Illinois Power Company

500 SOUTH 27TH STREET, P. O. BOX 511, DECATUR, ILLINOIS 62525-1805

U-0615
P23-83(03-17)6

Docket No. 50-461

March 17, 1983

Director of 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: Clinton Power Station Unit 1
Humphrey Concerns

Reference: IP letter U-0596 dated 2/4/83, G. E. Wuller to A. Schwencer, NRC, subject: Submittal addressing some John Humphrey concerns.

The referenced letter addressed some of the John Humphrey concerns as applicable to the Clinton Power Station (CPS). Enclosed are CPS responses on some additional Humphrey issues for NRC Staff review. Included are Action Plans #15, 18, 19, 22, 25, 28, 31 and 32. We believe that these responses will resolve the particular concern involved.

If there are any questions regarding this material, please contact me or J. H. Shepard (217) 424-6785.

Sincerely,

G. E. Wuller

G. E. Wuller
Supervisor-Licensing
Nuclear Station Engineering

GEW/jmm

enclosure

cc: D. H. Abelson, NRC Clinton Project Manager
Mr. M. B. Fields, NRC CSB
Mr. H. H. Livermore, NRC Resident Inspector
Illinois Department of Nuclear Safety
R. W. Evans, Quadrex Corporation

B001

Action Plan 15

4.6 The initial suppression pool temperature is assumed to be 95°F while the maximum expected service water temperature is 90°F for all GGNS accident analyses as noted in FSAR table 6.2-50. If the service water temperature is consistently higher than expected, as occurred at Kuosheng, the RHR system may be required to operate nearly continuously in order to maintain suppression pool temperature at or below the maximum permissible value.

Response

The program for resolution to close this issue for Clinton is as follows:

15.1 A discussion of peak service water temperature which is expected under nonaccident conditions will be provided. Also the expected peak suppression pool temperature under normal operating conditions will be discussed.

15.2 The conservatisms in the existing analyses defining peak service water temperature will be quantified to the extent possible.

Item 15.1

The maximum worst-case initial temperature of the lake where shutdown service water takes suction is approximately 90°F for the highest one (1) day average water temperature. This temperature is based upon the once-in-fifty-years worst-case situation (drought, temperature, plant at 100% power, etc.).

The peak suppression pool temperature under normal plant conditions if 95°F as limited by the technical specifications. The high temperature problem which prevailed at Kuosheng is not a concern for the Clinton Power Station because of the unlikelihood of the shutdown service water temperature being 90°F. Concluding that the continuous operation of the CPS RHR System is very remote, no reduction in the service life of the equipment is expected.

Item 15.2

Regarding the conservatisms in the present design, the ability of the suppression pool to accommodate accidents at the maximum (design) temperature is addressed in the response for Action Plan 28. Thus, from the information provided above this issue is closed for Clinton.

Action Plan 18

4.9 The effect on the long term containment response and the operability of the spray system due to cycling the containment sprays on and off to maximize pool cooling needs to be addressed. Also provide and justify the criteria used by the operator for switching from the containment spray mode to pool cooling mode, and back again.

5.3 Leakage from the drywell to containment will increase the temperature and pressure in the containment. The operators will have to use the containments spray in order to maintain containment temperature and pressure control. Given the decreased effectiveness of the RHR system in accomplishing this objective in the containment spray mode, the bypass leakage may increase the cyclical duty of the containment sprays.

Response

A criterion for transferring the RHR System from containment spray mode to suppression pool cooling mode will be developed to close this issue for Clinton. The results of Action Plans 10 and 11, which evaluated conservatisms in calculating pool temperature and containment pressure, showed that, during a DBA without drywell bypass, there will be no need for containment spray activation to control containment pressure or temperature.

The realistic analysis performed by GE demonstrated that the containment pressure will not exceed 8.1 psig - well below the design pressure of 15 psig, and also below the automatic spray actuation setpoint of 9 psig. The peak suppression pool temperature was 165°F, with the airspace temperature always lagging behind the pool temperature, by as much as 36°F. Since the peak pool temperature is quite insensitive to the size of the break, these results would apply across the entire spectrum of LOCAs.

Only when a drywell break is combined with a large drywell bypass leakage, will containment spray be needed to control containment pressure. For this case, the results of Action Plan 19 show that the decreased RHR heat exchanger effectiveness due to operation in the spray mode will not result in exceeding the suppression pool design temperature of 185°F, even with containment spray in continuous operation. This result was obtained by conservatively accounting for structural heat sinks in both drywell and containment airspaces.

Hence, it is concluded that the current operator procedures are adequate and need no modifications for the operation of containment sprays. And thus this issue is closed for Clinton.

Action Plan 19

5.1 The worst case of drywell to containment bypass leakage has been established as a small break accident. An intermediate break accident will actually produce the most significant drywell to containment leakage prior to initiation of containment sprays.

5.6 The test pressure of 3 psig specified for the periodic operational drywell leakage rate tests does not reflect additional pressurization in the drywell which will result from upper pool dump. This pressure also does not reflect additional drywell pressurization resulting from throttling of the ECCS to maintain vessel level which is required by the current EPG's.

9.2 The continuous steaming produced by throttling the ECCS flow will cause increased direct leakage from the drywell to the containment. This could result in increased containment pressures.

Response

The following program for resolution was used to close this issue for Clinton:

19.1 A complete spectrum of analyses for varying break sizes will be completed neglecting depressurization of the drywell prior to initiation of containment sprays, but including the effects of containment heat sinks.

19.2 Analyses will be completed to show that the allowable leakage of $A/\sqrt{K}$ equal to 1.0 is valid for Clinton.

19.3 Evaluate the need of reducing the allowable tech. spec. limiting conditions for the drywell leakage.

In response to 19.1 and 19.2 a spectrum of breaks ranging from SBA to DBA with a bypass leakage equivalent area of $A/\sqrt{K} = 0.9$ ft^2 were analyzed to determine the degree of containment pressurization prior to the initiation of containment spray. The analyses were performed using GE proprietary computer program VACBR04. Structural heat sinks and heat and mass transfer between suppression pool and containment air space were considered in the model. Free convection heat transfer coefficients were conservatively calculated to minimize the heat sink effectiveness. The duration of drywell pressurization is maximized by assuming that the operator controls the RPV water level, in a manner such that the break will not be flooded by ECCS system operation. Thus, there is no drywell steam condensation caused by a relatively cool break liquid flowing into the drywell to promote condensation.

The analyses show that the limiting drywell to containment bypass leakage results from a 2.5 ft^2 steam-line break accident. The peak containment pressure in this case, at the time of spray initation, was 14.5 psig - which is below the containment design pressure of 15 psig. Therefore, the previously calculated bypass leakage capability of $A/\sqrt{K}$ = 0.9 ft^2 for GGNS is still valid. This analysis envelopes CPS even though the bypass leakage $A/\sqrt{K}$ for Clinton is 1.0 ft^2. The bypass leakage variable is not as significant in the analysis as the structural heat sinks and the heat and mass transfer between the suppression pool and containment air space. These heat sinks and heat and mass transfer coefficients used in the analysis are conservative for Clinton.

Figure 19.1 shows the peak containment pressure as a function of break size, with bypass leakage of $A/\sqrt{K}$ = 0.9 ft^2.

In response to 19.3 a worst-case scenario for drywell bypass leakage, obtained as a result of the study under item 19.1, was evaluated for long-term containment pressurization. At 13 minutes after the break, the containment pressure is reduced due to automatic spray actuation. This worst-case scenario is predicated on operator action (per EPGs) to control the RPV water level, thus preventing ECCS water overflow into the drywell and resulting in continuous drywell pressurization. At 30 minutes post-LOCA, the upper pool dumps and the drywell-to-containment ΔP increases due to increased vent submergence. This, in turn, increases the steam bypass leakage, and results in additional containment pressurization. At approximately 50 minutes into the accident, the containment design pressure of 15 psig would be reached. However, the operator is directed, again by EPGs, to terminate the drywell (and thus containment) pressurization by flooding the drywell with ECCS water before the containment design pressure is reached.

It is therefore concluded that there is no need for reducing the allowable bypass leakage technical specification in consideration of the additional pressure produced by upper pool dump. Thus, this issue is closed for Clinton.

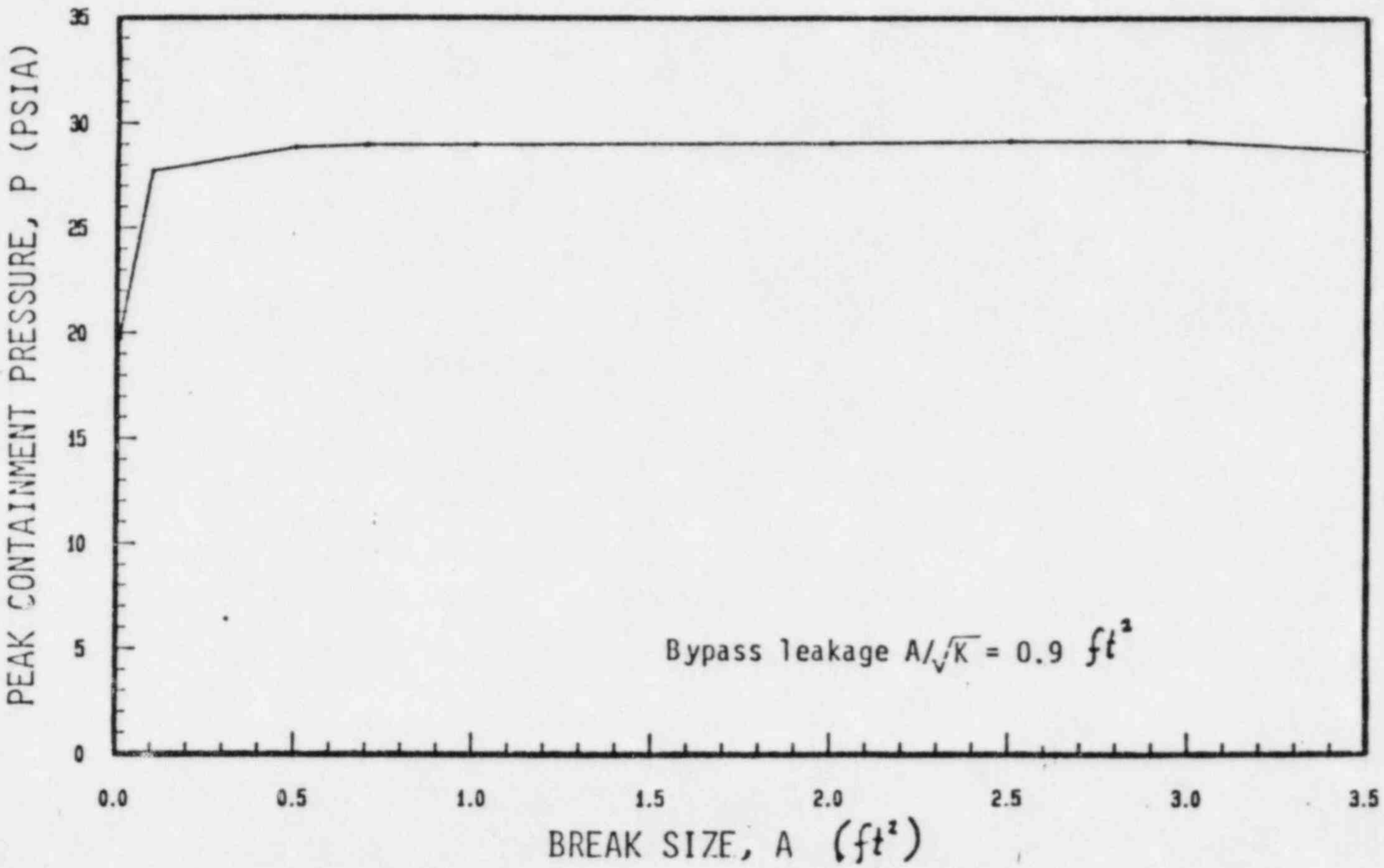

FIGURE 19.1 CONTAINMENT BYPASS LEAKAGE CAPABILITY

Action Plan 22

5.8 The possibility of high temperatures in the drywell without reaching the 2 psig high pressure scram level because of bypass leakage through the drywell wall should be addressed.

Response

The following program for resolution was used to close this issue for Clinton:

22.1 A new analysis will be performed using the capability of bypass leakage. This analysis will show that a temperature of 330°F is not reached in the drywell until after ten minutes. In this interval, the operator will have received sufficient information to manually scram the reactor.

22.2 Develop a list of alarms & displays which inform the operator of conditions in the drywell.

In response to 22.1, there are two reasons why the drywell temperature may increase from its equilibrium value during normal operation:

(a) increased heat addition (steam leak in the drywell), or,

(b) decreased heat removal (degradation or total loss of drywell fan coolers.)

The worst possible case is the combination of both (a) and (b). The scenario analyzed, the worst possible case, was a steam break in the drywell with a non-isolated containment, no drywell fan cooling, and the drywell capability of bypass leakage (effective GGNS area of 0.9 $feet^2$) taken into account. The analysis was performed using the General Electric proprietary computer program VACBR04. The purpose of the analysis was to determine the peak drywell temperature that could occur during the first 10 minutes after a break with the drywell pressure maintained below 2 psig. After 10 minutes it is assumed the operator will take some action to control drywell temperature e.g., scram and depressurize the reactor. The heat sources were obtained from data for Perry, a BWR/6 238 Mark III plant. It is estimated the total drywell heat load for GGNS is within 30% of the total drywell heat load for Perry. An increase of 30% in the drywell heat load used in the analysis would result in less than a 30% increase in the drywell temperature rise. A spectrum of break sizes was considered to determine the limiting case. The peak drywell temperature of 246°F occurred at 10 minutes for a break area of approximately .007 ft^2, at 111°F temperature rise from the initial drywell temperature of 135°F. This peak drywell temperature is well below the design temperature of 330°F, even if the calculated temperature rise is increased by 30%. Even though the bypass leakage for Clinton is 1.0 ft^2 the drywell heat load is a more significant variable than the bypass leakage value. This analysis is still conservative for CPS because the drywell heat load for Clinton is much smaller than for GGNS.

In response to 22.2, a Clinton specific list of alarms and parameter displays which are available to the operator to inform him of conditions in the drywell are developed in Table 22.1. This would include drywell cooling performance, temperature, airflows, leak detection, etc. Thus, from the information provided above, this issue is closed for CPS.

Table 22.1
Alarm & Displays For the Drywell
CONTAINMENT MONITORING

1EI-CM(later)	H_2/O_2 Concentration
1EI-CM(later)	H_2/O_2 Concentration
1LT-CM9later)	Drywell Sump Level
1ME-CM019	Drywell Air Humidity Lower Drain Cooler Inlet
1ME-CM020	Drywell Air Humidity Lower Drain Cooler Inlet
1ME-CM021	Drywell Air Humidity Upper Drain Cooler Inlet
1ME-CM022	Drywell Air Humidity Upper Drain Cooler Inlet
1ME-CM023	Drywell Air Humidity CRD Area
1MIS-CM025	Drywell Air Humidity Analyzer
1PT-CM063	Drywell Pressure
1PT-CM064	Drywell Pressure
1RE-CM059	Drywell High Range Gamma Radiation
1RE-CM060	Drywell High Range Gamma Radiation
1RIX-CM059	Drywell High Range Gamma Radiation
1RIX-CM060	Drywell High Range Gamma Radiation
1RØ-CM059	Drywell High Range Gamma Radiation
1RØ-CM060	Drywell High Range Gamma Radiation
1TE-CM065	Drywell Atmosphere Temperature
1TE-CM066	Drywell Atmosphere Temperature
1TE-CM067	Drywell Atmosphere Temperature
1TE-CM068	Drywell Atmosphere Temperature
1TE-CM069	Drywell Atmosphere Temperature
1TE-CM070	Drywell Atmosphere Temperature
1TE-CM071	Drywell Atmosphere Temperature
1TE-CM072	Drywell Atmosphere Temperature
1XX-CM125	H_2/O_2 Gas Chromatograph
1XX-CM126	H_2/O_2 Gas Chromatograph
1XX-CM139	H_2/O_2 Teleprinter
1XX-CM140	H_2/O_2 Teleprinter

LEAK DETECTION

1E31-N017A	Drywell Ambient Temperature
1E31-N017B	Drywell Ambient Temperature

1E31-N017C	Drywell Ambient Temperature
1E31-N017D	Drywell Ambient Temperature
1E31-N021	Drywell Air Cooler 1VP01CC Drain
1E31-N033A	Drywell Cooler 1VP01CD Drain Flow
1E31-N530	Drywell Cooler 1VP02SA Inlet
1E31-N531	Drywell Cooler 1VP02SA Outlet
1E31-N532	Drywell Cooler 1VP02SB Inlet
1E31-N533	Drywell Cooler 1VP02SB Outlet
1E31-N534	Drywell Cooler 1VP02SC Inlet
1E31-N535	Drywell Cooler 1VP02SC Outlet
1E31-N536	Drywell Cooler 1VP02SD Inlet
1E31-N537	Drywell Cooler 1VP02SD Outlet
1E31-N540	Drywell Cooler 1VP02SA Diff. Temp. Amplifier
1E31-N541	Drywell Cooler 1VP02SA Diff. Temp. Trip Unit
1E31-N542	Drywell Cooler 1VP02SB Diff. Temp. Amplifier
1E31-N543	Drywell Cooler 1VP02SB Diff. Temp Trip Unit
1E31-N544	Drywell Cooler 1VP02SC Diff. Temp. Amplifier
1E31-N545	Drywell Cooler 1VP02SC Diff. Temp. Trip Unit
1E31-N546	Drywell Cooler 1VP02SD Diff. Temp. Amplifier
1E31-N547	Drywell Cooler 1VP02SD Diff. Temp. Trip Unit
1E31-N572	Drywell Floor & Equipment Drains Inlet Flow Total
1E31-N575	Drywell Floor Drain Inlet Flow
1E31-N576	Drywell Equipment Drain Inlet Flow
1E31-N578	Drywell Equipment Drain Weir Box Level for Flow Meas.
1E31-N5781	Drywell Equipment Drain Weir Box Level for Flow Meas.
1E31-N5782	Drywell Equipment Drain Weir Level-Flow Convert
1E31-N5783	Drywell Equipment Drain Weir Flow Increase Alarm
1E31-N5784	Drywell Equipment Drain Weir Flow Increase Timer
1E31-N580	Drywell Floor Drain Weir Box Level for Flow Meas.
1E31-N5801	Drywell Floor Drain Weir Box Level for Flow Meas.
1E31-N5802	Drywell Floor Drain Weir Level-Flow Convert
1E31-N5803	Drywell Floor Drain Weir Flow Increase Alarm
1E31-N5804	Drywell Floor Drain Weir Flow Increase Timer
1E31-N590	Drywell Cooler 1VP02SA Water Inlet

LEAK DETECTION (cont'd)

1E31-N591	Drywell Cooler 1VP02SA Water Outlet
1E31-N592	Drywell Cooler 1VP02SB Water Inlet
1E31-N593	Drywell Cooler 1VP02SB Water Outlet
1E31-N594	Drywell Cooler 1VP02SC Water Inlet
1E31-N595	Drywell Cooler 1VP02SC Water Outlet
1E31-N596	Drywell Cooler 1VP02SD Water Inlet
1E31-N597	Drywell Cooler 1VP02SD Water Outlet
1E31-R520	Drywell Cooler 1VP02SA Diff. Temp. Indicator
1E31-R521	Drywell Cooler 1VP02SB Diff. Temp. Indicator
1E31-R522	Drywell Cooler 1VP02SC Diff. Temp. Indicator
1E31-R523	Drywell Cooler 1VP02SD Diff. Temp. Indicator
1E31-R600A	Drywell Cooler 1VP02CD Drain Flow
1E31-R603	Drywell Floor Drain Sump Pump Out Timer
1E31-R604	Drywell Floor Drain Sump Fill Up Timer
1E31-R605	Drywell Equipment Drain Sump Pump Out Timer
1E31-R606	Drywell Equipment Drain Sump Fill Up Timer
1E31-R608	Ambient Monitoring Multipoint Recorder
1E31-R609	Drywell Cooler 1VP02CC Drain Flow

RADIATION MONITORING

1UT-RM021A	Line Isolator
1UT-RM021B	Line Isolator
1UX-RM021	Communications Plug
1UT-RM022A	Line Isolator
1UT-RM022B	Line Isolator
1UX-RM0-2B	Line Isolator
1UX-RM022	Communications Plug
1UT-RM023A	Line Isolator
1UT-RM-23B	Line Isolator
1UX-RM023	Communications Plug
1UT-RM024A	Line Isolator
1UT-RM024B	Line Isolator
1UX-RM024B	Line Isolator
1UX-RM024	Communications Plug

RADIATION MONITORING (cont'd)

1UT-RM027A	Line Isolator
1UT-RM027B	Line Isolator
1UX-RM027	Communications Plug
1UT-RM028A	Line Isolator
1UT-RM028B	Line Isolator
1UX-RM028	Communications Plug
1UT-RM029A	Line Isolator
1UT-RM029B	Line Isolator
1UX-RM029	Communications Plug
1UT-RM030A	Line Isolator
1UT-RM030B	Line Isolator
1UX-RM030	Communications Plug

HVAC

1TE-VP033A	Lower Drywell Supply Fan 01CA
1TE-VP033G	Upper Drywell Supply Fan 01CC
1TE-VP033C	Lower Drywell
1TE-VP033D	Upper Drywell
1TE-VP033E	Drywell Head Cover
1TE-VP033F	CRD Area
1TE-VP033G	RPV Annulus
1TE-VP034A	Lower Drywell Supply Fan 01CB
1TE-VP034B	Upper Drywell Supply Fan 01CD
1TE-VP034C	Lower Drywell
1TE-VP034D	Upper Drywell
1TE0VP034E	Drywell Head Cover
1TE-VP034F	CRD Area
1TE-VP034G	RPV Annulus

MISCELLANEOUS

1B21-N094A	Drywell Pressure LPCS RHR-A ADS-ARI
1B21-N094B	Drywell Pressure RHR-B-C ADS-B RCIC
1B21-N094E	Drywell Pressure LPCS RHR-A ADS-A
1B21-N094F	Drywell Pressure RHR-B-C ADS-B
1C61-K501	Drywell Temp-Lower
1C61-K502	Drywell Temp-Upper
1C61-N501	Drywell Temp-Lower
1C61-N502	Drywell Temp-Lower
1C61-R501	Drywell Temp-Lower
1C51-R502	Drywell Temp-Upper

Action Plan 25

8.1 This issue is based on consideration that some technical specifications allow operation at parameter values that differ from the values used in assumptions for FSAR transient analyses. Normally analyses are done assuming a nominal containment pressure equal to ambient (0 psig) a temperature near maximum operating (90°F) and do not limit the drywell pressure equal to the containment pressure. The technical specifications permit operation under conditions such as a positive containment pressure (1.5 psig), temperatures less than the maximum (60 or 70°F) and drywell pressure can be negative with respect to the containment (-0.5 psid). All of these differences would result in transient response different than the FSAR descriptions.

Response

The following program for resolution was used to close this issue for Clinton:

25.1 A detailed summary of all conservatisms which currently exist in the containment response analyses which are part of the FSAR will be provided. Conservatisms in the suppression pool temperature analysis will be identified in Action Plan 12.

25.2 Complete an end point analysis to demonstrate that with all initial containment parameters at worst case values, the containment design pressure is still not significantly exceeded.

25.3 Perform an analysis with worst case values taking credit for realistic temperature differences between containment and suppression pool and the containment heat sinks.

25.4 A complete review of the technical specifications for containment conditions versus accident analysis assumptions will be made. A comparison of technical specification values and values used as initial assumptions in the accident analysis will be submitted.

Item 25.1

All conservatisms in the containment, pressure temperature and suppression pool temperature response including those referred to in Item 25.1 of the Program for Resolution are quantified and discussed in the information submitted under Action Plan 12.

Item 25.2

MP&L submitted a sensitivity study (see Reference 1) involving drywell and containment initial conditions similar to those at CPS, which affect Design Basis Accident (DBA) long-term containment response. That study basically drew on end-point calculations to establish sensitivity trends governing DBA peak containment pressure. The study concluded that even under conservative (adverse) drywell and containmnet initial conditions, peak containment pressures would not exceed design (15 psig).

The response provided by MP&L in Reference 1 also discussed at length the non-realistic nature of end-point analyses. As two examples:

1) Such end-point analyses neglect the DBA pressure-reducing action of the safety-grade redundant containment spray trains.

2) They also neglect the inherent energy-absorbing (pressure-reducing) action of the containment and drywell heat sinks -- energy sinks that become significant over the (typically) 4.0-5.0 hours post-LOCA when peak DBA pressure is reached.

The Containment Issues Owners Group (CIOG) has continued to evaluate varying combinations of conservative initial containment and drywell conditions. The CIOG has expanded the range of initial drywell pressures evaluated up to an initial drywell pressure that initiates reactor scram and generates a LOCA signal. These studies computed the peak containment pressure under hypothetical conditions where containment design temperatures of 185°F, and 100% RH, are attained in the containment airspace. The entire drywell air mass is assumed to be transferred to the containment with no redistribution to the drywell. The resulting sensitivity trend to varying initial drywell pressure, under "worst-case" initial conditions for all other parameters, is given in Figure 25-1 for initial drywell temperatures of 105°F and 135°F.

These results are excessively conservative with respect to GGNS & CPS. As noted in reference 1, the actual calculated peak long term post accident containment temperature is 180°F assuming that thermal equilibrium exists between the suppression pool and the containment air space. This is lower than the end point temperature used in the CIOG sensitivity study. The CIOG analyses also include the vapor pressure of water at 185°F which is also higher than the vapor pressure which would be predicted at GGNS & CPS using the conservative licensing basis assumptions. In addition, the air volume ratio of containment to drywell at CPS is 21% higher than the volume ratio considered in the CIOG analysis.

These results show that under excessively conservative, non-realistic assumptions and a methodology which neglects operator mitigating actions (EPG procedures), it is possible to compute end-point states for the containment airspace which exceed the containment design pressure. The CIOG does not believe that such end-point calculation results are appropriate for assessing the adequacy of containment design. The CIOG feels that no purpose is served in pursuing further contrived end-point computations of this nature and, accordingly, no further analysis on this issue is planned.

Item 25.3

A more realistic analysis, evaluated the conservatisms collectively associated with such end-point calculations. To recap that response, FSAR licensing basis assumptions were used in GE's latest proprietary long-term containment response code, SHEX, to establish a reference DBA containment response transient. Then, a re-run was made with a conservative (adverse) initial conditions mentioned above in the first paragraph, and with realistic accounting for containment and drywell heat sinks and (non-equilibrium) containment airspace temperatures that results from the counter-effects of pool surface evaporation and heat transfer, and heat transfer from airspace to heat sink. This comparison showed that the resulting "more realistic" peak containment airspace pressure, relative to the FSAR reference" case, is lower by 4.3 psi.

Item 25.4

IP has made a complete review of technical specification requirements and compared these with accident analysis assumptions used in the generic end point analysis response to item 25.2. The following list is a comparison of the major assumptions used in this analysis.

1) CPS technical specification 3.6.1.6 requires containment pressure to be no higher than +1.5 psig during operation. Generic end point analysis used a pressure of +1.0 psig. The generic end point analysis reported in item 25.2 utilized the standard BWR 6-238 technical specification parameters and performed a sensitivity study to determine the effect of variation in these parameters. Based on the analysis results and the consideration of 1) larger containment volume 2) lower power level and 3) the compressibility of the containment atmosphere, it is judged that the additional 0.5 psig allowed in the Clinton technical specification will have an insignificant effect on the final pressure in the containment following an accident.

2) CPS technical specification 3.6.2.5 requires drywell to containment differential pressure to be maintained between -.10 psid and +1.5 psid. This establishes maximum drywell initial pressure between 1.4 psig and 2.0 psig (SCRAM). Generic end point analysis considered a wider range of between .85 psig and 2.0 psig (SCRAM).

The wider range of initial drywell pressure considered in the generic end point analysis is a direct result of the higher initial pressure considered at CPS. This results in a narrower range of initial drywell pressure at CPS (i.e. 1.4 psig to 2.0 psig) which is a conservative assumption. The end results are a narrower range of final pressures but no change in the maximum pressure.

3) CPS technical specification 3.6.3.1 requires the suppression pool temperature not to exceed 95°F. A final temperature of 185°F, used in the generic end point analysis is obtained by calculation of a 90°F temperature swing. Also initial containment air temperature used in the analysis is 95°F.

The initial (95°F) and final (185°F) temperatures used in the analysis are based on technical specifications and FSAR design values. However the final temperature of 185°F is conservatively calculated to be 180°F which, if used, would lower the final calculated pressure considerably as shown by MP&Ls response to item 2 (Ref. 1)

4) CPS technical specifications do not limit low temperatures in the drywell, however the containment issues owners group have determined a minimum temperature of 105°F. The nominal temperature expected initially is 135°F, compared with a maximum operation temperature of 150°F per CPS technical specification 3.6.2.6.

The minimum initial drywell temperature of 105°F is a very conservative temperature used in the generic end point analysis and is substantially lower than the normal operating temperature at CPS.

<u>Reference</u>

1) MP&L's AECM-83/574, Item 2 of Action Plan 25.

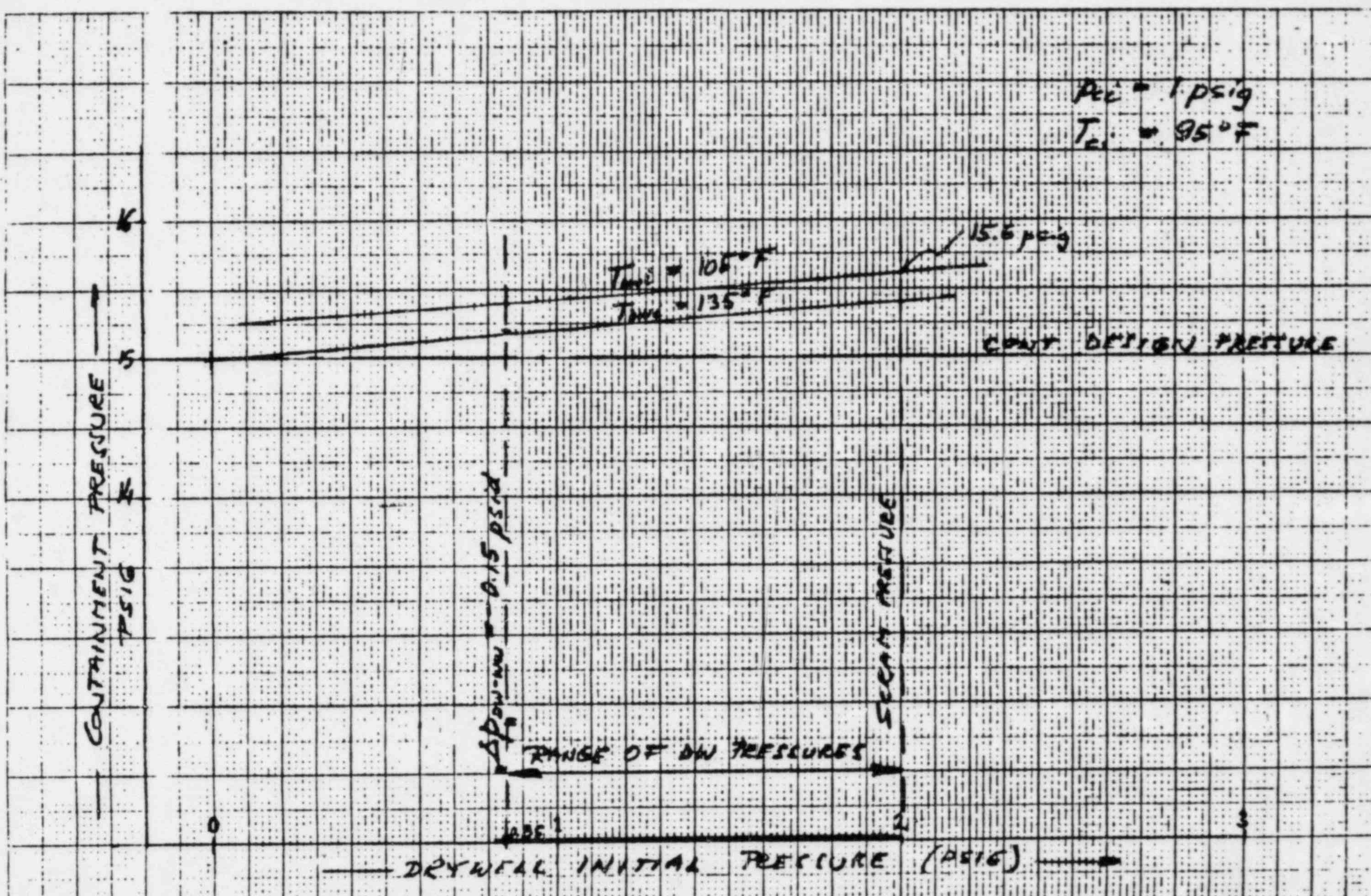

FIGURE 25-1 SENSITIVITY OF CONTAINMENT PRESSURE TO DRYWELL INITIAL CONDITIONS

Action Plan 28

9.3 It appears that some confusion exists as to whether SBA's and stuck open SRV accidents are treated as transients or design basis accidents. Clarify how they are treated and indicate whether the initial conditions were set at nominal or licensing values.

9.4 The design basis calculations for stuck open relief valves should not rely on a manually initiated scram to occur within a short time interval of the SRV occurrence. The analysis should assume that scram is initiated when the pool temperature reaches 110°F or 10 minutes after occurrence of the SORV.

Response

The program for resolution to close this issue at Clinton is as follows:

28.1 IPC will submit a letter confirming that the small break accident and the stuck open relief valve transient were treated as design basis accidents. The analyses for these transients are completed using licensing basis values for the initial conditions.

28.2 IPC will verify that the Chapter 15 analysis of a SORV assumes reactor scram occurs when suppression pool temperature reaches 110°F.

Item 28.1

IPC has verified that small break accidents, as discussed in FSAR Section 6.2.1, have been treated as design basis accidents with initial conditions consistent with other licensing analyses.

The stuck open relief valve transients and small break accident transients in the suppression pool have been evaluated (see attachment I). The results of this evaluation shows that the maximum suppression pool temperature expected is 171°F. This is less than the design temperature of 185°F.

Item 28.2

The analyses of SORV events discussed in Chapter 15 of the CPS-FSAR have been reviewed. In all cases, scram is not required to return the system to a stable operating mode or scram is initiated by the event.

Plant operational transients, such as a turbine trip or loss of normal feedwater flow will actuate the SRV's to maintain the vessel pressure within desirable limits. Once SRV's open, the steam released from the reactor is discharged through SRV lines into the suppression pool. Steam is then condensed in the pool in a stable condition. Extended steam blowdown into the pool at an elevated pool temperature could yield an unstable steam condensation which might cause severe dynamic loads on the containment structure.

The current practice to deal with this phenomenon is to restrict the allowable operating temperature envelope of the pool in the Technical Specification such that this instability will not occur. Early in 1981, the NRC issued the NUREG-0783 to establish the operational temperature limit for suppression pool and requested that analysis be performed to assess Mark I, II and III containment designs. The events requiring analysis by the NRC were carefully evaluated and a revised set of six transient cases which bounded all these events was identified.

The six identified transients are: (1) Stuck open relief valve (SORV) at full power with a loss of 1 residual heat removal (RHR) heat exchanger and with the condenser available to an RPV pressure of 150 psia; (2) SORV at full power with spurious isolation; (3) Isolation scram with 1 RHR heat exchanger available; (4) Isolation scram with SORV and loss of shutdown cooling; (5) Small break accident (SBA) with a loss of 1 RHR heat exchanger; and, (6) Small break accident (SBA) with loss of shutdown cooling. A detailed description of assumptions relevant to each of the cases is presented in Table 28.1 and 28.2. Table 28.3 presents the Clinton specific data that were used in these evaluations. Pertinent parameters related to the SRV's are presented in Table 28.4. The assumed system delay times are summarized in Table 28.5. The event sequence for each analysis is given in Table 28.6. Final results are shown in Table 28.7.

TABLE 28.1 CLINTON POWER STATION CONTROL LOGIC

Case Description	Shutdown Cooling Mode RHR 1	Shutdown Cooling Mode RHR 2	Suppression Pool Cooling Mode RHR 1	Suppression Pool Cooling Mode RHR 2	HPCS
1. SORV@POWER Loss of 1 RHR	+16 minutes after operator action (PR <135 psia)	Not used	TS1 + 10 minutes	Not used	Not used
2. SORV@POWER -SPURIOUS ISOLATION	Not used	Not used	TS1 + 10 minutes	TS1 + 10 minutes	Not used
3. ISOLATION SCRAM Loss of 1 RHR	+16 minutes after operator action (PR <135 psia)	Not used	TS1 + 10 minutes	Not used	Not used
4. ISOLATION/ SCRAM SORV	Not used	Not used	TS1 + 10 minutes	TS1 + 10 minutes	Not used
5. SBA Loss of 1 RHR	+16 minutes after operator action (PR <135 psia)	Not used	TS1 + 10 minutes	Not used	High drywel pressure signal with 27 second delay cycle on RPV wate level.
6. SBA, Loss of shutdown cooling	Not used	Not used	TS1 + 10 minutes	TS1 + 10 minutes	Same as 5

TABLE 28.2 CLINTON POWER STATION CONTROL LOGIC

Case Description	Main Feedwater	Condensate Booster Pump	MSIV Closure	Depressurization Rate Governor	Reactor Power
1. SORV@POWER Loss of 1 RHR	Fully available	Not Used	None	1) 35% of rated bypass 2) 100 DEG F/HR until RPV pressure = 135 psia. 3) SORV	SCRAM @ TS3
2. SORV@POWER -SPURIOUS ISOLATION	Available for makeup	Not Used	@T=0 seconds fully closed @ 3.5 seconds	1) 100 DEG F/HR 2) SORV	SCRAM @ T=0 seconds
3. ISOLATION/ SCRAM Loss of 1 RHR	Available for makeup	Not Used	@T=0 seconds fully closed @ 3.5 seconds	100 DEG F/HR until RPV pressure = 135 psia	SCRAM @ T=0 seconds
4. ISOLATION/ SCRAM SORV	Available for makeup	Not Used	@T=0 seconds fully closed @ 3.5 seconds	1) 100 DEG F/HR 2) (SORV)	SCRAM @ T=0 seconds
5. SBA Loss of 1 RHR	Flow in = Flow out until L8 reached-off for rest of transient	On when PR <500 psia	@T=0 seconds fully closed @ 3.5 seconds	1) HPCS 2) 100 DEG F/HR until RPV pressure = 135 psia 3) Break flow	SCRAM @ T=0 seconds
6. SBA Loss of Shutdown Cooling	Same as 5	Same as 5	@T=0 seconds fully closed @ 3.5 seconds	1) HPCS 2) 100 DEG F/HR 3) Break flow	SCRAM @ T=0 seconds

TABLE 28.3

Clinton Plant Specific Data

Reactor and Associated System Specifications

Reactor Core Power (102% rated)	2.797×10^6 Btu/sec
Reactor Volume	1.659×10^4 ft^3
Initial RPV Liquid Mass	4.392×10^5 lb_m
Initial RPV Vapor Mass	1.557×10^4 lb_m
Initial RPV Water Mass	4.5477×10^5 lb_m
Initial Steam Flow (Appendix B)	3.459×10^3 lb_m/sec
Initial Reactor Pressure	1040 psia
Turbine Bypass Flow Coefficient (Appendix B)	$26.51 \frac{lb_m}{sec} \frac{ft^3}{lb_m - psia}$
RPV Heat Structure Mass	2.534×10^6 lb_m
RPV Heat Structure Specific Heat	.111 Btu/lb_m -°F
RPV Heat Structure Area	6984.8 ft^2
RPV Heat Structure H.T.C.	36,000 Btu/ft^2 -°F hr
Feedwater liquid-level control efficient	100 lb_m/sec-in.
RPV maximum pressure for shutdown cooling	135 psia

Feedwater Enthalpy

Integrated FW Flow since Scram (lb_m)	FW Enthalpy (Btu/lb_m)
0.	398.0
124579	398.0
124580	358.0
605076	358.0
605077	310.0
642248	310.0
642249	271.0
1000000	271.0

TABLE 28.3(Cont'd)

Clinton Plant Specific Data

HPCS (see note 2 on page 28-19)	RPV Pressure (psia)	Flow (lb_m/sec)
	0	677.5
	214.7	677.5
	1161.7	193.6
	1191.7	64.6

Suppression Pool and Associated System Specifications

Initial Pool Mass	8.42×10^6 lb_m
Initial Pool Temperature	95°F
Service Water Temperature	95°F
RHR-RX Effectiveness	.449
RHR Mass Flow Rate - Pool Cooling	698.3 lb_m/sec
RHR Mass Flow Rate - Shutdown Cooling	698.3 lb_m/sec
Pool Cooling Technical Specification Temperature (TS1)	95°F
SCRAM Technical Specification Temperature (TS3).	110°F
Depressurization Technical Specification Temperature (TS4)	120°F

TABLE 28.4

SRV Specifications

Number of SRV's	16
SRV Seat Area (In^2)	14.65
Wetwell backpressure on SRV (PSIA)	20.5
SRV Loss Coefficient (choked flow)	1.0
SRV Loss Coefficient (friction flow)	1.88
SRV Reseat Differential Pressure (PSIA)	50
SRV Setpoints (PSIA)	1103.0 8 x 1113.0 7 x 1123.0

TABLE 28.5

System Delay Times

Delay time to establish turbine bypass flow	1200 sec.
Switchover time for shutdown cooling	960 sec.
Delay time for start of pool cooling	600 sec.
Delay time for initial HPCS operation	27 sec.
Time for complete MSIV closure	3.5 sec.
Time for complete turbine stop valve closure	20 sec.

TABLE 28.6

Event Sequence

CASE 1	Time (sec)
SORV, pool temperature at 95°	0
TS3, SCRAM, start of turbine stop valve closure*	406
1 RHR-HX in pool cooling	600
Turbine bypass flow established	1625
Turbine bypass flow stopped, start of manual depressurization (M.D.) @ 100°F/hr (P_{RPV} = 150 psia)	1875
Start of switch from pool cooling to shutdown cooling, end of M.D. (P_{RPV} = 135 psia)	3000
Start of shutdown cooling	3960

CASE 2	Time (sec)
SORV, pool temperature at TS1	0
Pool temperature at TS3, Reactor scrammed, start of MSIV Closure**	406
Two RHR-HX's in pool cooling	625
Pool temperature at TS4, start of M.D. @ 100°F/hr	650

* Turbine stop valve fully closed 20 sec. following start of closure.

** MSIV fully closed in 3.5 sec. following start of closure

TABLE 28.6(Cont'd)

Event Sequence

CASE 3	Time (sec)
SCRAM, TS1, start of MSIV closure*	0
SRV Operation on high RPV pressure	0 - 1910
1 RHR-HX in pool cooling	600.
TS4, start of M.D. @ 100°F/hr	2000.
Start of switch from pool cooling to shutdown cooling, end of M.D. (P_{RPV} = 135.0 psia)	9955.
Start of shutdown cooling	10209.

CASE 4	Time (sec)
TS1, SCRAM, SORV, start of MSIV closure*	0
SRV Operation on high RPV pressure	0-40
2 RHR-HX's in pool cooling	600
TS4, Start of M.D. @ 100°F/hr	990

CASE 5	
TS1, SCRAM, Small break, start of MSIV closure*	0
Initial HPCS Operation	27-235
SRV Operation on high RPV pressure	10-2840
1 RHR-HX in pool cooling	600
TS4, start of M.D. @ 100°F/hr	1700.
Second HPCS Operation	~980-1290
Pressurization of the RPV	~1290-1910
Third HPCS Operation	~2995-3150
TS4, start of M.D. @ 100°F/hr	3305

* MSIV fully closed in 3.5 sec. following start of closure.

TABLE 28.6(Cont'd)

Event Sequence	Time (sec)
FW condensate booster pump flow	3615
Start of switch from pool cooling to shutdown cooling, end of M.D. (P_{RPV} = 135.0 psia)	8485.
Start of shutdown cooling	9445.
CASE 6	
TS1, SCRAM, Small break, start of MSIV closure*	0
Initial HPCS Operation	~27-235
SRV Operation on high RPV pressure	~10-2840
2 RHR-HX's in Pool Cooling	600
Second HPCS Operation	~980-1290
Pressurization of the RPV	~1290~1910
Third HPCS Operation	~3150-3305
Pool temperature at TS4, start of M.D. at 100°F/hr	3460
FW Condensate Booster Pump Flow	4390

* MSIV fully closed 3.5 sec. following start of closure

TABLE 28.7

Maximum Suppression Pool Temperature

Case	Maximum Pool Temperature (°F)	RPV Pressure at Time of Max. Pool Temp. (psia)	Initial Pool Water Mass (lb_m)	Maximum Pool Water Mass (lb_m)
1	151.6	20.7	8.42×10^6	8.878×10^6
2	167.9	22.8	8.42×10^6	9.710×10^6
3	171.0	121.7	8.42×10^6	9.143×10^6
4	161.6	22.6	8.42×10^6	9.610×10^6
5	164.5	14.9	8.42×10^6	8.761×10^6
6	163.5	23.1	8.42×10^6	9.252×10^6

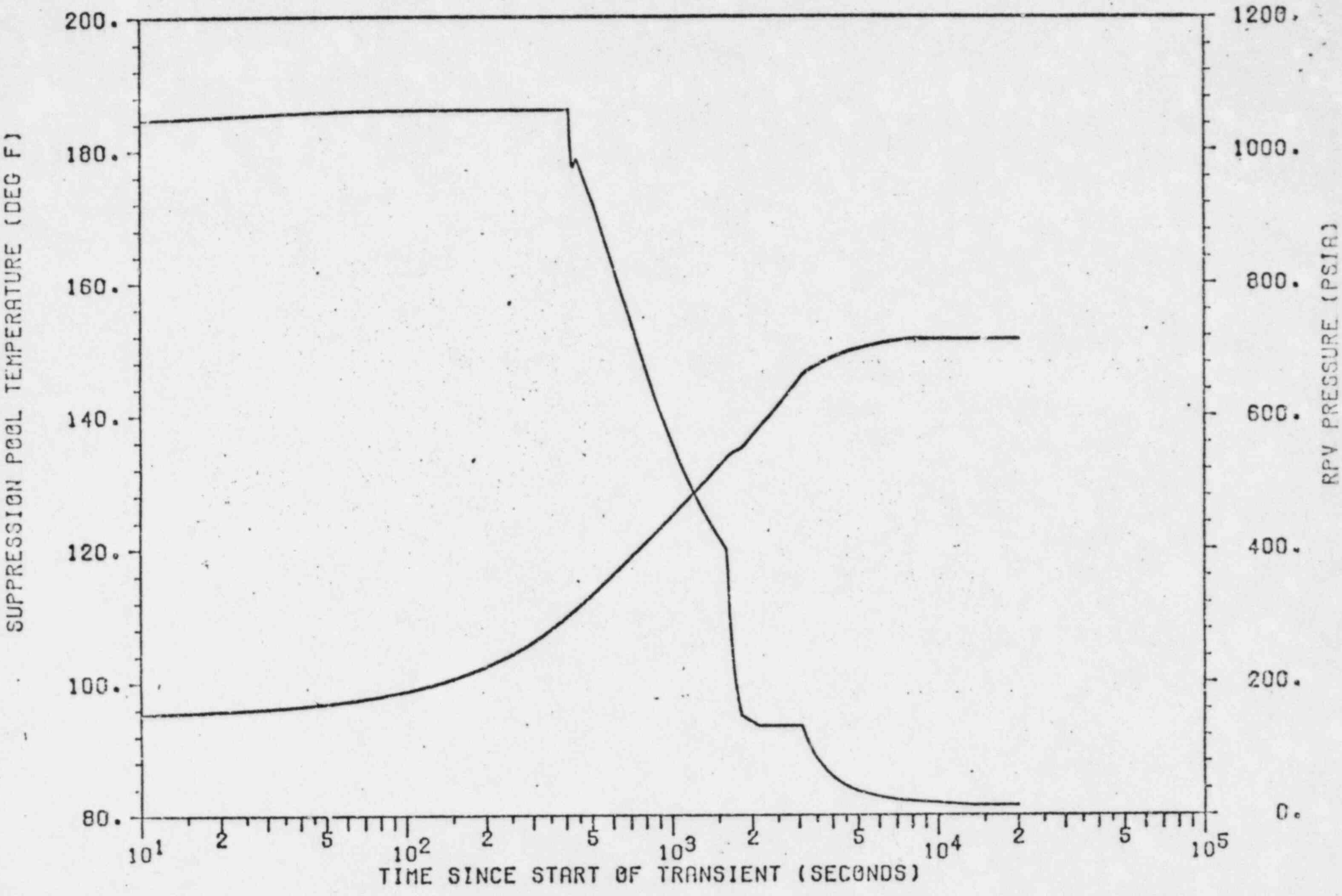

FIG 28.1-CASE 1:SORV AT FULL POWER - LOSS OF 1 RHR - PSJAE = [illegible]50 PSIA

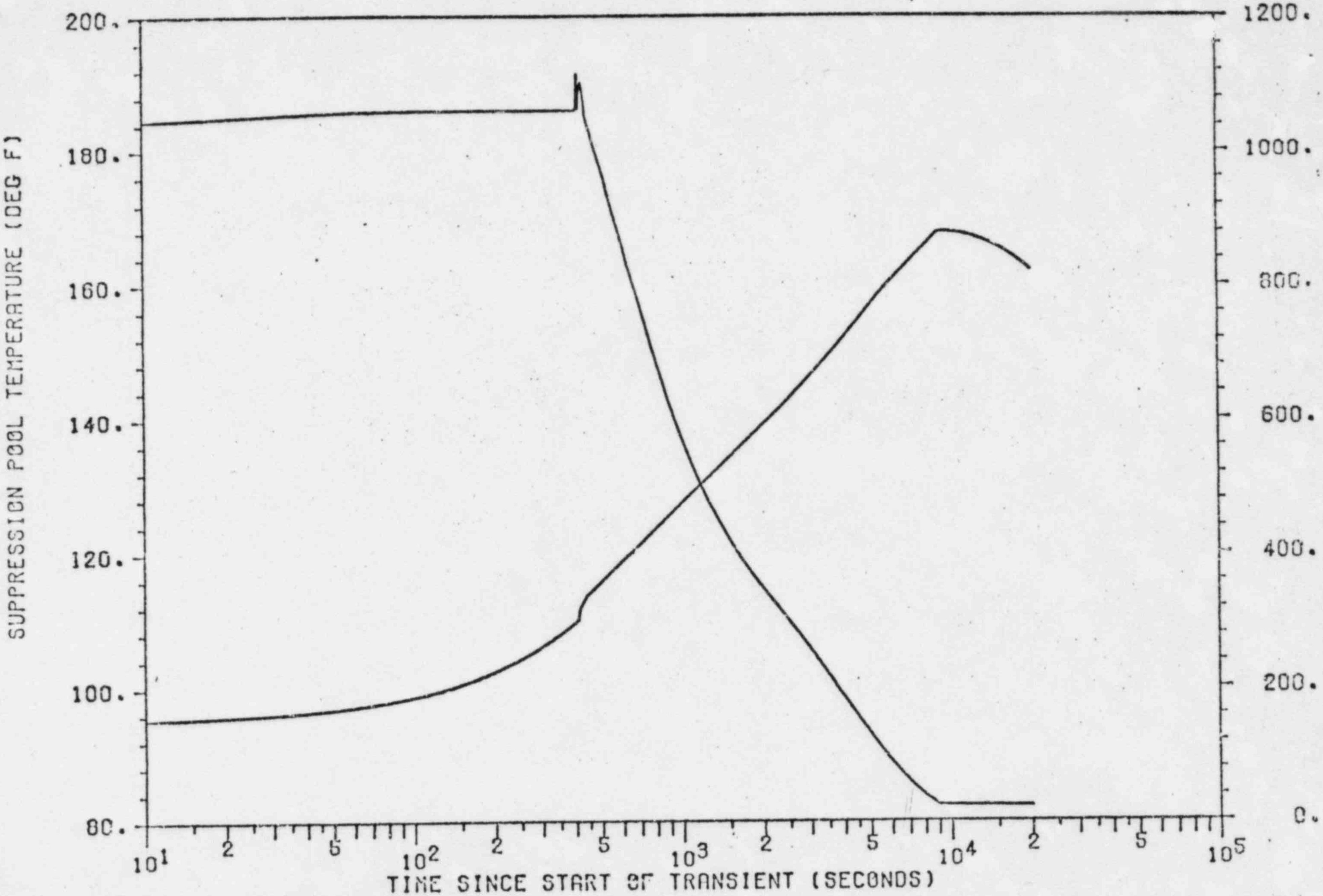

FIG 28.2 -CASE 2:SORV AT FULL POWER - SPURIOUS ISOLATION

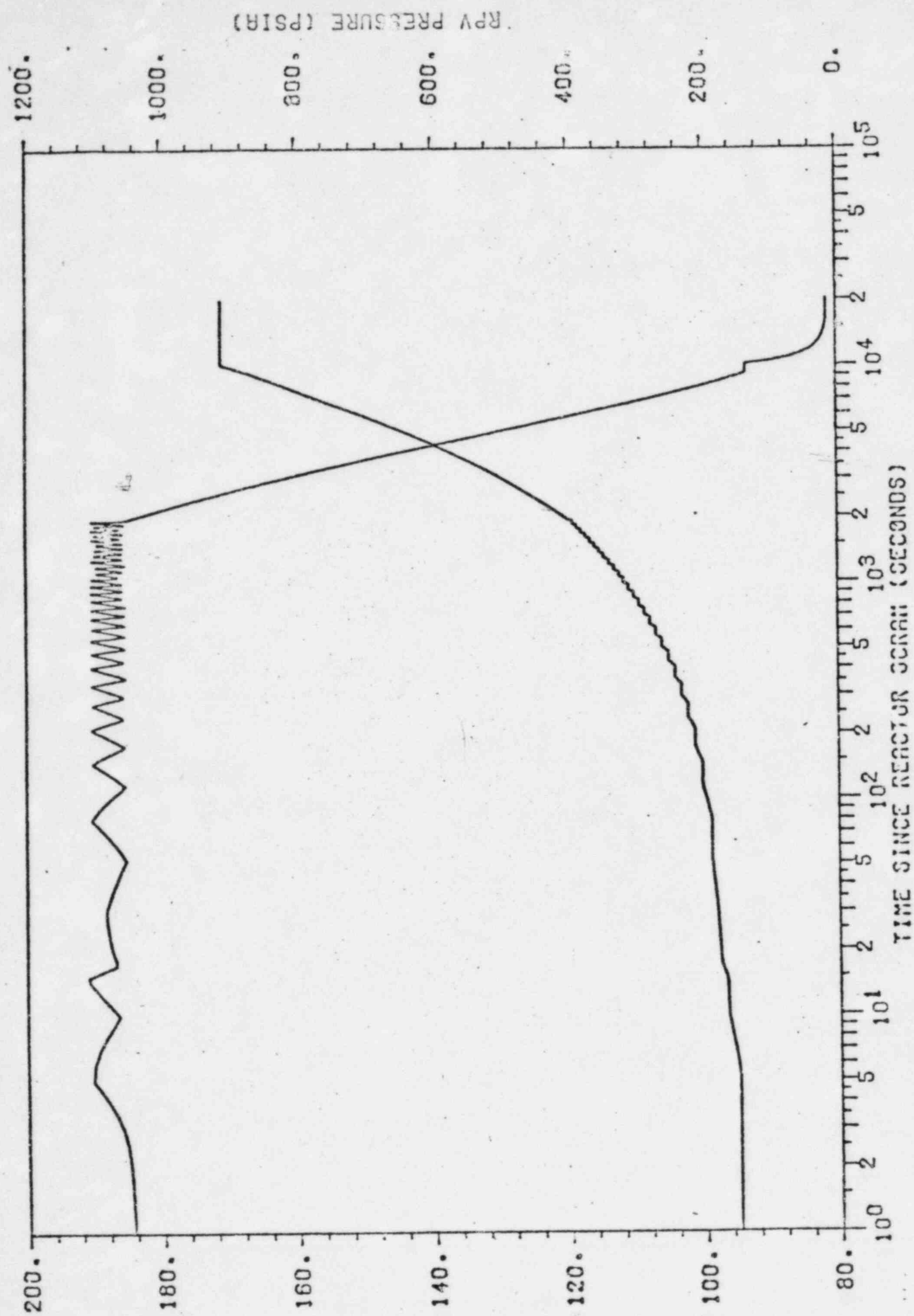

FIG 28.3-CASE 3:ISOLATION SCRAM - LOSS OF 1 RHR

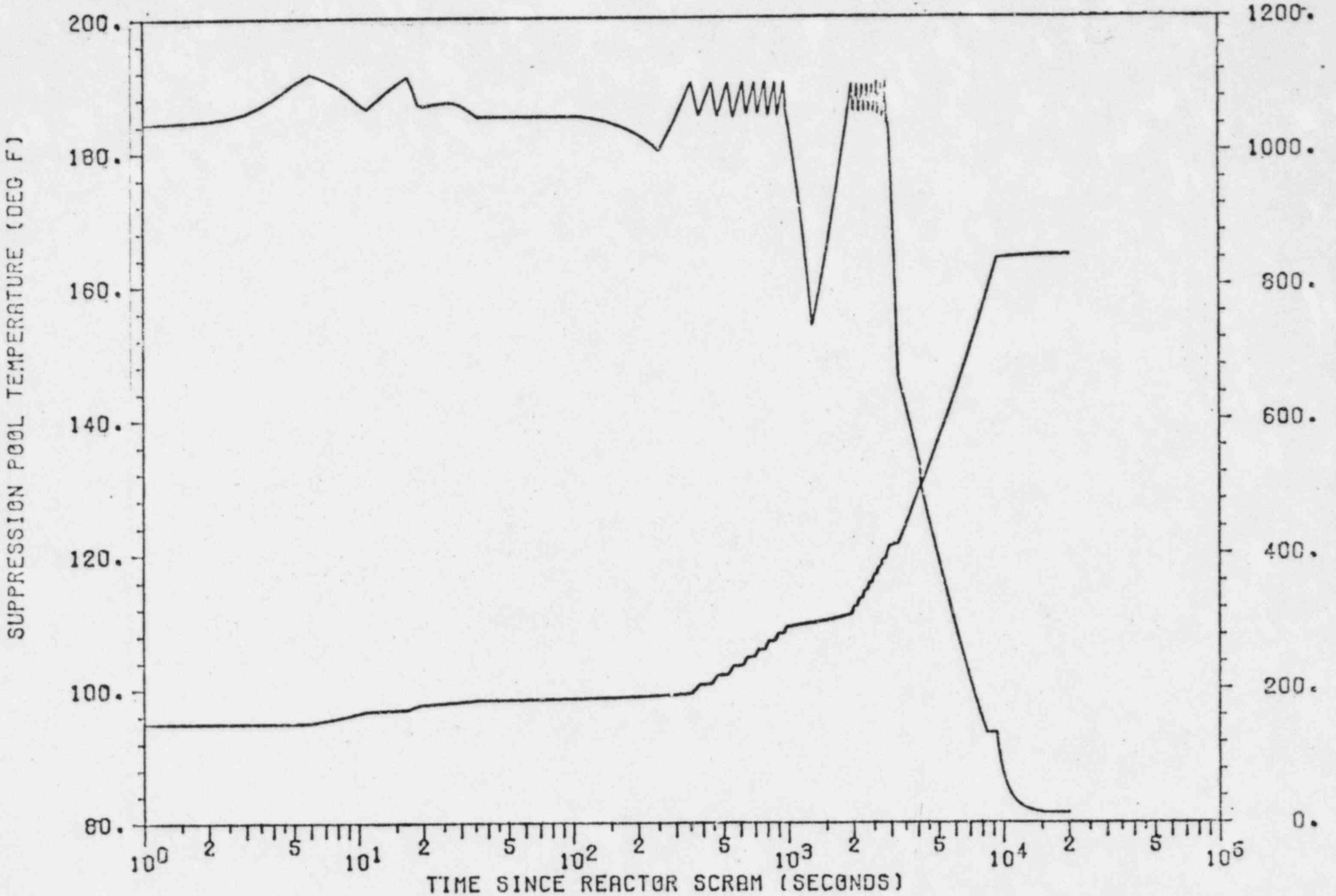

FIG 28.5-CASE 5:SBA - LOSS OF 1 RHR - INSTANTANEOUS COOLDOWN RATE

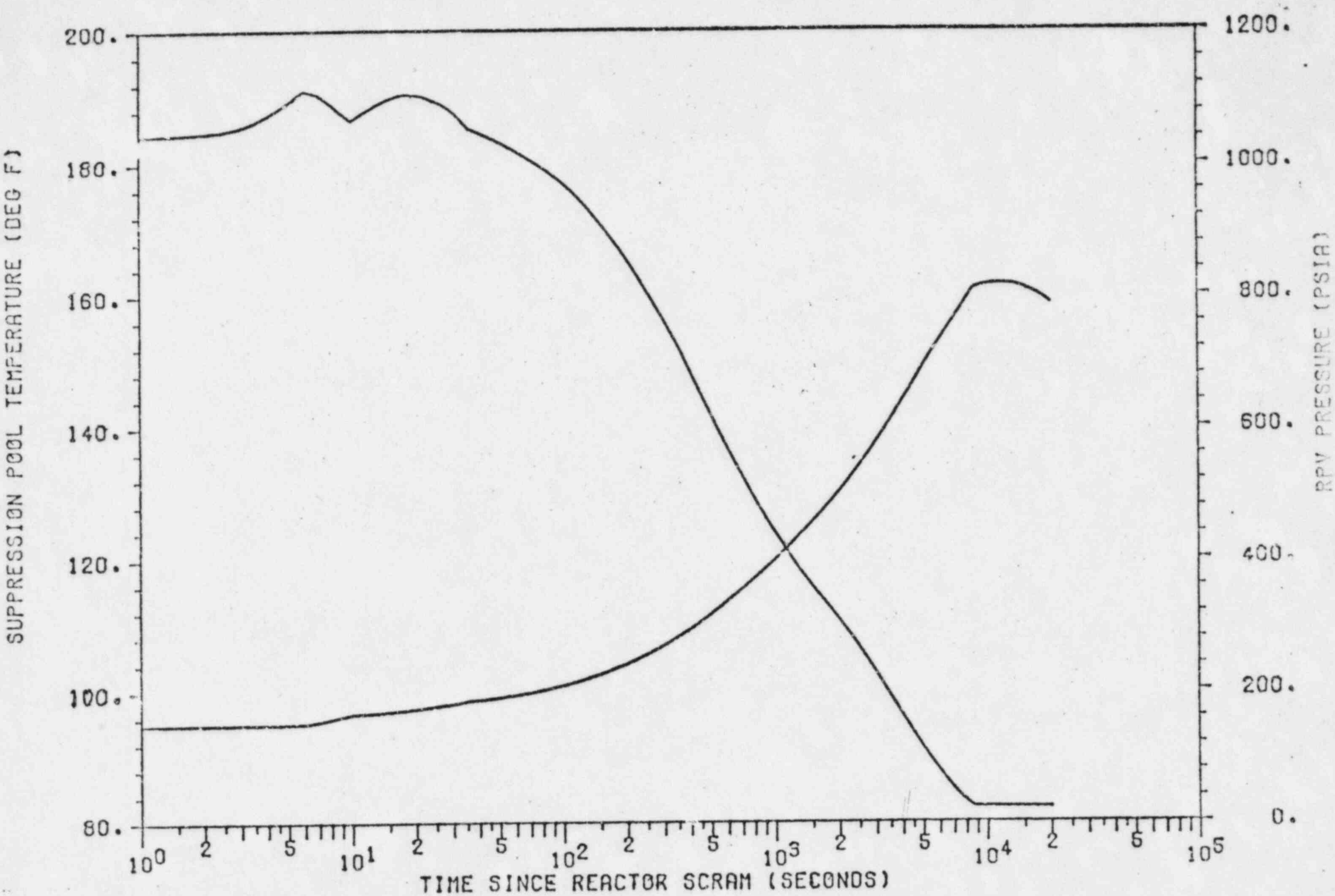

FIG 28.4 -CASE 4:ISOLATION SCRAM - SORV ON ISOLATION

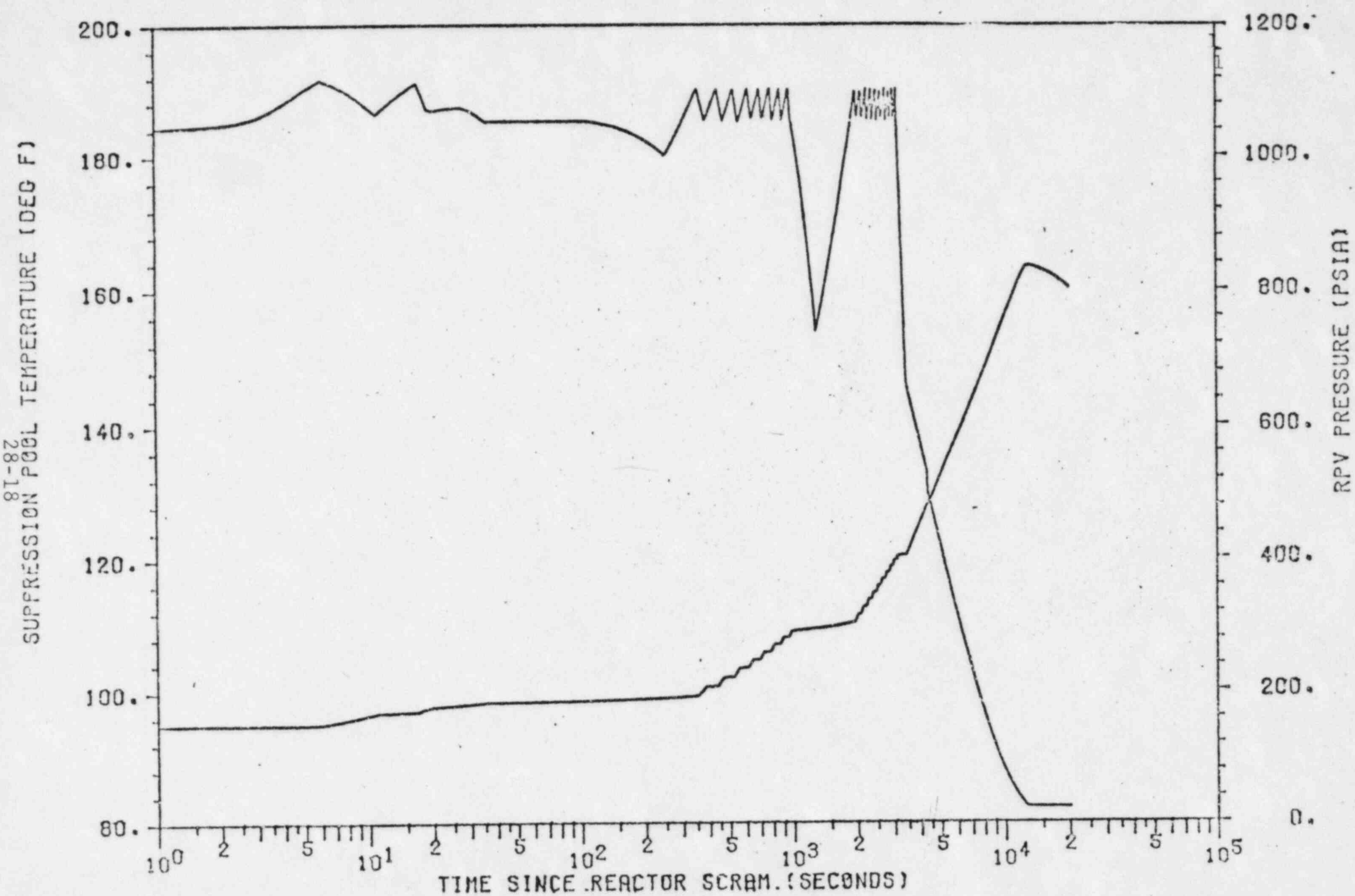

FIG 28.6 -CASE 6:SBA-LOSS OF SHUTDOWN COOLING-INSTANTANEOUS COOLDOWN RATE

Notes:

1. In the Events 3 and 4, it is not assumed that the containment accepts the "hot" portion of the feedwater in the feedwater system. This is because Events 3 and 4 are considered isolation events. The feedwater pumps are tripped at the time the break is detected. Following this, the pumps will coast down and the isolation valves will close in a short period of time. Therefore, consideration of feedwater addition is not modeled.

2. For Events 1 through 4, HPCS is considered available but it is not used in the analyses. In Event 5 and 6 HPCS is in the Standby Mode and is not pressurized so it will not be available in a DBA and should not be treated in a Small Break Accident.

3. In event 1 the turbine stop valve closes completely 20 seconds after the reactor is scrammed which effectively isolates the reactor from the main condenser. At 1200 seconds after scram, the turbine bypass valve opens the main condenser becomes available as a heat sink for reactor steam and RPV pressure drops until the RPV pressure becomes 150 psia. Then the turbine bypass flow is cut off and the depressurization rate of the RPV is reduced. At 1800 seconds after the scram, the manual depressurization of 100°F/hr. is initiated until the RPV pressure drops to 135 psia. This pressure is maintained until the switch over of the RHR system from pool cooling to shutdown cooling is accomplished. The RPV pressure continues to decrease until atmospheric pressure is reached.

4. A single SRV is modeled as open throughout the transient for Events 1 and 2. For Event 4, a single relief valve cycles throughout the transient.

   For Events 3, 5, and 6, nine SRV's open shortly after isolation and then reclose. These represent the two lowest setpoints (1103 and 1113 psi). Following reclosure, the low setpoint valve will cycle throughout the transient.

5. The RCIC is available in all Events but is not considered in the analysis. Use of the RCIC would reduce the thermal load on the suppression pool, dumping the energy to the condenser, thus producing a non-conservative evaluation of the suppression pool temperature.

6. In Events 1 through 4 the condensate storage system is available but is not considered in the analysis. Use of the condensate storage system would increase the thermal capacity of the suppression pool and thus produce non-bounding transients for the events under consideration.

7. The source of the decay heat curve used in the analyses is the CPS specific calculation performed by GE(22A3759AM, Rev. 3). This decay heat curve includes the effect of delayed neutrons and void collapse.

8. For Event 5 shutdown cooling is considered.

9. In Events 4 and 5 manual depressurization is considered.

Action Plan 31

11.0 Mark III load definitions are based upon the levels in the suppression pool and the drywell weir annulus being the same. The CPS technical specifications permit elevation differences between these pools. This may effect load definition for vent clearing.

Response

The following program was used to resolve this issue:

13.1 The maximum possible differences between weir annulus level and suppression pool level will be defined. This definition will include an evaluation of changing the vacuum breaker set point per Action Plan 29.

31.2 A discussion will be given of how pressure differences between the wetwell and the drywell will be controlled.

31.3 A discussion of how these pressure differences affect load definition will be provided.

Item 31.1

The maximum negative differential pressure which can exist between the drywell and containment is -0.20 psid which corresponds to the set point of the drywell vacuum breakers. This produces a maximum increase in weir annulus water level above suppression pool level or 5.54 inches. In actuality, it will not be possible to achieve any negative pressure in the drywell with respect to containment during normal plant operation.

The maximum positive differential pressure which can exist between the drywell and containment is 1.50 psid. This positive differential pressure produces a maximum increase in suppression pool level above weir annulus level of approximately 3.5 feet.

Item 32.2

The negative pressure condition in the drywell is controlled automatically by the vacuum relief valves (1HG010A D, 1HG011A D) in the Combustible Gas Control System. These valves automatically open at -0.20 psid to equalize the pressure between the drywell and the containment. The positive pressure condition in the drywell is controlled by the 24" drywell purge system valves (1VQ001A, 1VQ002) which are opened only when the operator must reduce the differential pressure under abnormal conditions.

Item 31.3

The differential pressure between the CPS drywell and containment air space is constrained within the normal range:

$$-0.10 \leq P_{DW-WW} \leq +1.50$$

with differential pressure in psid.

If the drywell pressure is greater than the containment airspace pressure the water level in the weir annulus will be depressed and consequently, the liquid inertia above the top vent will be reduced. This will cause the top vent to clear earlier following a postulated LOCA resulting in lower drywell pressure when the vents clear and a lower peak drywell pressure than has been calculated in the existing accident analysis. The lower driving pressures decrease the pool swell velocities, accelerations and loads.

If, on the other hand, the initial containment airspace pressure is greater than the initial drywell pressure, top vent clearing would be delayed which would increase the peak drywell pressure. An analysis was performed to determine the upper limit of this effect for the Clinton Power Station when the ΔP_{dw-ww} is -0.1 psid. This corresponds to the water in the weir annulus being elevated by almost 2.8 inches. The results of this analysis show this small change produces a negligible affect on the pool swell transient and drywell bypass leakage.

Action Plan 32

14.0 A failure in the check valve in the LPCI line to the reactor vessel could result in direct leakage from the pressure vessel to the containment atmosphere. This leakage might occur as the LPCI motor operated isolation valve is closing and the motor operated isolation valve in the containment spray line is opening. This could produce unanticipated increases in the containment pressure.

Response

The following program for resolution was used to close this issue out for Clinton:

32.1 The potential effect of maximum backflow which can occur will be estimated. This will include calculating maximum backflow which can occur, evaluating thermal interaction with the relatively cool RHR spray flow and estimating the limitations on flashing created by flow through the spray nozzles.

32.3 An evaluation of the possibility of adding interlocks to prevent simultaneous actuation of these valves will also be performed.

In response to 32.1, a schematic diagram depicting the arrangement of the LPCI system and the containment spray system is included as Figure 32-1. The diagram shows only one LPCI - spray system since the analysis considers only the single active component failure on one LPCI check valve following the postulated LOCA.

A bounding calculation was performed to evaluate the maximum containment airspace pressurization which could occur due to the postulated backflow. This calculation determined the maximum mass and energy addition to the airspace, then used a standard subroutine (THERMO) to determine the resultant containment pressure and temperature.*

---

* THERMO, a standard component of GE containment analysis computer codes, assumes thermodynamic equilibrium of all components (air, steam, liquid) in the airspace. Then, for a given airspace volume, air and water (steam and liquid) mass, and total internal energy, the airspace pressure and temperature are calculated.

System Performance

Key features of the system are:

1. The RHR pump shut-off head is 750 ft, which is approximately 325 psi.

2. Containment spray is actuated with a simultaneous signal to close the LPCI motor-operated valve and open the containment spray motor-operated valve.

3. Containment spray cannot be automatically actuated until 10 minutes after the LOCA. Automatic actuation then occurs only if the containment pressure is greater than or equal to 9 psig.

Valve closure and opening times, based on GGNS start-up data, are shown in Table 32.1. Conservatively assuming that the valve flow area equals the pipe flow area, and taking the maximum LPCI closing time and the minimum containment spray opening time, simplified valve flow area vs. time curves as shown in Figure 32-2 are assumed. These closure/opening times and valve flow area are conservative for CPS because the valves for Clinton are much smaller than GGNS meaning faster opening/closure times and lower flow areas.

Containment Response Calculation

The maximum mass and energy addition to the containment airspace due to reactor backflow is calculated by assuming critical flow at reactor pressure. Pipe flow areas of the LPCI/containment spray system vary from 0.56 - 19.7 $ft.^2$, so the critical flow limiting area will be at the LPCI or containment spray valves. Thus, the curve bounding the shaded triangle in Figure 32.2 represents the limiting flow area vs. time. An equivalent constant area over the "both-valves-open" window of 18.5 seconds (0.15 ft^2), was calculated to simplify the final calculation of containment pressurization.

Assumptions for analysis of net containment pressurization are:

1. Reactor pressure is 325 psia. (The failure of the check valve cannot occur until there has been LPCI flow to the vessel, opening the check valve, so the vessel pressure cannot be greater than 325 psia).

2. The containment air mass includes all of the air which was initially in the drywell.

3. Containment pressure = 9 psig at start of backflow.

Results and Conclusions

Results of this analysis are summarized in Table 32.2. The leakage from the reactor through the containment spray headers pressurized the containment 0.8 psi. Thus, this postulated reactor backflow pressure analysis is very conservative for CPS and does not represent a safety concern.

In answering 32.3, since the backflow increases the containment pressure by less than 1 psi, IP has determined that a detailed evaluation of providing interlocks to prevent this backflow is unwarranted.

Table 32.1

GGNS VALVE OPENING/CLOSURE TIMES

Valve	Opening (sec)	Closing (sec)
Containment Spray		
Valve #E12-F028A	65.0	N/A
Valve #E12-F028B	65.5	N/A
LPCI		
Valve #E12-F042A	N/A	18.5
Valve #E12-F042B	N/A	17.5

Table 32.2

CONTAINMENT PRESSURIZATION DUE TO REACTOR BACKFLOW THROUGH THE CONTAINMENT SPRAY SYSTEM

Containment pressure at start of backflow	9 psig
Pressurization due to reactor backflow	+0.8 psig
NET RESULTANT CONTAINMENT PRESSURE	9.8 psig

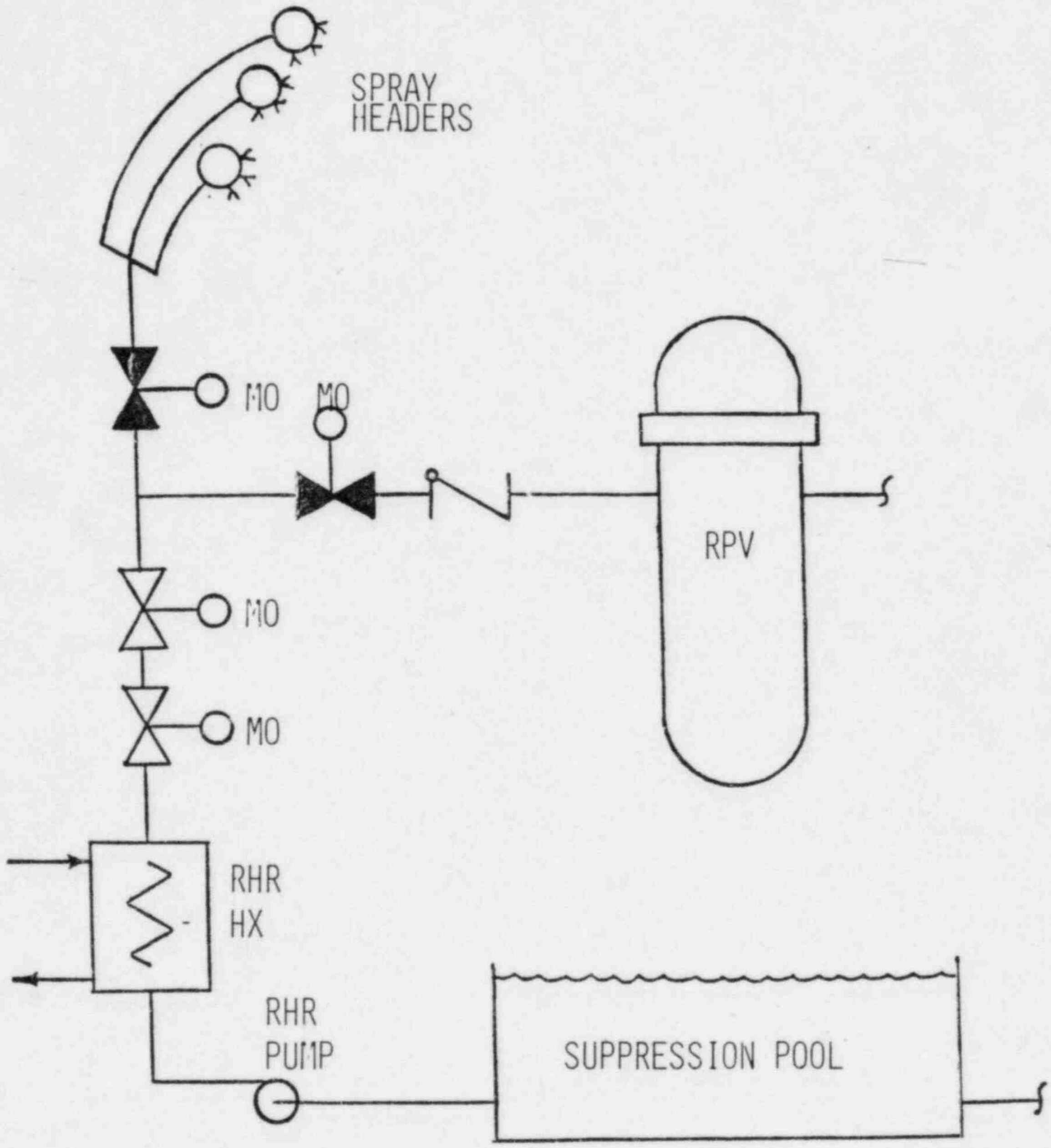

Figure 32-1 CPS Containment Spray and LPCI Piping Schematic

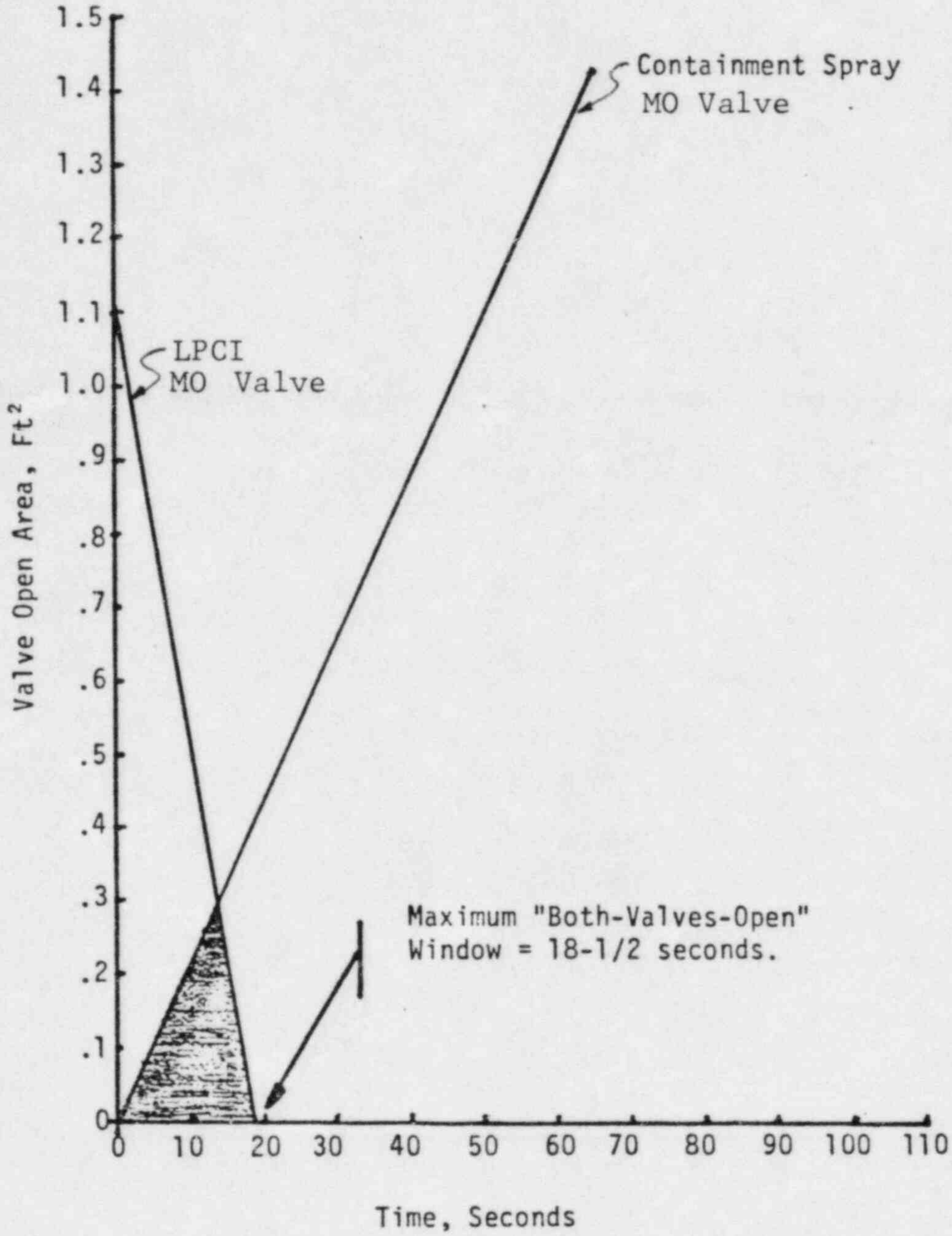

Figure 32.3. GGNS Valve Open Area vs. Time