WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WNP-2
CALCULATION COVER SHEET

DCP Page: NONE

PROJECT	3. DISCIPLINE	
WNP-2	Nuclear	PAGE 1.000 1. CALCULATION NO. NE-02-86-10 2. QUALITY CLASS I

4. EQUIPMENT PIECE NO.	5. SUPERSEDED BY
RHR System (LPCI), Relief Valves	None

6. SUBJECT: Reactor Depressurization Using Six Relief Valves With Reduced Coolant Injection

7. REMARKS: Appendix R Calculation, for Alternate Shut-down from Remote Control Room

CALCULATION PERFORMANCE RECORD

8. REVISION NO.	9. STATUS PRELIMINARY	FINAL	10. REVISION DESCRIPTION	11. PERFORMED BY / DATE
0		Final	New Issue	F. J. Markowski 30 JUL 86

VERIFICATION / APPROVAL RECORD

8. REVISION NO.	12. VERIFIED BY / DATE	13. APPROVED BY / DATE	14. TRANSMITTAL NO.
0	[signature] 8/15/86	D. L. Whitcomb 8/27/86	

8609150294 860909
PDR ADOCK 05000397
F PDR

968-18645 (7-84)

Verification Checklist For Calculations

Calculation *NE-02-86-10* Revision *0* was checked and verified using the following methods

[redacted] Checklist below

[redacted] Alternate Calculation, *See Appendix 5*

The calculation is adequate for the purpose intended.

[signature] *8/15/86* — Verifier Signature/Date

[initials] — Verifier Initial

Checklist Item	Initial
Logical Consistency of Analysis	*[initials]*
Accuracy of Input Data	*[initials]*
Consistency of Input Data with Approved Criteria	*[initials]*
Validity of Assumptions	*[initials]*
Appropriateness of Method	*[initials]*
Arithmetical Accuracy	*[initials]*
Reasonableness of Output Conclusion	*[initials]*
Other Elements Considered	*[initials]*

Comparison with LE modeled results verify logical consistency and qualitative behavior of this model. Differences in initial conditions and assumptions account for quantitative differences in outputs. Both models indicate large margins of safety for this scenario. This model appears to be adequate for this immediate application — any future applications should be verified *[initials]*

Calculation Index

Page 1.010
Calculation NE-02-86-10
Revision No. 0

Continued on Page 1.011

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Appendix 1 11 Pages

Bounding Estimate for Heatup Rate of Unsubmerged Fuel

Appendix 2 12 Pages

Bounding Estimate for Stored Structural Heat

Table of Contents Continued

Appendix 7 9 Pages

Completeness of the Postulated Hypothetical Scenario

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CALCULATION INPUT SUMMARY

1. PURPOSE / SCOPE OF ANALYSIS	2. PREPARED BY	PAGE
See Section 1: Purpose of Calculation, Page	F.J. Markowski	2.000
		3. CALCULATION NO. NE-02-86-10
	DATE 02 JUN 86	4. REVISION 0

5. REFERENCES

DOCUMENT NO.	ISSUE DATE OR REVISION	TITLE	AUTHOR

1. WNP-2 FSAR as of APR 1986

Chapter 5: Reactor Coolant System and Connected Systems

Chapter 6: Engineered Safety Features

→ continued on Page 2.001

6. ANALYSIS METHOD (CHECK APPROPRIATE BOXES)

☐ MANUAL (List source of equations in reference section above or document equations on page 5,000)

☒ COMPUTER

☐ VERIFIED PROGRAM: CODE NAME / REVISION: ______

☒ UNVERIFIED PROGRAM:

→ see Appendix 3

7. INPUT DATA AND ASSUMPTION SUMMARY

SOURCE OR REF.	PAGE OR SECTION	DATA / ASSUMPTION DESCRIPTION

Input data in Appendix 3 and Appendix 4.

Input assumptions (including scenario) described in Section 1 and Section 2 (Pages 5.001 thru 5.051)

USE ADDITIONAL PAGES IF NECESSARY

968-18631 (7-84)

References Continued

APPENDIX F: Plant Fire Protection Evaluation

2. G02-83-243

WNP-2 Fire Protection Safe Shutdown Analysis

Letter Report, G.D. Buckey to A. Schwencer, 21 MAR 83

3. IE Information Notice 84-09

Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems

USNRC, 13 FEB 84

4. SECY-85-306

Staff Recommendations Regarding Implementation of Appendix R to 10 CFR 50

11 Page Letter with 9 Enclosures

USNRC, 17 SEP 85

5. 10CFR50, Appendix R

References Continued

6. NEDO-24708A, Rev. 1

Additional Information for NRC Staff Generic Report on Boiling Water Reactors

General Electric Company

2 Volumes, DEC 80

7. NE-02-84-19, Rev. 0

Reactor Depressurization Using 18 Relief Valves

WPPSS, 20 DEC 84

8. NE-02-84-30, Rev. 0

Reactor Depressurization Using 3 Relief Valves

WPPSS, 15 DEC 84

9. NE-02-84-31, Rev. 0

Hydraulic Pressure Drop for RHR Loop B

WPPSS, 12 DEC 84

References Continued

10. L.S. Marks, Seventh Edition
Handbook for Mechanical Engineers
McGraw Hill, 1967

11. ASME Steam Tables, Fourth Edition
Thermodynamic Properties of Steam
ASME, 1979

12. FJM Engineering Log Vol. II, P. 88, 89
WNP-2 Reactor Liquid Level versus Volume, Including Void Fractions
Telecon with GE, 07 FEB 84

13. FJM Engineering Log Vol. II, P. 134, 135
WNP-2 Reactor Liquid Level Change on Scram
Telecon with Mike Wuestefeld, 16 APR 86

14. FJM Engineering Log Vol. II, P. 137
Coastdown of Feedpumps
Telecon with Richard Burk, 29 MAY 86

References Continued

15. Nureg/CR-2229 (EPRI NP-1783)

BWR Large Break Simulation Tests

Volume 1: Experimental Results and Analysis, 1982

Volume 2: Appendices, 1982

16. NUREG/CR-2230 (EPRI NP-1782)

BWR Small Break Simulation Tests With and Without Degraded ECC Systems, 1982

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WNP-2 CALCULATION OUTPUT SUMMARY

1. INTERFACING CALCULATIONS	2. PREPARED BY	PAGE
Calc. No. / Rev / How Affected Refs. 7, 8, 9 are related to this Calc. but not affected	F.J. Markowski DATE 07 APR 86	3.000 3. CALC. NO. NE-02-86-10 4. REVISION 0

5. DOCUMENTS / DRAWINGS AFFECTED

Document No.	Rev.	Page or Section	Title	EPN
None				

6. RESULTS AND CONCLUSIONS

See Pages 5.060 and 5.061

USE ADDITIONAL PAGES IF NECESSARY

68-18652 (7-84)

CALCULATION NO. NE-02-86-10

REVISION 0

SUBJECT Reactor Depressurization Using 6 Relief Valves

PREPARED BY F. J. Markowski DATE 07APR86 VERIFIED BY [signature] DATE 8/5/86

1. Purpose of Calculation

In the course of demonstrating compliance with applicable requirements and/or guidelines in Appendix R to Title 10, Part 50 of the Code of Federal Regulations (10 CFR 50), an Alternate Shutdown Cooling Mode (ASCM) has been developed which takes the reactor from hot standby conditions (right after the scram) directly to cold shutdown conditions by using rapid depressurization plus Low Pressure Coolant Injection (LPCI) from RHR Loop B only.

The necessity for the ASCM derives from the fact that special thermal protection (thermolagging) has not been applied to the cable trays of the HPCS and the RCIC systems, whereas the cable trays for actuation of the ~~reac~~ ~~tor vessel relief~~ ADS valves, for RHR Loop B

F.J.M.

and SSW Loop B have been thermally protected (thermolagged).

Extensive analysis of plant transient response in the ASCM (and some other extreme modes of operation) has been performed by General Electric for all of their product lines including the BWR-5 (WNP-2 is a BWR-5). This analysis is documented in NEDO-24708A (2 volumes; see Reference 6), which has been submitted to the NRC. Based on this GE analysis, G02-83-243 (Reference 2) had originally addressed the fire protection safe shutdown concern for WNP-2. However, further regulatory activity in the area of postulated hypothetical maximum fire scenario development and/or protection requirements

refinement has resulted in additional guidance issued by the NRC (see References 3 and 4) as well as a requirement for WNP-2 that two plant specific cases be evaluated:

1. The maximum blowdown case, using all 18 relief valves, and
2. The minimum blowdown case, using the 3 relief valves available from the Primary Remote Shutdown Panel (PRSP).

NE-02-84-19 (Reference 7) was performed to address the maximum blowdown case, and NE-02-84-30 (Ref. 8) was performed to evaluate the minimum blowdown case.

During the first refueling outage at WNP-2, the Alternate Remote Shutdown Panel (ARSP) has been made available

to plant operating personnel, so that now a total of 6 valves is available for remote plant control during emergency shutdown operation. The purpose of this calculation is to update the minimum blowdown case (which is the limiting one of the 2 above mentioned cases with respect to potential short term fuel undercooling) from using 3 valves to using the presently available 6 relief valves. Additionally, NE-02-84-30 (the 3 valve calculation) is based on a more simplified model which does not account for the level swell effect caused by the vapor voids in the reactor coolant. Since the level swell effect is very dominant during depressurization of saturated water (flashing occurs),

not accounting for this effect causes such extreme conservatisms that the resulting liquid level response may well be considered unrealistically pessimistic. Consequently, this calculation does take the level swell into account and therefore presents a more realistic, yet bounding plant response for the ASCM. Also, this present calculation models explicitely the suppression pool temperature. Furthermore, the heat stored in the thermally effective structural steel, which was previously considered only for the purpose of energy balance, is now simulated in such a way that its retarding effect on pressure decrease during depressurization and on begin of LPCI is fully accounted for.

2. Description of Analysis Model

The thermal hydraulic model consists of the reactor vessel with 18 relief valves, one single (ideally mixed or averaged) liquid mass inside the vessel, vapor voids within the liquid, vapor space above the liquid, suppression pool liquid (single node), RHR Loop B with actual RHR pump curve, plus pressure drop due to elevation difference and due to hydraulic friction in the pipe. Stored heat which is released from the thermally active steel structure during blowdown is modeled also. All of the thermally active structure is lumped into one node, and the heat release rate is calculated as described in the section on Thermal Power Calculation (see Page 5.010). The following pages give a more detailed model description.

2.1 Mass and Energy Equations

The analysis model has a total of 5 point masses (mass nodes):

1. Saturated liquid in the reactor vessel,
2. Vapor bubbles inside that liquid,
3. Dry, saturated vapor above the liquid level in the vessel,
4. Structural steel, releasing heat to the liquid node during cooldown, and
5. Subcooled liquid in suppression pool.

Appendix 3 shows a listing of the computer code: part STEDY (Page A3-02) for the initialization, part TRANS (Page A3-10) for the transient calculation.

Mass 1 (reactor coolant) is defined by input: VL (Page A3-03, Line 1580) is the

volume of the liquid, and its temperature is TCOL (Line 1640). The initial vapor bubble mass (Mass 2) is defined by VOIDFR (Line 1600), which is the ratio of the volume of all vapor bubbles to the volume of the reactor coolant including the bubbles. Mass 3 (dry steam) is defined as volume VVX (Line 5720) at the saturation temperature TCOL. Mass 4 (structural steel) is defined as STLMAS (Page A3-03, Line 2400). Mass 5 (subcooled liquid in suppression pool) is defined as volume VPOOL (Line 1680) at temperature TPOOL (Line 1700).

In the transient calculation module, we have Mass 1 updated as LMASS (Page A3-13, Line 5020; Page A3-14, Line 5240). Mass 2 and Mass 3 are lumped together in SMASS (Page A3-13, Line 5040

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and Page A3-14, Line 5220). Mass 2 by itself is calculated as STMTOT (Page A3-14, Line 5680). Mass 4 is transmitted to the transient calculation module as STLMAS (Page A3-10, Line 660), it never changes. Mass 5, the suppression pool mass, is calculated as POOLMASS (Page A3-11, Line 1800).

Energy is being tracked as it enters or leaves the reactor. SRVENG (Page A3-11, Line 1520) is the energy leaving thru the relief valves. ELPCI (Page A3-11, Line 1780) is the energy entering the vessel thru coolant injection. Suppression pool energy is updated as POOLENG (Page A3-11, Line 1820). Absorption of decay power by the reactor coolant and thermal power from cooling down the steel structure is addressed in Section 2.2, Thermal Power Calculation.

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2.2 Thermal Power Calculation

During the first 10 minutes of the transient the reactor is in hot standby. During the first 3.9 seconds of this time (which is the scram time), we have decreasing fission power as shown on the next page (Fig. 15.0-2, FSAR). From t=3.9 sec on we have decay power as shown on Page 5.012 (Fig. 6.2-27, FSAR). During the scram, the decreasing fission power is interpolated linearly. After completion of the scram, the decay power is interpolated logarithmically. The values for power versus time are shown on Page A3-08, Line 8140 thru Line 8360. The interpolation is performed in the decay power submodule (Page A3-14, Line 5880 thru Line 6300). A complete list of all tabulated values is shown on Pages A4-04 and A4-05.

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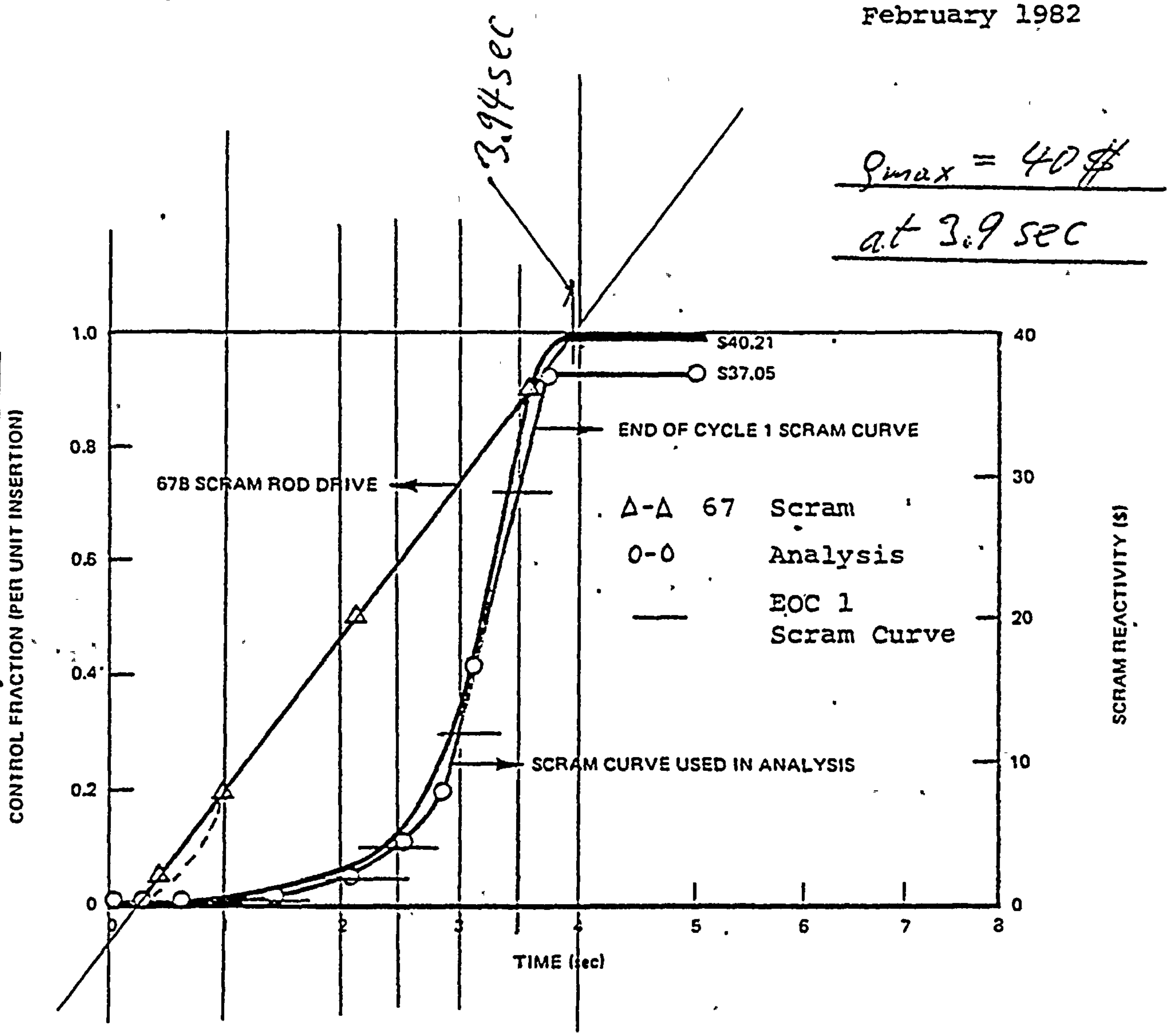
ρ_{max} = 40¢ at 3.9 sec

FSAR Figure 6.2-27



--- Revised Portion of Scram Speed Used in ODYN Analysis

For power at 3.9 sec see

(t / sec)	(ρ / pct)	(Power / pct)
0	0	100
1	1.4	98.7
2	5.1	95.3
2.5	10.5	90.3
3.0	30.3	71.9
3.5	72.4	33.0
3.9	100	7.4

interpolate linearly between these points

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	SCRAM POSITION AND REACTIVITY CHARACTERISTICS	FIGURE 15.0-2

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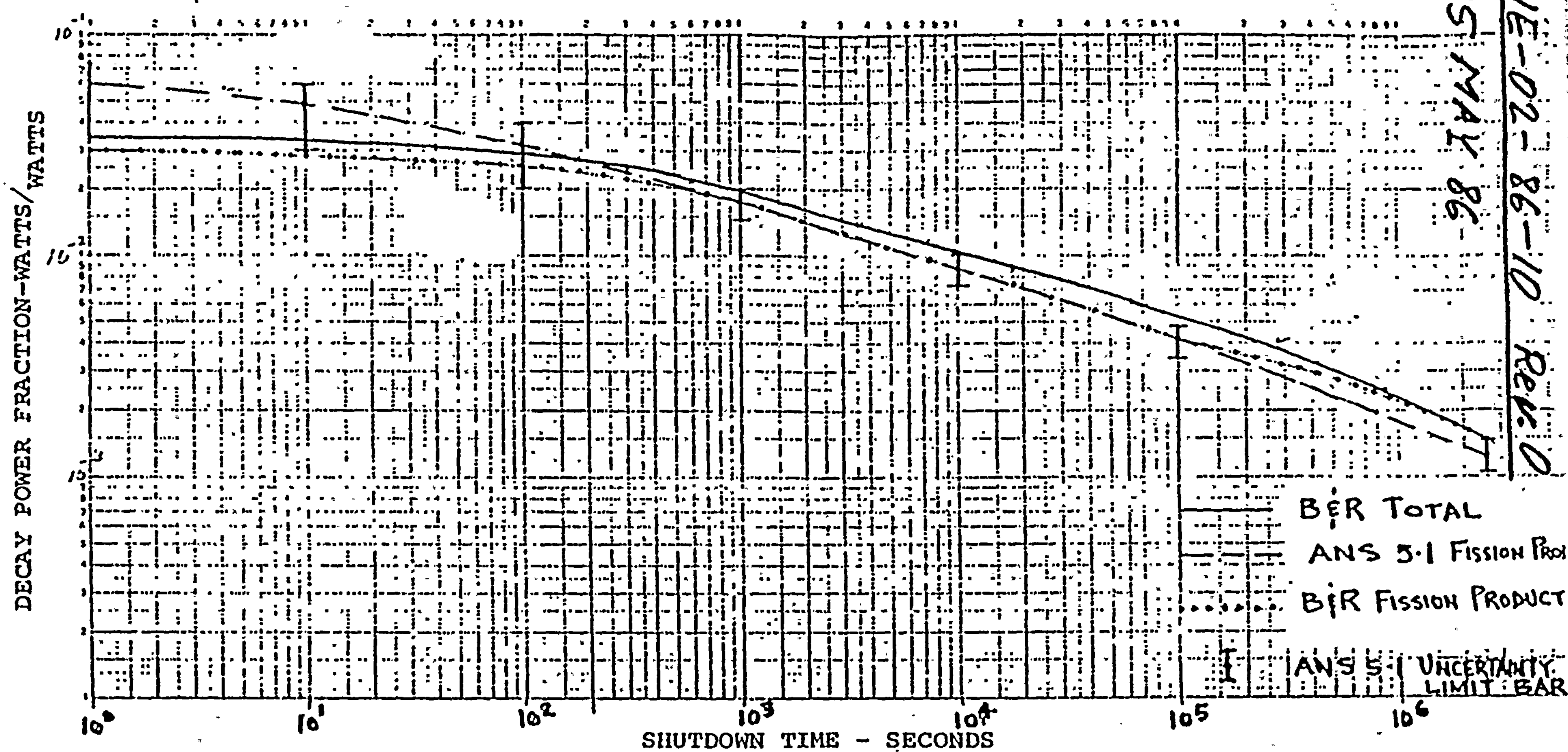

FSAR Fig. 6.2-27

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SUBJECT: Reactor Depressurization Using 6 Relief Valves

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In addition to decay power, we have 2 more sources of thermal energy during the transient: excess enthalpy made available whenever saturated water is depressurized and stored heat in the reactor vessel wall plus the internal steel structure (core support, shroud, etc.).

The integrated decay power (over one time step DT) is calculated as DQ (Page A3-11, Line 1400). DQNET in the thermal state submodule (Page A3-14, Line 5180) is the net energy available for steam generation:

DQNET = DQ + QDHF + QPOOL + QSTEEL with

DQ = decay heat, as mentioned already

QDHF = $Q_{\Delta HE}$ = excess enthalpy in liquid, released (or absorbed) during the time step (Line 5140)

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QPOOL = (negative) energy added by LPCI (pool water), see Line 5160

QSTEEL = (positive or negative) energy from changing the temperature of structural steel, see Page A3-11, Line 1880

Heat transfer from steel to reactor coolant is not modeled explicitely. As shown on Line 1880, the total available heat based on the temperature difference between steel and liquid is calculated and then multiplied by DT/TAUSTL where DT = 0.5 sec = time step (Page A3-03, Line 1820) and TAUSTL = 3.0 sec = time constant for transfering the available heat.ⓧ ~~This implies the assumption that all heat available will be transfered within 3 seconds.~~

ⓧ Page A3-10, Line 960

2.3 Steam Tables

Ideally, the authentic ASME Steam Tables as shown in Reference 11 should be stored in tabulated form in the computer code. However, this approach requires exceptionally large storage arrays. In order to keep storage requirements within workable limits, least square fits with fourth order polynomials have been chosen. The temperature in Fahrenheit is used as independent variable. Each thermal parameter is described by two curve pieces: one from 50 F to 400 F, the second from 400 F to 700 F. The polynomials are shown on Page A-3-08: Line 7540 thru Line 7620 for the lower temperature region and Line 7660 thru Line 7740 for temperatures above 400 F. As Line 7500 indicates, the polynomials are plotted on semilog paper (with ln(T) instead of

T on the x-axis). Lines 7860 thru 7940 are linear interpolation statements which eliminate discontinuities between the two curve pieces at the seam (400 F). For checking purposes, a sample from the steam tables is printed on Pages A4-03 and A4-04.

2.4 Steam Flow Thru Relief Valves

The next Page shows a schematic illustration of a WNP-2 relief valve. The basic hysteresis curve for the valve is shown on Page 5.019. Both Figures are from the FSAR (Ref. 1). Setpoint values for the valves are taken from the FSAR, Table 5.2-2 (Ref. 1, Page 5.2-49). Opening and closing setpoints are printed out on Page A4-05. The opening pressures are:

Group 1 (1076 + 15) psia = 1091 psia
Group 2 (1086 + 15) psia = 1101 psia
Group 3 (1096 + 15) psia = 1111 psia
Group 4 (1106 + 15) psia = 1121 psia
Group 5 (1116 + 15) psia = 1131 psia

The massflow thru a valve is calculated by the basic formula

$$\dot{M} = CA \frac{S}{v_g} \quad \text{in lb/sec}$$

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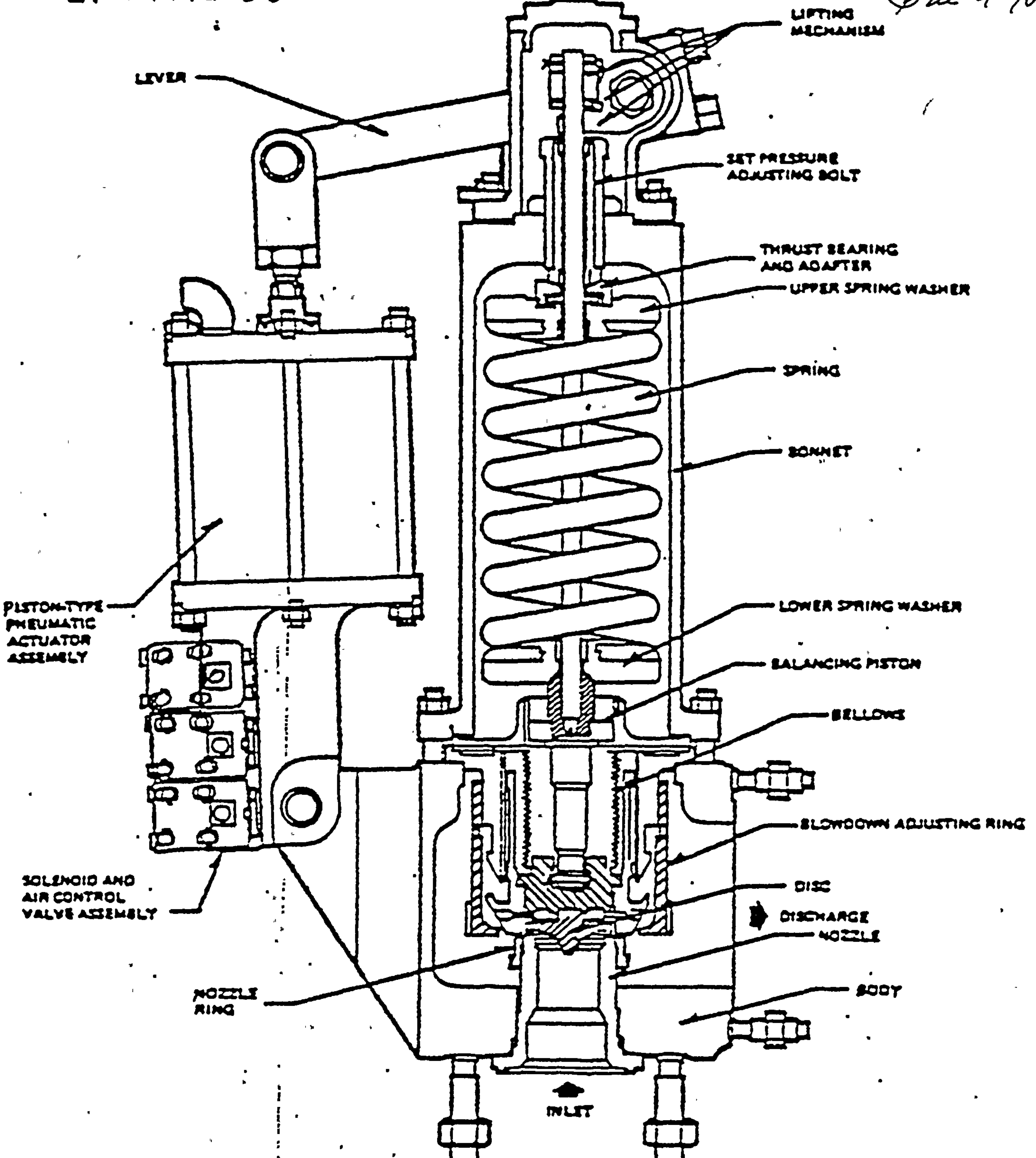
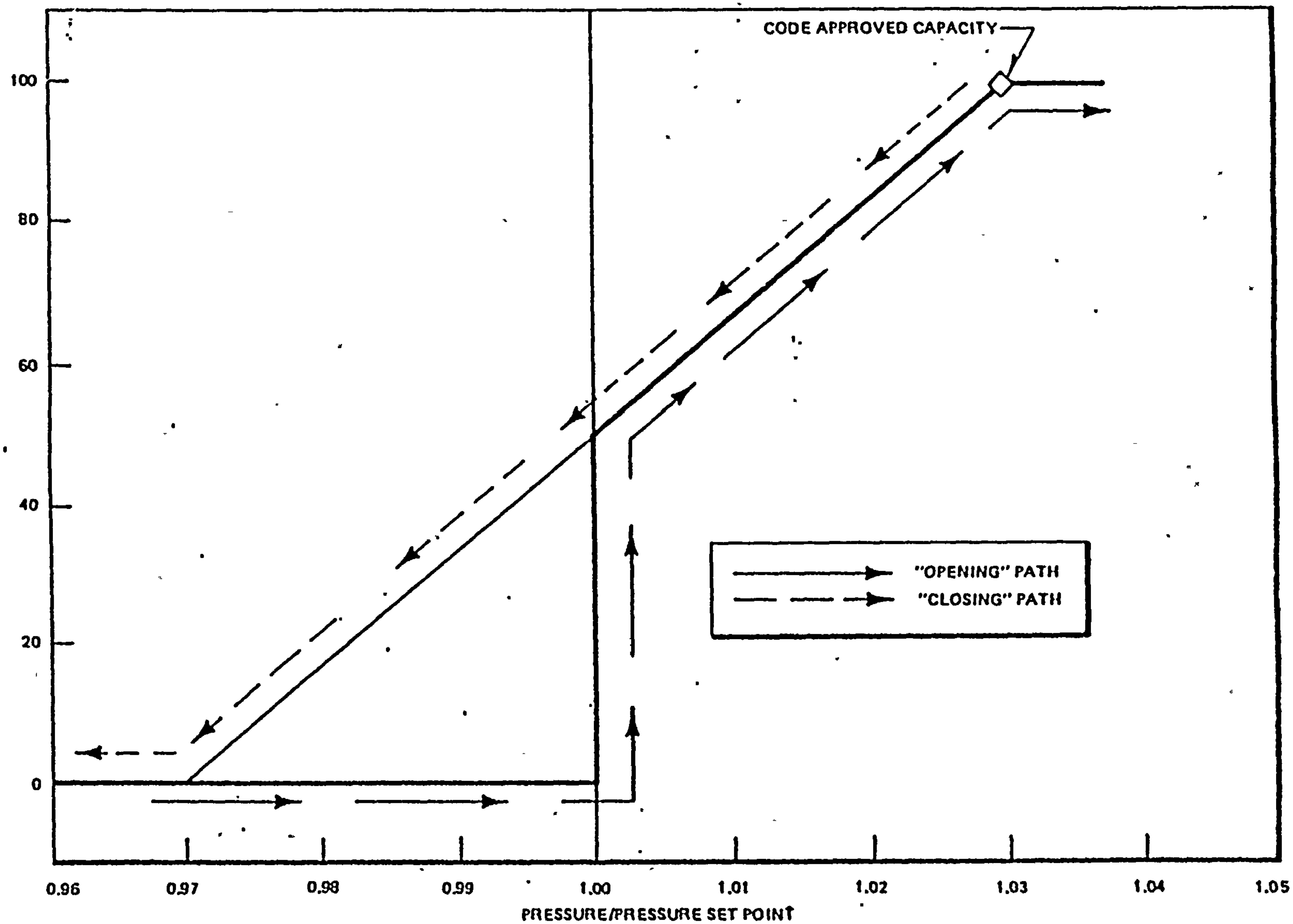
June 1983



Schematic of Crosby 6R10/8R10 Dual-Function Type Spring-Loaded Direct-Acting Safety/Relief Valve

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	SCHEMATIC OF SAFETY VALVE WITH AUXILIARY ACTUATING DEVICE	FIGURE 5.2-10

NE-02-86-10 Rer.0
27 MAY 86



WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

SIMULATED SAFETY RELIEF VALVE SPRING MODE CHARACTERISTIC USED FOR CAPACITY-SIZING ANALYSIS

FIGURE 5.2-2

Page 5.019

with

C = discharge coefficient

A = crossectional area in valve throat, in ft^2

S = sonic velocity in saturated steam at upstream pressure, in ft/sec

v_g = specific volume of steam at upstream pressure, in ft^3/lb

With the valve throat diameter of 4.84 in, the throat area is

$$A = \frac{\pi}{4}\left(\frac{4.84}{12}\right)^2 ft^2 = 0.127,767\ ft^2$$

According to FSAR Page 5.2-49, the relief valve has a flow capacity of

$$\dot{M} = \frac{863,900}{3,600}\ \frac{lb}{sec} \quad at$$

$$P = (1.03)(1148)\ psig \quad or$$

$$P = (1.03)(1148) + 14.7 = 1197.14\ psia$$

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At 1197.14 psia, we have from Ref. 11:

$$v_g = 0.363{,}462 \text{ ft}^3/\text{lb}$$

$$S = 1{,}449.572 \text{ ft/sec}$$

With these data we calculate the discharge coefficient:

$$\frac{863.9}{3.6} = C(0.127{,}767)\frac{1{,}449.572}{0.363{,}462}$$

$$C = \left(\frac{863.9}{3.6}\right)\left(\frac{0.363{,}462}{1{,}449.572}\right)\left(\frac{1}{0.127{,}767}\right)$$

$$C = 0.470{,}936$$

For simplicity we combine the two constants in the massflow formula into one:

$$K = CA = (0.470{,}936)(0.127{,}767) = 0.060{,}17$$

so that $\dot{M} = (0.060{,}17)\dfrac{S}{v_g}$

This massflow is calculated in the transient code module on Page A3-12, Line 2980 (VFLO).

The sonic velocity in saturated steam as a function of pressure is taken from the ASME Steam Tables (Ref. 11), Page 299, see next Page. The data are tabulated in the code on Page A3-09, starting at Line 8800. The table is printed out on Pages A4-05 and A4-06. Page 5.024 shows a graph of that function.

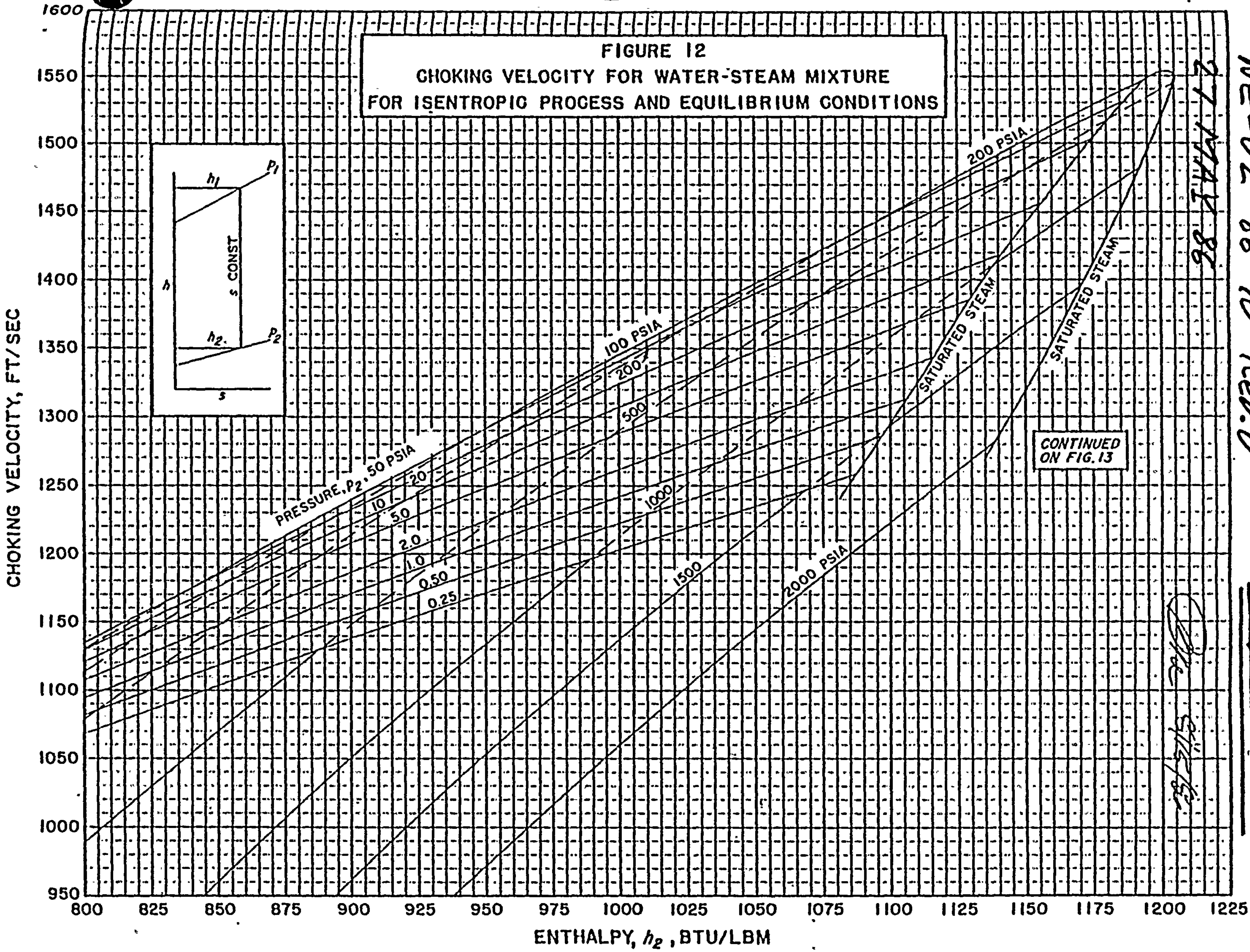

FIGURE 12

CHOKING VELOCITY FOR WATER-STEAM MIXTURE FOR ISENTROPIC PROCESS AND EQUILIBRIUM CONDITIONS

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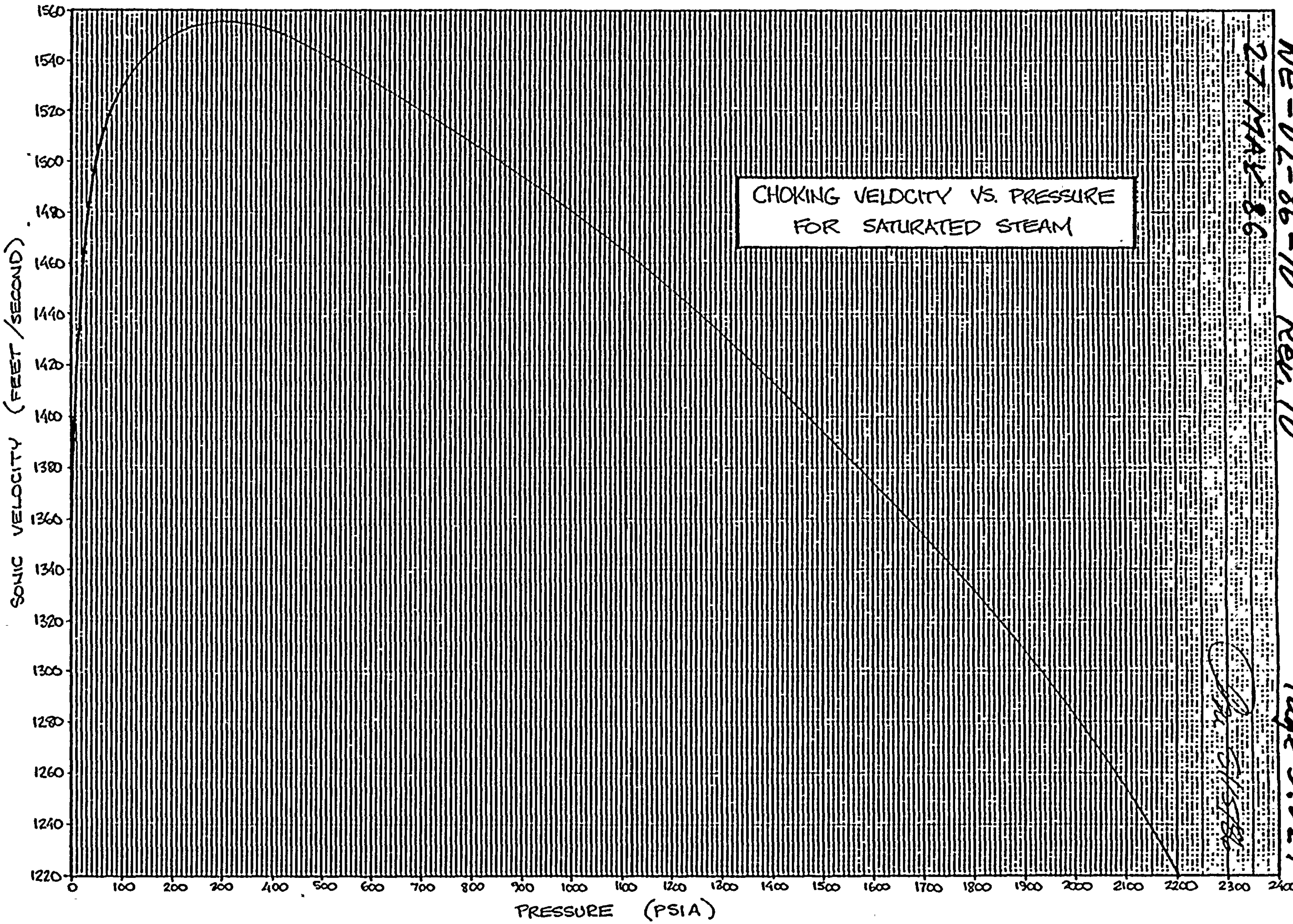
Charts



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Page 5.024

2.5 Calculation of Thermal State

The submodule for calculation of the new thermal state starts on Page A3-13, Line 4980. This submodule calculates the new thermal state at the end of each time step, based on

1. Conservation of energy
2. Conservation of mass
3. Boundary conditions

The (thermal, hydraulic and geometric) boundary conditions include valve opening setpoints, pump shutoff pressure for coolant injection, amount of decay power forced into the reactor liquid and reactor volume as a function of elevation. The equations for conservation of mass and energy are coupled by the thermal parameters tabulated in the steam tables.

Iterating on these equations produces the new thermal state values, provided the iteration scheme is convergent. Basically, the iteration procedure decides how much of the fluid residing in the reactor vessel is in liquid form and how much in vapor form. The iteration scheme used here utilizes the high sensitivity of the specific volume of steam (v_g) with respect to pressure or temperature.

First, the available net energy ~~for~~ evaporation is calculated, see Line 5180 on Page A3-14. Based on this energy and the heat of evaporation at the given pressure, the amount of new steam is calculated, Line 5200. Subtracting the evaporated mass from the liquid and ad-

ding it to the steam, the new required volume (at the given pressure) is calculated and then compared to the geometrically available volume. Based on the volume deviation, the iteration procedure then adjusts the temperature (temperature is the independent variable in the steam tables), recalculates the net energy available for evaporation, the amount of new steam, the required total volume, and so on. The convergence criterion (see ERMAX, Lines 5000 and 5300, Pages A3-13 and A3-14) is satis-fied when the volume difference between ~~thermally required volume~~ and geometrically available volume is less than 0.1 percent of the available volume (SYSVOL). The procedure requi-

res typically 3 to 6 iterations to satisfy this criterion. In case the procedure should run into numerical turbulence, warnings are provided from iteration 30 thru 35, see Lines 5400 and 5420, Page A3-14. The procedure has demonstrated excellent numerical stability.

2.6 Void Fraction Calculation

When operating at full power, the reactor liquid level is controled to stay at its normal setpoint:

$$LN = 46.963 \text{ ft}$$

above the vessel ~~level~~ bottom. When the reactor is scramed, some void collapse

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occurs, resulting in a decreased liquid level. Based on operating experience (see Reference 13), the typical level decrease on scram is about 20 inch. For conservatism, we assume here 24in = 2.0 ft of level decrease on scram. With liquid volume versus level information received from GE (Reference 12), we can tabulate the data as shown on the next page:

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Vessel Section	Geometric Volume ft3	Percent Liquid	Volume of Liquid only ft3
0-BAF	4,658	96.0	4,471.7
BAF-TAF	3,725	73.5	2,737.9
TAF-L1	293	83.9	245.8
L1-L2	3,092	97.3	3,008.5
L2-L3	1,266	87.5	1,107.8
L3-L4	501	92.1	461.4
L4-LN	122	92.6	113.0
Σ	13,657	—	12,146.1

The cumulative volume data (from the vessel bottom up) with correspon-ding level values are printed out on Page A4-02. These data apply to hot standby conditions. The data indicate that at full power temperature (which

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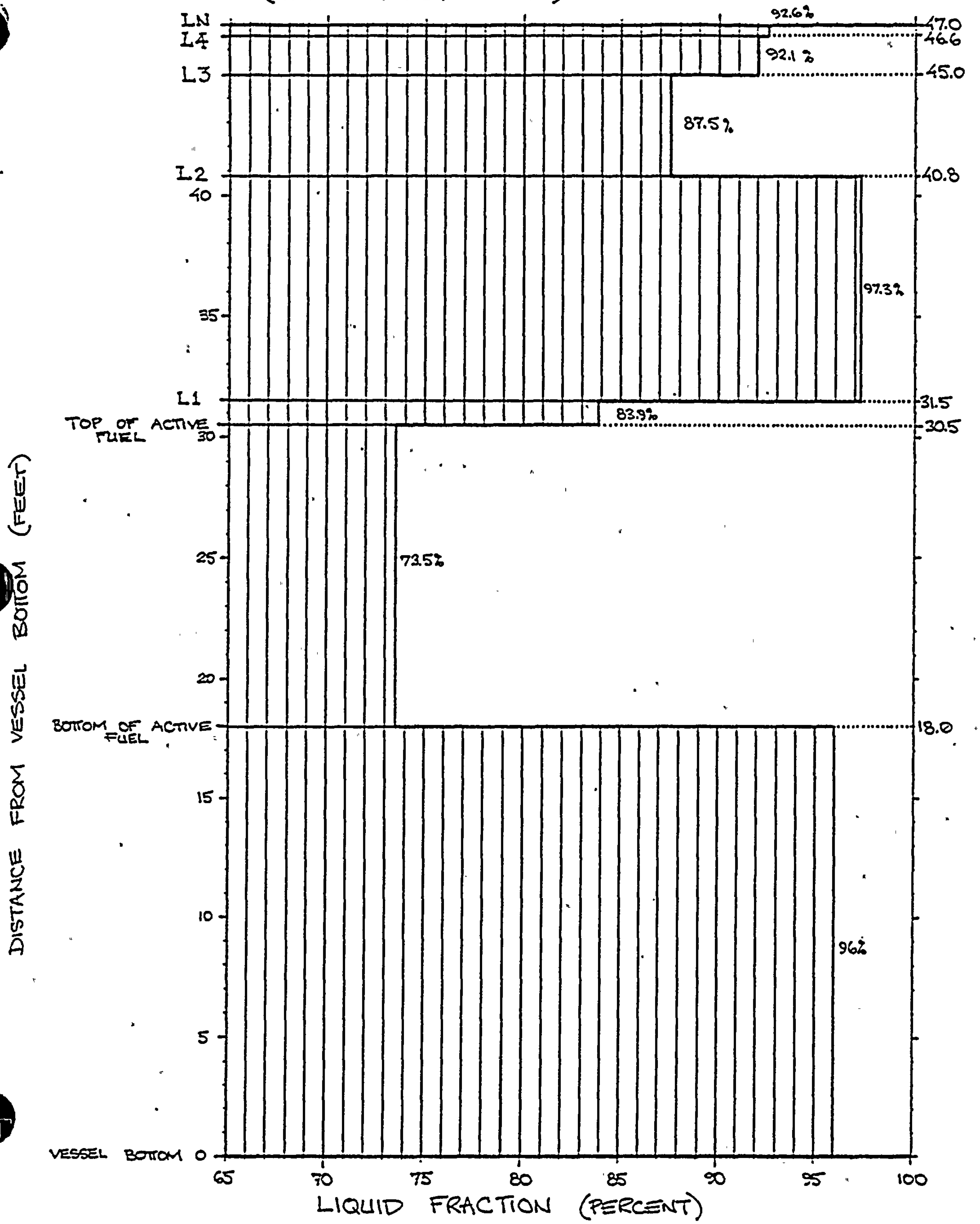
VOLUMETRIC LIQUID FRACTION AS A FUNCTION OF VESSEL LEVEL
(HOT STANDBY MODE)



is the same as hot standby temperature), 12,146.1 ft³ of liquid reside in a geometric volume of 13,657 ft³. This defines the averaged void fraction for the vessel (below the liquid level) at full power operation:

$$\alpha_{FP} = \frac{13,657 - 12,146.1}{13,657} = 11.06 \text{ pct}$$

With the normal level at LN = 46.963 ft, the hot standby level is

$$L_{HS} = (46.963 - 2) \text{ ft} = 44.963 \text{ ft} \approx 45 \text{ ft} = L3$$

From Page A4-02 we see that the geometric volume at L3 is

$$V_{L3} = 13,034.0 \text{ ft}^3$$

This defines the averaged void fraction

at hot standby conditions:

$$\alpha_{HS} = \frac{13,034 - 12,146.1}{13,034} = 6.81 \text{ pct}$$

This value is used for initialization, see Line 1600 on Page A3-03.

During the transient calculation, the void fraction is determined by the bubble release rate on one hand and by the generation rate of new bubbles on the other hand. In addition, the void fraction is linked to pressure changes: at a given bubble population, as pressure increases, bubbles get compressed, decreasing the void fraction; as pressure decreases, bubbles expand, increasing the void fraction. Decreasing pressure will also release ex-

cess enthalpy, causing an increase in bubble generation rate. For the transient analysis model, the thermal state at any point in time is approximated by the equilibrium conditions (saturated conditions at all times). The bubble generation rate depends on the net thermal energy available for evaporation together with the specific evaporation enthalpy at the present pressure. The bubble release rate does not directly depend on pressure, temperature or bubble generation rate. It does depend on local bubble density (local void fraction), local natural circulation currents, local buoyancy effects and other complicated phenomena which are not modeled explicitely. Rather,

we model the sum total effect of these phenomena in one single parameter, the level swell parameter. This simplification is consistent with other simplifications in the hydraulic model: local effects in three dimensional space are neglected, the liquid is lumped into one homogeneous waternode, called a point node. The level swell parameter is initialized to

TBUBL = 4.7

in Line 940, Page A3-10. This value has been derived from a series of parametric computer runs replicating transient level traces in Reference 6. Based on these level traces, the value is a lower bound estimate, that is,

the value has been determined to NOT be smaller than 4.7. In most cases, it produced no more than 80 percent of the level swell of the calibration trace. The submodule for transient void fraction calculation is on Page A3-14. In Line 5640 a retention factor is calculated for steam bubbles that have existed during the previous time step. In Line 5680 the total steam mass inside the liquid is calculated. It consists of a residual amount of old steam (retained from the previous time step) plus the new steam generated during the present time step. The resulting void volume (sum

of all bubble volumes) is calculated in Line 5700, and the void fraction is determined in Line 5740.

2.7 Reactor Liquid Level Calculation

Initially the reactor is running at full power with the liquid level at its normal setpoint. As described in Section 2.6, a 2.0 ft level drop on scram is assumed (see Page 5.029). During the first 10 minutes of the transient, liquid inventory is lost thru evaporation. A first order estimate of the amount of liquid lost is the integrated decay power over 10 min, divided by the heat

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of evaporation at 1,000 psia. Actually, the calculated amount of liquid lost is slightly higher than that because of loss of vapor thru the relief valves. The relief valves cycle on and off at a rate of approximately once per minute.

An extra conservatism has been included, as described in Section 2.2. The scram process itself (see Page 5.011) has been included as part of the transient, covering the first 3.9 sec. Normally this portion of decreasing fission power is assumed to be offset by water injection from the feed pumps, for which the coastdown time is estimated at about 15 sec.[1] The transient is then started with normal water inventory

(1) see Ref. 14

after completion of the scram (with decay power only). In our case, we left out the coastdown of the feedpumps but retained the fission heat generated during scram.

As described on Page 5.031, the liquid level is initially at 45 ft above the vessel bottom, which happens to be level setpoint L3. During the transient, the remaining liquid is calculated in the "new thermal state" submodule called on Line 1860, Page A3-11. On Line 1920, the "void fraction" submodule is called. On Line 2180, the "reactor level" submodule is called. The level submodule

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calculates the liquid level based on the volume of liquid plus volume of voids. This is done by linearly interpolating in the volume versus level function shown as a table on Page A4-02. This function was provided by General Electric, documented in Reference 12 (the Table on Page 5.030 is from the same source).

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2.8 Peak Fuel Cladding Temperature Calculation

The peak fuel cladding temperature is not modeled in the computer code. A fairly accurate upper bound estimate can be made by using a constant heatup rate which is based on the level of decay power at the time of beginning of fuel uncovery. This method is based on the rationale that over a small interval ~~of time~~ of a few minutes the decay power can be taken as a constant, provided the scram is at least 10 min away (otherwise the power decay should be taken into account). Likewise, the specific heat of the fuel pins is constant over a reason-

ably limited temperature range. This results in a linear heatup function. Numerous traces in NEDO-24708A (Reference 6) support this rationale.

In the previous minimum blowdown case, a heatup rate of 2 F/sec was used (see Reference 8, Page 5.072). Appendix 1 of this calculation gives supporting documentation for this heatup rate. As the level graph (see Page 5.054) shows, the fuel uncovery starts at t = 791 sec, and at t = 968 sec it is resubmerged, for a total uncovery period of Δt = 177 sec. As we see from the printout (Page A4-20), the temperature of the liquid coolant

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node in the reactor vessel is

$$T_c = 434\ F \quad at \quad t = 791\ sec$$

Setting the outside surface peak cladding temperature equal to the coolant bulk temperature (they are actually not equal; however, the difference is amply covered by conservative margin in the estimation methodology), we estimate an upper bound peak cladding temperature at

$$T_{PC} \leq 434\ F + 2\ F/sec\ (177)\ sec$$

$$T_{PC} \leq (434 + 354)\ F = 788\ F$$

This temperature is only about 200 F above the value at normal full power operation.

[illegible]

[illegible]

2.9 Suppression Pool Temperature Calculation

The suppression pool temperature is explicitely calculated in the computer model. The pool is started out at a conservatively high 90F (normal pool temperature is 70F), see Page A4-02. Whenever steam is released thru the relief valves, the condensation energy for that steam is deposited in the pool. As the transient calculation shows, a pool temperature of 136F is reached at t=1193 sec = 19.9 min into the transient. The reactor level at that time is about 0.1 ft below level setpoint L2, increasing at a rate of about 2.5ft/min. To reach the normal level setpoint LN would take approximately

$$\frac{(46.96 - 40.89)\ ft}{2.5\ ft/min} = 2.4\ min$$

At that point in time, the plant operater will turn off the LPCI and reconfigure the RHR system for the RSC (reactor shutdown cooling) mode. The pool could gain another 2F during that time, for a total of 138F. Once the RSC mode is initiated (Loop B of the RHR system and Loop B of the SSW system are both operable from the remote shutdown stations), the decay power is removed directly from the reactor vessel, so that no further pool heatup takes place. At 138F, the pool can be left to itself until Loop A of the RHR system has been returned to operability and can be used in the

SPC (suppression pool cooling) mode. If the repair time for Loop A of the RHR system should be longer than a week, or if the plant operater decides to use Loop A for reactor shutdown cooling also, the pool will simply cool down by itself. Concrete (plant foundation) is a fairly good thermal conductor, and the soil below the foundation is at a constant 55 F, constituting a heat sink of practically unlimited size.

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2.10 LPCI Pump Characteristic

The next page shows performance test data for one of the RHR pumps, reproduced from Page A3-02 of NE-02-84-19 (Reference 7). For all practical purposes the three RHR pumps are identical with respect to performance.

The pump data documented in Appendix 3 of Reference 7 have been used in tabular form here, see Line 8660 on Page A3-08. For easy reference the table is printed out, see bottom of Page A4-02. Pump flow and head are calculated in the transient segment of the code, see Page A3-11, Line 1700. The pump curve submodule is on Page A3-12, Line 3440. The iteration in this submodule is required because the flow

[illegible]

CUSTOMER ...ED	DESIGN CONDITIONS	Ingersoll-Rand	CURVE N-6... REV. 0
PROPOSAL NO. ... SYSTEM —	GPM 7450 EFF —	RHR Pump	PUMP 29APRD-5
SPECIAL NOTES SN-047311	T.H. (FT) 280 BHP — SG 1.0	DRAWN BY D.A.W.	DATE 12-26-74
TESTED IN ORDER SHELL	RPM 1770 DRIVER HP 800 HP MOTOR 1.0 S.F.		

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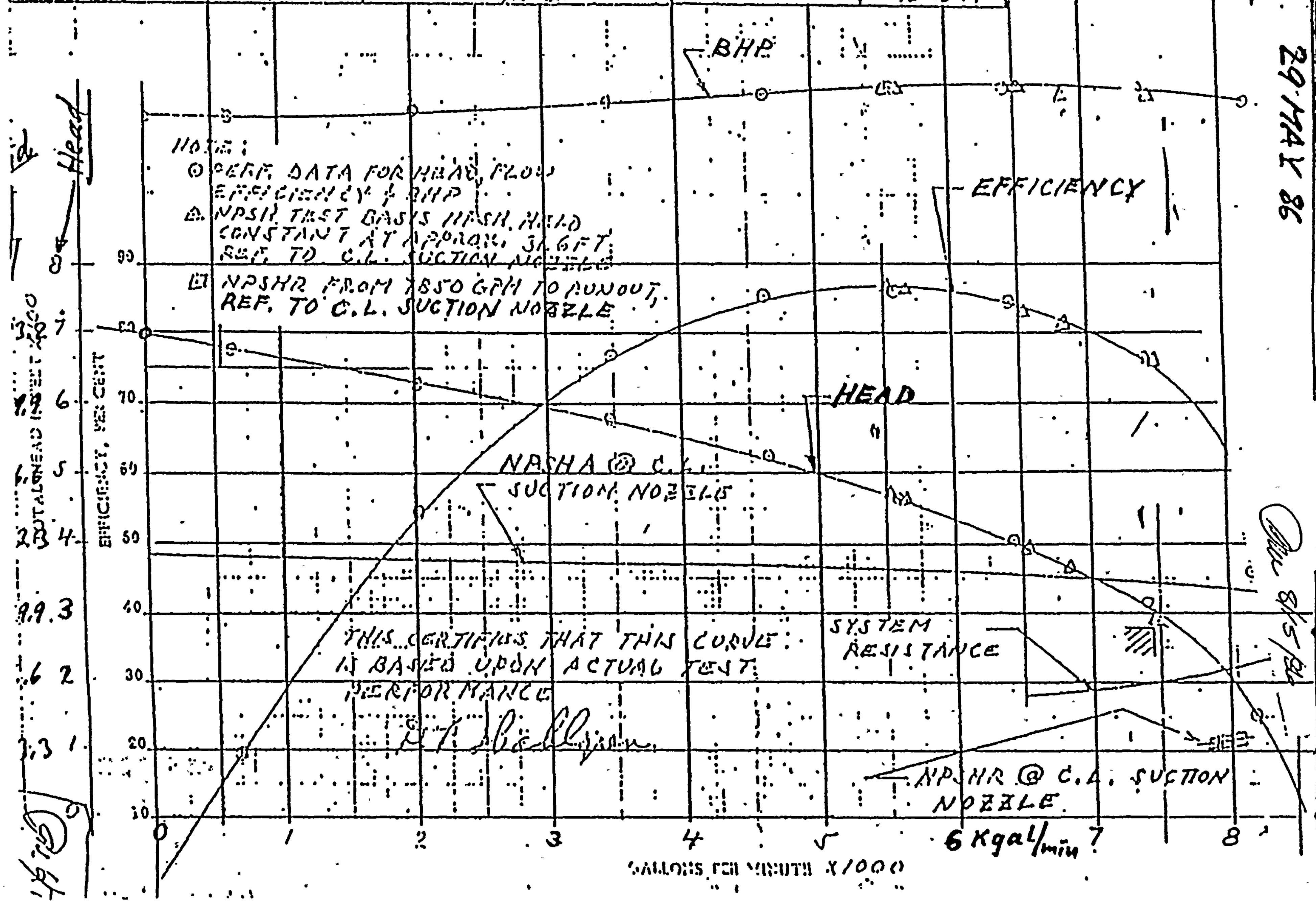

Page 5.047

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is treated as the dependent variable, and because the hydraulic friction losses are taken into account. In each iteration, the last used value for ΔP_{Fric} is used as the first estimate, and the ΔP gets adjusted (as function of the flow) until it changes by less than 0.1 percent, see Line 3640. The tabulation of pump head versus flow is dense enough that linear interpolation (see Lines 3580, 3600) provides satisfactory accuracy.

The printout of injection flow during the transient is shown in Appendix 4 starting on Page A4-21, column on rite hand side.

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2.11 Pressure Drop in the LPCI Line

Both kinds of hydraulic pressure drop are modeled in the LPCI line: the piezometric head loss caused by elevation differences and the hydraulic friction drop, which is proportional to the square of the volumetric flow. Calculation NE-02-84-31 (Reference 9) was performed for the purpose of determining a best estimate value for the hydraulic pressure loss along Loop B of the RHR system in the LPCI mode. Page 5.017 of Ref. 9 is reproduced on the next page. Line 1640 on Page A3-11 utilizes the elevation figures from Page 5.050, it calculates DELP as the piezometric pressure difference between pool level and vessel level. Line 1660 (Page A3-11) adds into it the pressure difference between vessel and containment.

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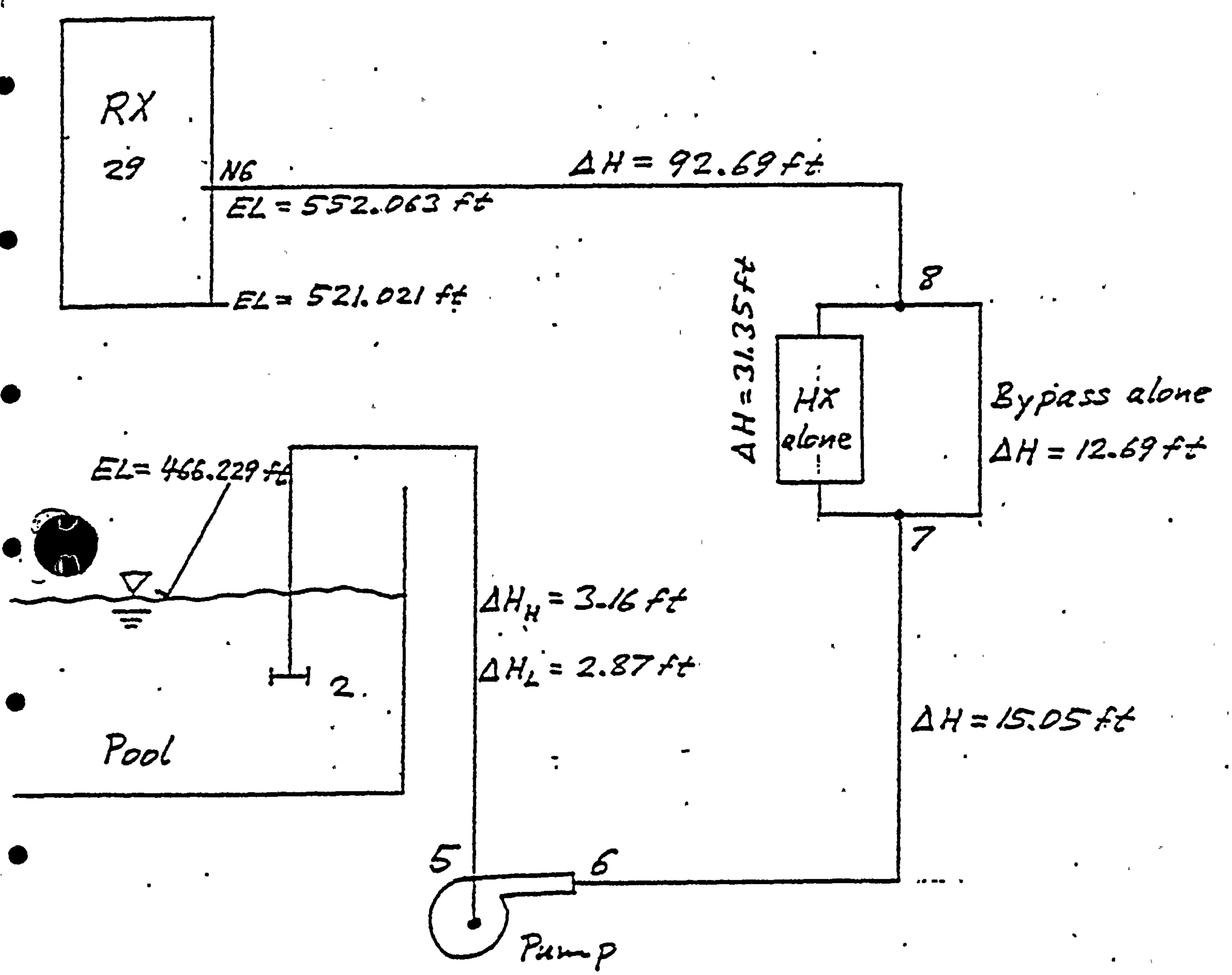
(From Page 5.017 of NE-02-84-31, Ref. 9)



Hydraulic Friction Losses at Rated Flow (7,450 gal/min) for RHR Loop B in LPCI Mode

From Page 5.024 of Reference 9 we use $\Delta H = 115.5$ ft as best estimate value (see the line "Total, HX + Bypass"). This head loss is for rated flow = 7.45 Kgal/min. The friction coefficient in psid is then

$$FRCOEF = 115.5 \text{ ft} \left(\frac{14.7 \text{ psid}}{33.93 \text{ ft}}\right)$$

which is initialized in Line 1140 on Page A3-10. The friction loss is then calculated as

$$DPFRIC = 115.5\left(\frac{14.7}{33.93}\right)\left(\frac{Q}{7.45}\right)^2$$

in Line 3620 on Page A3-12. DPFRIC is in psid and Q is in Kgal/min. Line 3460 (Page A3-12) sums up the total pressure drop, and Line 3600 calculates the flow in Kgal/min.

[illegible]
[illegible]

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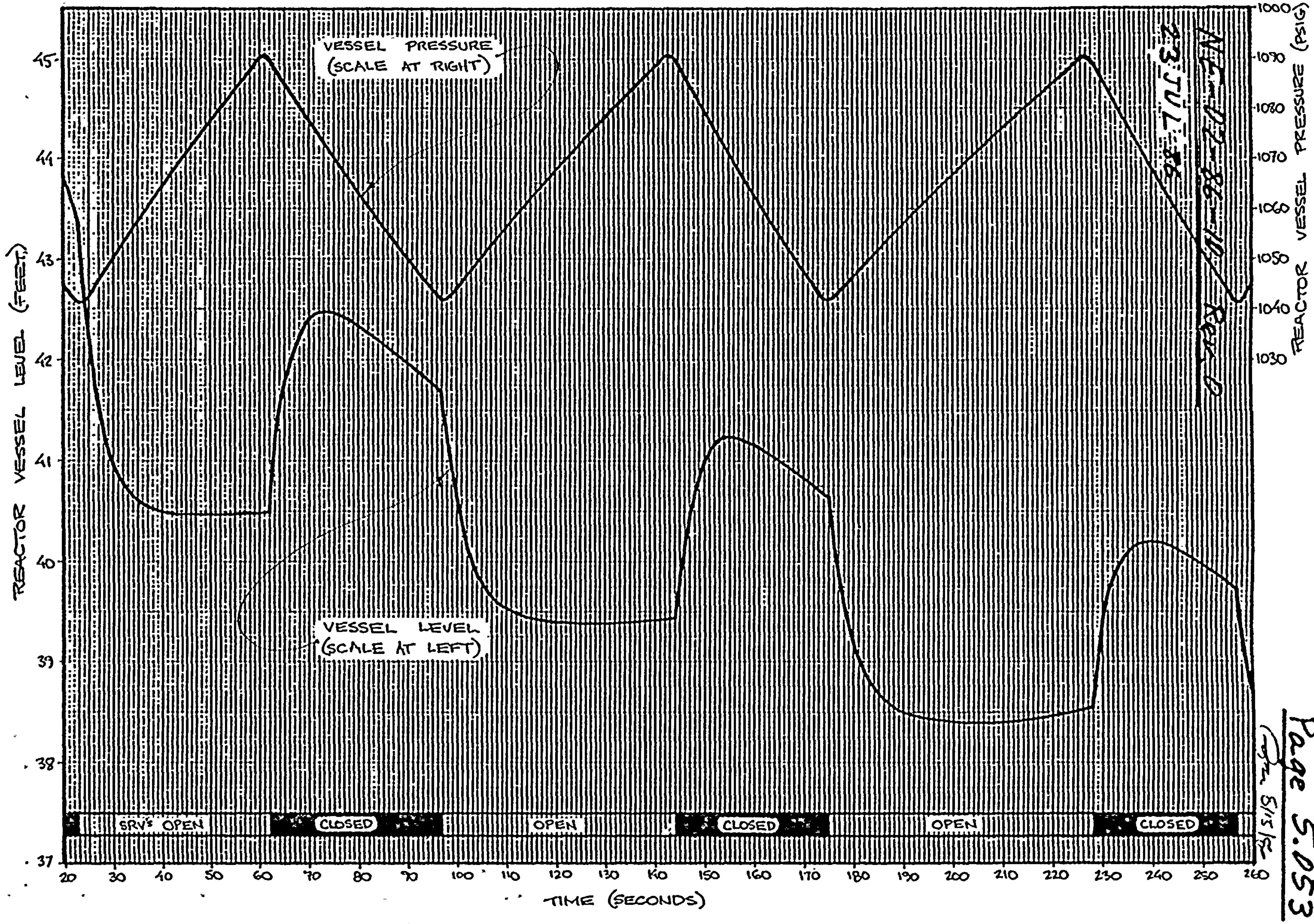
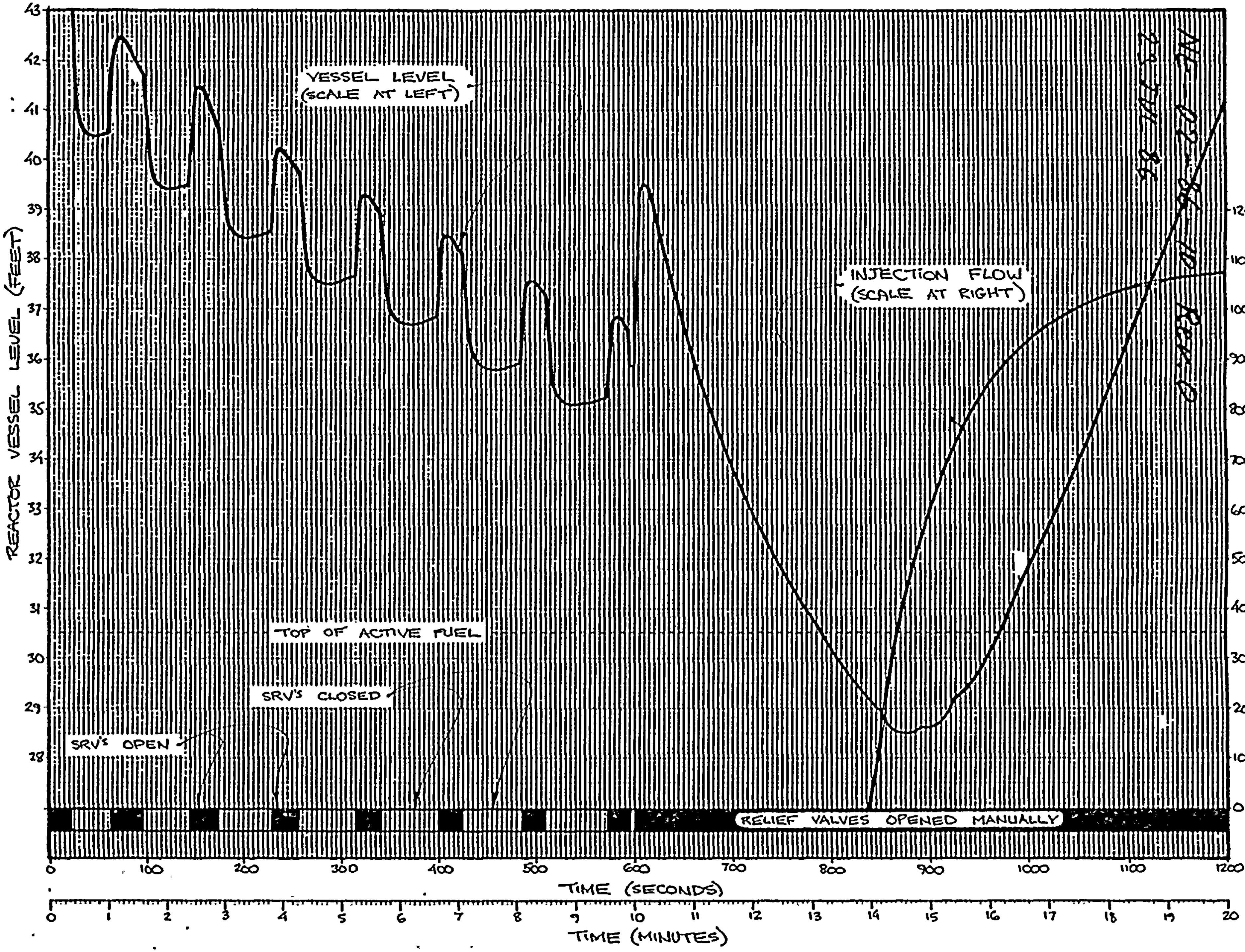
3. Discussion of Plant Transient Response

The next page shows a high resolution graph of vessel level and vessel pressure over the time interval of 20 sec thru 140 sec. The graph illustrates how the relief valve opening results in a remarkably linear pressure decrease, and how it just as linearly increases after the valve has closed. The level response is quite nonlinear. A very steep swell occurs right after the valve pops open. As vapor is lost thru the open valve, the level slowly decreases: the steam generation rate, even with flashing, does not keep up with the rate at which steam is lost. After the relief valve has closed, the level decreases just as steeply as it had previously increased.

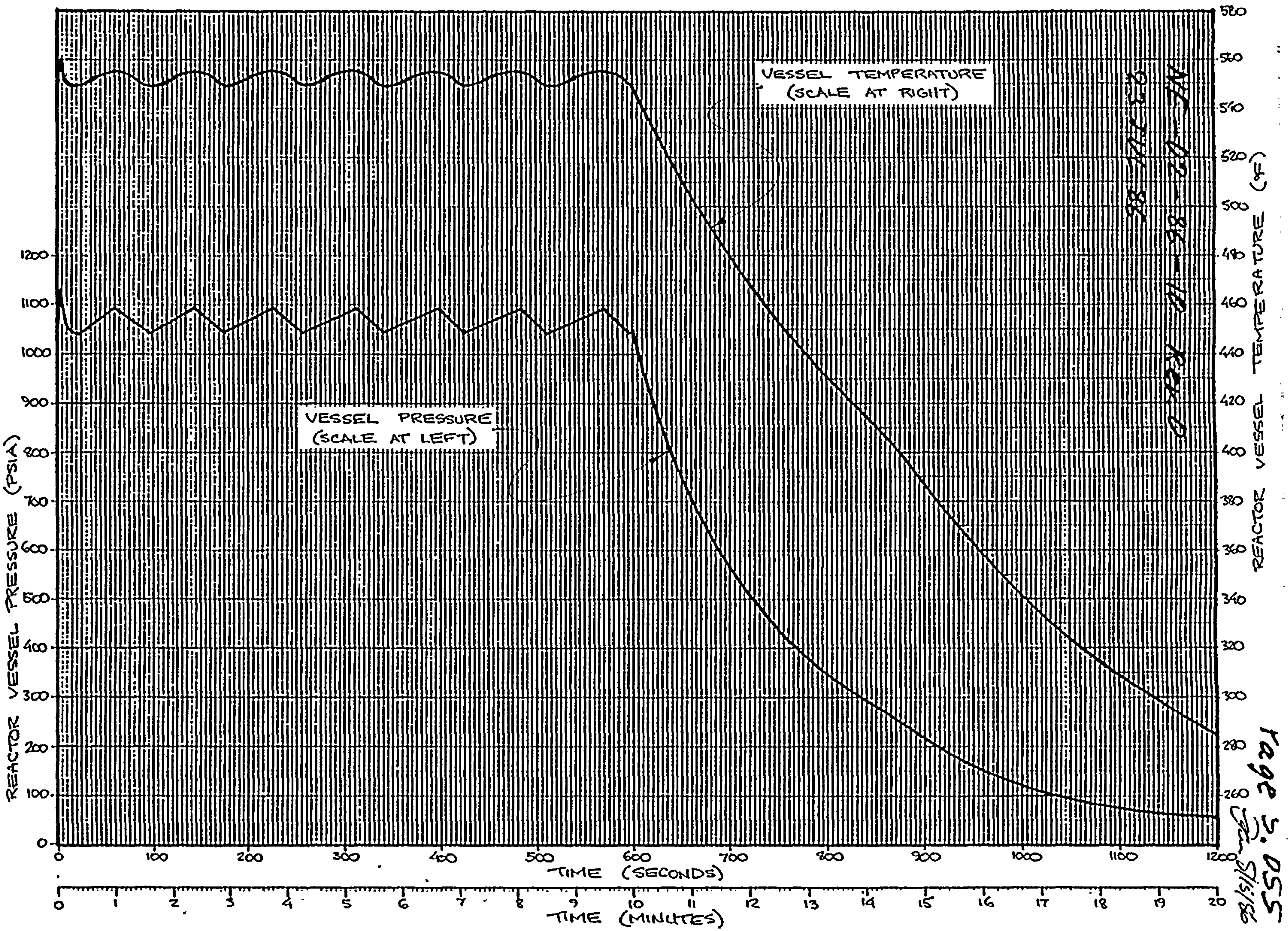


VESSEL PRESSURE
(SCALE AT RIGHT)
VESSEL LEVEL
(SCALE AT LEFT)
REACTOR VESSEL LEVEL (FEET)
REACTOR VESSEL PRESSURE (PSIG)
TIME (SECONDS)
SRV's OPEN
CLOSED
OPEN
CLOSED
OPEN
CLOSED

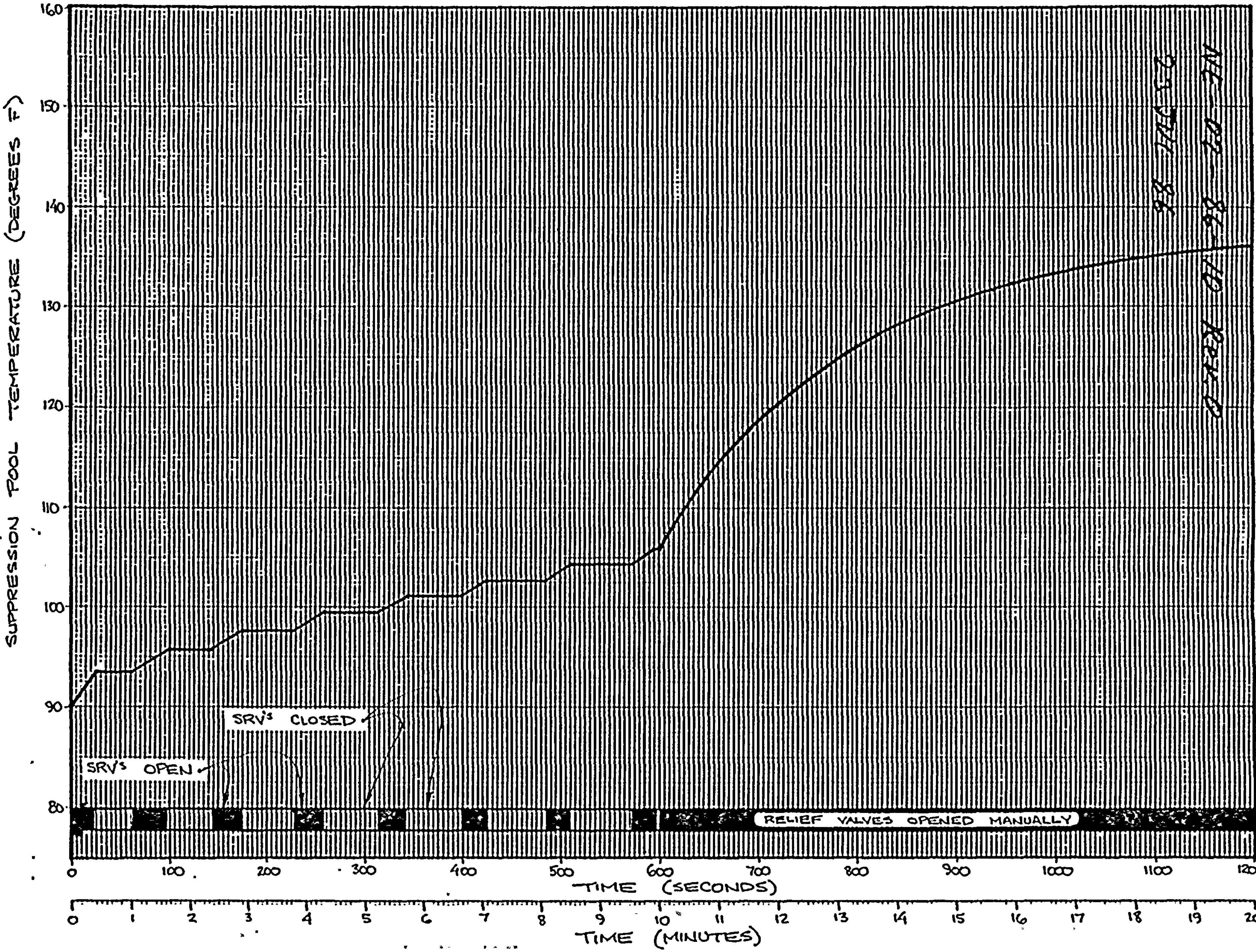


VESSEL LEVEL (SCALE AT LEFT)
INJECTION FLOW (SCALE AT RIGHT)
TOP OF ACTIVE FUEL
SRV'S CLOSED
SRV'S OPEN
RELIEF VALVES OPENED MANUALLY
REACTOR VESSEL LEVEL (FEET)
INJECTION FLOW (lb/second)
TIME (SECONDS)
TIME (MINUTES)
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0 100 200 300 400 500 600 700 800 900 1000 1100 1200
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Page 5.054



VESSEL TEMPERATURE
(SCALE AT RIGHT)
VESSEL PRESSURE
(SCALE AT LEFT)
REACTOR VESSEL PRESSURE (PSIA)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
REACTOR VESSEL TEMPERATURE (°F)
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
560
580
TIME (SECONDS)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200
TIME (MINUTES)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


SUPPRESSION POOL TEMPERATURE (DEGREES F)
160
150
140
130
120
110
100
90
80
SRV's CLOSED
SRV's OPEN
RELIEF VALVES OPENED MANUALLY
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
TIME (SECONDS)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
TIME (MINUTES)

Page 5.056

Page 5.054 shows the reactor liquid level response together with the injection flow. At the bottom is the indicator bar showing the valve openings. During the first 10 minutes the level drifts down from an initial value of 45 ft (see data on Page A4-06) to about 35.0 ft at a slowly decreasing rate. A steep level swell of 1.6 to 1.8 ft occurs every time the valves open. A level swell of 4.8 ft occurs when manual depressurization with 6 valves is initiated. This level swell results from vigorous flashing thruout the fluid region when the pressure starts to decrease exponentially (see Page 5.055, lower trace). From thereon the level decreases steeply, until it reaches the top of the active fuel at t=791 sec. Meanwhile the injection flow

has started at t = 837 sec. The liquid level reaches its minimum (about 2.0 ft below the top of the active fuel) at t = 873 sec. It goes back up and reaches the top of the active fuel again at t = 968 sec, for a total uncovery time of $\Delta t = 177$ sec. The slight kink in the level trace at t = 750 sec is caused by a sudden change in the level versus volume function as the level drops below the setpoint L1 (at 31.54 ft). After the level turns back up (at t = 873 sec), it recovers very quickly as the pressure decreases further and injection flow increases rapidly.

Page 5.055 shows the pressure trace and the temperature trace for the reactor

coolant. The pressure trace shows a total of 8 pressure decreases during the first 10 min, caused by the automatic relief valve openings. The temperature trace is naturally synchronized to the pressure trace. Both traces are rather repetitive until manual depressurization is initiated at t=10 min.

Page 5.056 shows the pool temperature versus time. The trace ~~nicely~~ illustrates how each each relief valve actuation causes a temperature increase of slightly less than 2 Fahrenheit. The tail end of the trace shows a drastic decrease in gradient, that is, the temperature increase gets progressively smaller. The trace illustrates that this particular transient is quite easy on the suppression pool.

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4. Results and Conclusions

The key results can be summarized as follows:

Start of Manual Depressurization	10.0 min
Start of LPCI Flow	14.0 min
Time of Minimum Coolant Level	14.6 min
Duration of Partial Fuel Uncovery	3.0 min
Vessel Depressurization Time	~10 min
Recommended Time for Shifting from LPCI Mode to RSC Mode	~20 min
Minimum Coolant Level	2.0 ft below TAF
Initial Coolant Temperature	552 F
Upper Bound Estimate for Peak Cladding Temperature at Minimum Coolant Level	788 F
Maximum Suppression Pool Temperature	~140 F

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

MANUAL CALCULATION

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REVISION 0

SUBJECT Reactor Depressurization Using 6 Relief Valves

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Although this transient is based on an unusually harsh (nonphysical) scenario, it will not result in any fuel overheating, undercooling and/or potential for cladding damage. Two recommendations can be derived:

1. Depressurize with all six valves as early as possible
2. After the reactor coolant level has recovered to its normal region, terminate the LPCI (low pressure coolant injection) mode and initiate the RSC (reactor shutdown cooling) mode.

APPENDIX 1

Bounding Estimate for Heatup Rate of Unsubmerged Fuel

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SUBJECT Appendix 1

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Traces from NEDO-24708A, Ref. 6

Ref. 6 Page	Temp. Gradient F/sec	Starting Time sec	Decay Power pct	Adjusted Temp. Gradient F/sec
4-1002	4.19	23.9	4.25	1.92
4-1085	1.64	1,394	1.72	1.85
4-1126	1.66	1,394	1.72	1.88
4-1175	1.64	1,383	1.722	1.85
4-1184	1.65	1,394	1.72	1.87
4-1191	1.63	1,392	1.72	1.84

The following 6 pages show fuel temperature traces from Reference 6. These traces are tabulated in the above table. The first column gives the appropriate page number in Reference 6. Column 2 shows the heatup rate as taken from the graph. In the third column, the time at which heatup starts is listed. The fourth column shows the ANS decay power at that time, in percent of full power. The fifth co-

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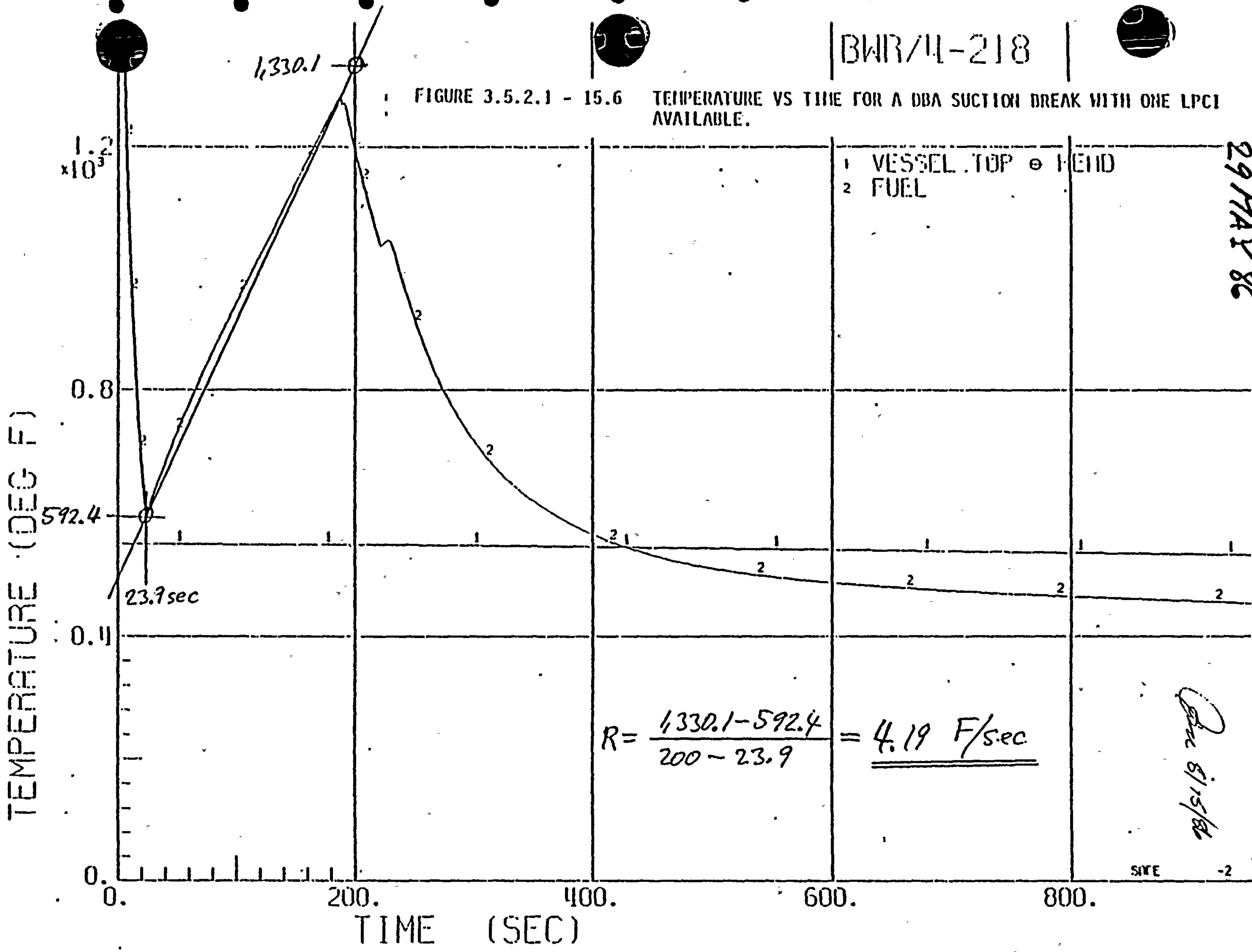
FIGURE 3.5.2.1 - 15.6 TEMPERATURE VS TIME FOR A DBA SUCTION BREAK WITH ONE LPCI AVAILABLE.



$$R = \frac{1{,}330.1 - 592.4}{200 - 23.9} = 4.19 \text{ F/sec}$$

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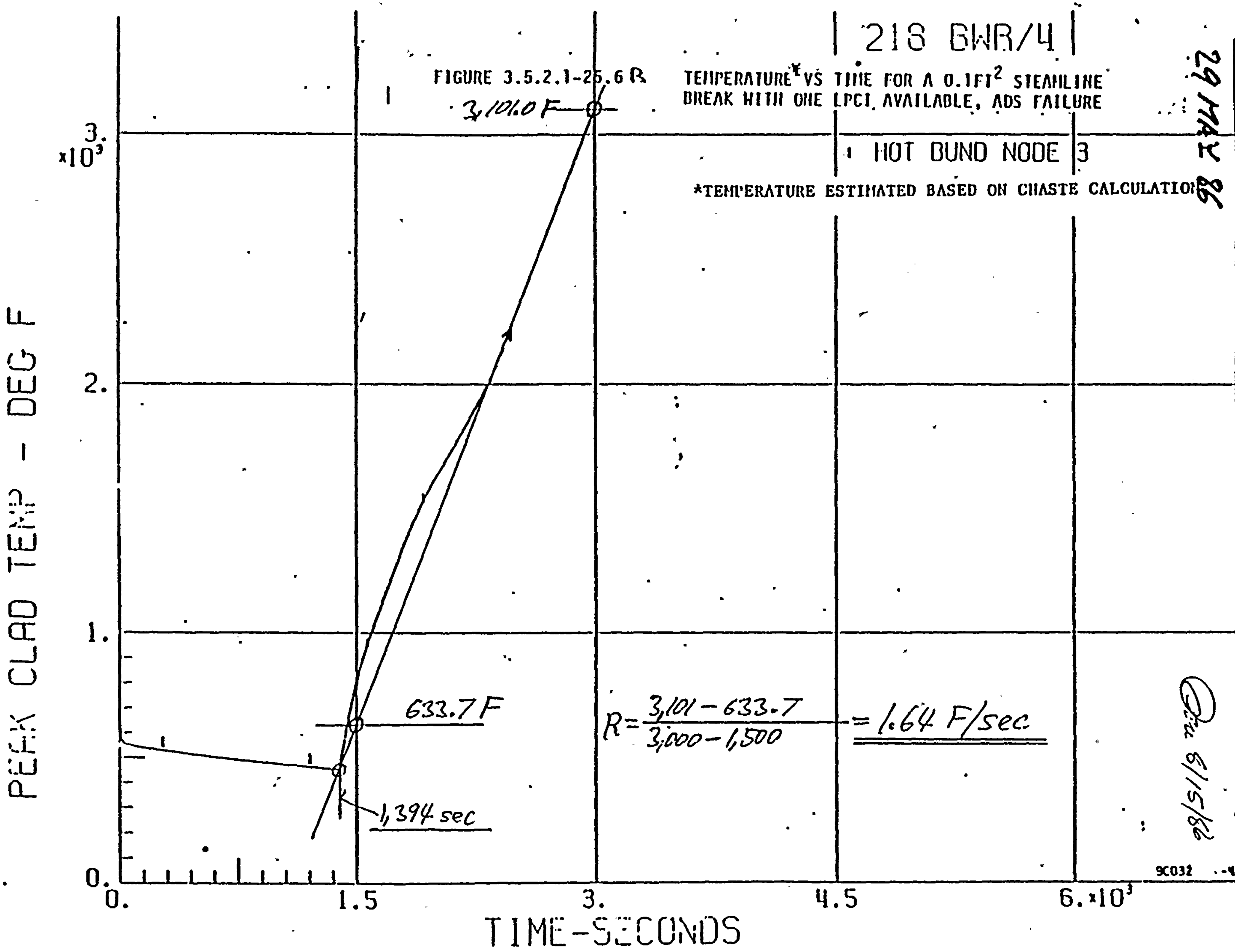

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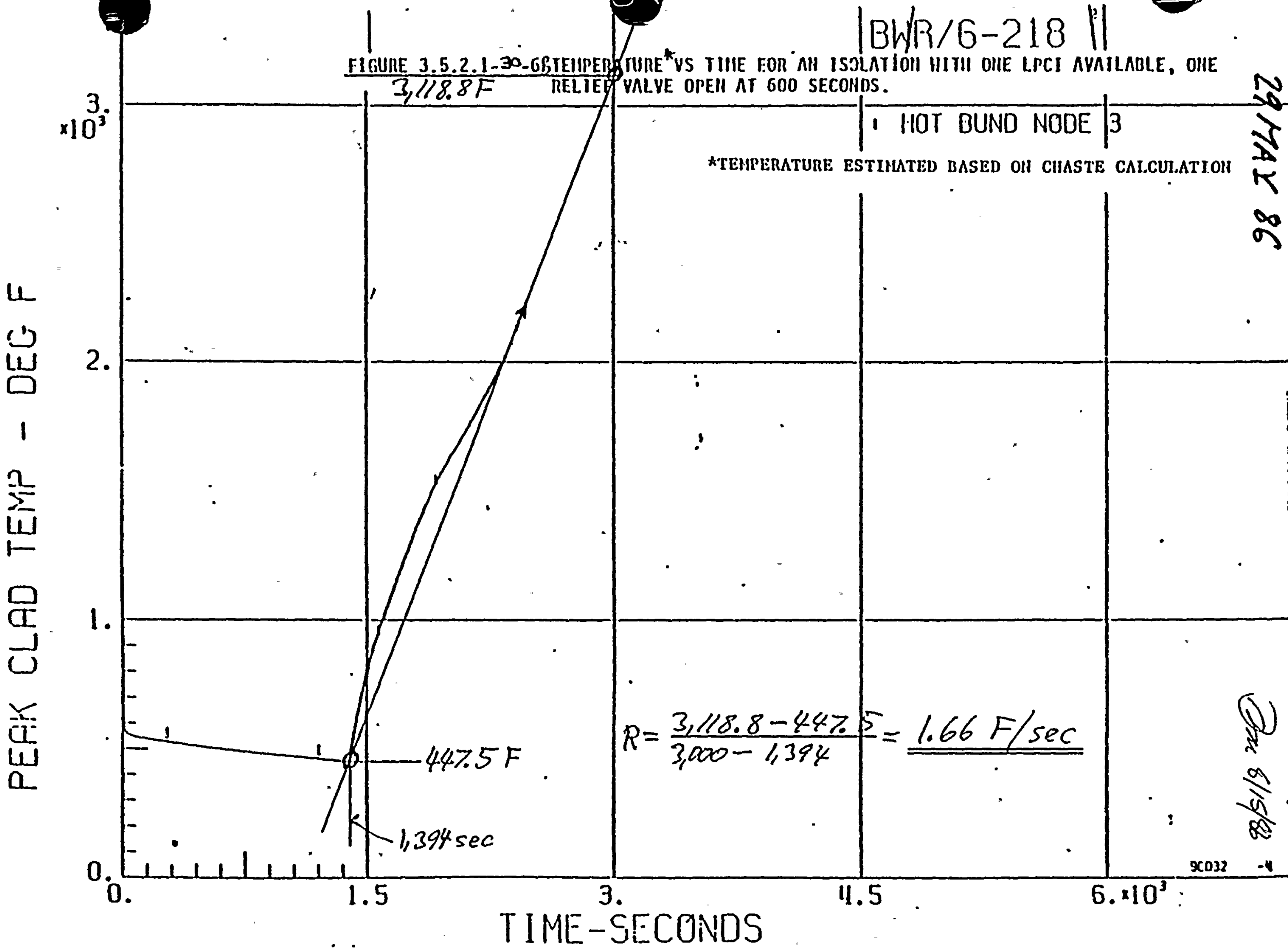

FIGURE 3.5.2.1-30-6 TEMPERATURE* VS TIME FOR AN ISOLATION WITH ONE LPCI AVAILABLE, ONE RELIEF VALVE OPEN AT 600 SECONDS.

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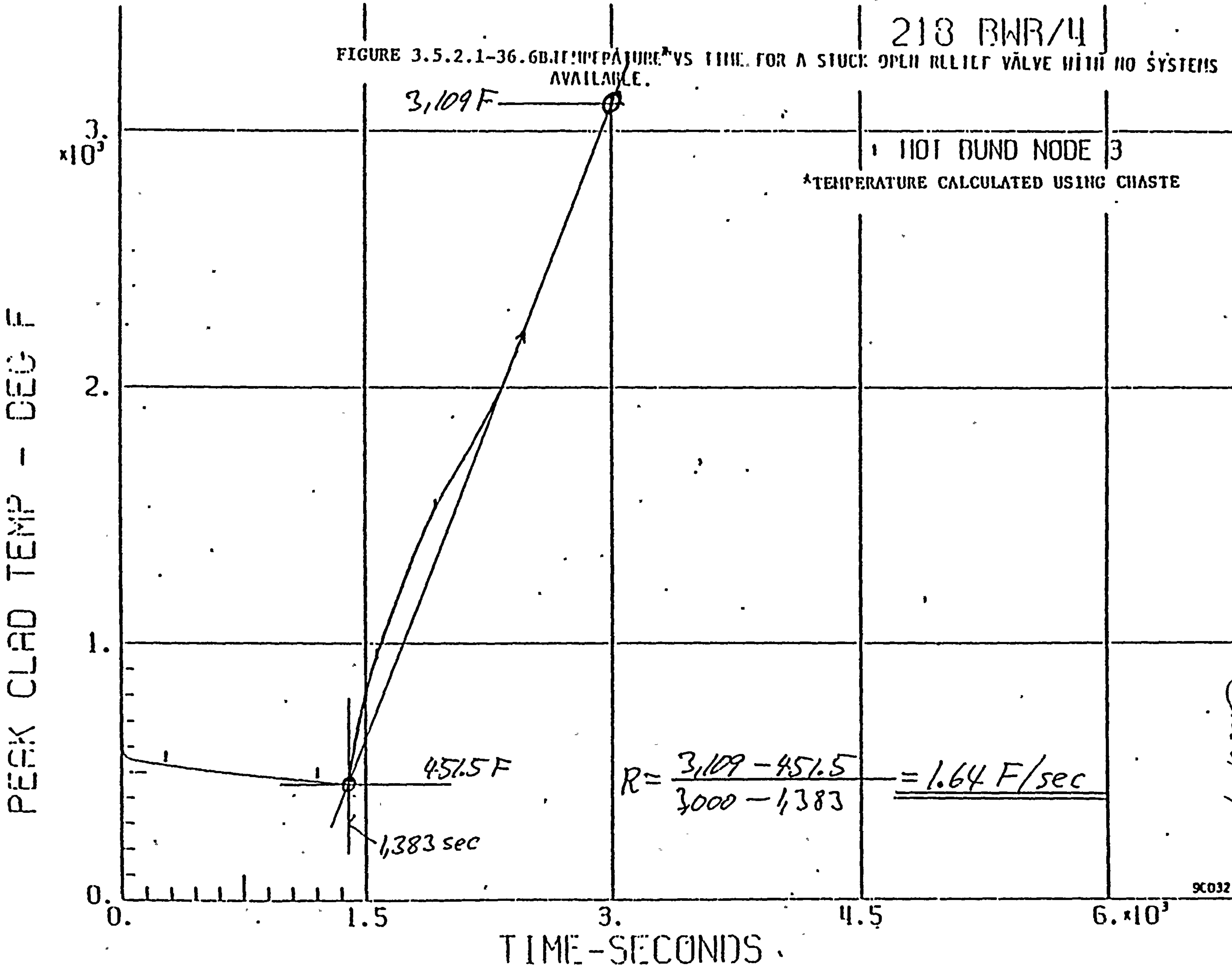
[illegible]

FIGURE 3.5.2.1-36.6B.TEMPERATURE* VS TIME FOR A STUCK OPEN RELIEF VALVE WITH NO SYSTEMS AVAILABLE.



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Page A1-06

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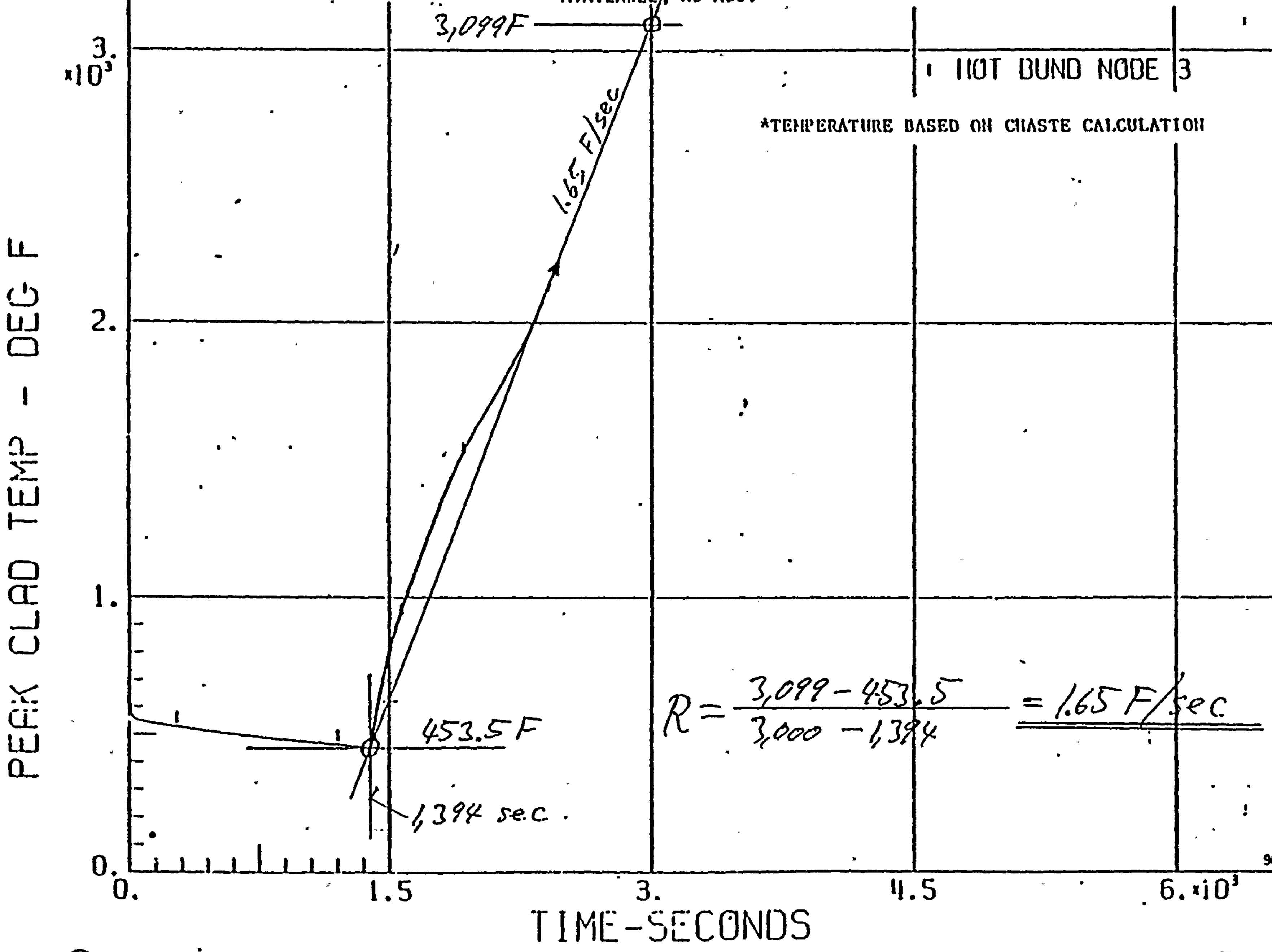
FIGURE 3.5.2.1-37.6B TEMPERATURE* VS TIME FOR A STUCK OPEN RELIEF VALVE WITH ONE LPCI AVAILABLE, NO ADS.



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Page A1-07

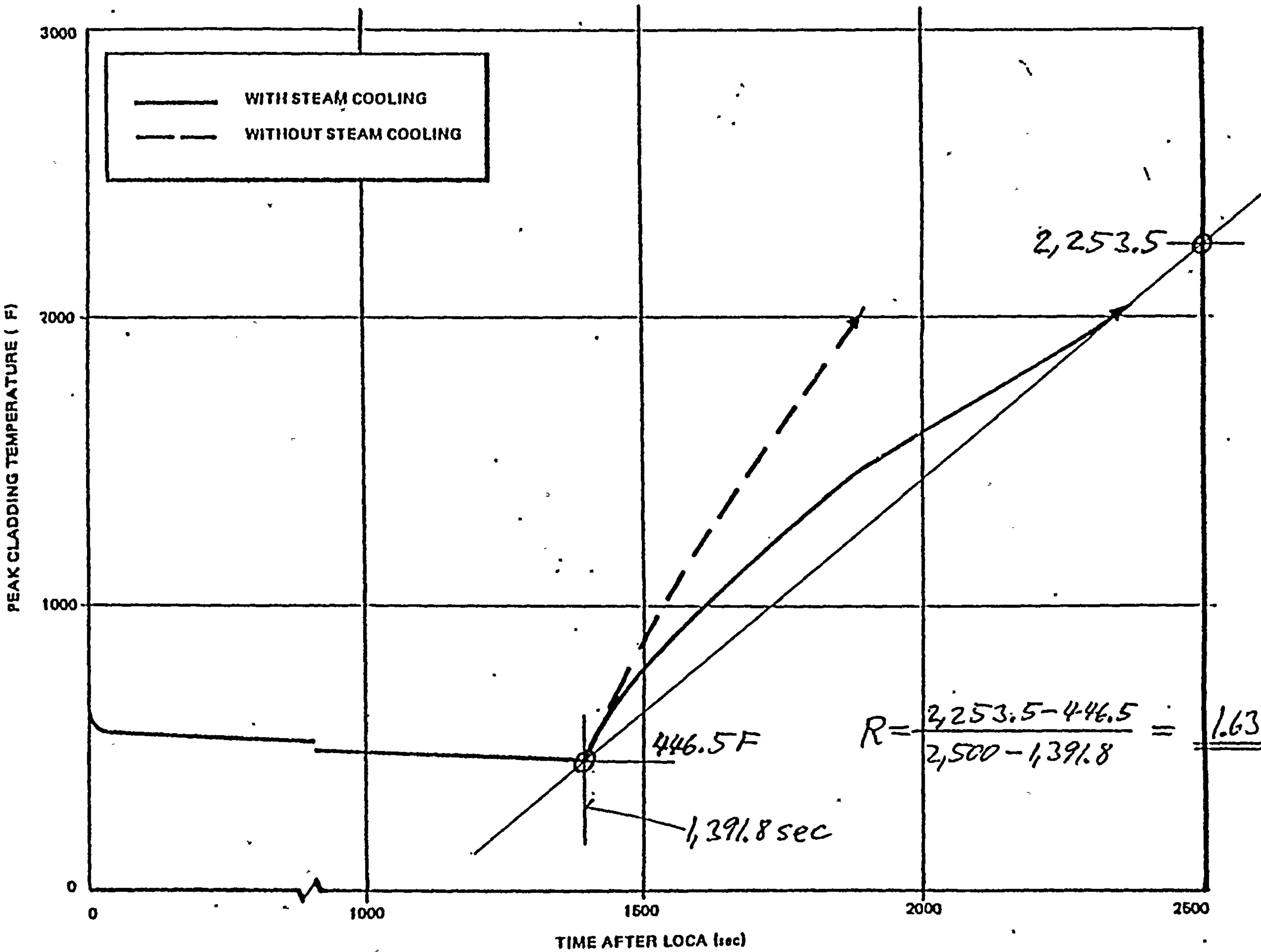

Figure 3.5.2.4-2. The Effect of Steam Cooling on Peak Cladding Temperature

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SUBJECT Appendix 1

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lumn shows the adjusted heatup rate for the ANS decay power at t = 815 sec. The heatup rate is adjusted by the ratio in decay power:

$$Rate(t_2) = Rate(t_1)\left(\frac{Power(t_2)}{Power(t_1)}\right)$$

with t_1 = time when heatup starts in GE trace, see Column 3

t_2 = 815 sec

$Power(t_2) = Power(815\,sec) = 1.945$ pct

The decay power in percent is read from the graph of ANS decay power on Page AI-10. The underlying rationale for this approach is that the heatup rate is determined by

1. The level of decay power imparted on the fuel rod; this is approximately constant over small intervals of time, especially if the scram occurred more

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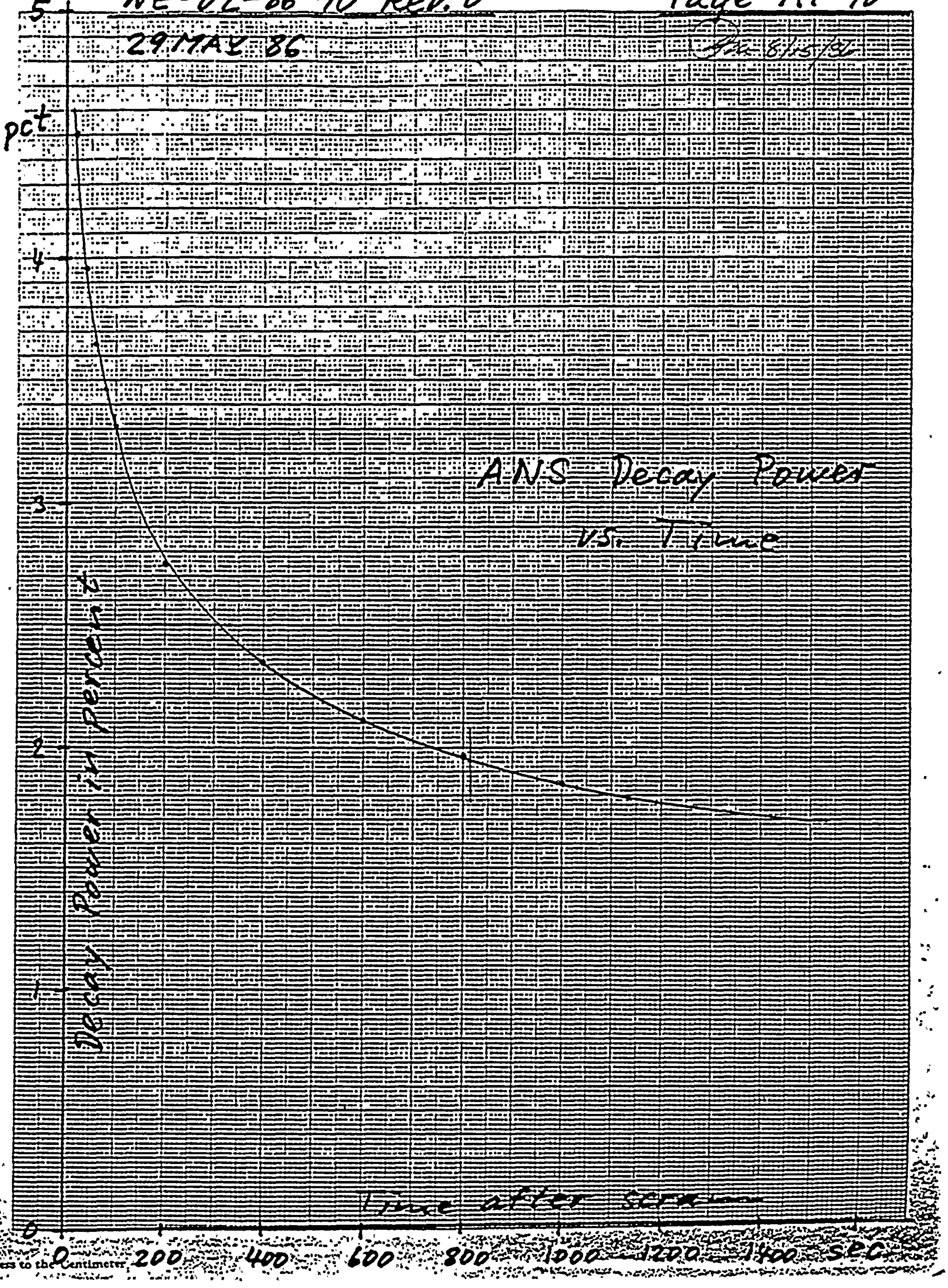

10 Millimeters to the Centimeter

than 10 min ago.

2. The specific heat (thermal capacity) of the fuel rod, which is approximately constant for reasonably limited temperature intervals sufficiently removed from the melting point.

3. The fact that the steam cooling effect, which is modeled in the GE CHASTE code, is not a strong function of the heatup rate.

These three arguments combine to justify using the decay power ratio for adjusting the heatup rate.

For all six traces tabulated on Page AI-02, the adjusted heatup rate (see last column of the table) is below 2.0 fahrenheit/second. In all of these 6 cases steam cooling is accounted for. Based on these results it can be stated that a heatup rate of 2.0 F/sec is an <u>upper</u> bound estimate.

APPENDIX 2

Bounding Estimate for Stored Structural Heat

In both previous depressurization calculations (References 7 and 8), the thermal power versus time was taken from FSAR Table 6.2-11 (Page 6.2-106) together with FSAR Figure 6.2-27, see Pages A4-02 and A4-03 of NE-02-84-19 (Reference 7). In this approach the stored structural heat is added in terms of additional thermal power during the first 30 seconds after the scram. This method of accounting for the stored heat is conservative insofar as the additional equivalent thermal power causes a temperature increase which stored heat cannot cause. Also, in terms of thermal energy accounting it is not relevant <u>when</u> the additional thermal power is added. However, as far as correct pressure calculation during depressurization is concerned, adding this additional heat <u>before</u> start of depressurization is non-conservative with respect to low pressure Coolant injection. In physical reality,

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the stored heat will somewhat retard the cooldown during depressurization, and consequently the reactor pressure will decrease more slowly, thereby delaying the start of low pressure coolant injection.

For this calculation, we determine the stored heat from the above data by integrating that extra hump on the decay power curve. From the amount of heat calculated, we determine a corresponding amount of steel which is then carried as a point node for steel, see Mass 4 on Page 5.007.

From Page A4-08 of NE-02-84-19 (Ref. 7) we get the integrated thermal power including stored heat for the first 30 sec:

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$$L_{30} = 0.0091 + 0.846,044 + 1.002,317 + 1.442,906 + 0.843,602 + 0.706,255 + 1.429,871 + 1.172,698$$

$$L_{30} = 7.44 \text{ unit} \cdot \text{sec}$$

To calculate the corresponding full power seconds for the case without stored heat adjustment, we integrate the thermal power during the scram plus the decay power from $t = 3.9$ sec to $t = 30$ sec. The tabulation on the next page shows the fission power data (during the scram) from Page 5.011. These data are linearly interpolated, and the power integral amounts to 3.1761 unit-sec, as the table shows. From $t = 3.9$ sec to $t = 30$ sec, we use the logarithmic decay

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time sec	Power frac	Energy unit·sec
0	1.000	—
1	0.987	0.9935
2	0.953	0.9700
2.5	0.903	0.4640
3.0	0.719	0.4055
3.5	0.330	0.2623
3.9	0.074	0.0808
Total		3.1761

power curve from Appendix 4 of Reference 7 (see also log-log graph on Page 5.012, use straight line in that graph). The straight line in the log-log graph is

$$\pi = A + B\tau \quad \text{with}$$

$\pi = \log(\text{Power})$, $\tau = \log(\text{time})$

We use 2 data points:

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time	Power	τ	π
3.9	0.074	0.591,065	−1.130,768
30	0.047	1.477,121	−1.327,902

from which we get the equations:

$$\left.\begin{array}{l} -1.130{,}768 = A + (0.591{,}065)\,B \\ -1.327{,}902 = A + (1.477{,}121)\,B \end{array}\right\}$$

Solving for A and B, we have

$A = -0.999,265$ $B = -0.222,485$

and $\pi = -0.999,265 - (0.222,485)\,\tau$

Using the method from Appendix 4 of Reference 7, we get for the integrated power from t = 3.9 sec to t = 30 sec

$$L = \left(\frac{10^{A}}{B+1}\right)\left\{30^{B+1} - 3.9^{B+1}\right\}$$

or with A and B inserted:

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$$L = \left(\frac{10^{-0.999,265}}{0.777,515}\right)\left\{30^{0.777,515} - 3.9^{0.777,515}\right\}$$

$L = 1.4423$ unit·sec

The integrated thermal power during the first 30 sec without stored heat adjustment is then:

$L'_{30} = 3.1761 + 1.4423 = 4.6184$ unit·sec

The adjustment for stored heat then amounts to

$\Delta L = 7.44 - 4.6184 = 2.82$ unit·sec

With a full power value of 3,489 MW (see Page A4-02), 2.82 full power seconds amount to:

$$\Delta L = (2.82 \text{ unit·sec})\left(3,489 \frac{MW}{unit}\right)\left(\frac{1 hr}{3,600 sec}\right)$$

$\Delta L = 2.733,05$ MW hr

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$$\Delta L = 2.733,05\ (10^3)\ KWhr \left(\frac{3,412\ btu}{KWhr}\right)$$

$$\Delta L = 9.3252\ Mbtu$$

From Marks (Reference 10) Page 4-12 we have for the specific heat of steel:

$$C = 0.127\ \frac{btu}{lb \cdot F}$$

To assure that the estimate for the participating steel mass is not too small, we assume that no stored heat is transacted below 250 F. This results in a temperature range of

$$\Delta T = (550 - 250)\,F = 300\,F$$

The thermally effective steel structure then amounts to

$$M = \frac{9.3252\ (10^6)\ btu \cdot lb \cdot F}{0.127\ btu \quad 300\ F} = 244.756\ Klb$$

$$M \approx 245\ Klb$$

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This value (Item 1 on Page A2-11) was used in the initial computer runs. However, when discussing the data with GE it was found that the figure is too small. The FSAR gives further information on Page 6.2-95 (see next Page). Using the values for D.2.a, D.2.b and D.2.d, we have Q = (106.1 + 58.6 + 25.2) Mbtu = 189.9 Mbtu. This results in the data of Item 2, Page A2-11. The GE plant transient model contains about 2.13 Mlb, see Item 3. The discussion with GE resulted in the figures shown in Item 4,

TABLE 6.2-3

ACCIDENT ASSUMPTIONS AND INITIAL CONDITIONS FOR RECIRCULATION LINE BREAK

A.	Effective Accident Break Area (Total), ft^2	3.106
B.	Components of Effective Break Area:	
	1. Recirculation Line Suction Nozzle Area, ft^2	2.508
	2. RWCU crosstie line, ft^2	.078
	3. Jet Pump Nozzles, ft^2	.520
C.	Break Area/Vent Area Ratio	.0105
D.	Primary System Energy Distribution (1)	
	1. Steam and Liquid Energy, 10^6 Btu	414
	2. Sensible Energy, 10^6 Btu	
	a. Reactor Vessel	106.1
	b. Reactor Internals (less core)	58.6
	c. Primary System Piping	34.6
	d. Fuel (2)	25.2
E.	Assumptions Used in Pressure Transient Analysis	
	1. Feedwater Valve Closure Time	Instantaneous
	2. MSIV Closure Time (sec)	3.5
	3. Scram Time (sec)	<1
	4. Liquid Carryover, %	100
	5. Turbine Stop Valve Closure (sec)	0.2

1. All energy values except fuel are based on a 32°F datum.
2. Fuel energy is based on a datum of 285°F datum.

Thermal Capacity Data

Item	Reference	Thermal Capacity btu/F	Steel Mass (1) Mlb
1	LOCA Data FSAR Page 6.2-106	31,115	0.245
2	FSAR Page 6.2-95	474,750	3.74
3	GE SAFE Model, max. available	270,000	2.13
4	Discussion with GE, Best Estimate	209,550	1.65

(1) Calculated with $c = 0.127 \frac{btu}{lb \cdot F}$ for steel and $\Delta T = 550 - 150 = 400 F$

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which is the best estimate for actively participating thermal capacity for the type of transient analyzed here.

APPENDIX 3

Listing of Computer Code

BLOWDOWN.01

in BASIC Language

```
20 REM REACTOR VESSEL DEPRESSURIZATION MODEL ***** STEADY STATE *****
40 REM *** PAGE 01, FILE WORKS1 *** SIDE BLOWDOWN.01 STEDY ***
60 DIM D(2,30),ELEV(13),VOL(13),SRSET(4,5),SFLOW(18),VOPEN(18),PROK(25),VLOK(25)
80 DIM POPEN(18),PCLOSE(18),KGPM(18),PUMP(18)
   DEFINT I,J
   DATE$="THU, 29 MAY 86, 08:00 HR"
140 I0=0 : I1=1 : I2=2 : I3=3 : I4=4 : I5=5:I6=6:I9=10 : I13=13 : I18=18
160 F0=0.0:F1=1.0:F2=2.0 : F100=100.0 : F1000=1000.0 : F36=3600.0
180 CLS
200 PRINT:PRINT:PRINT"REACTOR DEPRESSURIZATION CALCULATION":PRINT
220 NVLV = I18 :REM NUMBER OF RELIEF VALVES
240 NDHP = 30  :REM NUMBER OF DECAY HEAT CURVE POINTS
260 NLEV = I13 :REM NUMBER OF CURVE POINTS FOR REACTOR LIQU VOLUME VS LEVEL
280 NPMP = I18 :REM NUMBER OF CURVE POINTS FOR PUMP HEAD VERSUS VOLUMETRIC FLOW
300 NVOK = 21  :REM NUMBER OF CURVE POINTS FOR CHOKING VELOCITY VERSUS PRESSURE
320 FOR I=I1 TO NVLV
340 VOPEN(I) = F0
360 NEXT I
380 REM READ DATA FOR DECAY POWER VERSUS TIME (FIRST TIME, THEN POWER)
400 FOR I=I1 TO NDHP
420 READ D(I1,I)
440 NEXT I
460 FOR I=I1 TO NDHP
480 READ D(I2,I)
500 NEXT I
520 FOR I=I1 TO I5
540 REM READ 5 VALVE SETPOINTS FOR RELIEF FUNCTION
560 REM SRSET(1,I) = ON, SRSET(2,I) = OFF
580 READ SRSET(I1,I), SRSET(I2,I)
    NEXT I
    FOR I=I1 TO I5
640 REM READ 5 VALVE SETPOINTS FOR SAFETY FUNCTION
660 REM SRSET(3,I) = ON, SRSET(4,I) = OFF
680 READ SRSET(I3,I), SRSET(I4,I)
700 NEXT I
720 REM READ LIQUID VOLUME VERSUS REACTOR LEVEL ELEVATION
740 FOR I=I1 TO NLEV
760 READ ELEV(I)
780 NEXT I
800 FOR I=I1 TO NLEV
820 READ VOL(I)
840 NEXT I
860 REM READ PUMP HEAD (PSID) VS PUMP FLOW (KGAL/MIN)
880 FOR I=I1 TO NPMP
900 READ KGPM(I)
920 NEXT I
940 FOR I=I1 TO NPMP
960 READ PUMP(I)
980 NEXT I
1000 FOR I=I1 TO NVOK
1020 READ PROK(I)
1040 NEXT I
1060 FOR I=I1 TO NVOK
     READ VLOK(I)
     NEXT I
     REM LOAD VALVE SETPOINTS. USE RELIEF FUNCTION SETPOINTS (LOWER SETPOINTS)
1140 POPEN(I1) = SRSET(I1,I1)
1160 POPEN(I2) = POPEN(I1)
1180 PCLOSE(I1)= SRSET(I2,I1)
1200 PCLOSE(I2)= PCLOSE(I1)
1220 FOR N=I3 TO I4
```

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```
1300 RIPE  I  = BREF( I.N)
1320 FOLDEF I.= BREF( I.N)
1340 NEXT M
1360 NEXT N
1380 DEFSET = F0
1400 CLS:INPUT " READ DATA FROM FILE FLO T  (Y/N) ":Y$
1420 PRINT
1440 IF Y$ = "N" GO TO 1580 ELSE IF Y$ ><"Y" GO TO 1400
1460 FL$ = "FLO"
1480 OPEN  #I1,"D1:FL$"INPUT
1500 INPUT #I1,VL,VOIDFR,SYSVOL,TCOL,P0,VPOOL,TPOOL
1520 INPUT #I1,SDEP,PMIN,PMAX,NDP,TMAX,DT,NPROUT
1540 CLOSE #I1
1560 GOTO 1860
1580 INPUT "REACTOR LIQUID VOLUME WITHOUT VOIDS = ":VL
1600 INPUT "REACTOR VOID FRACTION AT HOT STANDBY = ":VOIDFR
1620 INPUT "REACTOR SYSTEM VOLUME                 = ":SYSVOL
1640 INPUT "REACTOR COOLANT TEMPERATURE           = ":TCOL
1660 INPUT "REACTOR POWER (MW)                    = ":P0
1680 INPUT "SUPPRESSION POOL VOLUME  (FT**3)      = ":VPOOL
1700 INPUT "INITIAL SUPPRESSION POOL TEMPERATURE= ":TPOOL
1720 INPUT "DEPRESSURIZATION START TIME          = ":SDEP
1740 INPUT "INITIAL CONTAINMENT PRESSURE          = ":PMIN
1760 INPUT "FINAL   CONTAINMENT PRESSURE= ":PMAX
1780 INPUT "NUMBER OF VALVES TO BE USED FOR DEPRESSURIZATION = ":NDP
1800 INPUT "MAX TIME IN SEC = ":TMAX
1820 INPUT "TIME STEP IN SEC = ":DT
1840 INPUT "PRINT FREQUENCY (NUMBER OF TIMESTEPS) = ":NPROUT
1860 CLS
1880 INPUT "WRITE INPUT TO FILE FLO T  (Y/N)   ":Y$
1900 IF Y$ = "N" GO TO 2000 ELSE IF Y$ ><"Y" GO TO 1860
1920 OPEN  #I1,"D1:FL$"OUTPUT
1940 PRINT #I1,VL,VOIDFR,SYSVOL,TCOL,P0,VPOOL,TPOOL
1960 PRINT #I1,SDEP,PMIN,PMAX,NDP,TMAX,DT,NPROUT
1980 CLOSE #I1
2000 CLS
2020 T = TCOL
2040 GOSUB 7480 :REM----------------------------------------->STEAM TABLES
2060 PVP = P
2080 POFF = PUMP(I1)
2100 VLX = VL / (F1-VOIDFR)
2120 RKAPA = 1.3  :REM ISENTROPIC EXPANSION COEFFICIENT FOR SATURATED STEAM
2140 RKX = RKAPA / (RKAPA-F1)       :REM SEE MARKS HANDBOOK, PAGE 4-63
2160 PCHOKE = (F2/(RKAPA+F1))^RKX :REM MIN PRESSURE RATIO FOR CHOKED FLOW
2180 VDI4 = 4.84                :REM VALVE THROAT DIAMETER.
2200 VARA = (4.84/12.0)^2
2220 VARA = (VARA*3.14159G)/4.0 :REM VALVE THROAT AREA
2240 RKV  = 0.470956 :REM DISCHARGE COEFFICIENT
2260 FOR I=I1 TO NVCK
2280 J=I
2300 IF PRCK(I) > PVP GO TO 2340
2320 NEXT I
2340 DVDX = (VLCK(J)-VLCK(J-I1))/(PRCK(J)-PRCK(J-I1))
2360 VEL = VLCK(J-I1) + DVDX*(PVP-PRCK(J-I1))
2380 VLVFLO = (RKV*VARA*VEL)/VG
2400 STLMAS = 245000.0 :REM LB OF THERMALLY ACTIVE STEEL STRUCTURE
2420 OPEN #I2,"P1:"OUTPUT
2440 INPUT " PRINT FULL SET OF INPUT DATA? (Y/N) ":YFUL$
2460 IF YFUL$ = "N" GO TO 2500 ELSE IF YFUL$><"Y" GO TO 2440
2480 GO TO 2540
2500 INPUT " PRINT THERMAL HYDRAULIC INPUT DATA? (Y/N) ":Y$
2520 IF Y$ = "N" GO TO 3080 ELSE IF Y$><"Y" GO TO 2500
2540 PRINT#I2," ":PRINT #I2,"     REACTOR DEPRESSURIZATION CALCULATION - INPUT DA
TA     ";DATE$
```

```
[illegible]
2610 PRINT #I3,"     REACTOR LIQUID VOLUME WITHOUT [illegible]  = ";
2620 PRINT #I3,USING" #####.#";VL;
2640 GOSUB 8020
2660 PRINT #I3,"     REACTOR VOID FRACTION AT HOT STANDBY = ";VOIDF
2680 PRINT #I3,"     REACTOR SYSTEM VOLUME               = ";
     PRINT #I3,USING" #####.#";SYSVOL;
     GOSUB 8020
2740 PRINT #I3,"     REACTOR COOLANT TEMPERATURE         = ";TCOL;" FAHRENHEIT"
2760 PRINT #I3,"     REACTOR POWER (THERMAL)             = ";PO;" MW"
2780 GOSUB 8080 :REM-----------------------------------------2 BLANK LINES
2800 PRINT #I3,"     SUPPRESSION POOL VOLUME             = ";
2820 PRINT #I3,USING" ######.#";VPOOL;
2840 GOSUB 8020
2860 PRINT #I3,"     INITIAL POOL TEMPERATURE            = ";TPOOL;" FAHRENHEIT"
2880 PRINT #I3,"     RHR PUMP  SHUTOFF HEAD              = ";POFF;" PSID"
2900 GOSUB 8080 :REM-----------------------------------------2 BLANK LINES
2920 PRINT #I3,"     DEPRESSURIZATION START TIME         = ";SDEP;" SEC"
2940 PRINT #I3,"     INITIAL CONTAINMENT PRESSURE        = ";PMIN;" LB/IN**2 ABS
"
2960 PRINT #I3,"     FINAL CONTAINMENT PRESSURE          = ";PMAX;" LB/IN**2 ABS
"
2980 GOSUB 8080 :REM-----------------------------------------2 BLANK LINES
3000 PRINT #I3,"     NUMBER OF VALVES TO BE USED FOR DEPRESSURIZATION.= ";NDP
3020 GOSUB 8080 :REM-----------------------------------------2 BLANK LINES
3040 PRINT #I3,"     MAXIMUM TIME = ";TMAX;" SEC. TIMESTEP = ";DT;" SEC"
3060 PRINT #I3,"     PRINT FREQUENCY (NR OF TIMESTEPS)      = ";NPROUT
3080 IF YFUL$="Y" GO TO 3140
3100 INPUT "PRINT LIQUID VOLUME VS REACTOR LEVEL? (Y/N)   ";Y$
3120 IF Y$ = "N" GO TO 3620 ELSE IF Y$><"Y" GO TO 3100
3140 GOSUB 8080
     PRINT #I3,"     LIQUID VOLUME VERSUS REACTOR LEVEL" : PRINT #I3, "  "
     PRINT #I3,"          LEVEL, FT      VOLUME, FT**3" : GOSUB 8080
3200 FOR I=I1 TO NLEV
3220 IF I=I1  THEN TAG$ = "BOT OF VES"
3240 IF I=I2  THEN TAG$ = "BOT ACT FUEL"
3260 IF I=I3  THEN TAG$ = "TOP ACT FUEL"
3280 IF I=I4  THEN TAG$ = "LEVEL L1"
3300 IF I=I5  THEN TAG$ = "LEVEL L2"
3320 IF I=6   THEN TAG$ = "LEVEL L3"
3340 IF I=7   THEN TAG$ = "LEVEL L4"
3360 IF I=8   THEN TAG$ = "LEVEL LN (NORMAL)"
3380 IF I=9   THEN TAG$ = "LEVEL L7"
3400 IF I=10  THEN TAG$ = "LEVEL L8"
3420 IF I=11  THEN TAG$ = "4 IN ABOVE L8"
3440 IF I=12  THEN TAG$ = "CENTERLINE STEAMLINE"
3460 IF I=I13 THEN TAG$ = "TOP OF VESSEL"
3480 PRINT #I3,USING"    ##   ";I;
3500 PRINT #I3,USING" ###.###";ELEV(I);
3520 PRINT #I3,USING"          #####.#     ";VOL(I);
3540 PRINT #I3, TAG$
3560 NEXT I
3580 TAG$ = " "
3600 IF YFUL$="Y" GO TO 3660
3620 INPUT" PRINT RHR PUMP CURVE? (Y/N)   ";Y$
3640 IF Y$ = "N" GO TO 3920 ELSE IF Y$><"Y" GO TO 3620
     GOSUB 8080
     PRINT #I3,"     RHR PUMP CURVE" : PRINT #3, " "
3700 PRINT #I3,"          PUMP FLOW, KGAL/MIN      PUMP HEAD, PSID      ";
3720 PRINT #I3," PUMP HEAD, FT"
3740 GOSUB 8080
3760 FOR I=I1 TO I13
3780 HEAD = PUMP(I) * 144.0*0.016033
[illegible]
```

```
[illegible] PRINT [illegible]                    [illegible]
3880 NEXT I
3900 IF YFUL$="Y" GO TO [illegible]
3920 INPUT "PRINT SAMPLE OF STEAM TABLES (Y/N) ";Y$
3940 IF Y$ = [illegible] GO TO [illegible] ELSE IF Y$<>"Y" GO TO [illegible]
[illegible] GOSUB 8080
[illegible] PRINT #3,"     SAMPLE FROM STEAM TABLE"
[illegible] GOSUB 8080
4020 PRINT #3,"     TEMP     PRES          VF              VG              HF      HG          UF
         UG    "
4040 GOSUB 8080
4060 T = 40.0 : J = 10
4080 FOR I=11 TO 68
4100 IF J < 5 GO TO 4160
4120 PRINT #3, " "
4140 J = 0
4160 J = J + 11
4180 T = T + 10.0
4200 GOSUB 7480 :REM------------------------------------------------STEAM TABLES
4220 PRINT #3,USING "      ###";T;
4240 PRINT #3,USING "  ####.####";P;
4260 PRINT #3,USING "  #.######";VF;
4280 PRINT #3,USING "  ####.#####";VG;
4300 PRINT #3,USING "  ###.###";HF;
4320 PRINT #3,USING "  ####.#";HG;
4340 PRINT #3,USING "  ###.###";EF;
4360 PRINT #3,USING "  ####.#";EG
4380 NEXT I
4400 GOSUB 8080 :REM-----------------------------------------------2 BLANK LINES
4420 IF YFUL$="Y" GO TO 4480
4440 INPUT "PRINT DATA FOR DECAY POWER CURVE ? (Y/N)   ";Y$
[illegible] IF Y$ = "N" GO TO 4840 ELSE IF Y$<>"Y" GO TO 4440
[illegible] PRINT #3," " : PRINT #3,"     DECAY POWER CURVE "
4500 GOSUB 8080 :REM-----------------------------------------------2 BLANK LINES
4520 PRINT #3,"     POINT   TIME,SEC    TIME,MIN   TIME,HR         POWER,FRAC      PO
WER,MW"
4540 PRINT #3," "
4560 FOR I=11 TO NOHP
4580 POW = D(12,I) * PO
4600 PRINT #3,USING "     ##  ";I;
4620 TIM = D(11,I)
4640 PRINT #3,USING " #######.##";TIM;
4660 TIM = TIM / 60.0
4680 PRINT #3,USING "  ######.##";TIM;
4700 TIM = TIM / 60.0
4720 PRINT #3,USING "  ####.###";TIM;
4740 PRINT #3,USING "        #.######";D(12,I);
4760 PRINT #3,USING "        #####.###";POW
4780 NEXT I
4800 GOSUB 8080 :REM-----------------------------------------------2 BLANK LINES
4820 IF YFUL$="Y" GO TO 4880
4840 INPUT "PRINT RELIEF VALVE DATA ? (Y/N)   ";Y$
4860 IF Y$ = "N" GO TO 5440 ELSE IF Y$<>"Y" GO TO 4840
4880 PRINT #3," " : PRINT #3,"     RELIEF VALVE DATA "
4900 GOSUB 8080 :REM-----------------------------------------------2 BLANK LINES
[illegible] PRINT #3,"     VALVE THROAT DIAMETER  = ";
[illegible] PRINT #3,USING " ##.###";VDIA;
[illegible] PRINT #3," INCH, CROSSECTION = ";VARA;" FT**2" : PRINT #3," "
4980 PRINT #3,"     DISCHARGE COEFFICIENT  = ";
5000 PRINT #3,USING" #.######";RKV : PRINT #3," "
5020 PRINT #3,"     VALVE FLOW AT REACTOR PRESSURE OF ";PVP;" PSIA IS ";VLVFLO;"
 LB/SEC" : PRINT #3," "
5040 PRINT #3,"     SONIC VELOCITY AT THAT PRESSURE IS ";VEL;" FT/SEC"
[illegible]
```

```
[illegible]
[illegible] PRINT #I3,"      VALVE     OPENING      CLOSING"
[illegible] PRINT #I3,"      LIMIT     PRESSURE     PRESSURE" : PRINT #I3,"
[illegible] FOR I=I1 TO NVLV
[illegible] PRINT #I3,USING "       ##  ";I;
[illegible] PRINT #I3,USING "       ####.#";POPEN(I);
[illegible] PRINT #I3,USING "       ####.#";PCLOSE(I)
        NEXT I
5220 GOSUB 9080 :REM---------------------------------------------'2 BLANK LINES
5260 PRINT #I3,"  SONIC VELOCITY TABEL (FROM ASME STEAM TABLES, PAGE 3??)"
5280 GOSUB 9080 :REM---------------------------------------------'2 BLANK LINES
5300 PRINT #I3,"     POINT    PRESSURE    VELOCITY" : PRINT #I3," "
5320 FOR I=I1 TO NVCN
5340 PRINT #I3,USING"     ## ";I;
5360 PRINT #I3,USING"      ####.#";PRCN(I);
5380 PRINT #I3,USING"      ####.#";VLCN(I)
5400 NEXT I
5420 GOSUB 9080 :REM---------------------------------------------'2 BLANK LINES
5440 RKV = RKV * VARA
5460 REM CALCULATE INITIAL LIQUID LEVEL IN REACTER
5480 FOR J=I1 TO NLEV
5500 IF VL>VOL(J) THEN I=J
5520 NEXT J
5540 DLDV = (ELEV(I+I1)-ELEV(I)) / (VOL(I+I1)-VOL(I))
5560 EL=ELEV(I) + DLDV * (VL-VOL(I))
5580 FOR J=I1 TO NLEV
5600 IF VLX>VOL(J) THEN I=J
5620 NEXT J
5640 DLDV = (ELEV(I+I1)-ELEV(I)) / (VOL(I+I1)-VOL(I))
5660 ELX=ELEV(I) + DLDV*(VLX-VOL(I))
5680 ELMIN = ELX : VLMIN = VLX
5700 VV  = SYSVOL - VL   :REM VV=TOTAL VAPOR VOLUME (INCL. VOIDS), FT**3
5720 VVX = VV - (VLX-VL) :REM VVX=VAPOR VOLUME ABOVE ACTUAL LIQUID LEVEL
5740 T   = TPOOL
5760 GOSUB 7480 :REM----------------------------------------------'STEAM TABLES
5780 POOLMASS = VPOOL/VF
5800 POOLENG=POOLMASS*(TPOOL - 32.0)
5820 T = TCOL
5840 FPOW = F1
5860 GOSUB 7480 :REM----------------------------------------------'STEAM TABLES
5880 LMASS = VL/VF   :REM LIQUID MASS IN REACTER, LB
5900 SMASS = VV/VG   :REM TOTAL VAPOR  MASS (INCLUDING VOIDS), LB
5920 SMASX = VVX/VG  :REM VAPOR MASS ABOVE LIQUID LEVEL, LB
5940 VFO = VF : VGO = VG
5960 HFO = HF : HGO = HG
5980 REM COOLANT QUALITY, SEE ELWAKIL PAGE 327
6000 XFR = F1 + ((F1-VOIDFR)/VOIDFR) * (VG/VF)
6020 XFR = F1/XFR
6040 CLS
6060 PRINT:PRINT"    REACTER DEPRESSURIZATION CALCULATION    "
6080 PRINT" SYSTEM VOLUME = ";SYSVOL
6100 PRINT" VLIQ = ";VL
6120 PRINT" VAPOR VOL = ";VV
6140 PRINT" MASS LIQU = ";LMASS
6160 PRINT" MASS STEAM = ";SMASS
6180 PRINT" FLUID MASS = ";(LMASS+SMASS)/F1000;" KLB"
6200 PRINT#I3," ":PRINT #I3,"     ***** INITIAL CONDITIONS ***** ";DATE$;" *****"
6220 GOSUB 9080 :REM---------------------------------------------'2 BLANK LINES
6240 PRINT #I3,"    TOTAL SYSTEM VOLUME                 = ";SYSVOL;" FT**3"
6260 PRINT #I3,"    LIQUID VOLUME WITHOUT VOIDS         = ";VL;" FT**3"
6280 PRINT #I3,"    LIQUID VOLUME WITH    VOIDS         = ";VLX;" FT**3"
6300 PRINT #I3,"    VAPOR VOLUME INCLUDING VOIDS        = ";VV;" FT**3 (TOTAL
VAPOR)"
[illegible]
```

[handwritten initials] 6/15/86

```
6380 PRINT #I[illegible]  MASS OF VAPOR ABOVE [illegible]  = [illegible]
"
6400 PRINT #I[illegible]  TOTAL MASS OF VAPOR [illegible]  = [illegible]
"
6420 PRINT #I[illegible]  TOTAL FLUID MASS (LIQUID+TOTAL VAPOR)  = " [illegible]
 LB"
6440 PRINT #I2,"    MASS OF THERMALLY ACTIVE STEEL STRUCTURE=  [illegible]
F";PRINT #I2," "
6460 PRINT #I2,"    COLLAPSED REACTOR LEVEL                  = ";EL;" FT (NO VOIDS
)"
6480 PRINT #I2,"    ACTUAL REACTOR LEVEL                     = ";ELX;" FT (WITH VO
IDS)"
6500 PRINT #I2,"    REACTOR PRESSURE                         = ";PVP;" LB/IN**2"
6520 PRINT #I2,"    REACTOR COOLANT TEMPERATURE              = ";TCOL;" FAHRENHEIT
"
6540 PRINT #I2,"    AVERAGE COOLANT QUALITY                  = ";
6560 PRINT #I2,USING" ##.###";XFF*F100;
6580 PRINT #I2," PERCENT"
6600 PRINT #I2,"    AVERAGE COOLANT VOID FRACTION            = ";
6620 PRINT #I2,USING" ##.###";VOIDFF*F100;
6640 PRINT #I2," PERCENT"
6660 VLXFF = VOL(8)
6680 VOIDFRF =((VLXFF-VL)/VLXFF)*F100
6700 PRINT #I2,"    CORRESPONDING AVERAGE VOLUMETRIC VOID AT "
6720 PRINT #I2,"    FULL POWER, WITH LEVEL AT SETPOINT LN  = ";
6740 PRINT #I2,USING" ##.###";VOIDFRF;
6760 PRINT #I2," PERCENT"
6780 PRINT #I2," "
6800 PRINT #I2,"    SPECIFIC VOLUME OF LIQUID                = ";VF0;" FT**3/LB"
6820 PRINT #I2,"    SPECIFIC VOLUME OF VAPOR                 = ";VG0;" FT**3/LB"
[illegible] PRINT #I2,"    SPECIFIC ENTHALPY OF LIQUID              = ";HF0;" BTU/LB"
[illegible] PRINT #I2,"    SPECIFIC ENTHALPY OF VAPOR               = ";HG0;" BTU/LB"
6880 Q0 = (P0*1000.0*3413.0)/F36':REM THERMAL POWER IN BTU/SEC
6900 MLPCI = F0 : TDD=F0 : TYME=F0 : LPIFLOW=F0 : PCONT=PMIN
6920 REM
6940 OPEN #I2,"D1:DEPRES.STE" OUTPUT
6960 PRINT #I2,I0,I1,I2,I3,I4,I5,IX,I1T,I1S,F0,F1,F3,F100,F1000
6980 PRINT #I2,NVLV,NDHP,NLEV,NPMP,NVCK,DEPSET,NPRINT,VPOOL
7000 FOR I=1 TO NDHP
7020 PRINT #I2,D(I1,I),D(I2,I)
7040 NEXT I
7060 FOR I=1 TO NLEV
7080 PRINT #I2,ELEV(I),VOL(I)
7100 NEXT I
7120 FOR I=I1 TO NPMP
7140 PRINT #I2,KGPM(I),PUMP(I)
7160 NEXT I
7180 FOR I=I1 TO NVCK
7200 PRINT #I2,PRCK(I),VLCK(I)
7220 NEXT I
7240 FOR I=I1 TO NVLV
7260 PRINT #I2,POPEN(I),PCLOSE(I)
7280 NEXT I
7300 PRINT #I2,VL,VLX,VOIDFF,SYSVOL,P0,Q0,VPOOL,TPOOL,ELX,ELMIN,POOLMASS
[illegible] PRINT #I2,SDEP,PMIN,PMAX,NDP,TMAX,TYME,DT,NPROUT
[illegible] PRINT #I2,VLMIN,VV,VVX,POOLENG,PPOW,LMASS,SMASS,SMASX,POFF,RKV,STLMAS
[illegible] PRINT #I2,MLPCI,LPIFLOW,ADSFLOW,SPVFLOW,TDD,PCONT,T,RVP,PCHOKE
7380 CLOSE #I2
7400 PRINT #I2," " : PRINT #I2,"    *** ALL DATA FOR STEADY STATE WRITTEN TO DIS
K, CHANNEL 2 *** "
7420 PRINT #I2," " : PRINT #I2,"    ***          ";DATE$;"                    **
* "
7440 [illegible]
```

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```
7500 REM ---------------------------------------------------------STEAM TABLES
7510 T = LOG(T) :REM EMBER. THIS IS REALLY LN(T), NOT LOG(T)
7520 IF T => 400.0 GOTO 7660
7540 P  = [illegible]
7560 VF = [illegible]
7580 VG =  25.9745 -T*(-14.3928 -T*( 6.75612  -T*[illegible]   -T*[illegible]
7600 HF =  1168.45 -T*(-2011.26 -T*( 734.824  -T*(-117.141     -T*7.47068)))
7620 HG = -1047.74 -T*( 1910.76 -T*(-640.337  -T*( 91.7478     -T*4.94574)))
7640 GOTO 7760
7660 P  =-30.1085  +T*( 8.31929 +T*(-0.736689 +T*(0.0246557    -T*0.00465033)))
7680 VF = 0.537042 +T*(-0.164    -T*( 0.0174162-T* -0.00150480 -T*0.00017[illegible])))
7700 VG =-0.865905 -T*( 3.31556  +T*(-0.450742 -T*(0.0181285    -T*0.00[illegible])))
7720 HF = 8238.74  +T*(-7030.65  -T*( 330.886  -T*(-33.5633     -T*3.44372)))
7740 HG = -10694.8 -T*( 3606.67  -T*(-350.015  +T*(33.1046      -T*3.33119)))
7760 P  = EXP(P)
7780 VG = EXP(VG)
7800 IF T < 390 GO TO 7960
7820 IF T > 410 GO TO 7960
7840 XTT = (T-390.0)/20.0
7860 P   = 220.481  + 55.51    * XTT
7880 VF  = 0.018479 - 0.000333 * XTT
7900 VG  = 2.08795  - 0.4154   * XTT
7920 HF  = 363.923  + 22.695   * XTT
7940 HG  = 1200.2   + 2.4      * XTT
7960 EF  = HF -    P * 0.18509 * VF
7980 EG  = HG -    P * 0.18509 * VG
8000 RETURN
8020 REM<--------------------------------------------SMALL PRINTOUT ROUTINE
8040 PRINT #I3," FT**3"
8060 RETURN
8080 REM SMALL PRINTOUT ROUTINE
[8100] PRINT #I3, " " : PRINT #I3, " "
[8120] RETURN
8140 REM DECAY POWER (FRACTION) VERSUS TIME (SEC) - SEE FSAR FIG. 15.0-3
8160 REM FSAR TABLE 6.3-11 (PAGE 6.2-106) AND FIG. 6.3-37 * JE MAY 86 *
8180 REM TIME IN SEC. 30 VALUES
8200 DATA 0.0,1.0,2.0,2.5,3.0,3.5,3.9
8220 DATA 30.0,50.0,100.0,200.0,300.0,400.0,500.0,600.0
8240 DATA 700.0,800.0,900.0,1000.0,2000.0,3000.0,4000.0,5000.0
8260 DATA 6000.0,7000.0,8000.0,9000.0,10000.0,100000.0,1000000.0
8280 REM DECAY POWER IN FRACTION, 30 VALUES
8300 DATA 1.0,0.997,0.953,0.903,0.719,0.330,0.074
8320 DATA 0.0471,0.043047,0.038100,0.033426,0.029508,0.027595,0.026203,0.025114
8340 DATA 0.024229,0.023488,0.022853,0.02230,0.018455,0.016826,0.015277,0.014377
8360 DATA 0.013679,0.013116,0.012647,0.012247,0.011900,0.006680,0.003670
8380 REM
8400 REM 5 VALVE SETPOINTS FOR RELIEF FUNCTION (PSIG); FIRST ON, THEN OFF
8420 DATA 1071.0,1041.0,1101.0,1051.0,1111.0,1061.0,1121.0,1071.0,1131.0,1081.0
8440 REM-------------------------------------------------------------------
8460 REM 5 VALVE SETPOINTS FOR SAFETY FUNCTION (PSIG): FIRST ON, THEN OFF
8480 DATA 1163.0,1113.0,1175.0,1125.0,1185.0,1135.0,1195.0,1145.0,1205.0,1155.0
8500 REM-------------------------------------------------------------------
8520 REM LIQUID VOLUME (FT**3) VERSUS REACTER LEVEL (FT), 13 VALUES
8540 REM FIRST READ LEVEL VALUES, THEN VOLUME VALUES
8560 DATA 0.0,19.036,30.526,31.542,40.792,45.000,46.583,46.961,47.333
[8580] DATA 48.583,48.920,54.000,72.540
[8600] DATA 0.0,4658,8383,8676,11768,13034,13535,13657,13916
[8620] DATA 14201,14372,15537,21005
8640 REM
8660 REM RHR PUMP HEAD (PSID) VERSUS PUMP FLOW (KGAL/MIN), 19 VALUES
8680 REM FIRST FLOW VALUES, THEN PUMP HEAD
8700 DATA 0.0,0.5,1.0,1.5,2.0,2.5,3.0,3.5,4.0,4.5,5.0,5.5,6.0,6.5,7.0
8720 DATA 7.5,8.0,8.5
8740 DATA [illegible]
```

```
[illegible] REM [illegible] SATURATED STEAM, [illegible] VALUES
8820 REM FIRST PRESSURE VALUES, THEN CHOKING VELOCITY IN FT/SEC
8830 REM FROM ASME STEAM TABLES (FOURTH EDITION, 1979) PAGE [illegible] FIG. [illegible]
8840 DATA [illegible]
8850 DATA [illegible]
[illegible] DATA [illegible]
[illegible] DATA [illegible]
```

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[illegible] 6/15/86

```
20 REM REACTER VESSEL DEPRESSURIZATION MODEL ***** TRANSIENT STATE *****
40 REM * PAGE OF * DRIVE 2 * FILE WORKT2 & CODE BLOWDOWN.II TRANS *
50 REM ***ADJUSTED FOR MINIFLOW LINE*** 24 JUL 86 ***
60 DIM D(2,30),ELEV(10),VOL(10),PFLOW(18),VOPEN(18),PROK(25),VLCK(25)
80 DIM POPEN(18),PCLOSE(18),KGPM(20),PUMP(20)
100 DEFINT I,J
120 DATE$="THU, 29 MAY 86, 11:38 HR"
140 CLS
160 PRINT:PRINT:PRINT"REACTER DEPRESSURIZATION CALCULATION":PRINT
180 OPEN #3,"P1:"OUTPUT
200 PRINT #3," ":PRINT #3,"    REACTOR DEPRESSURIZATION CALCULATION-TRANSIENT FA
RT-":DATE$
220 REM
240 OPEN #2,"D1:DEPRSS.STE" INPUT
260 REM
280 INPUT #2,I0,I1,I2,I3,I4,I5,I6,I17,I18,F0,F1,F2,F100,F1000
300 INPUT #I2,NVLV,NDHP,NLEV,NPMP,NVCK,DEPSET,NPRINT,VPOOL
320 FOR I=I1 TO NDHP
340 INPUT #I2,D(I1,I),D(I2,I)
360 NEXT I
380 FOR I=I1 TO NLEV
400 INPUT #I2,ELEV(I),VOL(I)
420 NEXT I
440 FOR I=I1 TO NPMP
460 INPUT #I2,KGPM(I),PUMP(I)
480 NEXT I
500 FOR I=I1 TO NVCK
520 INPUT #I2,PRCK(I),VLCK(I)
540 NEXT I
560 FOR I=I1 TO NVLV
580 INPUT #I2,POPEN(I),PCLOSE(I)
600 NEXT I
620 INPUT #I2,VL,VLX,VOIDFR,SYSVOL,P0,G0,VPOOL,TPOOL,ELX,ELMIN,POOLMASS
640 INPUT #I2,SDEP,PMIN,PMAX,NDP,TMAX,TYME,DT,NPROUT
660 INPUT #I2,VLMIN,VV,VVX,POOLENG,PPOW,LMASS,SMASS,SMASX,POFF,PKV,STLMAS
680 INPUT #I2,MLPCI,LPIFLOW,ADSFLOW,SRVFLOW,TDG,PCONT,T,RVP,PCHOKE
700 CLOSE #I2
720 LBAF   = ELEV(2)
740 LTAF   = ELEV(3)
760 VTAF   = VOL(3)
780 PRTLV1 = F0 - F100
800 PRTLV2 = F0 - F100
820 GOSUB 3720 :REM-------------------------------------------->STEAM TABLES
840 HFOLD=HF
860 SDEP = 600.0
880 NDP = 6
900 HFPOOL=TPOOL
920 STMOLD = SMASS - SMASX  :REM STEAM MASS INSIDE LIQUID
940 TBUBL  = 4.7   :REM PARAMETER FOR LEVEL SWELL EFFECT
960 TAUSTL = 4.0   :REM PARAMETER FOR HEAT TRANSFER FROM STRUCTURAL STEEL
980 QSTEEL = F0
1000 TSTEEL = T
1020 STLMAS = 1.65 * 1000.0 * 1000.0 :REM LB OF STRUCTURAL STEEL
1040 CSTEEL = 0.127     :REM BTU/(LB*F)
1060 TMAX   = 3600.0
1080 PPS = F0
1100 QLPCO  = 7.45 :REM AT 7.45 KGAL/MIN. DPFRIC=115.5 FT
1120 DPFRIC = F0
1140 FRCOEF = 115.5 * (14.7/33.93) :REM COEFFICIENT IN PSID
1160 OPEN #I1,"D1:ADS.DAT" OUTPUT
1180 PRINT #I3," ":PRINT #I3,"    DEPRESSURIZATION STARTS AT ":SDEP;
1200 PRINT #I3," SEC, TRUE ..."
```

```
1260 VLTI = E1
1280 REM MAIN ITERATING LOOP AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
1300 IF TYME > 21.0 THEN NLPS = 59
1320 REM IF TYME = 20.0 THEN DT = F1
1340 TYME = TYME + DT
[illegible]0 PRINT TYME;" SEC"
[illegible] GOSUB 5880 :REM-----------------------------------------------------------> DECAY POWER
[illegible]0 DQ = PPOW * QO * DT
1420 TDQ = TDQ + DQ
1440 FPS = FPS + PPOW*DT :REM FULL POWER SECONDS
1460 GOSUB 3720 :REM---------------------------------------------------------->STEAM TABLES
1480 GOSUB 2940 :REM-------------------------------------->MASSFLOW THRU RELIEF VALVES
1500 SRVMASS = (SRVFLOW+ADSFLOW)*DT :REM MASS LOST THRU SRV
1520 SRVENG = SRVMASS * HG         :REM ENERGY LOST THRU SRV
1540 TZ = T : TLPCI=TPOOL : T=TLPCI
1560 GOSUB 3720 :REM---------------------------------------------------------->STEAM TABLES
1580 T = TZ
1600 PCONT = PMIN + ((PMAX-PMIN)/1200.0)*TYME
1620 IF PCONT>PMAX THEN PCONT = PMAX
1640 DELP = (521.021 + EL - 466.229) / (VF*144)
1660 DELP = DELP + RVP - PCONT
1680 IF DELP > POFF GO TO 1740
1700 GOSUB 3440 :REM------------------------------------------------------>RHP PUMP FLOW
1720 LPIFLOW = QLPCI/(7.4805*60.0*VF)
1740 MLPCI = LPIFLOW * DT
1760 HFPOOL = HF
1780 ELPCI = MLPCI * HFPOOL
1800 POOLMASS = POOLMASS + SRVMASS - MLPCI
1820 POOLENG = POOLENG + SRVENG - ELPCI
1840 TPOOL = (POOLENG/POOLMASS) + 32.0
1860 GOSUB 4980 :REM---------------------------------------------------->NEW THERMAL STATE
[illegible] QSTEEL = (CSTEEL*STLMAS*(TSTEEL-T)) * DT/TAUSTL
[illegible] TSTEEL = TSTEEL - QSTEEL/(CSTEEL*STLMAS)
1920 GOSUB 5620 :REM--------------------------------------------------------->VOID FRACTION
1940 IF VLX => VLMIN GO TO 2000
1960 VLMIN = VLX
1980 TMIN = TYME
2000 TZ = T
2020 T = TPOOL
2040 GOSUB 3720 :REM---------------------------------------------------------->STEAM TABLES
2060 VPOOL = POOLMASS * VF
2080 HFPOOL = HF
2100 T = TZ
2120 NPRINT = NPRINT + I1
2140 IF NPRINT<NPROUT THEN GO TO 1280
2160 GOSUB 6500 :REM------------------------------------------------------->WRITE ON SCREEN
2180 GOSUB 6320 :REM-------------------------------------------------------->REACTOR LEVEL
2200 IF PRTLV1 > FO    GO TO 2300
2220 IF ELX     > LTAF GO TO 2300
2240 PRTLV1     = F100
2260 TUNC       = TYME
2280 PRINT #I3."     *** TOP OF FUEL UNCOVERED AT ";TYME;" SEC, LEV= ";ELX;" FT"
2300 IF PRTLV1 < F1    GO TO 2500
2320 IF PRTLV2 > FO    GO TO 2500
2340 IF ELX     < LTAF GO TO 2500
2[illegible] PRTLV2     = F100
[illegible] TEXP       = TYME - TUNC
2[illegible] DELUNC     = F100*(LTAF-ELMIN)/(LTAF-LBAF)
2420 PRINT #I3."     *** TOP OF FUEL RESUBMERGED AT ";TYME;" SEC. LEV= ";ELX;" FT
"
2440 PRINT #I3."     *** TOP OF FUEL WAS UNCOVERED FOR ";TEXP;" SEC "
2460 PRINT #I3."     *** AT LOWEST LEVEL, ";DELUNC;" PCT OF CORE WAS UNCOVERED"
2480 PRINT #I3."     *** MIN LEVEL WAS ";ELMIN;" FT, AT T= ";TMIN;" SEC"
2500 IF NLINE < NLPS GO TO 2560
```

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```
2560 REM ----------------------------------------------------PRINTOUT ROUTINE
2580 PCKMIN = PCONT/PCHOKE :REM MINIMUM VESSEL PRESSURE FOR CHOKED FLOW
2600 IF RVP < PCKMIN GO TO 2760
2620 IF TYME => TMAX GO TO 2800
2640 IF VLV > SYSVOL  GO TO 2700
2660 PRINT #I3," *** REACTOR ALL FILLED UP ***"
2680 GO TO 2800
2700 IF VLMIN => VTAF GO TO 2740
2720 PRINT"*****  WATER LEVEL BELOW TAF *****"
2740 GO TO 1290
2760 PRINT #I3," *** END OF CHOKED FLOW REGIME FOR VALVES ***"
2780 PRINT #I3," *** RVP, PCONT ";RVP;PCONT
2800 CLOSE #I3
2820 END :REM ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
2840 REM<---------------------------------------------MASSFLOW THRU RELIEF VALVES
2860 FOR I=I1 TO NVCK
2880 J = I
2900 IF PRCK(I) > RVP GO TO 2940
2920 NEXT I
2940 DVDX = (VLCK(J)-VLCK(J-I1))/(PRCK(J)-PRCK(J-I1))
2960 VEL  = VLCK(J-I1) + DVDX*(RVP-PRCK(J-I1))
2980 VFLO = (RKV*VEL)/VG
3000 IF TYME  < SDEP GO TO 3120
3020 IF DEPSET > F1  GO TO 3120
3040 FOR I=I1 TO NDP
3060 VOPEN(I) = F2
3080 NEXT I
3100 DEPSET = F2
3120 FOR I=I1 TO NVLV
3140 IF RVP>POPEN(I)   THEN SFLOW(I) = VFLO
3160 IF SFLOW(I)>F0    THEN SFLOW(I) = VFLO
3180 IF RVP<PCLOSE(I)  THEN SFLOW(I) = F0
3200 IF VOPEN(I)>F1    THEN SFLOW(I) = VFLO
3220 NEXT I
3240 ADSFLOW = F0
3260 SRVFLOW = F0
3280 FOR I=I1 TO NVLV
3300 IF VOPEN(I) < F1 GO TO 3360
3320 ADSFLOW = ADSFLOW + SFLOW(I)
3340 GO TO 3380
3360 SRVFLOW = SRVFLOW + SFLOW(I)
3380 NEXT I
3400 IF RVP < PCONT THEN ADSFLOW = F0
3420 RETURN
3440 REM<-------------------------------------------------------------RHR PUMP FLOW
3460 DPTOT  = DELP + DPFRIC
3480 DPFOLD = DPFRIC
3500 FOR I=I1 TO NPMP
3520 J = I
3540 IF PUMP(I) < DPTOT GO TO 3580
3560 NEXT I
3580 DQDH = (KGPM(J)-KGPM(J-I1)) / (PUMP(J-I1)-PUMP(J))
3600 QLPCP = KGPM(J) - DQDH*(DPTOT-PUMP(J))
3610 REM EMBER: QLPCI IS INJECTION FLOW, QLPCP IS PUMP FLOW (VOLUMETRIC)
3620 DPFRIC = FRCOEF * (QLPCP/QLPCO) * (QLPCP/QLPCO)
3640 IF ABS((DPFRIC-DPFOLD)/DPFOLD) < 0.001 GO TO 3660
3650 GO TO 3460
3660 QLPCP = QLPCP * F1000  :REM CHANGE FROM KGAL/MIN TO GAL/MIN
3682 IF QLPCP > 1500.0 GO TO 3690
3684 QLPCI = QLPCP - 500.0  :REM ***** ADJUST FOR MINIFLOW HERE *****
3686 IF QLPCI < F0 THEN QLPCI = F0
3688 GO TO 3700
3690 QLPCI = QLPCP
3700 RETURN
```

```
[illegible] IF T = [illegible] GO TO [illegible]
3780 P = -27.7[illegible] + Z*(27.7[illegible] - Z*(-8.[illegible] -Z*(1.[illegible] - Z*[illegible]
3[illegible] VF=[illegible] [illegible]
3820 VG = 25.[illegible] - Z*(-16.[illegible] - Z*(6.7[illegible] -Z*(- [illegible] - Z*0.[illegible]
3840 HF = 2065.[illegible] - Z*(-2.[illegible] + Z*(7[illegible] -Z*(-[illegible] - Z*[illegible]
3[illegible] HG = -1040.[illegible] -Z*([illegible] - Z*(-[illegible] -Z*([illegible] - Z*4.[illegible]
[illegible] GO TO 4000
[illegible] P = -30.1055 - Z*(3.[illegible] -Z*(-4.[illegible] - Z*(1.[illegible] - Z*4.[illegible]
3920 VF = 0.577042 - Z*(-0.164 -Z*(0.0174162 - Z*(-1.50488E-03-Z*1.7677E-04)))
3940 VG =-0.653705- Z*(3.31556- Z*(-0.450342 + Z*(0.0161625 - Z*4.55117E-07)))
3960 HF = 5[illegible].74 - Z*(-3020.65-Z*(330.[illegible] - Z*(-22.[illegible] - Z*7.44[illegible])))
3980 HG = -10684.5 -Z*(2606.57+ Z*(-250.01[illegible] - Z*(22.1046 - Z*[illegible]
4000 P = EXP(P)
4020 VG = EXP(VG)
4040 IF T < 390 GO TO 4200
4060 IF T > 410 GO TO 4200
4080 XTT = (T-390.0) / 20.0
4100 P = 220.481 + 55.81 * XTT
4120 VF = 0.018475 + 0.000335 * XTT
4140 VG = 2.08755 - 0.4154 * XTT
4160 HF = 363.902 + 20.605 * XTT
4180 HG = 1200.2 + 2.4 * XTT
4200 EF = HF - P * 0.18509 * VF
4220 EG = HG - P * 0.18509 * VG
4240 RETURN
4260 REM/--------------------------------------------------PRINT TWO BLANK LINES
4280 PRINT #I3, " " : PRINT #I3, " "
4300 RETURN
4320 REM/---------------------------------------------------------PRINT HEDLINES
4340 PRINT #I3," "
4360 PRINT #I3,"     MODEL  REAC  DECAY  REAC   REAC   REAC   REAC   SUPP MAN
P[illegible]T RV INJEC"
4[illegible] PRINT #I3,"    TIME   TEMP  POWER  PRES   LIQUID LEVEL  LIQUID POOL FLOW
   FLOW  FLOW"
4400 PRINT #I3,"     SEC    FAHR  FRAC   PSIA   FT**3  FT     KLB    TEMP LB/S
EC LB/SEC LB/SEC"
4420 PRINT #I3," "
4440 NLINE = I0
4460 RETURN
4480 REM/---------------------------------------------------PRINT RESULTS TO PAPER
4500 REM PRINT #1,TYME,T,PPOW,RVP,VL,EL,LMASS,TPOOL,SRVMASS/DT,SRVFLOW,MRCIC/DT
4520 PRINT #I3,USING "     ####.#";TYME;
4540 PRINT #I3,USING " ###.#";T;
4560 REM IF LPIFLOW=F0 GO TO 4620
4580 REM PRINT#I3,USING " ######";LL;
4600 REM GO TO 4640
4620 PRINT #I3,USING " #.####";PPOW;
4640 PRINT #I3,USING " ####.#";RVP;
4660 PRINT #I3,USING " #####.#";VLX;
4680 PRINT #I3,USING " ##.##";ELX;
4700 PRINT #I3,USING " ####.###";LMASS/F1000;
4720 PRINT #I3,USING " ###.#";TPOOL;
4740 PRINT #I3,USING " ####.#";ADSFLOW;
4760 IF LPIFLOW = F0 GO TO 4820
4780 PRINT #I3,USING " ####.#";VOIDFR*F100;
48[illegible] GO TO 4840
4[illegible] PRINT #I3,USING " ####.#";SRVFLOW;
4[illegible] REM IF LPIFLOW >< F0 GO TO 4900
4860 REM PRINT #I3,USING " ######";LL
4880 REM GO TO 4920
4885 IF LPIFLOW >< F0 GO TO 4900
4890 PRINT #I3,USING " ####.#";VOIDFR*F100;
4895 GO TO 4920
4900 PRINT #I3,USING " ####.#";[illegible]
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```
4960 RETURN
4980 REM<------------------------------------------------CALCULATE NEW THERMAL STATE
5000 L=I1 : FOLD=F1 : FNEW=F1 : DTEMP=F1*F2 : ERMAX = F1/F1000
5020 LMASS = LMASS + MLPOI
5040 SMASS = SMASS - SFVMASS :REM TOTAL STEAM. INCLUDING VOIDS
5060 TMASS = LMASS + SMASS
5080 SMOLD = SMASS
5100 GOSUB 3720 :REM-----------------------------------------------------STEAM TABLES
5120 HEVAP = HG - HF
5140 QDHF  = (HFOLD - HF) * LMASS
5160 QPOOL = (HFPOOL-HF) * MLPOI
5180 DQNET = DQ + QDHF + QPOOL - QSTEEL
5200 STMNEW = DQNET/HEVAP   :REM NEW STEAM INSIDE LIQUID
5220 SMASS = SMOLD + STMNEW :REM TOTAL STEAM. INSIDE LIQUID AND ABOVE LIQUID
5240 LMASS = TMASS - SMASS
5260 VOL   = SMASS*VG + LMASS*VF
5280 VOLERR= VOL - SYSVOL
5300 IF ABS(VOLERR/SYSVOL) < ERMAX GO TO 5500
5320 FNEW = SGN(VOLERR)
5340 IF SGN(FNEW)=SGN(FOLD) GO TO 5380
5360 DTEMP = DTEMP/F2
5380 T = T + FNEW*DTEMP
5400 IF L>29 THEN PRINT #I3."CONVERGENCE - L.SMOLD.SMASS.VOL.VOLERR ":L;SMOLD:SMASS:VOL:VOLERR
5420 IF L>29 THEN PRINT #I3."CONVERGENCE - L,T,P.DQ.DQNET.STMNEW.HEVAP ":L:T;P:DQ:DQNET:STMNEW:HEVAP
5440 FOLD = FNEW
5460 L = L + I1
5480 IF L<36 GO TO 5100
5500 HFOLD = HF
5520 RVP = P
5540 IF RVP < PCONT THEN RVP=PCONT
5560 VL = LMASS * VF
5580 LL = L
5600 RETURN
5620 REM<-----------------------------------------------CALCULATE VOID FRACTION
5640 FACTOR = F1 - DT/TBUBL
5660 IF FACTOR < F0 THEN FACTOR = F0
5680 STMTOT = STMOLD*FACTOR + STMNEW :REM STEAM MASS INSIDE LIQUID
5700 VOID = STMTOT * VG
5720 VLX = VL + VOID
5740 VOIDFR = VOID/VLX
5760 REM PRINT #3." "
5780 REM PRINT #3."STMTOT,VOID.VOIDFR.HFEXC.STMNEW ":STMTOT:VOID:VOIDFR:HFEXC:STMNEW : PRINT #3," "
5800 REM PRINT #3."STMOLD.SMAS.DQTOT.DQNET.HEVAP":STMOLD:SMASS:DQTOT:DQNET:HEVAP : PRINT #3," "
5820 REM PRINT #3."TIME.PRES.TEMP.HFOLD.HFLMAS";TYME;P:T;HFOLD:HF;LMASS :PRINT #3," "
5840 STMOLD = STMTOT
5860 RETURN
5880 REM<-----------------------------------------------CALCULATE DECAY POWER
5900 FOR J=I1 TO NDHP
5920 K = J
5940 IF D(I1.J) > TYME GO TO 5980
5960 NEXT J
5980 IF K => 8 GO TO 6160
6000 XX = TYME - DT/F2
6020 X1 = D(I1.K-I1)
6040 X2 = D(I1.K)
6060 Z1 = D(I2.K-I1)
6080 Z2 = D(I2.K)
6100 DPDT = (Z2-Z1)/(X2-X1)
6120 PPOW = Z1 + DPDT * (XX-X1)
```

Dm 8/15/86

8/15/86

```
[illegible]
6200 X2 = LOG(D(I1,K))
6220 Z1 = LOG(X(I2,(-I1))
6240 Z2 = LOG(T(I2,K))
6260 DPDT = (Z2-Z1)/(X2-X1)
6280 FPOW = EXP(Z1 + DPDT * (XX-X1))
     RETURN
6320 REM-----------------------------------------------CALCULATE REACTOR LEVEL
6340 FOR J=I1 TO NLEV
6360 IF VLX > VOL(J) THEN I=J
6380 NEXT J
6400 DLDV = (ELEV(I+1)-ELEV(I))/(VOL(I+1)-VOL(I)) :REM GRADIENT, FT/FT**3
6420 ELX=ELEV(I) + DLDV*(VLX-VOL(I))
6440 REM PRINT #3,"VOID,VOIDFR,HFEXC,STMNEW ";VOID;VOIDFR;HFEXC;STMNEW : PRINT #
3," "
6460 IF ELX < ELMIN THEN ELMIN = ELX
6480 RETURN
6500 REM:---------------------------------------------------WRITE ON CRT SCREEN
6520 CLS : PRINT"*******************************************"
6540 PRINT" WNP-2 DEPRESSURIZATION CALCULATION "
6560 PRINT: PRINT"     TIME = ";TYME;"SEC":PRINT:PRINT
6580 PRINT"TEMPERATURE      = ";T
6600 PRINT"PRESSURE         = ";RVP
6620 PRINT"DECAY HEAT       = ";FPS;" FULL POWER SECONDS"
6640 GO TO 6900
6660 PRINT"TOTAL DECAY HEAT (BTU) = "; TDQ
6680 PRINT"FRACTIONAL POWER = ";FPOW
6700 PRINT"LIQUID MASS          = ";LMASS
6720 PRINT"STEAM MASS     = ";SMASS
6740 PRINT"SRV FLOW (LB/SEC)   = ";SRVMASS/DT
6760 PRINT"SRV ENERGY REMOVAL (BTU/SEC) = ";SRVENS/DT
6780 PRINT"DECAY HEAT (BTU/SEC)    = "; DQ/DT
6800 PRINT"LPCI FLOW (LB/SEC)    = ";MLPCI/DT;"      LPCI TEMP = ";TLPCI
6820 PRINT"POOL MASS                 = ";POOLMASS;"      POOL VOLUME = ";VPOOL
6840 PRINT"POOL TEMPERATURE        = ";TPOOL
6860 PRINT"MINIMUM VESSEL VOL                  = ";VLMIN;"   AT ";TMIN;" SEC"
6880 PRINT"VESSEL LIQUID VOLUME = ";VL
6900 PRINT"WATER LEVEL ELEVATION    = ";ELX
6920 PRINT"MIN WATER LEVEL    =";ELMIN;"AT TIME ";TMIN
6940 RETURN
```

APPENDIX 4

Printouts of Computer Results
from Code BLOWDOWN.01

REACTOR DEPRESSURIZATION CALCULATION - INPUT DATA [illegible]

INITIALIZATION ROUTINE, CALCULATED STEADY STATE

[illegible] 8/15/86

REACTOR LIQUID VOLUME WITHOUT VOIDS = 13146.1 FT**3
REACTOR VOID FRACTION AT HOT STANDBY = .068
REACTOR SYSTEM VOLUME = 21005.0 FT**3
REACTOR COOLANT TEMPERATURE = 551.5 FAHRENHEIT
REACTOR POWER (THERMAL) = 3293 MW

SUPPRESSION POOL VOLUME = 127037.0 FT**3
INITIAL POOL TEMPERATURE = 95 FAHRENHEIT
RHR PUMP SHUTOFF HEAD = 303.2 PSID

DEPRESSURIZATION START TIME = 600 SEC
INITIAL CONTAINMENT PRESSURE = 15 LB/IN**2 ABS
FINAL CONTAINMENT PRESSURE = 70 LB/IN**2 ABS

NUMBER OF VALVES TO BE USED FOR DEPRESSURIZATION = 6

MAXIMUM TIME = 1800 SEC. TIMESTEP = .5 SEC
PRINT FREQUENCY (NR OF TIMESTEPS) = 2

LIQUID VOLUME VERSUS REACTOR LEVEL

	LEVEL. FT	VOLUME. FT**3	
1	0.000	0.0	BOT OF VES
2	18.026	4658.0	BOT ACT FUEL
3	30.526	8383.0	TOP ACT FUEL
4	31.540	8674.0	LEVEL L1
5	40.792	11768.0	LEVEL L2
6	45.000	13034.0	LEVEL L3
7	46.523	13535.0	LEVEL L4
8	46.963	13657.0	LEVEL LN (NORMAL)
9	47.333	13836.0	LEVEL L7
10	48.583	14201.0	LEVEL L8
11	48.920	14372.0	4 IN ABOVE L8
12	54.000	15837.0	CENTERLINE STEAMLINE
13	72.540	21005.0	TOP OF VESSEL

RHR PUMP CURVE

	PUMP FLOW, KGAL/MIN	PUMP HEAD, PSID	PUMP HEAD, FT
1	0.00	303.20	700.01
2	0.50	295.30	681.77
3	1.00	287.40	663.54
4	1.50	279.50	645.30
5	2.00	271.70	627.29
6	2.50	263.30	609.05
7	3.00	255.90	590.81
8	[illegible]	[illegible]	[illegible]

[signature] 5/15/86

[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]
17	8.00	[illegible]	[illegible]
18	8.50	11.51	[illegible]

NE-02-86-10 Rev.0

SAMPLE FROM STEAM TABLE

TEMP	PRES	VF	VG	HF	HG	UF	UG
50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	0.2559	0.016028	1207.47000	[illegible]	[illegible]	[illegible]	[illegible]
70	[illegible]	[illegible]	[illegible]	38.074	[illegible]	38.073	[illegible]
80	0.5067	0.016089	633.87000	48.440	1095.8	48.478	[illegible]
90	0.6969	0.016118	468.17600	58.073	1100.1	58.070	1039.7
100	0.9487	0.016148	350.18400	68.417	1104.4	68.410	[illegible]
110	1.2748	0.016180	265.17800	78.295	1108.8	78.295	1046.3
120	1.6937	0.016214	203.05400	88.158	1113.2	88.153	1049.6
130	2.2253	0.016251	157.15100	98.012	1117.7	98.005	1052.9
140	2.8931	0.016291	122.92700	107.877	1122.0	107.868	1056.2
150	3.7241	0.016336	97.05050	117.763	1126.3	117.752	1059.4
160	4.7485	0.016384	77.31040	127.678	1130.6	127.664	1062.6
170	6.0009	0.016437	62.10620	137.627	1134.7	137.609	1065.7
180	7.5197	0.016493	50.25920	147.612	1138.8	147.590	1068.8
190	9.3479	0.016554	41.02580	157.635	1142.7	157.606	1071.7
200	11.5327	0.016619	33.70540	167.695	1146.6	167.660	1074.6
210	14.1255	0.016686	27.87600	177.793	1150.3	177.749	1077.4
220	17.1861	0.016760	23.20030	187.926	1153.9	187.873	1080.1
230	20.7737	0.016837	19.42420	198.094	1157.3	198.029	1082.8
240	24.9563	0.016917	16.35480	208.294	1160.7	208.216	1085.3
250	29.8064	0.017001	13.84440	218.526	1164.2	218.433	1087.8
260	35.4014	0.017088	11.77910	228.786	1167.4	228.674	1090.3
270	41.8242	0.017178	10.07060	239.073	1170.5	238.940	1092.5
280	49.1630	0.017272	8.64973	249.388	1173.5	249.228	1094.7
290	57.5111	0.017369	7.46202	259.730	1176.3	259.505	1096.9
300	66.9668	0.017468	6.46447	270.075	1179.1	269.859	1099.0
310	77.6334	0.017571	5.62277	280.450	1181.8	280.157	1101.0
320	89.6174	0.017676	4.90944	290.843	1184.4	290.548	1103.0
330	103.0380	0.017783	4.30036	301.249	1186.9	300.909	1104.9
340	118.0050	0.017894	3.78062	311.669	1189.4	311.278	1106.7
350	134.6450	0.018006	3.33866	322.103	1191.7	321.653	1108.5
360	153.0810	0.018121	2.95556	332.548	1193.9	332.031	1110.2
370	173.4430	0.018238	2.62455	[illegible]	1196.1	342.411	1111.9
380	195.8640	0.018358	2.33759	353.456	1198.2	352.790	1113.5
390	220.4210	0.018479	2.08798	363.922	1200.2	363.168	1115.0
400	248.3360	0.018648	1.88029	375.265	1201.4	374.408	1116.0
410	275.9910	0.018818	1.67358	386.407	1202.6	385.646	1117.2
420	308.2850	0.018909	1.50557	396.727	1204.6	395.648	1118.7
430	343.3770	0.019024	1.35684	407.127	1206.1	405.984	1119.9
440	381.4270	0.019142	1.22420	417.891	[illegible]	416.558	1120.4

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
490	566.5120	0.01[illegible]	0.5[illegible]	4[illegible]	12[illegible]	[illegible]	111[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
510	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].1	
520	[illegible]	[illegible]	0.5[illegible]	[illegible]	11[illegible]	[illegible]	111[illegible]	
530	[illegible]	[illegible]	[illegible]	524.5[illegible]	[illegible]	[illegible]	11[illegible].2	
540	7[illegible]	0.0[illegible]	0.46[illegible]	5[illegible].271	11[illegible]	5[illegible]	110[illegible].8	
550	1044.5[illegible]	0.0[illegible]	1.4[illegible]	[illegible]	11[illegible].7	546.[illegible]	1107.3	
560	1171.3400	0.02214[illegible]	[illegible]	5[illegible]	11[illegible].7	[illegible]	1114.5	
570	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1101.5	
580	1[illegible].3500	0.0[illegible]	0.[illegible]	5[illegible]	1177.[illegible]	5[illegible]	10[illegible]	
590	1426.[illegible]	0.0[illegible]	0.[illegible]	[illegible]	[illegible]	[illegible]	[illegible].9	
600	[illegible]	0.0[illegible]	0.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
610	[illegible]	[illegible]	0.[illegible]	[illegible]	[illegible]	[illegible]	1087.6	
620	17[illegible].1400	0.02[illegible]	[illegible]	6[illegible]	11[illegible]	6[illegible]	10[illegible]	
630	[illegible].6000	0.02[illegible]	0.[illegible]	65[illegible].4[illegible]	[illegible]	[illegible]	1079.5	
640	[illegible]1.[illegible]	0.02[illegible]	0.1[illegible]	67[illegible].1[illegible]	1147.[illegible]	6[illegible]	107[illegible]	
650	[illegible].4500	0.02[illegible]	[illegible]	6[illegible]	[illegible]	6[illegible]	1070.8	
660	[illegible]	0.02[illegible]	0.1[illegible]	6[illegible]	11[illegible]	6[illegible]	106[illegible]	
670	[illegible]4.[illegible]	0.0[illegible]	0.14[illegible]	7[illegible]	11[illegible]	[illegible]	1061.5	
680	[illegible]61.[illegible]	0.0[illegible]	0.1[illegible]	7[illegible]	1124.1	7[illegible]	105[illegible]	
690	[illegible]	0.0[illegible]	0.1[illegible]	7[illegible]	[illegible]	7[illegible]	1051.5	
700	[illegible]18.4000	0.02[illegible]	0.11[illegible]	7[illegible]	1111.4	7[illegible]	104[illegible]	

DECAY POWER CURVE

POINT	TIME,SEC	TIME,MIN	TIME,HR	POWER,FRAC	POWER,MW
1	0.00	0.00	0.000	1.000000	3455.000
2	1.00	0.02	0.000	0.987000	3447.640
3	2.00	0.03	0.001	0.953000	3325.020
4	2.50	0.04	0.001	0.903000	3150.579
5	3.00	0.05	0.001	0.715000	2505.590
6	3.50	0.06	0.001	0.330000	1151.370
7	3.90	0.07	0.001	0.074000	255.186
8	30.00	0.50	0.008	0.047100	164.732
9	50.00	0.83	0.014	0.043047	150.191
10	100.00	1.67	0.028	0.038100	132.931
11	200.00	3.33	0.056	0.032426	113.134
12	300.00	5.00	0.083	0.029508	102.955
13	400.00	6.67	0.111	0.027598	96.289
14	500.00	8.33	0.139	0.026202	91.419
15	600.00	10.00	0.167	0.025114	87.623
16	700.00	11.67	0.194	0.024229	84.535
17	800.00	13.33	0.222	0.023488	81.950
18	900.00	15.00	0.250	0.022853	79.734
19	1000.00	16.67	0.278	0.022300	77.805
20	2000.00	33.33	0.556	0.018455	64.403
21	3000.00	50.00	0.833	0.016226	57.629
22	4000.00	66.67	1.111	0.015275	53.305
23	5000.00	83.33	1.389	0.014377	50.161
24	6000.00	100.00	1.667	0.013675	47.726
25	7000.00	116.67	1.944	0.013116	45.762
26	8000.00	133.33	2.222	0.012647	44.125

RELIEF VALVE DATA

VALVE THROAT DIAMETER = [illegible] INCH, CROSSSECTION = [illegible] FT**2

DISCHARGE COEFFICIENT = [illegible]

VALVE FLOW AT REACTER PRESSURE OF [illegible] PSIA IS [illegible] LB/SEC

SONIC VELOCITY AT THAT PRESSURE IS [illegible]471.84 FT/SEC

VALVE SETPOINTS IN [illegible] ADS FOR AUTOMATIC PRESSURE RELIEF (FROM FSAR PAGE 5.2-49)

VALVE NUMBER	OPENING PRESSURE	CLOSING PRESSURE
1	1091.0	1041.0
2	1091.0	1041.0
3	1101.0	1051.0
4	1101.0	1051.0
5	1101.0	1051.0
6	1101.0	1051.0
7	1111.0	1061.0
8	1111.0	1061.0
9	1111.0	1061.0
10	1111.0	1061.0
11	1121.0	1071.0
12	1121.0	1071.0
13	1121.0	1071.0
14	1121.0	1071.0
15	1131.0	1081.0
16	1131.0	1081.0
17	1131.0	1081.0
18	1131.0	1081.0

SONIC VELOCITY TABEL (FROM ASME STEAM TABLES, PAGE 299)

POINT	PRESSURE	VELOCITY
1	5.0	1385.0
2	10.0	1419.0
3	20.0	1455.0
4	50.0	1502.0
5	80.0	1521.0
6	100.0	1530.0
7	200.0	1550.0
8	300.0	1556.0
9	400.0	1551.0
10	500.0	1543.0
11	600.0	1531.0
12	700.0	1520.0
13	800.0	1507.0
14	1000.0	1481.0
15	1200.0	1449.0
16	1400.0	1415.0
17	[illegible]	[illegible]

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***** INITIAL CONDITIONS ***** THU. [illegible] MAY [illegible], [illegible] HR *****
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[signature] 5/5/86

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TOTAL SYSTEM VOLUME                          = [illegible]  FT**3
LIQUID VOLUME WITHOUT VOIDS                  = [illegible]  FT**3
LIQUID VOLUME WITH    VOIDS                  = [illegible]  FT**3
VAPOR VOLUME INCLUDING VOIDS                 = [illegible]  FT**3 (TOTAL VAPOR)
VAPOR VOLUME ABOVE ACTUAL LIQUID LEVEL       = [illegible]  FT**3

MASS OF LIQUID ONLY (VOIDS EXCLUDED)         = [illegible]  KLB
MASS OF VAPOR ABOVE LIQUID                   = [illegible]  KLB
TOTAL MASS OF VAPOR (VOIDS INCLUDED)         = [illegible]  KLB
TOTAL FLUID MASS (LIQUID+TOTAL VAPOR)        = [illegible]  KLB
MASS OF THERMALY ACTIVE STEEL STRUCTURE=  ~~[illegible] KLB~~  1,650 KLB (Page A3-10, Line 1020) F.J.M.

COLLAPSED REACTOR LEVEL                      = [illegible]  FT (NO VOIDS)
ACTUAL REACTOR LEVEL                         = 44.[illegible]  FT (WITH VOIDS)
REACTOR PRESSURE                             = [illegible]  LB/IN**2
REACTOR COOLANT TEMPERATURE                  = [illegible]  FAHRENHEIT
AVERAGE COOLANT QUALITY                      = [illegible] PERCENT
AVERAGE COOLANT VOID FRACTION                =  [illegible].800 PERCENT
CORRESPONDING AVERAGE VOLUMETRIC VOID AT
FULL POWER, WITH LEVEL AT SETPOINT LN        =  11.06[illegible] PERCENT

SPECIFIC VOLUME OF LIQUID                    = 2.18711E-02  FT**3/LB
SPECIFIC VOLUME OF VAPOR                     = .416665  FT**3/LB
SPECIFIC ENTHALPY OF LIQUID                  = 552.047  BTU/LB
SPECIFIC ENTHALPY OF VAPOR                   = 1188.41  BTU/LB

*** ALL DATA FOR STEADY STATE WRITTEN TO DISK, CHANNEL 2 ***

***          THU. 29 MAY 86, 08:00 HR                        ***
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final case 28 JUL 86

REACTOR REPRESSURIZATION CALCULATION—TRANSIENT [illegible]

NE-02-86-10 Rev.0 *full RHR pump curve* [illegible]

DEPRESSURIZATION STARTS AT [illegible] SEC. [illegible] VALVES USED

TAUSTL = 4.0 *Page A4-07*

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB.	SUPP POOL TEMP	MAIN ?? FLOW LB/SEC	?? FLOW LB/SEC	~~FLOW~~ (*void fraction in pct*)
0.0	551.5	1.0000	1057.3	13022.3	44.99	555.750	90.0	0.0	0.0	6.8
1.0	555.4	0.9955	1091.5	13135.0	45.22	554.691	90.0	0.0	0.0	7.1
2.0	558.4	0.9780	1117.7	13489.8	46.44	553.266	90.1	0.0	1775.3	9.4
3.0	559.7	0.9135	1129.0	14314.1	48.81	550.177	90.5	0.0	3171.6	14.9
4.0	557.9	0.0746	1113.4	14954.8	50.94	547.057	91.0	0.0	3168.4	19.2
5.0	555.6	0.0708	1093.0	15377.5	52.48	544.258	91.4	0.0	3106.3	22.2
6.0	553.4	0.0679	1073.4	15756.0	53.86	541.374	91.9	0.0	3049.7	24.8
7.0	551.7	0.0655	1058.9	15717.1	54.29	538.716	92.2	0.0	2140.8	25.9
8.0	551.1	0.0636	1053.5	15576.3	53.10	537.425	92.4	0.0	1274.6	24.6
9.0	550.8	0.0619	1048.7	15259.9	52.00	536.448	92.6	0.0	1268.1	23.2
10.0	550.6	0.0604	1049.3	14721.5	50.13	535.974	92.6	0.0	421.6	20.5
11.0	550.6	0.0591	1049.3	14293.1	48.76	535.495	92.7	0.0	421.8	18.2
12.0	550.6	0.0580	1049.3	13921.8	47.66	535.066	92.8	0.0	421.8	16.1
13.0	550.6	0.0569	1049.3	13627.9	46.87	534.671	92.8	0.0	421.8	14.2
14.0	550.5	0.0560	1048.7	13357.8	46.15	534.234	92.9	0.0	421.6	12.9
15.0	550.4	0.0551	1048.2	13205.1	45.54	533.815	92.9	0.0	421.4	11.7
16.0	550.3	0.0543	1047.2	13070.3	45.11	533.344	93.0	0.0	421.2	10.9
17.0	550.2	0.0536	1046.1	12959.8	44.75	532.882	93.1	0.0	421.0	10.2
18.0	550.1	0.0529	1045.6	12840.1	44.36	532.493	93.1	0.0	420.5	9.5
19.0	550.1	0.0523	1045.0	12737.2	44.01	532.111	93.2	0.0	420.1	8.8
20.0	549.9	0.0517	1044.0	12674.4	43.80	531.668	93.2	0.0	419.7	8.5
21.0	549.8	0.0511	1042.9	12622.7	43.63	531.231	93.3	0.0	419.4	8.2
22.0	549.7	0.0506	1041.9	12578.5	43.49	530.796	93.4	0.0	419.0	8.0
23.0	549.6	0.0501	1040.8	12540.2	43.36	530.364	93.4	0.0	418.6	7.8
24.0	549.8	0.0496	1042.9	12354.6	42.74	530.342	93.4	0.0	0.0	6.3
25.0	550.1	0.0491	1045.0	12196.6	42.22	530.349	93.4	0.0	0.0	5.1
26.0	550.3	0.0487	1046.6	12097.0	41.85	530.310	93.4	0.0	0.0	4.2
27.0	550.4	0.0483	1048.2	11995.0	41.55	530.284	93.4	0.0	0.0	3.5
28.0	550.6	0.0479	1049.3	11943.9	41.38	530.202	93.4	0.0	0.0	3.0
29.0	550.8	0.0475	1050.9	11877.9	41.16	530.194	93.4	0.0	0.0	2.5
30.0	550.9	0.0472	1052.5	11821.1	40.97	530.191	93.4	0.0	0.0	2.0
31.0	551.1	0.0469	1053.5	11799.7	40.90	530.127	93.4	0.0	0.0	1.8
32.0	551.3	0.0466	1055.1	11756.9	40.76	530.130	93.4	0.0	0.0	1.4
33.0	551.4	0.0464	1056.2	11747.1	40.73	530.072	93.4	0.0	0.0	1.3
34.0	551.6	0.0461	1057.8	11714.0	40.63	530.080	93.4	0.0	0.0	1.0
35.0	551.7	0.0459	1058.9	11710.1	40.62	530.024	93.4	0.0	0.0	1.0
36.0	551.9	0.0457	1060.5	11683.7	40.54	530.037	93.4	0.0	0.0	0.7
37.0	552.0	0.0454	1061.5	11685.3	40.54	529.984	93.4	0.0	0.0	0.7
38.0	552.1	0.0452	1062.6	11699.0	40.56	529.933	93.4	0.0	0.0	0.8
39.0	552.3	0.0450	1064.2	11667.1	40.49	529.949	93.4	0.0	0.0	0.5
40.0	552.4	0.0448	1065.3	11672.3	40.51	529.898	93.4	0.0	0.0	0.6
41.0	552.6	0.0446	1066.4	11678.6	40.52	529.850	93.4	0.0	0.0	0.6
42.0	552.7	0.0444	1067.5	11686.3	40.55	529.803	93.4	0.0	0.0	0.7
43.0	552.9	0.0443	1069.1	11667.7	40.49	529.823	93.4	0.0	0.0	0.5
44.0	553.0	0.0441	1070.2	11675.3	40.51	529.777	93.4	0.0	0.0	0.5
45.0	553.2	0.0439	1071.8	11656.2	40.46	529.798	93.4	0.0	0.0	0.4
46.0	553.3	0.0437	1072.8	11664.4	40.48	529.752	93.4	0.0	0.0	0.4
47.0	553.4	0.0436	1073.9	11672.8	40.51	529.709	93.4	0.0	0.0	0.5
48.0	553.6	0.0434	1075.0	11680.0	40.53	529.665	93.4	0.0	0.0	0.5
49.0	553.7	0.0432	1076.1	11688.3	40.55	529.622	93.4	0.0	0.0	0.6
50.0	553.9	0.0431	1077.7	11670.2	40.50	529.647	93.4	0.0	0.0	0.4
51.0	554.0	0.0429	1078.8	11678.0	40.52	529.606	93.4	0.0	0.0	0.4
52.0	554.1	0.0428	1079.9	11684.5	40.54	529.564	93.4	0.0	0.0	0.5
53.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.5
57.0	554.9	0.0421	1088.4	11887.1	40.81	527.571	93.4	[illegible]	[illegible]	[illegible]
[illegible]	555.0	[illegible]	[illegible]	[illegible]	[illegible]	527.487	93.4	[illegible]	[illegible]	0.3

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB.	SUPP POOL TEMP	MAN FW FLOW LB/SEC	AUT FW FLOW LB/SEC	~~FLOW LB/SEC~~ void fraction in pct
59.0	555.1	0.0418	1088.6	11681.4	41.57	527.425	93.4	0.0	0.0	0.3
60.0	555.3	0.0417	1087.7	11688.3	41.55	527.787	93.4	0.0	0.0	0.4
61.0	555.4	0.0416	1090.5	11674.3	41.57	529.783	93.4	0.0	0.0	0.4
62.0	555.3	0.0415	1090.2	11773.9	40.81	529.111	93.5	0.0	439.0	1.2
63.0	555.1	0.0414	1088.6	11885.6	41.18	528.712	93.5	0.0	438.1	2.2
64.0	554.9	0.0412	1087.0	11777.7	41.53	528.294	93.6	0.0	437.5	[illegible]
65.0	554.8	0.0411	1085.7	12057.6	41.75	527.812	93.6	0.0	436.8	3.8
66.0	554.6	0.0410	1083.7	12121.6	41.97	527.419	93.7	0.0	436.1	4.4
67.0	554.4	0.0409	1082.1	12175.2	42.15	526.971	93.8	0.0	435.7	4.9
68.0	554.3	0.0408	1081.0	12192.9	42.24	526.554	93.8	0.0	435.0	5.2
69.0	554.1	0.0407	1079.3	12228.4	42.33	526.128	93.9	0.0	434.3	5.5
70.0	553.9	0.0406	1077.7	12237.8	42.42	525.671	94.0	0.0	433.9	5.9
71.0	553.8	0.0405	1076.6	12256.7	42.42	525.278	94.0	0.0	433.5	6.0
72.0	553.6	0.0404	1075.0	12276.7	42.48	524.818	94.1	0.0	433.3	6.2
73.0	553.4	0.0403	1073.9	12266.0	42.45	524.423	94.1	0.0	432.1	6.2
74.0	553.3	0.0402	1072.3	12279.6	42.49	523.964	94.2	0.0	431.7	6.4
75.0	553.1	0.0401	1071.2	12263.7	42.44	523.549	94.3	0.0	431.0	6.4
76.0	552.9	0.0400	1069.6	12273.2	42.47	523.111	94.3	0.0	430.6	6.6
77.0	552.8	0.0399	1068.5	12254.0	42.41	522.717	94.4	0.0	429.9	6.5
78.0	552.6	0.0398	1066.9	12260.7	42.43	522.260	94.4	0.0	429.5	6.7
79.0	552.5	0.0397	1065.8	12239.1	42.36	521.868	94.5	0.0	428.9	6.6
80.0	552.4	0.0396	1064.8	12216.2	42.28	521.476	94.6	0.0	428.2	6.5
81.0	552.2	0.0396	1063.2	12221.1	42.30	521.021	94.6	0.0	427.7	6.7
82.0	552.1	0.0395	1062.1	12197.6	42.22	520.630	94.7	0.0	427.1	6.6
83.0	551.9	0.0394	1060.5	12201.0	42.23	520.177	94.7	0.0	426.6	6.7
84.0	551.8	0.0393	1059.4	12176.7	42.15	519.785	94.8	0.0	426.0	6.6
85.0	551.6	0.0392	1057.8	12179.6	42.16	519.336	94.9	0.0	425.5	6.7
86.0	551.4	0.0391	1056.7	12154.5	42.08	518.948	94.9	0.0	424.9	6.6
87.0	551.3	0.0391	1055.1	12157.3	42.09	518.498	95.0	0.0	424.4	6.8
88.0	551.1	0.0390	1054.1	12133.3	42.00	518.111	95.1	0.0	423.8	6.6
89.0	550.9	0.0389	1052.5	12134.5	42.01	517.667	95.1	0.0	423.3	6.8
90.0	550.8	0.0388	1051.4	12109.3	41.93	517.278	95.2	0.0	422.7	6.7
91.0	550.6	0.0388	1049.8	12111.3	41.93	516.830	95.2	0.0	422.3	6.8
92.0	550.5	0.0387	1048.7	12086.0	41.85	516.446	95.3	0.0	421.6	6.7
93.0	550.3	0.0386	1047.2	12088.0	41.86	516.001	95.4	0.0	421.2	6.8
94.0	550.1	0.0385	1045.6	12088.3	41.86	515.553	95.4	0.0	420.5	6.9
95.0	550.0	0.0385	1044.5	12062.9	41.77	515.171	95.5	0.0	420.1	6.8
96.0	549.8	0.0384	1042.9	12063.2	41.77	514.726	95.5	0.0	419.4	6.9
97.0	549.7	0.0383	1041.9	12038.1	41.69	514.346	95.6	0.0	419.0	6.8
98.0	549.7	0.0383	1041.9	11982.1	41.44	514.096	95.6	0.0	0.0	6.3
99.0	549.9	0.0382	1043.4	11827.1	40.99	514.064	95.6	0.0	0.0	5.2
100.0	550.1	0.0381	1045.0	11711.3	40.62	514.053	95.6	0.0	0.0	4.2
101.0	550.2	0.0380	1046.1	11637.4	40.40	513.991	95.6	0.0	0.0	3.6
102.0	550.3	0.0379	1047.2	11576.8	40.22	513.941	95.6	0.0	0.0	3.1
103.0	550.5	0.0379	1048.7	11501.3	39.99	513.961	95.6	0.0	0.0	2.4
104.0	550.6	0.0378	1049.8	11461.2	39.87	513.924	95.6	0.0	0.0	2.1
105.0	550.8	0.0377	1050.9	11428.2	39.78	513.891	95.6	0.0	0.0	1.8
106.0	550.9	0.0376	1051.9	11403.1	39.70	513.862	95.6	0.0	0.0	1.5
107.0	551.0	0.0375	1053.0	11382.9	39.64	513.835	95.6	0.0	0.0	1.3
108.0	551.1	0.0374	1054.1	11366.5	39.59	513.809	95.6	0.0	0.0	1.2
109.0	551.3	0.0374	1055.1	11353.3	39.55	513.784	95.6	0.0	0.0	1.1
110.0	551.4	0.0373	1056.2	11342.8	39.52	513.760	95.6	0.0	0.0	1.0
111.0	551.5	0.0372	1057.3	11334.4	39.49	513.737	95.6	0.0	0.0	0.9
112.0	551.6	0.0371	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	95.6	0.0	0.0	0.6
116.0	552.1	0.0368	1062.6	11312.9	39.43	513.630	95.6	0.0	0.0	[illegible]
117.0	552.3	0.0368	1063.7	11311.0	39.43	513.610	95.6	0.0	[illegible]	0.6

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MODEL TIME SEC	REAC TEMP FAHF	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAN RV FLOW LB/SEC	AUT RV FLOW LB/SEC	~~[illegible]~~ void fraction in pct
118.0	552.4	0.0367	1064.8	11309.9	39.42	513.591	95.6	0.0	0.0	0.6
119.0	552.5	0.0366	1065.8	11307.2	39.41	513.567	95.6	0.0	0.0	0.5
120.0	552.6	0.0365	1066.9	11305.0	39.41	513.549	95.6	0.0	0.0	0.5
121.0	552.8	0.0365	1068.0	11303.3	39.40	513.529	95.6	0.0	0.0	0.5
122.0	552.9	0.0364	1069.1	11301.9	39.40	513.510	95.6	0.0	0.0	0.4
123.0	553.0	0.0363	1070.2	11300.8	39.39	513.492	95.6	0.0	0.0	0.4
124.0	553.1	0.0363	1071.3	11300.2	39.39	513.474	95.6	0.0	0.0	0.4
125.0	553.2	0.0362	1072.3	11299.8	39.39	513.457	95.6	0.0	0.0	0.4
126.0	553.4	0.0361	1073.4	11299.7	39.39	513.440	95.6	0.0	0.0	0.3
127.0	553.5	0.0361	1074.5	11299.7	39.39	513.424	95.6	0.0	0.0	0.3
128.0	553.6	0.0360	1075.6	11298.0	39.39	513.406	95.6	0.0	0.0	0.3
129.0	553.8	0.0359	1076.6	11296.7	39.38	513.388	95.6	0.0	0.0	0.3
130.0	553.9	0.0359	1077.7	11295.7	39.38	513.372	95.6	0.0	0.0	0.3
131.0	554.0	0.0358	1078.8	11294.8	39.38	513.356	95.6	0.0	0.0	0.2
132.0	554.1	0.0357	1079.3	11318.7	39.45	513.275	95.6	0.0	0.0	0.4
133.0	554.2	0.0357	1080.4	11316.7	39.44	513.258	95.6	0.0	0.0	0.4
134.0	554.3	0.0356	1081.5	11315.0	39.44	513.243	95.6	0.0	0.0	0.4
135.0	554.4	0.0355	1082.6	11313.6	39.43	513.228	95.6	0.0	0.0	0.4
136.0	554.6	0.0355	1083.7	11312.6	39.43	513.213	95.6	0.0	0.0	0.3
137.0	554.7	0.0354	1084.8	11312.0	39.43	513.200	95.6	0.0	0.0	0.3
138.0	554.8	0.0354	1085.9	11309.8	39.42	513.184	95.6	0.0	0.0	0.3
139.0	554.9	0.0353	1087.0	11308.0	39.42	513.170	95.6	0.0	0.0	0.2
140.0	555.1	0.0352	1088.1	11306.5	39.41	513.156	95.6	0.0	0.0	0.2
141.0	555.1	0.0352	1088.6	11329.6	39.48	513.078	95.6	0.0	0.0	0.4
142.0	555.3	0.0351	1089.7	11327.1	39.47	513.063	95.6	0.0	0.0	0.4
143.0	555.4	0.0351	1090.8	11325.0	39.47	513.050	95.6	0.0	0.0	0.4
144.0	555.3	0.0350	1090.2	11395.6	39.68	512.840	95.7	0.0	439.0	1.0
145.0	555.1	0.0350	1088.1	11522.8	40.06	512.410	95.7	0.0	438.1	2.2
146.0	554.8	0.0349	1085.9	11630.6	40.38	511.988	95.8	0.0	437.2	3.3
147.0	554.6	0.0348	1084.2	11698.0	40.58	511.557	95.8	0.0	436.6	3.7
148.0	554.4	0.0348	1082.6	11751.3	40.74	511.145	95.9	0.0	435.7	4.5
149.0	554.3	0.0347	1081.0	11793.8	40.88	510.726	96.0	0.0	435.0	4.7
150.0	554.1	0.0347	1079.3	11827.4	40.99	510.303	96.0	0.0	434.3	5.3
151.0	553.9	0.0346	1077.7	11853.2	41.08	509.877	96.1	0.0	433.7	5.6
152.0	553.7	0.0346	1076.1	11872.5	41.14	509.448	96.1	0.0	433.0	5.9
153.0	553.5	0.0345	1074.5	11886.3	41.19	509.018	96.2	0.0	432.3	6.1
154.0	553.3	0.0345	1072.8	11897.3	41.22	508.589	96.3	0.0	431.9	6.3
155.0	553.1	0.0344	1071.2	11904.4	41.25	508.159	96.3	0.0	431.2	6.4
156.0	552.9	0.0344	1069.6	11908.1	41.26	507.729	96.4	0.0	430.6	6.6
157.0	552.8	0.0343	1068.5	11884.6	41.18	507.362	96.5	0.0	429.9	6.5
158.0	552.6	0.0343	1066.9	11885.0	41.18	506.932	96.5	0.0	429.3	6.6
159.0	552.4	0.0342	1065.3	11883.7	41.18	506.502	96.6	0.0	428.6	6.7
160.0	552.3	0.0342	1063.7	11879.9	41.16	506.072	96.6	0.0	427.9	6.7
161.0	552.1	0.0341	1062.1	11876.7	41.15	505.645	96.7	0.0	427.5	6.8
162.0	551.9	0.0341	1060.5	11872.2	41.14	505.217	96.8	0.0	426.9	6.9
163.0	551.8	0.0340	1059.4	11841.8	41.04	504.853	96.8	0.0	426.2	6.7
164.0	551.6	0.0340	1057.8	11836.9	41.02	504.427	96.9	0.0	425.5	6.8
165.0	551.4	0.0339	1056.2	11830.8	41.00	504.000	96.9	0.0	424.9	6.8
166.0	551.2	0.0339	1054.6	11823.9	40.98	503.573	97.0	0.0	424.2	6.9
167.0	551.0	0.0338	1053.0	11818.0	40.96	503.149	97.1	0.0	423.8	7.0
168.0	550.8	0.0338	1051.4	11811.1	40.94	502.725	97.1	0.0	423.1	7.0
169.0	550.7	0.0337	1050.3	11778.9	40.93	502.364	97.2	0.0	422.5	6.8
170.0	550.5	0.0337	1048.7	11773.6	40.91	501.941	97.2	0.0	421.8	6.9
171.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
174.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	97.5	0.0	415.4	6.9
175.0	549.6	0.0335	1041.7	11714.3	40.67	499.700	97.5	0.0	415.3	1.7
176.0	549.6	0.0334	1041.7	11600.9	40.39	499.[illegible]	97.6	0.0	0.0	5.3

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAN RV FLOW LB/SEC	AUT RV FLOW LB/SEC	~~[illegible] FLOW LB/SEC~~ (void fraction in pct)
177.0	549.8	0.0334	1042.9	11494.9	39.55	499.651	97.6	0.0	0.0	5.2
178.0	549.9	0.0333	1044.0	11399.7	39.65	499.591	97.6	0.0	0.0	4.4
179.0	550.1	0.0333	1045.0	11330.7	39.45	499.545	97.6	0.0	0.0	3.7
180.0	550.3	0.0332	1046.6	11229.8	39.13	499.573	97.6	0.0	0.0	2.9
181.0	550.4	0.0332	1047.7	11176.1	39.02	499.547	97.6	0.0	0.0	2.4
182.0	550.4	0.0332	1048.2	11155.9	38.96	499.463	97.6	0.0	0.0	2.1
183.0	550.6	0.0331	1049.3	11117.4	38.85	499.444	97.6	0.0	0.0	1.9
184.0	550.7	0.0331	1050.3	11085.6	38.75	499.427	97.6	0.0	0.0	1.6
185.0	550.8	0.0330	1051.4	11057.5	38.67	499.416	97.6	0.0	0.0	1.3
186.0	550.9	0.0330	1052.5	11036.5	38.60	499.403	97.6	0.0	0.0	1.1
187.0	551.1	0.0329	1053.5	11017.5	38.55	499.393	97.6	0.0	0.0	0.9
188.0	551.2	0.0329	1054.6	11002.0	38.50	499.384	97.6	0.0	0.0	0.8
189.0	551.3	0.0329	1055.1	11013.5	38.53	499.314	97.6	0.0	0.0	0.9
190.0	551.4	0.0328	1056.2	11001.7	38.50	499.306	97.6	0.0	0.0	0.8
191.0	551.5	0.0328	1057.3	10990.4	38.47	499.296	97.6	0.0	0.0	0.6
192.0	551.6	0.0327	1058.3	10980.9	38.44	499.289	97.6	0.0	0.0	0.5
193.0	551.8	0.0327	1059.4	10973.2	38.41	499.283	97.6	0.0	0.0	0.5
194.0	551.9	0.0327	1060.5	10965.3	38.39	499.275	97.6	0.0	0.0	0.4
195.0	551.9	0.0326	1061.0	10982.7	38.44	499.206	97.6	0.0	0.0	0.5
196.0	552.1	0.0326	1062.1	10975.7	38.42	499.199	97.6	0.0	0.0	0.4
197.0	552.2	0.0325	1063.2	10969.9	38.40	499.193	97.6	0.0	0.0	0.4
198.0	552.3	0.0325	1064.2	10963.4	38.38	499.186	97.6	0.0	0.0	0.3
199.0	552.4	0.0325	1065.3	10958.1	38.37	499.181	97.6	0.0	0.0	0.2
200.0	552.5	0.0324	1065.8	10977.5	38.43	499.113	97.6	0.0	0.0	0.4
201.0	552.6	0.0324	1066.9	10972.3	38.41	499.108	97.6	0.0	0.0	0.3
202.0	552.8	0.0324	1068.0	10966.3	38.39	499.101	97.6	0.0	0.0	0.3
203.0	552.9	0.0323	1069.1	10961.2	38.38	499.097	97.6	0.0	0.0	0.2
204.0	552.9	0.0323	1069.6	10980.8	38.44	499.029	97.6	0.0	0.0	0.4
205.0	553.1	0.0322	1070.7	10975.8	38.42	499.025	97.6	0.0	0.0	0.3
206.0	553.2	0.0322	1071.8	10969.8	38.40	499.019	97.6	0.0	0.0	0.3
207.0	553.3	0.0322	1072.3	10989.6	38.46	498.951	97.6	0.0	0.0	0.4
208.0	553.4	0.0321	1073.4	10982.8	38.44	498.945	97.6	0.0	0.0	0.4
209.0	553.5	0.0321	1074.5	10977.9	38.43	498.942	97.6	0.0	0.0	0.3
210.0	553.6	0.0321	1075.6	10972.1	38.41	498.937	97.6	0.0	0.0	0.3
211.0	553.7	0.0320	1076.1	10991.1	38.47	498.870	97.6	0.0	0.0	0.4
212.0	553.8	0.0320	1077.2	10985.4	38.45	498.866	97.6	0.0	0.0	0.3
213.0	553.9	0.0320	1077.7	11004.4	38.51	498.799	97.6	0.0	0.0	0.5
214.0	554.0	0.0319	1078.8	10998.9	38.49	498.796	97.6	0.0	0.0	0.5
215.0	554.1	0.0319	1079.9	10993.5	38.47	498.791	97.6	0.0	0.0	0.4
216.0	554.3	0.0319	1081.0	10987.2	38.46	498.788	97.6	0.0	0.0	0.3
217.0	554.4	0.0318	1082.1	10981.1	38.44	498.784	97.6	0.0	0.0	0.2
218.0	554.4	0.0318	1082.6	10999.5	38.49	498.719	97.6	0.0	0.0	0.4
219.0	554.6	0.0318	1083.7	10993.5	38.48	498.715	97.6	0.0	0.0	0.3
220.0	554.6	0.0317	1084.2	11012.2	38.53	498.649	97.6	0.0	0.0	0.5
221.0	554.8	0.0317	1085.3	11006.4	38.51	498.647	97.6	0.0	0.0	0.4
222.0	554.9	0.0317	1086.4	10999.9	38.49	498.643	97.6	0.0	0.0	0.4
223.0	555.0	0.0316	1087.5	10994.4	38.48	498.641	97.6	0.0	0.0	0.3
224.0	555.1	0.0316	1088.6	10988.3	38.46	498.638	97.6	0.0	0.0	0.3
225.0	555.2	0.0316	1089.2	11006.4	38.51	498.573	97.6	0.0	0.0	0.4
226.0	555.3	0.0315	1090.2	11000.4	38.50	498.571	97.6	0.0	0.0	0.3
227.0	555.4	0.0315	1090.8	11018.9	38.55	498.507	97.6	0.0	0.0	0.5
228.0	555.3	0.0315	1090.2	11083.3	38.74	498.313	97.6	0.0	459.3	1.1
229.0	555.1	0.0314	1088.1	11201.9	39.17	497.904	97.7	[illegible]	475.[illegible]	2.3
230.0	554.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.0
234.0	554.3	0.0312	1078.8	11500.1	[illegible]	[illegible]	[illegible]	0.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] 5/15/[illegible]

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQ [illegible] KLB	SUPP POOL TEMP	MAN SV FLOW LB/SEC	ALT SV FLOW LB/SEC	[illegible] (void fraction in pct)
236.0	553.6	0.0312	1075.0	11555.1	40.16	494.953	98.1	0.0	433.5	6.1
237.0	553.4	0.0312	1073.4	11566.9	40.19	494.541	98.1	0.0	433.1	6.7
238.0	553.2	0.0311	1071.8	11571.7	40.20	494.129	98.2	0.0	431.8	6.4
239.0	553.0	0.0311	1070.2	11573.5	40.21	493.719	98.3	0.0	430.8	6.5
240.0	552.9	0.0311	1068.5	11572.9	40.21	493.308	98.3	0.0	430.1	6.6
241.0	552.6	0.0311	1066.9	11569.4	40.15	492.897	98.4	0.0	429.7	6.7
242.0	552.4	0.0310	1065.3	11562.4	40.18	492.486	98.5	0.0	428.6	6.7
243.0	552.3	0.0310	1063.7	11555.2	40.16	492.068	98.5	0.0	427.9	6.8
244.0	552.1	0.0310	1062.1	11547.0	40.13	491.656	98.6	0.0	427.3	6.8
245.0	551.9	0.0309	1060.5	11538.0	40.10	491.246	98.6	0.0	426.6	6.9
246.0	551.7	0.0309	1058.9	11528.6	40.08	490.836	98.7	0.0	426.0	6.9
247.0	551.5	0.0309	1057.3	11518.7	40.05	490.426	98.8	0.0	425.3	6.9
248.0	551.3	0.0308	1055.7	11508.4	40.02	490.018	98.8	0.0	424.7	6.9
249.0	551.1	0.0308	1054.1	11497.9	39.98	489.610	98.9	0.0	424.0	6.9
250.0	550.9	0.0308	1052.5	11487.2	39.95	489.202	98.9	0.0	423.3	6.9
251.0	550.8	0.0308	1050.9	11476.3	39.92	488.795	99.0	0.0	422.7	6.9
252.0	550.6	0.0307	1049.3	11465.4	39.89	488.388	99.1	0.0	422.0	7.0
253.0	550.4	0.0307	1047.7	11454.3	39.85	487.983	99.1	0.0	421.4	7.0
254.0	550.2	0.0307	1046.1	11443.1	39.82	487.577	99.2	0.0	420.7	7.0
255.0	550.0	0.0307	1044.5	11432.0	39.79	487.173	99.2	0.0	420.1	7.0
256.0	549.8	0.0306	1042.9	11420.8	39.75	486.768	99.3	0.0	419.4	7.0
257.0	549.6	0.0306	1041.3	11409.6	39.72	486.364	99.3	0.0	418.8	7.0
258.0	549.6	0.0306	1041.3	11326.0	39.47	486.145	99.4	0.0	0.0	6.4
259.0	549.8	0.0305	1042.9	11186.0	39.05	486.122	99.4	0.0	0.0	5.3
260.0	549.9	0.0305	1044.0	11088.2	38.76	486.078	99.4	0.0	0.0	4.3
261.0	550.1	0.0305	1045.0	11006.6	38.51	486.041	99.4	0.0	0.0	3.6
262.0	550.2	0.0305	1046.1	10937.9	38.31	486.014	99.4	0.0	0.0	3.0
263.0	550.3	0.0304	1047.2	10880.5	38.14	485.995	99.4	0.0	0.0	2.5
264.0	550.4	0.0304	1048.2	10832.8	37.99	485.982	99.4	0.0	0.0	2.0
265.0	550.6	0.0304	1049.3	10791.6	37.87	485.971	99.4	0.0	0.0	1.6
266.0	550.7	0.0304	1050.3	10757.3	37.77	485.962	99.4	0.0	0.0	1.3
267.0	550.8	0.0303	1050.9	10752.8	37.75	485.900	99.4	0.0	0.0	1.1
268.0	550.9	0.0303	1051.9	10728.1	37.68	485.857	99.4	0.0	0.0	1.0
269.0	551.0	0.0303	1053.0	10706.3	37.62	485.851	99.4	0.0	0.0	0.8
270.0	551.1	0.0302	1053.5	10711.6	37.63	485.831	99.4	0.0	0.0	0.9
271.0	551.2	0.0302	1054.6	10695.1	37.58	485.830	99.4	0.0	0.0	0.7
272.0	551.3	0.0302	1055.7	10679.9	37.54	485.829	99.4	0.0	0.0	0.5
273.0	551.4	0.0302	1056.2	10690.7	37.57	485.769	99.4	0.0	0.0	0.6
274.0	551.5	0.0301	1057.3	10678.9	37.53	485.769	99.4	0.0	0.0	0.5
275.0	551.6	0.0301	1058.3	10667.1	37.50	485.769	99.4	0.0	0.0	0.4
276.0	551.7	0.0301	1058.9	10680.9	37.54	485.707	99.4	0.0	0.0	0.5
277.0	551.8	0.0301	1059.9	10671.3	37.51	485.709	99.4	0.0	0.0	0.4
278.0	551.9	0.0300	1061.0	10661.6	37.48	485.709	99.4	0.0	0.0	0.3
279.0	552.0	0.0300	1061.5	10676.9	37.53	485.649	99.4	0.0	0.0	0.4
280.0	552.1	0.0300	1062.1	10692.0	37.57	485.589	99.4	0.0	0.0	0.6
281.0	552.2	0.0300	1063.2	10683.5	37.55	485.590	99.4	0.0	0.0	0.5
282.0	552.3	0.0299	1064.2	10674.6	37.52	485.591	99.4	0.0	0.0	0.4
283.0	552.4	0.0299	1064.8	10690.4	37.57	485.532	99.4	0.0	0.0	0.5
284.0	552.5	0.0299	1065.8	10682.6	37.54	485.534	99.4	0.0	0.0	0.4
285.0	552.6	0.0299	1066.9	10674.4	37.52	485.535	99.4	0.0	0.0	0.4
286.0	552.8	0.0298	1068.0	10665.9	37.49	485.535	99.4	0.0	0.0	0.3
287.0	552.8	0.0298	1068.5	10681.8	37.54	485.476	99.4	0.0	0.0	0.4
288.0	552.9	0.0298	1069.6	10674.0	37.52	485.477	99.4	0.0	0.0	0.3
289.0	553.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	99.4	[illegible]	[illegible]	0.4
293.0	553.4	0.0297	1073.9	10682.2	37.54	[illegible]	99.4	[illegible]	[illegible]	[illegible]
294.0	553.5	0.0297	1075.0	[illegible]	37.52	[illegible]	99.4	[illegible]	[illegible]	0.2

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MSL FW FLOW LB/SEC	OUT FW FLOW LB/SEC	~~[illegible]~~ void fraction in pct
295.0	553.6	0.0296	1075.6	10689.3	37.56	485.310	99.4	0.0	0.0	0.4
296.0	553.8	0.0296	1076.6	10681.6	37.54	485.313	99.4	0.0	0.0	0.3
297.0	553.9	0.0296	1077.7	10677.6	37.53	485.316	99.4	0.0	0.0	0.2
298.0	553.9	0.0296	1078.3	10689.7	37.57	485.258	99.4	0.0	0.0	0.4
299.0	554.0	0.0295	1078.8	10705.3	37.61	485.230	99.4	0.0	0.0	0.5
300.0	554.1	0.0295	1079.9	10697.6	37.59	485.233	99.4	0.0	0.0	0.4
301.0	554.3	0.0295	1081.0	10689.9	37.57	485.204	99.4	0.0	0.0	0.3
302.0	554.4	0.0295	1082.1	10680.9	37.54	485.209	99.4	0.0	0.0	0.1
303.0	554.4	0.0294	1082.6	10696.6	37.59	485.151	99.4	0.0	0.0	0.4
304.0	554.5	0.0294	1083.2	10711.9	37.63	485.093	99.4	0.0	0.0	0.5
305.0	554.6	0.0294	1084.2	10703.8	37.61	485.097	99.4	0.0	0.0	0.4
306.0	554.8	0.0294	1085.3	10693.3	37.58	485.100	99.4	0.0	0.0	0.3
307.0	554.9	0.0294	1086.4	10686.6	37.56	485.103	99.4	0.0	0.0	0.2
308.0	554.9	0.0293	1087.0	10702.0	37.60	485.045	99.4	0.0	0.0	0.4
309.0	555.0	0.0293	1087.5	10717.0	37.65	484.983	99.4	0.0	0.0	0.5
310.0	555.1	0.0293	1088.6	10708.8	37.62	484.993	99.4	0.0	0.0	0.4
311.0	555.3	0.0293	1089.7	10700.3	37.60	484.996	99.4	0.0	0.0	0.3
312.0	555.4	0.0292	1090.8	10691.5	37.57	484.999	99.4	0.0	0.0	0.2
313.0	555.4	0.0292	1091.3	10706.5	37.62	484.942	99.4	0.0	0.0	0.4
314.0	555.2	0.0292	1089.2	10830.5	37.99	484.566	99.4	0.0	438.6	1.6
315.0	554.9	0.0292	1087.0	10936.4	38.30	484.164	99.5	0.0	437.7	2.7
316.0	554.7	0.0292	1084.8	11025.8	38.57	483.744	99.6	0.0	436.8	3.6
317.0	554.4	0.0291	1082.6	11100.3	38.79	483.309	99.6	0.0	435.9	4.4
318.0	554.2	0.0291	1080.4	11161.4	38.98	482.864	99.7	0.0	435.0	5.0
319.0	554.0	0.0291	1078.8	11189.5	39.06	482.475	99.7	0.0	434.3	5.3
320.0	553.8	0.0291	1076.6	11232.3	39.15	482.019	99.8	0.0	433.5	5.8
321.0	553.6	0.0291	1075.0	11244.4	39.23	481.633	99.9	0.0	432.8	6.0
322.0	553.4	0.0290	1073.4	11253.3	39.25	481.236	99.9	0.0	432.1	6.2
323.0	553.2	0.0290	1071.8	11254.5	39.26	480.827	100.0	0.0	431.2	6.3
324.0	552.9	0.0290	1069.6	11277.3	39.32	480.368	100.1	0.0	430.6	6.6
325.0	552.8	0.0290	1068.0	11273.1	39.31	479.968	100.1	0.0	429.9	6.7
326.0	552.6	0.0289	1066.4	11267.1	39.29	479.569	100.2	0.0	429.3	6.8
327.0	552.4	0.0289	1064.8	11258.2	39.27	479.169	100.2	0.0	428.4	6.8
328.0	552.2	0.0289	1063.2	11248.5	39.24	478.771	100.3	0.0	427.7	6.8
329.0	551.9	0.0289	1061.0	11251.5	39.28	478.313	100.4	0.0	427.1	7.0
330.0	551.8	0.0289	1059.4	11249.3	39.24	477.914	100.4	0.0	426.4	7.0
331.0	551.6	0.0288	1057.8	11236.9	39.20	477.515	100.5	0.0	425.7	7.0
332.0	551.4	0.0288	1056.2	11222.8	39.16	477.119	100.5	0.0	424.9	7.0
333.0	551.2	0.0288	1054.6	11208.8	39.12	476.723	100.6	0.0	424.2	7.0
334.0	550.9	0.0288	1052.5	11218.6	39.15	476.258	100.7	0.0	423.6	7.2
335.0	550.8	0.0288	1050.9	11203.5	39.10	475.872	100.7	0.0	422.9	7.2
336.0	550.6	0.0287	1049.3	11189.0	39.06	475.477	100.8	0.0	422.3	7.2
337.0	550.4	0.0287	1047.7	11174.8	39.02	475.084	100.8	0.0	421.6	7.2
338.0	550.2	0.0287	1046.1	11159.3	38.97	474.689	100.9	0.0	420.7	7.1
339.0	550.0	0.0287	1044.5	11144.3	38.93	474.296	100.9	0.0	420.1	7.1
340.0	549.8	0.0287	1042.9	11129.9	38.88	473.904	101.0	0.0	419.6	7.1
341.0	549.6	0.0286	1040.8	11179.5	38.91	473.453	101.1	0.0	418.8	7.3
342.0	549.8	0.0286	1042.9	10968.1	38.39	473.434	101.1	0.0	0.0	5.2
343.0	549.9	0.0286	1044.0	10858.3	38.07	473.429	101.1	0.0	0.0	4.9
344.0	550.1	0.0286	1045.0	10748.0	37.80	473.388	101.1	0.0	0.0	4.1
345.0	550.2	0.0286	1046.1	10691.8	37.57	473.341	101.1	0.0	0.0	3.4
346.0	550.3	0.0285	1047.2	10627.7	37.38	[illegible]	101.1	0.0	0.0	2.5
347.0	550.4	0.0285	1048.3	10574.3	37.22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
348.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	101.1	0.0	0.0	1.0
352.0	550.9	0.0284	1052.8	10447.6	36.85	473.208	101.1	0.0	[illegible]	1.1
353.0	551.0	0.0284	1053.0	10460.2	36.88	473.140	101.1	0.0	[illegible]	1.1

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRACT	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAN. RV FLOW LB/SEC	AUT RV FLOW LB/SEC	~~[illegible]~~ void fraction in pct
354.0	551.1	0.0284	1054.0	10431.9	36.80	473.182	101.1	0.0	0.0	0.9
355.0	551.3	0.0284	1055.1	10414.4	36.75	473.155	101.1	0.0	0.0	[illegible]
356.0	551.4	0.0284	1056.2	10398.4	36.67	473.155	101.1	0.0	0.0	0.5
357.0	551.4	0.0283	1056.7	10407.8	36.72	473.104	101.1	0.0	0.0	0.6
358.0	551.5	0.0283	1057.3	10418.0	36.75	473.057	101.1	0.0	0.0	0.7
359.0	551.6	0.0283	1058.7	10405.6	36.72	473.055	101.1	0.0	0.0	0.6
360.0	551.8	0.0283	1059.4	10374.2	36.65	473.061	101.1	0.0	0.0	0.4
361.0	551.9	0.0283	1060.5	10382.8	36.65	473.065	101.1	0.0	0.0	0.3
362.0	551.9	0.0283	1061.0	10375.9	36.65	473.012	101.1	0.0	0.0	0.4
363.0	552.1	0.0283	1062.1	10384.9	36.65	473.016	101.1	0.0	0.0	0.3
364.0	552.1	0.0282	1062.6	10378.1	36.69	472.963	101.1	0.0	0.0	0.4
365.0	552.2	0.0282	1063.2	10411.4	36.73	472.909	101.1	0.0	0.0	0.6
366.0	552.3	0.0282	1064.2	10401.8	36.70	472.915	101.1	0.0	0.0	0.4
367.0	552.4	0.0282	1064.8	10414.9	36.74	472.860	101.1	0.0	0.0	0.6
368.0	552.5	0.0281	1065.8	10405.1	36.71	472.866	101.1	0.0	0.0	0.5
369.0	552.6	0.0281	1066.9	10395.4	36.69	472.871	101.1	0.0	0.0	0.3
370.0	552.8	0.0281	1068.0	10385.5	36.66	472.877	101.1	0.0	0.0	0.2
371.0	552.8	0.0281	1068.5	10399.6	36.70	472.824	101.1	0.0	0.0	0.4
372.0	552.9	0.0281	1069.6	10389.3	36.67	472.829	101.1	0.0	0.0	0.3
373.0	553.0	0.0281	1070.2	10403.2	36.71	472.776	101.1	0.0	0.0	0.4
374.0	553.1	0.0280	1070.7	10416.8	36.75	472.723	101.1	0.0	0.0	0.5
375.0	553.2	0.0280	1071.8	10407.8	36.72	472.730	101.1	0.0	0.0	0.4
376.0	553.3	0.0280	1072.3	10421.1	36.76	472.676	101.1	0.0	0.0	0.5
377.0	553.4	0.0280	1073.4	10411.8	36.73	472.682	101.1	0.0	0.0	0.4
378.0	553.5	0.0280	1074.5	10402.2	36.71	472.688	101.1	0.0	0.0	0.3
379.0	553.6	0.0280	1075.6	10392.4	36.68	472.694	101.1	0.0	0.0	0.2
380.0	553.7	0.0279	1076.1	10406.7	36.72	472.642	101.1	0.0	0.0	0.3
381.0	553.8	0.0279	1077.2	10396.6	36.69	472.648	101.1	0.0	0.0	0.2
382.0	553.9	0.0279	1077.7	10410.5	36.73	472.596	101.1	0.0	0.0	0.4
383.0	553.9	0.0279	1078.3	10424.1	36.77	472.543	101.1	0.0	0.0	0.5
384.0	554.1	0.0279	1079.3	10415.2	36.75	472.551	101.1	0.0	0.0	0.4
385.0	554.1	0.0278	1079.9	10428.4	36.78	472.498	101.1	0.0	0.0	0.5
386.0	554.3	0.0278	1081.0	10419.2	36.76	472.505	101.1	0.0	0.0	0.4
387.0	554.3	0.0278	1081.5	10432.1	36.80	472.452	101.1	0.0	0.0	0.5
388.0	554.4	0.0278	1082.6	10422.5	36.77	472.459	101.1	0.0	0.0	0.4
389.0	554.6	0.0278	1083.7	10412.8	36.74	472.466	101.1	0.0	0.0	0.3
390.0	554.7	0.0278	1084.8	10403.0	36.71	472.473	101.1	0.0	0.0	0.2
391.0	554.8	0.0277	1085.3	10416.9	36.75	472.422	101.1	0.0	0.0	0.3
392.0	554.9	0.0277	1086.4	10406.8	36.72	472.428	101.1	0.0	0.0	0.2
393.0	554.9	0.0277	1087.0	10420.4	36.76	472.376	101.1	0.0	0.0	0.4
394.0	555.1	0.0277	1088.1	10410.0	36.73	472.383	101.1	0.0	0.0	0.2
395.0	555.1	0.0277	1088.6	10423.7	36.77	472.331	101.1	0.0	0.0	0.4
396.0	555.3	0.0277	1089.7	10413.8	36.74	472.337	101.1	0.0	0.0	0.2
397.0	555.3	0.0277	1090.2	10425.9	36.78	472.286	101.1	0.0	0.0	0.4
398.0	555.4	0.0276	1090.8	10438.9	36.82	472.234	101.1	0.0	0.0	0.5
399.0	555.3	0.0276	1090.2	10496.2	36.99	472.061	101.1	0.0	437.3	1.1
400.0	555.1	0.0276	1089.1	10605.7	37.31	471.683	101.2	0.0	438.1	2.2
401.0	554.8	0.0276	1085.9	10698.9	37.59	471.284	101.2	0.0	437.2	3.2
402.0	554.6	0.0276	1083.7	10777.1	37.83	470.869	101.3	0.0	436.3	4.0
403.0	554.3	0.0276	1081.5	10841.3	38.02	470.442	101.3	0.0	435.5	4.7
404.0	554.1	0.0275	1079.3	10894.7	38.18	470.006	101.4	0.0	434.6	5.3
405.0	553.8	0.0275	1077.2	10937.1	38.31	469.564	101.5	0.0	433.7	5.8
406.0	553.6	0.0275	1075.6	10945.7	38.34	469.178	101.5	0.0	[illegible]	6.0
407.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAIN FW FLOW LB/SEC	ALT FW FLOW LB/SEC	void fraction in pct
[illegible]	552.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
411.0	552.6	0.0274	1066.4	10957.0	38.46	467.115	101.7	[illegible]	[illegible]	[illegible]
[illegible]	552.4	0.0274	1064.8	[illegible]	38.42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
413.0	552.2	0.0274	1063.2	10944.4	38.39	466.339	102.0	0.0	427.7	6.9
414.0	551.9	0.0274	1061.0	10975.2	38.42	465.897	102.0	0.0	427.1	7.1
415.0	551.8	0.0274	1059.4	10961.7	38.38	465.506	102.1	0.0	426.4	7.1
416.0	551.6	0.0274	1057.8	10946.7	38.33	465.115	102.1	0.0	425.5	7.1
417.0	551.3	0.0273	1055.7	10954.7	38.36	464.677	102.2	0.0	424.9	7.3
418.0	551.1	0.0273	1054.1	10938.7	38.3[illegible]	464.237	102.2	0.0	424.3	7.3
419.0	550.9	0.0273	1052.5	10923.6	38.26	463.800	102.3	0.0	423.7	7.2
420.0	550.7	0.0273	1050.3	10925.0	38.29	463.457	102.4	0.0	422.7	7.4
421.0	550.5	0.0273	1048.7	10910.7	38.23	463.071	102.4	0.0	422.0	7.3
422.0	550.3	0.0273	1047.2	10892.5	38.17	462.686	102.5	0.0	421.2	7.3
423.0	550.1	0.0272	1045.6	10875.2	38.12	462.302	102.5	0.0	420.5	7.2
424.0	549.9	0.0272	1043.4	10881.6	38.14	461.882	102.6	0.0	419.9	7.4
425.0	549.7	0.0272	1041.9	10864.3	38.09	461.480	102.7	0.0	419.2	7.3
426.0	549.7	0.0272	1041.9	10777.6	37.83	461.271	102.7	0.0	0.0	6.6
427.0	549.8	0.0272	1042.9	10642.2	37.48	461.204	102.7	0.0	0.0	5.6
428.0	550.0	0.0272	1044.5	10540.3	37.12	461.215	102.7	0.0	0.0	4.5
429.0	550.1	0.0272	1045.6	10457.1	36.87	461.186	102.7	0.0	0.0	3.7
430.0	550.3	0.0271	1046.6	10386.9	36.66	461.167	102.7	0.0	0.0	3.1
431.0	550.4	0.0271	1047.7	10326.4	36.48	461.154	102.7	0.0	0.0	2.5
432.0	550.5	0.0271	1048.7	10275.9	36.33	461.148	102.7	0.0	0.0	2.0
433.0	550.6	0.0271	1049.3	10256.3	36.27	461.090	102.7	0.0	0.0	1.8
434.0	550.6	0.0271	1049.8	10242.2	36.23	461.033	102.7	0.0	0.0	1.7
435.0	550.8	0.0271	1050.9	10210.7	36.13	461.036	102.7	0.0	0.0	1.4
436.0	550.8	0.0271	1051.4	10205.4	36.12	460.982	102.7	0.0	0.0	1.3
437.0	550.9	0.0270	1052.5	10181.0	36.04	460.987	102.7	0.0	0.0	1.1
438.0	551.1	0.0270	1053.5	10159.1	35.98	460.972	102.7	0.0	0.0	0.8
439.0	551.2	0.0270	1054.6	10135.4	35.92	460.995	102.7	0.0	0.0	0.6
440.0	551.3	0.0270	1055.1	10145.3	35.94	460.948	102.7	0.0	0.0	0.7
441.0	551.4	0.0270	1056.2	10128.7	35.89	460.954	102.7	0.0	0.0	0.5
442.0	551.4	0.0270	1056.7	10136.9	35.91	460.905	102.7	0.0	0.0	0.6
443.0	551.6	0.0270	1057.8	10133.3	35.87	460.911	102.7	0.0	0.0	0.4
444.0	551.6	0.0269	1058.3	10133.1	35.90	460.862	102.7	0.0	0.0	0.5
445.0	551.8	0.0269	1059.4	10118.8	35.86	460.869	102.7	0.0	0.0	0.4
446.0	551.8	0.0269	1059.9	10129.6	35.89	460.819	102.7	0.0	0.0	0.5
447.0	551.9	0.0269	1060.5	10140.8	35.92	460.770	102.7	0.0	0.0	0.6
448.0	552.0	0.0269	1061.5	10130.0	35.89	460.779	102.7	0.0	0.0	0.4
449.0	552.1	0.0269	1062.1	10141.6	35.93	460.729	102.7	0.0	0.0	0.6
450.0	552.2	0.0269	1063.2	10131.2	35.90	460.738	102.7	0.0	0.0	0.4
451.0	552.3	0.0268	1063.7	10143.0	35.93	460.688	102.7	0.0	0.0	0.6
452.0	552.4	0.0268	1064.8	10132.7	35.90	460.697	102.7	0.0	0.0	0.4
453.0	552.4	0.0268	1065.3	10144.5	35.94	460.647	102.7	0.0	0.0	0.6
454.0	552.6	0.0268	1066.4	10134.2	35.90	460.656	102.7	0.0	0.0	0.4
455.0	552.6	0.0268	1066.9	10146.1	35.94	460.606	102.7	0.0	0.0	0.5
456.0	552.8	0.0268	1068.0	10135.9	35.91	460.615	102.7	0.0	0.0	0.4
457.0	552.8	0.0268	1068.5	10147.7	35.94	460.565	102.7	0.0	0.0	0.5
458.0	552.9	0.0267	1069.6	10137.5	35.91	460.574	102.7	0.0	0.0	0.4
459.0	553.0	0.0267	1070.2	10149.3	35.95	460.524	102.7	0.0	0.0	0.5
460.0	553.1	0.0267	1071.2	10139.1	35.92	460.533	102.7	0.0	0.0	0.4
461.0	553.2	0.0267	1071.8	10150.9	35.95	460.483	102.7	0.0	0.0	0.5
462.0	553.3	0.0267	1072.8	10140.8	35.92	460.493	102.7	0.0	0.0	0.4
463.0	553.4	0.0267	1073.4	10152.6	35.96	460.443	102.7	0.0	0.0	0.5
464.0	553.5	0.0267	1074.5	10142.4	35.93	460.453	102.7	0.0	0.0	0.4
465.0	553.6	0.0267	1075.0	10154.1	35.96	460.403	102.7	0.0	0.0	0.5
466.0	553.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0.0	0.3
470.0	554.1	0.0265	1079.7	10144.4	35.97	460.330	102.7	0.0	0.0	0.4
471.0	554.2	0.0265	1080.4	10133.0	35.91	460.335	102.7	0.0	0.0	0.3

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MODEL TIME SEC	REAC TEMP FAHF	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB.	SUPP POOL TEMP	MAN PV FLOW LB/SEC	AUT PV FLOW LB/SEC	~~FLOW LB/SEC~~ void fraction in pct
472.0	554.3	0.0265	1081.0	10145.0	35.94	460.290	102.7	0.0	0.0	0.4
473.0	554.4	0.0265	1082.1	10133.7	35.91	460.277	102.7	0.0	0.0	0.2
474.0	554.4	0.0265	1082.6	10145.9	35.94	460.251	102.7	0.0	0.0	0.4
475.0	554.6	0.0265	1083.7	10134.7	35.91	460.240	102.7	0.0	0.0	0.2
476.0	554.6	0.0265	1084.2	10147.0	35.94	460.212	102.7	0.0	0.0	0.3
477.0	554.8	0.0265	1085.3	10135.9	35.91	460.221	102.7	0.0	0.0	0.2
478.0	554.8	0.0265	1085.9	10148.2	35.95	460.174	102.7	0.0	0.0	0.3
479.0	554.9	0.0265	1087.0	10137.3	35.91	460.183	102.7	0.0	0.0	0.2
480.0	555.0	0.0265	1087.5	10149.5	35.95	460.136	102.7	0.0	0.0	0.3
481.0	555.1	0.0264	1088.6	10138.7	35.92	460.145	102.7	0.0	0.0	0.2
482.0	555.2	0.0264	1089.2	10151.0	35.95	460.098	102.7	0.0	0.0	0.3
483.0	555.3	0.0264	1090.2	10140.2	35.92	460.107	102.7	0.0	0.0	0.2
484.0	555.3	0.0264	1090.2	10174.2	36.02	460.001	102.7	0.0	0.0	0.6
485.0	555.3	0.0264	1089.7	10228.2	36.19	459.834	102.7	0.0	439.0	1.1
486.0	555.0	0.0264	1087.5	10333.6	36.50	459.467	102.8	0.0	437.9	2.3
487.0	554.7	0.0264	1084.8	10445.2	36.83	459.021	102.8	0.0	437.0	3.4
488.0	554.4	0.0264	1082.6	10517.6	37.05	458.613	102.9	0.0	435.9	4.2
489.0	554.2	0.0263	1080.4	10577.3	37.23	458.194	103.0	0.0	435.0	4.9
490.0	553.9	0.0263	1078.3	10625.8	37.37	457.768	103.0	0.0	434.1	5.4
491.0	553.8	0.0263	1076.6	10644.1	37.43	457.396	103.1	0.0	433.5	5.7
492.0	553.5	0.0263	1074.5	10677.5	37.53	456.963	103.2	0.0	432.6	6.1
493.0	553.3	0.0263	1072.8	10683.0	37.55	456.586	103.2	0.0	431.9	6.2
494.0	553.1	0.0263	1070.7	10705.6	37.61	456.150	103.3	0.0	431.0	6.6
495.0	552.9	0.0263	1069.1	10702.1	37.60	455.771	103.3	0.0	430.4	6.7
496.0	552.6	0.0263	1066.9	10717.3	37.65	455.333	103.4	0.0	429.5	6.9
497.0	552.4	0.0262	1065.3	10707.6	37.62	454.953	103.5	0.0	428.8	6.9
498.0	552.2	0.0262	1063.2	10717.7	37.65	454.515	103.5	0.0	427.9	7.2
499.0	552.0	0.0262	1061.5	10703.7	37.61	454.135	103.6	0.0	427.2	7.1
500.0	551.8	0.0262	1059.9	10685.1	37.56	453.755	103.6	0.0	426.4	7.1
501.0	551.6	0.0262	1057.8	10695.0	37.58	453.320	103.7	0.0	425.7	7.3
502.0	551.4	0.0262	1056.2	10678.5	37.53	452.942	103.8	0.0	425.1	7.2
503.0	551.1	0.0262	1054.1	10683.2	37.55	452.507	103.8	0.0	424.2	7.4
504.0	550.9	0.0262	1052.5	10665.0	37.49	452.129	103.9	0.0	423.6	7.4
505.0	550.8	0.0261	1050.9	10645.9	37.44	451.751	103.9	0.0	422.7	7.3
506.0	550.5	0.0261	1048.7	10650.2	37.45	451.318	104.0	0.0	422.0	7.5
507.0	550.3	0.0261	1047.2	10631.4	37.39	450.943	104.0	0.0	421.4	7.4
508.0	550.1	0.0261	1045.0	10634.5	37.40	450.510	104.1	0.0	420.5	7.5
509.0	549.9	0.0261	1043.4	10614.9	37.34	450.134	104.2	0.0	419.9	7.5
510.0	549.7	0.0261	1041.9	10594.7	37.28	449.759	104.2	0.0	419.0	7.4
511.0	549.7	0.0261	1041.9	10508.8	37.03	449.555	104.3	0.0	0.0	6.7
512.0	549.9	0.0261	1043.4	10371.3	36.61	449.546	104.3	0.0	0.0	5.4
513.0	550.0	0.0260	1044.5	10273.2	36.32	449.502	104.3	0.0	0.0	4.5
514.0	550.1	0.0260	1045.6	10189.6	36.07	449.473	104.3	0.0	0.0	3.7
515.0	550.3	0.0260	1046.6	10118.8	35.86	449.455	104.3	0.0	0.0	3.0
516.0	550.3	0.0260	1047.3	10081.2	35.75	449.390	104.3	0.0	0.0	2.7
517.0	550.4	0.0260	1048.2	10030.0	35.59	449.386	104.3	0.0	0.0	2.2
518.0	550.6	0.0260	1049.3	9985.9	35.46	449.385	104.3	0.0	0.0	1.7
519.0	550.6	0.0260	1049.8	9970.9	35.42	449.332	104.3	0.0	0.0	1.6
520.0	550.7	0.0260	1050.3	9960.8	35.39	449.281	104.3	0.0	0.0	1.5
521.0	550.8	0.0260	1051.4	9932.9	35.30	449.287	104.3	0.0	0.0	1.2
522.0	550.9	0.0259	1051.9	9930.1	35.29	449.238	104.3	0.0	0.0	1.1
523.0	551.0	0.0259	1053.0	9908.4	35.23	449.246	104.3	0.0	0.0	0.9
524.0	551.1	0.0259	1053.5	9910.4	35.23	449.198	104.3	0.0	0.0	0.9
525.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	104.3	0.0	0.0	0.4
529.0	551.6	0.0259	1057.8	9874.2	35.13	449.108	104.3	0.0	0.0	1.5
530.0	551.7	0.0259	1058.9	9881.3	35.08	449.134	104.3	0.0	0.0	0.3

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SURF BOIL TEMP	MAN RV FLOW LB/SEC	AUT RV FLOW LB/SEC	void fraction in pct
531.0	551.8	0.0258	1059.4	9869.9	35.11	449.031	104.3	0.0	0.0	0.4
532.0	551.9	0.0258	1060.5	9857.0	35.08	449.099	104.3	0.0	0.0	0.3
533.0	551.9	0.0258	1061.0	9867.6	35.11	449.054	104.3	0.0	0.0	0.4
534.0	552.1	0.0258	1062.1	9855.5	35.07	449.063	104.3	0.0	0.0	0.3
535.0	552.1	0.0258	1062.1	9898.3	35.17	448.961	104.3	0.0	0.0	0.6
536.0	552.3	0.0258	1063.2	9874.6	35.13	448.971	104.3	0.0	0.0	0.5
537.0	552.3	0.0258	1063.7	9886.7	35.16	448.933	104.3	0.0	0.0	0.6
538.0	552.4	0.0258	1064.8	9875.4	35.13	448.934	104.3	0.0	0.0	0.4
539.0	552.4	0.0258	1065.3	9895.9	35.16	448.897	104.3	0.0	0.0	0.6
540.0	552.6	0.0257	1066.4	9875.1	35.13	448.898	104.3	0.0	0.0	0.4
541.0	552.7	0.0257	1067.5	9863.0	35.09	448.906	104.3	0.0	0.0	0.3
542.0	552.8	0.0257	1068.0	9873.9	35.13	448.860	104.3	0.0	0.0	0.4
543.0	552.9	0.0257	1069.1	9862.0	35.09	448.869	104.3	0.0	0.0	0.3
544.0	552.9	0.0257	1069.6	9873.3	35.12	448.824	104.3	0.0	0.0	0.4
545.0	553.1	0.0257	1070.7	9861.8	35.09	448.834	104.3	0.0	0.0	0.2
546.0	553.1	0.0257	1071.2	9873.3	35.12	448.789	104.3	0.0	0.0	0.3
547.0	553.2	0.0257	1071.8	9883.4	35.15	448.741	104.3	0.0	0.0	0.5
548.0	553.3	0.0257	1072.3	9893.7	35.18	448.695	104.3	0.0	0.0	0.6
549.0	553.4	0.0256	1073.4	9882.8	35.15	448.705	104.3	0.0	0.0	0.4
550.0	553.4	0.0256	1073.9	9893.3	35.18	448.659	104.3	0.0	0.0	0.5
551.0	553.6	0.0256	1075.0	9882.7	35.15	448.671	104.3	0.0	0.0	0.4
552.0	553.6	0.0256	1075.6	9893.4	35.18	448.625	104.3	0.0	0.0	0.5
553.0	553.8	0.0256	1076.6	9881.6	35.15	448.634	104.3	0.0	0.0	0.4
554.0	553.9	0.0256	1077.7	9869.9	35.11	448.644	104.3	0.0	0.0	0.3
555.0	553.9	0.0256	1078.3	9881.1	35.15	448.599	104.3	0.0	0.0	0.4
556.0	554.1	0.0256	1079.3	9869.8	35.11	448.609	104.3	0.0	0.0	0.3
557.0	554.1	0.0256	1079.3	9902.5	35.21	448.509	104.3	0.0	0.0	0.6
558.0	554.2	0.0255	1080.4	9891.4	35.18	448.518	104.3	0.0	0.0	0.4
559.0	554.3	0.0255	1081.0	9901.6	35.21	448.473	104.3	0.0	0.0	0.5
560.0	554.4	0.0255	1082.1	9890.8	35.18	448.484	104.3	0.0	0.0	0.4
561.0	554.4	0.0255	1082.6	9901.3	35.21	448.438	104.3	0.0	0.0	0.5
562.0	554.6	0.0255	1083.7	9890.8	35.18	448.450	104.3	0.0	0.0	0.4
563.0	554.7	0.0255	1084.8	9879.0	35.14	448.460	104.3	0.0	0.0	0.3
564.0	554.8	0.0255	1085.3	9889.8	35.17	448.415	104.3	0.0	0.0	0.4
565.0	554.9	0.0255	1086.4	9878.3	35.14	448.425	104.3	0.0	0.0	0.2
566.0	554.9	0.0255	1086.4	9910.5	35.24	448.333	104.3	0.0	0.0	0.6
567.0	555.0	0.0254	1087.5	9899.2	35.20	448.335	104.3	0.0	0.0	0.4
568.0	555.1	0.0254	1088.1	9909.2	35.23	448.289	104.3	0.0	0.0	0.5
569.0	555.2	0.0254	1089.2	9895.3	35.20	448.301	104.3	0.0	0.0	0.4
570.0	555.3	0.0254	1089.7	9905.6	35.23	448.255	104.3	0.0	0.0	0.5
571.0	555.4	0.0254	1090.8	9896.6	35.19	448.265	104.3	0.0	0.0	0.4
572.0	555.5	0.0254	1091.9	9884.7	35.16	448.276	104.3	0.0	0.0	0.3
573.0	555.2	0.0254	1089.2	10017.5	35.56	447.878	104.3	0.0	438.6	1.7
574.0	554.9	0.0254	1086.4	10133.1	35.90	447.452	104.4	0.0	437.5	2.9
575.0	554.6	0.0254	1084.2	10209.7	36.13	447.043	104.4	0.0	436.6	3.8
576.0	554.4	0.0254	1082.1	10274.3	36.33	446.662	104.5	0.0	435.7	4.5
577.0	554.1	0.0253	1079.9	10327.4	36.48	446.251	104.6	0.0	434.8	5.1
578.0	553.9	0.0253	1077.7	10370.4	36.61	445.872	104.6	0.0	433.9	5.6
579.0	553.6	0.0253	1075.6	10404.5	36.71	445.409	104.7	0.0	433.0	6.1
580.0	553.4	0.0253	1073.9	10409.7	36.73	445.039	104.7	0.0	432.1	6.2
581.0	553.2	0.0253	1071.8	[illegible]	36.80	444.613	104.8	0.0	431.5	6.6
582.0	552.9	0.0253	1069.6	10450.0	36.85	444.183	104.9	0.0	430.6	6.3
583.0	552.5	0.0253	1068.0	10442.6	36.83	443.811	104.9	0.0	[illegible]	6.9
584.0	552.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	442.117	105.2	0.0	426.6	7.2
588.0	551.5	0.0252	1055.7	10474.9	36.80	441.781	105.2	0.0	[illegible]	7.[illegible]
589.0	551.4	0.0252	1056.7	10415.[illegible]	36.75	441.405	105.3	0.0	425	7.3

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[illegible] 8/15/86

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID MLB	SUPP POOL TEMP	MAN RV FLOW LB/SEC	AUT RV FLOW LB/SEC	~~[illegible] FLOW [illegible]~~ void fraction in pct
590.0	551.2	0.0252	1054.6	10418.9	36.76	440.927	105.3	0.0	424.4	7.5
591.0	551.0	0.0252	1052.0	10395.5	36.70	440.611	105.4	0.0	423.6	7.4
592.0	550.8	0.0252	1050.9	10400.7	36.70	440.187	105.5	0.0	422.9	7.5
593.0	550.6	0.0252	1049.3	10379.6	36.64	439.816	105.5	0.0	422.0	7.5
594.0	550.3	0.0252	1047.2	10359.1	36.64	439.[illegible]	105.[illegible]	0.0	421.4	7.6
595.0	550.1	0.0252	1045.4	10346.9	36.58	439.126	105.6	0.0	420.7	7.5
596.0	549.9	0.0252	1043.4	10321.[illegible]	36.53	438.[illegible]	105.7	0.0	419.8	7.6
597.0	549.7	0.0251	1041.9	10321.4	36.52	438.[illegible]	105.7	0.0	419.3	7.[illegible]
598.0	549.7	0.0251	1041.9	10355.2	36.57	438.075	105.8	0.0	0.0	6.8
599.0	549.9	0.0251	1043.4	10119.7	35.26	438.024	105.8	0.0	0.0	5.5
600.0	549.4	0.0251	1079.3	10237.1	36.31	437.425	105.9	1255.3	0.0	6.8
601.0	548.4	0.0251	1030.5	10504.6	37.01	436.344	106.0	1243.0	0.0	9.6
602.0	547.4	0.0251	1022.4	10777.3	37.71	435.307	106.2	1237.7	0.0	11.9
603.0	546.5	0.0251	1015.2	10894.9	38.12	434.144	106.4	1228.5	0.0	13.5
604.0	545.6	0.0251	1007.9	11025.4	38.57	433.085	106.6	1219.3	0.0	14.8
605.0	544.6	0.0251	1001.2	11110.0	38.82	432.012	106.7	1210.4	0.0	15.5
606.0	543.9	0.0251	994.1	11192.6	39.09	430.904	106.9	1201.6	0.0	16.8
607.0	543.1	0.0250	987.0	11272.7	39.31	429.795	107.1	1193.9	0.0	17.6
608.0	542.3	0.0250	980.9	11294.5	39.35	428.786	107.2	1185.1	0.0	18.0
609.0	541.5	0.0250	974.3	11310.7	39.41	427.729	107.4	1176.9	0.0	18.5
610.0	540.7	0.0250	967.8	11325.0	39.45	426.671	107.6	1168.8	0.0	18.9
611.0	539.9	0.0250	961.3	11332.1	39.51	425.617	107.7	1160.7	0.0	19.3
612.0	539.1	0.0250	954.9	11347.5	39.52	424.569	107.9	1153.3	0.0	19.6
613.0	538.3	0.0250	948.9	11330.4	39.45	423.572	108.0	1145.3	0.0	19.7
614.0	537.5	0.0250	942.6	11319.2	39.45	422.530	108.2	1137.3	0.0	20.0
615.0	536.7	0.0250	936.2	11312.2	39.47	421.493	108.4	1129.0	0.0	20.2
616.0	535.9	0.0250	930.4	11292.5	39.34	420.510	108.5	1121.2	0.0	20.3
617.0	535.1	0.0250	924.1	11275.5	39.32	419.482	108.7	1114.9	0.0	20.5
618.0	534.4	0.0249	918.7	11242.8	39.22	418.507	108.8	1107.2	0.0	20.6
619.0	533.6	0.0249	912.5	11210.6	39.12	417.539	109.0	1100.0	0.0	20.6
620.0	532.8	0.0249	906.7	11203.4	39.10	416.537	109.1	1092.9	0.0	20.8
621.0	532.1	0.0249	900.6	11170.5	39.00	415.565	109.3	1085.3	0.0	20.9
622.0	531.3	0.0249	895.0	11135.7	38.91	414.610	109.4	1078.2	0.0	20.9
623.0	530.6	0.0249	889.3	11108.3	38.82	413.660	109.6	1071.2	0.0	21.0
624.0	529.8	0.0249	883.7	11078.5	38.73	412.714	109.7	1064.3	0.0	21.0
625.0	529.0	0.0249	877.6	11073.8	38.72	411.723	109.9	1056.8	0.0	21.2
626.0	528.3	0.0249	872.1	11044.0	38.63	410.783	110.0	1049.9	0.0	21.3
627.0	527.5	0.0249	866.6	11015.3	38.54	409.848	110.2	1043.1	0.0	21.4
628.0	526.8	0.0249	861.0	10987.7	38.46	408.917	110.3	1036.3	0.0	21.4
629.0	526.0	0.0248	855.6	10961.2	38.38	407.991	110.5	1029.5	0.0	21.5
630.0	525.3	0.0248	850.1	10935.6	38.30	407.069	110.6	1022.8	0.0	21.6
631.0	524.6	0.0248	845.1	10887.8	38.16	406.200	110.7	1016.7	0.0	21.5
632.0	523.8	0.0248	839.7	10866.9	38.10	405.290	110.9	1010.0	0.0	21.6
633.0	523.1	0.0248	834.3	10846.6	38.04	404.382	111.0	1003.4	0.0	21.7
634.0	522.3	0.0248	829.0	10826.9	37.98	403.477	111.2	996.5	0.0	21.8
635.0	521.6	0.0248	824.1	10783.9	37.85	402.623	111.3	990.2	0.0	21.7
636.0	520.9	0.0248	818.5	10767.6	37.80	401.727	111.4	984.3	0.0	21.8
637.0	520.2	0.0248	814.0	10726.5	37.68	400.879	111.6	977.8	0.0	21.8
638.0	519.4	0.0248	808.7	10713.2	37.64	399.993	111.7	971.9	0.0	21.9
639.0	518.8	0.0248	803.9	10674.8	37.52	399.152	111.8	965.5	0.0	21.9
640.0	518.0	0.0247	798.7	10664.1	37.49	398.273	112.0	959.6	0.0	22.1
641.0	517.3	0.0247	794.0	10627.7	37.38	397.440	112.1	953.3	0.0	22.0
642.0	516.6	0.0247	788.8	10619.1	37.35	396.567	112.2	947.5	0.0	22.2
643.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

647.0	513.?	0.0247	765.1	10470.?	36.97	392.475	112.9	919.5	0.0	22.5
648.0	512.4	0.0247	761.8	10462.0	36.89	392.228	113.0	912.9		22.5

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAX FW FLOW LB/SEC	AUT FW FLOW LB/SEC	~~(struck-through heading)~~ void fraction in percent
649.0	511.7	0.0247	755.5	10452.4	36.81	391.827	113.2	906.5	0.0	22.5
650.0	511.0	0.0247	751.2	10413.3	36.74	390.102	113.3	901.2	0.0	22.6
651.0	510.3	0.0246	746.8	10389.4	36.67	389.374	113.4	895.7	0.0	22.6
652.0	509.6	0.0246	742.3	10366.8	36.60	388.431	113.5	890.2	0.0	22.7
653.0	508.9	0.0246	737.8	10346.7	36.54	387.641	113.6	885.2	0.0	22.7
654.0	508.3	0.0246	733.3	10327.6	36.48	386.854	113.8	879.8	0.0	22.8
655.0	507.6	0.0246	728.9	10309.5	36.43	386.071	113.9	874.6	0.0	22.9
656.0	506.9	0.0246	724.2	10285.7	36.30	385.331	114.0	869.9	0.0	22.8
657.0	506.3	0.0246	720.4	10251.?	36.25	384.554	114.1	863.6	0.0	22.9
658.0	505.6	0.0246	716.0	10238.2	36.21	383.778	114.3	858.3	0.0	23.0
659.0	504.9	0.0246	711.7	10222.0	36.17	383.007	114.4	853.5	0.0	23.1
660.0	504.3	0.0246	707.7	10182.4	36.05	382.280	114.5	848.2	0.0	23.0
661.0	503.6	0.0246	703.4	10171.3	36.01	381.514	114.6	843.0	0.0	23.2
662.0	502.9	0.0245	699.4	10134.7	35.91	380.797	114.7	838.2	0.0	23.1
663.0	502.3	0.0245	695.1	10126.2	35.85	380.034	114.8	833.0	0.0	23.3
664.0	501.6	0.0245	690.9	10119.1	35.84	379.279	114.9	828.3	0.0	23.4
665.0	500.9	0.0245	687.0	10084.5	35.76	378.524	115.1	823.0	0.0	23.4
666.0	500.3	0.0245	683.1	10052.9	35.66	377.855	115.2	818.4	0.0	23.3
667.0	499.6	0.0245	678.9	10049.0	35.65	377.107	115.3	813.3	0.0	23.5
668.0	499.0	0.0245	675.1	10018.8	35.56	376.403	115.4	808.6	0.0	23.3
669.0	498.4	0.0245	671.3	9990.8	35.48	375.702	115.5	803.9	0.0	23.5
670.0	497.8	0.0245	667.5	9963.2	35.39	375.003	115.6	798.9	0.0	23.5
671.0	497.1	0.0245	663.4	9964.9	35.40	374.268	115.7	794.3	0.0	23.7
672.0	496.4	0.0245	659.6	9939.6	35.32	373.574	115.8	789.7	0.0	23.7
673.0	495.8	0.0245	655.9	9916.0	35.35	372.884	116.0	785.2	0.0	23.7
674.0	495.1	0.0244	651.8	9921.4	35.27	372.158	116.1	780.7	0.0	24.0
675.0	494.5	0.0244	648.1	9899.4	35.30	371.472	116.2	776.2	0.0	24.0
676.0	493.9	0.0244	644.4	9878.7	35.14	370.789	116.3	771.7	0.0	24.1
677.0	493.3	0.0244	640.7	9859.3	35.05	370.108	116.4	767.3	0.0	24.1
678.0	492.6	0.0244	637.1	9841.0	35.03	369.431	116.5	762.9	0.0	24.2
679.0	492.0	0.0244	633.4	9823.7	34.98	368.755	116.6	758.4	0.0	24.2
680.0	491.4	0.0244	629.8	9807.4	34.93	368.082	116.7	754.1	0.0	24.3
681.0	490.8	0.0244	626.3	9764.0	34.80	367.449	116.8	745.7	0.0	24.1
682.0	490.2	0.0244	622.7	9780.3	34.76	366.781	116.9	745.6	0.0	24.2
683.0	489.6	0.0244	619.4	9738.1	34.73	366.117	117.0	741.1	0.0	24.3
684.0	488.9	0.0244	615.8	9726.2	34.68	365.453	117.1	736.8	0.0	24.4
685.0	488.3	0.0244	612.3	9715.9	34.65	364.794	117.2	733.9	0.0	24.5
686.0	487.8	0.0243	609.1	9677.7	34.54	364.172	117.3	728.7	0.0	24.4
687.0	487.1	0.0243	605.6	9669.5	34.51	363.517	117.4	724.4	0.0	24.5
688.0	486.6	0.0243	602.4	9633.1	34.41	362.899	117.5	720.2	0.0	24.4
689.0	485.9	0.0243	598.9	9627.9	34.39	362.283	117.6	716.4	0.0	24.6
690.0	485.3	0.0243	595.4	9622.9	34.37	361.601	117.7	712.3	0.0	24.7
691.0	484.8	0.0243	591.3	9590.4	34.29	360.991	117.8	708.5	0.0	24.7
692.0	484.1	0.0243	588.9	9587.8	34.27	360.347	117.9	704.4	0.0	24.8
693.0	483.6	0.0243	585.5	9553.5	34.18	359.742	118.0	700.7	0.0	24.8
694.0	483.0	0.0243	582.7	9528.1	34.09	359.138	118.1	696.7	0.0	24.7
695.0	482.4	0.0243	579.3	9525.8	34.10	358.503	118.2	693.0	0.0	24.9
696.0	481.8	0.0243	576.3	9502.1	34.01	357.908	118.3	689.0	0.0	24.9
697.0	481.2	0.0243	572.9	9505.4	34.03	357.371	118.4	685.3	0.0	25.1
698.0	480.6	0.0242	569.9	9480.2	33.95	356.676	118.5	681.7	0.0	25.0
699.0	480.1	0.0242	566.8	9455.5	33.87	356.082	118.6	677.7	0.0	25.0
700.0	479.5	0.0242	563.8	9433.5	33.81	355.491	118.7	674.2	0.0	25.2
701.0	478.9	0.0242	560.5	9440.5	33.82	354.868	118.8	671.6	0.0	25.3
702.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT^3	REAC LEVEL FT	REAC LIQUID MLB	SUMP FLD TEMP	MASS OF FLOW LB/SEC	[illegible] FLOW LB/SEC	[illegible] (void fraction in percent)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.3
706.0	476.1	0.0242	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.3
707.0	475.9	0.0242	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.2
708.0	474.9	0.0242	541.1	9314.2	33.45	350.811	119.4	625.2	0.0	25.4
709.0	474.4	0.0242	537.1	9300.5	33.41	350.330	119.3	642.4	0.0	25.5
710.0	473.8	0.0242	534.2	9285.0	33.37	349.589	119.6	635.0	0.0	25.6
711.0	473.3	0.0241	531.3	9276.1	33.34	349.089	119.7	633.6	0.0	25.6
712.0	472.7	0.0241	528.5	9266.1	33.31	348.574	119.5	631.6	0.0	25.7
713.0	472.1	0.0241	525.6	9256.9	33.28	347.959	119.8	627.2	0.0	25.8
714.0	471.6	0.0241	522.8	9248.2	33.25	347.396	119.9	625.8	0.0	25.9
715.0	471.1	0.0241	520.3	9209.9	33.14	346.867	120.0	622.5	0.0	25.7
716.0	470.5	0.0241	517.5	9203.3	33.12	346.307	120.1	617.2	0.0	25.8
717.0	469.9	0.0241	514.7	9192.4	33.10	345.751	120.2	616.2	0.0	26.0
718.0	469.4	0.0241	512.2	9163.6	33.00	345.227	120.3	613.0	0.0	25.8
719.0	468.9	0.0241	509.4	9160.5	32.99	344.674	120.4	609.7	0.0	26.0
720.0	468.3	0.0241	506.6	9158.9	32.99	344.122	120.4	606.8	0.0	26.1
721.0	467.8	0.0241	504.2	9126.7	32.89	343.604	120.5	603.5	0.0	26.0
722.0	467.3	0.0241	501.4	9126.3	32.89	343.055	120.6	600.3	0.0	26.2
723.0	466.8	0.0240	499.0	9096.2	32.80	342.540	120.7	597.4	0.0	26.1
724.0	466.2	0.0240	496.3	9098.0	32.80	341.995	120.8	594.2	0.0	26.3
725.0	465.7	0.0240	493.9	9070.0	32.72	341.484	120.9	591.3	0.0	26.2
726.0	465.1	0.0240	491.2	9073.7	32.73	340.943	120.9	588.1	0.0	26.4
727.0	464.6	0.0240	488.8	9047.3	32.65	340.434	121.0	585.3	0.0	26.3
728.0	464.1	0.0240	486.1	9052.7	32.67	339.896	121.1	582.1	0.0	26.5
729.0	463.6	0.0240	483.7	9027.6	32.59	339.390	121.2	579.3	0.0	26.4
730.0	463.1	0.0240	481.4	9004.4	32.52	338.898	121.3	576.5	0.0	26.4
731.0	462.5	0.0240	478.7	9013.0	32.55	338.354	121.3	573.3	0.0	26.6
732.0	462.0	0.0240	476.4	8990.9	32.48	337.854	121.4	570.6	0.0	26.6
733.0	461.5	0.0240	474.0	8970.3	32.42	337.356	121.5	567.8	0.0	26.6
734.0	460.9	0.0240	471.4	8983.8	32.46	336.829	121.6	565.0	0.0	26.8
735.0	460.4	0.0240	469.1	8963.0	32.40	336.333	121.6	562.0	0.0	26.8
736.0	459.9	0.0239	466.9	8944.5	32.35	335.837	121.7	559.2	0.0	26.8
737.0	459.4	0.0239	464.5	8927.2	32.29	335.345	121.8	556.5	0.0	26.8
738.0	458.9	0.0239	462.2	8911.4	32.25	334.854	121.9	553.8	0.0	26.8
739.0	458.4	0.0239	459.9	8896.8	32.20	334.366	122.0	551.1	0.0	26.8
740.0	457.9	0.0239	457.6	8883.4	32.16	333.879	122.0	548.4	0.0	26.9
741.0	457.4	0.0239	455.3	8871.3	32.13	333.394	122.1	545.8	0.0	26.9
742.0	456.9	0.0239	453.1	8860.2	32.09	332.910	122.2	543.1	0.0	26.9
743.0	456.4	0.0239	450.8	8850.1	32.06	332.427	122.3	540.4	0.0	27.0
744.0	455.9	0.0239	448.6	8840.6	32.03	331.946	122.3	537.9	0.0	27.1
745.0	455.4	0.0239	446.4	8833.0	32.01	331.465	122.4	535.2	0.0	27.1
746.0	454.9	0.0239	444.1	8824.0	31.99	330.986	122.5	533.6	0.0	27.2
747.0	454.4	0.0239	441.9	8816.5	31.96	330.508	122.5	529.9	0.0	27.3
748.0	453.9	0.0239	439.7	8809.5	31.94	330.031	122.6	527.4	0.0	27.4
749.0	453.4	0.0239	437.5	8802.9	31.92	329.554	122.7	524.8	0.0	27.4
750.0	453.0	0.0238	435.6	8765.4	31.81	329.111	122.8	522.5	0.0	27.3
751.0	452.5	0.0238	433.4	8762.3	31.80	328.640	122.8	520.0	0.0	27.4
752.0	452.0	0.0238	431.2	8759.4	31.79	328.170	122.9	517.4	0.0	27.5
753.0	451.5	0.0238	429.1	8757.0	31.78	327.700	123.0	514.9	0.0	27.6
754.0	451.1	0.0238	427.2	8723.1	31.68	327.262	123.0	512.6	0.0	27.4
755.0	450.6	0.0238	425.0	8722.5	31.68	326.796	123.1	510.1	0.0	27.6
756.0	450.1	0.0238	422.9	8724.1	31.69	326.330	123.2	507.6	0.0	27.7
757.0	449.6	0.0238	421.0	8693.9	31.59	325.895	123.3	505.4	0.0	27.6
758.0	449.1	0.0238	418.9	8695.5	31.60	325.433	123.3	502.9	0.0	27.8
759.0	448.7	0.0238	417.0	8665.7	31.51	325.001	123.4	500.5	0.0	27.6
760.0	448.2	0.0238	414.9	8670.7	31.52	324.541	123.5	497.7	0.0	27.8
761.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28.0
765.0	445.9	0.0237	405.2	8600.2	31.31	322.749	123.7	487.[illegible]	[illegible]	[illegible]
766.0	445.4	0.0237	403.4	8588.2	31.27	321.[illegible]	123.8	484.[illegible]	[illegible]	[illegible]

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MODEL TIME SEC	RE-D TEMP F	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID MASS	REAC LEVEL FT	REAC LIQUID LB	SUPP POOL TEMP	MAN RX FLOW LB/SEC	AUT RX FLOW LB/SEC	~~[illegible]~~
767.0	444.9	0.0237	401.4	8597.5	31.27	321.476	123.9	482.5	0.0	28.1
768.0	444.5	0.0237	399.6	8575.7	31.19	321.054	124.0	480.1	0.0	28.1
769.0	444.0	0.0237	397.5	8585.8	31.24	320.606	124.1	478.0	0.0	28.2
770.0	443.6	0.0237	395.7	8566.8	31.17	320.187	124.1	475.9	0.0	28.2
771.0	443.1	0.0237	393.9	8550.2	31.11	319.770	124.2	473.8	0.0	28.2
772.0	442.7	0.0237	392.1	8533.1	31.04	319.357	124.3	471.4	0.0	28.1
773.0	442.2	0.0237	390.3	8547.1	31.10	318.910	124.3	469.3	0.0	28.4
774.0	441.8	0.0237	388.4	8533.3	31.04	318.491	124.4	467.3	0.0	28.4
775.0	441.3	0.0237	386.6	8517.1	30.99	318.057	124.5	465.0	0.0	28.4
776.0	440.9	0.0237	384.9	8503.0	30.94	317.672	124.5	463.2	0.0	28.4
777.0	440.4	0.0236	383.3	8489.1	30.89	317.261	124.6	460.8	0.0	28.4
778.0	440.0	0.0236	381.4	8476.1	30.85	316.851	124.6	458.8	0.0	28.4
779.0	439.6	0.0236	379.7	8464.1	30.81	316.442	124.7	456.8	0.0	28.4
780.0	439.1	0.0236	378.0	8453.3	30.77	316.035	124.8	454.7	0.0	28.4
781.0	438.7	0.0236	376.3	8443.3	30.74	315.630	124.8	452.7	0.0	28.4
782.0	438.3	0.0236	374.5	8434.4	30.70	315.225	124.9	450.7	0.0	28.5
783.0	437.8	0.0236	372.8	8426.3	30.68	314.821	125.0	448.7	0.0	28.5
784.0	437.4	0.0236	371.1	8419.0	30.65	314.418	125.0	446.7	0.0	28.6
785.0	436.9	0.0236	369.5	8412.4	30.63	314.016	125.1	444.7	0.0	28.6
786.0	436.5	0.0236	367.8	8406.4	30.61	313.615	125.1	442.8	0.0	28.7
787.0	436.1	0.0236	366.1	8400.9	30.59	313.214	125.2	440.8	0.0	28.8
788.0	435.6	0.0236	364.4	8396.9	30.57	312.817	125.3	439.1	0.0	28.8
789.0	435.2	0.0236	362.7	8393.7	30.56	312.420	125.3	437.2	0.0	28.9
790.0	434.8	0.0236	361.1	8391.0	30.55	312.023	125.4	435.2	0.0	29.0
*** TOP OF FUEL UNCOVERED AT 791 SEC. LEV= 30.4282 FT										
791.0	434.4	0.0236	359.7	8353.9	30.43	311.653	125.4	433.3	0.0	28.8
792.0	433.9	0.0235	358.0	8352.9	30.42	311.252	125.5	431.4	0.0	28.9
793.0	433.5	0.0235	356.4	8353.4	30.43	310.866	125.6	429.7	0.0	29.0
794.0	433.1	0.0235	354.7	8354.4	30.43	310.474	125.6	427.8	0.0	29.2
795.0	432.7	0.0235	353.3	8320.6	30.32	310.107	125.7	425.9	0.0	29.0
796.0	432.3	0.0235	351.7	8323.0	30.33	309.717	125.7	424.0	0.0	29.1
797.0	431.8	0.0235	350.1	8326.4	30.34	309.328	125.8	422.4	0.0	29.2
798.0	431.4	0.0235	348.7	8295.0	30.23	308.965	125.8	420.5	0.0	29.1
799.0	431.0	0.0235	347.0	8299.7	30.25	308.578	125.9	418.6	0.0	29.2
800.0	430.6	0.0235	345.7	8270.2	30.15	308.217	126.0	417.0	0.0	29.1
801.0	430.2	0.0235	344.1	8277.2	30.17	307.833	126.0	415.1	0.0	29.2
802.0	429.8	0.0235	342.5	8285.2	30.20	307.449	126.1	413.6	0.0	29.4
803.0	429.4	0.0235	341.1	8257.7	30.11	307.090	126.1	411.7	0.0	29.3
804.0	428.9	0.0235	339.5	8267.4	30.14	306.709	126.2	410.1	0.0	29.5
805.0	428.6	0.0235	338.2	8241.5	30.05	306.352	126.2	408.3	0.0	29.3
806.0	428.1	0.0234	336.6	8252.8	30.09	305.973	126.3	406.7	0.0	29.6
807.0	427.8	0.0234	335.2	8228.4	30.01	305.617	126.4	404.9	0.0	29.4
808.0	427.3	0.0234	333.8	8233.2	29.99	305.252	126.4	403.3	0.0	29.5
809.0	427.0	0.0234	332.4	8200.9	29.92	304.900	126.5	401.7	0.0	29.4
810.0	426.5	0.0234	330.9	8215.3	29.96	304.533	126.5	399.8	0.0	29.6
811.0	426.2	0.0234	329.5	8193.9	29.89	304.172	126.6	398.3	0.0	29.6
812.0	425.7	0.0234	328.0	8210.0	29.95	303.798	126.6	396.8	0.0	29.8
813.0	425.3	0.0234	326.7	8189.8	29.88	303.447	126.7	395.0	0.0	29.7
814.0	425.0	0.0234	325.4	8170.6	29.81	303.099	126.7	393.5	0.0	29.7
815.0	424.6	0.0234	324.0	8152.9	29.75	302.752	126.8	391.9	0.0	29.6
816.0	424.2	0.0234	322.5	8173.0	29.82	302.381	126.8	390.2	0.0	29.9
817.0	423.8	0.0234	321.3	8155.0	29.76	302.035	126.9	388.7	0.0	29.8
818.0	423.4	0.0234	319.9	8139.0	29.71	301.690	126.9	387.3	0.0	29.8
819.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

void fraction input

823.0	421.5	0.0233	313.3	8113.5	29.51	297.957	127.2	377.3	[illegible]	[illegible]
824.0	421.1	0.0233	312.6	8099.9	29.55	299.617	127.3	378.?	[illegible]	30.0
825.0	420.7	0.0233	310.7	8089.7	29.54	299.273	127.3	376.2	[illegible]	[illegible]

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAN FW FLOW LB/SEC	~~[illegible] FLOW [illegible]~~	INJEC FLOW LB/SEC
826.0	420.3	0.0233	309.4	8080.4	29.51	298.940	127.4	375.1	~~0.0~~	30.0
827.0	420.0	0.0233	308.2	8072.0	29.48	298.623	127.4	373.6	~~0.0~~	30.1
828.0	419.6	0.0233	306.9	8064.5	29.46	298.267	127.5	372.2	~~0.0~~	30.1
829.0	419.2	0.0233	305.6	8075.9	29.50	297.915	127.5	371.6	~~0.0~~	30.3
830.0	418.8	0.0233	304.3	8068.7	29.47	297.533	127.6	369.1	~~0.0~~	30.3
831.0	418.4	0.0233	303.1	8062.1	29.45	297.248	127.6	367.7	~~0.0~~	30.3
832.0	418.1	0.0233	301.8	8055.9	29.43	296.913	127.7	366.3	~~0.0~~	30.4
833.0	417.7	0.0233	300.6	8050.3	29.41	296.580	127.7	364.9	~~0.0~~	30.4
834.0	417.3	0.0233	299.3	8045.2	29.37	296.247	127.8	363.5	~~0.0~~	30.5
835.0	417.0	0.0233	298.2	8033.4	29.32	295.929	127.8	362.1	~~0.0~~	30.4
836.0	416.6	0.0233	297.0	8019.5	29.31	295.598	127.9	360.7	~~0.0~~	30.4
837.0	416.2	0.0232	295.8	8015.5	29.29	295.273	127.9	359.3	30.5	6.1
838.0	415.8	0.0232	294.5	8007.1	29.26	294.943	128.0	357.8	30.5	16.2
839.0	415.5	0.0232	293.3	7995.3	29.23	294.666	128.0	356.4	30.5	26.1
840.0	415.1	0.0232	292.1	7980.9	29.18	294.383	128.1	355.0	30.4	36.0
841.0	414.7	0.0232	290.9	7964.4	29.12	294.113	128.1	353.6	30.4	45.7
842.0	414.3	0.0232	289.6	7965.0	29.12	293.846	128.2	352.2	30.4	55.4
843.0	413.9	0.0232	288.4	7944.4	29.05	293.603	128.2	350.7	30.3	65.7
844.0	413.5	0.0232	287.1	7940.7	29.04	293.361	128.2	349.1	30.4	75.9
845.0	413.1	0.0232	285.7	7954.2	29.09	293.122	128.3	347.7	30.6	85.2
846.0	412.7	0.0232	284.5	7926.8	28.99	292.917	128.3	346.1	30.4	96.0
847.0	412.3	0.0232	283.1	7936.2	29.03	292.704	128.4	344.7	30.5	105.1
848.0	411.9	0.0232	281.9	7904.9	28.92	292.525	128.4	343.1	30.3	115.6
849.0	411.5	0.0232	280.6	7909.8	28.94	292.337	128.5	341.5	30.4	126.0
850.0	411.0	0.0232	279.2	7913.2	28.95	292.162	128.5	340.1	30.5	134.9
851.0	410.6	0.0232	277.8	7877.5	28.83	292.097	128.6	338.6	30.2	213.8
852.0	410.1	0.0231	276.3	7884.2	28.85	292.017	128.6	336.8	30.3	225.4
853.0	409.7	0.0231	275.1	7860.7	28.77	291.964	128.7	335.2	30.1	235.2
854.0	409.3	0.0231	274.0	7842.5	28.71	291.922	128.7	333.1	30.0	244.1
855.0	408.8	0.0231	272.5	7843.7	28.72	291.880	128.8	331.5	30.0	253.1
856.0	408.4	0.0231	271.7	7821.1	28.64	291.863	128.8	329.7	29.9	261.7
857.0	408.0	0.0231	270.4	7819.5	28.63	291.844	128.8	328.1	29.9	270.2
858.0	407.6	0.0231	269.2	7816.3	28.62	291.837	128.9	326.3	29.9	278.9
859.0	407.1	0.0231	268.0	7812.5	28.61	291.842	128.9	324.7	29.9	286.9
860.0	406.7	0.0231	266.8	7807.6	28.60	291.858	129.0	323.0	29.9	295.4
861.0	406.2	0.0231	265.5	7824.4	28.65	291.873	129.0	321.3	30.0	304.0
862.0	405.8	0.0231	264.3	7817.0	28.63	291.910	129.1	319.6	30.0	312.4
863.0	405.3	0.0231	263.1	7808.5	28.60	291.959	129.1	318.0	29.9	320.9
864.0	404.9	0.0231	261.9	7799.3	28.57	292.018	129.2	316.3	29.9	329.2
865.0	404.5	0.0231	260.6	7789.7	28.53	292.088	129.2	314.6	29.8	338.1
866.0	404.0	0.0231	259.4	7776.6	28.49	292.169	129.2	312.9	29.7	347.0
867.0	403.6	0.0231	258.1	7787.1	28.53	292.249	129.3	311.3	29.8	355.2
868.0	403.1	0.0230	256.9	7772.5	28.48	292.351	129.3	309.6	29.7	364.0
869.0	402.7	0.0230	255.6	7780.7	28.50	292.452	129.4	308.0	29.7	372.2
870.0	402.2	0.0230	254.3	7787.3	28.53	292.563	129.4	306.4	29.8	380.9
871.0	401.7	0.0230	253.0	7793.0	28.55	292.686	129.4	304.9	29.9	388.9
872.0	401.3	0.0230	251.7	7777.0	28.56	292.818	129.5	303.2	29.9	397.5
873.0	400.8	0.0230	250.5	7776.5	28.49	292.975	129.5	301.7	29.7	405.5
874.0	400.3	0.0230	249.2	7778.6	28.50	293.129	129.6	300.0	29.7	414.6
875.0	399.9	0.0230	247.9	7779.2	28.50	293.293	129.6	298.5	29.7	423.0
876.0	399.4	0.0230	246.6	7778.6	28.50	293.463	129.6	296.9	29.7	431.4
877.0	398.9	0.0230	245.3	7776.5	28.49	293.654	129.7	295.4	29.7	439.8
878.0	398.4	0.02??	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

void fraction input

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAN. RA FLOW LB/SEC	~~[illegible]~~ void fraction in pct	INJEC FLOW LB/SEC
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475.4
882.0	396.5	[illegible]	[illegible]	[illegible]	28.54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
883.0	[illegible]	[illegible]	[illegible]	[illegible]	28.54	[illegible]	[illegible]	286.4	[illegible]	485.0
884.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
885.0	395.1	0.0229	234.6	7798.0	28.56	295.464	130.0	283.4	29.7	501.9
886.0	394.6	0.0229	233.7	7787.8	28.53	295.735	130.0	281.9	29.5	509.0
887.0	394.1	0.0229	231.7	7803.4	28.58	296.003	130.1	280.5	29.6	515.7
888.0	393.7	0.0229	230.6	7791.8	28.54	296.291	130.1	279.1	29.5	522.8
889.0	393.2	0.0229	229.2	7806.3	28.59	296.576	130.2	277.7	29.6	529.4
890.0	392.7	0.0229	227.9	7797.5	28.55	296.881	130.2	276.3	29.4	536.5
891.0	392.2	0.0229	226.6	7807.3	28.59	297.183	130.2	275.0	29.5	543.1
892.0	391.7	0.0229	225.2	7820.1	28.64	297.492	130.3	273.5	29.6	550.0
893.0	391.2	0.0229	223.9	7805.3	28.59	297.822	130.3	272.1	29.4	556.5
894.0	390.7	0.0229	222.5	7817.7	28.63	298.147	130.3	270.9	29.5	562.7
895.0	390.2	0.0229	221.1	7829.4	28.67	298.480	130.4	269.5	29.5	569.2
896.0	389.7	0.0229	219.8	7823.5	28.65	298.829	130.4	268.1	29.4	575.7
897.0	389.2	0.0229	218.5	7808.4	28.60	299.173	130.4	266.6	29.2	581.7
898.0	388.7	0.0229	217.1	7822.9	28.65	299.550	130.5	265.1	29.3	587.6
899.0	388.2	0.0229	215.9	7814.3	28.62	299.926	130.5	263.5	29.2	593.9
900.0	387.7	0.0229	214.6	7807.9	28.60	300.308	130.6	262.0	29.0	599.8
901.0	387.2	0.0228	213.3	7803.5	28.58	300.699	130.6	260.6	28.9	605.6
902.0	386.7	0.0228	212.0	7825.8	28.66	301.093	130.6	259.0	29.1	611.7
903.0	386.2	0.0228	210.8	7822.6	28.65	301.487	130.7	257.5	29.0	617.5
904.0	385.7	0.0228	209.5	7820.5	28.64	301.897	130.7	256.1	28.9	622.9
905.0	385.2	0.0228	208.3	7819.8	28.63	302.314	130.7	254.6	28.8	628.3
906.0	384.7	0.0228	207.0	7819.8	28.64	302.738	130.8	253.2	28.7	633.6
907.0	384.1	0.0228	205.7	7846.5	28.73	303.156	130.8	251.7	28.9	639.2
908.0	383.6	0.0228	204.5	7842.9	28.72	303.592	130.8	250.2	28.8	644.5
909.0	383.1	0.0228	203.3	7847.7	28.73	304.035	130.9	248.8	28.7	649.7
910.0	382.6	0.0228	202.1	7849.3	28.73	304.484	130.9	247.4	28.7	654.9
911.0	382.1	0.0228	200.9	7851.6	28.74	304.940	130.9	246.0	28.6	660.1
912.0	381.6	0.0228	199.7	7854.9	28.75	305.402	131.0	244.6	28.5	665.2
913.0	381.1	0.0228	198.5	7858.9	28.77	305.870	131.0	243.1	28.5	670.3
914.0	380.6	0.0228	197.3	7863.8	28.78	306.345	131.0	241.7	28.5	675.4
915.0	380.1	0.0228	196.2	7869.6	28.80	306.825	131.1	240.3	28.4	680.4
916.0	379.6	0.0228	194.9	7903.6	28.92	307.299	131.1	238.8	28.6	685.7
917.0	379.1	0.0228	193.7	7908.9	28.94	307.790	131.1	237.4	28.6	690.4
918.0	378.6	0.0227	192.6	7914.6	28.95	308.286	131.2	236.0	28.6	695.1
919.0	378.1	0.0227	191.5	7891.5	28.88	308.801	131.2	234.6	28.3	699.8
920.0	377.6	0.0227	190.3	7900.4	28.91	309.310	131.2	233.3	28.2	704.2
921.0	377.1	0.0227	189.2	7910.4	28.94	309.825	131.3	232.0	28.2	702.8
922.0	376.6	0.0227	188.1	7921.3	28.98	310.345	131.3	230.6	28.2	713.3
923.0	376.1	0.0227	186.9	7932.9	29.02	310.870	131.3	229.3	28.2	717.9
924.0	375.6	0.0227	185.8	7945.3	29.06	311.399	131.3	227.9	28.3	722.4
925.0	375.1	0.0227	184.7	7958.0	29.10	311.934	131.4	226.6	28.3	726.9
926.0	374.6	0.0227	183.5	7971.2	29.14	312.475	131.4	225.2	28.3	731.4
927.0	374.2	0.0227	182.5	7958.1	29.09	313.032	131.4	224.0	28.0	735.5
928.0	373.7	0.0227	181.4	7971.1	29.14	313.584	131.5	222.6	28.1	739.9
929.0	373.2	0.0227	180.3	7988.0	29.20	314.179	131.5	221.3	28.1	744.3
930.0	372.7	0.0227	179.3	7973.9	29.15	314.712	131.5	220.0	27.9	748.7
931.0	372.2	0.0227	178.2	7997.2	29.22	315.279	131.6	218.8	28.0	752.7
932.0	371.7	0.0227	177.1	8013.3	29.29	315.845	131.6	217.5	28.0	756.9
933.0	371.2	0.0227	176.1	8002.1	29.25	316.476	131.6	216.2	27.8	760.9
934.0	370.7	0.0227	175.0	8024.7	29.33	317.017	131.6	215.0	27.9	764.8
935.0	370.3	0.0227	174.0	8015.7	29.29	317.613	131.7	213.7	27.7	768.8
936.0	369.8	0.0226	172.9	8041.3	29.38	318.207	131.7	212.5	27.8	772.5
937.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID MLB	SUPP POOL TEMP	RHR FLOW LB/SEC	~~[illegible]~~ (void fraction inpct)	INJEC FLOW LB/SEC
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	27.5	797.7
941.0	367.3	0.0226	167.3	[illegible]	29.54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29.54	[illegible]	[illegible]	[illegible]	27.6	794.9
943.0	[illegible]	[illegible]	[illegible]	[illegible]	29.52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
944.0	365.7	0.0226	164.9	8125.5	29.46	323.133	131.9	212.9	27.7	802.7
945.0	365.4	0.0226	163.9	8128.6	29.57	323.771	132.0	211.7	27.6	805.8
946.0	365.0	0.0226	162.9	8133.4	29.59	324.415	132.0	206.6	27.5	809.1
947.0	364.5	0.0226	162.0	8139.9	29.71	325.363	132.1	199.6	27.4	811.8
948.0	364.0	0.0226	161.1	8146.7	29.77	325.712	132.1	198.2	27.4	814.5
949.0	363.6	0.0226	160.1	8155.1	29.74	326.770	132.1	197.1	27.3	820.0
950.0	363.1	0.0226	159.2	8164.9	29.79	327.029	132.1	196.0	27.2	823.2
951.0	362.6	0.0226	158.2	8176.7	29.87	327.652	132.1	194.9	27.2	826.2
952.0	362.2	0.0226	157.3	8190.5	29.89	328.358	132.1	193.8	27.1	828.9
953.0	361.7	0.0226	156.4	8206.6	29.93	329.028	132.2	192.7	27.3	831.8
954.0	361.2	0.0225	155.5	8224.0	29.95	329.700	132.2	191.6	27.3	834.7
955.0	360.8	0.0225	154.6	8205.6	29.97	330.388	132.2	190.5	27.0	837.6
956.0	360.3	0.0225	153.7	8226.6	30.00	331.067	132.2	189.4	27.1	840.5
957.0	359.8	0.0225	152.8	8247.0	30.05	331.748	132.3	188.3	27.1	843.3
958.0	359.4	0.0225	151.9	8278.1	30.07	332.445	132.3	187.3	26.9	846.0
959.0	358.9	0.0225	151.0	8261.7	30.12	333.133	132.3	186.2	27.0	848.8
960.0	358.5	0.0225	150.1	8290.3	30.21	333.825	132.3	185.2	27.1	851.4
961.0	358.0	0.0225	149.3	8281.0	30.18	334.531	132.4	184.2	26.9	854.2
962.0	357.6	0.0225	148.4	8310.7	30.29	335.226	132.4	183.2	27.0	856.5
963.0	357.1	0.0225	147.6	8307.4	30.27	335.940	132.4	182.1	26.9	859.6
964.0	356.7	0.0225	146.7	8323.7	30.33	336.649	132.4	181.1	26.9	862.1
965.0	356.2	0.0225	145.9	8321.7	30.32	337.367	132.5	180.1	26.7	864.8
966.0	355.8	0.0225	145.1	8341.5	30.39	338.082	132.5	179.1	26.8	867.4
967.0	355.3	0.0225	144.3	8343.4	30.39	338.806	132.5	178.2	26.6	869.9

*** TOP OF FUEL RESUBMERGED AT 968 SEC. LEV= 30.5??? FT

*** TOP OF FUEL WAS UNCOVERED FOR 1?? SEC

*** AT LOWEST LEVEL, 16.??? PCT OF CORE WAS UNCOVERED

*** MIN LEVEL WAS 28.47?? FT, AT T= 8??.? SEC

968.0	354.9	0.0225	143.4	8367.0	30.54	339.520	132.5	177.1	26.9	872.6
969.0	354.4	0.0225	142.6	8390.6	30.55	340.248	132.6	176.2	26.8	875.1
970.0	354.0	0.0225	141.8	8376.1	30.57	340.980	132.6	175.2	26.7	877.6
971.0	353.6	0.0225	141.0	8404.0	30.60	341.715	132.6	174.2	26.6	880.1
972.0	353.1	0.0224	140.2	8413.8	30.63	342.452	132.6	173.3	26.6	882.6
973.0	352.7	0.0224	139.4	8426.0	30.68	343.193	132.7	172.4	26.5	885.0
974.0	352.3	0.0224	138.6	8440.1	30.72	343.935	132.7	171.4	26.5	887.5
975.0	351.8	0.0224	137.8	8456.3	30.78	344.681	132.7	170.5	26.5	889.9
976.0	351.4	0.0224	137.1	8474.0	30.84	345.428	132.7	169.6	26.5	892.1
977.0	351.0	0.0224	136.3	8472.7	30.84	346.184	132.7	168.7	26.4	894.0
978.0	350.5	0.0224	135.6	8495.2	30.91	346.936	132.8	167.7	26.4	896.2
979.0	350.1	0.0224	134.8	8475.7	30.85	347.700	132.8	166.8	26.1	898.2
980.0	349.7	0.0224	134.1	8504.1	30.95	348.460	132.8	166.0	26.2	900.1
981.0	349.2	0.0224	133.3	8534.2	31.05	349.218	132.8	165.1	26.4	902.2
982.0	348.8	0.0224	132.6	8540.7	31.08	349.984	132.9	164.2	26.3	904.2
983.0	348.4	0.0224	131.9	8532.0	31.04	350.759	132.9	163.3	26.0	906.2
984.0	348.0	0.0224	131.1	8569.2	31.17	351.524	132.9	162.4	26.2	908.1
985.0	347.5	0.0224	130.4	8585.2	31.23	352.297	132.9	161.6	26.2	910.1
986.0	347.1	0.0224	129.7	8603.4	31.29	353.072	132.9	160.7	26.2	912.0
987.0	346.7	0.0224	129.0	8600.4	31.28	353.855	133.0	159.9	26.1	913.9
988.0	346.3	0.0224	128.3	8599.3	31.28	354.640	133.0	159.0	25.9	915.7
989.0	345.9	0.0224	127.6	8624.6	31.36	355.421	133.0	158.2	26.0	917.7
990.0	345.5	0.0224	126.9	8627.8	31.37	356.210	133.0	157.3	25.9	919.7
991.0	345.1	0.0223	126.2	8633.5	31.39	357.001	133.1	156.5	25.8	921.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	123.?	87??.?	31.??	[illegible]	133.?	153.1	25.?	935.8
996.0	343.0	0.0223	122.?	8733.3	31.??	36?.???	133.3	152.3	25.?	931.?
997.0	342.3	0.0223	122.?	87??.?	31.??	[illegible]	133.?	151.?	25.?	932.?
998.0	342.?	0.0223	121.?	87??.?	31.??	[illegible]	133.?	151.?	25.?	934
999.0	342.?	0.0223	121.?	87??.?	31.??	[illegible]	133.?	150.?	25.?	935.?
1000.0	341.?	0.0223	120.?	87??.?	31.??	36?.???	133.3	149.?	25.?	937.5
1001.0	341.0	0.0223	119.?	87??.?	31.??	36?.???	133.3	148.?	25.?	939.3
1002.0	340.?	0.0223	119.?	87??.?	31.??	36?.???	133.3	147.?	25.?	[illegible]

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MODEL TIME SEC	READ TEMP FAHR	DECAY POWER FRAD	READ PRES PSIA	READ LIQUID FT**3	READ LEVEL FT	RPAL LIQUID KLB	SUPR FUEL TEMP	MAX FR FLOW LB/SEC	~~[illegible]~~ (voids in percent)	INJEC FLOW LB/SEC
1003.0	340.3	0.0223	118.4	8806.3	31.93	364.653	133.3	147.2	25.3	942.7
1004.0	339.9	0.0223	117.8	8826.9	31.96	367.478	133.3	146.4	25.4	944.3
1005.0	339.5	0.0223	117.2	8829.3	32.00	368.299	133.3	145.7	25.4	945.?
1006.0	339.1	0.0223	116.6	8845.6	32.05	369.122	133.4	145.0	25.4	947.6
1007.0	338.7	0.0223	115.9	8867.3	32.10	369.939	133.4	144.3	25.4	949.3
1008.0	338.3	0.0223	115.3	8883.3	32.16	370.776	133.4	143.5	25.4	950.9
1009.0	337.9	0.0222	114.7	8906.1	32.23	371.604	133.4	142.8	25.4	952.5
1010.0	337.5	0.0222	114.2	8907.3	32.22	372.441	133.4	142.1	25.3	954.1
1011.0	337.1	0.0222	113.6	8931.1	32.31	373.273	133.5	141.4	25.3	955.7
1012.0	336.8	0.0222	113.0	8932.0	32.31	374.113	133.5	140.7	25.2	957.2
1013.0	336.4	0.0222	112.4	8966.3	32.41	374.948	133.5	140.0	25.3	958.8
1014.0	336.0	0.0222	111.8	8973.5	32.43	375.791	133.5	139.3	25.2	960.2
1015.0	335.6	0.0222	111.3	8982.4	32.46	376.635	133.5	138.6	25.2	961.6
1016.0	335.3	0.0222	110.7	8994.5	32.49	377.481	133.5	137.9	25.1	963.0
1017.0	334.9	0.0222	110.1	9009.5	32.54	378.328	133.6	137.2	25.1	964.3
1018.0	334.5	0.0222	109.6	9027.1	32.59	379.176	133.6	136.6	25.1	965.7
1019.0	334.1	0.0222	109.0	9046.9	32.65	380.025	133.6	135.9	25.1	967.0
1020.0	333.8	0.0222	108.5	9060.8	32.72	380.875	133.6	135.3	25.1	968.3
1021.0	333.4	0.0222	107.9	9064.8	32.71	381.724	133.6	134.6	25.0	969.6
1022.0	333.0	0.0222	107.4	9093.7	32.79	382.587	133.7	134.0	25.0	970.9
1023.0	332.7	0.0222	106.9	9093.6	32.79	383.445	133.7	133.3	24.9	972.3
1024.0	332.3	0.0222	106.3	9126.3	32.89	384.307	133.7	132.7	25.0	973.5
1025.0	331.9	0.0222	105.8	9131.6	32.90	385.166	133.7	132.1	24.9	974.8
1026.0	331.6	0.0221	105.3	9140.7	32.93	386.031	133.7	131.4	24.8	976.0
1027.0	331.2	0.0221	104.8	9151.6	32.96	386.897	133.7	130.8	24.8	977.7
1028.0	330.8	0.0221	104.3	9165.3	33.0?	387.763	133.8	130.2	24.7	978.6
1029.0	330.5	0.0221	103.7	9181.5	33.05	388.631	133.8	129.6	24.7	979.8
1030.0	330.1	0.0221	103.2	9201.8	33.10	389.501	133.8	129.0	24.7	981.0
1031.0	329.8	0.0221	102.7	9224.3	33.18	390.371	133.8	128.4	24.3	982.2
1032.0	329.4	0.0221	102.2	9217.5	33.16	391.249	133.8	127.7	24.3	983.4
1033.0	329.1	0.0221	101.7	9245.5	33.25	392.121	133.8	127.1	24.6	984.6
1034.0	328.7	0.0221	101.2	9244.1	33.24	393.002	133.9	126.6	24.5	985.8
1035.0	328.4	0.0221	100.7	9277.6	33.34	393.876	133.9	126.0	24.6	987.0
1036.0	328.0	0.0221	100.2	9281.6	33.35	394.758	133.9	125.4	24.5	988.1
1037.0	327.7	0.0221	99.8	9288.9	33.38	395.642	133.9	124.8	24.4	989.3
1038.0	327.3	0.0221	99.3	9298.1	33.40	396.527	133.9	124.2	24.3	990.5
1039.0	327.0	0.0221	98.8	9310.6	33.44	397.413	133.9	123.6	24.3	991.6
1040.0	326.6	0.0221	98.4	9325.8	33.49	398.299	134.0	123.1	24.3	992.7
1041.0	326.3	0.0221	97.9	9343.6	33.54	399.186	134.0	122.5	24.3	993.8
1042.0	326.0	0.0221	97.4	9361.9	33.60	400.075	134.0	121.9	24.3	995.0
1043.0	325.6	0.0220	97.0	9388.0	33.67	400.964	134.0	121.4	24.3	996.0
1044.0	325.3	0.0220	96.5	9414.3	33.75	401.855	134.0	120.8	24.3	997.2
1045.0	324.9	0.0220	96.1	9408.1	33.73	402.757	134.0	120.3	24.1	998.3
1046.0	324.6	0.0220	95.6	9440.6	33.83	403.645	134.1	119.7	24.2	999.3
1047.0	324.3	0.0220	95.2	9440.0	33.83	404.545	134.1	119.2	24.1	1000.4
1048.0	323.9	0.0220	94.7	9477.8	33.94	405.443	134.1	118.6	24.2	1001.5
1049.0	323.6	0.0220	94.3	9487.3	33.96	406.341	134.1	118.1	24.1	1002.5
1050.0	323.3	0.0220	93.8	9493.9	33.98	40?.245	134.	117.5	24.1	1003.6
1051	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	174.3	115.8	33.7	1007.7
1055.0	321.6	0.0220	91.7	9575.3	34.27	411.777	174.3	115.[illegible]	33.[illegible]	1008.7
1056.0	321.3	0.0220	91.3	9591.3	34.31	412.683	174.3	114.8	33.[illegible]	1009.7
1057.0	321.0	0.0220	90.9	9592.4	34.33	413.598	174.3	113.7	33.7	1010.7
1058.0	320.7	0.0220	90.5	9623.4	34.38	414.508	174.3	113.4	33.8	1011.7
1059.0	320.3	0.0220	90.1	9620.3	34.37	415.424	174.3	112.9	33.7	1012.7
1060.0	320.0	0.0219	89.6	9657.3	34.48	416.337	174.3	112.4	33.8	1013.7
1061.0	319.7	0.0219	89.3	9659.3	34.48	417.257	174.3	111.7	33.[illegible]	[illegible]

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAX FR FLOW LB/SEC	~~[illegible]~~ (voids in percent)	INJEC FLOW LB/SEC
1062.0	319.4	0.0219	88.8	9664.9	34.50	418.178	174.3	111.3	33.8	1015.6
1063.0	319.1	0.0219	88.4	9712.9	34.64	419.092	174.3	111.0	33.8	1016.5
1064.0	318.8	0.0219	88.0	9722.8	34.67	420.011	174.3	110.5	33.7	1017.5
1065.0	318.4	0.0219	87.7	9735.5	34.71	420.936	174.4	110.0	33.6	1018.4
1066.0	318.1	0.0219	87.3	9751.2	34.76	421.859	174.4	109.5	33.6	1019.4
1067.0	317.8	0.0219	86.9	9730.6	34.73	422.791	174.4	109.1	33.7	1020.3
1068.0	317.5	0.0219	86.5	9755.1	34.77	423.717	174.4	108.6	33.3	1021.2
1069.0	317.2	0.0219	86.1	9782.4	34.85	424.643	174.4	108.2	33.4	1022.1
1070.0	316.9	0.0219	85.7	9811.4	34.94	425.569	174.4	107.7	33.8	1023.1
1071.0	316.6	0.0219	85.4	9802.3	34.91	426.503	174.4	107.2	33.2	1023.9
1072.0	316.3	0.0219	85.0	9828.2	35.02	427.431	174.5	106.8	33.4	1024.8
1073.0	316.0	0.0219	84.6	9834.6	35.01	428.367	174.5	106.3	33.2	1025.7
1074.0	315.7	0.0219	84.3	9876.2	35.13	429.297	174.5	105.9	33.3	1026.6
1075.0	315.4	0.0219	83.9	9879.9	35.14	430.234	174.5	105.4	33.2	1027.4
1076.0	315.1	0.0219	83.5	9885.7	35.16	431.173	174.5	105.0	33.1	1027.9
1077.0	314.8	0.0219	83.2	9895.3	35.19	432.110	174.5	104.6	33.1	1028.5
1078.0	314.5	0.0218	82.8	9929.5	35.29	433.048	174.5	104.1	33.2	1029.3
1079.0	314.2	0.0218	82.5	9945.0	35.34	433.983	174.6	103.7	33.1	1029.5
1080.0	313.9	0.0218	82.1	9943.1	35.33	434.926	174.6	103.3	33.0	1030.1
1081.0	313.6	0.0218	81.8	9965.6	35.40	435.866	174.6	102.8	33.0	1030.6
1082.0	313.3	0.0218	81.4	9990.7	35.48	436.808	174.6	102.4	33.0	1031.1
1083.0	313.0	0.0218	81.1	10020.6	35.56	437.745	174.6	102.0	33.1	1031.6
1084.0	312.7	0.0218	80.8	10008.9	35.53	438.693	174.6	101.6	32.9	1032.1
1085.0	312.4	0.0218	80.4	10044.0	35.63	439.633	174.6	101.1	33.0	1032.7
1086.0	312.1	0.0218	80.1	10038.7	35.62	440.582	174.7	100.8	32.8	1033.2
1087.0	311.8	0.0218	79.7	10080.7	35.74	441.533	174.7	100.3	33.0	1033.7
1088.0	311.6	0.0218	79.4	10081.1	35.75	442.471	174.7	100.0	32.8	1034.2
1089.0	311.3	0.0218	79.1	10096.1	35.76	443.420	174.7	99.6	32.7	1034.7
1090.0	311.0	0.0218	78.8	10114.8	35.85	444.366	174.7	99.1	32.8	1035.2
1091.0	310.7	0.0218	78.4	10127.5	35.85	445.316	174.7	98.8	32.7	1035.6
1092.0	310.4	0.0218	78.1	10142.0	35.93	446.266	174.7	98.4	32.7	1036.1
1093.0	310.1	0.0218	77.8	10160.0	35.98	447.216	174.7	98.0	32.7	1036.6
1094.0	309.9	0.0218	77.5	10181.0	36.04	448.166	174.8	97.6	32.7	1037.1
1095.0	309.6	0.0218	77.2	10204.4	36.11	449.117	174.8	97.2	32.7	1037.6
1096.0	309.3	0.0218	76.9	10230.2	36.19	450.053	174.8	96.8	32.7	1038.0
1097.0	309.0	0.0217	76.5	10234.9	36.21	451.023	174.8	96.4	32.6	1038.5
1098.0	308.8	0.0217	76.2	10266.8	36.30	451.973	174.8	96.0	32.7	1039.0
1099.0	308.5	0.0217	75.9	10255.7	36.27	452.930	174.8	95.7	32.5	1039.4
1100.0	308.2	0.0217	75.6	10293.5	36.39	453.885	174.8	95.3	32.6	1039.9
1101.0	307.9	0.0217	75.3	10290.7	36.37	454.845	174.9	94.9	32.4	1040.3
1102.0	307.7	0.0217	75.0	10312.8	36.44	455.801	174.9	94.5	32.4	1040.8
1103.0	307.4	0.0217	74.7	10313.7	36.44	456.761	174.9	94.2	32.3	1041.3
1104.0	307.1	0.0217	74.4	10342.8	36.53	457.717	174.9	93.8	32.4	1041.7
1105.0	306.9	0.0217	74.1	10375.3	36.63	458.674	174.9	93.5	32.5	1042.1
1106.0	306.6	0.0217	73.8	10388.1	36.66	459.635	174.9	93.1	32.4	1042.6
1107.0	306.3	0.0217	73.6	10403.9	36.70	460.596	174.9	92.8	32.4	1043.0
1108.0	306.1	0.0217	73.3	10418.6	36.76	461.557	174.9	92.4	32.3	1043.4
1109.0	305.8	0.0217	73.0	10429.6	36.82	462.519	175.0	92.0	32.7	1043.9
1110.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1045.5
1114.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	135.?	90.?	[illegible]	[illegible]
1115.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1046.4
1116.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1047.2
1118.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1048.0
1120.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAIN ST FLOW LB/SEC	~~[illegible]~~ voids in percent	INJEC FLOW LB/SEC
1121.0	302.7	0.0216	69.7	10615.1	37.35	474.124	135.1	88.0	21.9	1048.5
1122.0	302.5	0.0216	69.5	10629.2	37.38	475.096	135.1	87.7	21.8	1049.2
1123.0	302.2	0.0216	69.2	10644.1	37.43	476.068	135.1	87.4	21.8	1049.6
1124.0	302.0	0.0216	69.0	10661.6	37.49	477.040	135.1	87.1	21.8	1050.0
1125.0	301.7	0.0216	68.7	10683.9	37.55	478.013	135.1	86.8	21.8	1050.4
1126.0	301.5	0.0216	68.4	10708.1	37.62	478.985	135.2	86.4	21.8	1050.8
1127.0	301.2	0.0216	68.1	10733.9	37.70	479.957	135.2	86.1	21.8	1051.1
1128.0	301.0	0.0216	67.9	10732.3	37.71	480.934	135.2	85.8	21.7	1051.5
1129.0	300.7	0.0216	67.7	10742.0	37.73	481.911	135.2	85.5	21.6	1051.9
1130.0	300.5	0.0216	67.4	10779.0	37.83	482.885	135.2	85.2	21.7	1052.3
1131.0	300.2	0.0216	67.2	10791.0	37.87	483.862	135.2	84.9	21.7	1052.7
1132.0	300.0	0.0216	67.0	10806.4	37.92	484.839	135.2	84.6	21.6	1053.0
1133.0	299.7	0.0216	66.7	10825.3	37.97	485.817	135.2	84.3	21.6	1053.4
1134.0	299.5	0.0215	66.5	10819.1	37.95	486.799	135.3	84.0	21.4	1053.8
1135.0	299.3	0.0215	66.2	10844.7	38.03	487.777	135.3	83.7	21.5	1054.1
1136.0	299.0	0.0215	66.0	10874.3	38.12	488.755	135.3	83.4	21.5	1054.5
1137.0	298.8	0.0215	65.8	10878.4	38.13	489.737	135.3	83.2	21.4	1054.9
1138.0	298.6	0.0215	65.5	10895.8	38.15	490.720	135.3	82.9	21.3	1055.2
1139.0	298.3	0.0215	65.3	10926.3	38.23	491.698	135.3	82.6	21.5	1055.6
1140.0	298.1	0.0215	65.1	10937.6	38.31	492.681	135.3	82.3	21.4	1055.9
1141.0	297.8	0.0215	64.8	10956.2	38.37	493.663	135.3	82.0	21.4	1056.3
1142.0	297.6	0.0215	64.6	10976.9	38.43	494.646	135.3	81.7	21.4	1056.6
1143.0	297.4	0.0215	64.4	10970.0	38.40	495.634	135.4	81.5	21.2	1057.0
1144.0	297.1	0.0215	64.2	10996.6	38.48	496.617	135.4	81.2	21.2	1057.3
1145.0	296.9	0.0215	63.9	11027.5	38.58	497.600	135.4	80.9	21.2	1057.7
1146.0	296.7	0.0215	63.7	11029.8	38.59	498.588	135.4	80.6	21.2	1058.0
1147.0	296.5	0.0215	63.5	11036.5	38.60	499.575	135.4	80.4	21.1	1058.3
1148.0	296.2	0.0215	63.3	11045.7	38.63	500.563	135.4	80.1	21.0	1058.7
1149.0	296.0	0.0215	63.1	11059.1	38.67	501.551	135.4	79.8	21.0	1059.0
1150.0	295.8	0.0215	62.8	11075.8	38.72	502.539	135.4	79.5	20.9	1059.3
1151.0	295.6	0.0215	62.6	11095.6	38.78	503.527	135.4	79.3	20.9	1059.7
1152.0	295.3	0.0215	62.4	11118.1	38.85	504.515	135.4	79.0	20.9	1060.0
1153.0	295.1	0.0215	62.2	11143.0	38.92	505.504	135.5	78.8	21.0	1060.3
1154.0	294.9	0.0214	62.0	11172.3	39.01	506.493	135.5	78.5	21.0	1060.6
1155.0	294.7	0.0214	61.8	11171.4	39.01	507.485	135.5	78.2	20.9	1061.0
1156.0	294.4	0.0214	61.6	11176.0	39.02	508.478	135.5	78.0	20.8	1061.3
1157.0	294.2	0.0214	61.4	11214.6	39.14	509.466	135.5	77.7	20.9	1061.6
1158.0	294.0	0.0214	61.1	11224.0	39.16	510.459	135.5	77.5	20.8	1061.9
1159.0	293.8	0.0214	60.9	11237.4	39.20	511.452	135.5	77.2	20.8	1062.2
1160.0	293.6	0.0214	60.7	11254.0	39.25	512.446	135.5	77.0	20.8	1062.5
1161.0	293.3	0.0214	60.5	11274.3	39.32	513.439	135.5	76.7	20.8	1062.9
1162.0	293.1	0.0214	60.3	11294.7	39.38	514.432	135.6	76.5	20.8	1063.2
1163.0	292.9	0.0214	60.1	11322.0	39.46	515.426	135.6	76.2	20.8	1063.5
1164.0	292.7	0.0214	59.9	11318.4	39.45	516.423	135.6	76.0	20.6	1063.8
1165.0	292.5	0.0214	59.7	11350.7	39.54	517.417	135.6	75.7	20.7	1064.1
1166.0	292.3	0.0214	59.5	11353.2	39.55	518.415	135.6	75.5	20.6	1064.4
1167.0	292.0	0.0214	59.4	11357.8	39.56	519.413	135.6	75.3	20.5	1064.7
1168.0	291.8	0.0214	59.2	11401.1	39.69	520.407	135.6	75.0	20.6	1065.0
1169.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1066.1
1173.0	290.5	0.0214	55.2	11461.6	39.87	528.404	175.7	73.7	20.7	[illegible]
1174.0	290.2	0.0213	55.9	11489.4	39.96	529.402	175.7	73.1	21.4	1066.7
1175.0	290.4	0.0213	57.8	11521.2	40.06	527.411	175.7	73.6	20.8	[illegible]
1176.0	291.2	0.0213	57.7	[illegible]	40.15	530.414	175.7	73.2	21.2	1067.3
1177.0	291.6	0.0213	57.8	11524.7	[illegible]	529.418	175.7	73.1	21.2	[illegible]
1178.0	289.7	0.0213	57.7	11546.6	40.15	530.436	175.7	72.7	20.4	1067.9
1179.0	289.5	0.0213	57.4	11575.7	40.22	531.410	175.7	72.5	[illegible]	[illegible]

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MODEL TIME SEC	REAC TEMP FAHR	DECAY POWER FRAC	REAC PRES PSIA	REAC LIQUID FT**3	REAC LEVEL FT	REAC LIQUID KLB	SUPP POOL TEMP	MAIN PV FLOW LB/SEC	~~[illegible]~~ voids in pct	INJEC FLOW LB/SEC
1180.0	289.3	0.0213	56.9	11588.5	40.26	532.417	175.7	72.7	20.2	1068.4
1181.0	289.1	0.0213	56.7	11604.4	40.31	533.417	175.7	72.1	21.2	1068.7
1182.0	288.9	0.0213	56.6	11624.1	40.36	534.420	175.8	71.9	20.2	1067.[illegible]
1183.0	288.7	0.0213	56.4	11646.9	40.43	535.424	175.8	71.6	20.2	1069.2
1184.0	288.5	0.0213	56.2	11658.3	40.44	536.432	175.8	71.4	20.4	1069.5
1185.0	288.3	0.0213	56.0	11686.7	40.49	537.436	175.8	71.2	20.1	1069.8
1186.0	288.1	0.0213	55.9	11699.6	40.59	538.440	175.8	71.0	20.2	1070.1
1187.0	287.9	0.0213	55.7	11699.2	40.59	539.448	175.8	70.8	21.0	1070.3
1188.0	287.7	0.0213	55.5	11738.7	40.70	540.452	175.8	70.6	20.1	1070.6
1189.0	287.5	0.0213	55.4	11744.0	40.72	541.460	175.8	70.4	20.0	1070.8
1190.0	287.3	0.0213	55.2	11751.4	40.74	542.469	175.8	70.1	19.9	1071.1
1191.0	287.1	0.0213	55.0	11762.7	40.78	543.478	175.8	69.9	19.9	1071.4
1192.0	286.9	0.0213	54.8	11777.9	40.82	544.486	175.9	69.7	19.8	1071.6
1193.0	286.8	0.0213	54.7	11796.4	40.89	545.495	175.9	69.5	19.8	1071.9

*** END OF CHOKED FLOW REGIME FOR VALVES ***

*** RVP, PCONT 54.6814 29.9125

$P_{REACTOR} = 54.68$ psia

$P_{CONTAINMENT} = 29.91$ psia $= 15.21$ psig

APPENDIX 5

Independent Calculation G-KK-6-140

by General Electric Company

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[signature] 8/15/86

GENERAL ELECTRIC

NUCLEAR ENERGY BUSINESS OPERATIONS
GENERAL ELECTRIC COMPANY • 175 CURTNER AVENUE • SAN JOSE, CALIFORNIA 95125

G-KK-6-140
July 17, 1986

Mr. L.T. Harrold, MD 994E
Assistant Director, Generation Engineering
Washington Public Power Supply System
P.O. Box 968
Richland, Washington 99352

Subject: SUPPLY SYSTEM NUCLEAR PLANT NO. 2
FIRE PROTECTION ANALYSIS FOR HANFORD 2

Reference: WRO-C0875-GE-86-P2-18

Attention: G.L. Gelhaus, MD 981A

Attached is the subject report as requested by the referenced WRO. This analysis assumed that six relief valves are manually opened and only one LPCI pump (Loop B) is available. The analysis clearly demonstrates that adequate shutdown capability exists to meet the performance requirement of no fuel cladding damage as specified in 10CFR50 Appendix R for the event analyzed.

If you have any questions or require additional information, please contact G.L. Hayes.

Very truly yours,

G. L. Hayes for

J. Armenta, Manager
Customer Services - Western Region

cc: F. Markowski/SS, 981A
WG Edmonds/SS, 982A
JG Tellefson/SS, 994E
GL Hayes/GE, 981C
San Jose GE Files/394

FIRE PROTECTION ANALYSIS

FOR

HANFORD 2

PREPARED BY: J M Baker for Ram Seetharaman
Ram Seetharaman
Plant Performance Engineering

APPROVED BY: DA Hamon acting for AE Rogers 6/27/86
A.E. Rogers, Manager
Plant Performance Engineering

TABLE OF CONTENTS

1. INTRODUCTION

This report presents an analysis performed to demonstrate adequate safe shutdown capability for a hypothetical fire event at Hanford 2. This analysis considers the performance of the minimum safe shutdown systems to the event scenario supplied by Washington Public Power Supply System (WPPSS). The analysis was performed to assist WPPSS in showing compliance with the requirements of 10CFR50.48 and 10CFR50 Appendix R.

Section III.L of 10CFR50 Appendix R requires that fuel cladding damage shall not occur during a plant fire event using the alternative or dedicated shutdown capability. Fuel cladding damage will not occur if the fuel heatup response, and in particular the peak cladding temperature (PCT), are sufficiently below the cladding perforation limits.

2. SUMMARY AND CONCLUSIONS

Analyses were performed to demonstrate that the minimum set of safe shutdown systems defined for Hanford 2 have the capability to comply with the requirements of 10CFR50.48 and 10CFR50 Appendix R. The analyses considered the effects of loss of offsite power and loss of feedwater with only the minimum safe shutdown systems operable.

The analyses clearly demonstrate that adequate shutdown capability exists to meet the performance requirement of no fuel cladding damage as specified in 10CFR50 Appendix R for the event analyzed.

3. ANALYSIS

3.1 ANALYSIS METHOD

The General Electric evaluation model (SAFE) was used to perform the analysis. The SAFE model predicts the reactor pressure, water level and steam flow response. If core uncovery occurs, this information is then used to determine the steam cooling heat transfer coefficients for the fuel rods during the event as described in Section 3.5.2.4.2 of Reference 1. The General Electric evaluation model (CHASTE) is then used to calculate the fuel rod heat-up and the resulting Peak Cladding Temperature (PCT). The assumptions related to initial conditions, operator actions, and other event parameters are discussed in the following sections.

3.2 GENERAL EVENT DESCRIPTION

The initial conditions for the postulated fire event are described as follows. At the start of the postulated fire event, the reactor is assumed to be operating at full power, normal water level, and steady state conditions. The design basis fire event is assumed to occur at time zero with instantaneous loss of all unprotected safe shutdown systems. It is conservatively assumed that the loss of offsite power occurs at the same time which leads to events such as reactor scram, turbine trip, loss of feedwater and isolation.

Immediately after scram and isolation, the reactor pressure increase is limited by operation of the SRVs. After the SRVs open, the vessel pressure immediately drops.

Normally the high pressure makeup systems, i.e., High Pressure Core Spray (HPCS) and Reactor Core Isolation Cooling (RCIC), will operate to supply coolant inventory upon a sufficient drop in reactor water level. For this event, however, the RCIC and the HPCS systems are assumed unavailable since they are not operable from the remote shutdown panel or will be disabled by the postulated fire.

It is assumed that after 10 minutes 6 relief valves will be manually opened to depressurize the vessel. As the reactor depressurizes, RHR loop "B" only comes on (automatically) for LPCI. Only one LPCI pump is assumed available. The LPCI pump is then able to deliver water into the vessel and rapidly restore the water level to near normal.

3.3 ASSUMPTIONS

The analysis of this loss-of-coolant event is based on the following assumptions:

a. No credit is assumed for offsite power. For analysis purposes, this assumption is simulated by the loss of offsite power and reactor isolation at time zero to maximize the primary system stored energy.

b. Six safety relief valves and one LPCI system are assumed available. The relief valve depressurization is assumed to be initiated 10 minutes into the event.

c. The fire event does not occur simultaneously or coincident with any other abnormal conditions except the loss of offsite power. No other challenges to the safe shutdown systems are considered as part of this analysis.

d. Plant operating and system actuation parameters are consistent with the plant safety analysis and technical specifications for the initiating event.

e. The reactor decay heat is modeled with the mean value of the 1979 ANS decay heat. This is judged to be the most appropriate decay heat assumption for this study and is also consistent with previous analyses for the Emergency Procedure Guidelines (Reference 1).

f. The initial core power is conservatively set at 104.2% of rated. Initial steam flow, core flow, and vessel pressure are consistent with the heat balance for 104.2% rated core power.

g. The core remains in nucleate boiling until core uncovery. This is again supported by test results described in Reference 1.

h. Essentially no credit is taken for feedwater flow. With the loss of offsite power, the flow is linearly ramped to zero flow in 1 second. The feedwater enthalphy is constant during the coastdown.

4. RESULTS

The performance of the minimum safe shutdown systems was evaluated for the event scenario described in Section 3.2 assuming the conditions discussed in Section 3.3. The results of the analysis are shown in Figures 4-1 through 4-5. The depressurization and rate of vessel inventory loss increases when the 6 SRVs are manually opened 600 seconds into the event. The minimum water level inside the shroud occurs about 15 minutes into the event and is located approximately 4.1 feet below the top of the active fuel. As soon as LPCI flow enters the vessel the water level begins to rise. The fuel node having the highest calculated peak cladding temperature (PCT) is uncovered for 272 seconds. The PCT is calculated to be 762°F and occurs approximately 19 minutes after initiation of the event.

No fuel cladding damage is expected to occur at this low temperature. No fuel rod perforations are expected to occur below 925°C (approximately 1700°F) based on General Electric cladding swelling and rupture model (see References 2 and 3). This model has been approved by the US NRC (Reference 4). Cladding expansion begins about 200°F lower than the perforation temperature (Reference 5), so no fuel cladding damage should occur as long as the peak cladding temperature remains below 1500°F.

The sensitivity of the peak cladding temperature to the specific fuel design is not expected to be substantial for this event since fuel uncovery does not occur until well after initiation of the event and the period of core uncovery is most strongly a function of ECCS performance characteristics. The actual peak cladding temperature is dependent on the thermal characteristics of the fuel (i.e. heat generation and gap conductance).

While calculating suppression pool temperature no pool cooling is assumed and the final pool temperature is the maximum value. The pool temperature is 90°F at the beginning of the transient. All the mass and energy flow out of the SRVs is assumed to be absorbed completely in the pool volume at 1575 seconds into the event when the water level inside the shroud is restored to its initial level. During this time approximately 420 million BTUs of thermal energy are added to the pool by 0.35 million pounds of steam. The initial pool mass is approximately 6.9 million pounds of water at 90°F. An energy balance yields a final pool temperature of approximately 145°F.

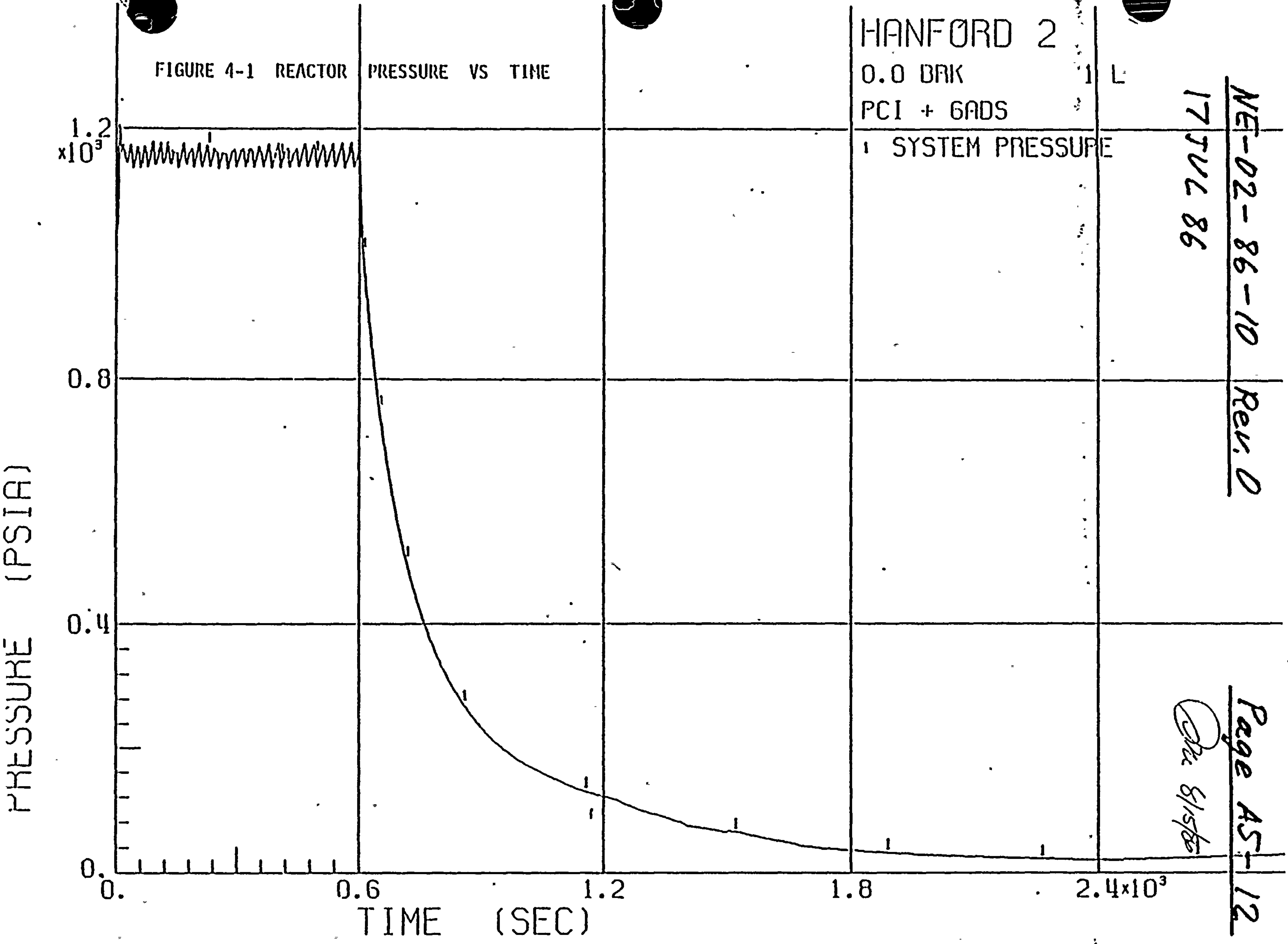

FIGURE 4-1 REACTOR PRESSURE VS TIME

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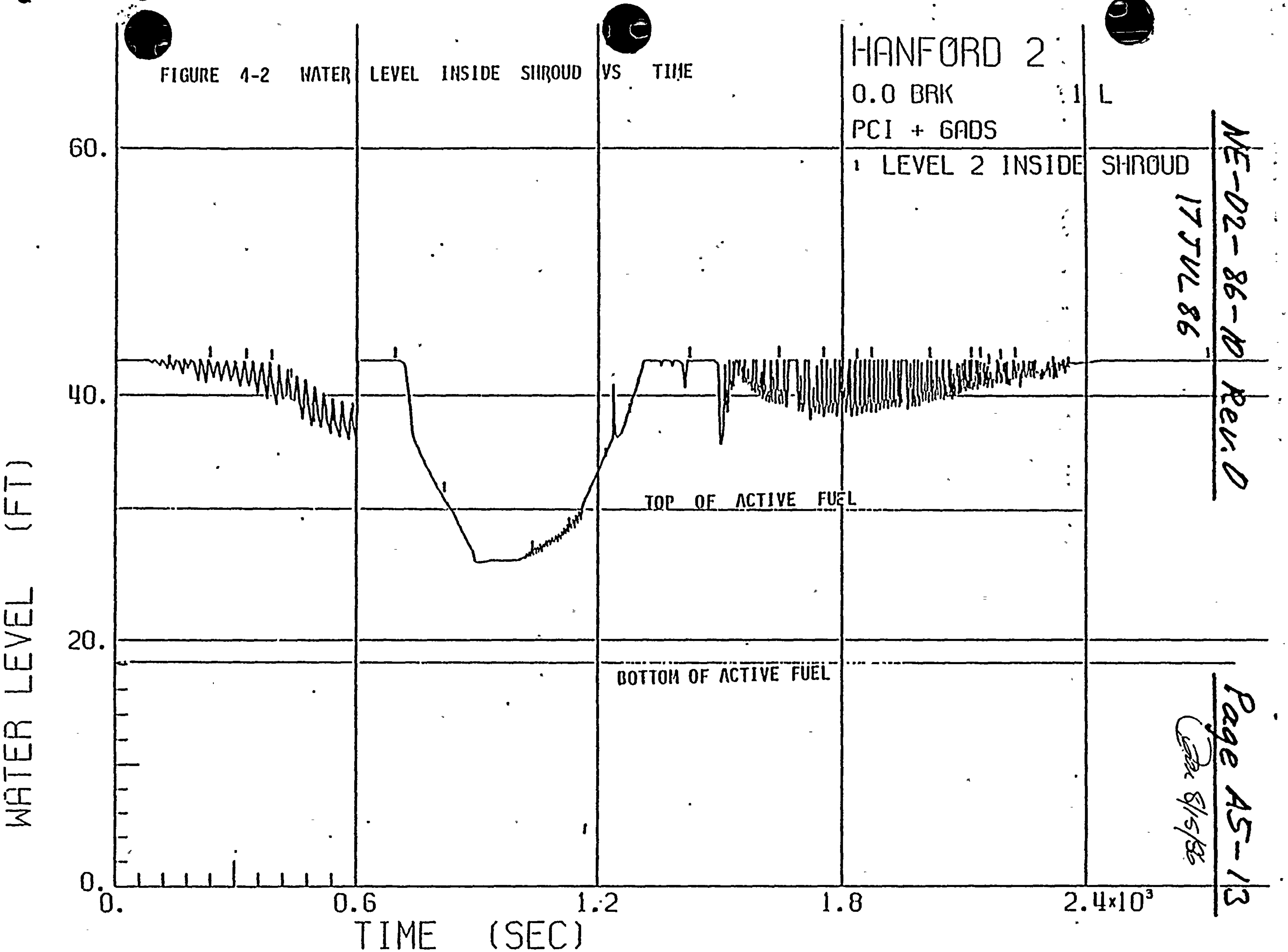
FIGURE 4-2 WATER LEVEL INSIDE SHROUD VS TIME
HANFORD 2
0.0 BRK 1 L
PCI + 6ADS
1 LEVEL 2 INSIDE SHROUD
TOP OF ACTIVE FUEL
BOTTOM OF ACTIVE FUEL
60.
40.
20.
0.
0.6
1.2
1.8
2.4×10³
WATER LEVEL (FT)
TIME (SEC)
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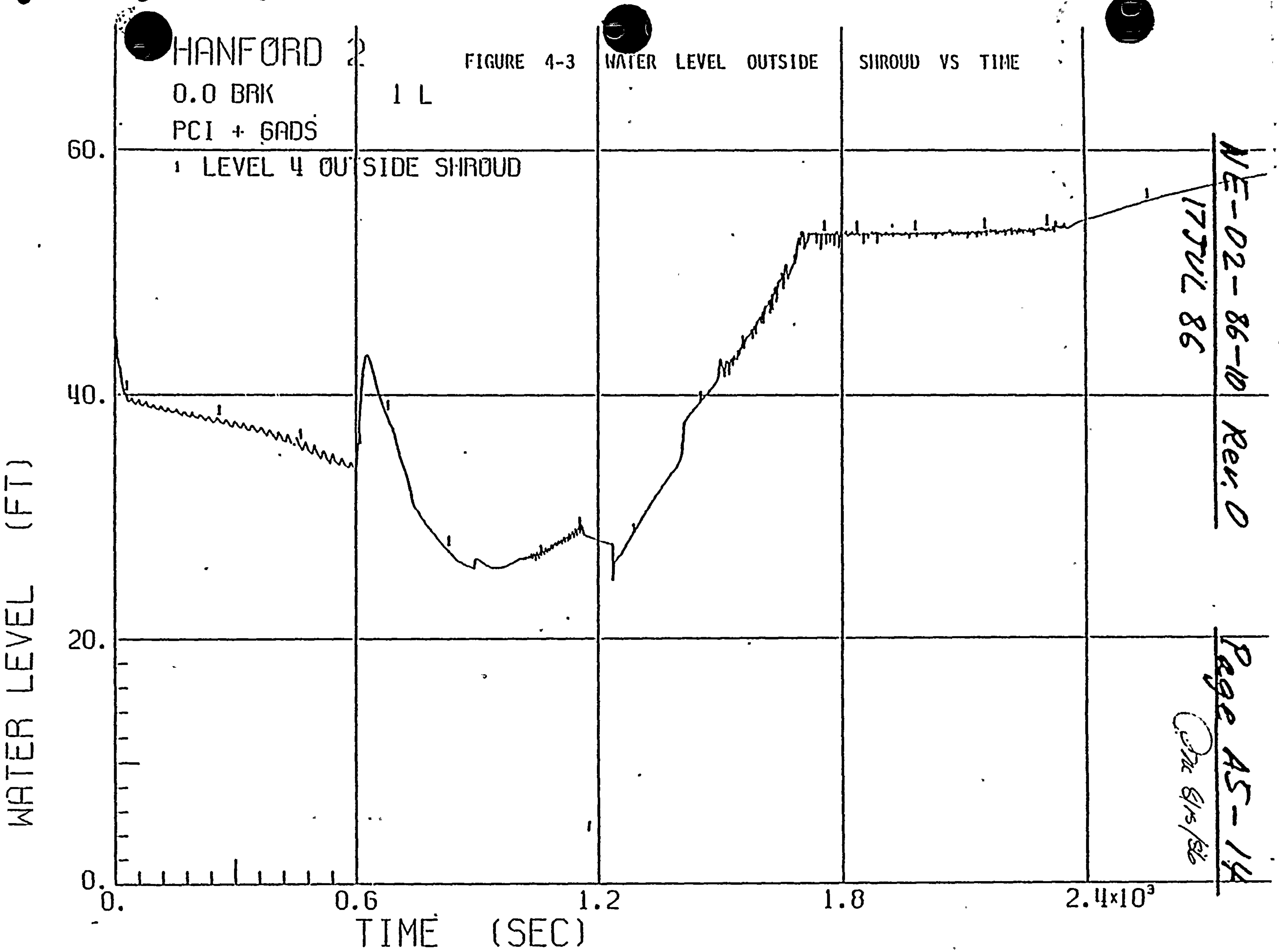

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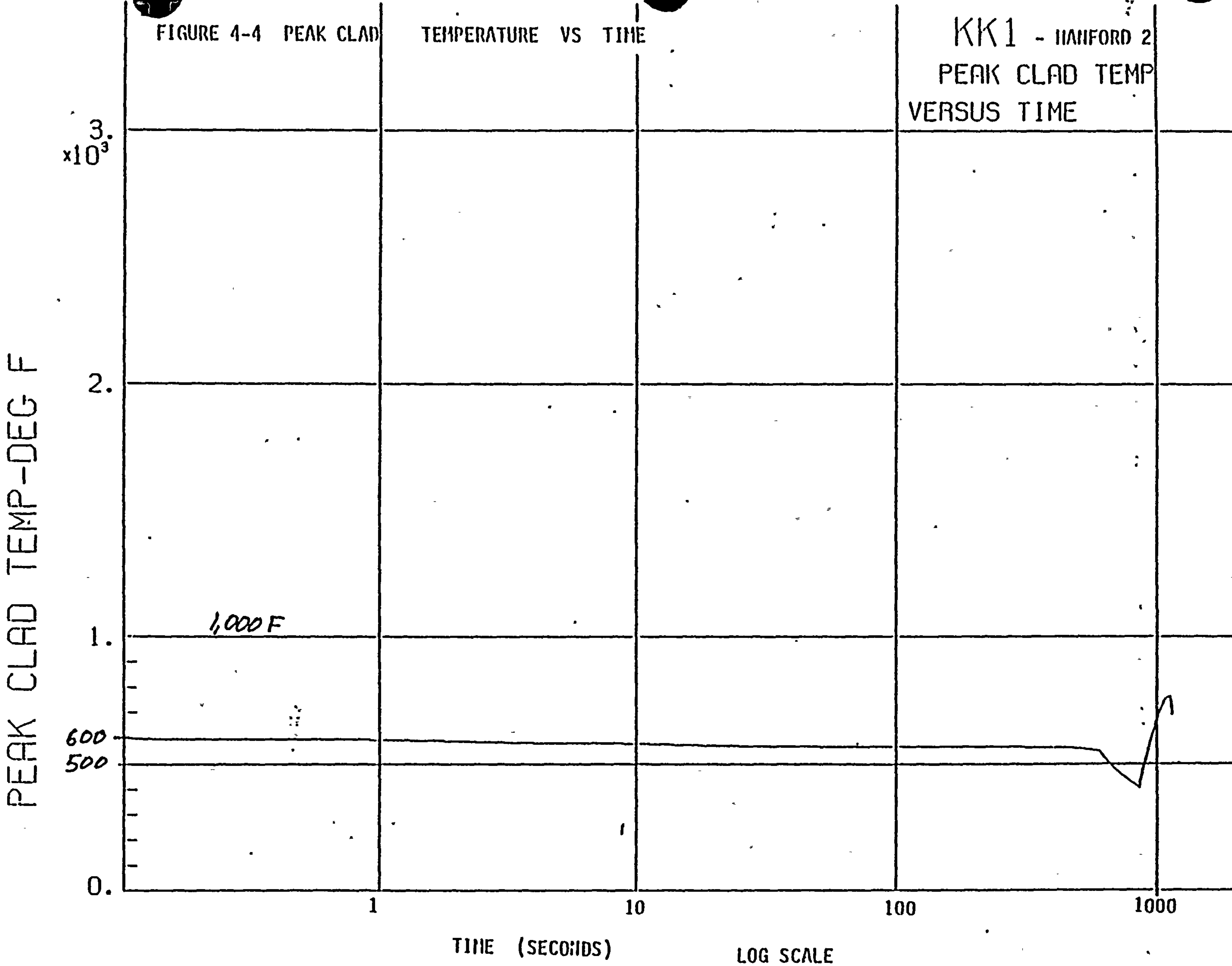

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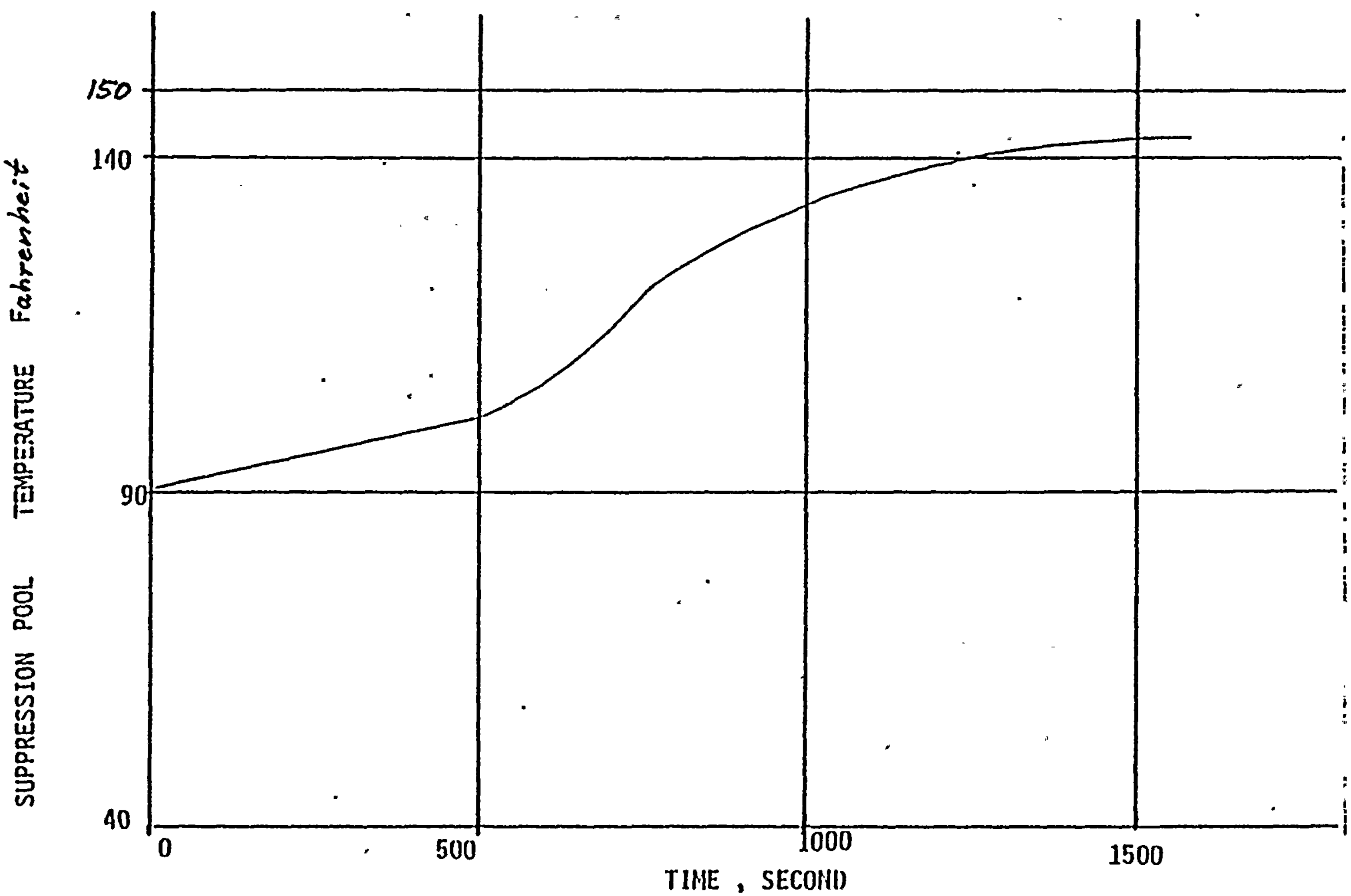
FIGURE 4-5 POOL TEMPERATURE VS TIME

(SUPPRESSION POOL)



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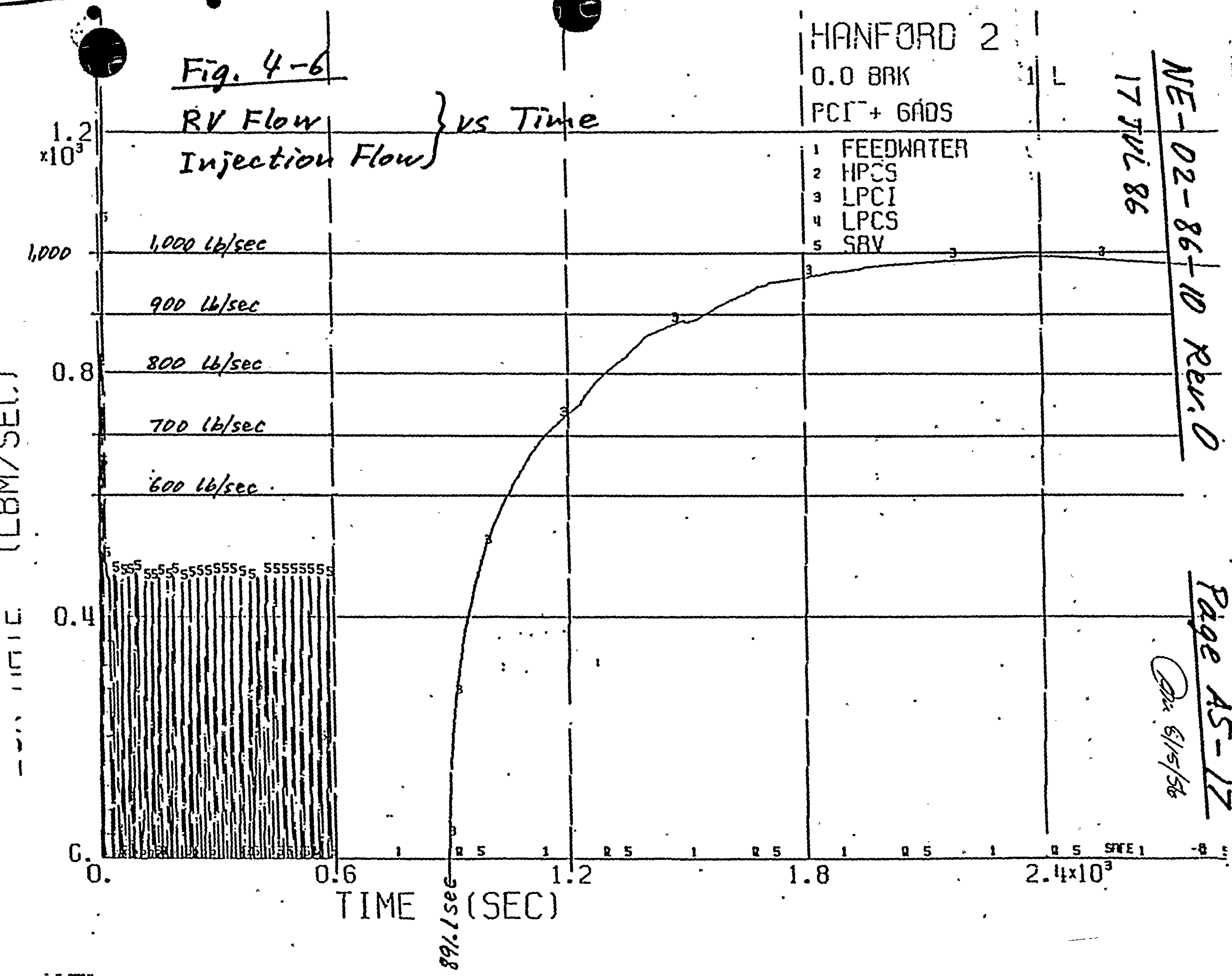

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5. REFERENCES

1. "Additional Information Required for NRC Staff Generic Report on Boiling Water Reactors", NEDO-24708A, Revision 1, December, 1980.

2. Letter, R. H. Buchholz (GE) to D.D. Eisenhut (NRC), "GE Cladding Hoop Stress at Perforation, "MFN 278-79, November 16, 1979.

3. "Cladding Swelling and Rupture Models for LOCA Analysis, "NUREG-0630, April 1980.

4. Letter, Harold Bernard (NRC) to G.G. Sherwood (GE), "Supplementary Acceptance of Licensing Topical Report NEDE 20566A(P), " May 11, 1982.

5. "General Electric Company Analytical Model for Loss-of-Coolant Analysis in Accordance with 10CFR50 Appendix K, Vol. I, "NEDO-20566, January 1976.

APPENDIX 6

Comparison of Results and Discussion of Differences between G-KK-6-140 and NE-02-86-10

The independent analysis done by GE (App. 5) shows somewhat less favorable results than NE-02-86-10:

1. The fuel uncovery time is longer
2. The minimum coolant level is lower
3. The injection flow is lower

Consequently, all significant input data and modeling features were discussed with GE. It was found that the original WPPSS calculation needed the stored heat adjusted (see Pages A2-09 thru A2-12), and it needed to account

for the RHR pump miniflow (about 500 gal/min), which causes a decrease in available shutoff head by about 7.5 psid. After these two adjustments were made, the following differences remain:

1. The WPPSS analysis uses the actual RHR pump curve (see Page 5.047), while the GE analysis is based on a generic pump curve, adjusted for FSAR Chap. 15 type analysis (FSAR Figure 6.3-9, see next page). The FSAR curve has a shutoff head of 227.9 psid, while the actual curve has a

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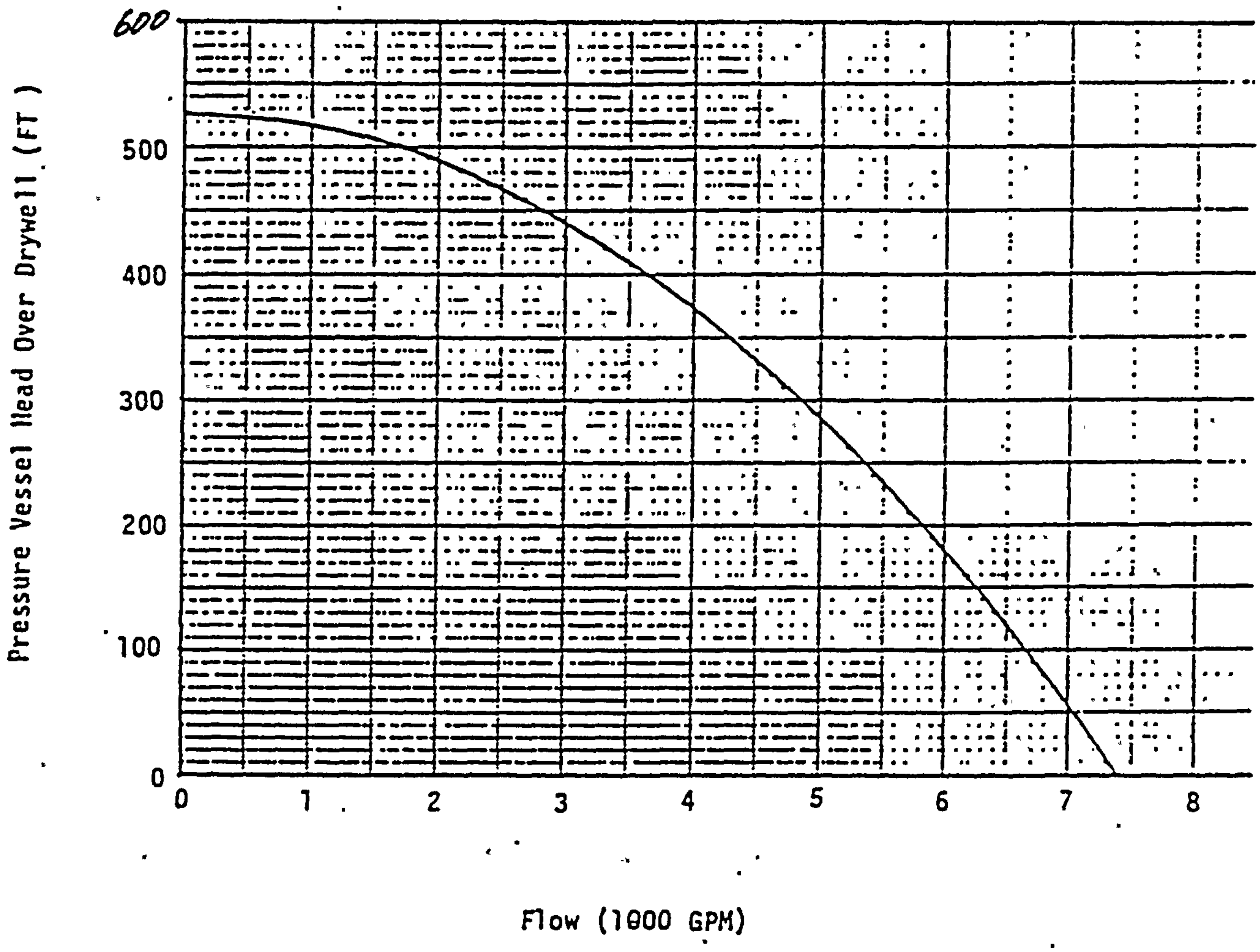
(FOR 1 PUMP ONLY)



→ Curve is tabulated on next page

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PUMP CURVE 21 JUL 86

	PUMP FLOW (GAL MIN)	PUMP (DIFF. PSI)	PUMP HEAD, FT
1	0.00	227.90	522.16
2	0.50	225.70	521.08
3	1.00	224.40	515.08
4	1.50	219.70	507.21
5	2.00	212.70	490.15
6	2.50	202.80	468.21
7	3.00	190.60	440.05
8	3.50	178.10	411.18
9	4.00	161.20	372.17
10	4.50	143.30	[illegible]
11	5.00	123.90	286.05
12	5.50	101.80	235.03
13	6.00	78.40	181.01
14	6.50	53.00	122.36
15	7.00	27.90	64.95
16	7.50	0.00	0.00
17	8.00	0.00	0.00
18	8.50	0.00	0.00

Pump Curve

***** INITIAL CONDITIONS ***** THU, 29 MAY 86, 08:00 HR *****

```
TOTAL SYSTEM VOLUME                           =  21005   FT**3
LIQUID VOLUME WITHOUT VOIDS                   =  12146.1   FT**3
LIQUID VOLUME WITH    VOIDS                   =  12033.2   FT**3
VAPOR VOLUME INCLUDING VOIDS                  =  8858.5   FT**3 (TOTAL VAPOR)
VAPOR VOLUME ABOVE ACTUAL LIQUID LEVEL        =  7972.7   FT**3

MASS OF LIQUID ONLY (VOIDS EXCLUDED)          =  552.781  KLB
MASS OF VAPOR ABOVE LIQUID                    =  19.1742  KLB
TOTAL MASS OF VAPOR (VOIDS INCLUDED)          =  21.3415  KLB
TOTAL FLUID MASS (LIQUID+TOTAL VAPOR)         =  574.811  KLB
MASS OF THERMALY ACTIVE STEEL STRUCTURE=  [illegible]  KLB
                                          1,650

COLLAPSED REACTER LEVEL                       =  43.0438  FT (NO VOIDS)
ACTUAL REACTER LEVEL                          =  44.9943  FT (WITH VOIDS)
REACTOR PRESSURE                              =  1057.27  LB/IN**2
REACTOR COOLANT TEMPERATURE                   =  551.5  FAHRENHEIT
AVERAGE COOLANT QUALITY                       =   0.322 PERCENT
AVERAGE COOLANT VOID FRACTION                 =   2.800 PERCENT
CORRESPONDING AVERAGE VOLUMETRIC VOID AT
FULL POWER, WITH LEVEL AT SETPOINT LN         =  11.060 PERCENT

SPECIFIC VOLUME OF LIQUID                     =  2.19711E-02   FT**3/LB
SPECIFIC VOLUME OF VAPOR                      =  .416665   FT**3/LB
SPECIFIC ENTHALPY OF LIQUID                   =  552.047   BTU/LB
SPECIFIC ENTHALPY OF VAPOR                    =  1188.41   BTU/LB

*** ALL DATA FOR STEADY STATE WRITTEN TO DISK, CHANNEL 2 ***

***          THU, 29 MAY 86, 08:00 HR                  ***
```

shutoff head of 303.2 psid (minus 7.5 psid for miniflow). The effect on results is significant.

2. The WPPSS decay power curve is about 12 pct too high after T = 100 sec, compared to the best estimate curve used by GE. The effect on results is minimal.
3. For the total primary coolant system volume, the WPPSS figure of 21,005 ft^3 is 4.5 pct low. Effect on results is negligible.

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4. For initial liquid inventory, the WPPSS figure of 555.35 Klb is 0.9 pct low. Effect on results: none.

5. For the relief valves, the GE analysis uses the spring setpoints combined with a 30 psid hysteresis (between opening and closing). The WPPSS analysis uses the power actuation set points combined with a hysteresis of 50 psid. The WPPSS data are more realistic, but no effect on results is expected.

6. For calculation of massflow thru the relief valves GE uses the Moody

Table (homog. equilibrium model) with an effective valve crossectional area calibrated at 1,200 psia. The WPPSS analysis uses the actual valve crossection times a discharge coefficient, together with a sonic velocity table taken from the ASME Steam Tables (see Pages 5.023, 5.024 and A4-05). The GE model tends to produce massflow values slightly on the low side for lower pressures (below ~400 psia), which is equivalent to having a slightly smaller valve crossectional area. The ef-

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fect on results should be negligible.

7. The GE analysis does not assume an increase in containment pressure, while the WPPSS analysis assumes an increase to 30 psia = 15 psig, based on the fact that containment cooling is postulated to be unavailable during the transient. The effect on results is noticeable (higher injection flow because of higher pump suction pressure).

8. The GE analysis uses an initial liquid level of 44.6 ft, while the WPPSS model uses 45.0 ft. According to GE, both of these values

are conservative. A true best estimate would be 46.6 ft, based on realistic feedpump coastdown and control system action. However, the higher level of 46.6 ft was not used. Efect on results would be small.

9. The WPPSS model has only 2 fluid nodes in the reactor vessel: one for liquid, one for vapor. Consequently, the LPCI flow is mixed with the entire liquid inventory. This results in the liquid node staying in saturation (and no void collapse taking place) during depressuri-

zation: stored heat, decay heat and excess enthalpy from the depressurizing liquid supply enough heat to sustain flashing even with the coolant coming in.

The GE model[1] is much more articulate, it has 5 fluid nodes in the vessel. However, it lumps all core coolant inside the shroud into one node, ignoring the fuel assembly cans. The incoming liquid is then mixed with this node, causing it to go subcooled (all voids collapse). The level trace on

(1) SAFE code

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Page A5-13 is for this node.

At first glance the GE model appears more realistic than the WPPSS model. However, the opposite is the case. The WPPSS level trace is somewhat more representative of the liquid level inside the fuel cans, while the GE trace is more representative of the liquid level outside the cans (also called bypass region). Therefore, the GE trace is pessimistic as far as actual fuel uncovery is concerned.

In physical reality, LPCI goes into the bypass region, causing void collapse there and cooling the outside surface of the cans, while the liquid level inside the cans is being kept up by sustained flashing and by vapor bubbles blowing in thru the side entry orifices from the flashing lower plenum. The counter current flow limiting (CCFL) effect precludes draining of liquid from the cans. (Ref. 15, Ref. 16)

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The final conclusion is that the actual liquid level inside the cans is likely to be <u>higher</u> than the level trace from the WPPSS model indicates because flashing inside the cans is sustained thru-out the critical "fuel uncovery" period, without mixing of cold coolant inside the cans taking place. The GE trace is considered strongly conservative, more representative of the uncovery of control blades than uncovery of fuel assemblies.

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10. The maximum peak cladding temperature in the GE analysis is calculated with the CHASTE code, while the WPPSS analysis uses a highly conservative upper bound estimate. This results in the GE value (762 F) being 26 F below the WPPSS value (788 F) although the GE analysis shows a total fuel uncovery time of 5.4 min[1] versus 3.0 min for the WPPSS analysis. The hot fuel node in CHASTE is uncovered for 4.5 min (see Page A5-10).

(1) Page A5-13

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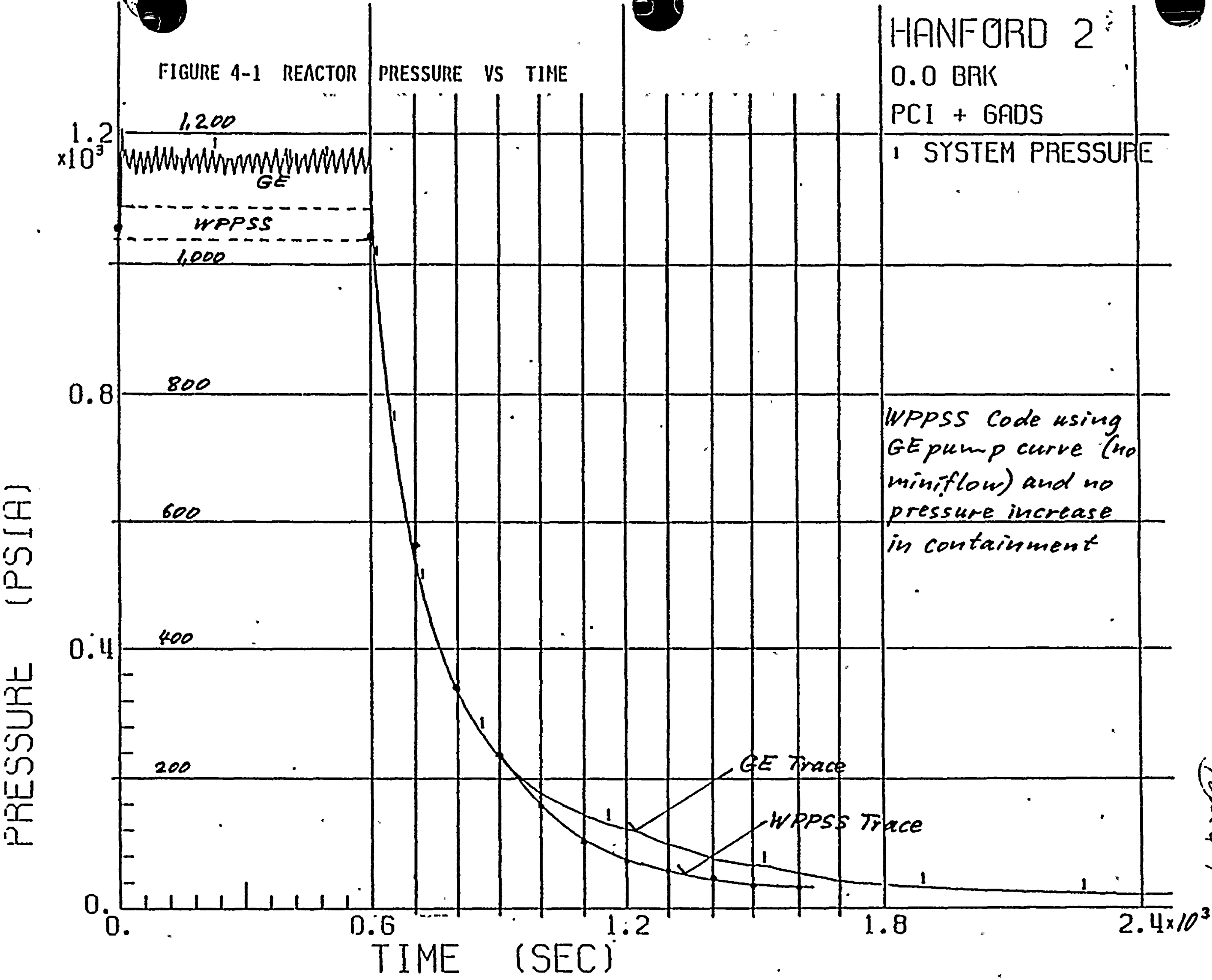
For the purpose of verification, a comparison run has been made with the WPPSS model, using the decreased pump curve (Page A6-04) and no containment pressure increase. The traces on the following pages show the results. The graphs demonstrate good agreement between the 2 models.



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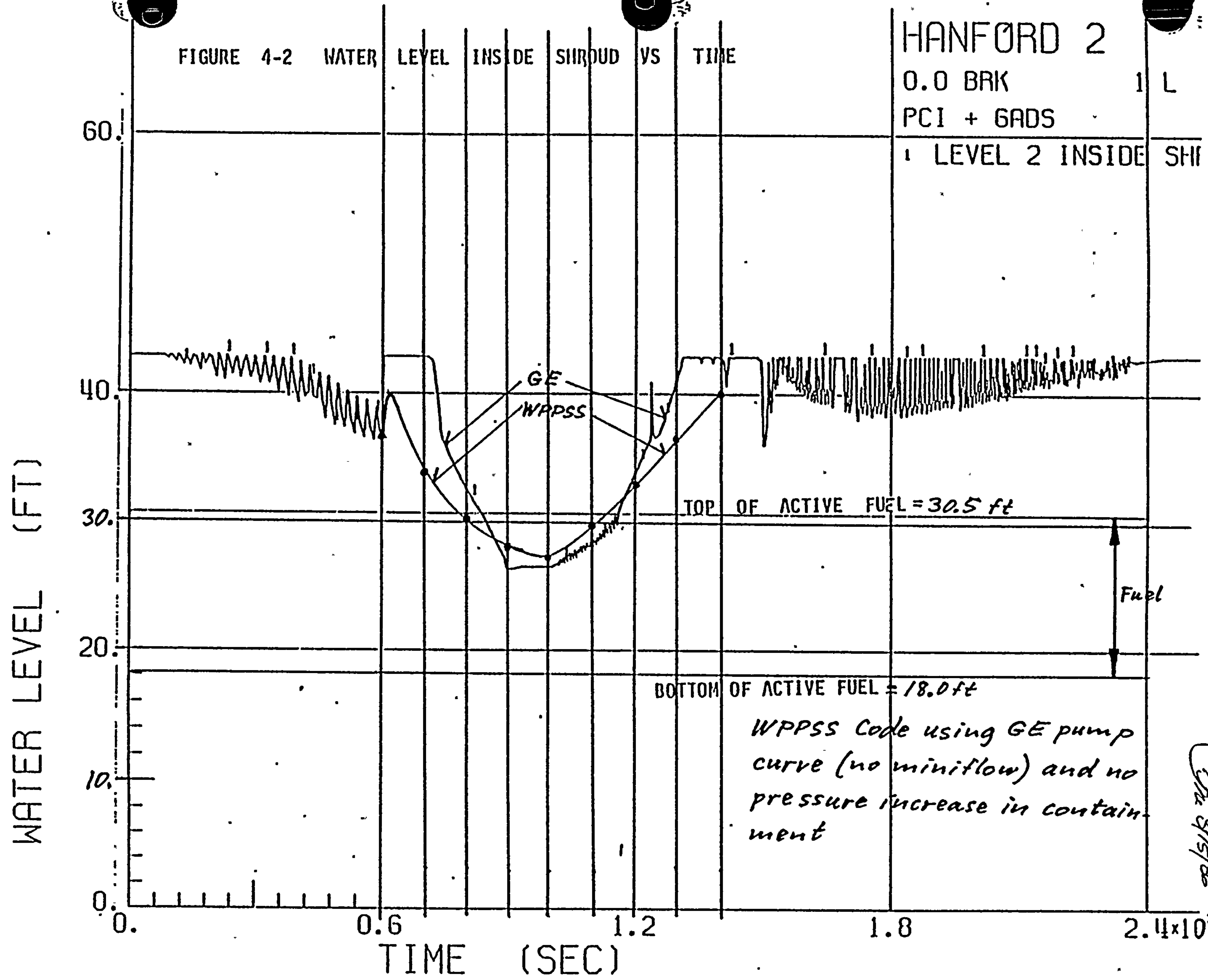

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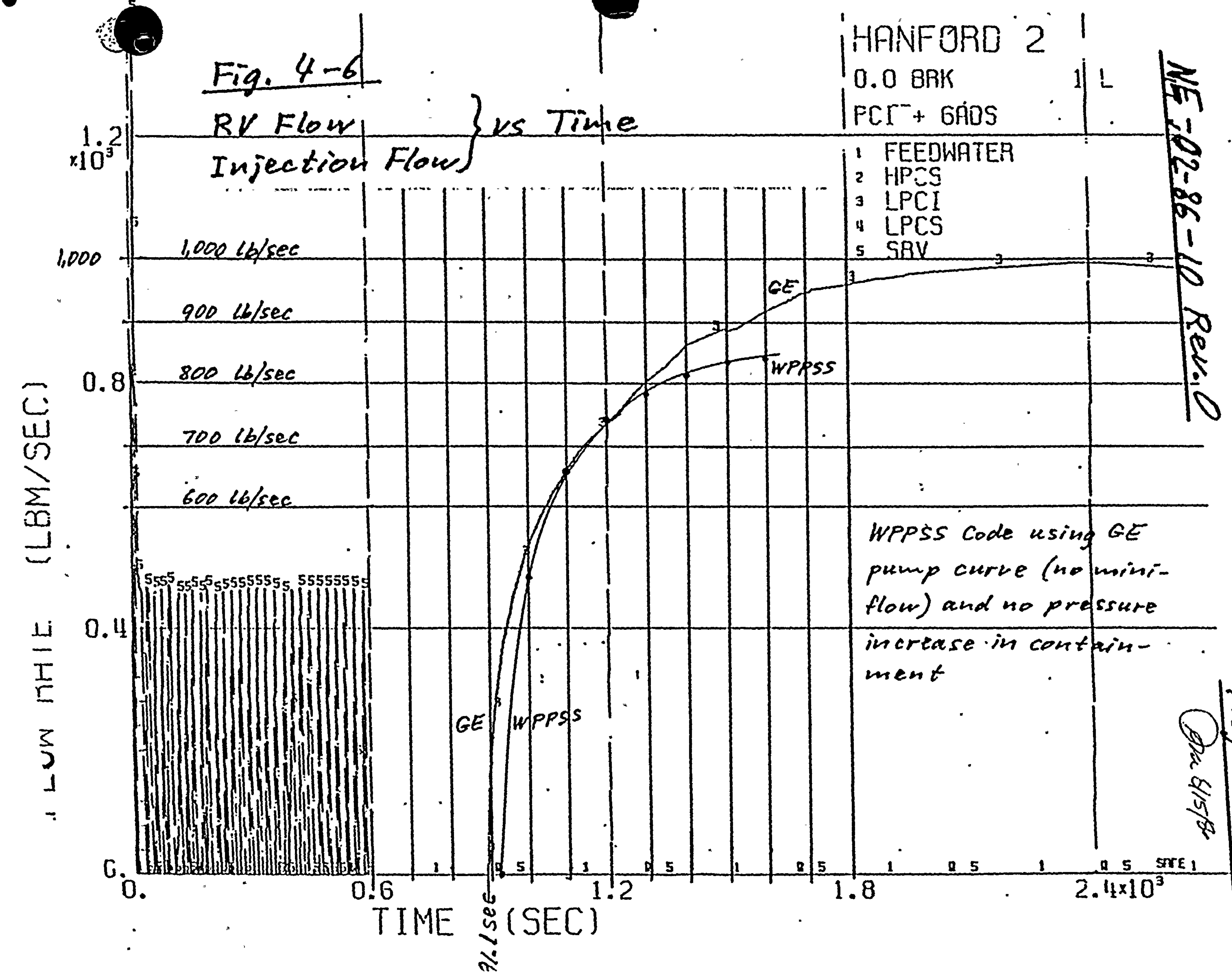

Fig. 4-6
RV Flow
Injection Flow
vs Time
HANFORD 2
0.0 BRK
PCI + 6ADS
1 FEEDWATER
2 HPCS
3 LPCI
4 LPCS
5 SRV
1,000 lb/sec
900 lb/sec
800 lb/sec
700 lb/sec
600 lb/sec
1,000
1.2
x10³
0.8
0.4
0.
GE
WPPSS
WPPSS Code using GE pump curve (no mini-flow) and no pressure increase in containment
FLOW RATE (LBM/SEC)
0.
0.6
1.2
1.8
2.4x10³
TIME (SEC)
917 sec
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APPENDIX 7

Completeness of the Postulated Hypothetical Scenario

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The scenario evaluated in this report is intended to bound the worst accumulation of fire damage and/or malfunctions postulated for a 10 CFR 50, Appendix R fire event. It is noted that the probabilities of simultaneous occurrence of the design basis fire with any combination of the other postulated failures are extremely small. Thus, the evaluated scenario does not have a single, well defined initiator, nor is the number and/or combination of postulated malfunctions based on a specific physical rationale.

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For the purpose of this evaluation the question of completeness has been raised: is there a modification in boundary and/or initial conditions which would alter the final results in a thermally detrimental way?

Out of several possibilities which were evaluated, only two were identified which would potentially affect the conclusions in an adverse way:

Case 1: Offsite power is not lost, ~~so that~~ and containment cooling is available. Consequently, no containment pressure increase would be postulated,

which would result in slightly lower injection flow.

Case 2: A relief valve either sticks open or is kept open by a hot short, so that liquid coolant depletion during the first 10 min is increased.

As the tabulation of key relevant results on Page A7-05 shows, the differences between Case 1 and the Base Case are minimal: the minimum level is lower by 0.2 ft, the total uncovery time is increased by only 20 sec, and the upper bound estimate for maximum peak cladding temperature is in-

Case	Liquid Level at t=10 min	Reactor Pressure at t=10 min	Minimum Liquid Level	Total Fuel Uncovery Time	Estimated Max. Peak Cladding Temp.
—	ft	psia	ft	sec	F
Base Case	36.2	1039	28.5	177	788
Case 1	36.2	1039	28.3	197	828
Case 2	33.8	883	28.6	172	777

For Base Case see Page 5.060 and Appendix 4

Case 1 = <u>No</u> loss of offsite power

Case 2 = 1 relief stuck open for $t > 1.0$ sec

Two modifications of the base case

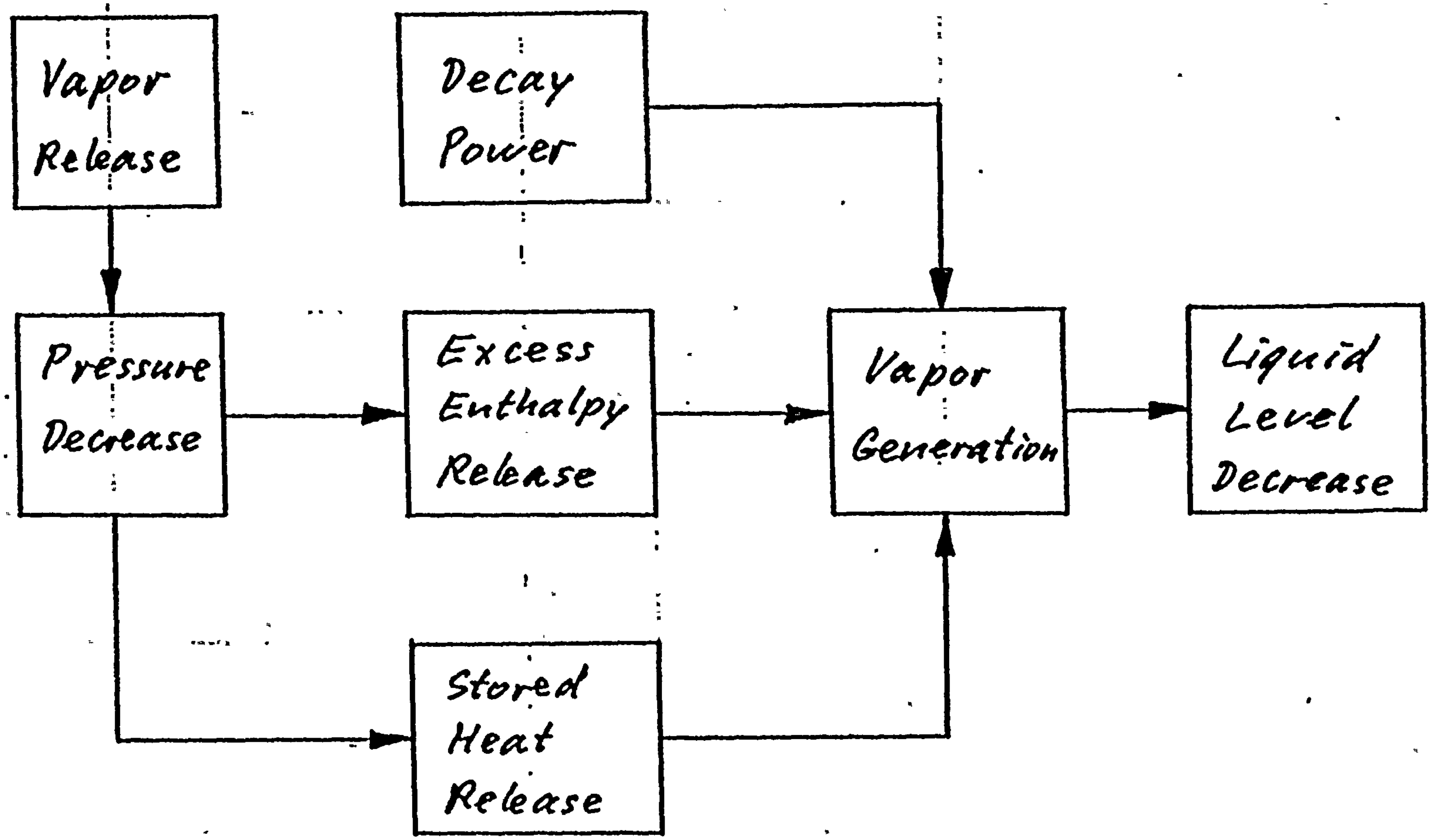
creased by 40 Fahrenheit. The PCT was calculated from

$$T = 434 + (2)(197) = 828\ F$$

For Case 2 the results look actually better than the Base Case. Its upper bound estimate for maximum peak cladding temperature is

$$T = 433 + (2)(172) = 777\ F$$

Looking at this case, it can basically be stated that each psi of pressure decrease is "paid for" by a certain amount of liquid lost to evaporation. The sketch on Page A7-07 illustrates this. The amount of ex-



The three heat sources during depressurization

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cess enthalpy per psi of pressure decrease, and also the heat of evaporation, vary somewhat with pressure. It appears from the results of Case 2 that the thermal "price" to be paid (in terms of lb of liquid per psi of pressure decrease) is slightly lower at elevated pressures.

Although it is possible to construct various modifications for this scenario which would somewhat affect the numerical results, no modifications have been identified which would invalidate

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~~validate~~ the conclusion that the plant is capable of tolerating this postulated event with a wide margin of Safety.