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WCAP-13908

Analysis of Containment Response Following Steamline Break Accidents for Diablo Canyon Units 1 and 2

December 1993

WESTINGHOUSE CLASS 3

WCAP-13908

"ANALYSIS OF CONTAINMENT RESPONSE FOLLOWING MAIN STEAMLINE BREAK ACCIDENTS FOR DIABLO CANYON UNITS 1 AND 2"

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T. J. Murphy
J. S. Narula
L. C. Smith

December 1993

Approved by: J. A. Gresham, Manager
Containment and
Radiological Analyses

WESTINGHOUSE ELECTRIC CORPORATION
Nuclear Technology Division
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355

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EXECUTIVE SUMMARY

Containment Integrity Analyses have been performed as part of the Diablo Canyon Containment Margin Improvement Program. The objective of the program was to provide containment integrity analysis results using the current Diablo Canyon specific information and new more realistic models. In this way the licensing basis for Units 1 and 2 is clarified and updated, and pressure margin for operation of Units 1 and 2 has been determined and thus made available for possible future use.

The results of the analysis ensure that the pressure inside containment will remain below the containment building design pressure if a Main Steamline Break (MSLB) inside containment should occur during plant operation. The peak calculated pressure for the limiting MSLB is 42.25 psig. The design pressure is 47 psig. The peak calculated containment steam temperature is 326.0°F.

A composite temperature profile has been constructed from the results of this analysis. The profile was shown to be mostly bounded by previous analyses.

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1.0 INTRODUCTION

1.1 PURPOSE OF ANALYSIS

This report presents the Diablo Canyon Nuclear Power Plant Main Steamline Break (MSLB) containment integrity analyses, performed as part of a 1993 containment margin improvement program. This report details analyses performed to calculate containment pressures and temperatures following the rupture of a high-energy steamline inside containment. Using revised assumptions, discussed in this report, considerable reduction in calculated peak pressures has been obtained compared to the current licensing basis analysis. The overall objective of this analysis is to provide Pacific Gas and Electric with additional containment margin for operational flexibility.

This report provides the analytical basis with respect to the MSLB containment response for operation of the Diablo Canyon Nuclear Power Plant Units 1 and 2 at the described conditions.

The analyses presented address the consequences of the mass and energy that is released to containment as a result of a rupture of a high energy main steamline pipe. The mass and energy release data is subsequently used to verify, via calculations, that the containment design pressure is not exceeded in the event of a MSLB. The containment temperature response is also generated for equipment qualification.

1.2 INVESTIGATION OF INPUT ASSUMPTIONS

The purpose of the MSLB Containment Integrity analysis is to demonstrate the acceptability of the Containment Safeguards Systems to mitigate the consequences of a hypothetical rupture of a steamline pipe. The impact of steamline mass and energy releases on containment pressures is addressed to assure the containment pressure remains below its design pressure of 47 psig. Conservative assumptions are made during the overall process to ensure a bounding analysis.

The assumptions used in the 1989 BIT removal analysis (Reference 1) have been investigated to determine the parameters which would offer significant benefits. These include:

- Consistent off-site power assumption
- Core reactivity feedback coefficients
- Auxiliary feedwater as a function of steam generator pressure (rather than a constant bounding value)
- Containment spray flow as a function of containment backpressure
- Revised containment spray flows for short-term events
- More realistic feedwater isolation valve closure assumptions
- New steamline break protection model

1.2.1 Consistent Offsite Power Availability

One of the conservative assumptions that has been historically made is with respect to the availability of off-site power. Under current MSLB containment analysis methodology, the mass and energy releases have been generated assuming that off-site power was available for the duration of the transient. This maximizes primary-to-secondary heat transfer because of the forced reactor coolant flow from the Reactor Coolant Pumps (RCPs). The containment integrity calculations then assume that off-site power is not available, which extends the safeguards equipment startup delays due to diesel startup and load sequencing time. These two assumptions contradict each other, but result in an analysis which bounds both with and without off-site power considerations. To remove this unnecessary conservatism, the limiting cases were analyzed with a consistent off-site power availability assumption.

1.2.2 Core Reactivity Feedback Coefficients

The previous main steamline break analysis (Reference 1) used hot full power, all rods in, moderator

density coefficients (HFP ARI MDC) for the at power and part power cases. It is appropriate to assume the full power density coefficients prior to reactor trip. However, for this particular event in which the majority of the transient occurs after reactor trip, it is extremely conservative to assume HFP MDCs for the entire transient. Due to recent LOFTRAN code modifications, this analysis employs the capability of modelling separate MDCs before and after reactor trip. This creates the possibility of incorporating the more appropriate hot zero power stuck rod MDCs for the post-trip transient. This allows for an overall more realistic model.

1.2.3 Auxiliary Feedwater as a Function of Steam Generator Pressure

Previous analyses have assumed a large constant auxiliary feedwater flow rate to the faulted steam generator and minimal flow to the intact steam generators. These auxiliary feedwater flow rates do not consider the relatively high faulted steam generator pressures early in the transient which would reduce flow. This analysis employs a more realistic auxiliary feedwater model in which the flow rate is input as a function of the steam generator pressure. See Section 2.3.2 for a further discussion on the auxiliary feedwater flow.

1.2.4 Revised Containment Spray Flows

The containment spray flows in this analysis were calculated as a function of containment backpressure. Previous analyses assumed a constant spray flow at the containment design pressure. The revised assumption allows for significantly increased flow during portions of the transient where containment pressure is below design.

In addition, containment spray flows were increased for events requiring spray flow for approximately 600 seconds or less. Previous analyses used flowrates calculated assuming the refueling water storage

tank (RWST) to be completely drained. This analysis, however, accounted for additional spray flow by assuming the RWST level to be drained to a level representative of the MSLB transient having continued for 600 seconds past containment spray initiation. For transients requiring more than 600 seconds of containment spray, this assumption was not made.

1.2.5 Revised Feedwater Isolation Valve Closure Assumptions

Previous analyses for a steamline break have used an extremely conservative assumption regarding the behavior of the Feedwater Isolation Valve (FIV). Past analyses assumed the FIV instantaneously closes at 65 seconds. This methodology is very conservative since no credit was taken for the actual closure characteristics of the valve. The assumption used in this analysis was to assume a linear closure characteristic which still bounds the actual closure characteristic of the valve.

1.2.6 New Steamline Break Protection

The previous main steamline break analysis (Reference 1) was performed to bound both "old" and "new" steamline break protection system logic. Consistent with the planned Eagle 21 upgrade, this analysis was based on new steamline break protection. Sensitivities performed in support of the BIT elimination study demonstrated that this will provide a benefit. Note that a description of the differences between the two protection systems can also be found in Reference 1.

1.2.7 Containment Pressure High-High SA Reduction

Investigation of the Eagle 21 setpoint study (Reference 2) revealed that sufficient margin exists between the containment high-high safety analysis limit (SA) and the plant trip setpoint so that a 2 psi reduction in the SA could be implemented without having to revise the containment high-high Technical Specification setpoint. The reduced containment high-high SA allows for earlier steamline isolation and

actuation of the containment spray system, providing a benefit in both the resulting mass and energy releases and the containment response. An evaluation supporting the reduced SA can be found in Reference 3.

2.0 MASS AND ENERGY RELEASE ANALYSIS FOR POSTULATED SECONDARY SYSTEM RUPTURES INSIDE CONTAINMENT

2.1 METHOD OF ANALYSIS

The mass and energy releases following a steam line rupture are dependent upon the configuration of the plant steam system and containment design, as well as the plant operating conditions and size of the rupture. The cases examined in this study were chosen to determine a limiting case, in terms of containment temperature and pressure response, for Diablo Canyon Units 1 and 2.

The analysis of the main steam line break (MSLB) inside containment includes a calculation of the mass and energy release from the blowdown and the corresponding containment response. The containment response is discussed in Section 3.0.

The following items must be considered for a steam line rupture inside containment analysis:

- nuclear kinetics characteristics and power generation in the reactor core,
- stored energy in both the primary reactor system and the secondary steam plant,
- main and auxiliary feedwater systems operation,
- safety systems operation (e.g. Reactor trip, Steamline Isolation, ECCS),
- break size/location and
- blowdown characteristics.

The analyses described in this report utilize a steamline break mass and energy release methodology developed by Westinghouse which considers all of these factors, such that conservative yet realistic steamline break blowdown transients may be determined.

This methodology is based upon information presented in the following reports:

- WCAP-8822,"Mass and Energy Releases Following a Steam Line Rupture" (Reference 4),
- WCAP-7907-P-A,"LOFTRAN Code Description" (Reference 5).

WCAP-8822 forms the basis for assumptions and models used in the calculation of the mass and energy releases resulting from a steamline rupture. WCAP-8822 presents an extensive analysis of the nature of the effluent releases from Westinghouse supplied steam generators following a postulated main steamline rupture, as well as a discussion of the methods and models used.

Transient mass and energy releases following a postulated secondary side pipe break are calculated using the NRC-approved LOFTRAN code (Reference 5). LOFTRAN is used for studies of the transient response of a PWR system to specified perturbations in process parameters. The code simulates a multi-loop system including the reactor vessel, hot and cold leg piping, steam generator (shell and tube sides), and the pressurizer. A neutron point kinetics model is used and the reactivity effects of the moderator, fuel, boron, and rods are included. The secondary side of the steam generator is modeled as a homogeneous saturated mixture. Protection and control systems are simulated, as well as the Emergency Core Cooling System and cold leg accumulators. The calculation of secondary side break flow is based on the Moody critical flow correlation (Reference 6) with $fl/D = 0$.

2.2 DEFINITION OF CASES

The postulated break area can have competing effects on blowdown results. Larger break areas will be more likely to result in large amounts of water being entrained in the blowdown. However, larger breaks also result in earlier generation of protective trip signals following the break and a reduction of both the

power production by the plant and the amount of high energy fluid available to be released to the containment.

To determine the effects of plant power level and break area on the mass and energy releases from a ruptured steamline, spectrums of both variables have been evaluated. For plant power levels of 102%, 70%, 30% and 0% of nominal full load power, five break sizes have been defined. These break areas (consistent with Reference 4) are defined as:

1. A full double-ended rupture (DER) at the outlet of one steam generator nozzle. Note that a DER is defined as a rupture in which the steam pipe is completely severed and the ends of the break displace from each other.
2. A full DER downstream of the flow restrictor in one steam line.
3. A small DER at the steam generator nozzle having an area just larger than that at which water entrainment occurs.
4. A small DER at the steam generator nozzle having an area just smaller than that at which water entrainment occurs.
5. A small split rupture that will neither generate a steamline isolation signal from the Westinghouse Solid State Protection System nor result in water entrainment in the break effluent.

Using the results of the previous Diablo Canyon main steamline break analysis (Reference 1) as a basis, the limiting cases for each break scenario were selected and analyzed to obtain a conservative determination of the peak containment pressures and temperatures following a main steamline break. Note that it was not necessary to analyze the cases assuming a full DER downstream of the flow restrictor because a full DER upstream of the flow restrictor and a small DER in which water entrainment occurs yield bounding results. The selected cases with effective forward flow break area are given in Table 2-1.

2.3 MASS AND ENERGY RELEASE CALCULATION ASSUMPTIONS

The key assumptions made in the calculation of mass and energy releases for input to the containment analysis are discussed in this section.

2.3.1 REACTOR COOLANT SYSTEM

Table 2-2 identifies the nominal plant design parameters considered in this analysis.

Initial Power Level

Steamline breaks can be postulated to occur with the plant in any operating condition ranging from zero to full power. Since steam generator mass decreases with increasing power level, breaks occurring at lower power levels will generally result in a greater total mass release to containment. However, because of increased stored energy in the primary plant, increased heat transfer in the steam generator, and additional energy generation in the fuel, the energy release to the containment from breaks postulated to occur during "at power" operation may be greater than for breaks occurring with the plant at a zero power condition. Additionally, steam pressure and the dynamic conditions in the steam generators change with increasing power and have a significant influence on both the rate of blowdown and the amount of moisture entrained in the fluid leaving the break.

Because of the opposing effects (mass versus energy release) of changing power level on steamline break releases, no single power level can be singled out as a worst case initial condition for a steamline break event. Therefore, several different power levels spanning from full to zero power conditions were investigated.

In general, the plant initial conditions for each case are assumed to be at the nominal value, with

appropriate uncertainties included. Table 2-3 identifies the values assumed for RCS pressure, RCS vessel average temperature, pressurizer water volume, steam generator water level, and feedwater enthalpy corresponding to each power level analyzed.

Core Decay Heat

Core residual heat generation assumed is based on the 1979 ANS Decay Heat + 2σ model (Reference 7).

Reactor Coolant Metal Heat Capacity

As the primary plant cools, the temperature of the primary coolant drops below the temperature of the reactor coolant piping, the reactor vessel, and the reactor coolant pumps. As this occurs, the heat stored in the metal is available to be transferred to the steam generator with the broken line. Stored metal heat does not have a major impact on the calculated mass and energy releases. The effects of this RCS metal heat are included in the results using conservative thick metal masses and heat transfer coefficients.

Core Reactivity Coefficients

Conservative core reactivity coefficients corresponding to end-of-cycle conditions were chosen to maximize the reactivity feedback effects resulting from the steamline break. Use of maximum reactivity feedback results in higher power generation if the reactor is critical, thus maximizing heat transfer to the steam generator secondary. The most reactive control rod assembly is assumed to be stuck out of the core. As mentioned in section 1.2.2, a more appropriate assumption was employed in this analysis compared to the current licensing basis analysis regarding the moderator density coefficients. For the post-reactor trip transient, a HZP stuck rod moderator density coefficient was used.

Rod Control

The rod control system was assumed to be in manual operation for all analyses.

2.3.2 SECONDARY SYSTEM

Main Feedwater System

The rapid depressurization which occurs following a steamline rupture typically results in large amounts of water being added to the steam generators through the main feedwater system. Rapid closing feedwater control valves in the main feedwater lines limit this effect. The feedwater addition which occurs prior to closing of the feedwater line control valves influences the steam generator blowdown in several ways. First, the rapid addition increases the amount of entrained water in large break cases by lowering the bulk quality of the steam exiting the rupture. Secondly, because the water entering the steam generator is subcooled, it lowers the steam pressure thereby reducing the flow rate out of the break. As the steam generator pressure decreases some of the fluid in the feedwater lines downstream of the control valves will flash into the steam generators providing additional secondary fluid which may exit out the rupture. Finally, the increased flow causes an increase in the heat transfer rate from the primary to secondary system resulting in greater energy being released out the break. Since these are competing effects on the total mass and energy release, no "worst case" feedwater transient can be defined for all plant conditions.

In the analyses, the worst effects of each variable have been assumed. For example, moisture entrainment for each break is calculated assuming conservatively small feedwater additions such that the entrained water is minimized. Determination of total steam generator inventory however is based on conservatively large feedwater additions as described below.

Main feedwater flow was conservatively modeled by assuming an increase in feedwater flow in response to increases in steam flow following initiation of the steamline break. This maximizes the total mass addition prior to feedwater isolation. For the split breaks and small double-ended rupture cases, feedwater flow was increased proportionally with the steam releases from the steam generators.

For the large double-ended rupture cases, the initial feedwater flow was assumed to be the nominal flow for the power level considered. In response to the rapid depressurization of the steam generator, a sharp increase in the feedwater flow was assumed until trip of the main feedwater pumps (at approximately 2 seconds). The flow was then decreased linearly to coincide with the feedwater pump coastdown. The cases that assumed failure of the feedwater control valve (7 second closure valve) took credit for the feedwater flow delivered from the condensate pumps, that was limited by closure of the feedwater isolation valve (60 second closure valve). The previous analysis assumed that the feedwater isolation valve remained full open for 60 seconds after the isolation signal was received. In reality, this valve begins closing immediately and the flow resistance in the line gradually increases over the 60 second time period. This analysis took credit for the valve behavior by assuming a linear closing characteristic that conservatively bounds the actual closure characteristic of the valve.

Following feedwater isolation, as the steam generator pressure decreases, some of the fluid in the feedwater lines downstream of the isolation valve may flash to steam if the feedwater temperature exceeds the saturation pressure. This unisolatable feedwater line volume is an additional source of high energy fluid that was assumed to be discharged out of the break.

Auxiliary Feedwater System

Generally, within the first minute following a steamline break, the auxiliary feedwater system will be

initiated on any one of several protection system signals. Addition of auxiliary feedwater to the steam generators will increase the secondary mass available for release to containment as well as increase the heat transferred to the secondary fluid. As mentioned previously, this analysis assumes auxiliary feedwater flow as a function of steam generator pressure. The flow rates were developed by PG&E with the following conservative assumptions. Two sets of data were assumed in the analyses. The first set assumed that all four steam generators were depressurizing equally prior to steamline isolation. The second set assumed that the faulted steam generator continued to depressurize and the intact steam generators were at the shell design pressure plus 3% uncertainty (1118 psig, see Reference 9) with the flow rates modeled as a function of the faulted steam generator pressure. These flow rates were used after steamline isolation. To maximize the flow to the faulted steam generator, no credit is taken for the auxiliary feedwater runout protection system. This maximizes the steam generator inventory which is available to be released to containment.

The auxiliary feedwater flow rates were developed with the following conservatisms incorporated. The flow rates to the faulted loop were assumed to be conservatively high, maximizing the available mass for release to containment, and the flow rates to the intact loops were assumed to be conservatively low, minimizing the available mass for secondary side heat removal. Operator action is credited to terminate the auxiliary feedwater flow after 10 minutes. Justification for the 10 minute operator action time was provided to the NRC via Reference 8.

Steam Generator Fluid Mass

Maximum initial steam generator masses were used in all of the cases analyzed. The use of high initial steam generator masses maximizes the steam generator inventory available for release to containment. The initial masses were calculated as the mass corresponding to the programmed level +5% narrow range

level. Note that the initial SG mass assumptions from the input data of Reference 9 show a programmed level of plus 5% narrow range level for the faulted steam generator and a minus 5% narrow range level for the intact steam generators. Employing this assumption would have an insignificant effect on the mass and energy releases generated. Therefore, the initial steam generator masses used in this analysis correspond to plus 5% narrow range level, consistent with the assumptions of WCAP 8822 (Reference 4).

Steam Generator Reverse Heat Transfer

Once the steamline isolation is complete, those steam generators in the intact steam loops become sources of energy which can be transferred to the steam generator with the broken line. This energy transfer occurs via the primary coolant. As the primary plant cools, the temperature of the coolant flowing in the steam generator tubes drops below the temperature of the secondary fluid in the intact steam generators resulting in energy being returned to the primary coolant. This energy is then available to be transferred to the steam generator with the broken steam line. The effects of reverse steam generator heat transfer are included in the results.

Break Flow Model

Piping discharge resistances were not included in the calculation of the releases resulting from the steamline ruptures (Moody Curve, Reference 6, for an fl/D = 0 was used).

Steam Line Volume Blowdown

The contribution to the mass and energy releases from the secondary plant steam piping was included in the mass and energy release calculations. For all ruptures, the steam piping volume blowdown begins at the time of the break and linearly decreases until the entire piping inventory is released. The flowrate was determined using the Moody correlation, the pipe cross-sectional area, and the initial steam pressure.

Following the piping blowdown, reverse flow from the intact steam generators continues to simulate the reverse steam flow prior to steamline isolation.

In the small DER and split break cases, the steam remaining in the unisolated portion of the steamlines subsequent to steamline isolation is added to the initial faulted steam generator inventory and has the effect of increasing the steam generator dryout time.

For large DER cases, the unisolatable steamline mass is included in the mass exiting the break from the time of steamline isolation (or closure of the check valves) until the unisolatable mass is completely released to containment.

2.3.3 PROTECTION SYSTEM

The protection systems available to mitigate the effects of a MSLB accident inside containment are listed below along with the corresponding actuation signals modeled. The setpoints and delay times modeled in this analysis are provided in Table 2-4.

Reactor Trip

The following reactor trip signals were modeled in the analysis:

- Low pressurizer pressure
- Low steamline pressure
- Overpower ΔT
- High Containment Pressure

Emergency Core Cooling

The following ECCS signals were modeled in the analysis:

- 2/4 Low pressurizer pressure signals
- 2/3 Low steamline pressure signals
- 2/3 High containment pressure signals

Steamline Isolation

Main steam isolation valve actuation was modeled following receipt of any of the following:

- 2/3 Low steamline pressure signal
- 2/4 High-high containment pressure

Feedwater Isolation

Feedwater system isolation was modeled to occur on any ECCS signal.

Containment Fan Coolers

Containment fan coolers actuated upon receipt of a containment high pressure signal.

Containment Spray

Containment spray was modeled following receipt of a high-high containment pressure signal.

2.3.4 EMERGENCY CORE COOLING SYSTEM

ECCS Flowrate

Minimum emergency core cooling system (ECCS) flow rates corresponding to the failure of one ECCS train were assumed in this analysis. A minimum ECCS flow is conservative since the reduced boron

addition maximizes a return to power resulting from the RCS cooldown. The higher power generation increases heat transfer to the secondary side, maximizing steam flow out of the break. The delay time to achieve full ECCS flow was assumed to be 25 seconds for cases with offsite power available and 38 seconds for cases without offsite power available.

2.3.5 SAFETY SYSTEM FAILURE CONSIDERATIONS

To avoid unnecessary conservatism, multiple failure assumptions were not made in the analysis. Each case analyzed considers only one single failure. The following single failures are postulated which may significantly affect the containment results. Note that only cases determined to be the limiting failure scenarios from the previous main steamline break analysis (Reference 1) were explicitly addressed in this study.

Failure of Feedwater Control Valve (FCV) in Faulted Loop

If the main FCV in the feedwater line to the faulted steam generator is assumed to fail in the open position, main feedwater would continue from the condensate pumps until isolation is provided via the backup feedwater isolation valve (60-second closure time). Also, the unisolatable feedwater line volume will increase by the volume of the feedwater line between the isolation valve and the feedwater control valve. This additional inventory would then be available to be released to containment. Note that credit was taken in this analysis for the feedwater isolation valve closure characteristics (see Section 1.2.5 and the discussion on the Main Feedwater System in Section 2.3.2).

Failure of the Auxiliary Feedwater Runout Protection System

Failure of the auxiliary runout protection system results in an increased auxiliary feedwater flow rate to the faulted steam generator. The increased auxiliary feedwater flow rate provides additional steam

generator inventory which is available to be released to containment. It also helps to maintain a higher pressure in the faulted steam generator. The pressure difference between the faulted generator and the containment is the driving force for the mass and energy releases. Note that the previous MSLB analysis (Reference 1) demonstrated that the FCV failure cases bound the cases assuming failure of the AFW runout protection system. Therefore, it was not necessary to analyze this failure as part of this study.

Failure of Faulted Loop Main Steamline Isolation Valve (MSIV)

Failure of the faulted loop MSIV delays isolation of the intact loops and results in larger unisolatable steamline volume. Prior to steamline isolation, all loops are feeding the break. Steamline isolation bottles up the intact steam generators and the faulted steam generator continues to blow down. After isolation, reverse flow continues until the unisolatable volume is depleted. Note that Diablo Canyon has main steamline check valves (MSCVs) which would prevent reverse flow in the steamlines. However, these valves are non-safety grade and are not credited in the analysis.

Loss of One Containment Safeguards Train

The limiting single failure assumed from a containment response perspective is typically a diesel failure. A diesel failure can result in a loss of a containment spray pump and one or more fan coolers, reducing the heat removal from the containment. The limiting containment failure is accounted for in the containment response analysis for these cases. No specific failures are modeled in the mass and energy release calculations.

2.3.6 RESULTS

Table 2-5 provides a summary of the mass/energy cases analyzed for use in the MSLB containment

analysis. For each case the initial NSSS power level, break size, mass/energy single failure assumed (if any), entrainment and offsite power assumptions are identified. The time of reactor trip (along with the actuation signal), feedwater isolation and steamline isolation are provided for each case. Note that for cases that credit High Containment Pressure (Hi) or High-High Containment Pressure (Hi-Hi) the actuation times were determined iteratively from preliminary LOFTRAN and COCO analyses and confirmed in the final analysis.

Note that the maximum return to power observed in the cases analyzed is bounded by that obtained from the previous analysis (Reference 1).

A table of mass and energy release rates for the limiting pressure case (Case 10A) is provided in Appendix A, along with a table of the steam generator pressure versus time for the faulted and intact loops. Time history plots of the containment pressure and temperature response are provided in Section 3.0.

TABLE 2-1
MAIN STEAMLINE BREAK CASES

Case #	Power (%)	Break Type	Break Size (ft^2)	Entrainment	Failure	Offsite Power
1A	102	SMALL DER	0.6	NO	MSIV	YES
2A	70	SMALL DER	0.5	NO	MSIV	"
3A	30	SMALL DER	0.4	NO	MSIV	"
4A	102	SMALL DER	0.7	YES	MSIV	"
5A	70	SMALL DER	0.6	YES	MSIV	"
6A	30	SMALL DER	0.5	YES	MSIV	"
7A*	102	SMALL DER	0.7	YES	MSIV	"
8A	102	SPLIT BREAK	0.86	NO	MSIV	"
9A	70	SPLIT BREAK	0.908	NO	MSIV	"
10A	30	SPLIT BREAK	0.944	NO	MSIV	"
10B	30	SPLIT BREAK	0.944	NO	MSIV	NO
11A	0	SPLIT BREAK	0.40	NO	MSIV	YES
12A	102	LARGE DER	3.69	YES	FCV	"
13A	70	LARGE DER	3.69	YES	FCV	"
14A	30	LARGE DER	3.69	YES	FCV	"
15A	0	LARGE DER	3.69	YES	FCV	"
16A	70	SMALL DER	0.5	NO	CST	"

MSIV - Main Steam Isolation Valve Failure
FCV - Feedwater Control Valve Failure
CST - Containment Safeguards Train Failure

* - Case 7A is the same as Case 4A with the Low Steamline Pressure setpoint lowered to 15 psia. This case was investigated in the previous analysis (Reference 1) to determine if protection relied on the Low Steamline Pressure setpoint of 459 psia. It is included in this study for additional information only.

TABLE 2-2
FULL POWER REACTOR COOLANT
SYSTEM NOMINAL PARAMETERS[1]

NSSS Power, Mwt	3423
Core Power, Mwt	3411
Reactor Coolant Pump Heat, Mwt	12
Reactor Coolant Flow, Total, gpm	354000
Pressurizer Pressure, psia	2250
Reactor Coolant Temperature, °F	
Core Outlet	614.8
Vessel Outlet	610.1
Core Average	581.8
Vessel Average	577.6
Vessel/Core Inlet	545.1
Steam Generator	
Steam Temperature, °F	525
Steam Pressure, psia	844

[1] Nominal parameters for the partial power cases are adjusted accordingly.

TABLE 2-3
LOFTRAN INITIAL CONDITION ASSUMPTIONS

	POWER LEVEL (%)			
PARAMETER	102	70	30	0
RCS Average Temp. (°F)	584.8	575.6	563.4	547.0
RCS Flowrate (gpm)	354000	354000	354000	354000
RCS Pressure (psia)	2250	2250	2250	2250
Pressurizer Water Volume (ft^3)	1090.71	891.25	641.94	454.95
Feedwater Enthalpy (Btu/lbm)	419.5	375.0	310.0	70.9
SG Water Level (% Span)	49	49	49	49

TABLE 2-4
SAFETY SYSTEM ASSUMPTIONS

PARAMETER	VALUE
Trip Setpoints	
Low Pressurizer Pressure Reactor Trip (psia)	1784
Low Pressurizer Pressure ECCS injection (psia)	1695
Low Steamline Pressure (psia)	459
Overpower ΔT	1.1453
High Containment Pressure (psig)	5.0
Other Actuation Signals	
High-High Containment Pressure (psig)	24.7
Time Constants	
Steamline Pressure Lead Time Constant (sec)	50.0
Steamline Pressure Lag Time Constant (sec)	5.0
Time Delays (sec)	
Low Pressurizer Pressure Reactor Trip Delay	2.0
Low Steamline Pressure Reactor Trip Delay	2.0
Overpower ΔT Reactor Trip Delay	7.0
High Containment Pressure Reactor Trip Delay	2.0
Steamline Isolation Valve Closure	10.0
Feedwater Isolation Delay	9.0
- with FCV Failure	64.0
ECCS Reactor Trip Delay	2.0
ECCS Start Up Time	
- with offsite power	25.0
- without offsite power	38.0
Auxiliary Feedwater Delay	0.0

TABLE 2-5
MSLB CASE SUMMARY

Case #	Power (%)	Break Size (ft^2)	Failure	Entrain-ment	Offsite Power	Reactor Trip (@ sec)	FWI Signal (@ sec)	SLI Signal (@ sec)
1A	102	0.6 (DER)	MSIV	NO	YES	LSP (2.09)	LSP (11.09)	LSP (12.09)
2A	70	0.5 (DER)	MSIV	NO	YES	LSP (3.336)	LSP (12.336)	LSP (13.336)
3A	30	0.4 (DER)	MSIV	NO	YES	Hi (10.28)	Hi (19.28)	Hi-Hi (93.40)
4A	102	0.7 (DER)	MSIV	YES	YES	LSP (1.67)	LSP (10.67)	LSP (11.67)
5A	70	0.6 (DER)	MSIV	YES	YES	LSP (2.36)	LSP (11.36)	LSP (12.36)
6A	30	0.5 (DER)	MSIV	YES	YES	LSP (5.72)	LSP (14.72)	LSP (15.72)
7A *	102	0.7 (DER)	MSIV	YES	YES	Hi (6.58)	Hi (15.58)	Hi-Hi (62.0)
8A	102	0.86 (SPLIT)	MSIV	NO	YES	Hi (11.10)	Hi (20.10)	Hi-Hi (83.0)
9A	70	0.908 (SPLIT)	MSIV	NO	YES	Hi (9.88)	Hi (18.88)	Hi-Hi (80.0)
10A	30	0.944 (SPLIT)	MSIV	NO	YES	Hi (8.51)	Hi (17.51)	Hi-Hi (79.4)
10B	30	0.944 (SPLIT)	MSIV	NO	NO	Hi (8.51)	Hi (17.51)	LSP (64.49)
11A	0	0.40 (SPLIT)	MSIV	NO	YES	Manual (0.0)	Hi (28.42)	LSP (240.79)
12A	102	3.69 (DER)	FCV	YES	YES	LSP (0.29)	LSP (64.29)	LSP (10.29)
13A	70	3.69 (DER)	FCV	YES	YES	LSP (0.30)	LSP (64.30)	LSP (10.30)
14A	30	3.69 (DER)	FCV	YES	YES	LSP (0.32)	LSP (64.32)	LSP (10.32)
15A	0	3.69 (DER)	FCV	YES	YES	Manual (0.0)	LSP (64.32)	LSP (10.32)
16A	70	0.5 (DER)	CST	NO	YES	Hi (17.50)	Hi (26.50)	LSP (43.99)

DER - Double-ended rupture
MSIV - Main Steam Isolation Valve Failure
FCV - Feedwater Control Valve Failure
CST - Containment Safeguards Train Failure
LSP - Low Steamline Pressure Setpoint
Hi - Containment High Setpoint
Hi-Hi - Containment High-High Setpoint

* - As discussed for Table 2-1, this case assumes a low steamline pressure setpoint of 15psia and is presented as additional information only.

3.0 CONTAINMENT INTEGRITY ANALYSIS

3.1 Description of COCO Code

The COCO computer code (reference 10) is used to analyze the containment pressure and temperature transient response following a main steamline break accident. COCO is a mathematical model of a generalized containment; the proper selection of various options in the code allows the creation of a specific model for the particular containment design. The values used in the specific model for the different aspects of the containment are derived from plant specific data.

The COCO computer code consists of time-dependent conservation equations of mass and energy, together with steam tables, equations of state and other auxiliary relationships. Transient conditions are determined for both the containment steam-air mixture and the sump water. The energy equation is applied to the containment shell to obtain transient temperature gradients as well as heat stored in and conducted through the structure. Heat removal by means of energy storage in equipment within the containment, internal sprays, emergency containment coolers, and sump water recirculation cooling system is considered.

The containment air-steam-water mixture is separated into two distinct systems. The first system consists of the air-steam phase, while the second system is the water phase in the containment sump. This division permits more accurate representation of the distinct physical phenomena occurring in each system.

The steam-air mixture and water phase are assumed to have uniform properties. In addition, temperature equilibrium between the air and steam is assumed. However, this does not imply continual thermal equilibrium between the steam-air mixture and water phase. Sufficient relationships to solve the problem

independent of this restriction are provided by the equations of conservation of mass and energy as applied to each system, together with appropriate equations of state and heat transfer boundary conditions.

Air inside the containment is treated as an ideal gas. Thermodynamic properties of water and steam are derived from compressed water and steam tables.

Heat transfer through, and heat storage in, interior and exterior walls of the containment structure are considered. Structural heat sinks, consisting of steel and concrete, are modeled as slabs having specific areas and layers of varying thicknesses. The thermal conductivity, density and specific heat of each layer are specified at an initial temperature.

Discharge mass and energy flow rates through the rupture are established by separate analyses of the steam generator transient (see Section 2.0). This information is supplied as time-dependent data to the code.

The COCO code has been benchmarked against the CVTR tests. (Reference 11) The CVTR tests were super-heated steam blowdown tests. The containment free volume is about one-eighth of a typical three loop PWR containment. The blowdown steam enthalpy was 1195 BTU/lbm, which is about the same as that for a postulated steam line break with no moisture carry-over.

Diablo Canyon specific models were developed for use with the COCO code. Inputs restricted by Technical Specifications were based on the limiting condition allowed, or, in some cases, on a more limiting condition as requested by Pacific Gas and Electric. The analysis utilized plant specific Diablo Canyon mass and energy release data as input, as discussed in section 2.0. Input assumptions for the

COCO model are summarized in Table 3-1.

The COCO containment response model also included a model of the Diablo Canyon CFCU, CCW, and ASW heat removal systems, enabling the code to calculate the transient temperature response of the CCW system for a given M&E release. Integrating the CCW/ASW system directly into the containment response model allowed the analysis to directly account for thermal feedback effects and to more accurately model the transient containment heat removal of the CFCUs.

3.2 Containment Fan Cooler Units

Containment fan coolers are required to cool the containment atmosphere in the event of an accident resulting in high containment pressures. Each Diablo Canyon CFCU contains 2 banks of continuous water tube cooling coils, arranged in series. The heat removal performance characteristics were determined using the Westinghouse computer code, HECO.

PG&E has implemented a CCW flow balance for Diablo Canyon Units 1 and 2. The flow balance insures CCW flow to the Containment Fan Cooler Units (CFCUs) cooling coils between 2000 and 2500 gpm when two or three CCW pumps are running and header C is isolated. When only two CCW pumps run and header C is not isolated (as might occur with a bus H failure), CCW to CFCU cooling coil flow might be as low as 1600 gpm. Therefore, to assure a bounding analysis, the CCW to CFCU cooling coil flow was assumed to be 1600 gpm for the entire analysis.

Diablo Canyon has five fan cooling units in each containment. However, the containment analysis assumed two fan coolers out of service. Thus, for secondary side failure cases, three fan coolers were assumed to be available during the accident. For cases involving the failure of the solid state protection

system (SSPS) only two fan coolers were assumed to be available.

3.3 Containment Spray

The containment spray (CS) system flow rate is modeled as a function of the containment pressure. Two containment spray pumps were assumed to operate for cases with no failures in the containment safeguards systems. For failures involving the solid state protection system, only the spray pump producing the smallest flowrate was assumed to operate.

3.4 Structural Heat Sinks

The net free volume in the analysis is 2.55 million cubic feet. The structural heat sink parameters modeled in the analysis are summarized in Table 3-2.

3.5 CCW System

The function of the component cooling water system is to provide cooling to safety related equipment. The CCW system is cooled by the auxiliary salt water (ASW) system. The CCW heat exchanger UA used in this analysis is based on heat transfer coefficients presented in Reference 12. Conservative values for tube and shell water temperature were assumed. A CCW heat exchanger fouling factor of 0.0005 for the shell and tube was used in this analysis. This value is consistent with past analyses (reference 12). The model of the CCW system in COCO is a simplified representation of the CCW system. The model explicitly calculates the heat load imposed on the system by the CFCUs. The flow rates and heat loads associated with the balance of plant components are lumped together in the model. In each case only a single CCW heat exchanger and a single ASW pump is assumed.

3.6 Containment Safeguards Actuation

The CFCUs are actuated on the high containment pressure signal. A setpoint of 5 psig for this signal

was assumed, consistent with the signal used at Diablo Canyon. The technical specifications require a high setpoint of less than or equal to 3.0 psig. The additional margin is used to account for instrument uncertainty and to add additional conservatism. The initiation of the fan coolers have included a 38 or 48 second delay, for cases with and without off-site power, respectively. This delay accounts for sequencer logic and the time required for the fans to come up to full speed. Sensitivities were performed with respect to fan cooler delay. These are discussed in Section 3-10.

The containment spray is actuated on the high-high containment pressure signal. A setpoint of 24.7 psig was used for this analysis. The technical specifications require a high-high setpoint of less than or equal to 22.0. As with the high setpoint, the additional margin has been added to account for instrument uncertainty and to add additional conservatism into the results. The initiation of containment spray has been delayed 74.5 or 80 seconds, for cases with and without off-site power, respectively. This delay accounts for sequencer logic and the time required for the pumps to deliver full flow.

3.7 Initial Conditions

At the initiation of the accident, the containment is assumed to be at a temperature of 120°F and a pressure of 1.3 psig with a relative humidity of 18%. Sensitivities were performed on containment humidity, and are discussed in section 3-10. The temperature of the RWST, and consequently the containment spray and SI water, has been assumed to be 100°F in the containment studies.

3.8 Availability of Offsite Power

All cases, except 10A and 10B, were run with the assumption of no offsite power available. While this contradicts the assumption made in the generation of the mass and energy releases, the assumption enables an analysis which bounds both the offsite power available and unavailable cases. Cases 10A and 10B,

however, were analyzed with assumptions consistent with the generation of the mass and energy releases. Thus, case 10A was run with the assumption of offsite power, while case 10B was run without this assumption.

3.9 Containment Pressure Calculation

The mass and energy analysis described in Section 2.0 and the containment model described in this section were used to calculate the containment response to a range of MSLB accident events. Table 3-3 summarizes the results obtained. Figures 3-1 through 3-34 present the pressure and temperature transients for each case. Figure 3-35 presents a composite temperature plot for use with equipment qualification. The composite temperature plot represents a bounding temperature transient for all MSLB accident events. Digitized data of the composite temperature transient is presented in Table 3-4.

For each transient, containment pressures rise as significant amounts of mass and energy is released from the faulted steam generator. The initial slope of the pressure transient is approximately correlated with the time of steamline isolation. Cases involving longer steamline isolation times (Table 2-5) show a rapid pressure increase followed by a dip in containment pressure due to containment spray actuation. Generally, the pressure transients will show either a dip or a change in slope due to the actuation of containment sprays. Containment fan cooler and spray actuation times are presented in Table 3-5. The containment pressures may continue to increase following containment spray initiation as mass and energy continues to be released from the faulted steam generator. This will continue until the steam generator begins to dry out. As the steam generator dries out, the magnitude of the mass and energy releases and resulting containment pressures is reduced.

An overall MSLB peak pressure of 42.25 psig was found for case 10A. Figures 3-10 and 3-27 show pressure and temperature plots of this case. Table 3-6 shows the sequence of events for case 10A. The

peak MSLB temperature was found to be 326.0°F in case 9A. The pressure and temperature plots for this case are shown in Figures 3-9 and 3-26. Note that case 7A produced a peak temperature of 343.9°F. This case, however, represents the containment response to a scenario similar to case 4A, with a low steamline pressure setpoint of 15 psia. This has been included for information only.

3.10 Sensitivities

Containment Fan Cooler Delay Times

A sensitivity was performed on case 10A with respect to fan cooler delay times. This sensitivity was an increase in the fan cooler delay time from 38 to 58 seconds. This resulted in a peak pressure of 42.29 psi and a peak temperature of 331.39°F. Thus, this increase of twenty seconds on the delay time increased the peak pressure by 0.04 psi and the peak temperature by 8.8°F. Pressure and temperature plots are shown in Figures 3-36 and 3-37, respectively.

Humidity

The containment analysis assumed a humidity of 18%. Three sensitivities were performed with respect to increasing humidity to 100%. These were for case 10A and case 9A. Case 10A showed a peak pressure of 41.29 psig and a peak temperature of 318.1°F Thus, both peak pressure and temperature decreased at the higher humidity for case 10A. One hundred percent humidity for case 9A resulted in a peak pressure of 39.25 and a peak temperature of 322°F. Here, both peak pressure and temperature decreased. Containment pressure and temperature plots for these two humidity sensitivities are shown in Figures 3-38 through 3-41.

Thus, it is shown that lower humidity is conservative for peak pressure. For temperature, the humidity sensitivities have not shown consistent results. However, the sensitivities have shown that the effect of humidity on temperature is less than the effect of the fan cooler delay time. All cases, except for case

10A, has used the longer delay time associated with the no offsite power assumption. This will result in higher temperatures. Sensitivities for case 10A has shown that lower humidity is conservative for temperature.

TABLE 3-1

CONTAINMENT ANALYSIS PARAMETERS

ASW temperature (°F)	64
Refueling water temperature (°F)	100
RWST minimum water deliverable volume (gal)	3.50×10^5
Initial containment temperature (°F)	120
Initial containment pressure (psia)	16.0
Initial relative humidity (%)	18
Net free volume (ft^3)	2.55×10^6
Fan Coolers	
Total	5
Analysis maximum	3
Analysis minimum	2
Setpoint (psig)	5.0
Delay time (sec)	
Without Offsite Power	48.0
With Offsite Power	38.0
Spray Pumps	
Total	2
Analysis maximum	2
Analysis minimum	1
Setpoint (psig)	24.7
Delay time (sec)	
Without Offsite Power	80.0
With Offsite Power	74.5

TABLE 3-2
DESIGN BASIS CONTAINMENT INTEGRITY HEAT SINK DATA

Item	Material	Weight (Kips)	Area (Ft^2)	Effective Thickness (Inches)
Annulus Steel-Structural Steel Grating	Carbon Carbon	953 78	41,269 21,900	0.565 0.088
Class I Platform-Structural Steel Grating	Carbon Carbon	87 28	9,634 7,700	0.22 0.088
Class II Platform-Steel & Grating	Carbon	89	21,307	0.102
Ventilation (HVAC) System	Carbon	53	18,424	0.071
Polar Crane & Dome Service Crane (including Mods, Hook, Block & Cable)	Carbon	685	23,682	0.708
Conduit and Trays	Carbon	155	30,000	0.127
Rupture Restraints	Carbon	316	10,004	0.773
Containment Liner Plate	Carbon	1386	90,560	0.375
Equipment Hatch & Personnel Locks	Carbon	91	1,391	1.596
NSSS Equipment Supports	Carbon	857	19,111	1.098
Embeds	Carbon	187	6,141	0.745
Containment Penetrations	Carbon	28	720	0.96
Fuel Transfer Canal (Stainless Steel)	Stainless	52	8,852	0.144
Other Misc. Stainless Steel Structures	·ainless	23	857	0.654
Reactor Missile Shield Structure	Carbon	33	1,248	0.642
Concrete Floors at 140'-0 & Below	Concrete	-	21,867	12"
Concrete Floors at 91'-0 (2'-0 thick)	Concrete	-	13,012	24"
Concrete Walls Below El. 140'-0	Concrete	-	43,803	12"
Concrete Walls Above El. 140'0	Concrete	-	14,295	12"
S/G Snubbers	Carbon	64.0	522	3.0
Large Bore Pipe Supports	Carbon	488.4	15,947	0.75
Fan Coolers, 120°F Initial Temperature	Carbon	-	7,750	1.68
Accumulators, 120°F Initial Temperature	Carbon	-	3,650	1.92
RCP Motors, 200°F Initial Temperature(b)	Carbon	-	1,610	6.99

(a) Density of carbon and stainless steel is 490 lb/ft^3

(b) Reactor coolant pump motor temperature determined from average °F static temperature was determined from RTD readings.

Table 3-3
MSLB CASE SUMMARY

Case #	Power (%)	Break Size (ft^2)	Failure	Entrain-ment	Offsite Power	Peak Press. (psia)	Peak Temp. (°F)
1A	102	0.6 (DER)	MSIV	NO	YES	31.83	282.6
2A	70	0.5 (DER)	MSIV	NO	YES	31.96	271.5
3A	30	0.4 (DER)	MSIV	NO	YES	32.62	316.6
4A	102	0.7 (DER)	MSIV	YES	YES	32.16	281.84
5A	70	0.6 (DER)	MSIV	YES	YES	32.99	259.2
6A	30	0.5 (DER)	MSIV	YES	YES	33.16	247.7
7A *	102	0.7 (DER)	MSIV	YES	YES	39.31	343.9
8A	102	0.86 (SPLIT)	MSIV	NO	YES	38.91	325.0
9A	70	0.908 (SPLIT)	MSIV	NO	YES	40.23	326.0
10A	30	0.944 (SPLIT)	MSIV	NO	YES	42.25	322.6
10B	30	0.944 (SPLIT)	MSIV	NO	NO	27.58	321.9
11A	0	0.40 (SPLIT)	MSIV	NO	YES	31.42	266.9
12A	102	3.69 (DER)	FCV	YES	YES	38.26	256.8
13A	70	3.69 (DER)	FCV	YES	YES	41.23	261.5
14A	30	3.69 (DER)	FCV	YES	YES	41.00	261.1
15A	0	3.69 (DER)	FCV	YES	YES	39.56	258.9
16A	70	0.5 (DER)	CST	NO	YES	32.88	273.8

* - As discussed for Table 2-1, this case assumes a low steamline pressure setpoint of 15psia and is presented as additional information only.

Table 3-4
Composite Containment Temperature vs. Time

Time		Temp
0	ALL	120
0.5	CASE 14A	141.0717
1	CASE 15A	151.1832
9	CASE 4A	200.2558
17	CASE 1A	224.7275
25	CASE 10A	250.7597
33	"	273.6484
41	"	291.4664
49	CASE 10B	304.897
57	"	315.416
65	"	319.755
73	CASE 9A	322.776
81	"	325.1748
89	"	325.9918
97	"	325.0241
105	"	323.0871
113	CASE 8A	320.7998
121	"	318.1961
141	"	311.044
161	"	294.8207
181	CASE 16A	272.1716
281	"	261.0059
381	CASE 8A	252.7604
481	CASE 9A	258.2929
581	CASE 10A	262.0624
681	"	260.3019
703.7	"	258.4499
781	CASE 6A	246.4853
1031	CASE 3A	245.1676
1252.1	CASE 11A	239.697

Table 3-5
Containment Spray and Fan Cooler Initiation Times

Case	Fan Cooler Initiation (sec)	Spray Initiation (sec)
1A	55.0	296.1
2A	55.9	425.6
3A	57.4	163.2
4A	54.0	256.1
5A	55.3	349.2
6A	56.6	455.3
7A	54.1	123.8
8A	58.1	151.9
9A	56.9	149.6
10A	46.0	143.6
10B	56.0	149.3
11A	66.3	444.7
12A	50.6	148.9
13A	50.5	156.3
14A	50.2	165.5
15A	50.2	197.6
16A	64.4	390.2

Table 3-6
Sequence of Events for Case 10A

Time (Seconds)	Event
0.0	Start of accident
8.51	Reactor Trip
17.51	Feedwater Isolation
46.0	Containment fan coolers start
79.4	Steamline Isolation
143.6	Containment sprays start
583.5	Steam Generator Tube Uncovery
607.2	Peak Pressure Reached

Figure 3-1
Case 1A
Containment Pressure
0.6 ft² Double Ended Rupture
102% Power - MSIV Failure

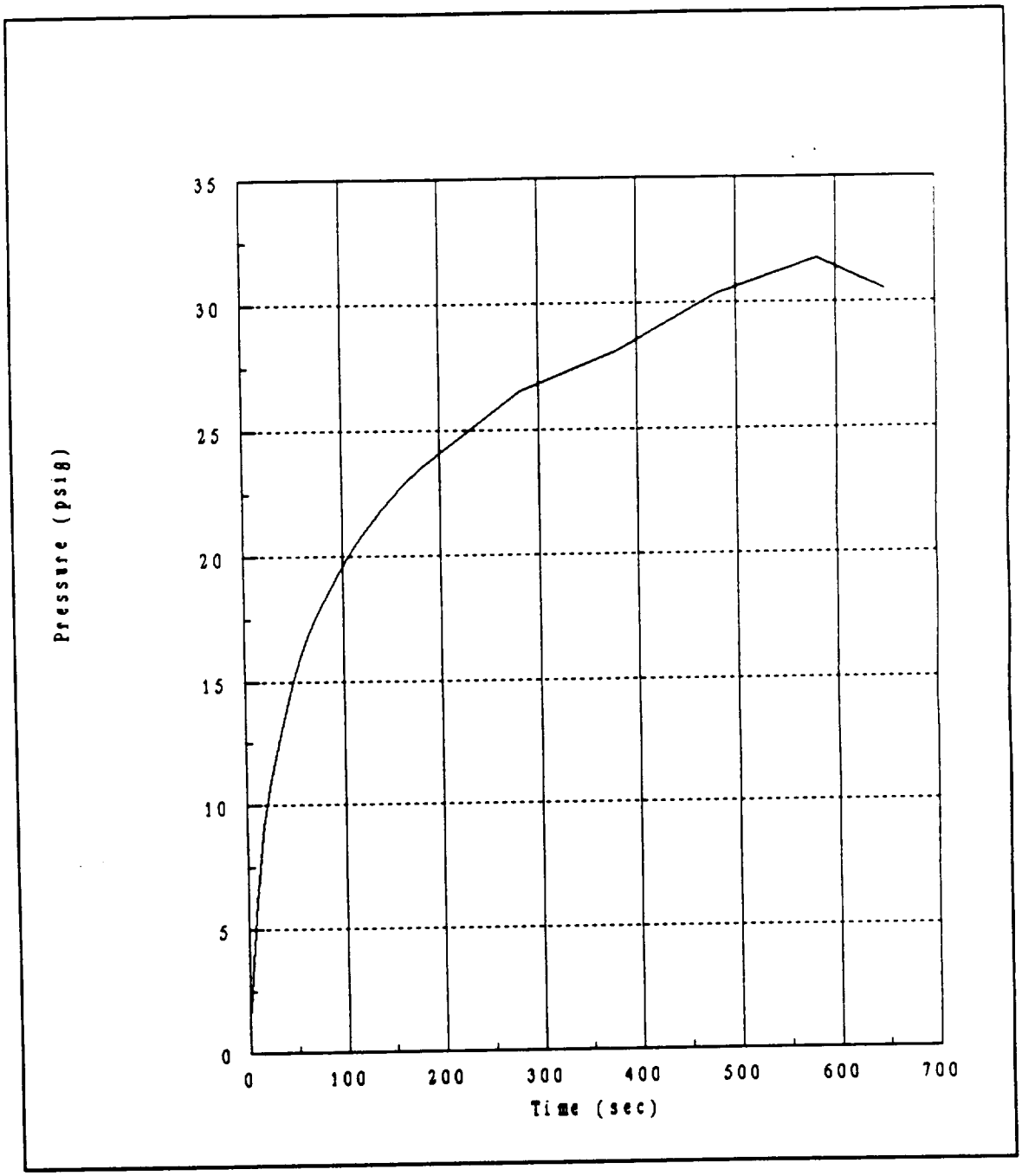


Figure 3-2
Case 2A
Containment Pressure
0.5 ft^2 Double Ended Rupture
70% Power - MSIV Failure

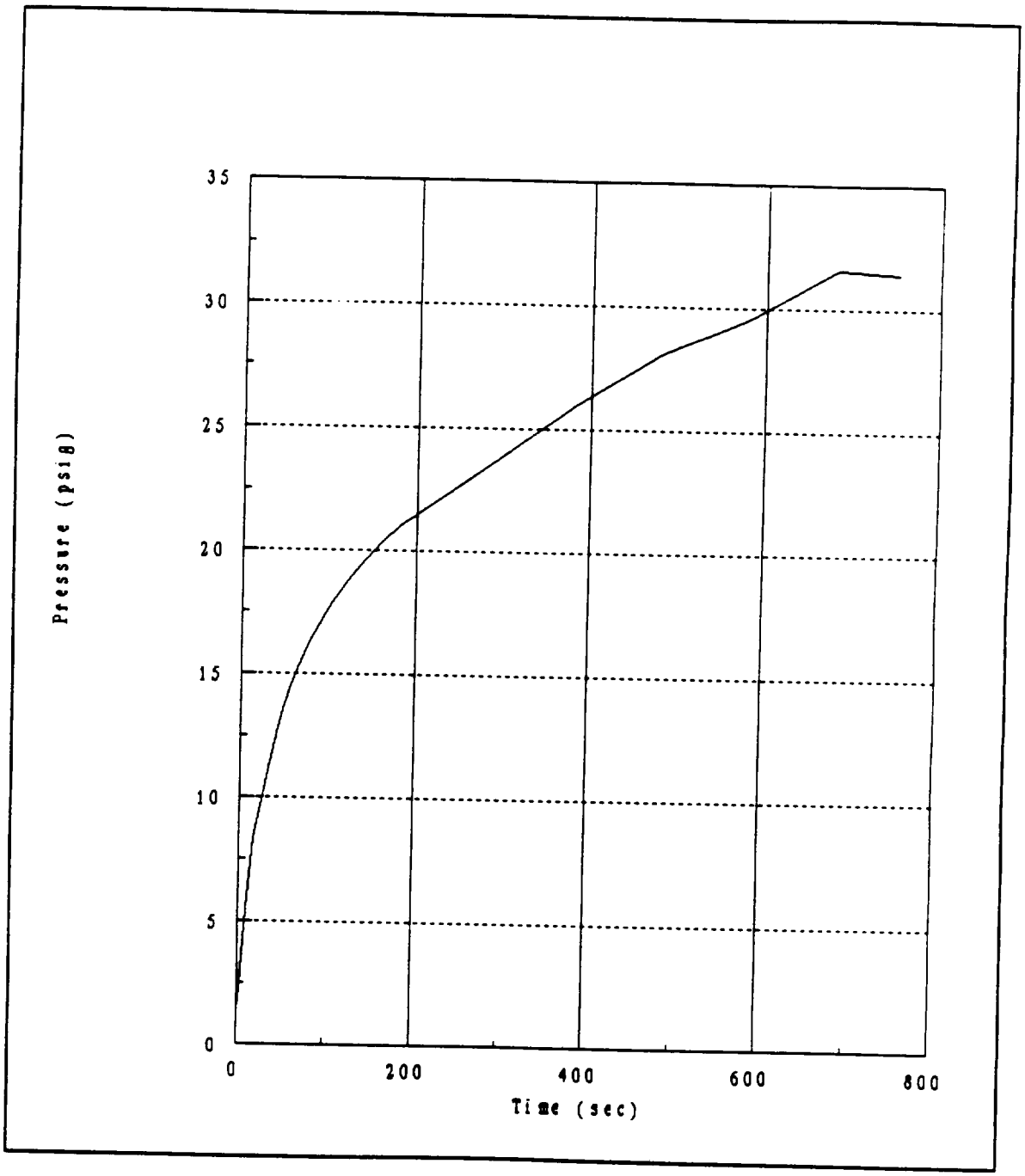


Figure 3-3
Case 3A
Containment Pressure
0.4 ft^2 Double Ended Rupture
30% Power - MSIV Failure

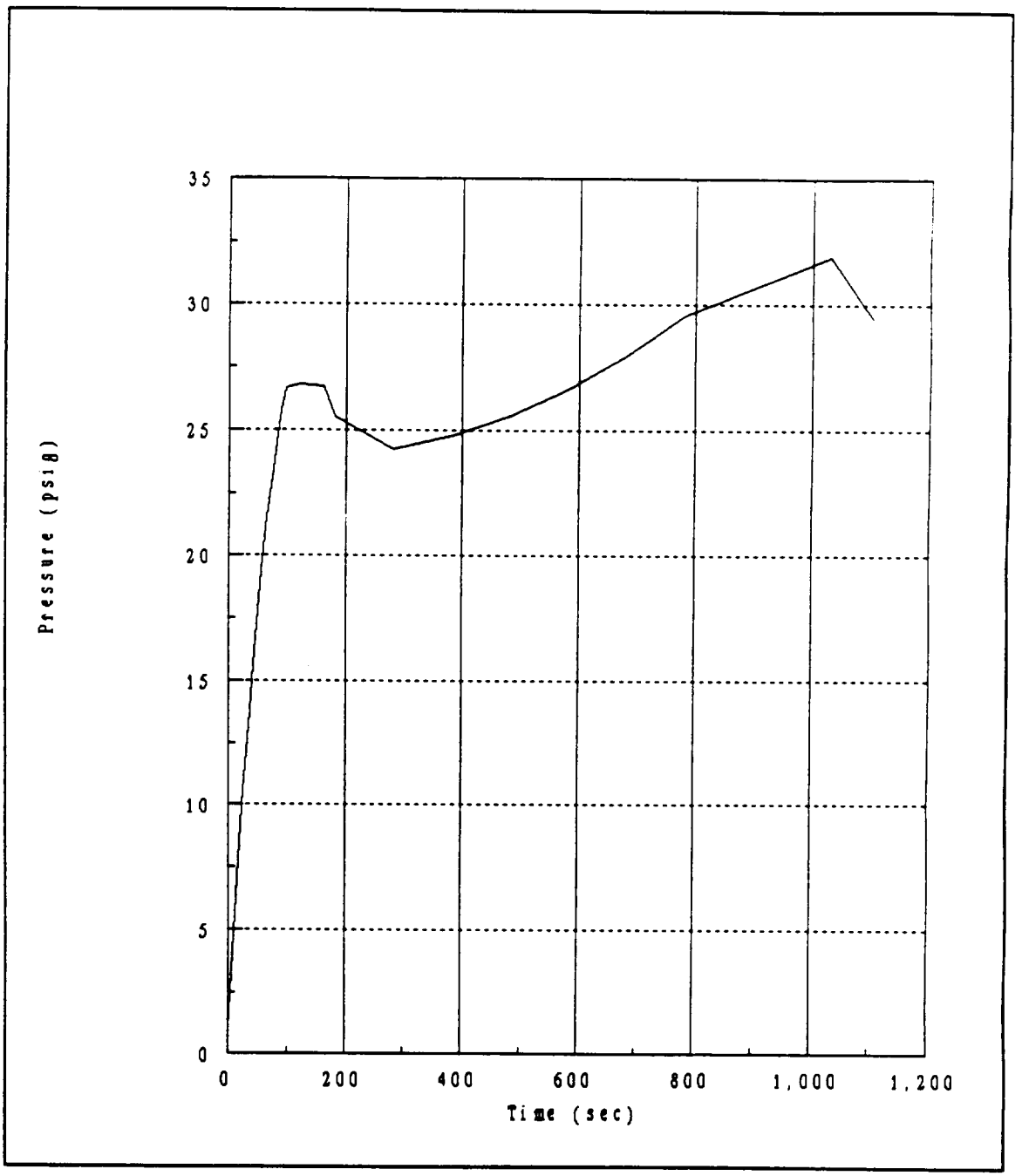


Figure 3-4
Case 4A
Containment Pressure
0.7 ft² Double Ended Rupture
102% Power - MSIV Failure

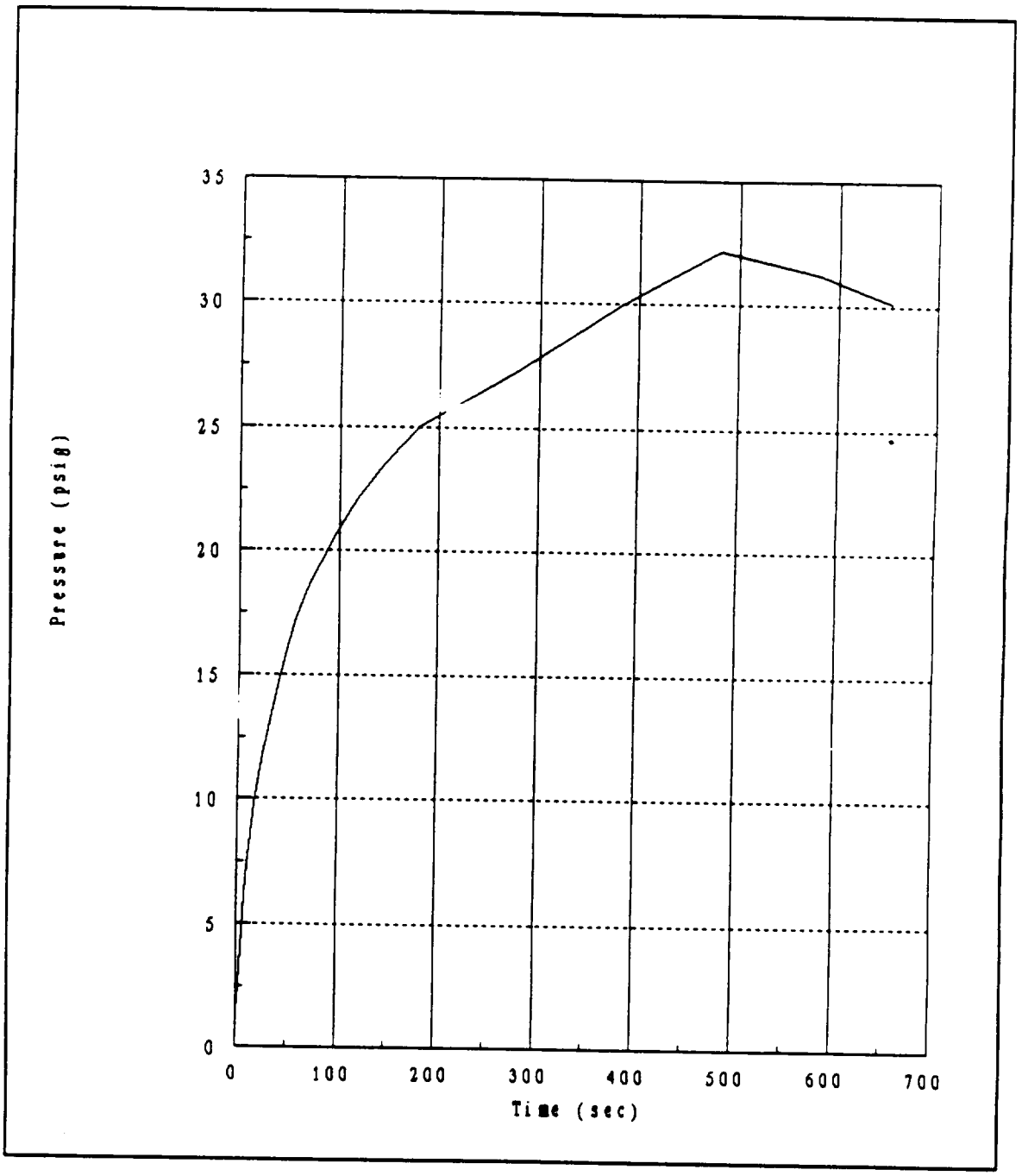


Figure 3-5
Case 5A
Containment Pressure
0.6 ft² Double Ended Rupture
70% Power - MSIV Failure

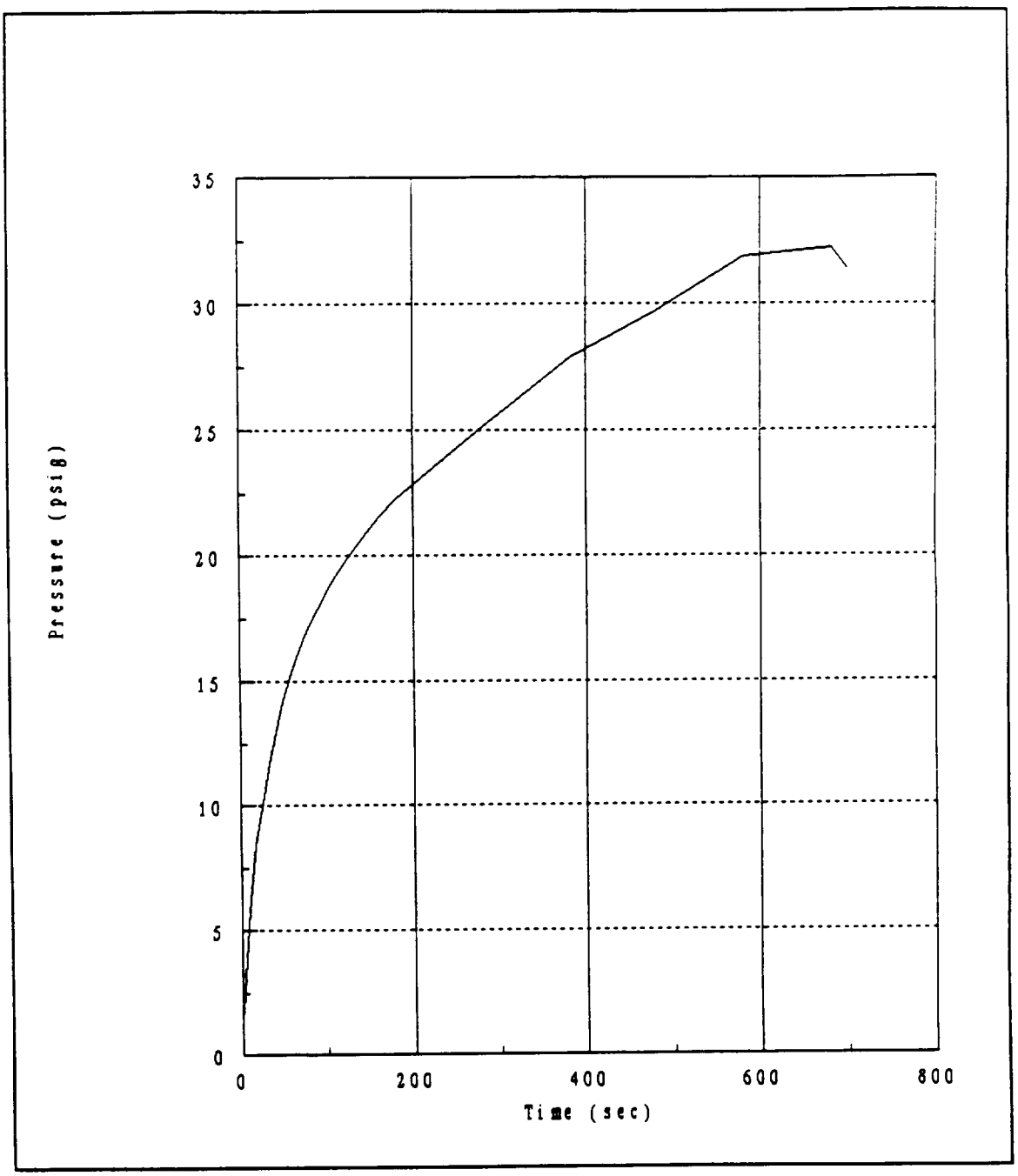


Figure 3-6
Case 6A
Containment Pressure
0.5 ft² Double Ended Rupture
30% Power - MSIV Failure

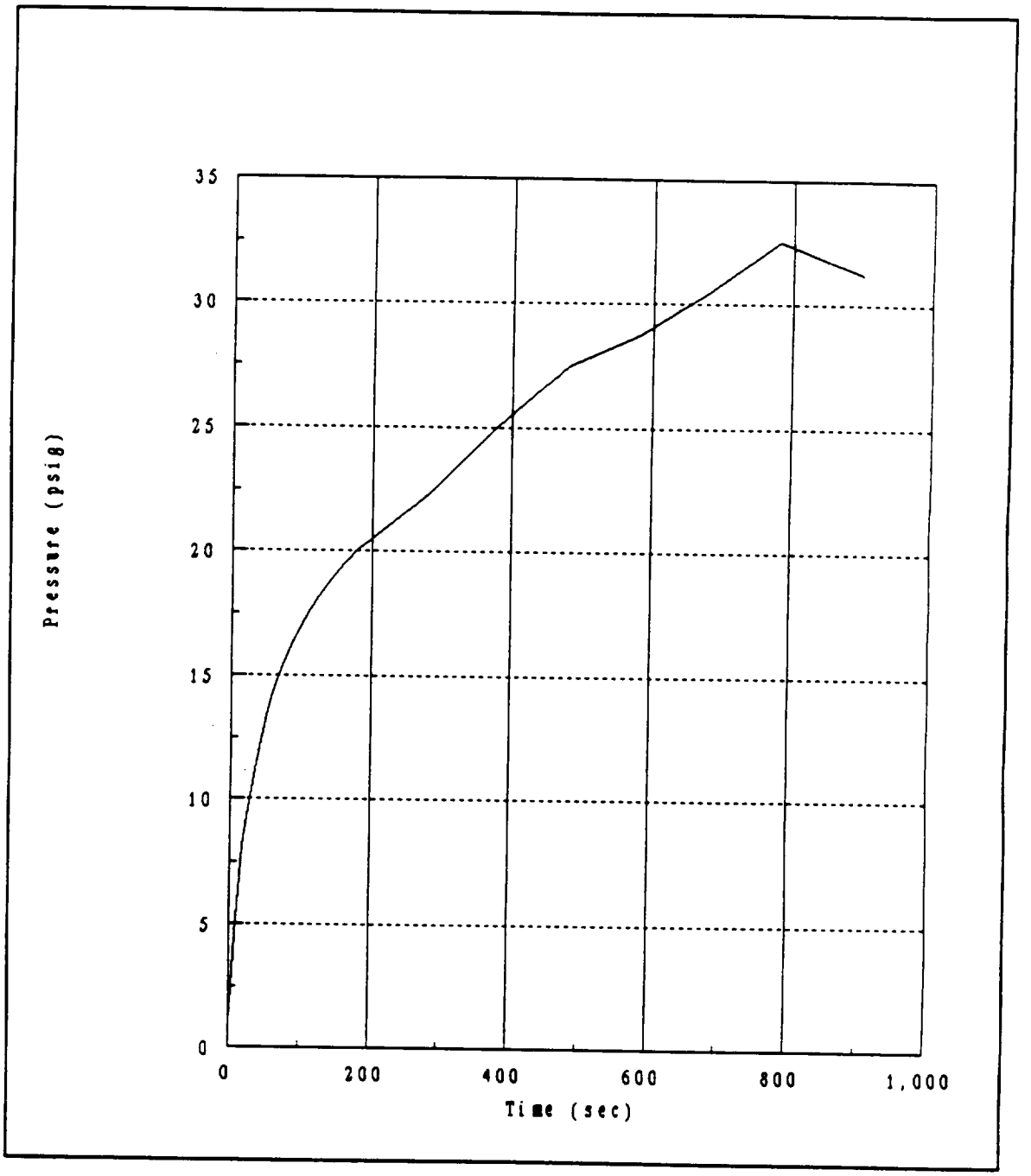


Figure 3-7
Case 7A
Containment Pressure
0.7 ft^2 Double Ended Rupture
102% Power - MSIV Failure

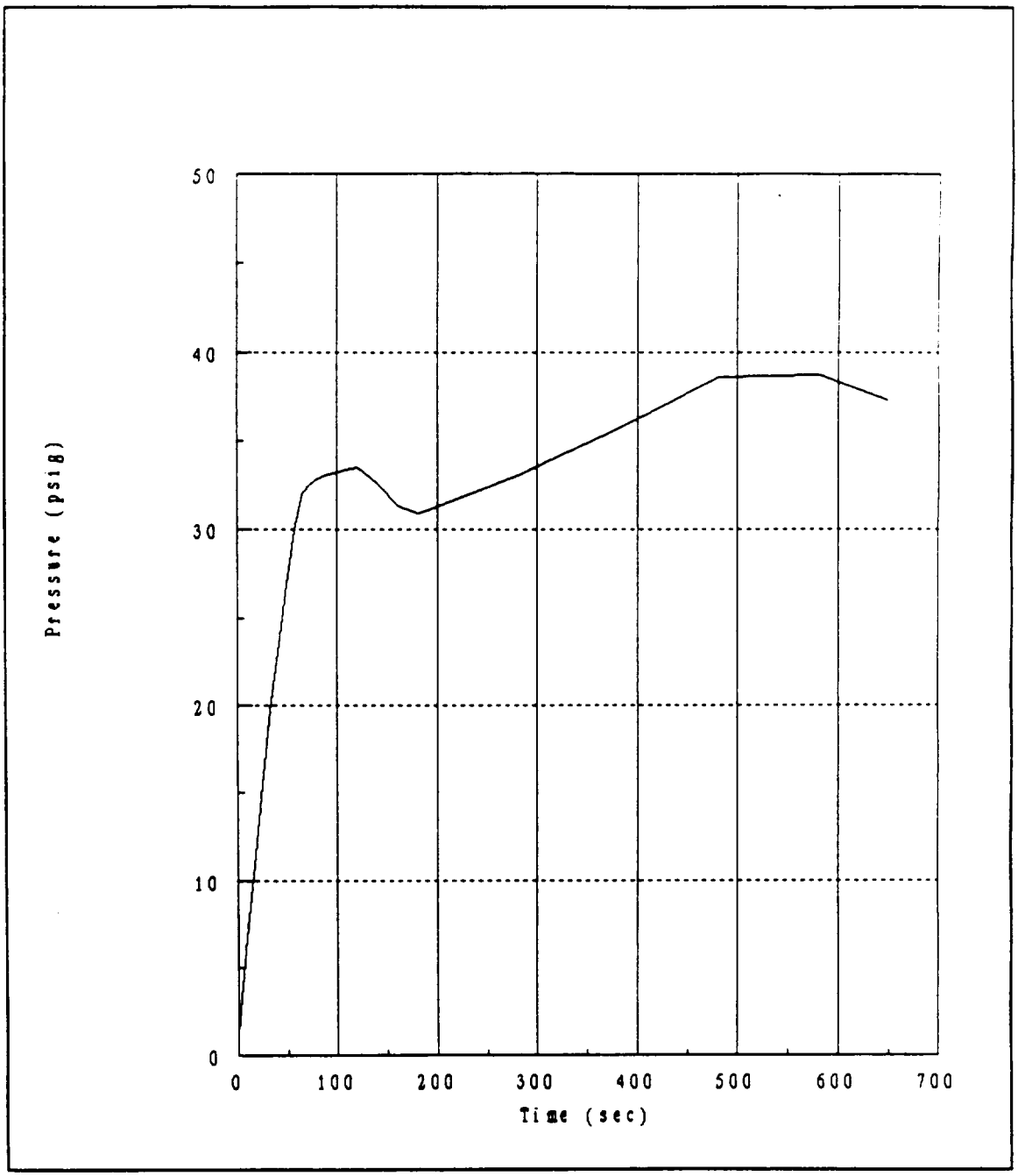


Figure 3-8
Case 8A
Containment Pressure
0.86 ft² Split Break
102% Power - MSIV Failure

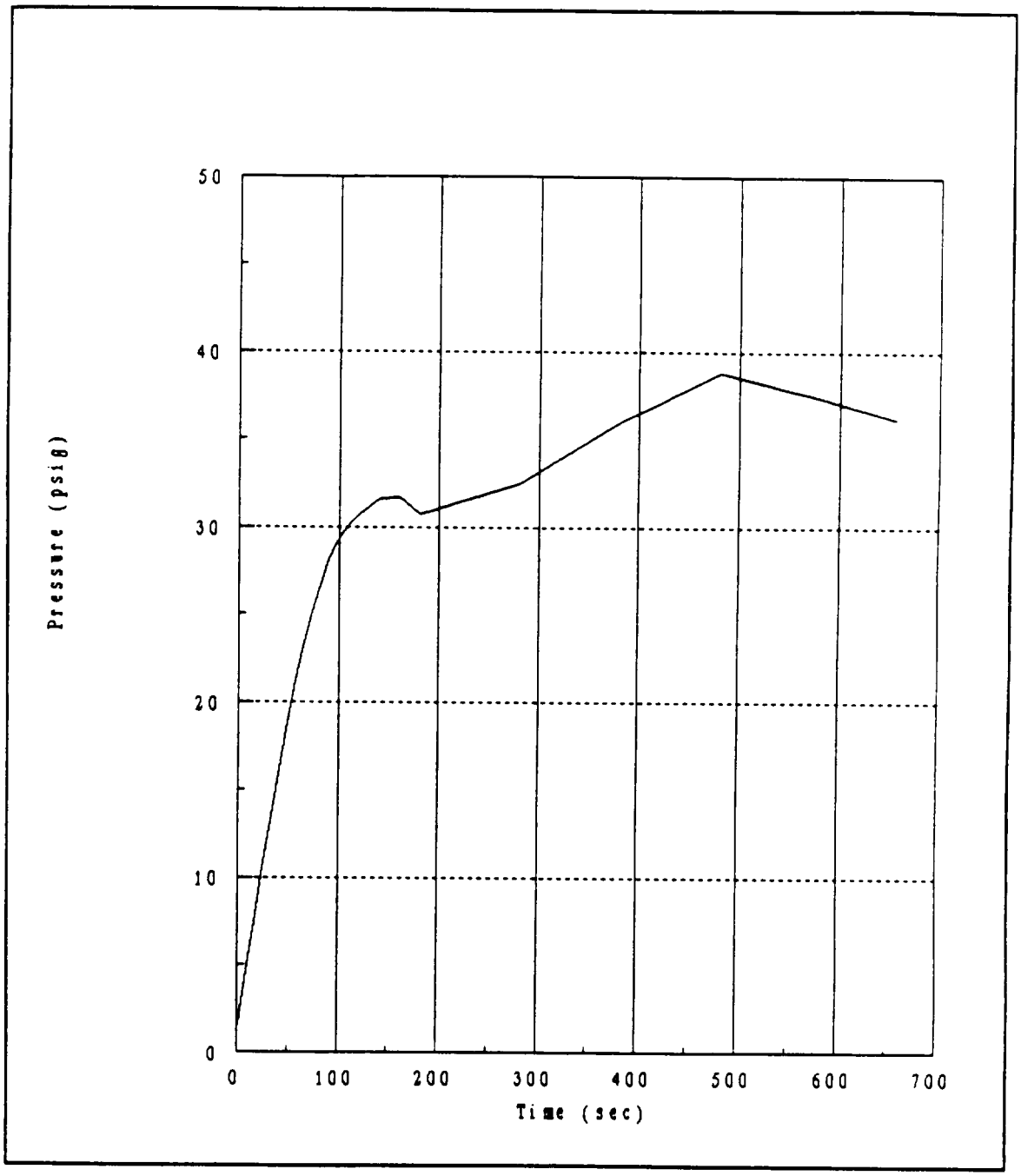


Figure 3-9
Case 9A
Containment Pressure
0.908 ft^2 Split Break
70% Power - MSIV Failure

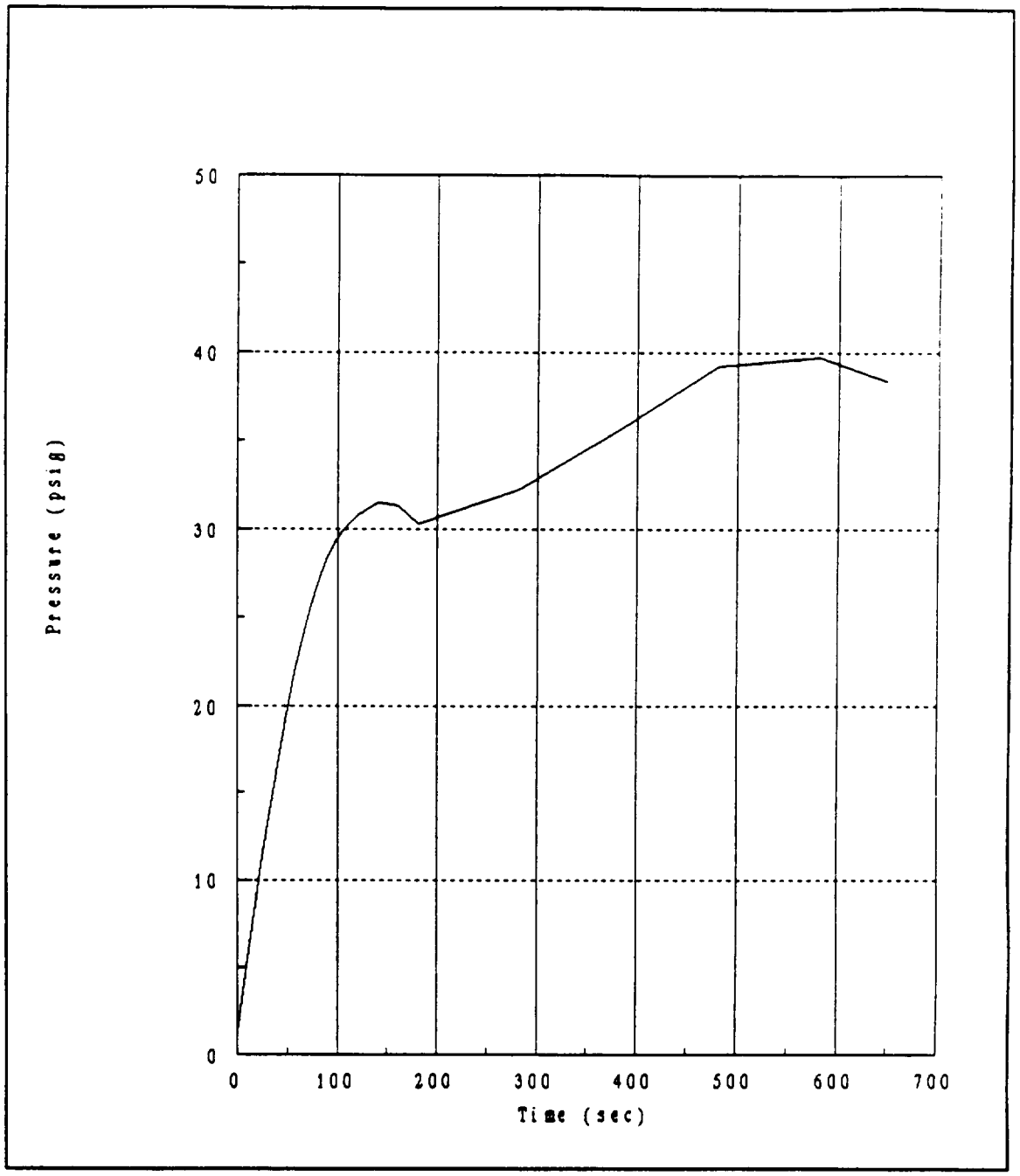


Figure 3-10
Case 10A
Containment Pressure
0.944 ft² Split Break
30% Power - MSIV Failure

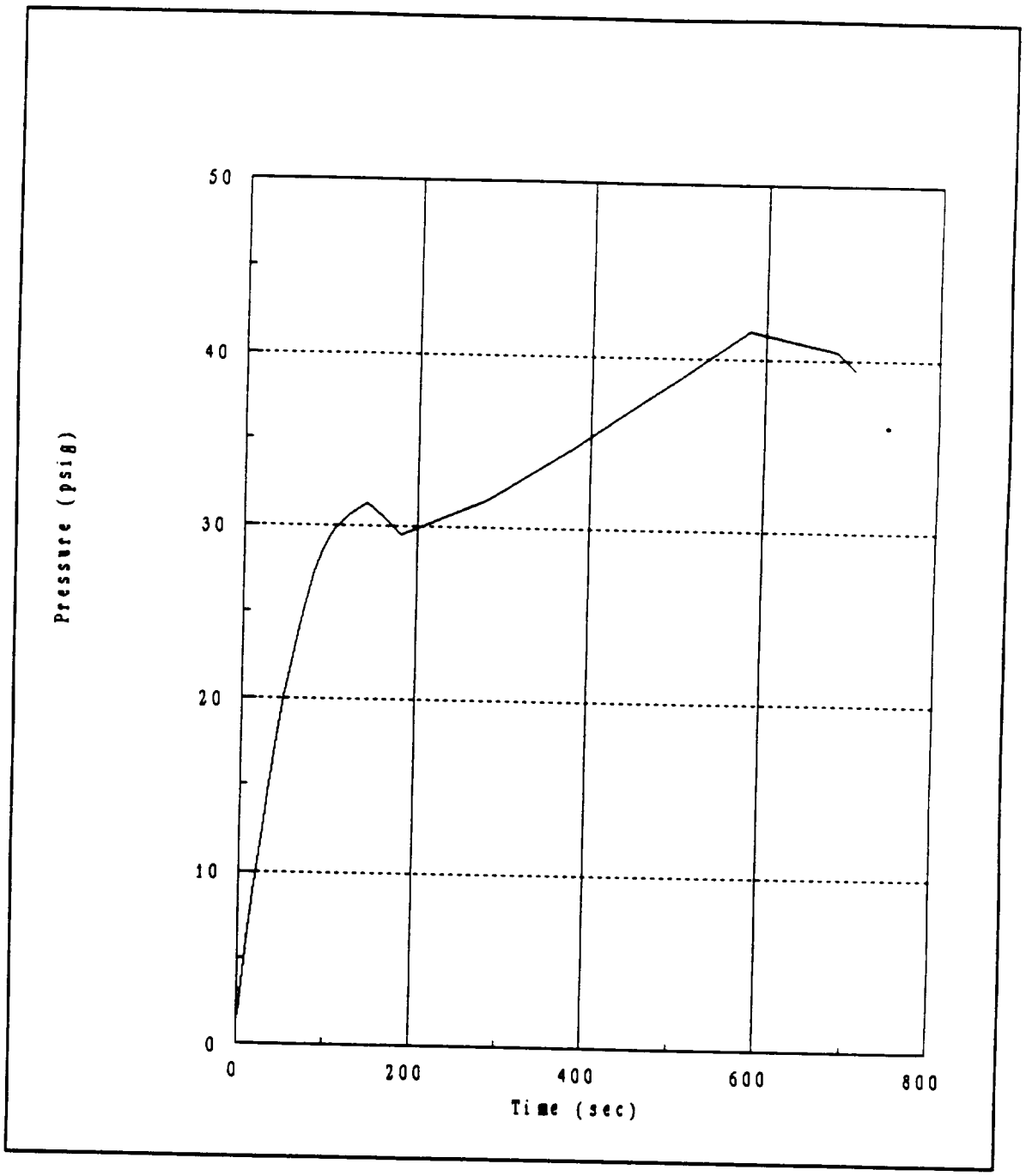


Figure 3-11
Case 10B
Containment Pressure
0.944 ft^2 Split Break
30% Power - MSIV Failure

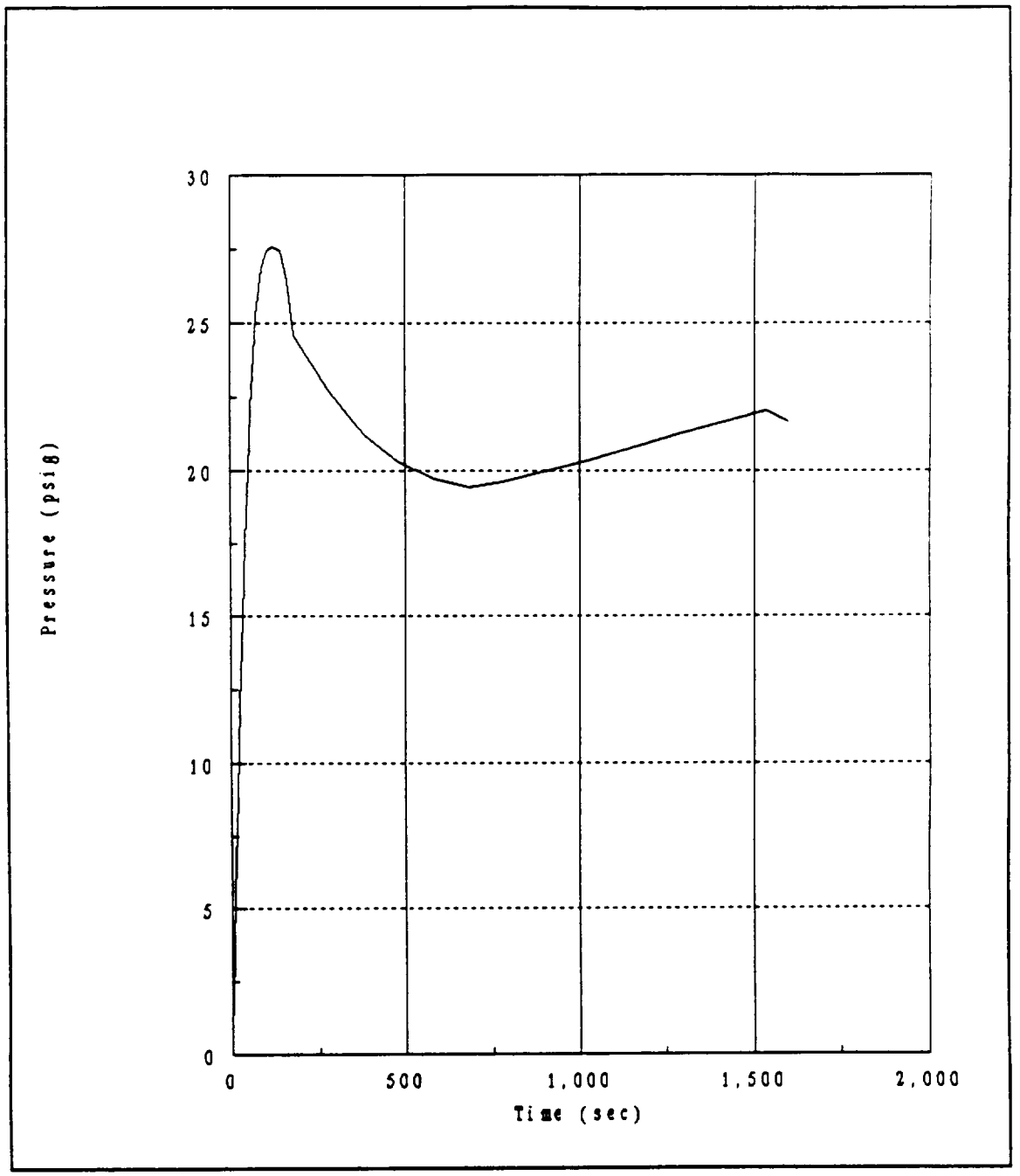


Figure 3-12
Case 11A
Containment Pressure
0.4 ft^2 Split Break
0% Power - MSIV Failure

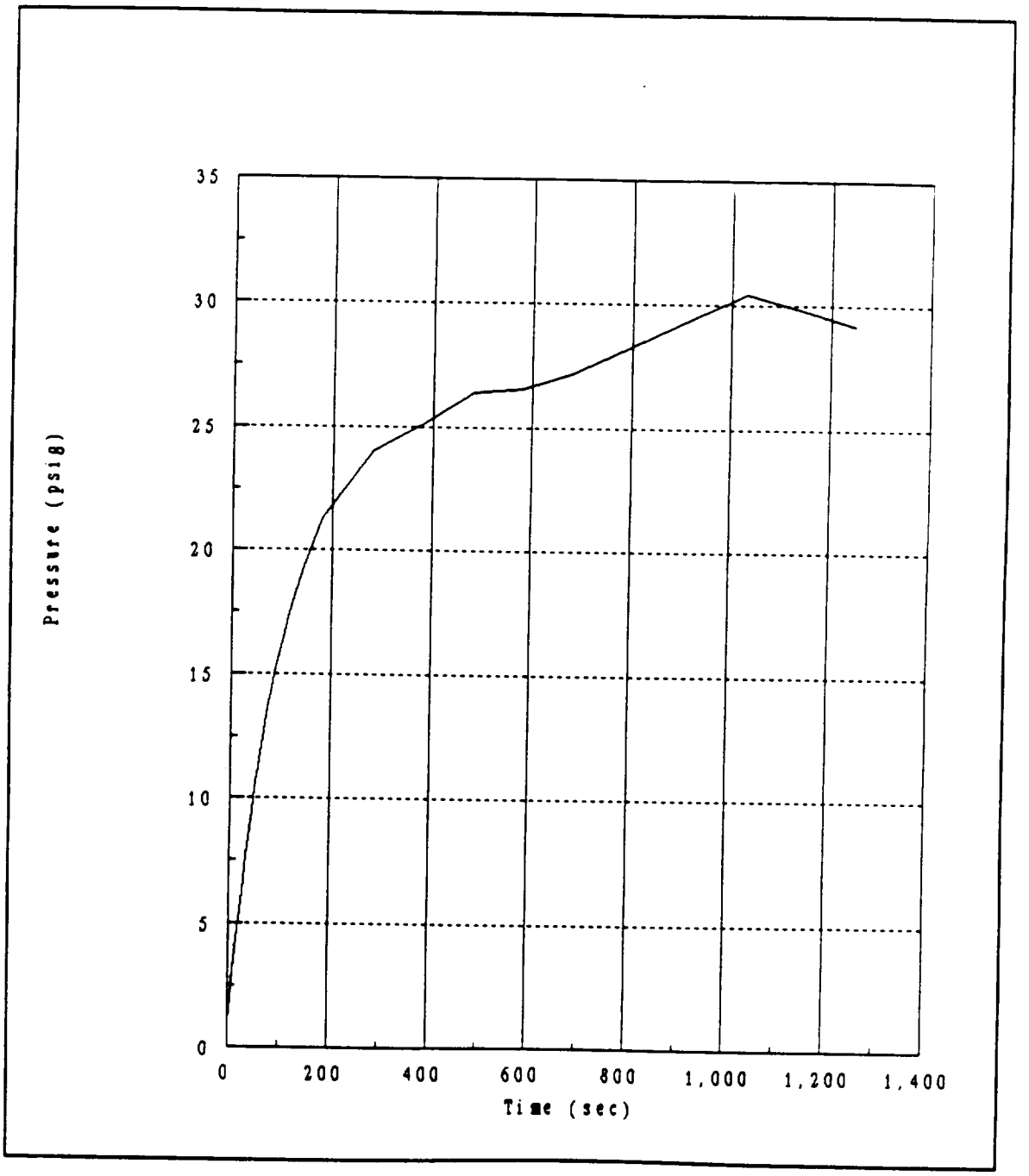


Figure 3-13
Case 12A
Containment Pressure
3.69 ft^2 Double Ended Rupture
102% Power - FRV Failure

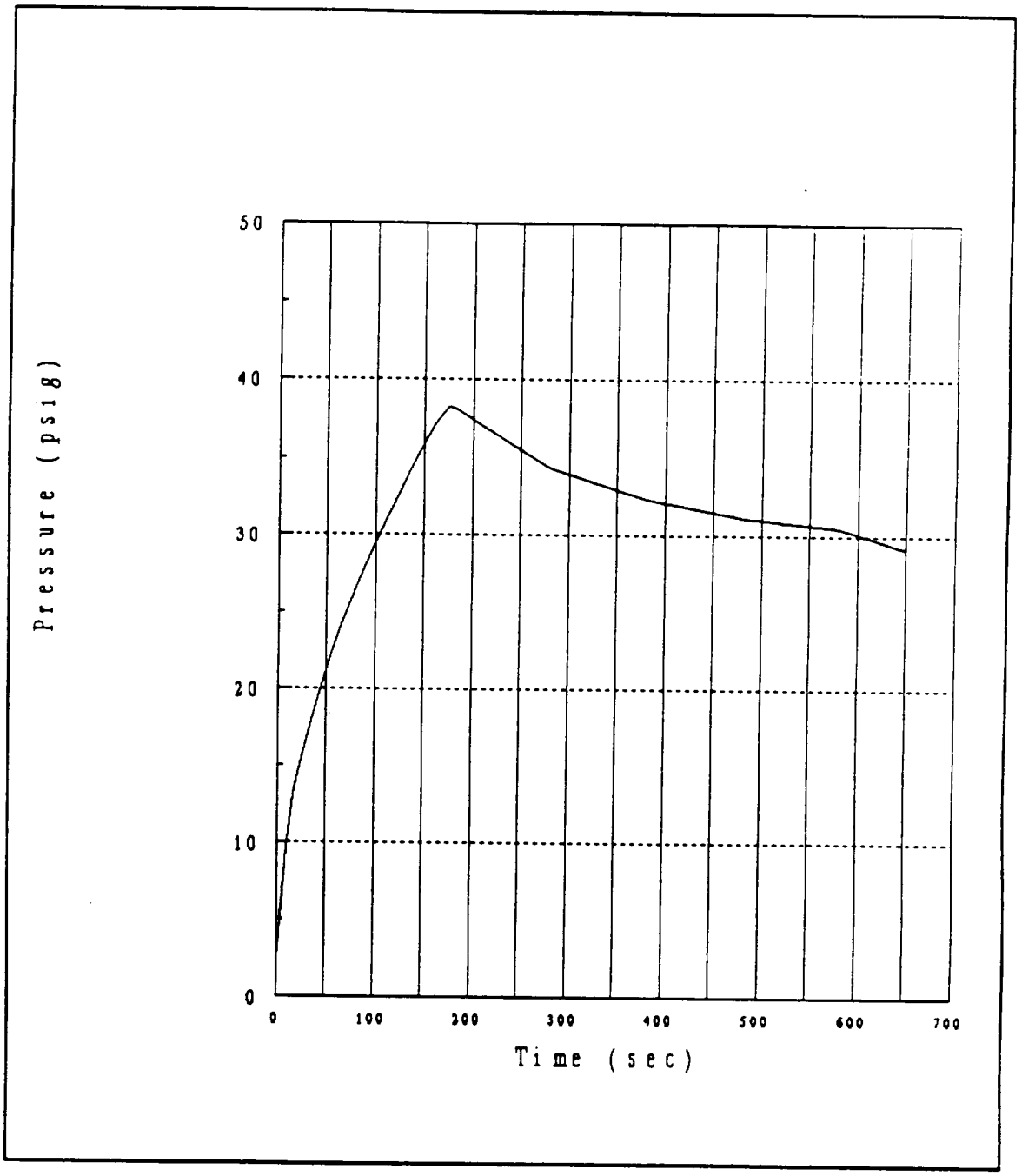


Figure 3-14
Case 13A
Containment Pressure
3.69 ft^2 Double Ended Rupture
70% Power - FRV Failure

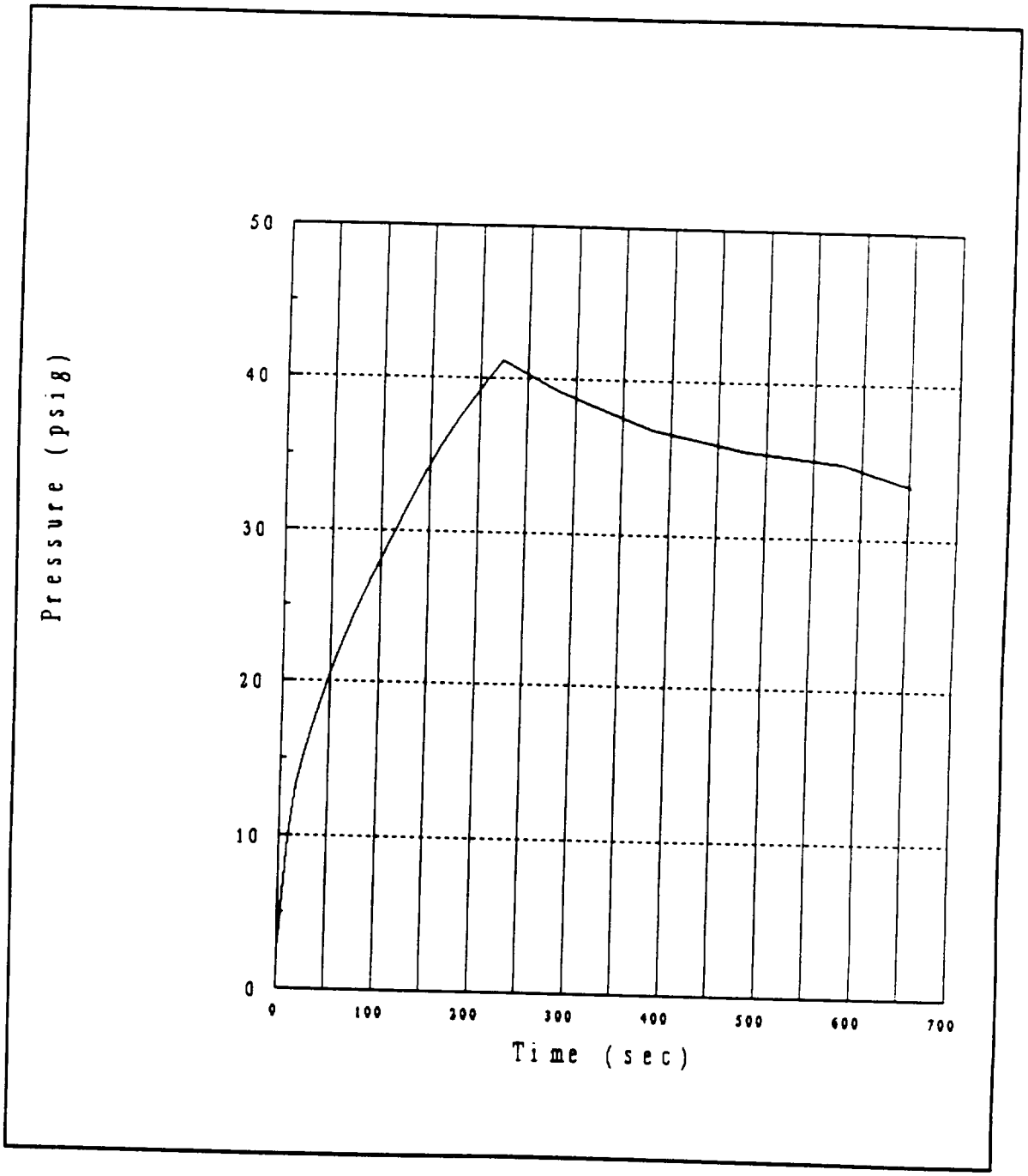


Figure 3-15
Case 14A
Containment Pressure
3.69 ft^2 Double Ended Rupture
30% Power - FRV Failure

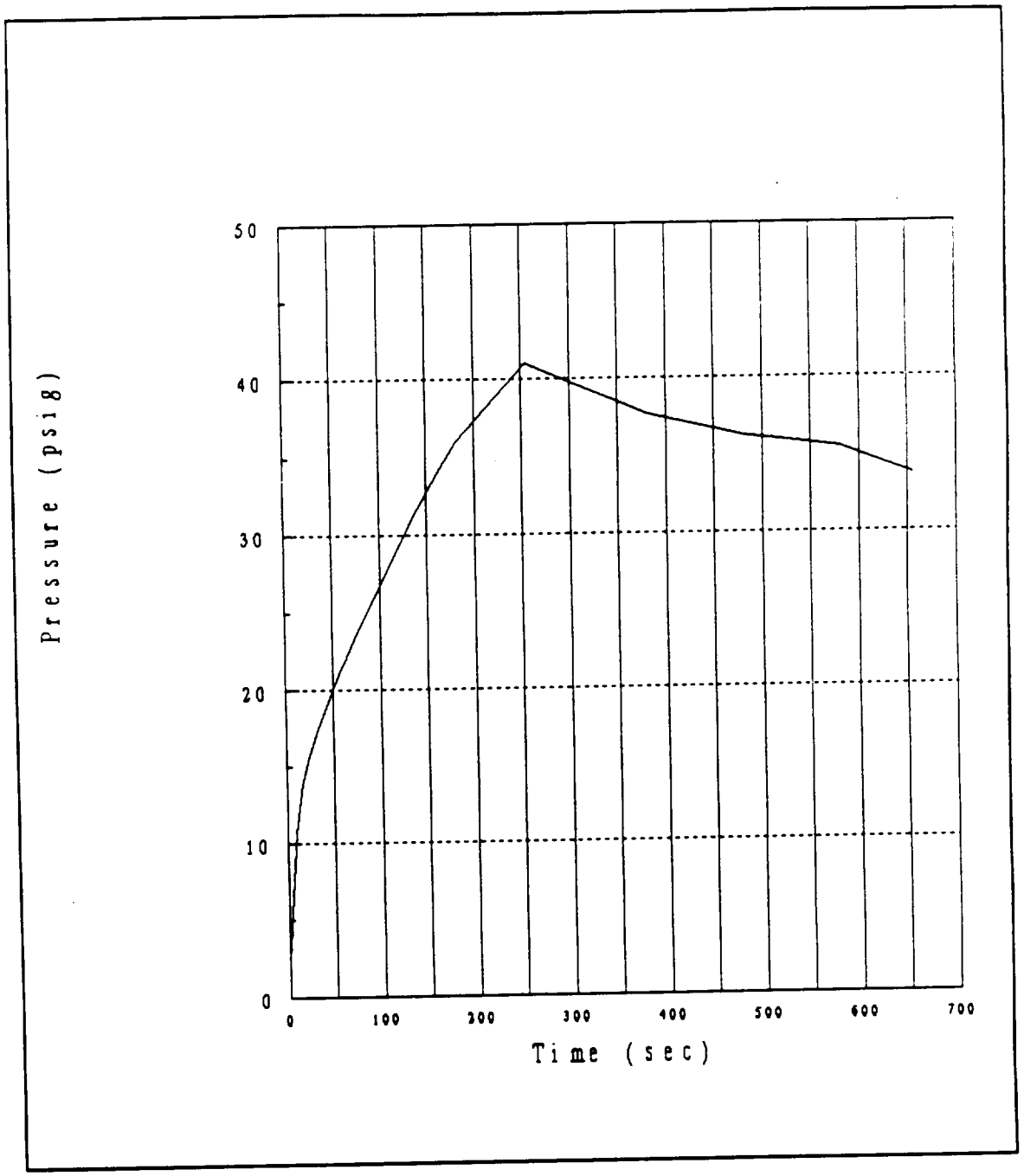


Figure 3-16
Case 15A
Containment Pressure
3.69 ft^2 Double Ended Rupture
0% Power - FRV Failure

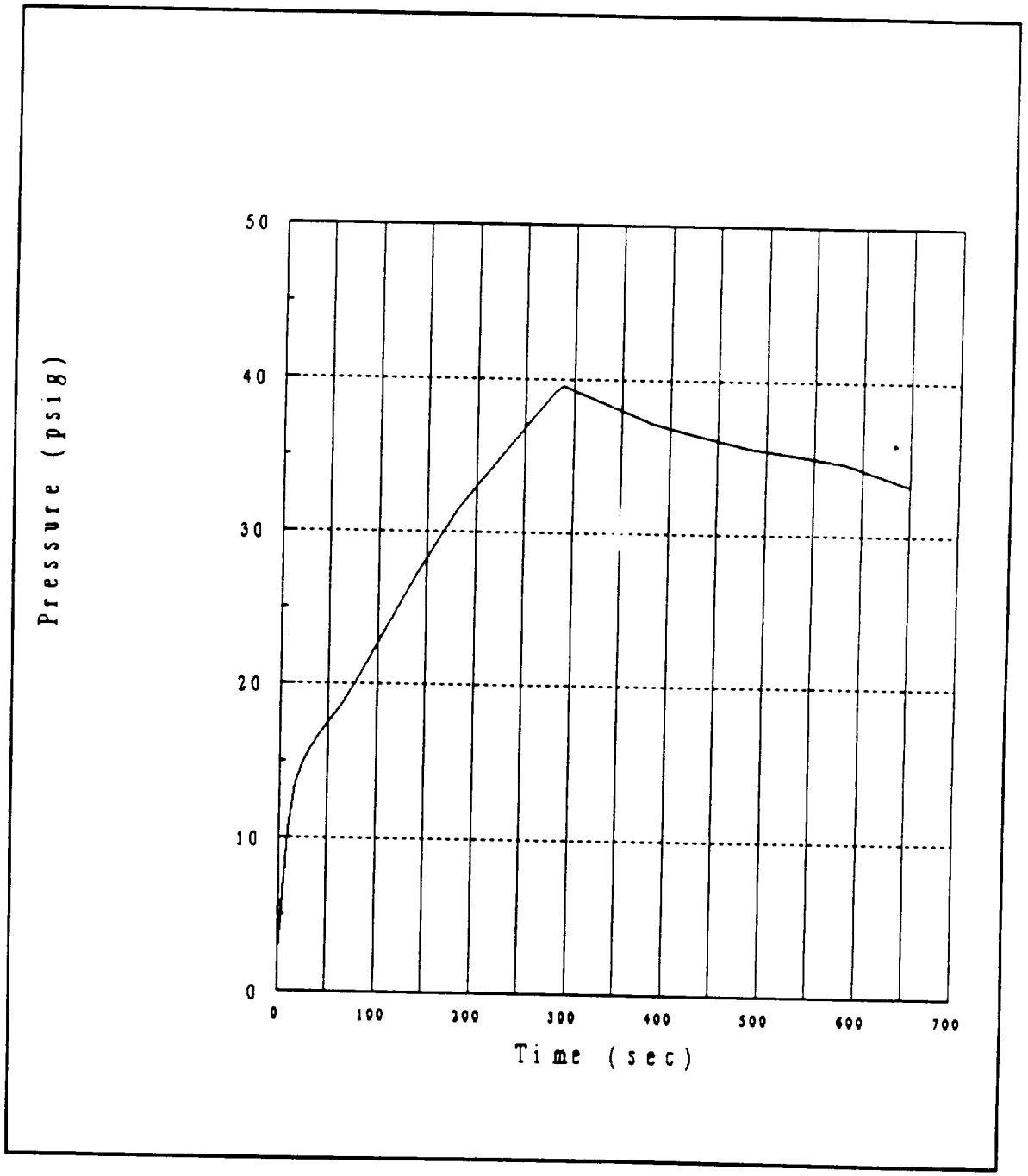


Figure 3-17
Case 16A
Containment Pressure
0.5 ft^2 Double Ended Rupture
70% Power - SSPS Failure

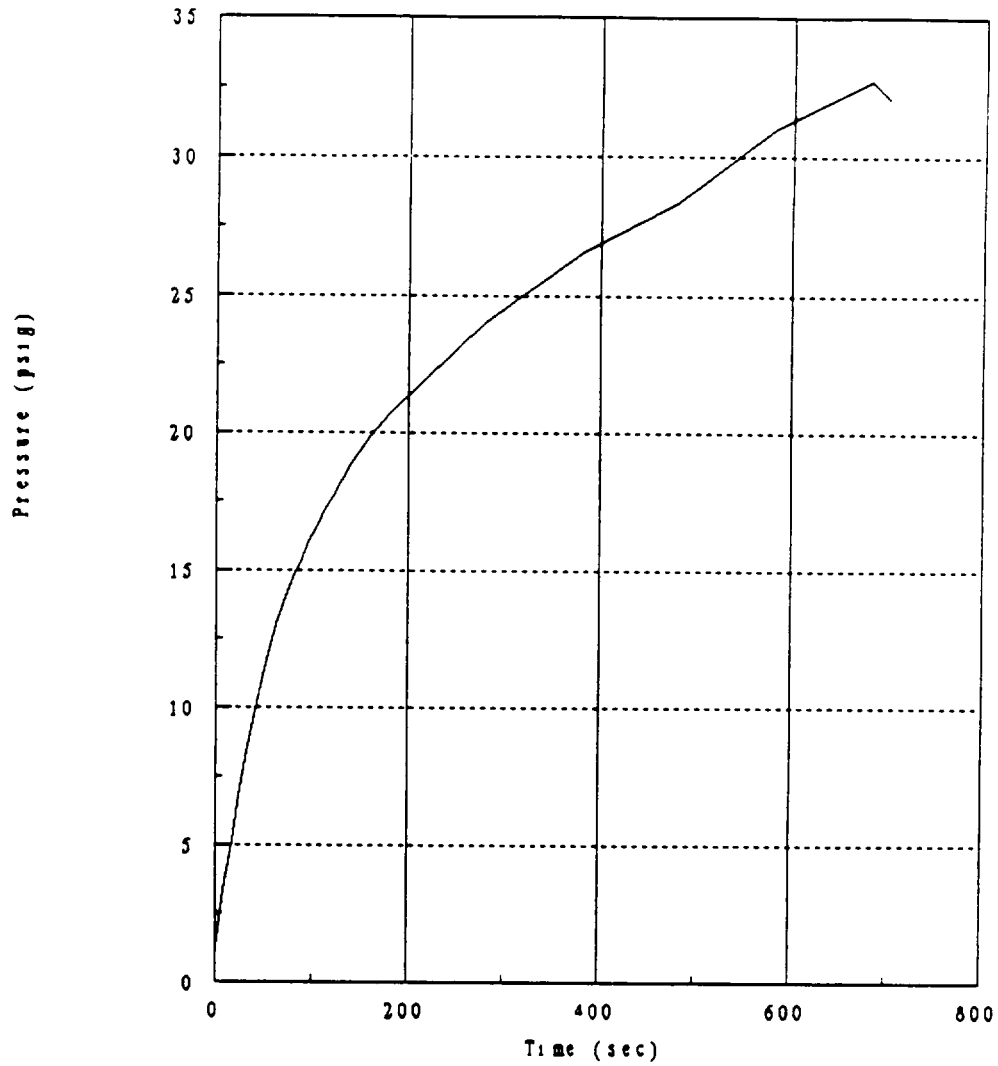


Figure 3-18
Case 1A
Containment Temperature
0.6 ft^2 Double Ended Rupture
102% Power - MSIV Failure

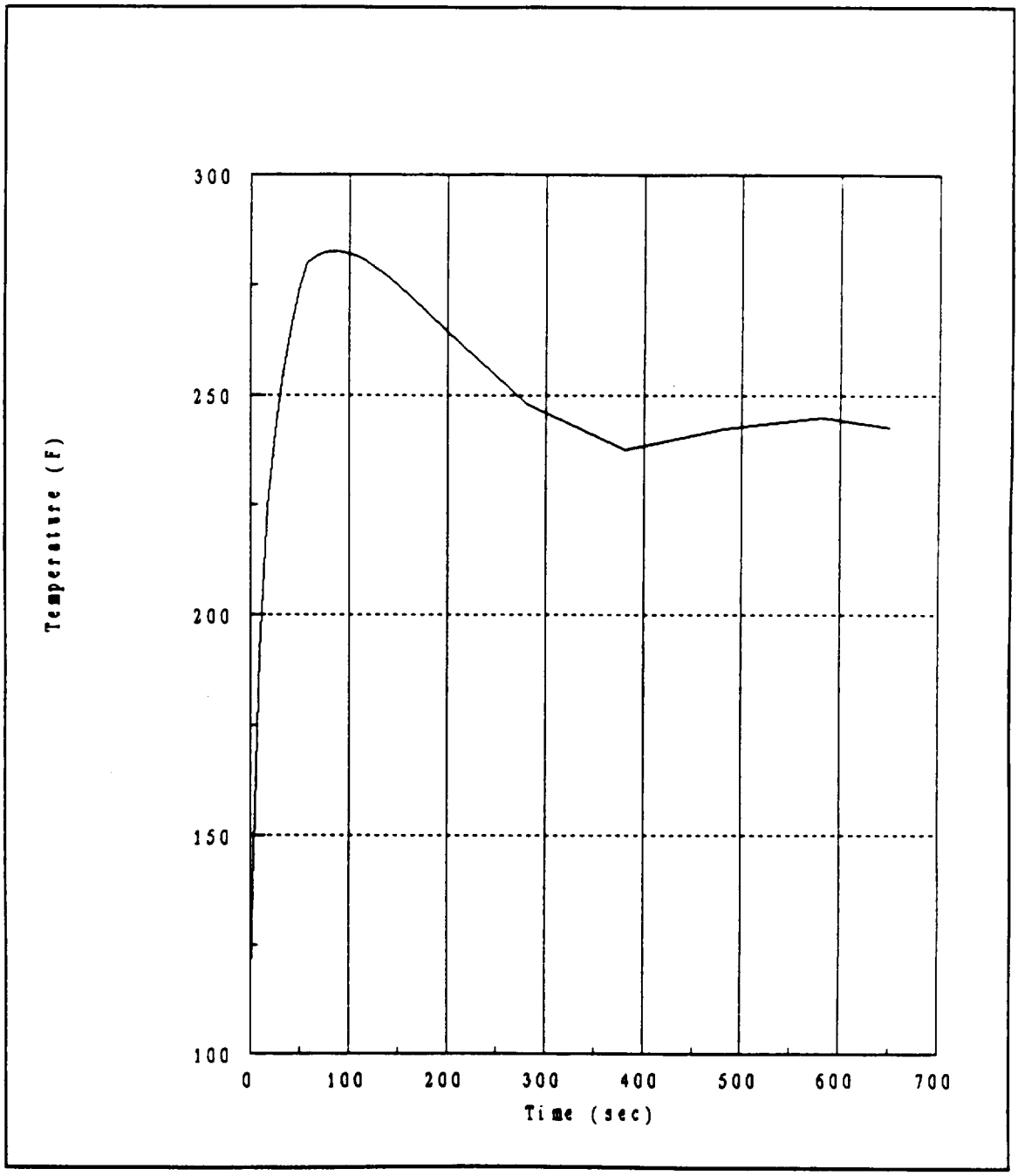


Figure 3-19
Case 2A
Containment Temperature
0.5 ft^2 Double Ended Rupture
70% Power - MSIV Failure

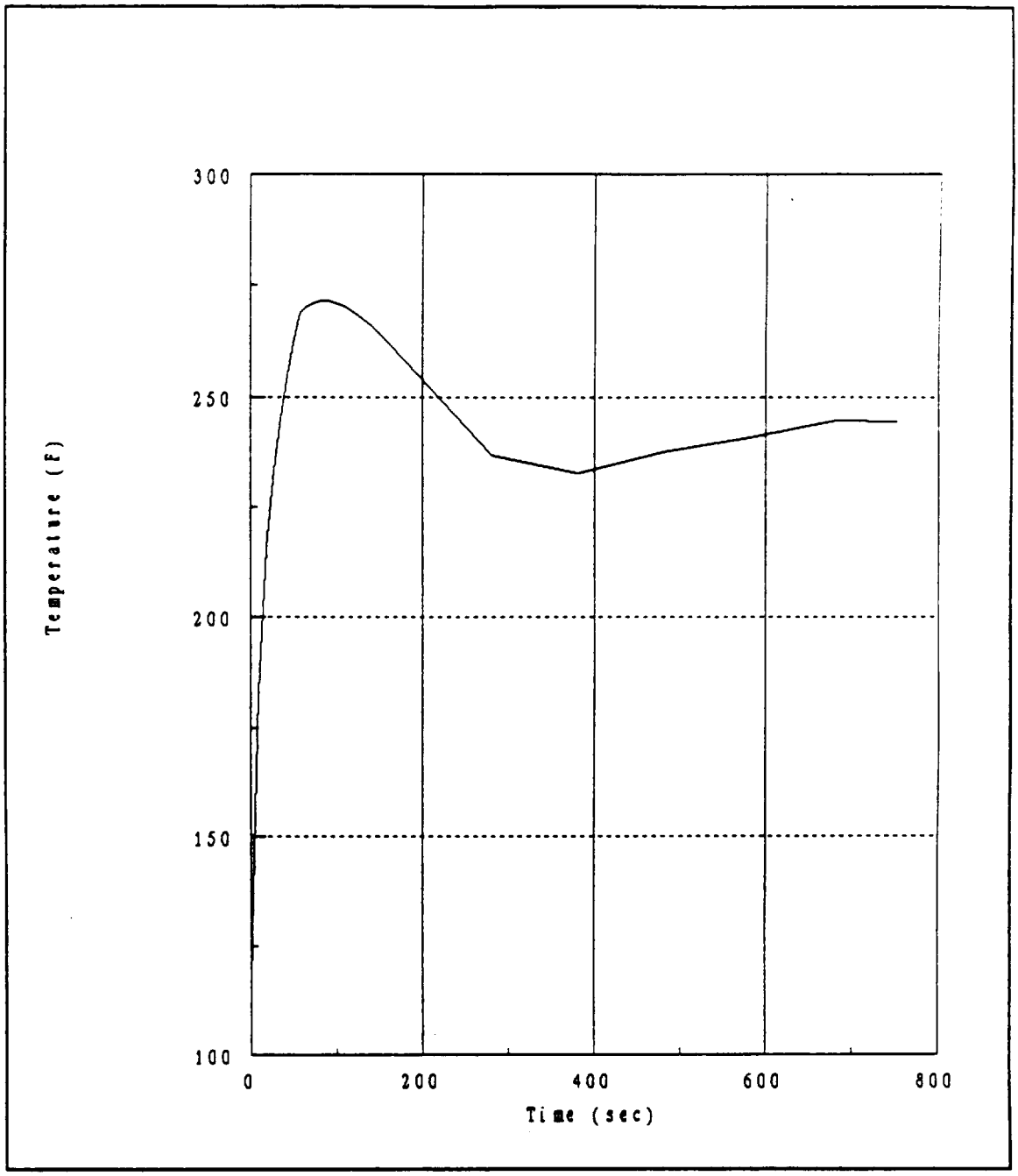


Figure 3-20
Case 3A
Containment Temperature
0.4 ft² Double Ended Rupture
30% Power - MSIV Failure

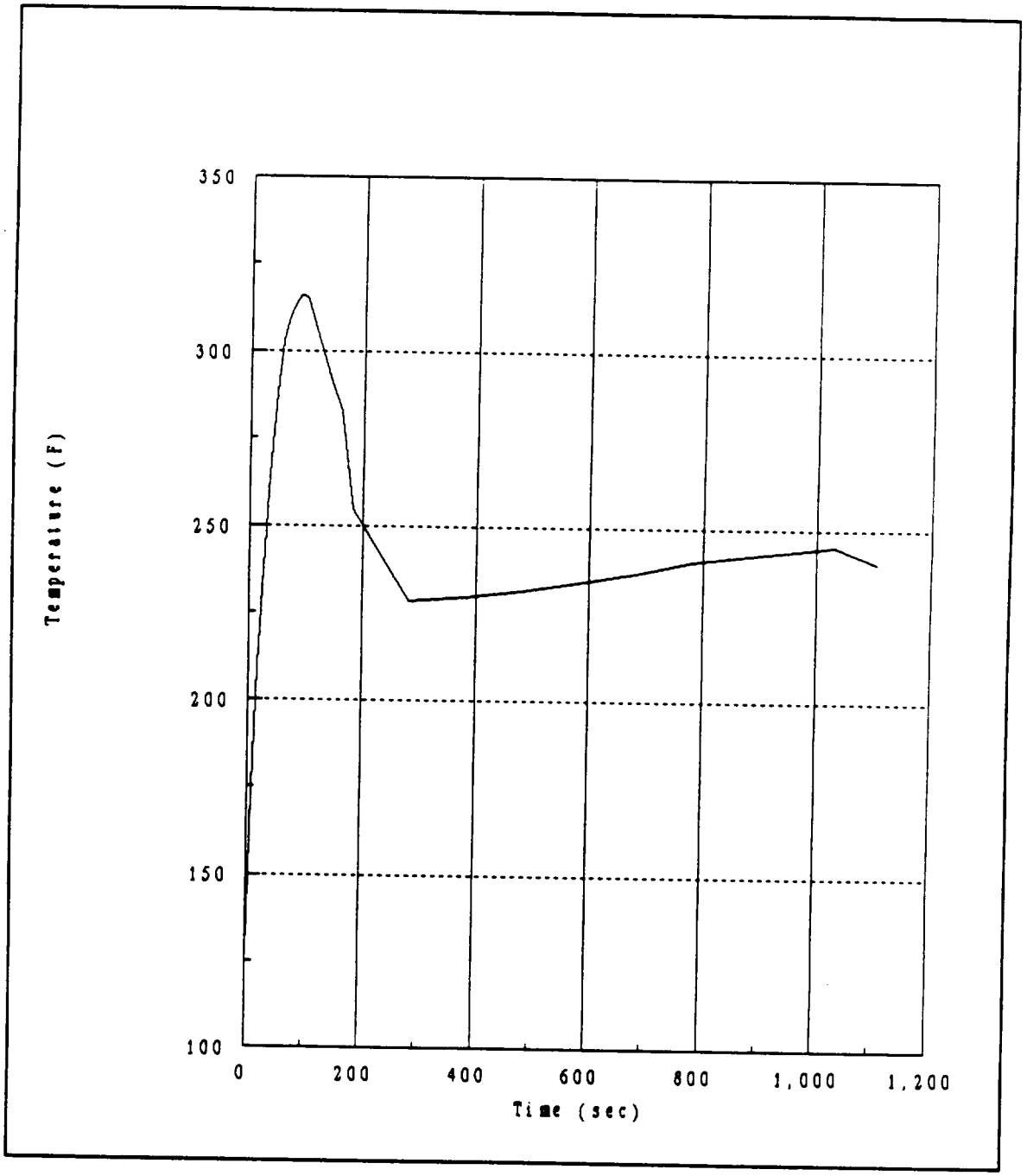


Figure 3-21
Case 4A
Containment Temperature
0.7 ft^2 Double Ended Rupture
102% Power - MSIV Failure

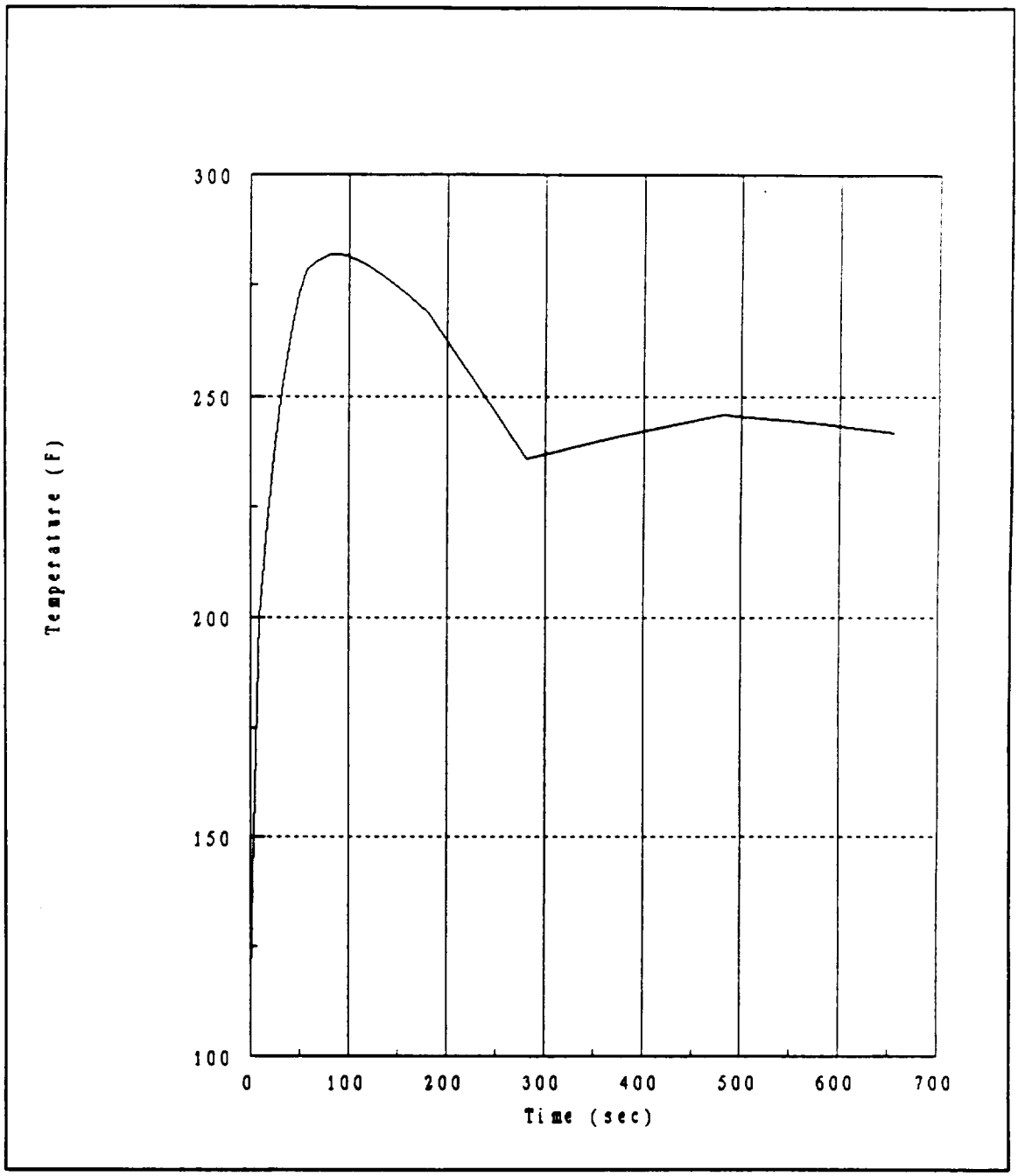


Figure 3-22
Case 5A
Containment Temperature
0.6 ft² Double Ended Rupture
70% Power - MSIV Failure

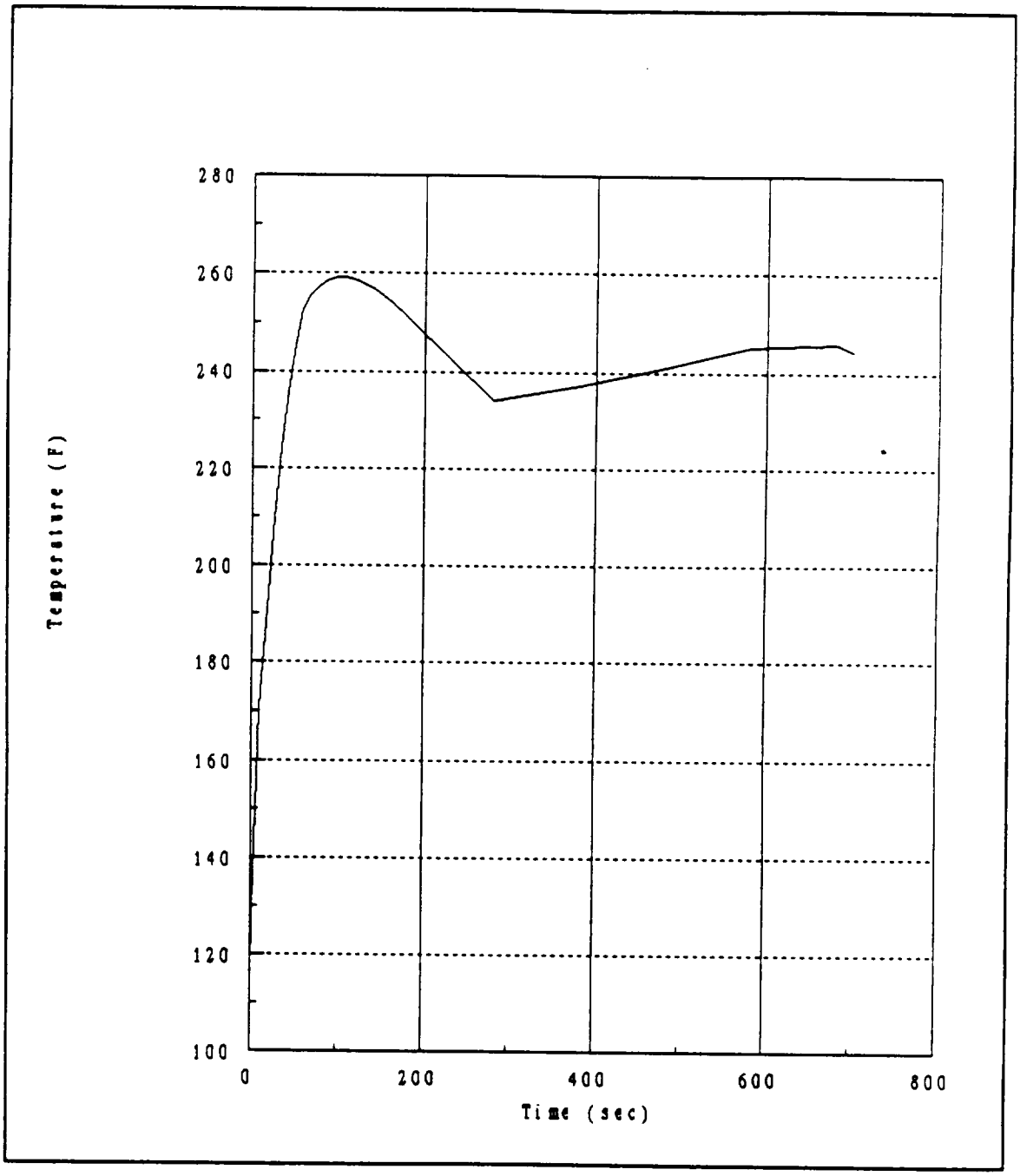


Figure 3-23
Case 6A
Containment Temperature
0.5 ft² Double Ended Rupture
30% Power - MSIV Failure

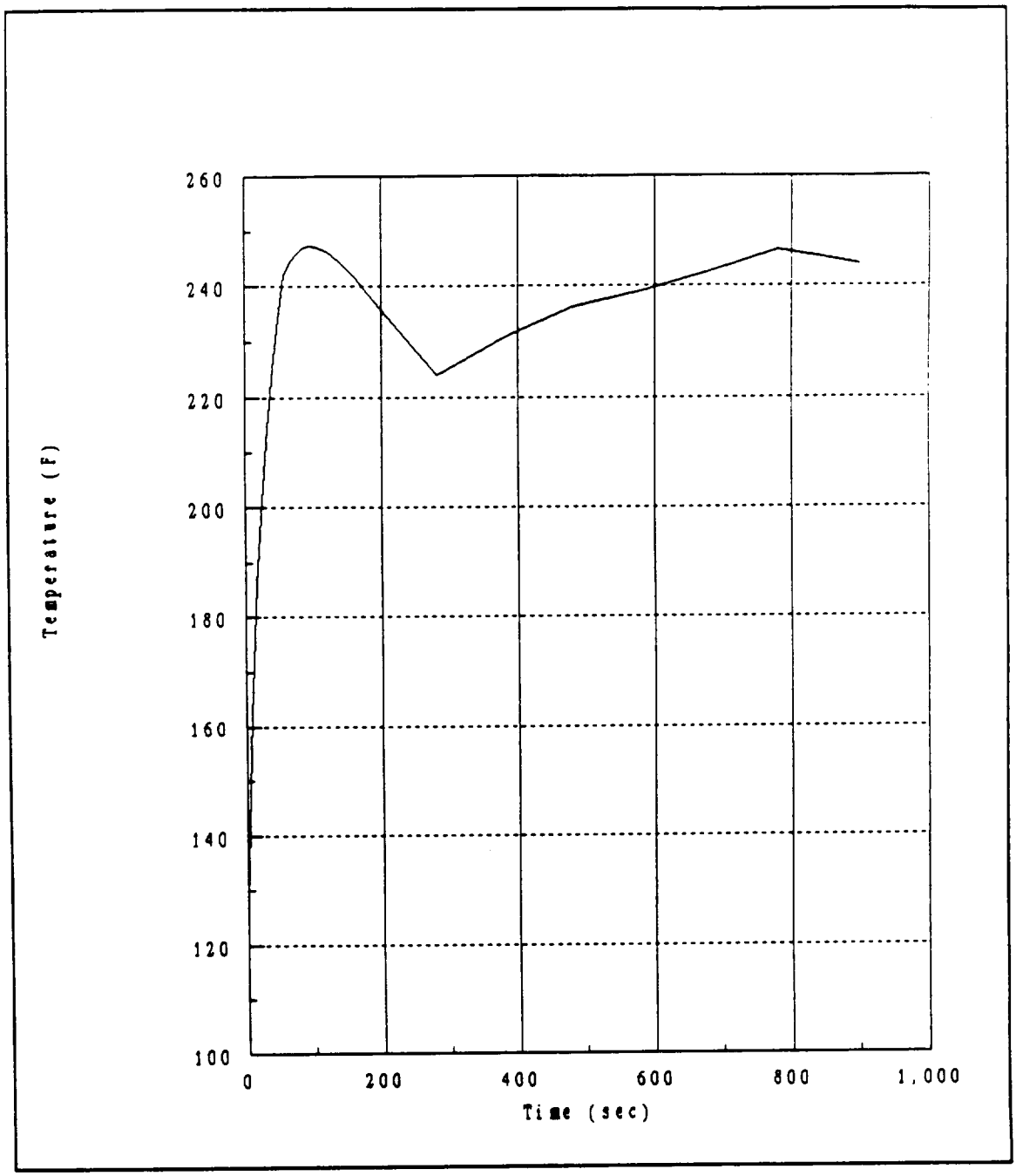


Figure 3-24
Case 7A
Containment Temperature
0.7 ft^2 Double Ended Rupture
102% Power - MSIV Failure

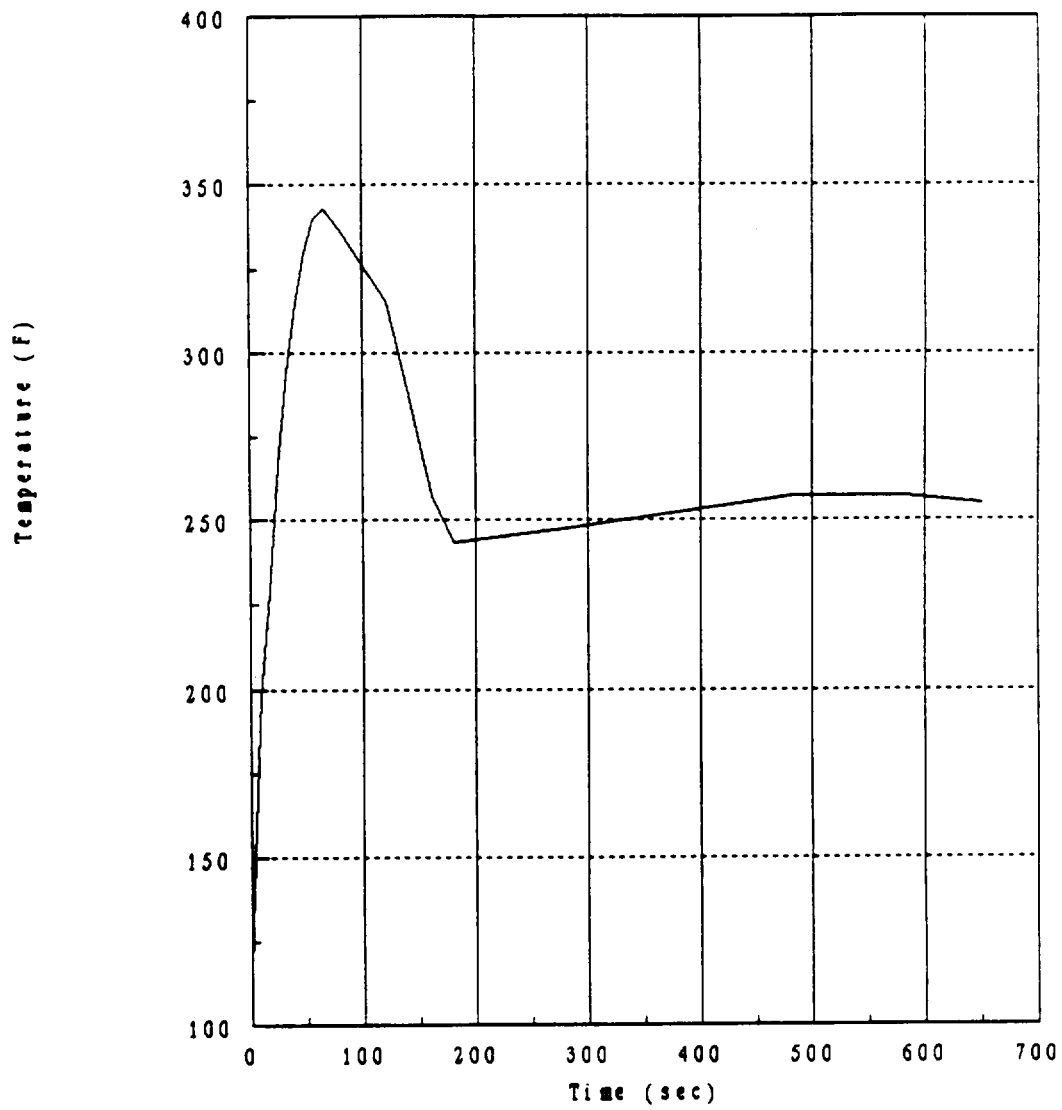


Figure 3-25
Case 8A
Containment Temperature
0.86 ft^2 Split Break
102% Power - MSIV Failure

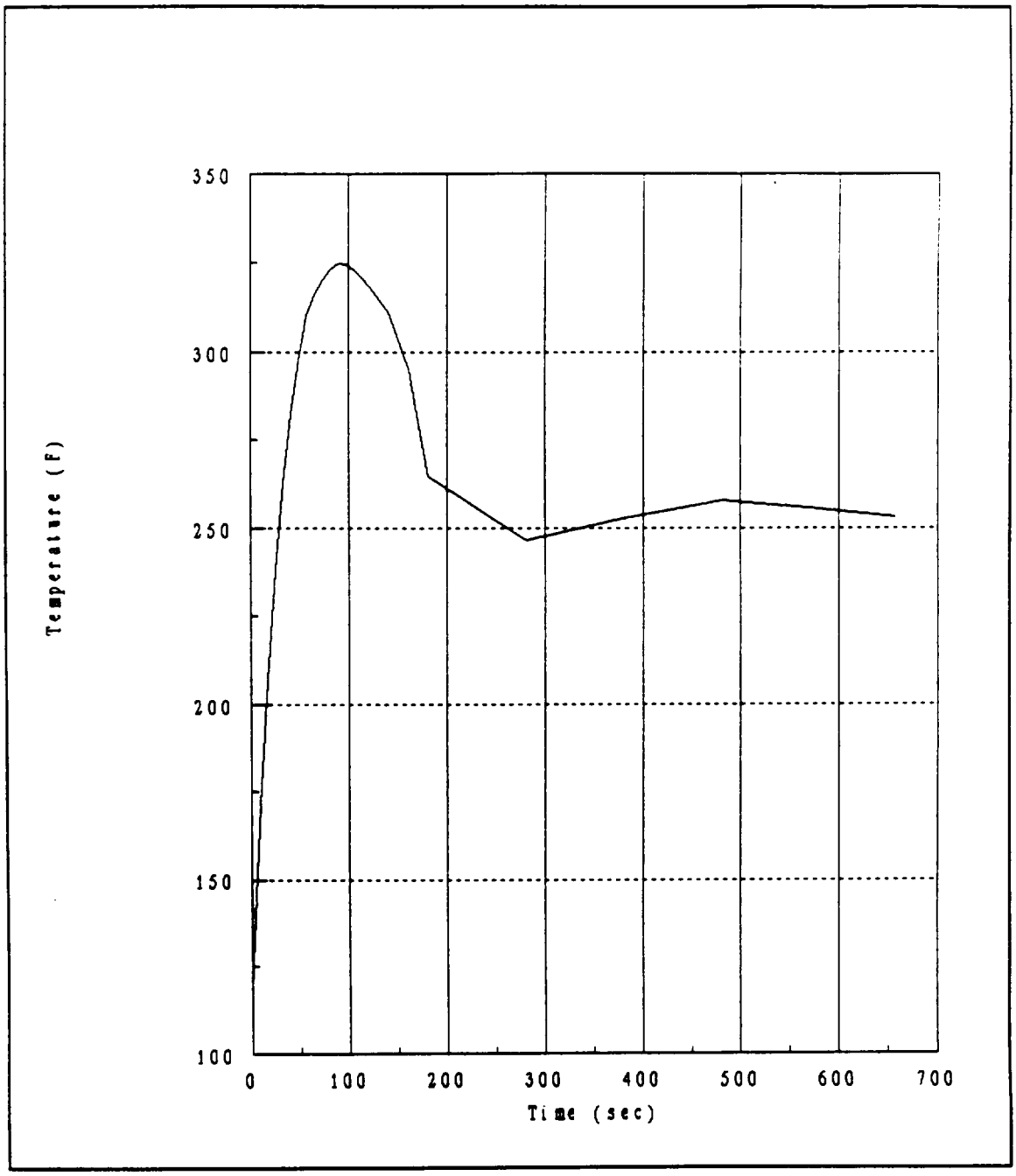


Figure 3-26
Case 9A
Containment Temperature
0.908 ft^2 Split Break
70% Power - MSIV Failure

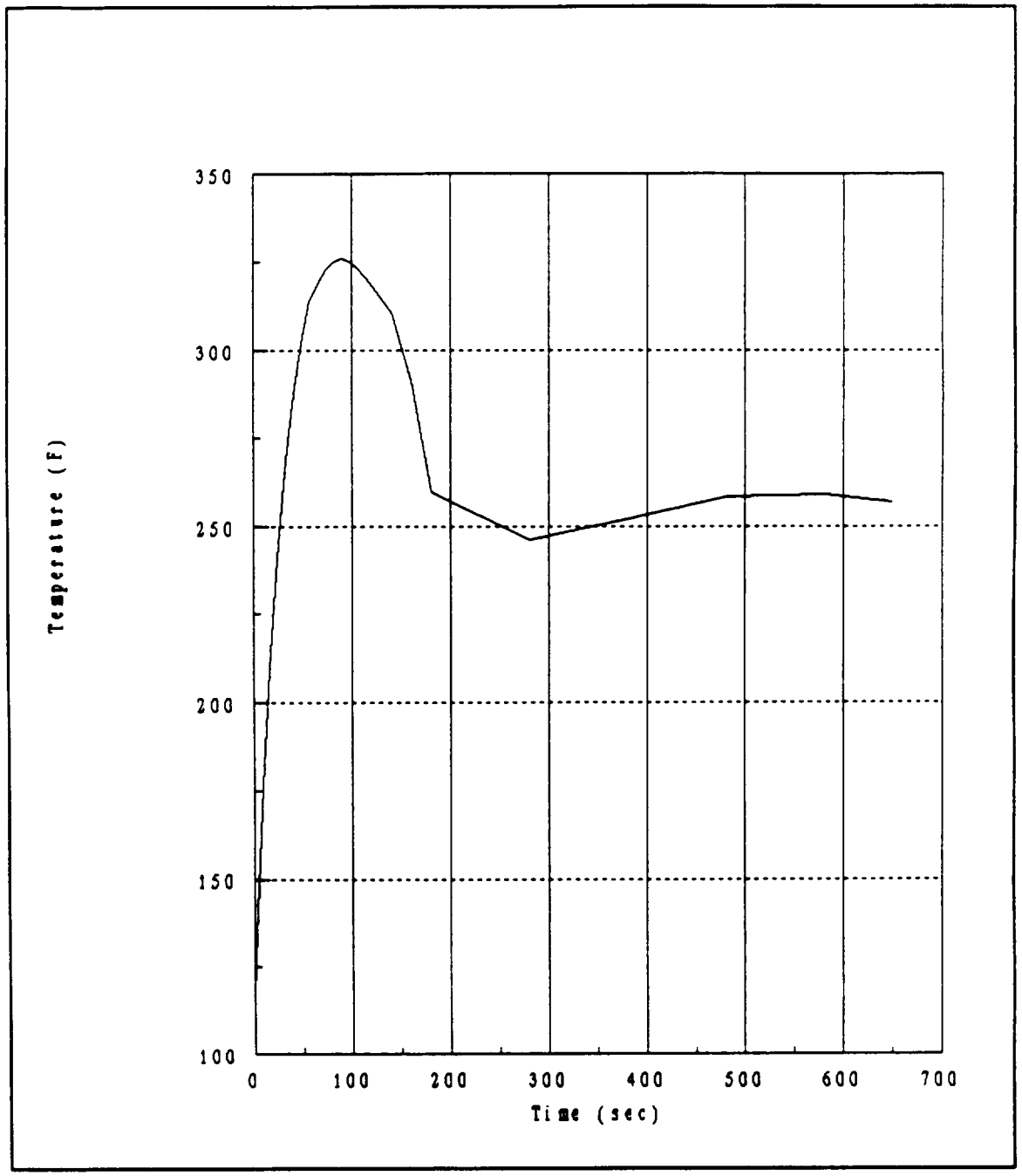


Figure 3-27
Case 10A
Containment Temperature
0.944 ft^2 Split Break
30% Power - MSIV Failure

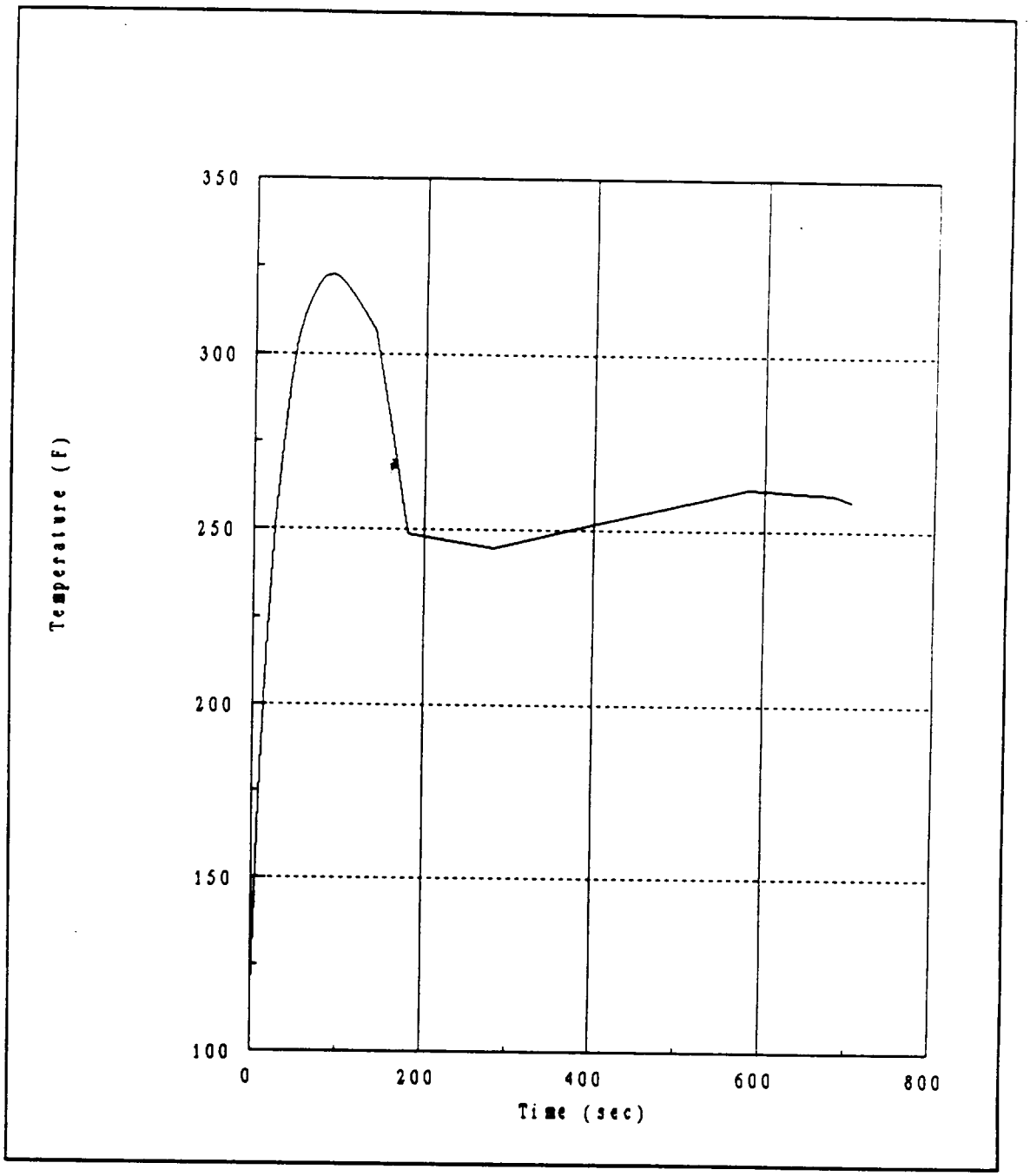


Figure 3-28
Case 10B
Containment Temperature
0.944 ft^2 Split Break
30% Power - MSIV Failure

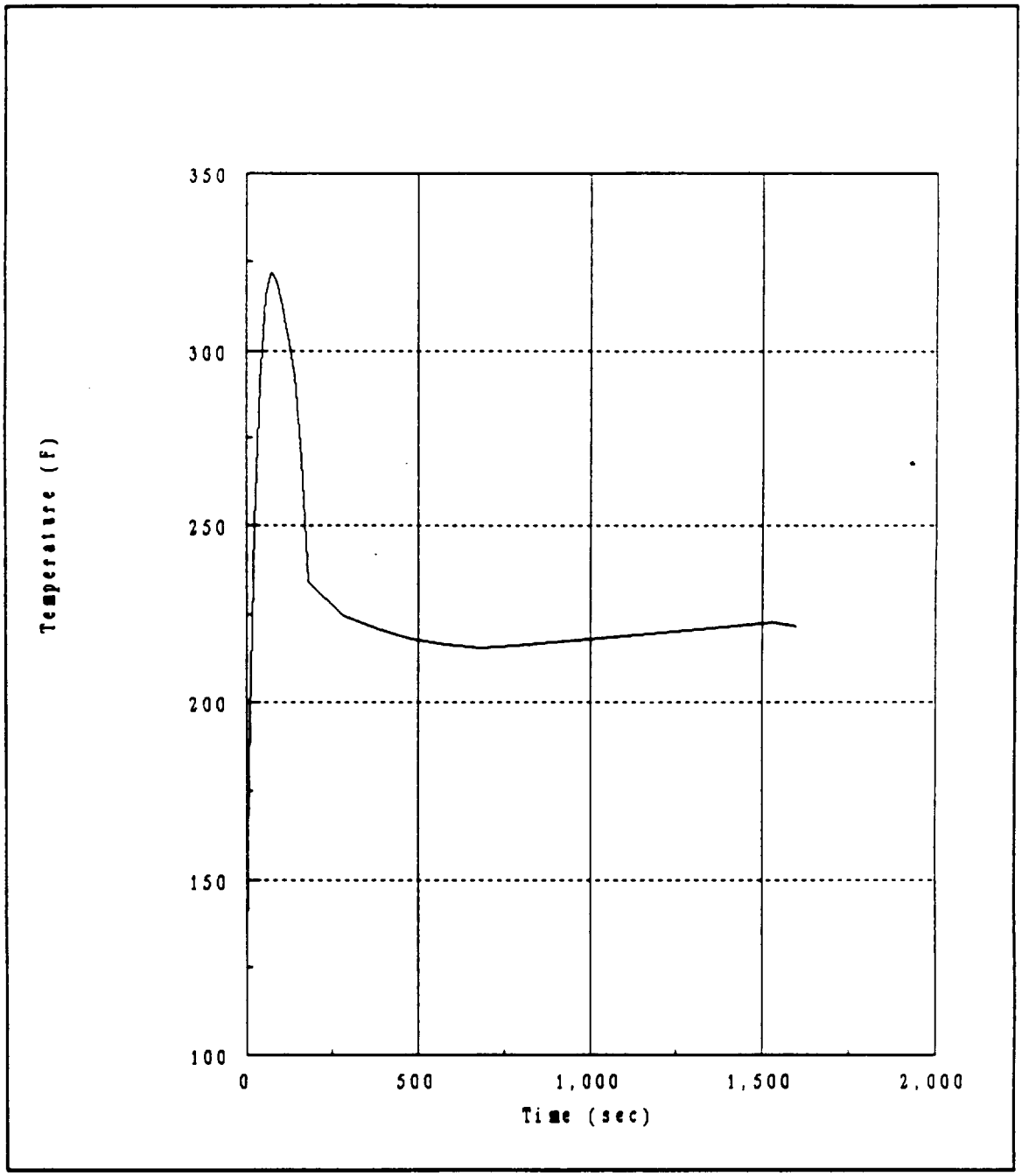


Figure 3-29
Case 11A
Containment Temperature
0.4 ft^2 Split Break
0% Power - MSIV Failure

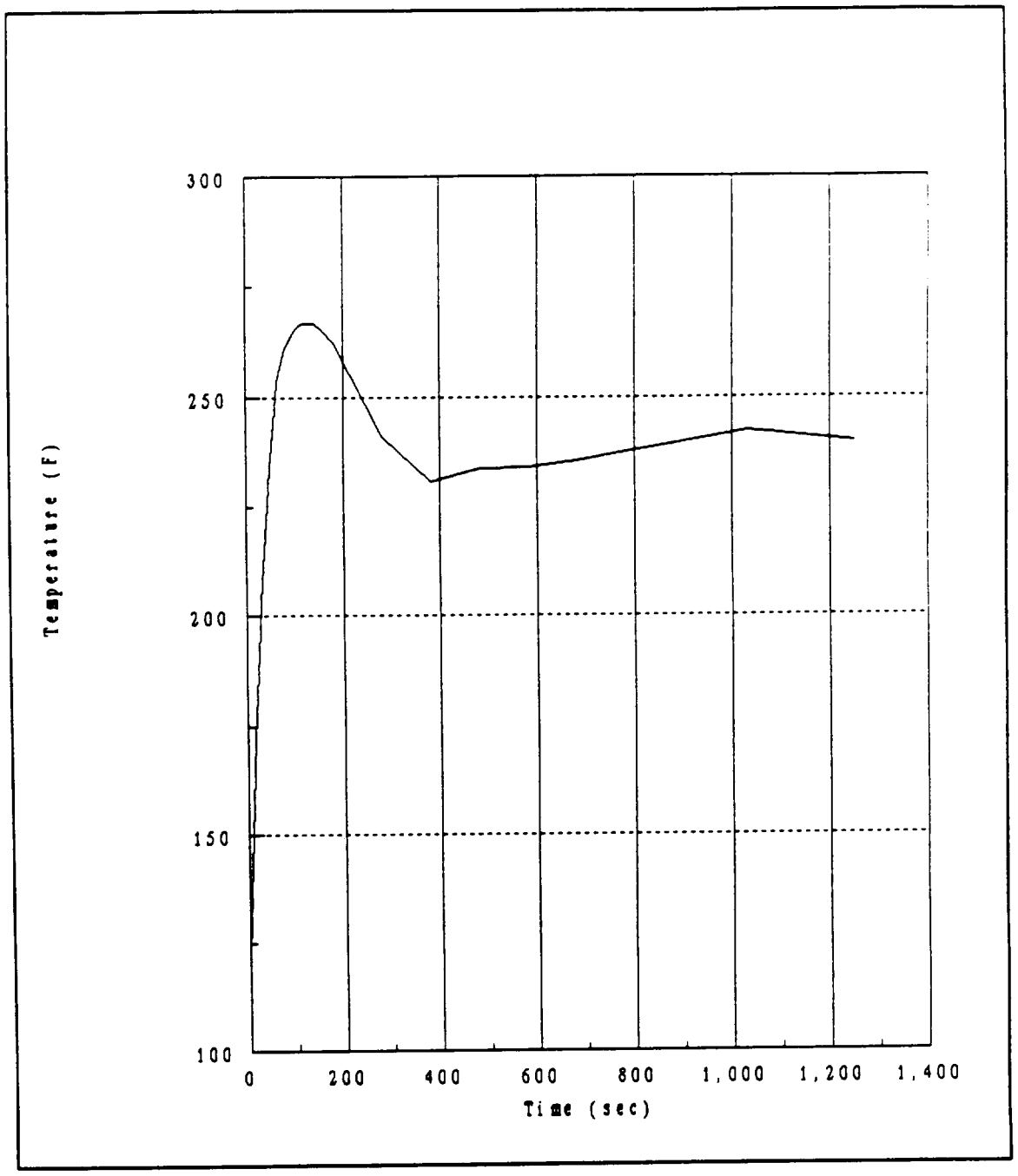


Figure 3-30
Case 12A
Containment Temperature
3.69 ft² Double Ended Rupture
102% Power - FRV Failure

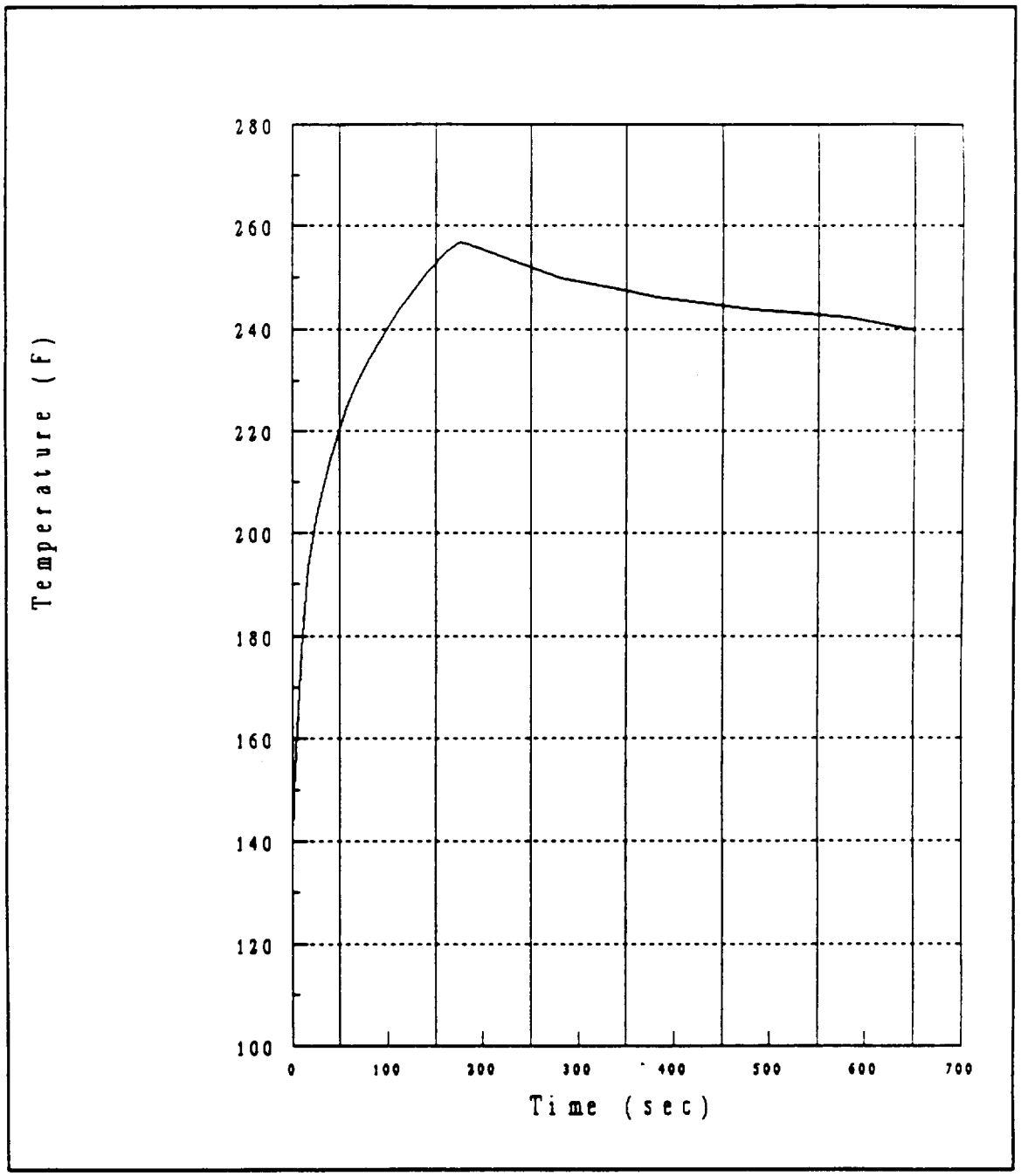


Figure 3-31
Case 13A
Containment Temperature
3.69 ft² Double Ended Rupture
70% Power - FRV Failure

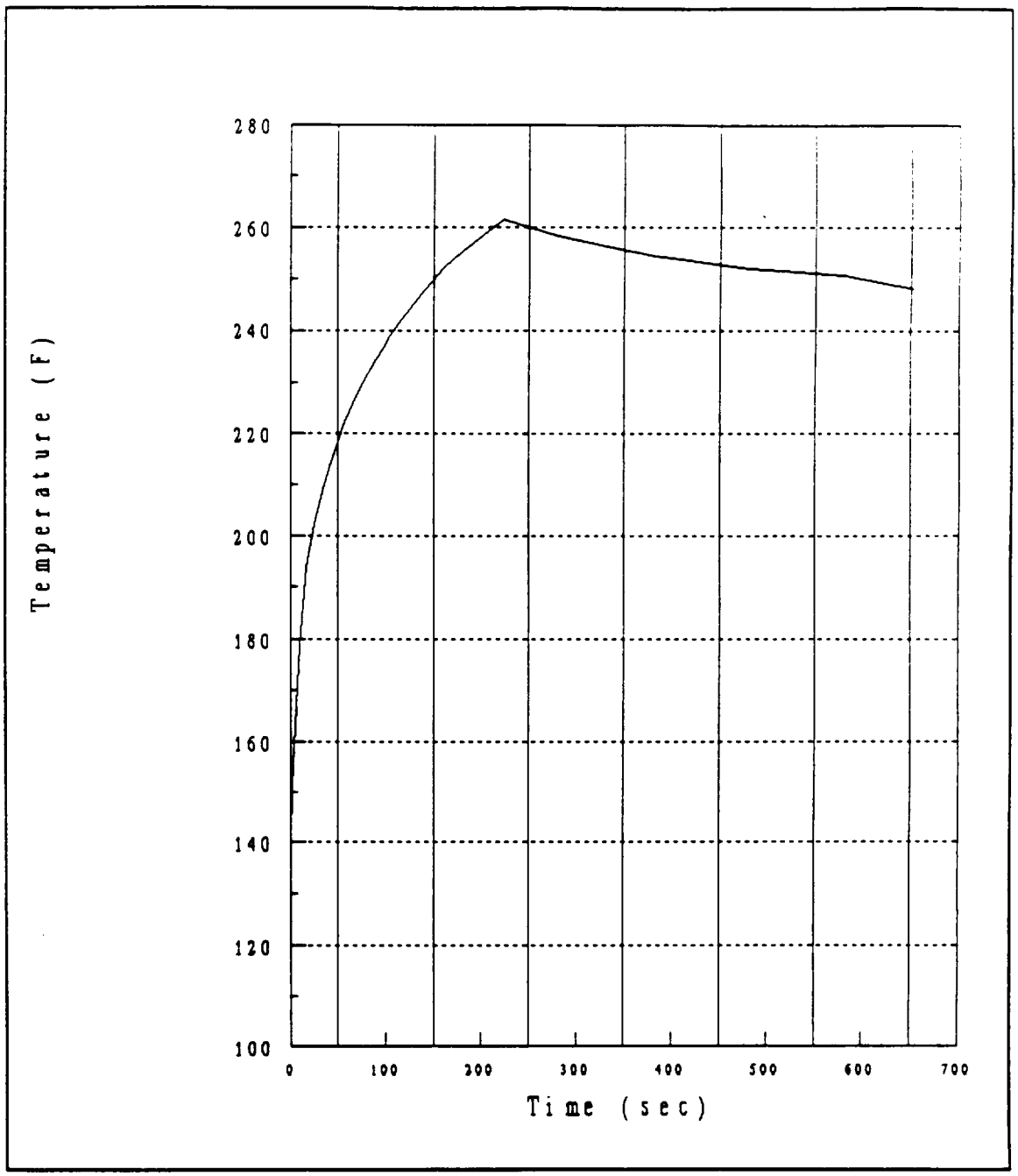


Figure 3-32
Case 14A
Containment Temperature
3.69 ft^2 Double Ended Rupture
30% Power - FRV Failure

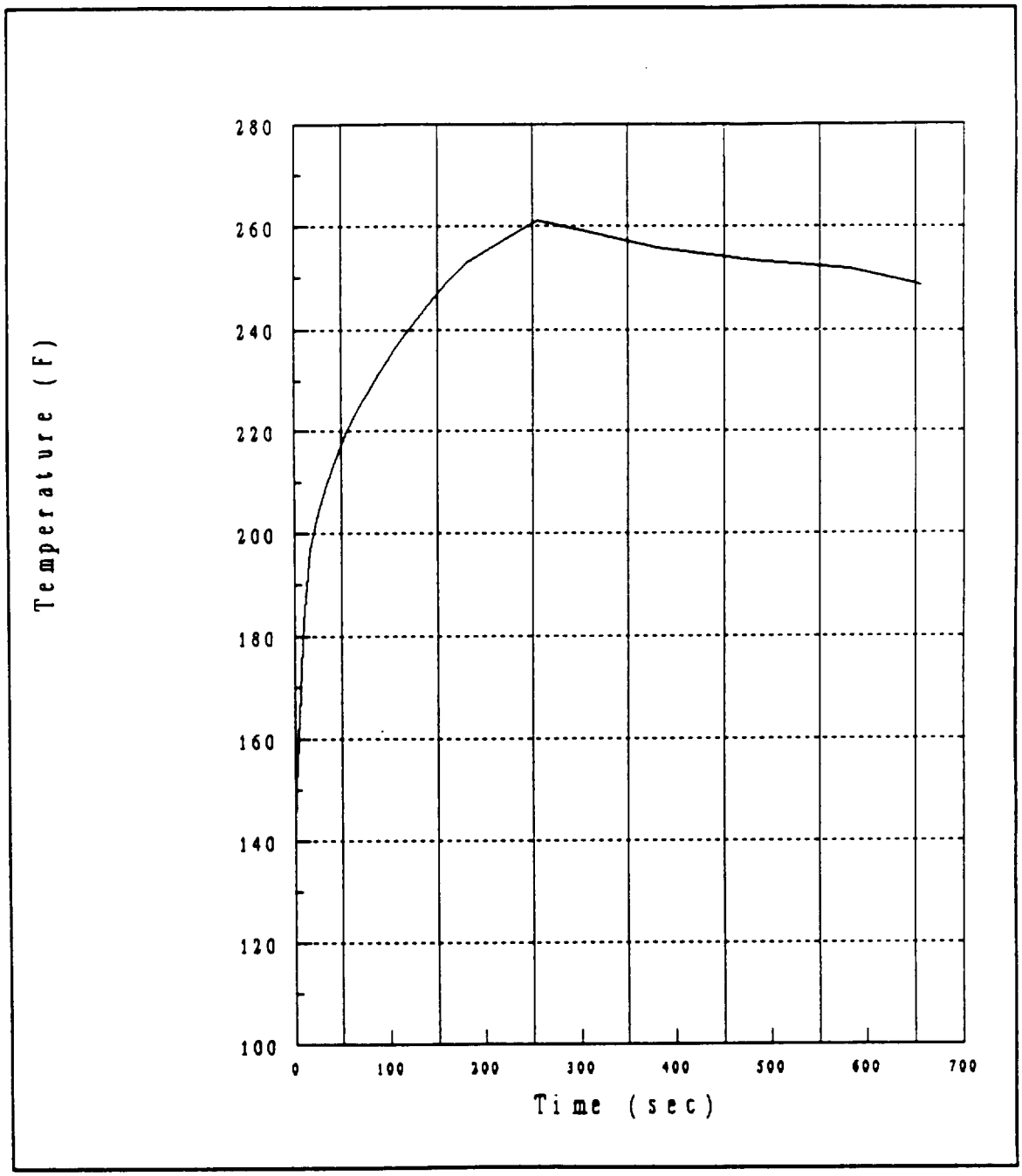


Figure 3-33
Case 15A
Containment Temperature
3.69 ft² Double Ended Rupture
0% Power - FRV Failure

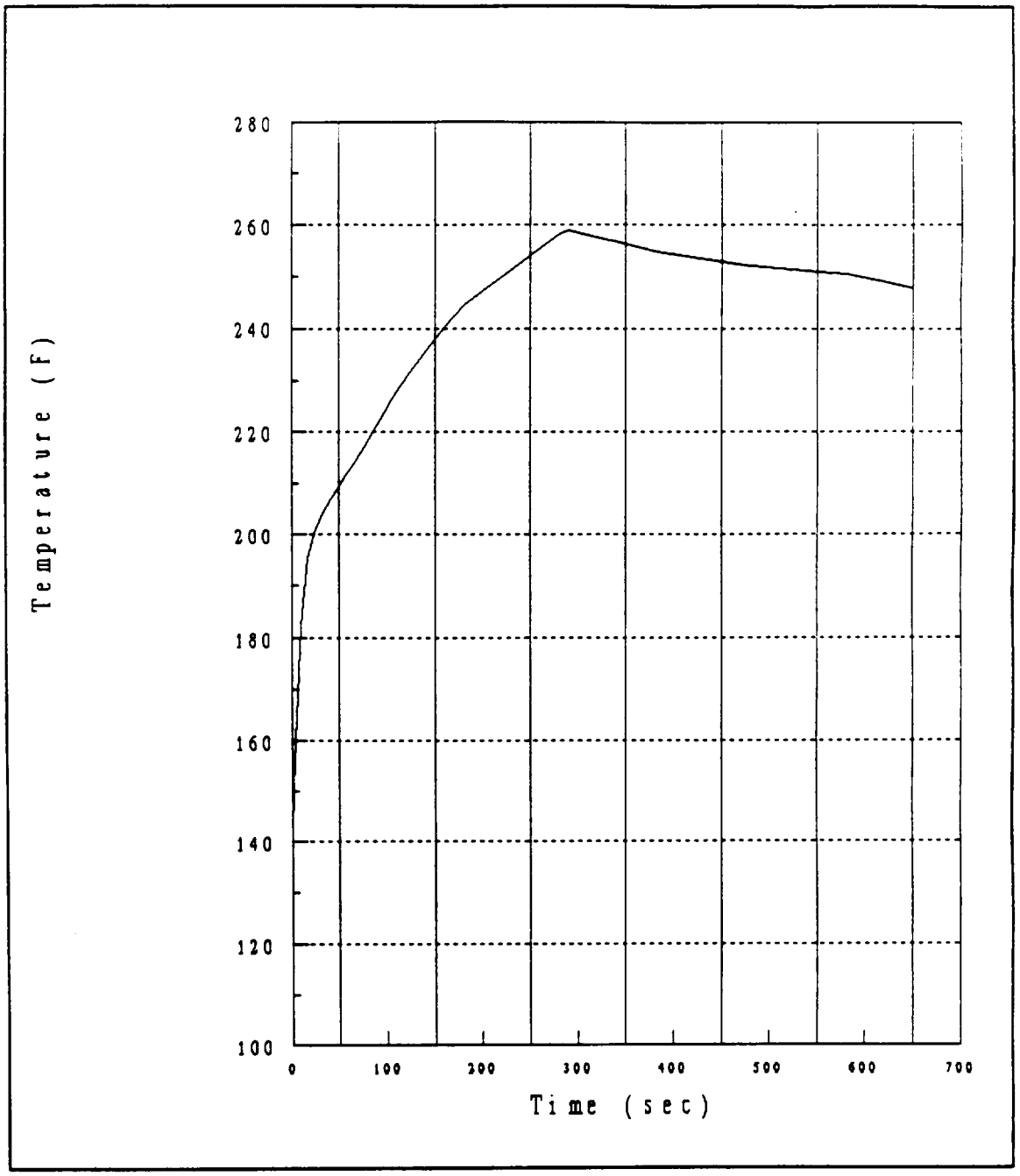


Figure 3-34
Case 16A
Containment Temperature
0.5 ft^2 Double Ended Rupture
70% Power - SSPS Failure

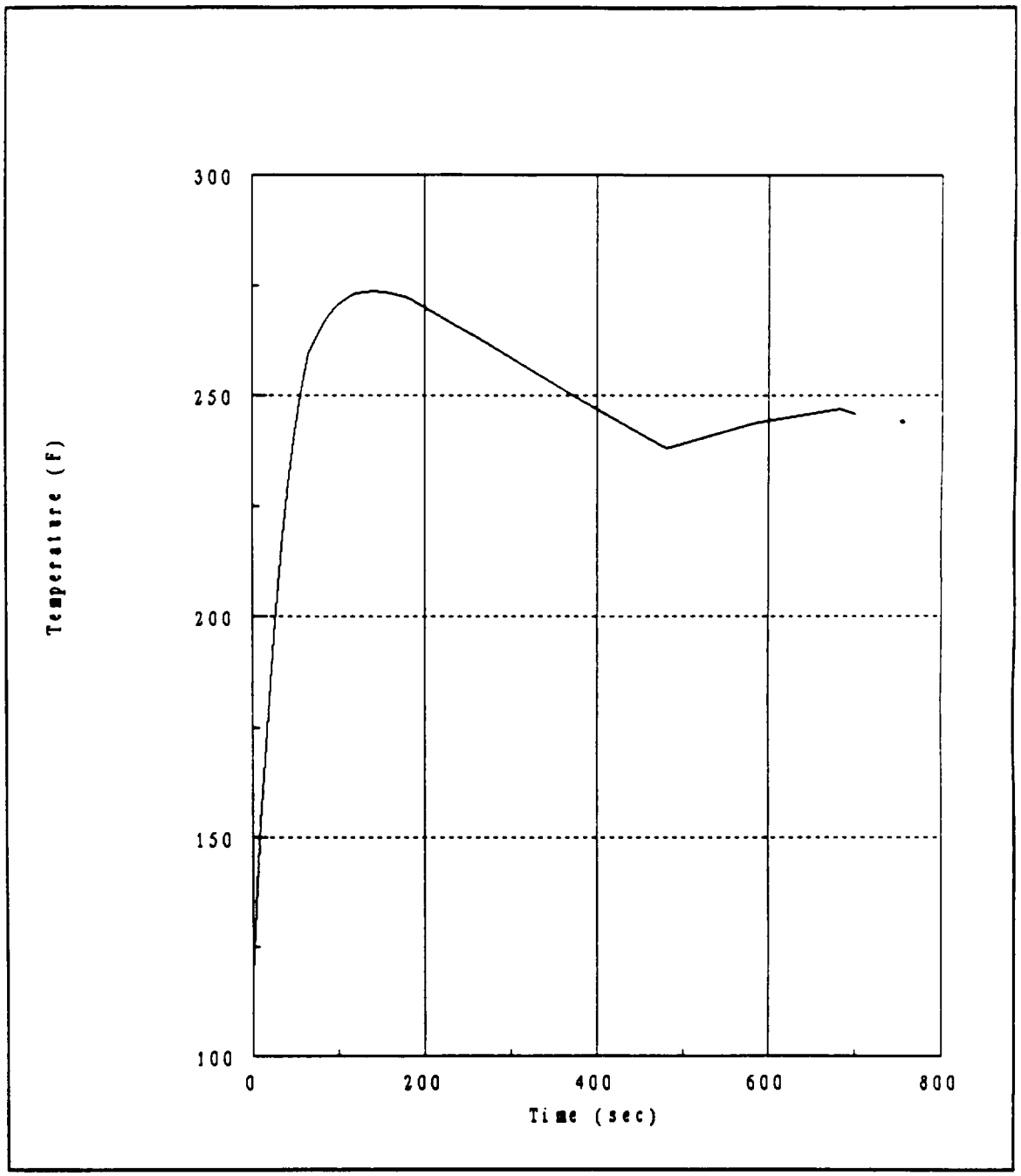


Figure 3-35
Composite Temperature Plot

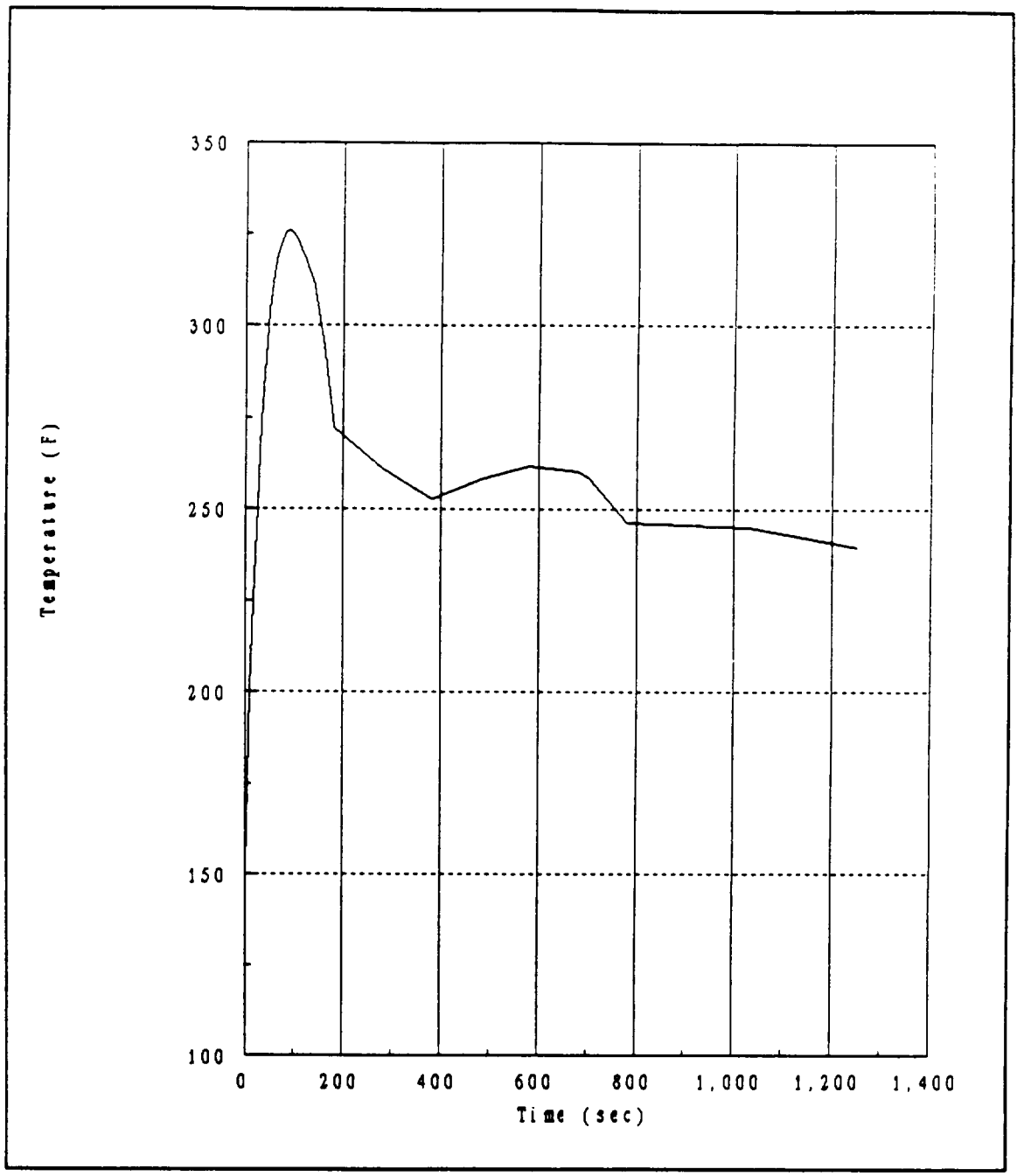


Figure 3-36
Case 10A
Fan Cooler Delay Sensitivity
Containment Pressure Versus Time

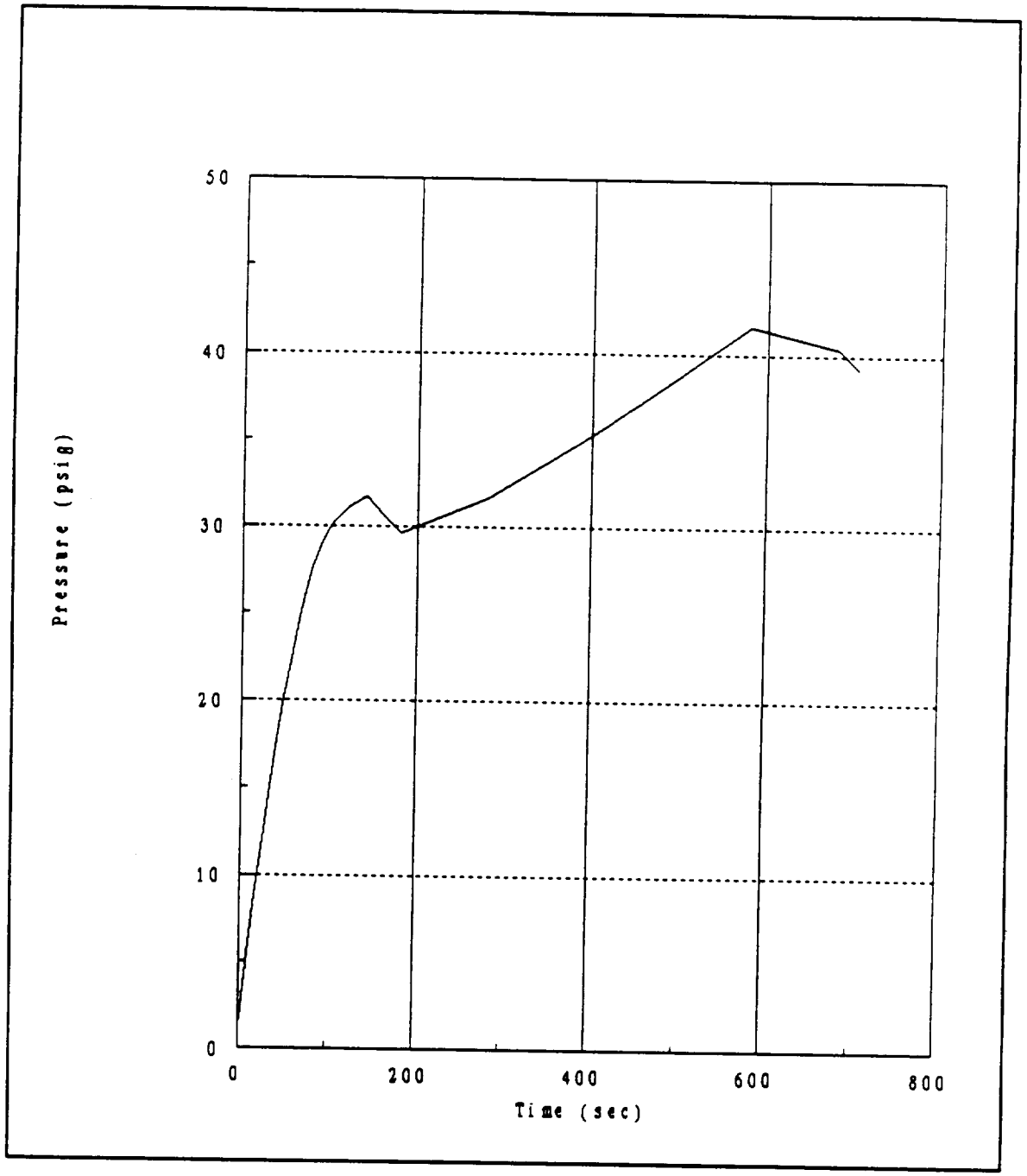


Figure 3-37
Case 10A
Fan Cooler Delay Sensitivity
Containment Temperature Versus Time

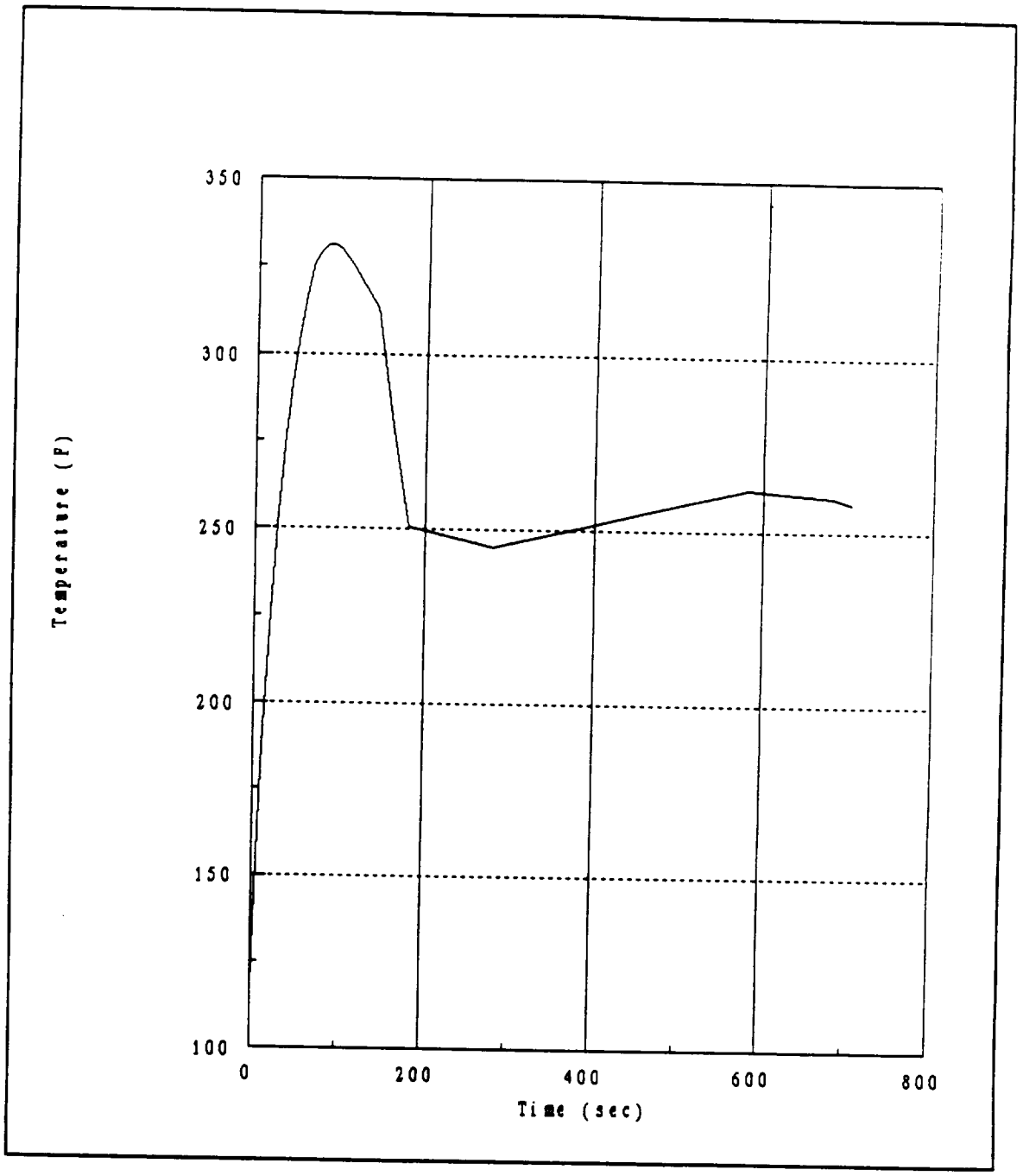


Figure 3-38
Case 10A
Humidity Sensitivity
Containment Pressure Versus Time

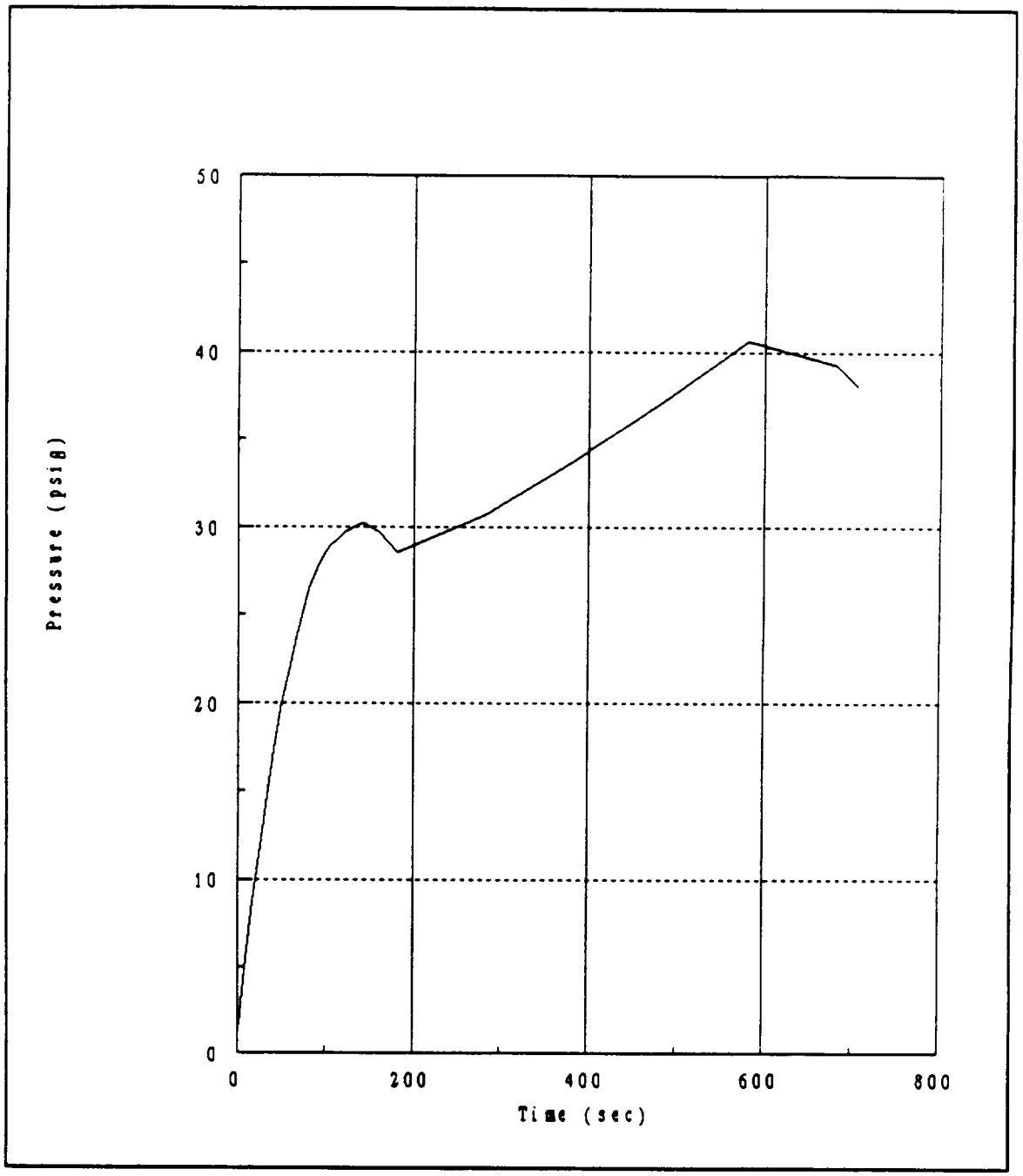


Figure 3-39
Case 10A
Humidity Sensitivity
Containment Temperature Versus Time

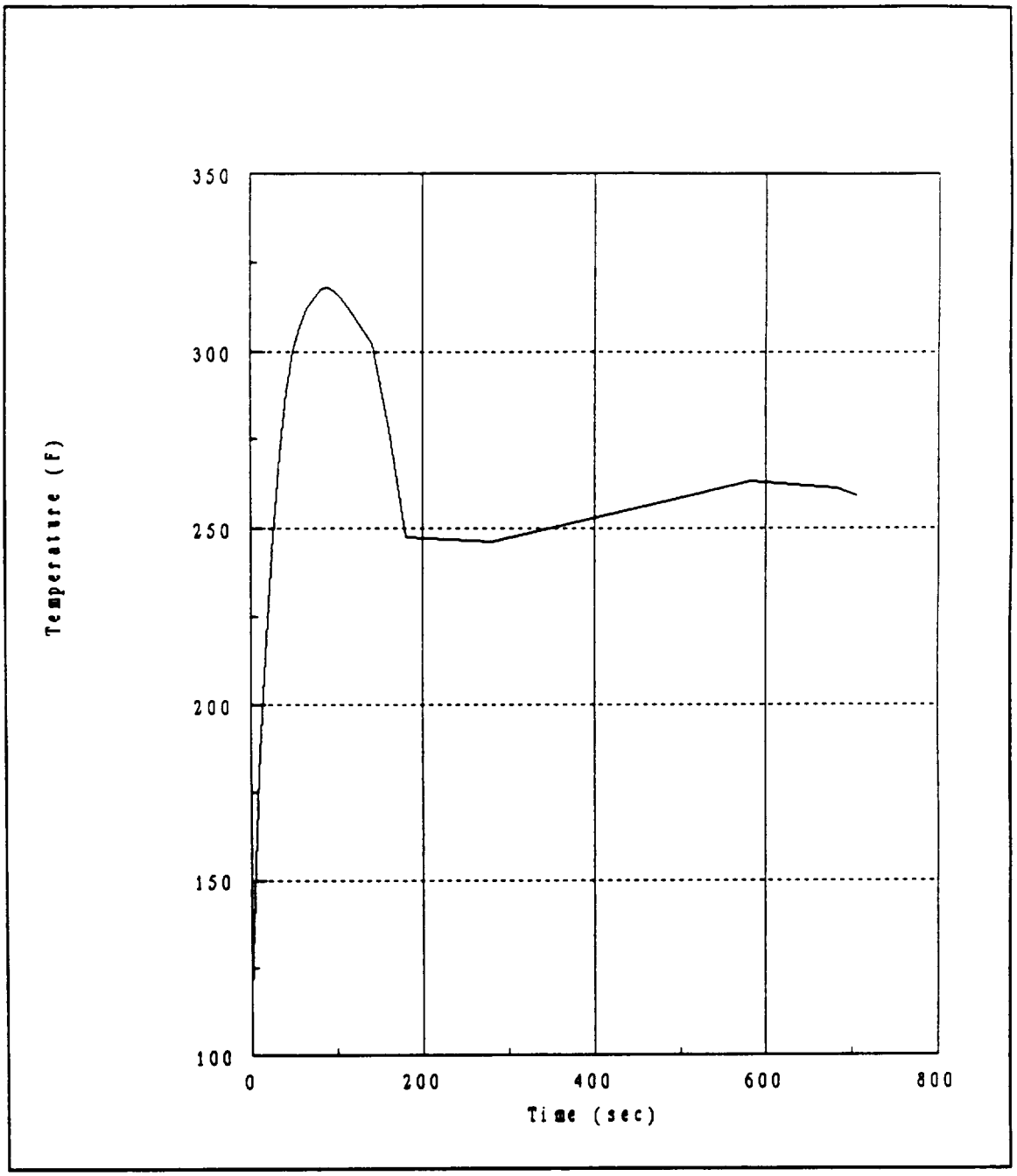


Figure 3-40
Case 9A
Humidity Sensitivity
Containment Pressure Versus Time

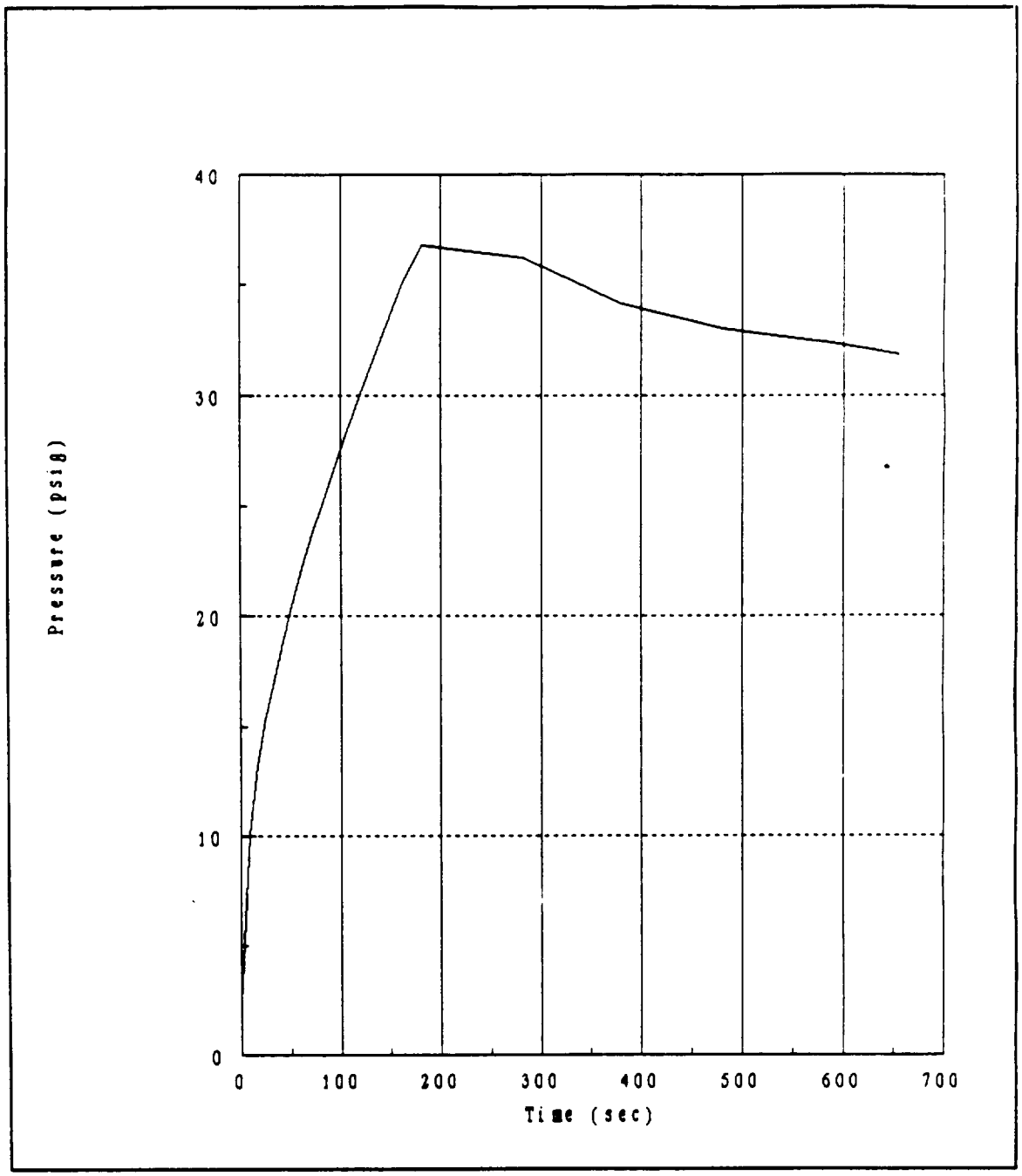
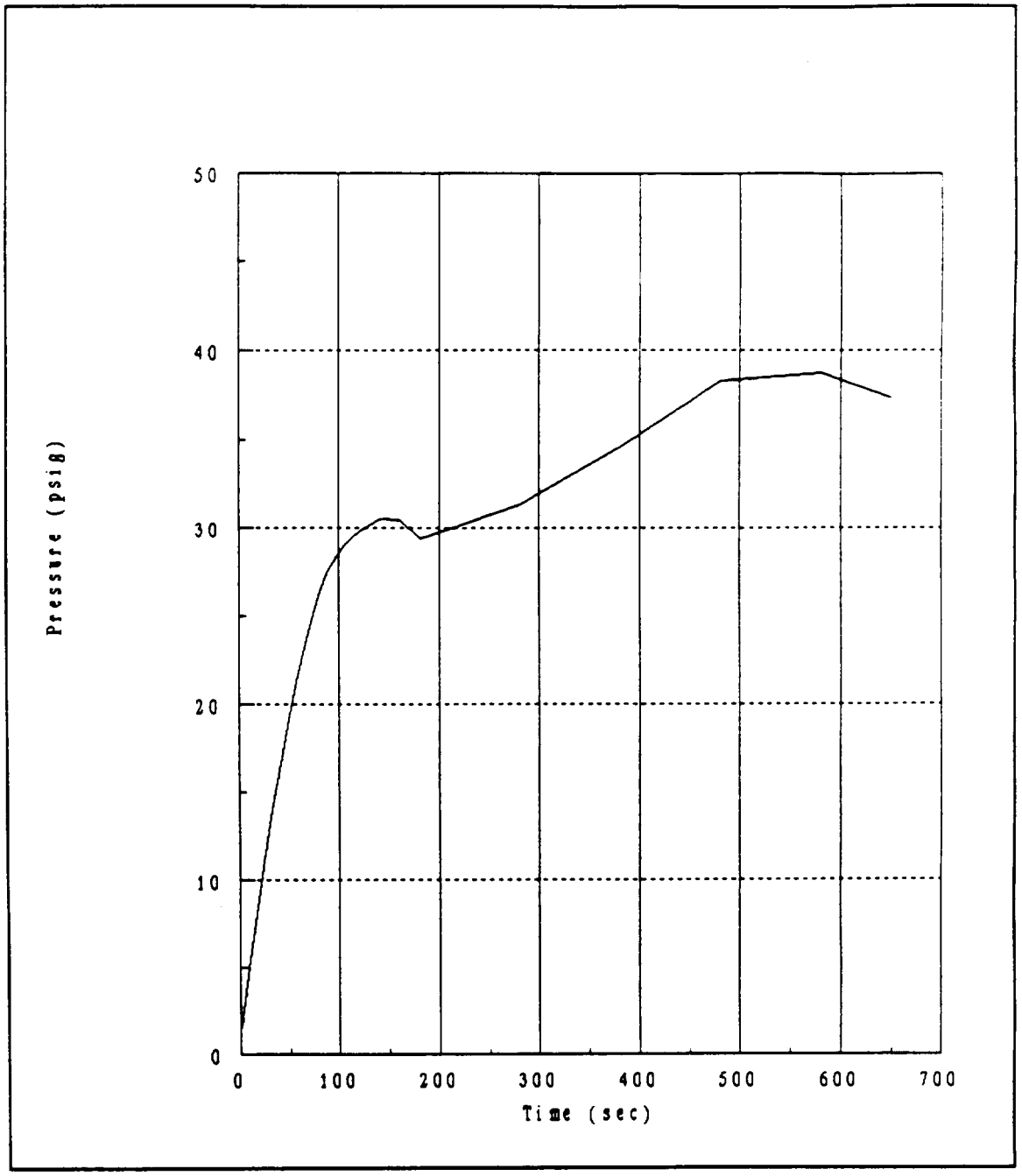


Figure 3-41
Case 9A
Humidity Sensitivity
Containment Temperature Versus Time



4.0 CONCLUSIONS

Based upon information provided in this report, it is demonstrated that the containment safeguards system are fully capable of mitigating the consequences of a hypothetical main steamline break. This analysis, based on current operating conditions, resulted in an overall peak pressure of 42.25 psig for a 30% power 0.944 ft^2 split break with the failure of a main steamline isolation valve. The calculated pressure margin is 4.75 psig to a containment design pressure of 47.0.

The composite temperature profile generated for this report is bounded, from 33 to 681 seconds, by the composite temperature profile in Reference 1. Reference 1 did not construct a composite profile beyond 681 seconds.

The containment pressure and temperature response is determined for both loss of coolant and main steamline break accidents. Hence, the LOCA may bound the main steamline break accident results.

5.0 REFERENCES

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2. Andre, S.V., "Westinghouse Setpoint Methodology for Protection Systems Diablo Canyon Stations Eagle 21 Version", WCAP-11082 Rev. 1, September 1992.

3. SECL-93-267,"Evaluation of a Reduction in the Containment High-High Safety Analysis Limit for the Diablo Canyon Units 1 and 2"

4. Land R. E., "Mass and Energy Releases Following a Steam Line Rupture", WCAP-8822 (Proprietary), WCAP-8860 (Non-Proprietary), September 1976.

5. Burnett, T. W. T., et al., "LOFTRAN Code Description", WCAP-7907-P-A (Proprietary), WCAP-7907-A (Non-Proprietary), April 1984.

6. Moody, F. J.,"Maximum Flow Rate of a Single Component, Two-Phase Mixture", Journal of Heat Transfer, 87, 134 (1965).

7. ANSI/ANS-5.1-1979,"American National Standard for Decay Heat Power in Light Water Reactors", August 1979.

8. PGE Letter - Philip A. Crane J.R to John F. Stolz, Response to NRC Request for Additional Information, January 28, 1980.

9. PGE Letter 209288 - Michael R. Tresler to Scott A. McHugh, "Input Data for New Containment Analysis", 6/28/93.

10. "Containment Pressure Analysis Code",WCAP-8327, June 1974

11. Schmitt, R. C., Bingham, G. E., and Norberg, J. A., "Simulated Design Basis Accident Tests of the Carolinas Virginia Tuber Reactor Containment - Final Report", IN-1403, Idaho Nuclear Corporation, December 1970.

12. "Auxiliary Salt Water and Component Cooling Water Flow and Temperature Study for Diablo Canyon Units 1 and 2",WCAP-12526, Revision 1, June 1992.

APPENDIX A

- Case 10A SG Pressure vs. Time
- Case 10A Mass and Energy Releases

LIMITING PEAK CONTAINMENT PRESSURE MASS AND ENERGY RELEASES

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
.0000	.0000	.0000	.0000	.0000
.2000	1959.	2.335	.3919	.4669
.4000	1952.	2.326	.7823	.9322
.6000	1952.	2.326	1.173	1.397
.8000	1945.	2.318	1.562	1.861
1.000	1939.	2.312	1.950	2.323
1.200	1933.	2.305	2.336	2.784
1.400	1928.	2.298	2.722	3.244
1.600	1922.	2.291	3.106	3.702
1.800	1916.	2.285	3.490	4.159
2.000	1911.	2.279	3.872	4.615
2.200	1905.	2.272	4.253	5.069
2.400	1900.	2.266	4.633	5.523
2.600	1895.	2.260	5.012	5.975
2.800	1889.	2.254	5.390	6.425
3.000	1884.	2.248	5.767	6.875
3.200	1879.	2.242	6.142	7.323
3.400	1874.	2.236	6.517	7.771
3.600	1869.	2.231	6.891	8.217
3.800	1864.	2.225	7.264	8.662
4.000	1860.	2.219	7.636	9.106
4.200	1855.	2.214	8.007	9.548
4.400	1850.	2.208	8.377	9.990
4.600	1846.	2.203	8.746	10.43
4.800	1841.	2.198	9.114	10.87
5.000	1837.	2.192	9.482	11.31
5.200	1832.	2.187	9.848	11.75
5.400	1828.	2.182	10.21	12.18
5.600	1823.	2.177	10.58	12.62
5.800	1819.	2.173	10.94	13.05
6.000	1815.	2.167	11.31	13.49
6.200	1811.	2.163	11.67	13.92
6.400	1807.	2.158	12.03	14.35
6.600	1803.	2.153	12.39	14.78
6.800	1799.	2.149	12.75	15.21
7.000	1795.	2.144	13.11	15.64
7.200	1791.	2.140	13.47	16.07
7.400	1787.	2.135	13.82	16.49
7.600	1783.	2.131	14.18	16.92
7.800	1780.	2.126	14.54	17.35
8.000	1776.	2.122	14.89	17.77
8.200	1772.	2.118	15.25	18.19

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
8.400	1769.	2.114	15.60	18.62
8.600	1765.	2.109	15.95	19.04
8.800	1762.	2.105	16.31	19.46
9.000	1758.	2.101	16.66	19.88
9.200	1754.	2.096	17.01	20.30
9.400	1750.	2.092	17.36	20.72
9.600	1746.	2.087	17.71	21.13
9.800	1742.	2.083	18.06	21.55
10.00	1739.	2.078	18.40	21.97
10.20	1735.	2.074	18.75	22.38
10.40	1731.	2.070	19.10	22.80
10.60	1734.	2.073	19.44	23.21
10.80	1734.	2.074	19.79	23.63
11.00	1734.	2.074	20.14	24.04
11.20	1734.	2.073	20.48	24.45
11.40	1732.	2.072	20.83	24.87
11.60	1731.	2.070	21.18	25.28
11.80	1730.	2.069	21.52	25.70
12.00	1729.	2.068	21.87	26.11
12.20	1729.	2.067	22.21	26.52
12.40	1728.	2.066	22.56	26.94
12.60	1727.	2.065	22.90	27.35
12.80	1726.	2.064	23.25	27.76
13.00	1725.	2.063	23.59	28.18
13.20	1724.	2.062	23.94	28.59
13.40	1723.	2.061	24.28	29.00
13.60	1722.	2.060	24.63	29.41
13.80	1722.	2.059	24.97	29.82
14.00	1721.	2.058	25.32	30.24
14.20	1720.	2.057	25.66	30.65
14.40	1720.	2.057	26.01	31.06
14.60	1719.	2.056	26.35	31.47
14.80	1718.	2.055	26.69	31.88
15.00	1718.	2.054	27.04	32.29
15.20	1717.	2.053	27.38	32.70
15.40	1716.	2.053	27.72	33.11
15.60	1716.	2.052	28.07	33.52
15.80	1715.	2.051	28.41	33.93
16.00	1714.	2.050	28.75	34.34
16.20	1713.	2.049	29.09	34.75
16.40	1713.	2.048	29.44	35.16
16.60	1712.	2.048	29.78	35.57
16.80	1711.	2.047	30.12	35.98
17.00	1710.	2.045	30.46	36.39

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
17.20	1709.	2.044	30.81	36.80
17.40	1708.	2.043	31.15	37.21
17.60	1707.	2.042	31.49	37.62
17.80	1706.	2.040	31.83	38.02
18.00	1705.	2.039	32.17	38.43
18.20	1705.	2.039	32.51	38.84
18.40	1704.	2.038	32.85	39.25
18.60	1702.	2.036	33.19	39.65
18.80	1702.	2.035	33.53	40.06
19.00	1701.	2.034	33.87	40.47
19.20	1699.	2.033	34.21	40.88
19.40	1698.	2.032	34.55	41.28
19.60	1697.	2.030	34.89	41.69
19.80	1696.	2.029	35.23	42.09
20.00	1694.	2.027	35.57	42.50
20.50	1692.	2.024	36.42	43.51
21.00	1688.	2.020	37.26	44.52
21.50	1684.	2.015	38.10	45.53
22.00	1680.	2.010	38.94	46.53
22.50	1675.	2.005	39.78	47.54
23.00	1671.	1.999	40.62	48.54
23.50	1666.	1.994	41.45	49.53
24.00	1661.	1.988	42.28	50.53
24.50	1656.	1.983	43.11	51.52
25.00	1652.	1.977	43.93	52.51
25.50	1647.	1.972	44.76	53.49
26.00	1642.	1.966	45.58	54.48
26.50	1638.	1.961	46.40	55.46
27.00	1633.	1.955	47.21	56.43
27.50	1628.	1.950	48.03	57.41
28.00	1623.	1.944	48.84	58.38
28.50	1619.	1.938	49.65	59.35
29.00	1614.	1.933	50.45	60.32
29.50	1609.	1.927	51.26	61.28
30.00	1604.	1.921	52.06	62.24
30.50	1599.	1.915	52.86	63.20
31.00	1594.	1.910	53.66	64.15
31.50	1589.	1.904	54.45	65.10
32.00	1584.	1.898	55.24	66.05
32.50	1579.	1.892	56.03	67.00
33.00	1574.	1.886	56.82	67.94
33.50	1569.	1.880	57.61	68.88
34.00	1564.	1.875	58.39	69.82
34.50	1559.	1.869	59.17	70.75

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
35.00	1555.	1.863	59.94	71.69
35.50	1549.	1.857	60.72	72.61
36.00	1545.	1.852	61.49	73.54
36.50	1539.	1.845	62.26	74.46
37.00	1535.	1.840	63.03	75.38
37.50	1530.	1.834	63.79	76.30
38.00	1525.	1.829	64.56	77.21
38.50	1520.	1.823	65.32	78.13
39.00	1516.	1.817	66.07	79.03
39.50	1510.	1.811	66.83	79.94
40.00	1506.	1.806	67.58	80.84
40.50	1501.	1.800	68.33	81.74
41.00	1497.	1.795	69.08	82.64
41.50	1491.	1.789	69.83	83.53
42.00	1487.	1.784	70.57	84.43
42.50	1482.	1.778	71.31	85.32
43.00	1477.	1.772	72.05	86.20
43.50	1473.	1.767	72.79	87.09
44.00	1468.	1.762	73.52	87.97
44.50	1464.	1.756	74.25	88.84
45.00	1459.	1.751	74.98	89.72
45.50	1455.	1.746	75.71	90.59
46.00	1450.	1.740	76.43	91.46
46.50	1446.	1.735	77.16	92.33
47.00	1441.	1.730	77.88	93.19
47.50	1437.	1.724	78.60	94.06
48.00	1432.	1.719	79.31	94.92
48.50	1428.	1.714	80.03	95.77
49.00	1423.	1.708	80.74	96.63
49.50	1419.	1.703	81.45	97.48
50.00	1415.	1.698	82.15	98.33
50.50	1410.	1.693	82.86	99.17
51.00	1406.	1.688	83.56	100.0
51.50	1401.	1.683	84.26	100.9
52.00	1397.	1.677	84.96	101.7
52.50	1393.	1.672	85.66	102.5
53.00	1389.	1.667	86.35	103.4
53.50	1384.	1.662	87.04	104.2
54.00	1380.	1.657	87.73	105.0
54.50	1376.	1.652	88.42	105.9
55.00	1372.	1.647	89.11	106.7
55.50	1367.	1.642	89.79	107.5
56.00	1363.	1.637	90.47	108.3
56.50	1359.	1.633	91.15	109.1

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
57.00	1355.	1.628	91.83	109.9
57.50	1351.	1.623	92.51	110.8
58.00	1347.	1.618	93.18	111.6
58.50	1343.	1.613	93.85	112.4
59.00	1339.	1.608	94.52	113.2
59.50	1335.	1.603	95.19	114.0
60.00	1331.	1.599	95.85	114.8
60.50	1327.	1.594	96.52	115.6
61.00	1323.	1.589	97.18	116.4
61.50	1319.	1.585	97.84	117.2
62.00	1315.	1.580	98.49	118.0
62.50	1311.	1.575	99.15	118.7
63.00	1307.	1.571	99.80	119.5
63.50	1303.	1.566	100.5	120.3
64.00	1299.	1.562	101.1	121.1
64.50	1295.	1.557	101.8	121.9
65.00	1292.	1.553	102.4	122.6
65.50	1288.	1.548	103.0	123.4
66.00	1284.	1.544	103.7	124.2
66.50	1281.	1.540	104.3	125.0
67.00	1277.	1.535	105.0	125.7
67.50	1273.	1.531	105.6	126.5
68.00	1270.	1.527	106.2	127.3
68.50	1266.	1.522	106.9	128.0
69.00	1263.	1.518	107.5	128.8
69.50	1259.	1.514	108.1	129.5
70.00	1255.	1.509	108.8	130.3
70.50	1252.	1.505	109.4	131.0
71.00	1248.	1.501	110.0	131.8
71.50	1245.	1.497	110.6	132.5
72.00	1241.	1.492	111.2	133.3
72.50	1237.	1.488	111.9	134.0
73.00	1234.	1.484	112.5	134.8
73.50	1230.	1.480	113.1	135.5
74.00	1227.	1.475	113.7	136.3
74.50	1223.	1.471	114.3	137.0
75.00	1220.	1.467	114.9	137.7
75.50	1216.	1.463	115.5	138.5
76.00	1213.	1.459	116.1	139.2
76.50	1209.	1.455	116.8	139.9
77.00	1206.	1.451	117.4	140.6
77.50	1203.	1.446	118.0	141.4
78.00	1199.	1.442	118.6	142.1
78.50	1196.	1.438	119.2	142.8

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
79.00	1192.	1.434	119.8	143.5
79.50	1189.	1.430	120.3	144.2
80.00	1188.	1.429	120.9	144.9
80.50	1161.	1.397	121.5	145.6
81.00	1142.	1.374	122.1	146.3
81.50	1124.	1.353	122.7	147.0
82.00	1107.	1.333	123.2	147.7
82.50	1091.	1.313	123.8	148.3
83.00	1075.	1.295	124.3	149.0
83.50	1060.	1.277	124.8	149.6
84.00	1046.	1.259	125.3	150.2
84.50	1032.	1.242	125.9	150.9
85.00	1018.	1.226	126.4	151.5
85.50	1005.	1.210	126.9	152.1
86.00	992.6	1.195	127.4	152.7
86.50	980.4	1.181	127.9	153.3
87.00	968.6	1.167	128.3	153.9
87.50	957.3	1.153	128.8	154.4
88.00	946.4	1.140	129.3	155.0
88.50	935.8	1.127	129.8	155.6
89.00	925.6	1.115	130.2	156.1
89.50	915.4	1.103	130.7	156.7
90.00	905.9	1.091	131.1	157.2
90.50	896.6	1.080	131.6	157.8
91.00	887.7	1.069	132.0	158.3
91.50	879.0	1.059	132.5	158.8
92.00	870.5	1.049	132.9	159.3
92.50	862.3	1.039	133.3	159.9
93.00	854.3	1.029	133.8	160.4
93.50	846.6	1.020	134.2	160.9
94.00	839.0	1.011	134.6	161.4
94.50	831.6	1.002	135.0	161.9
95.00	824.4	.9930	135.4	162.4
95.50	817.4	.9845	135.8	162.9
96.00	810.6	.9763	136.2	163.4
96.50	803.9	.9682	136.6	163.9
97.00	797.4	.9604	137.0	164.3
97.50	791.0	.9527	137.4	164.8
98.00	784.8	.9451	137.8	165.3
98.50	778.7	.9378	138.2	165.8
99.00	772.7	.9306	138.6	166.2
99.50	766.9	.9236	139.0	166.7
100.0	761.2	.9167	139.4	167.1
101.0	752.8	.9066	140.1	168.0

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
102.0	742.2	.8938	140.9	168.9
103.0	732.1	.8816	141.6	169.8
104.0	722.4	.8698	142.3	170.7
105.0	713.1	.8586	143.0	171.6
106.0	704.2	.8478	143.7	172.4
107.0	695.6	.8375	144.4	173.2
108.0	687.4	.8276	145.1	174.1
109.0	679.5	.8180	145.8	174.9
110.0	671.9	.8088	146.5	175.7
111.0	664.6	.8000	147.1	176.5
112.0	657.6	.7915	147.8	177.3
113.0	650.8	.7833	148.4	178.1
114.0	644.3	.7754	149.1	178.8
115.0	638.0	.7678	149.7	179.6
116.0	631.9	.7605	150.4	180.4
117.0	626.1	.7534	151.0	181.1
118.0	620.5	.7467	151.6	181.9
119.0	615.1	.7401	152.2	182.6
120.0	609.9	.7338	152.8	183.3
121.0	604.9	.7278	153.4	184.1
122.0	600.1	.7219	154.0	184.8
123.0	595.4	.7163	154.6	185.5
124.0	590.9	.7108	155.2	186.2
125.0	586.6	.7056	155.8	186.9
126.0	582.4	.7006	156.4	187.6
127.0	578.4	.6957	157.0	188.3
128.0	574.5	.6910	157.5	189.0
129.0	570.8	.6865	158.1	189.7
130.0	567.2	.6822	158.7	190.4
131.0	563.7	.6780	159.2	191.1
132.0	560.4	.6739	159.8	191.7
133.0	557.2	.6700	160.4	192.4
134.0	554.1	.6663	160.9	193.1
135.0	551.1	.6626	161.5	193.7
136.0	548.2	.6591	162.0	194.4
137.0	545.4	.6558	162.6	195.0
138.0	542.8	.6525	163.1	195.7
139.0	540.2	.6494	163.6	196.4
140.0	537.7	.6464	164.2	197.0
141.0	535.3	.6435	164.7	197.6
142.0	533.0	.6408	165.3	198.3
143.0	530.8	.6381	165.8	198.9
144.0	528.7	.6355	166.3	199.6
145.0	526.7	.6331	166.8	200.2

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
146.0	524.7	.6307	167.4	200.8
147.0	522.8	.6284	167.9	201.4
148.0	521.0	.6262	168.4	202.1
149.0	519.3	.6241	168.9	202.7
150.0	517.7	.6221	169.4	203.3
151.0	516.1	.6202	170.0	203.9
152.0	514.6	.6184	170.5	204.6
153.0	513.1	.6166	171.0	205.2
154.0	511.7	.6150	171.5	205.8
155.0	510.4	.6134	172.0	206.4
156.0	509.1	.6118	172.5	207.0
157.0	507.9	.6104	173.0	207.6
158.0	506.8	.6090	173.5	208.2
159.0	505.7	.6076	174.0	208.8
160.0	504.6	.6064	174.5	209.4
161.0	503.6	.6052	175.0	210.1
162.0	502.7	.6040	175.6	210.7
163.0	501.8	.6029	176.1	211.3
164.0	501.0	.6019	176.6	211.9
165.0	500.2	.6009	177.1	212.5
166.0	499.4	.6000	177.6	213.1
167.0	498.7	.5992	178.1	213.7
168.0	498.0	.5983	178.6	214.3
169.0	497.4	.5975	179.0	214.9
170.0	496.7	.5968	179.5	215.5
171.0	496.2	.5961	180.0	216.1
172.0	495.6	.5955	180.5	216.6
173.0	495.1	.5948	181.0	217.2
174.0	494.6	.5942	181.5	217.8
175.0	494.2	.5937	182.0	218.4
176.0	493.7	.5932	182.5	219.0
177.0	493.3	.5927	183.0	219.6
178.0	493.0	.5922	183.5	220.2
179.0	492.6	.5918	184.0	220.8
180.0	492.3	.5914	184.5	221.4
181.0	492.0	.5910	185.0	222.0
182.0	491.7	.5907	185.5	222.6
183.0	491.4	.5903	186.0	223.2
184.0	491.2	.5900	186.5	223.8
185.0	490.9	.5898	186.9	224.3
186.0	490.7	.5895	187.4	224.9
187.0	490.5	.5892	187.9	225.5
188.0	490.3	.5890	188.4	226.1
189.0	490.1	.5888	188.9	226.7

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
190.0	490.0	.5886	189.4	227.3
191.0	489.8	.5884	189.9	227.9
192.0	489.7	.5882	190.4	228.5
193.0	489.5	.5881	190.9	229.1
194.0	489.4	.5879	191.4	229.6
195.0	489.3	.5878	191.8	230.2
196.0	489.2	.5877	192.3	230.8
197.0	489.1	.5876	192.8	231.4
198.0	489.0	.5874	193.3	232.0
199.0	488.9	.5873	193.8	232.6
200.0	488.9	.5873	194.3	233.2
201.0	488.8	.5872	194.8	233.8
203.5	488.7	.5870	196.0	235.2
206.0	488.6	.5869	197.2	236.7
208.5	488.5	.5868	198.4	238.2
211.0	488.5	.5868	199.7	239.6
213.5	488.4	.5867	200.9	241.1
216.0	488.4	.5867	202.1	242.6
218.5	488.3	.5866	203.3	244.0
221.0	488.3	.5866	204.5	245.5
223.5	488.3	.5866	205.8	247.0
226.0	488.3	.5866	207.0	248.4
228.5	488.3	.5866	208.2	249.9
231.0	488.3	.5866	209.4	251.4
233.5	488.3	.5866	210.6	252.8
236.0	488.4	.5867	211.9	254.3
238.5	488.4	.5867	213.1	255.8
241.0	488.4	.5867	214.3	257.2
243.5	488.4	.5867	215.5	258.7
246.0	488.5	.5868	216.8	260.2
248.5	488.5	.5868	218.0	261.6
251.0	488.5	.5868	219.2	263.1
253.5	488.5	.5869	220.4	264.6
256.0	488.6	.5869	221.6	266.0
258.5	488.6	.5869	222.9	267.5
261.0	488.6	.5869	224.1	269.0
263.5	488.6	.5870	225.3	270.4
266.0	488.6	.5870	226.5	271.9
268.5	488.7	.5870	227.7	273.4
271.0	488.7	.5870	229.0	274.8
273.5	488.7	.5871	230.2	276.3
276.0	488.7	.5871	231.4	277.8
278.5	488.8	.5871	232.6	279.2
281.0	488.8	.5871	233.9	280.7

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
283.5	488.8	.5872	235.1	282.2
286.0	488.8	.5872	236.3	283.6
288.5	488.8	.5872	237.5	285.1
291.0	488.8	.5872	238.7	286.6
293.5	488.9	.5873	240.0	288.0
296.0	488.9	.5873	241.2	289.5
298.5	488.9	.5873	242.4	291.0
301.0	488.9	.5873	243.6	292.4
303.5	488.9	.5873	244.9	293.9
306.0	488.9	.5874	246.1	295.4
308.5	489.0	.5874	247.3	296.8
311.0	489.0	.5874	248.5	298.3
313.5	489.0	.5874	249.7	299.8
316.0	489.0	.5874	251.0	301.3
318.5	489.0	.5874	252.2	302.7
321.0	489.0	.5874	253.4	304.2
323.5	489.0	.5875	254.6	305.7
326.0	489.0	.5875	255.9	307.1
328.5	489.1	.5875	257.1	308.6
331.0	489.1	.5875	258.3	310.1
333.5	489.1	.5875	259.5	311.5
336.0	489.1	.5875	260.7	313.0
338.5	489.1	.5875	262.0	314.5
341.0	489.1	.5876	263.2	315.9
343.5	489.1	.5876	264.4	317.4
346.0	489.1	.5876	265.6	318.9
348.5	489.1	.5876	266.9	320.3
351.0	489.1	.5876	268.1	321.8
353.5	489.2	.5876	269.3	323.3
356.0	489.2	.5876	270.5	324.8
358.5	489.2	.5876	271.8	326.2
361.0	489.2	.5877	273.0	327.7
363.5	489.2	.5877	274.2	329.2
366.0	489.2	.5877	275.4	330.6
368.5	489.2	.5877	276.6	332.1
371.0	489.2	.5877	277.9	333.6
373.5	489.2	.5877	279.1	335.0
376.0	489.2	.5877	280.3	336.5
378.5	489.3	.5877	281.5	338.0
381.0	489.3	.5877	282.8	339.4
383.5	489.3	.5878	284.0	340.9
386.0	489.3	.5878	285.2	342.4
388.5	489.3	.5878	286.4	343.9
391.0	489.3	.5878	287.7	345.3

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
393.5	489.3	.5878	288.9	346.8
396.0	489.3	.5878	290.1	348.3
398.5	489.3	.5878	291.3	349.7
401.0	489.3	.5878	292.5	351.2
403.5	489.3	.5878	293.8	352.7
406.0	489.4	.5879	295.0	354.1
408.5	489.4	.5879	296.2	355.6
411.0	489.4	.5879	297.4	357.1
413.5	489.4	.5879	298.7	358.6
416.0	489.4	.5879	299.9	360.0
418.5	489.4	.5879	301.1	361.5
421.0	489.4	.5879	302.3	363.0
423.5	489.4	.5880	303.6	364.4
426.0	489.4	.5880	304.8	365.9
428.5	489.5	.5880	306.0	367.4
431.0	489.5	.5880	307.2	368.8
433.5	489.5	.5880	308.5	370.3
436.0	489.5	.5880	309.7	371.8
438.5	489.5	.5880	310.9	373.3
441.0	489.5	.5881	312.1	374.7
443.5	489.5	.5881	313.3	376.2
446.0	489.5	.5881	314.6	377.7
448.5	489.6	.5881	315.8	379.1
451.0	489.6	.5881	317.0	380.6
453.5	489.6	.5881	318.2	382.1
456.0	489.6	.5882	319.5	383.5
458.5	489.6	.5882	320.7	385.0
461.0	489.6	.5882	321.9	386.5
463.5	489.6	.5882	323.1	388.0
466.0	489.7	.5882	324.4	389.4
468.5	489.7	.5882	325.6	390.9
471.0	489.7	.5883	326.8	392.4
473.5	489.7	.5883	328.0	393.8
476.0	489.7	.5883	329.3	395.3
478.5	489.7	.5883	330.5	396.8
481.0	489.7	.5883	331.7	398.3
483.5	489.8	.5883	332.9	399.7
486.0	489.8	.5884	334.2	401.2
488.5	489.8	.5884	335.4	402.7
491.0	489.8	.5884	336.6	404.1
493.5	489.8	.5884	337.8	405.6
496.0	489.8	.5884	339.1	407.1
498.5	489.8	.5884	340.3	408.5
501.0	489.9	.5885	341.5	410.0

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
503.5	489.9	.5885	342.7	411.5
506.0	489.9	.5885	344.0	413.0
508.5	489.9	.5885	345.2	414.4
511.0	489.9	.5885	346.4	415.9
513.5	489.9	.5886	347.6	417.4
516.0	490.0	.5886	348.9	418.8
518.5	490.0	.5886	350.1	420.3
521.0	490.0	.5886	351.3	421.8
523.5	490.0	.5886	352.5	423.3
526.0	490.0	.5887	353.8	424.7
528.5	490.0	.5887	355.0	426.2
531.0	490.1	.5887	356.2	427.7
533.5	490.1	.5887	357.4	429.1
536.0	490.1	.5888	358.7	430.6
538.5	490.1	.5888	359.9	432.1
541.0	490.1	.5888	361.1	433.6
543.5	490.1	.5888	362.3	435.0
546.0	490.2	.5888	363.6	436.5
548.5	490.2	.5888	364.8	438.0
551.0	490.2	.5889	366.0	439.5
553.5	490.2	.5889	367.2	440.9
556.0	490.2	.5889	368.5	442.4
558.5	490.2	.5889	369.7	443.9
561.0	490.3	.5890	370.9	445.3
563.5	490.3	.5890	372.1	446.8
566.0	490.3	.5890	373.4	448.3
568.5	490.3	.5890	374.6	449.8
571.0	490.4	.5891	375.8	451.2
573.5	490.3	.5891	377.0	452.7
576.0	490.4	.5891	378.3	454.2
578.5	490.4	.5891	379.5	455.7
581.0	490.4	.5892	380.7	457.1
583.5	490.0	.5886	381.9	458.6
586.0	481.7	.5785	383.1	460.0
588.5	465.2	.5585	384.3	461.4
591.0	454.5	.5455	385.4	462.8
593.5	434.4	.5212	386.5	464.1
596.0	416.6	.4995	387.6	465.4
598.5	393.4	.4713	388.6	466.5
601.0	369.6	.4425	389.5	467.6
603.5	346.4	.4145	390.3	468.7
606.0	330.0	.3940	391.2	469.7
608.5	257.3	.3059	391.8	470.4
611.0	192.6	.2282	392.3	471.0

CASE 10A - SPLIT DER (0.944 FT2) - 30% POWER - MSIV FAILURE

Time (sec)	Mass Flow (lbm/sec)	Energy Flow (10^6 Btu/sec)	Integrated Mass (10^3 lbm)	Integrated Energy (10^6 Btu)
613.5	152.7	.1803	392.7	471.4
616.0	127.1	.1496	393.0	471.8
618.5	217.9	.2612	393.5	472.5
621.0	406.3	.4863	394.6	473.7
623.5	320.0	.3820	395.4	474.6
626.0	258.4	.3072	396.0	475.4
628.5	193.3	.2290	396.5	476.0
631.0	151.1	.1783	396.9	476.4
633.5	118.8	.1396	397.2	476.8
636.0	98.05	.1149	397.4	477.1
638.5	82.68	.0966	397.6	477.3
641.0	70.20	.0818	397.8	477.5
643.5	27.25	.0317	397.9	477.6
646.0	2.734	.0032	397.9	477.6
648.5	.2405	.0003	397.9	477.6
651.0	.0210	.0000	397.9	477.6
653.5	.0018	.0000	397.9	477.6
656.0	.0002	.0000	397.9	477.6
658.5	.0000	.0000	397.9	477.6

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
.0000	1011.	1011.
.2000	1009.	1009.
.4000	1006.	1006.
.6000	1003.	1003.
.8000	1000.	999.7
1.000	997.5	996.8
1.200	994.7	994.0
1.400	991.9	991.1
1.600	989.2	988.4
1.800	986.5	985.7
2.000	983.8	983.0
2.200	981.2	980.3
2.400	978.6	977.7
2.600	976.0	975.1
2.800	973.5	972.6
3.000	971.0	970.1
3.200	968.5	967.6
3.400	966.0	965.2
3.600	963.6	962.8
3.800	961.2	960.4
4.000	958.9	958.1
4.200	956.5	955.7
4.400	954.2	953.4
4.600	952.0	951.2
4.800	949.7	949.0
5.000	947.5	946.8
5.200	945.3	944.6
5.400	943.2	942.4
5.600	941.1	940.3
5.800	939.0	938.2
6.000	936.9	936.1
6.200	934.8	934.1
6.400	932.8	932.1
6.600	930.8	930.1
6.800	928.8	928.1
7.000	926.9	926.2
7.200	925.0	924.3
7.400	923.1	922.4
7.600	921.2	920.5
7.800	919.3	918.6
8.000	917.5	916.8
8.200	915.7	915.0
8.400	913.9	913.2

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
8.600	912.1	911.4
8.800	910.1	909.4
9.000	908.1	907.5
9.200	906.1	905.5
9.400	904.2	903.6
9.600	902.3	901.7
9.800	900.4	899.8
10.00	898.5	898.0
10.20	896.7	896.1
10.40	894.9	894.3
10.60	894.2	893.8
10.80	893.6	893.4
11.00	893.1	892.9
11.20	892.5	892.4
11.40	892.0	891.9
11.60	891.4	891.4
11.80	890.9	890.9
12.00	890.5	890.5
12.20	890.0	890.0
12.40	889.5	889.6
12.60	889.1	889.1
12.80	888.7	888.7
13.00	888.2	888.3
13.20	887.8	887.9
13.40	887.4	887.5
13.60	887.1	887.1
13.80	886.7	886.7
14.00	886.3	886.4
14.20	886.0	886.0
14.40	885.6	885.7
14.60	885.3	885.3
14.80	884.9	885.0
15.00	884.6	884.7
15.20	884.2	884.3
15.40	883.9	884.0
15.60	883.5	883.6
15.80	883.1	883.2
16.00	882.8	882.8
16.20	882.3	882.4
16.40	881.9	882.0
16.60	881.5	881.5
16.80	881.0	881.0
17.00	880.5	880.5

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
17.20	879.9	880.0
17.40	879.4	879.4
17.60	878.8	878.8
17.80	878.5	878.6
18.00	878.2	878.3
18.20	877.9	877.9
18.40	877.5	877.5
18.60	877.1	877.1
18.80	876.6	876.6
19.00	876.1	876.1
19.20	875.5	875.5
19.40	874.9	874.9
19.60	874.3	874.2
19.80	873.6	873.6
20.00	872.9	872.9
20.50	871.1	871.0
21.00	869.2	869.1
21.50	867.1	867.0
22.00	864.9	864.8
22.50	862.7	862.5
23.00	860.4	860.2
23.50	858.0	857.8
24.00	855.6	855.5
24.50	853.2	853.1
25.00	850.8	850.7
25.50	848.4	848.3
26.00	846.0	845.9
26.50	843.6	843.5
27.00	841.2	841.1
27.50	838.8	838.6
28.00	836.4	836.2
28.50	833.9	833.8
29.00	831.5	831.3
29.50	829.1	828.9
30.00	826.6	826.4
30.50	824.1	824.0
31.00	821.7	821.5
31.50	819.2	819.0
32.00	816.7	816.5
32.50	814.2	814.0
33.00	811.7	811.5
33.50	809.2	809.0
34.00	806.7	806.5

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
34.50	804.2	804.0
35.00	801.7	801.5
35.50	799.2	799.0
36.00	796.7	796.5
36.50	794.2	794.0
37.00	791.8	791.6
37.50	789.3	789.1
38.00	786.8	786.7
38.50	784.4	784.2
39.00	782.0	781.8
39.50	779.5	779.3
40.00	777.1	776.9
40.50	774.7	774.5
41.00	772.3	772.1
41.50	769.9	769.7
42.00	767.5	767.4
42.50	765.2	765.0
43.00	762.8	762.6
43.50	760.5	760.3
44.00	758.1	757.9
44.50	755.8	755.6
45.00	753.5	753.3
45.50	751.1	751.0
46.00	748.8	748.7
46.50	746.5	746.4
47.00	744.2	744.1
47.50	742.0	741.8
48.00	739.7	739.5
48.50	737.4	737.2
49.00	735.2	735.0
49.50	732.9	732.7
50.00	730.7	730.5
50.50	728.5	728.3
51.00	726.2	726.1
51.50	724.0	723.9
52.00	721.8	721.7
52.50	719.6	719.5
53.00	717.5	717.3
53.50	715.3	715.1
54.00	713.1	713.0
54.50	711.0	710.8
55.00	708.8	708.7
55.50	706.7	706.5

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
56.00	704.6	704.4
56.50	702.5	702.3
57.00	700.3	700.2
57.50	698.2	698.1
58.00	696.2	696.0
58.50	694.1	693.9
59.00	692.0	691.9
59.50	689.9	689.8
60.00	687.9	687.7
60.50	685.9	685.7
61.00	683.8	683.7
61.50	681.8	681.7
62.00	679.8	679.7
62.50	677.8	677.7
63.00	675.8	675.7
63.50	673.8	673.7
64.00	671.9	671.7
64.50	669.9	669.8
65.00	668.0	667.9
65.50	666.1	666.0
66.00	664.2	664.1
66.50	662.4	662.2
67.00	660.5	660.4
67.50	658.6	658.5
68.00	656.8	656.7
68.50	654.9	654.8
69.00	653.1	652.9
69.50	651.2	651.1
70.00	649.4	649.2
70.50	647.5	647.4
71.00	645.7	645.5
71.50	643.8	643.7
72.00	642.0	641.9
72.50	640.2	640.1
73.00	638.4	638.2
73.50	636.5	636.4
74.00	634.7	634.6
74.50	632.9	632.8
75.00	631.1	631.0
75.50	629.4	629.2
76.00	627.6	627.4
76.50	625.8	625.7
77.00	624.0	623.9

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
77.50	622.3	622.2
78.00	620.5	620.4
78.50	618.8	618.7
79.00	617.1	616.9
79.50	615.2	615.4
80.00	604.7	616.7
80.50	594.9	617.9
81.00	585.6	619.0
81.50	576.7	620.1
82.00	568.1	621.0
82.50	559.9	622.0
83.00	552.0	622.9
83.50	544.4	623.7
84.00	537.1	624.5
84.50	530.1	625.3
85.00	523.3	626.0
85.50	516.8	626.7
86.00	510.4	627.3
86.50	504.4	627.9
87.00	498.5	628.5
87.50	492.8	629.0
88.00	487.3	629.5
88.50	482.0	629.9
89.00	476.9	630.3
89.50	471.9	630.7
90.00	467.1	631.0
90.50	462.4	631.3
91.00	457.9	631.6
91.50	453.4	631.9
92.00	449.1	632.1
92.50	445.0	632.3
93.00	440.9	632.5
93.50	436.9	632.7
94.00	433.0	632.8
94.50	429.3	633.0
95.00	425.6	633.1
95.50	422.0	633.2
96.00	418.5	633.3
96.50	415.0	633.3
97.00	411.7	633.4
97.50	408.4	633.4
98.00	405.2	633.4
98.50	402.0	633.5

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
99.00	399.0	633.4
99.50	396.0	633.4
100.0	393.0	633.4
101.0	387.4	633.3
102.0	381.9	633.2
103.0	376.8	633.0
104.0	371.8	632.8
105.0	367.0	632.5
106.0	362.5	632.3
107.0	358.1	631.9
108.0	353.8	631.6
109.0	349.8	631.2
110.0	345.9	630.8
111.0	342.1	630.4
112.0	338.5	629.9
113.0	335.0	629.4
114.0	331.7	628.9
115.0	328.5	628.4
116.0	325.4	627.9
117.0	322.4	627.3
118.0	319.5	626.8
119.0	316.7	626.2
120.0	314.1	625.7
121.0	311.5	625.1
122.0	309.0	624.5
123.0	306.6	623.9
124.0	304.3	623.4
125.0	302.1	622.8
126.0	299.9	622.2
127.0	297.9	621.6
128.0	295.9	621.1
129.0	294.0	620.5
130.0	292.1	619.9
131.0	290.3	619.3
132.0	288.6	618.7
133.0	286.9	618.1
134.0	285.3	617.5
135.0	283.8	616.9
136.0	282.3	616.3
137.0	280.8	615.7
138.0	279.4	615.1
139.0	278.1	614.5
140.0	276.8	613.9

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
141.0	275.6	613.3
142.0	274.4	612.7
143.0	273.3	612.1
144.0	272.2	611.5
145.0	271.1	610.8
146.0	270.1	610.2
147.0	269.1	609.6
148.0	268.2	609.0
149.0	267.3	608.4
150.0	266.4	607.8
151.0	265.6	607.2
152.0	264.8	606.6
153.0	264.1	606.1
154.0	263.3	605.5
155.0	262.7	604.9
156.0	262.0	604.3
157.0	261.4	603.7
158.0	260.8	603.2
159.0	260.2	602.6
160.0	259.7	602.1
161.0	259.2	601.5
162.0	258.7	601.0
163.0	258.2	600.4
164.0	257.8	599.9
165.0	257.4	599.3
166.0	257.0	598.8
167.0	256.6	598.2
168.0	256.2	597.7
169.0	255.9	597.1
170.0	255.6	596.6
171.0	255.3	596.1
172.0	255.0	595.5
173.0	254.7	595.0
174.0	254.5	594.5
175.0	254.3	594.0
176.0	254.0	593.5
177.0	253.8	593.0
178.0	253.6	592.6
179.0	253.5	592.1
180.0	253.3	591.7
181.0	253.1	591.3
182.0	253.0	590.9
183.0	252.8	590.5

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
184.0	252.7	590.2
185.0	252.6	589.9
186.0	252.5	589.6
187.0	252.4	589.3
188.0	252.3	589.0
189.0	252.2	588.7
190.0	252.1	588.4
191.0	252.0	588.2
192.0	252.0	588.0
193.0	251.9	587.7
194.0	251.8	587.5
195.0	251.8	587.3
196.0	251.7	587.1
197.0	251.7	586.9
198.0	251.6	586.8
199.0	251.6	586.6
200.0	251.5	586.5
201.0	251.5	586.3
203.5	251.4	586.0
206.0	251.4	585.7
208.5	251.4	585.4
211.0	251.3	585.2
213.5	251.3	584.9
216.0	251.3	584.7
218.5	251.3	584.6
221.0	251.3	584.4
223.5	251.3	584.3
226.0	251.3	584.1
228.5	251.3	584.0
231.0	251.3	583.9
233.5	251.3	583.8
236.0	251.3	583.7
238.5	251.3	583.7
241.0	251.3	583.6
243.5	251.3	583.6
246.0	251.4	583.5
248.5	251.4	583.5
251.0	251.4	583.5
253.5	251.4	583.5
256.0	251.4	583.4
258.5	251.4	583.4
261.0	251.4	583.4
263.5	251.4	583.4

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
266.0	251.5	583.4
268.5	251.5	583.4
271.0	251.5	583.4
273.5	251.5	583.4
276.0	251.5	583.5
278.5	251.5	583.5
281.0	251.5	583.5
283.5	251.5	583.5
286.0	251.5	583.5
288.5	251.5	583.6
291.0	251.6	583.6
293.5	251.6	583.6
296.0	251.6	583.7
298.5	251.6	583.7
301.0	251.6	583.7
303.5	251.6	583.8
306.0	251.6	583.8
308.5	251.6	583.8
311.0	251.6	583.9
313.5	251.6	583.9
316.0	251.6	583.9
318.5	251.6	584.0
321.0	251.6	584.0
323.5	251.7	584.1
326.0	251.7	584.1
328.5	251.7	584.1
331.0	251.7	584.2
333.5	251.7	584.2
336.0	251.7	584.3
338.5	251.7	584.3
341.0	251.7	584.4
343.5	251.7	584.4
346.0	251.7	584.4
348.5	251.7	584.5
351.0	251.7	584.5
353.5	251.7	584.6
356.0	251.7	584.6
358.5	251.7	584.6
361.0	251.7	584.7
363.5	251.7	584.7
366.0	251.7	584.8
368.5	251.7	584.8
371.0	251.8	584.9

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
373.5	251.8	584.9
376.0	251.8	584.9
378.5	251.8	585.0
381.0	251.8	585.0
383.5	251.8	585.1
386.0	251.8	585.1
388.5	251.8	585.1
391.0	251.8	585.2
393.5	251.8	585.2
396.0	251.8	585.3
398.5	251.8	585.3
401.0	251.8	585.3
403.5	251.8	585.4
406.0	251.8	585.4
408.5	251.8	585.5
411.0	251.8	585.5
413.5	251.8	585.5
416.0	251.9	585.6
418.5	251.9	585.6
421.0	251.9	585.7
423.5	251.9	585.7
426.0	251.9	585.7
428.5	251.9	585.8
431.0	251.9	585.8
433.5	251.9	585.9
436.0	251.9	585.9
438.5	251.9	585.9
441.0	251.9	586.0
443.5	251.9	586.0
446.0	251.9	586.1
448.5	251.9	586.1
451.0	251.9	586.1
453.5	251.9	586.2
456.0	252.0	586.2
458.5	252.0	586.3
461.0	252.0	586.3
463.5	252.0	586.3
466.0	252.0	586.4
468.5	252.0	586.4
471.0	252.0	586.4
473.5	252.0	586.5
476.0	252.0	586.5
478.5	252.0	586.6

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
481.0	252.0	586.6
483.5	252.0	586.6
486.0	252.0	586.7
488.5	252.1	586.7
491.0	252.1	586.8
493.5	252.1	586.8
496.0	252.1	586.8
498.5	252.1	586.9
501.0	252.1	586.9
503.5	252.1	586.9
506.0	252.1	587.0
508.5	252.1	587.0
511.0	252.1	587.1
513.5	252.1	587.1
516.0	252.1	587.1
518.5	252.2	587.2
521.0	252.2	587.2
523.5	252.2	587.3
526.0	252.2	587.3
528.5	252.2	587.3
531.0	252.2	587.4
533.5	252.2	587.4
536.0	252.2	587.4
538.5	252.2	587.5
541.0	252.2	587.5
543.5	252.2	587.6
546.0	252.3	587.6
548.5	252.3	587.6
551.0	252.3	587.7
553.5	252.3	587.7
556.0	252.3	587.8
558.5	252.3	587.8
561.0	252.3	587.8
563.5	252.3	587.9
566.0	252.3	587.9
568.5	252.3	588.0
571.0	252.3	588.0
573.5	252.4	588.0
576.0	252.4	588.1
578.5	252.4	588.1
581.0	252.4	588.2
583.5	249.9	588.2
586.0	242.5	588.2

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
588.5	236.9	588.3
591.0	227.4	588.3
593.5	218.4	588.4
596.0	207.0	588.5
598.5	195.0	588.6
601.0	182.1	588.8
603.5	176.2	590.1
606.0	145.6	591.2
608.5	111.4	592.3
611.0	86.79	593.4
613.5	70.14	594.5
616.0	59.08	595.7
618.5	205.2	596.9
621.0	177.4	598.0
623.5	146.3	598.9
626.0	111.9	599.5
628.5	86.49	600.0
631.0	66.89	600.5
633.5	54.05	601.1
636.0	44.52	601.8
638.5	37.37	602.7
641.0	31.99	603.5
643.5	30.12	604.4
646.0	29.95	605.3
648.5	29.93	606.2
651.0	29.93	607.1
653.5	29.93	608.0
656.0	29.93	608.9
658.5	29.93	609.9
661.0	29.93	610.8
663.5	29.93	611.7
666.0	29.93	612.6
668.5	29.93	613.5
671.0	29.93	614.4
673.5	29.93	615.2
676.0	29.93	616.1
678.5	29.93	616.9
681.0	29.93	617.8
683.5	29.93	618.6
686.0	29.93	619.4
688.5	29.93	620.2
691.0	29.93	620.9
693.5	29.93	621.7

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
696.0	29.93	622.5
698.5	29.93	623.2
701.0	29.93	623.9
703.5	29.93	624.6
706.0	29.93	625.3
708.5	29.93	626.0
711.0	29.93	626.6
713.5	29.93	627.3
716.0	29.93	627.9
718.5	29.93	628.5
721.0	29.93	629.2
723.5	29.93	629.8
726.0	29.93	630.4
728.5	29.93	630.9
731.0	29.93	631.5
733.5	29.93	632.1
736.0	29.93	632.6
738.5	29.93	633.2
741.0	29.93	633.7
743.5	29.93	634.2
746.0	29.93	634.8
748.5	29.93	635.3
751.0	29.93	635.8
753.5	29.93	636.3
756.0	29.93	636.8
758.5	29.93	637.3
761.0	29.93	637.8
763.5	29.93	638.2
766.0	29.93	638.7
768.5	29.93	639.2
771.0	29.93	639.6
773.5	29.93	640.1
776.0	29.93	640.5
778.5	29.93	641.0
781.0	29.93	641.4
783.5	29.93	641.9
786.0	29.93	642.3
788.5	29.93	642.7
791.0	29.93	643.2
793.5	29.93	643.6
796.0	29.93	644.0
798.5	29.93	644.4
801.0	29.93	644.9

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
803.5	29.93	645.3
806.0	29.93	645.7
808.5	29.93	646.1
811.0	29.93	646.5
813.5	29.93	646.9
816.0	29.93	647.3
818.5	29.93	647.7
821.0	29.93	648.1
823.5	29.93	648.5
826.0	29.93	648.9
828.5	29.93	649.3
831.0	29.93	649.7
833.5	29.93	650.1
836.0	29.93	650.5
838.5	29.93	650.9
841.0	29.93	651.3
843.5	29.93	651.7
846.0	29.93	652.0
848.5	29.93	652.4
851.0	29.93	652.8
853.5	29.93	653.2
856.0	29.93	653.6
858.5	29.93	654.0
861.0	29.93	654.3
863.5	29.93	654.7
866.0	29.93	655.1
868.5	29.93	655.5
871.0	29.93	655.9
873.5	29.93	656.2
876.0	29.93	656.6
878.5	29.93	657.0
881.0	29.93	657.4
883.5	29.93	657.8
886.0	29.93	658.1
888.5	29.93	658.5
891.0	29.93	658.9
893.5	29.93	659.3
896.0	29.93	659.6
898.5	29.93	660.0
901.0	29.93	660.4
903.5	29.93	660.8
906.0	29.93	661.1
908.5	29.93	661.5

CASE 10A - SG PRESSURE VS. TIME

Time (sec)	Faulted SG Pressure (psia)	Intact SG Pressure (psia)
911.0	29.93	661.9
913.5	29.93	662.3
916.0	29.93	662.6
918.5	29.93	663.0
921.0	29.93	663.4
923.5	29.93	663.8
926.0	29.93	664.1
928.5	29.93	664.5
931.0	29.93	664.9
933.5	29.93	665.3
936.0	29.93	665.6
938.5	29.93	666.0
941.0	29.93	666.4
943.5	29.93	666.7
946.0	29.93	667.1
948.5	29.93	667.5
951.0	29.93	667.9