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SUBJECT: Forwards repsonse to NRC 850312 request for addl info re pressurizer safety valves.Info establishes acceptability of increased blowdown of pressurizer safety valves for power operation.

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Director of Nuclear Reactor Regulation
Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ANPP-32381-EEVB/GEC
April 12, 1985

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Pressurizer Safety Valves
Docket Nos. STN 50-528(License No. NPF-34)/529/530
File: 85-056-26; G.1.01.10

References: (1) Letter from G. W. Knighton, NRC, to E. E. Van Brunt, Jr., ANPP, dated December 18, 1984 (ANPP-31502); Subject: Post-FDA Proposed CESSAR Changes.

(2) Letter from G. W. Knighton, NRC, to E. E. Van Brunt, Jr., ANPP, dated March 12, 1985; Subject: Request for Additional Information-Palo Verde Safety Valves.

Dear Mr. Knighton:

License No. NPF-34 for PVNGS Unit 1 in Section 2.C(22) is conditioned as follows:

> "Pressurizer Safety Valves (Section 5.4, SSER 7)
> Prior to initial criticality, APS shall establish the acceptability of increased blowdown of the pressurizer safety valves for power operation."

The PVNGS Unit 1 license was conditioned as a result of the staff continuing its review of the safety significance of the safety valve increased blowdown on power operation as discussed in Reference 1. The staff has since determined that additional information is required to complete the review. This request for additional information was transmitted to ANPP in Reference 2.

Attached, for the staff's review, are the responses to the request for information required to complete the review. The submittal of this information also establishes the acceptability of the increased blowdown of the pressurizer safety valves for power operation as required by License Condition 2.C(22).

Please contact Mr. W. F. Quinn of my staff if you have any questions on this matter.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/KLM/mb
Attachment

A001
1/1

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ANPP-32381

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Executive Vice President, Arizona Nuclear Power Project, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt
Edwin E. Van Brunt, Jr.

Sworn to before me this 11 day of April, 1985.

Nora E. Meador
Notary Public

My Commission Expires:

My Commission Expires April 6, 1987

PVNGS RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

PALO VERDE SAFETY VALVES

NRC Question 1

Discuss the overall effects of Palo Verde plant specific changes (e.g., AFWS, HPSI, LPSI, primary and secondary safety valve paraameters) on the results of the loss of load analyses documented in the CE Topical Report CEN-227.

Response

The loss of load analysis (loss of condenser vacuum) has been redone with all the Palo Verde specific changes using CESEC. The results are compared to the feedwater line break (FWLB) and are presented in the answer to NRC Question 4.

NRC Question 2

Page 5A-4 of CESSAR FSAR Amendment 9 indicates that the pressurizer safety valve nozzle elevation is at 107% pressurizer level. Appendix C-1 of CEN-227 indicates that the nozzle elevation is at 100% pressurizer level. Explain the above discrepancy.

Response

The pressurizer safety valve nozzle elevation presented in CESSAR Appendix 5A Section 2.2.3.2 (pg. 5A-4) is incorrect. The correct nozzle elevation is 100%. This correction was forwarded for NRC review by C-E letter LD-85-016 dated April 2, 1985. This change will be included in CESSAR in a future amendment.

NRC Question 3

Both CESSAR FSAR Amendment 9 and CEN-227 indicate that the pressurizer water level reaches a maximum value of 98% during a loss of load transient with 20% primary safety valve blowdown. This pressurizer water level is close to the safety valve nozzle elevation. Provide a discussion of the possible water carryover to the safety valves and its consequences. Specifically, discuss if water carryover will or will not occur for this (or any other) event. If it will occur, please confirm that the safety valves are designed and certified for two-phase flow relief. If not, please discuss why you consider the safety valve design in compliance with GDC-1.

Response

Water carryover to the pressurizer safety valves (PSV's) will not occur for the limiting Palo Verde transient. Specific results are presented in the answer to NRC Question 4.

NRC Question 4

A postulated FWLB may lead to the most limiting transient of RCS temperature and pressurizer water level. Provide the results of an FWLB analysis using Palo Verde plant specific parameters (e.g. AFWS, HPSI, LPSI, Primary and Secondary Safety Valves). Provide the transient curve to show the temporal behavior of pressurizer water level, RCS subcooling margin, RCS pressure and DNBR.

Response

PVNGS FSAR Section 15.2 provides results for those events that fall in the Decreased Heat Removal category and result in the greatest increase in pressurizer water level and RCS temperature. Of these transients, the Loss of Condenser Vacuum (LOCV) and Feedwater Line Break (FWLB) events are the most adverse.

The LOCV transient presented in CESSAR Section 15.2.3 assumes that both main steam and feedwater flow are instantaneously terminated at the initiation of the event. The LOCV is more adverse than the loss of load analysis due to the fact that the loss of load analysis ramps main feedwater to 5% of its initial flow. This larger reduction in heat removal capability results in a higher peak RCS pressure and pressurizer level for the LOCV transient.

The FWLB transient presented in PVNGS FSAR Section 15.2.8 assumes a loss of offsite power concurrent with a turbine generator trip and was analyzed to demonstrate that there is adequate long term RCS heat removal capability even with the PVNGS specific degraded auxiliary feedwater system performance.

In order to determine which of these two transients (FWLB or LOCV) result in the greatest increase in pressurizer water level, the NSSS responses to these events were simulated using all the PVNGS specific parameters (e.g. AFW, HPSI, LPSI, Primary and Secondary safety valves) and the CESEC III code. These transients were analyzed with an equivalent set of initial conditions which are provided in Table 1. Figure 1 provides the pressurizer water volume results for the LOCV and FWLB transients. As is shown, the maximum pressurizer water volume for the FWLB transient with the loss of offsite power (LOP) is 1206 ft^3 and for the LOCV transient, 1193 ft^3.

In addition to the FWLBLOP, the FWLB was simulated with a-c power available, to determine which situation results in the greatest increase in pressurizer level. Figure 2 provides the pressurizer water volume results of the FWLB transients using the initial conditions stated in Table 1. As would be expected, the results of these cases are identical until the turbine generator trips and the reactor coolant pumps coastdown for the case with LOP. This figure demonstrates that the case with LOP results in a greater pressurizer level transient (1206 ft^3) than the case with a-c power available (1194 ft^3). This is caused by the decrease in RCS heat removal (due to reactor coolant pump coastdown) dominating the additional pump heat added to the RCS if a-c power was available.

As a result of this study, the most limiting transient with respect to maximizing pressurizer water level is the FWLBLOP for PVNGS Units 1, 2 and 3.

To determine the maximum pressurizer water level of the FWLBLOP, the initial conditions of the event provided in Table 1 were adjusted in the following manner:

a) The initial pressurizer pressure is raised from 2250 psia to the maximum Tech Spec pressurizer pressure of 2370 psia. Although this change causes an earlier reactor trip on high pressurizer pressure, and therefore less pressurizer insurge, the maximum pressurizer level is potentially greater due to the larger volume of flashed steam as pressurizer pressure decreases during the extended blowdown.

b) The initial assumed pressurizer water volume is increased from 900 ft^3 to 948 ft^3 which is the maximum Tech Spec value. This assures that the maximum level of the transient is the greatest value achievable.

c) The blowdown setting of the PSV's is increased from the nominal value of 13.5% (closure at pressures below 2162.5 psia) to 18.5% (closure at pressures below 2040 psia). The maximum pressurizer level of the transient is increased primarily due to the fact that a larger volume of flashed steam will be generated during the increased blowdown.

d) The initial RCS cold leg temperature is increased from 565^{o}F to 570^{o}F which is the maximum Tech Spec value. While this change does not significantly increase the pressurizer water volume, it does reduce the RCS subcooling margin, which is of interest when concerned with RCS voiding.

The other significant initial conditions for the FWLBLOP case to maximize the pressurizer water volume are summarized in Table 2.

The limiting FWLBLOP case was simulated with the CESEC III code and the results are discussed below. Figure 3 provides the pressurizer water volume for the transient. The solid line indicates the CESEC predicted pressurizer level response and shows a maximum value of 1178 ft^3. Figure 4 provides the RCS pressure response as a function of time for this transient. Figure 5 provides the RCS subcooled margin and Figure 6 provides the DNBR for the transient. As demonstrated by these figures, there is adequate subcooled margin available to prevent RCS voiding, and the minimum DNBR for the transient remains well above 1.19.

The CESEC code assumes that the subcooled insurge is mixed homogeneously with the water volume in the pressurizer. The pressurizer water volume is assumed to be saturated liquid at the initiation of the event. This mixing potentially underpredicts the volume of water that will flash due to the additional depressurization caused by the increased PSV blowdown. Secondly, the code assumes instantaneous phase separation of any voids formed during the depressurization which may underpredict the pressurizer level response.

To conservatively account for these two phenomena, the CESEC pressurizer level results presented in Figure 3 were adjusted. The adjusted value is also shown in Figure 3. Although some mixing will occur, the adjustment assumed that none of the subcooled insurge entering the pressurizer during the transient mixed with the 948 ft^3 of saturated liquid (at 2370 psia) in the pressurizer at the initiation of the event. This maximized the potential for this initial volume to flash during the depressurization caused by the increased blowdown, maximizing the pressurizer level response.

The additional volume added to the CESEC predicted response to account for phase separation is calculated in the following manner:

> As the pressurizer pressure drops below its initial value of 2370 psia, the volume initially in the pressurizer is assumed to begin to flash. Thereafter, in discrete time intervals during the depressurization to 2040 psia (18.5% blowdown), an average void fraction is calculated. Once this average void fraction is calculated, a linear bubble gradient is assumed over the volume initially present in the pressurizer. This is reasonable since the static pressure will be highest near the bottom, and since the bubbles tend to coalesce as they rise through the mixture (this method is analogous to what the RELAP and RETRAN simulation codes utilize). Coupled with this assumed void distribution, a conservatively low bubble rise velocity of 0.5 ft/sec is assumed. This velocity is based on the Wilson bubble velocity model using an average void fraction which is small compared to the void fraction present in the pressurizer steam-liquid interface when the pressure is dropped to 2040 psia. A more realistic value of the bubble rise velocity at this interval is approximately 2.0 ft/sec.

This conservative adjustment to the limiting FWLBLOP increases the CESEC predicted maximum level response by 193 ft^3 (from 1178 ft^3 to 1371 ft^3). Even for this limiting case, the pressurizer level is 20% below the elevation of the bottom of the PSV nozzle (this corresponds to a value greater than 7ft below the nozzle). Because of this large margin to the PSV nozzle, water carryover will not occur for this or any other event, and therefore no concern exists regarding two phase safety valve discharge.

TABLE 1

INITIAL CONDITIONS USED TO DETERMINE WHICH
CHAPTER 15 TRANSIENT IS LIMITING FOR PRESSURIZER LEVEL

	NOMINAL PLANT OPERATING CONDITIONS	ANALYSIS VALUE LOCV	ANALYSIS VALUE FWLB
Power, MWT	3817	3893	3893
Cold Leg Temperature, ^oF	565	565	565
Pressurizer Pressure, psia	2250	2250	2250
PSV Opening Setpoint, psia	2500	2500	2500
High PZR Press. Trip Setpoint, psia	2400	2450	2475
PSV Closing Setpoint, psia	2162.5	2162.5	2162.5
Pressurizer level, ft^3 (%)	900 (52.7)	900	900
PZR Pressure Control System	Auto	Manual	Manual
PZR Level Control System	Auto	Manual	Manual
Feedwater Pipe Break Area, Ft^2	---	---	0.2
Moderator Temp Coefficient	---	Most Positive Tech Spec Value	Most Positive Tech Spec Value
Steam Bypass Control System	Auto	Manual	Manual
Off-Site Electrical Power After Turbine Trip	Available	Available	Available/ Unavailable

TABLE 2

INITIAL CONDITIONS FOR THE LIMITING FWLB WITH RESPECT TO MAXIMIZING PRESSURIZER WATER LEVEL

	Nominal Plant Operating Conditions	Analysis Value
Power, MWT	3817	3893
Cold Leg Temperature, °F	565	570
Pressurizer Pressure, psia	2250	2370
PSV Opening Setpoint, psia	2500	2525
High PZR Pressure Trip Setpoint, psia	2400	2475
PSV Closing Setpoint, psia	2162.5	2040.0
Pressurizer Level, $Ft.^3$ (%)	900 (52.7)	948 (56)
PZR Pressure Control System	Automatic	Manual
PZR Level Control System	Automatic	Manual
Steam Generator Inventory	173000	107500
Feedwater Pipe Break Area, $Ft.^2$	----	0.2
Moderator Temperature Coefficient	----	Most Positive Technical Specification Value
Steam Bypass Control System	Automatic	Manual
Offsite Elect. Power After Turbine Trip	Available	Unavailable

FIGURE 1
COMPARISON OF THE FWLB WITH LOP
AND THE LOCV TRANSIENT REGARDING PRESSURIZER LEVEL

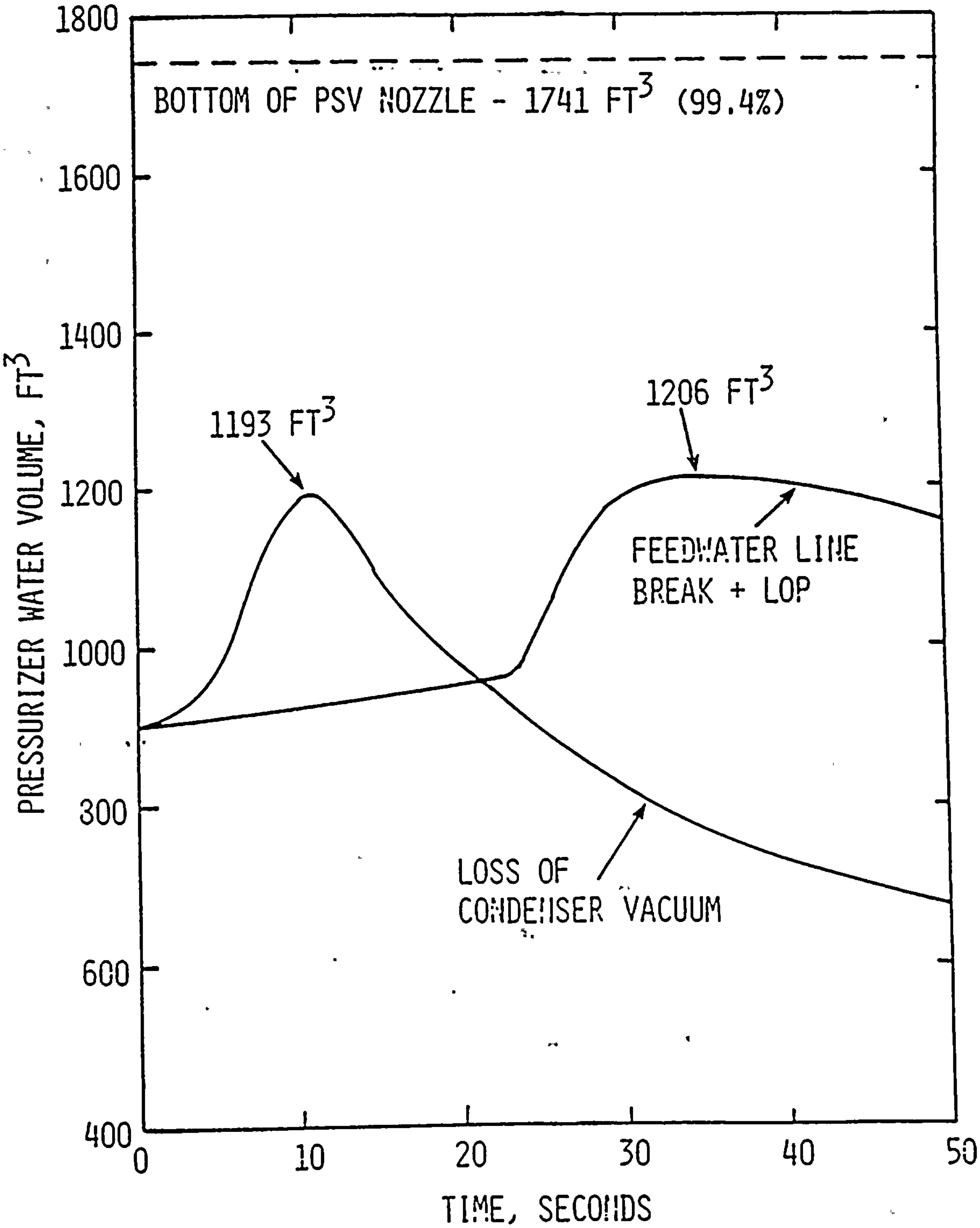


FIGURE 2

COMPARISON OF THE PRESSURIZER LEVEL RESPONSE OF THE FWLB TRANSIENT WITH AND WITHOUT THE LOSS OF OFFSITE POWER

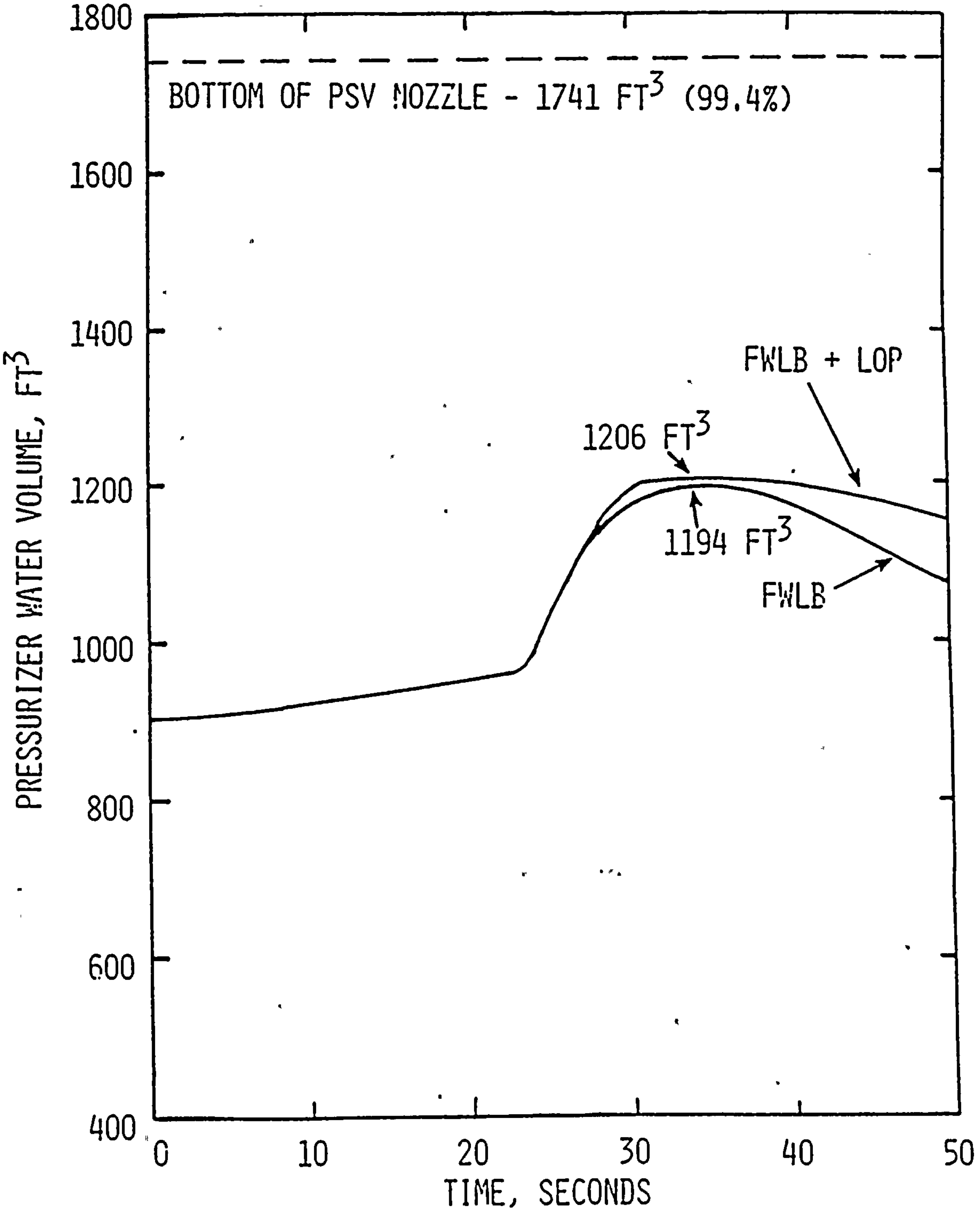


FIGURE 3

PRESSURIZER LEVEL RESPONSE FOR THE LIMITING FWLB TRANSIENT WITH LOP

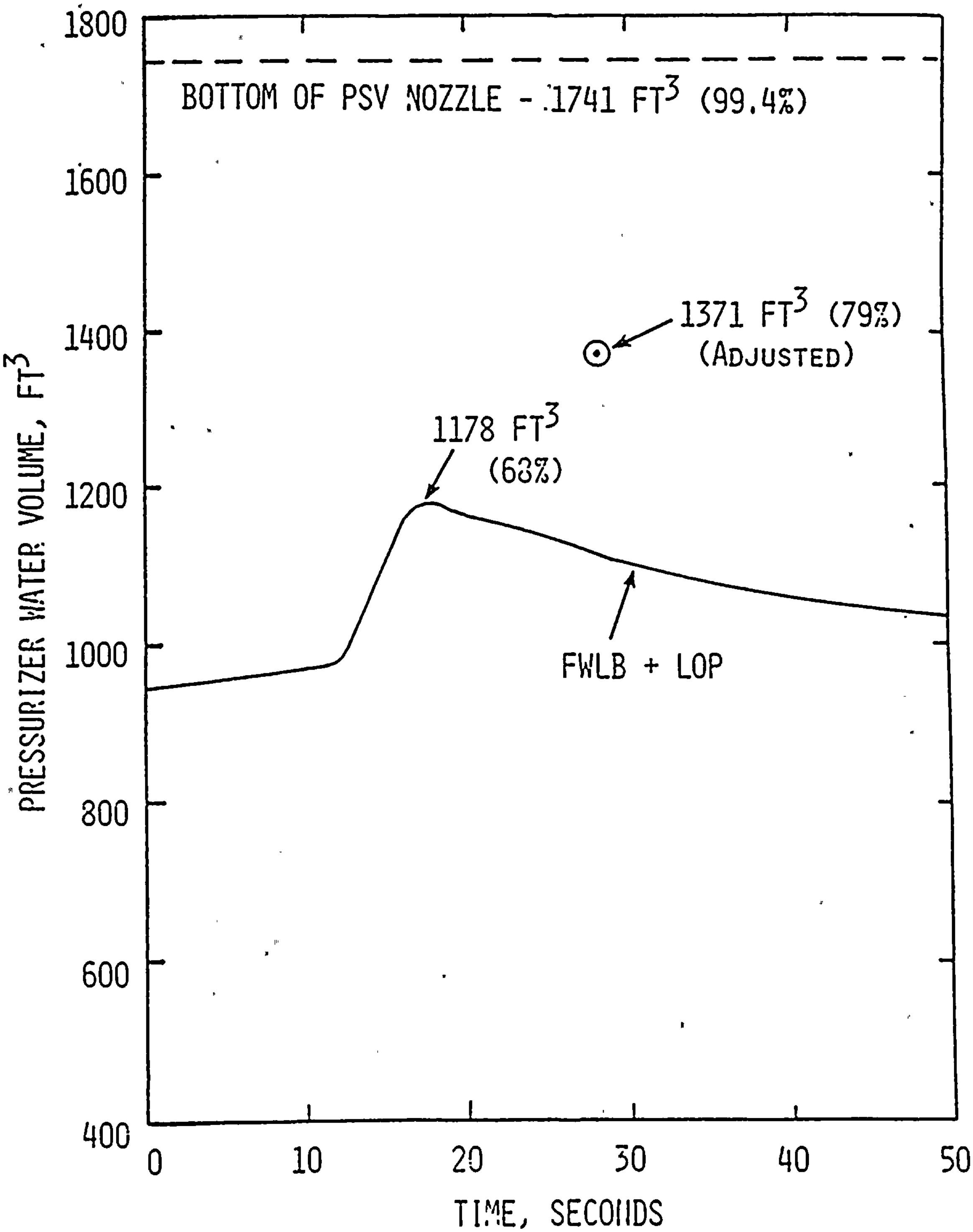


FIGURE 4

RCS PRESSURE RESPONSE
FOR THE LIMITING FWLB TRANSIENT WITH LOP

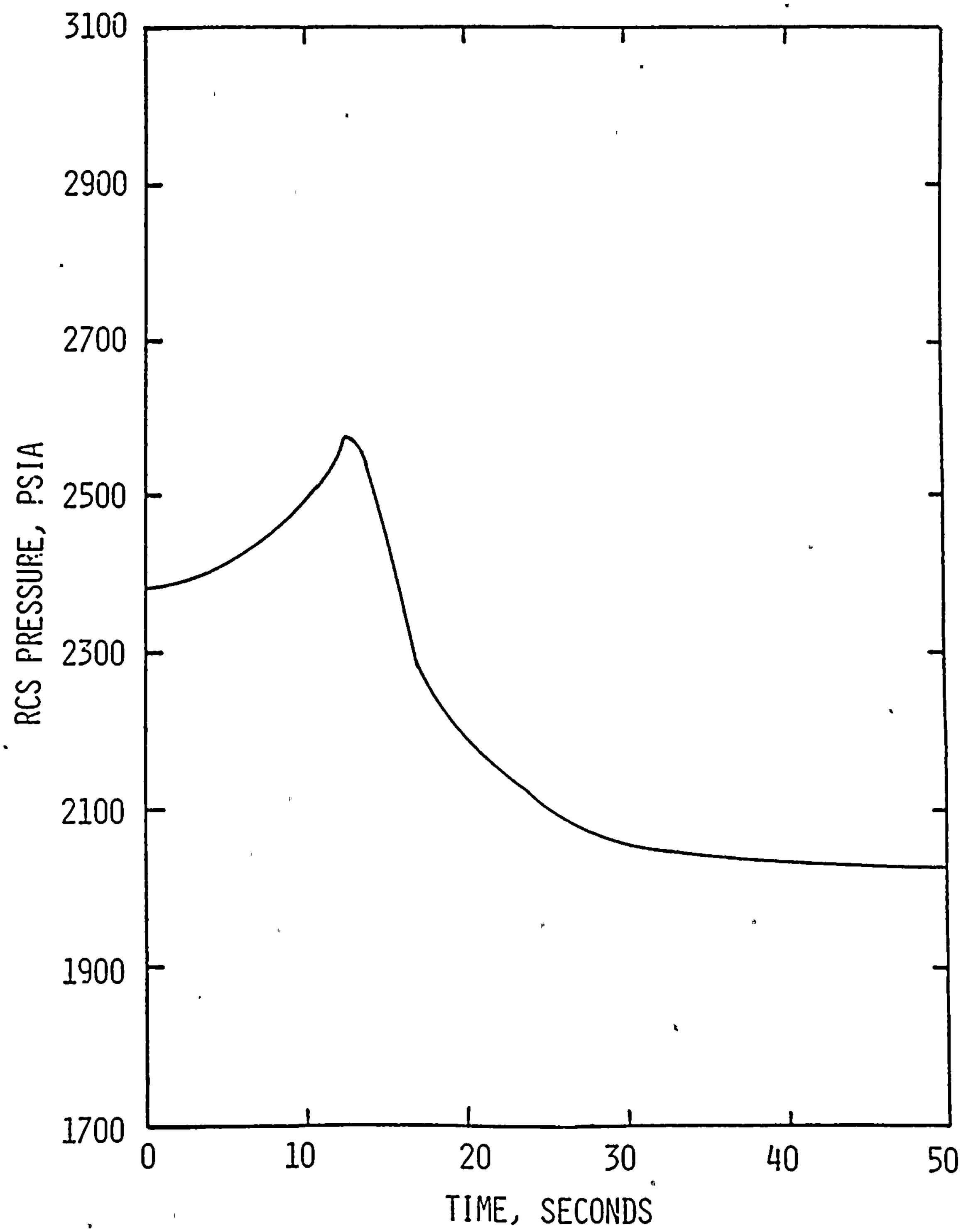


FIGURE 5
RCS SUBCOOLING MARGIN
FOR THE LIMITING FWLB TRANSIENT WITH LOP

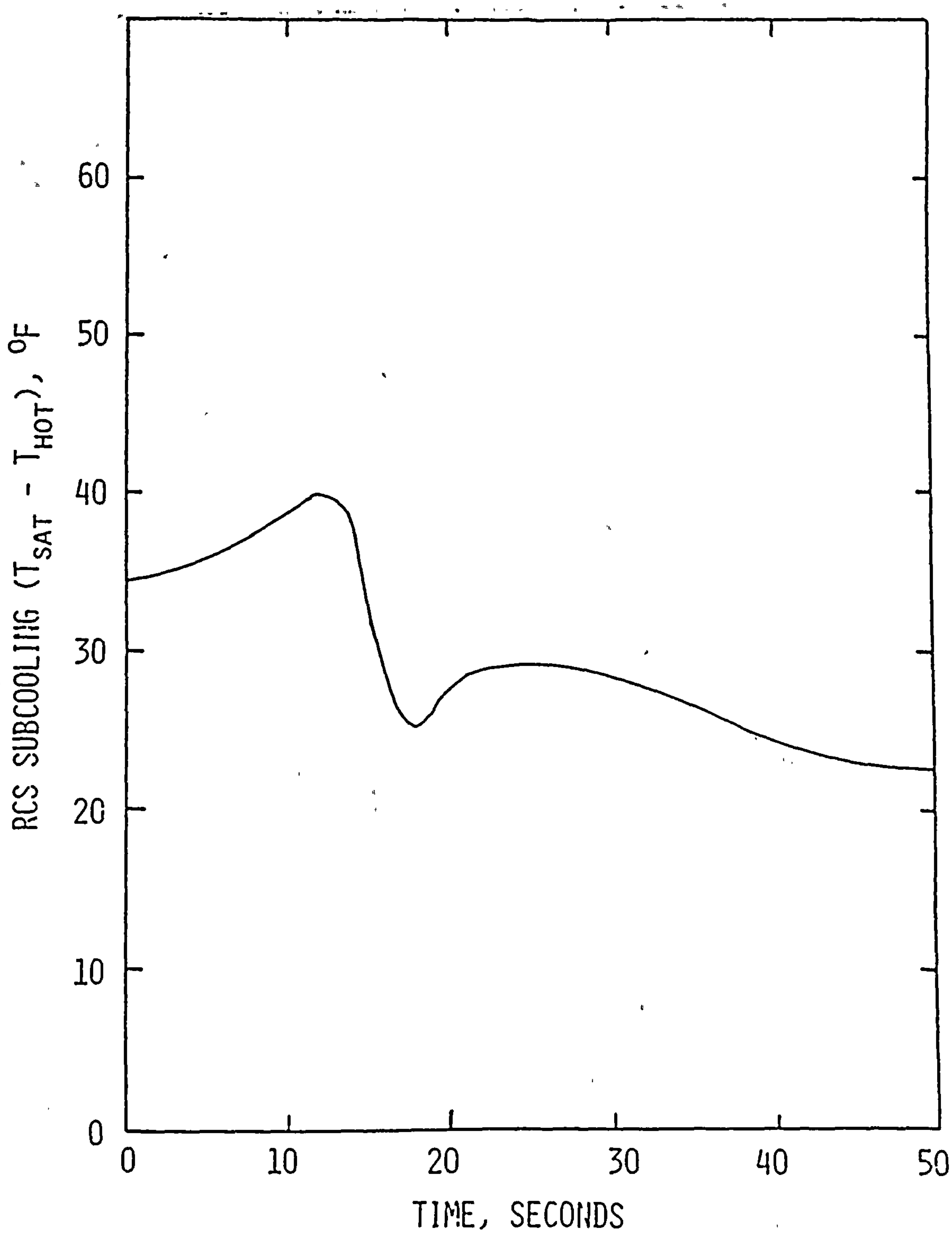
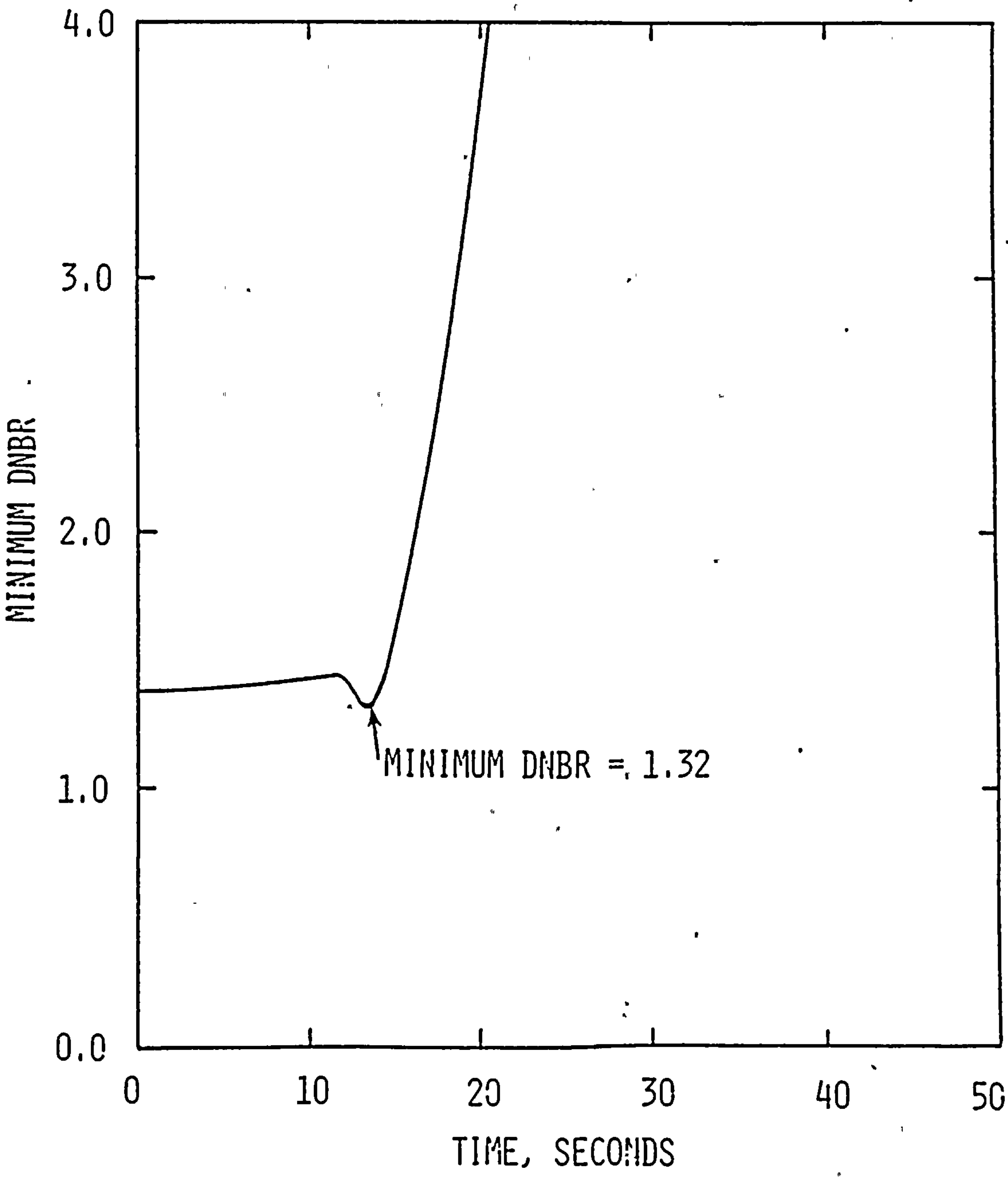


FIGURE 6

MINIMUM DNBR RESPONSE

FOR THE LIMITING FWLB TRANSIENT WITH LOP



NRC Question 5

Provide the results of an evaluation with regard to the overall effects of all events analyzed in Chapter 15 of the FSAR. Incorporate the changes made in Palo Verde plant on AFW, HPSI, Primary and Secondary Safety Valves.

Response

The results of this evaluation are presented in the response to License Condition 2.C (21).