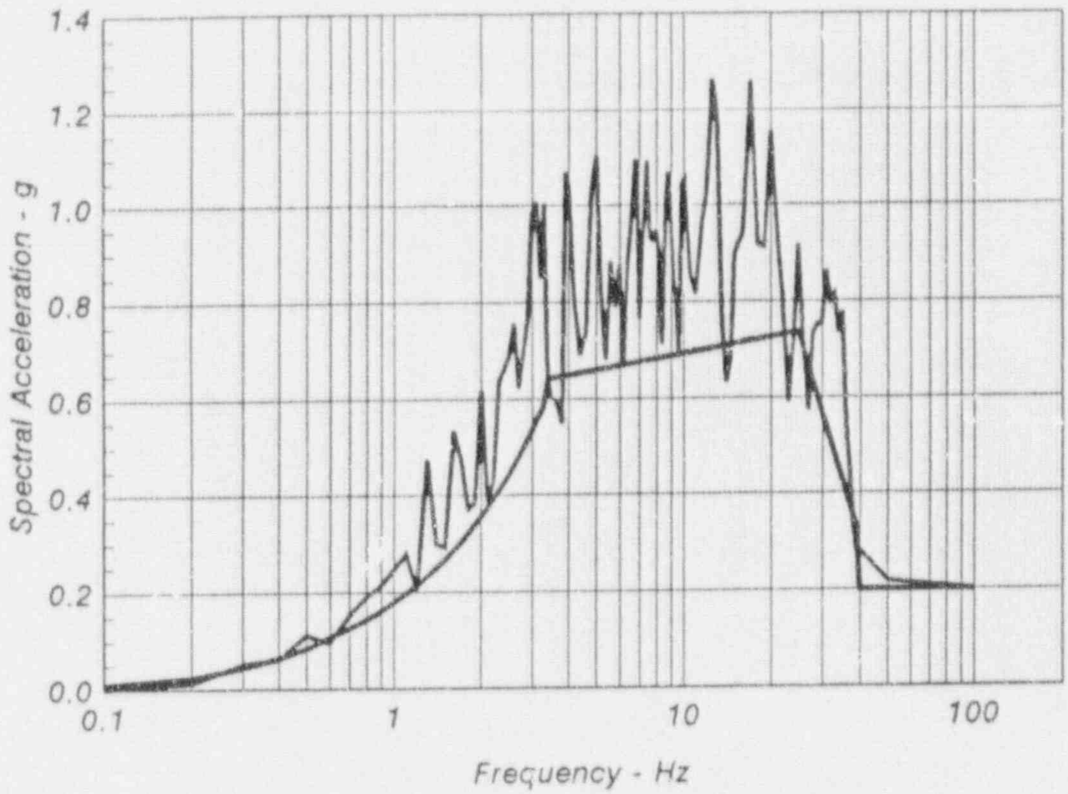


Fig. 3a Spectral Acceleration for Target Spectrum and for the Vertical Synthetic Time History -- Spectral Damping = 0.01

Q-220.9 - 9

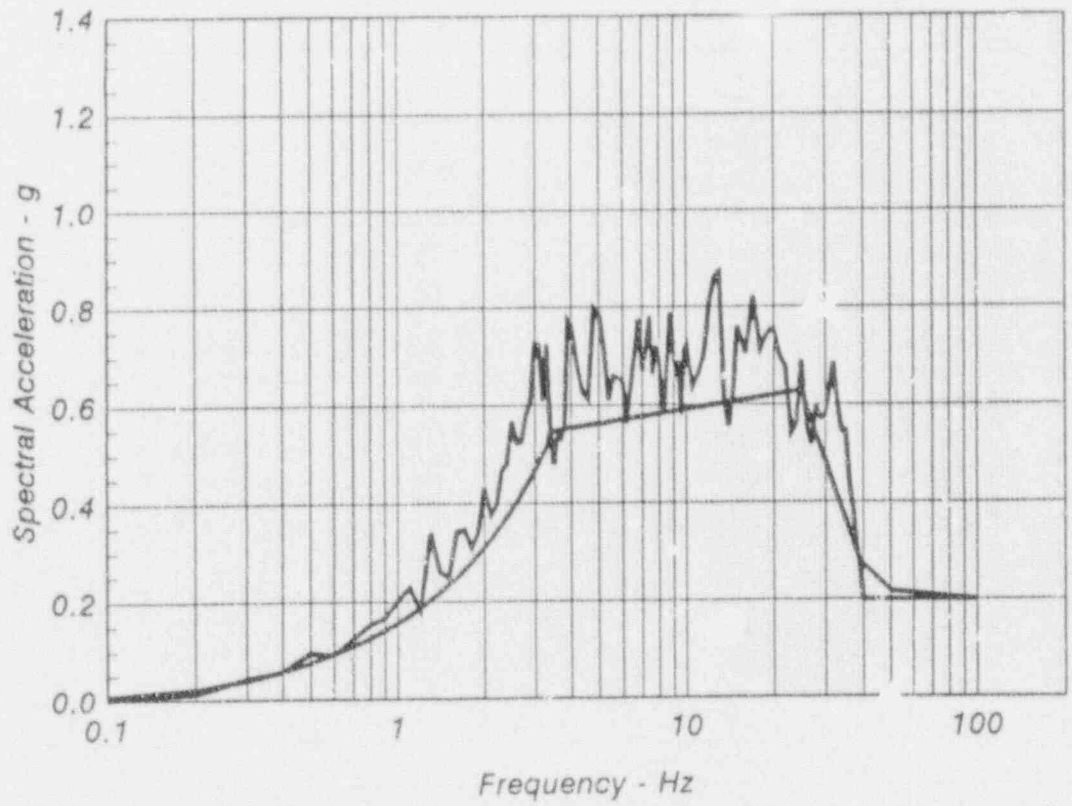


Fig. 3b Spectral Acceleration for Target Spectrum and for the Vertical Synthetic Time History -- Spectral Damping = 0.02

Q-220.9 - 10

RAI 220.9

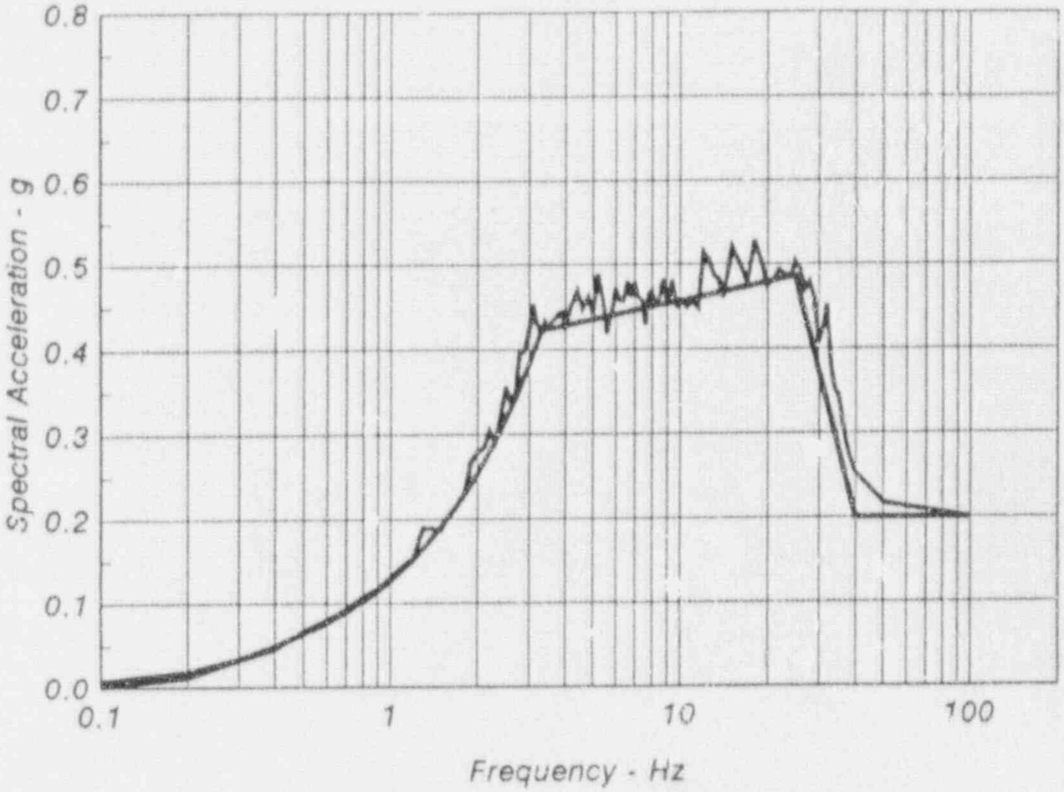


Fig. 3c Spectral Acceleration for Target Spectrum and for the Vertical Synthetic Time History -- Spectral Damping = 0.05

Q-220.9 - 11

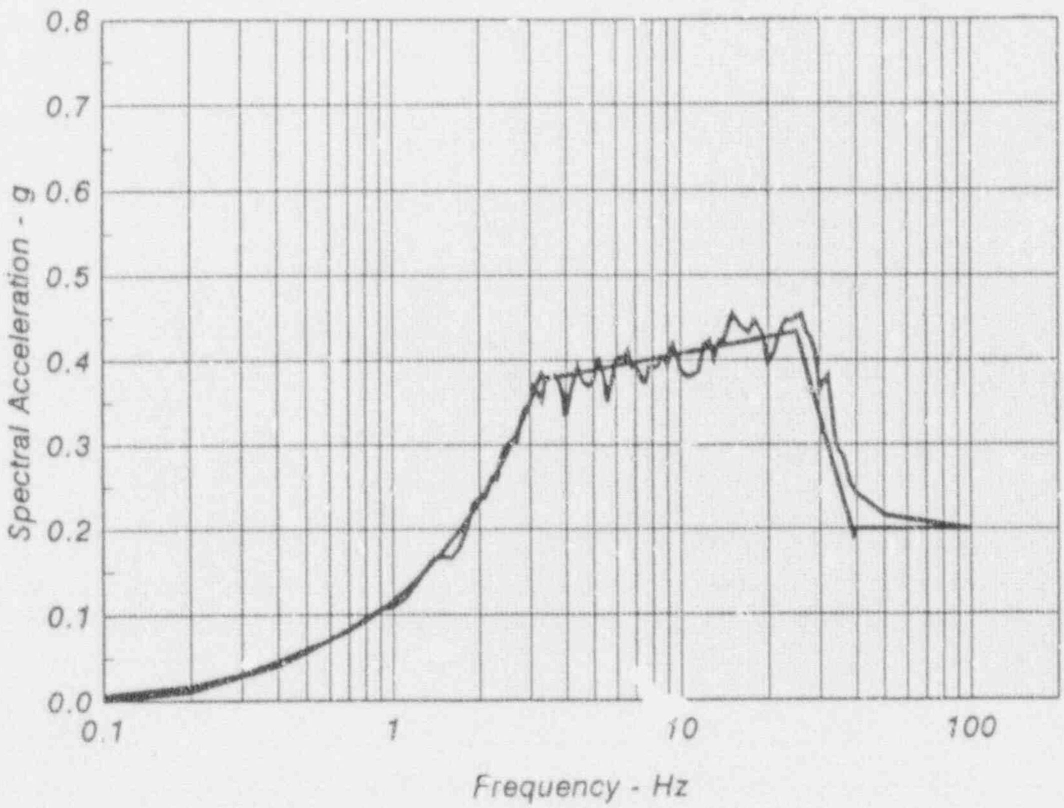


Fig. 3d Spectral Acceleration for Target Spectrum and for the Vertical Synthetic Time History -- Spectral Damping = 0.07

Q-220.9 - 12

Question 230.6

Section 2.5.2.5.2 - Ground water condition is not discussed for the four selected site categories. If the soil is saturated with ground water, the soil stiffness will be less due to reduced effective confining pressure. Several other parameters (e.g., soil density, Poisson's Ratio, etc.) will be affected where ground water fluctuations could occur. Provide information on how such parametric changes are considered.

Response 230.6

The possible variations in ground water conditions are not explicitly considered in the System 80+ design. The maximum shear wave velocities were selected to represent a very wide range of possible subsurface conditions. Accordingly, as long as the site specific set of measured shear wave velocities is within the range identified in CESSAR-DC, the effects of water level, unit weights...etc. are implicitly accounted for.

Question 230.8

Section 2.5.2.5.2 - Figures 2.5-3 and 2.5-4 were published in 1970. New data have been published by the same authors in 1984 and 1988. There is significant difference between the new and the old data. Provide justification for the use of old data.

Response 230.8

Figure 1, which is provided with the response to RAI 230.7, includes the range of available modulus reduction curves for both cohesive as well as cohesionless soils. The response to that RAI indicates the adequacy of the selected modulus reduction curves. While there are some differences in the measured damping values, the curve of soil damping versus shear strain given in CESSAR-DC (the lower range in Fig. 2.5-4) is still a lower range for the new data.

Accordingly, the modulus and damping relationships presented in CESSAR-DC are considered appropriate.

Enclosure II to
LD-92-030

REVISED RAI RESPONSES

QUESTION 220.55

SECY-90-016 Issues in CESSAR-DC; Issues 1 and 11 - Public Safety Goals and Containment Performance.

Section 5.4 Appendix B addresses the staff guidance of Containment Conditional Failure Probability (CCFP) of 0.1. The SRM related to SECY-90-016 also recommends the use of deterministic objectives. As such, the staff (ESGB) would prefer a deterministically established containment performance objective, such as establishing containment structural failure criteria based on the maximum strains (in general shell and in localized areas) as limited by global restraints and functionality of various features related to the mitigation of the consequences of accidents. Provide information regarding the ultimate capacity of the containment considering the above attributes. (see also RAI 720.24 in Section 7 of Appendix B).

RESPONSE 220.55 (Revision 1)

Combustion Engineering agrees that the staff position on Issue 11 of SECY-90-016 permits a demonstration of adequate containment performance by either a 0.1 Containment Conditional Failure Probability (CCFP) criterion or by a deterministic goal that offers equivalent protection. It is our understanding that the staff is concerned with the use of the 0.1 CCFP criterion because of the uncertainties inherent in the PRA methods, especially those associated with seismic hazards. Therefore, C-E is investigating the use of an alternate, deterministic criterion to gain additional insight into System 80+ containment performance for severe accident conditions.

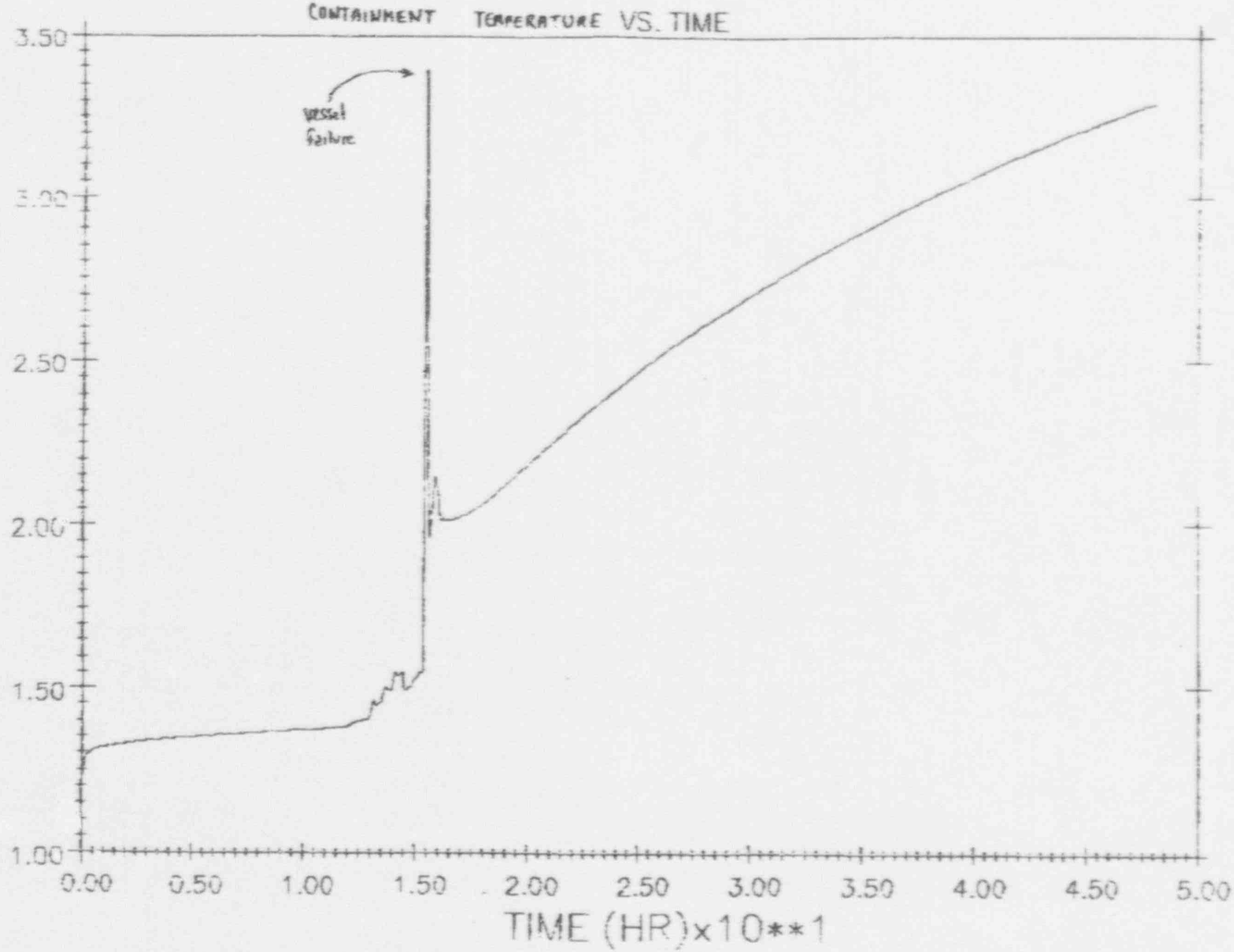
For this investigation, the choice of the severe accident sequences and the assumptions on degraded core behavior will be based on best-estimate judgments which will be consistent with the MAAP analysis reported in the PRA documented in Appendix B of CESSAR-DC. The purpose of this analysis is to determine the time response of the containment pressure and temperature for a representative severe accident scenario. Using this information, the length of time the containment pressure remains below the ASME Service Level C criterion is determined. For the System 80+ containment, the ASME service Level C criterion is about 156 psia at a containment temperature of 350 degrees F.

Using the above guidelines, a station blackout scenario was simulated using the MAAP computer code. With battery power available, auxiliary feedwater flow is assumed to be provided by the turbine driven auxiliary feedwater pump for a period of eight hours. Following the unavailability of auxiliary feedwater at eight hours, the vessel fails at 15.5 hours due to the loss of core cooling. Cavity flooding is assumed to occur prior to vessel failure. Combined with the deentraining characteristic of the System 80+ cavity, this will result in the retention of approximately 87.5% of the corium within the cavity. For this scenario, the containment pressure remains below 100 psia for up to 50 hours after the initiation of the station blackout (Please see attached Figure 1). The containment temperature does not exceed 350 degrees F during this time frame (Please see Figure 2). These results demonstrate that, for this best estimate severe accident scenario, the containment pressure remains well below ASME Service Level C criterion of 156 psia for more than 50 hours.

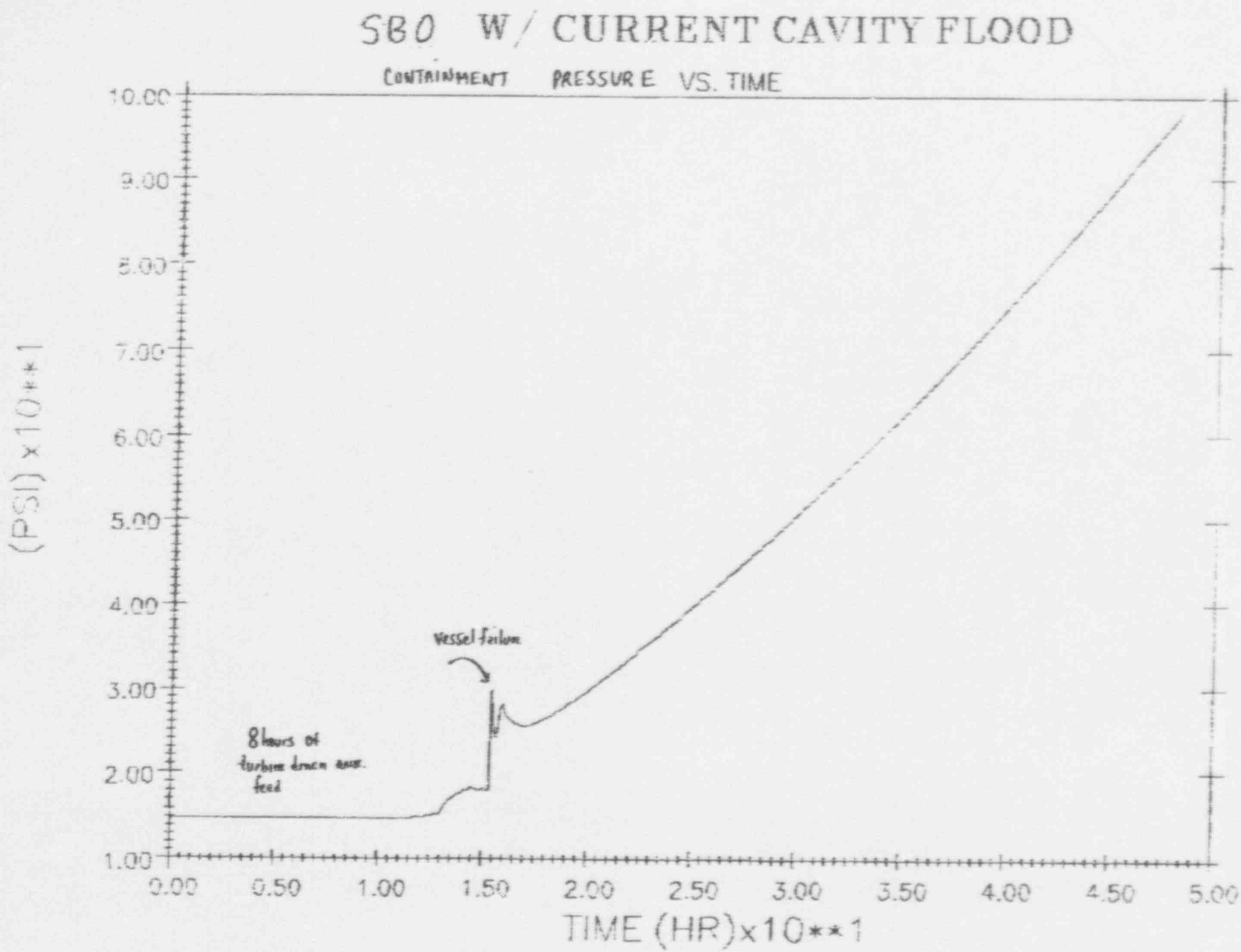
220.55

The ultimate pressure capacity for the System 80+ containment is approximately 185 psia at a temperature of 290 degrees F. This value is not considered specifically in the above evaluation, but is included here to demonstrate the additional margin to System 80+ containment integrity during a severe accident.

SBO W/ CURRENT CAVITY FLOOD

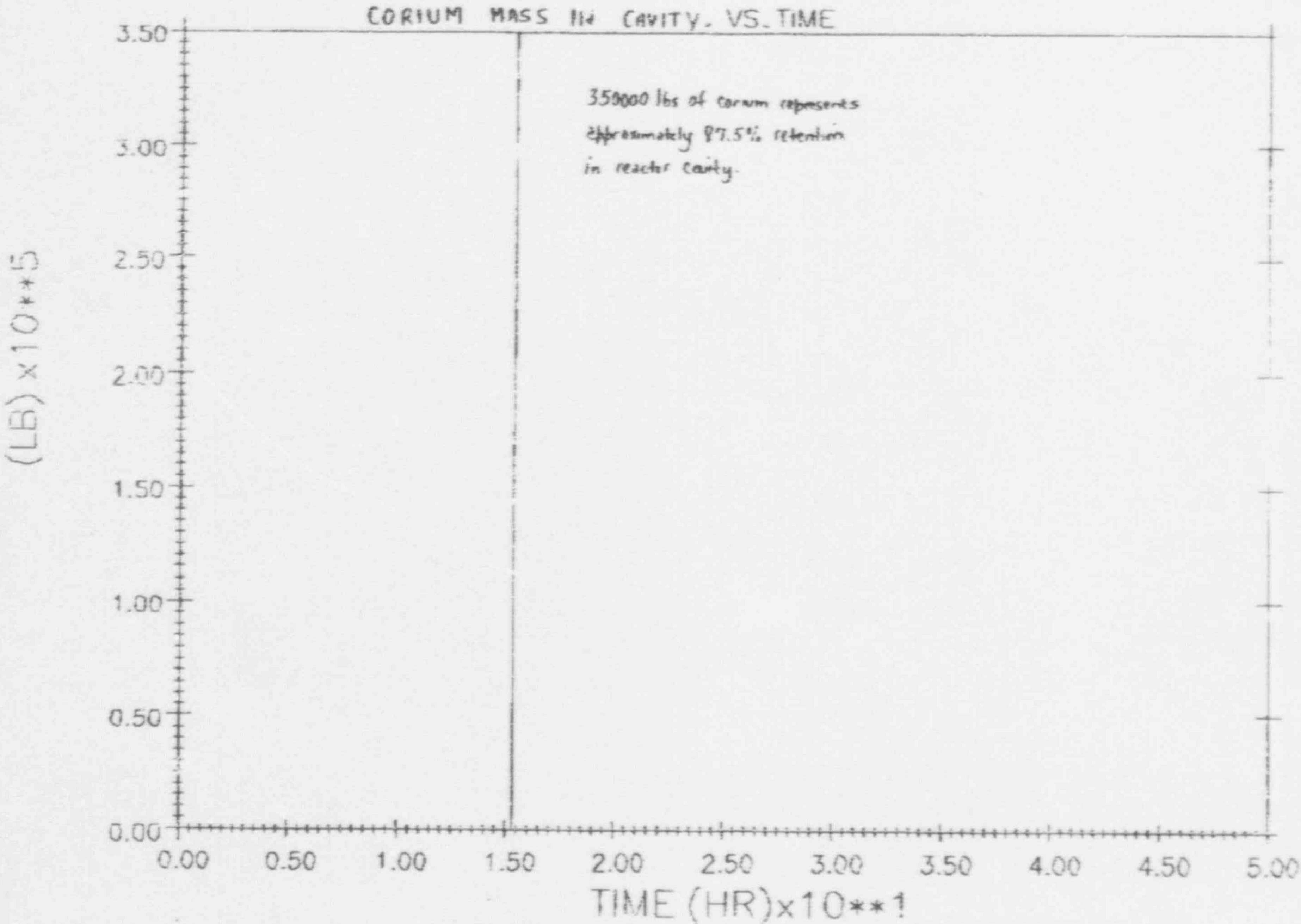


220.55


SBO W/ CURRENT CAVITY FLOOD
CONTAINMENT PRESSURE VS. TIME
(PSI) x10**1
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
TIME (HR)x10**1
Vessel failure
8 hours of turbine driven aux. feed

220.55

SBO W/ CURRENT CAVITY FLOOD



220.55

Question 410.102a

In Section 6.8.3 of the CESSAR the statement is made that the instrumentation requirements for the in-containment refueling water storage tank (IRWST) are described in Section 7.4.1.3. However, this section was not provided in Amendment I. Therefore, provide information on the instrumentation requirements for the operation of the IRWST, including level, temperature, and pressure indication and alarms.

Response 410.102a (Revision 1)

A description of In-Containment Water Storage System instrumentation will be added to Section 6.8.3 in the next amendment of CESSAR-DC. The description that will be added is attached to this response.

6.8.3 INSTRUMENTATION REQUIREMENTS

Instrumentation requirements are described in Section 7.4.1.3. I

Add Section 6.8.3 as shown on the attached pages.

410.102a

6.8.3 INSTRUMENTATION

In-Containment Water Storage System instrumentation is designed in accordance with the applicable portions of IEEE Standards and NRC Regulatory Guides identified in Section 7.1.2.

6.8.3.1 Level

A. In-Containment Refueling Water Storage Tank

Three full range 0-100% level indication channels are provided.

One channel is designated as non-1E and indicates IRWST fluid level locally.

Two channels provide level indication in the control room. These channels are designed to electrical class 1E requirements. Level alarms are provided in the control room. A high level setpoint is established to warn the operator when the IRWST may be overfilled. A low level alarm setpoint is established to warn the operator when the level is reduced to the volume required for safety injection/containment spray pump operation and for steam relief system operation.

The two electrical class 1E level channels are used for post-accident monitoring of IRWST fluid level.

B. Holdup Volume Tank

Two level switches and two full range 0-100% level indication channels are provided.

The level switches are used to detect the presence of fluid in the holdup tank; the switches are non-1E. The switches will actuate an alarm in the control room to alert the operator that the HVT is filling with water.

The two full range 0-100% channels are powered by the vital instrument bus. Level indication is provided in the control room to allow the operator to monitor HVT level after an accident.

C. Reactor Cavity

A single level switch and two full range 0-100% level indication channels are provided.

The level switch is used to detect the presence of fluid in the reactor cavity; the switch is non-1E. The switch will actuate an alarm in the control room to alert the operator that the reactor cavity is filling with water.

410.102a

The two full range 0-100% channels are powered by the vital instrument bus. Level indication is provided in the control room to allow the operator to monitor reactor cavity fluid level after an accident.

6.8.3.2 Temperature

A. In-Containment Refueling Water Storage Tank

Three IRWST fluid temperature measurement channels are provided.

One channel is designated as non-1E and provides IRWST fluid temperature indication locally inside the containment.

The two remaining channels are designed to electrical class 1E requirements. These channels provide IRWST fluid temperature indication in the control room; a high/low temperature alarm is provided to alert the operator when IRWST temperature approaches the minimum or maximum allowable Technical Specification limits. The range of the channels is adequate to cover the maximum temperature condition expected to occur during steam relief system operation.

6.8.3.3 Pressure

A. In-Containment Refueling Water Storage Tank

Two wide range channels powered by the vital instrument bus are provided. Each channel provides an indication of IRWST pressure in the control room. The range of the instrumentation is adequate to cover the maximum pressure expected to occur during steam relief system operation.

Question 500.25 (b)

Section 6, item H, of Appendix 13A notes that the Nuplex 80+ instrumentation and controls design incorporates "on-line monitoring of fluid and electrical systems making detection of sabotage attempts more likely." Would this system be able to detect mispositioning of manual isolation valves in these systems. If not, discuss timeliness of discovery should a locked valve outside containment be either mistakenly or deliberately mispositioned.

Response 500.25 (b) (Revision 1)

Detection of inadvertently or intentionally mispositioned valves located outside of containment would take place as part of routine and surveillance testing, system walk downs, and valve position verification procedures performed prior to plant and system start-up. Administrative controls are provided to minimize the possibility of mispositioning a manual valve. These controls include administrative control of keys for locked valves, maintenance procedures which require authorization by the control room staff prior to valve operation, and indication of the effect of the valve's new position (as input by the control room staff) on system, train, or flow path availability. This effect, if any, would be indicated on the Success Path Monitoring function of the DPS. This continued indication of the effect on system, train, or flow path availability would serve as a constant reminder to the control room staff that the valve is not in it's required position.

These administrative controls, which will minimize the possibility of mispositioning a manual valve, combined with the valve position verification procedures will reduce the likelihood of either inadvertently or deliberate mispositioning of manual valves occurring or going undetected

1.

Question: TASK ACTION PLAN ITEM B-17

CRITERIA FOR SAFETY-RELATED OPERATOR ACTIONS

C-E did not address this item. An assessment of how the System 80+ design meets Item B-17 is required to close out this issue.

Response: (Revision 1)

Task Action Plan Item B-17 is addressed in Table A1-1, CESSAR-DC, Appendix A, dated 12/15/89. Item B-17 was identified as a category 1e item which is defined on Page A-1 of Appendix A as follows: "The issue has been superseded by one or more USI's and GSI's."

TMI Action Plan Item I.D.1, Control Room Design Review, will address this concern. Automated, redundant, safety grade controls will be employed to reduce the potential for operator error during accident conditions.

The Operational Support Information (OSI) Program will provide or reference the material necessary to determine what safety related operator actions may be necessary in the emergency procedure guides. ~~A description of this plan will be submitted in the near future.~~