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for U.S. Nuclear Regulatory Commission

EXPERIMENT PREDICTION FOR LOFT NONNUCLEAR EXPERIMENT L1-4

JAMES R. WHITE VICTOR T. BERTA
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April 1977

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April 6, 1977

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TRANSMITTAL OF THE EXPERIMENT PREDICTION FOR LOFT EXPERIMENT L1-4 - LFB-59-77

Dear Mr. Tiller:

Attached is the Experiment Prediction for LOFT Experiment L1-4. This report contains the WHAM and RELAP4 computer code predictions of the thermal-hydraulic response of the LOFT system during subcooled and saturated blowdown. We welcome your comments.

Very truly yours,

L. F. Burdige
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EXPERIMENT PREDICTION FOR LOFT
NONNUCLEAR EXPERIMENT L1-4

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EXPERIMENT PREDICTION FOR LOFT
NONNUCLEAR EXPERIMENT L1-4

by

James R. White
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EG&G Idaho, Inc.

April 1977

PREPARED FOR THE
U.S. NUCLEAR REGULATORY COMMISSION AND
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
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ABSTRACT

A computer analysis, using the WHAM and RELAP4 computer codes was performed to predict the LOFT system thermal-hydraulic response for Experiment L1-4 of the nonnuclear (isothermal) test series. Experiment L1-4 will simulate a 200% double-ended offset shear in the cold leg of a four-loop large pressurized water reactor. A core simulator will be used to provide a reactor vessel pressure drop representative of the LOFT nuclear core. Experiment L1-4 will be initiated with a nominal isothermal primary coolant temperature of 282.2°C, a pressurizer pressure of 15.51 MPa, and a primary coolant flow of 270.9 kg/s.

In general, the predictions of saturated blowdown for Experiment L1-4 are consistent with the expected system behavior, and predicted trends agree with results from Semiscale Test S-01-4A, which simulated the L1-4 experiment conditions.

SUMMARY

This document contains a prediction of the LOFT system thermal-hydraulic response for Experiment L1-4 of the nonnuclear (isothermal) test series. Comprehensive predictions of system response are furnished to emphasize and clarify significant points of pretest predictions and to illustrate how Experiment L1-4 test objectives will be met. Detailed predictions are presented for most measurement transducers to be recorded during the experiment with the exception of those transducers for which analytical model limitations do not permit a comparable prediction. The detailed predictions provide definitive information regarding instrument range settings and possible pretest instrument rearrangements.

The predictions are based primarily on the WHAM and RELAP4 computer codes. A detailed description of the analytical codes and models is included in Section IV of this document. The analytical methods and models which are utilized in the pretest predictions should be recognized as "best estimate" predictive mechanisms.

Experiment L1-4 will simulate a 200% (double-ended offset) shear in the cold leg of a four-loop large pressurized water reactor. A core simulator will be used instead of a nuclear core and will provide a representative reactor vessel pressure drop. The experiment will be initiated with a nominal isothermal primary coolant temperature of 282°C, a pressurizer pressure of 15.5 MPa, and a primary coolant flow of 271 kg/s.

In general, the predictions of saturated blowdown are consistent with the expected system behavior, and predicted trends agree with results of LOFT Experiment L1-3A and Semiscale Test S-01-4A. Comparison with LOFT and Semiscale data is done in Section II to provide increased confidence in the LOFT predictions.

LIST OF ACRONYMS

CE	Combustion Engineering
CHF	Critical Heat Flux
ECC	Emergency Core Coolant
ECCS	Emergency Core Cooling System
EOS	Experiment Operating Specification
EP	Experiment Prediction
HEM	Homogenous Equilibrium Model
HPIS	High-Pressure Injection System
LOCE	Loss-of-Coolant Experiment
LPIS	Low-Pressure Injection System
LPWR	Large Pressurized Water Reactor
PCS	Primary Coolant System
PPS	Plant Protection System
QOBV	Quick-Opening Blowdown Valve
SCS	Secondary Coolant System

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EXPERIMENT PREDICTION FOR LOFT NONNUCLEAR EXPERIMENT L1-4

I. INTRODUCTION

Some of the more important reasons for doing an experiment prediction include:

- (1) Determining whether a test will meet its stated objectives
- (2) Evaluating parameters that affect the safety of the facility during the intended test
- (3) Providing input to the operating procedure for event times
- (4) Providing information for possible instrument range adjustments
- (5) Providing information to evaluate the capability of the modeling techniques employed in experiment prediction analysis.

The purposes of this experiment prediction (EP) document are to:

- (1) Provide comprehensive pretest predictions for those test parameters which are related to the specific objectives of the particular Loss-of-Coolant Experiment (LOCE) L1-4, and which are illustrative of how these objectives are accomplished
- (2) Provide detailed pretest predictions for each measurement transducer to be recorded during the LOCE with the exception of strain gages and accelerometers
- (3) Provide a description of the calculational techniques used in performing the pretest predictions.

LOFT Test Series L1 consists of five nonnuclear LOCEs in which the parameters to be varied are break size, break location, emergency core cooling system (ECCS) injection location, and primary coolant system (PCS) flow resistance. Each experiment will be initiated with a nominal isothermal PCS temperature of 282°C and with PCS flow at 271 kg/s. In order to provide for a representative reactor vessel pressure drop, a core simulator will be installed in all but the final experiment, Experiment L1-5, of the nonnuclear test series. For Experiment L1-5, the core simulator will be replaced by a nuclear core. One of the major purposes of the LOFT nonnuclear LOCEs is to make available large scale isothermal blowdown and reflood system data as a first phase of the LOFT experimental program. More specific purposes include facility checkout for a LOCE, operator training, and procedure checkout prior to nuclear operation. General requirements for the test series are specified in Reference 1.

Experiment L1-4, will simulate a 200% (100% of the break area of each leg) double-ended offset shear in the cold leg of a four-loop large pressurized water reactor (LPWR). For Experiment L1-4, the intact loop ΔP (excluding the reactor vessel) will be scaled by the "core flow area" technique (low flow resistance). Prerupture system conditions, as specified in the Experiment Operating Specification (EOS) Volume 2 for Experiment L1-4^[2], are listed in Table I. For comparison purposes, prerupture system conditions for the Semiscale MOD-1 counterpart test, S-01-4A^[3], are listed in Table II. The blowdown transient will be initiated by opening the two quick-opening blowdown valves (QOBVs). The break opening time will be about 17.5 msec. The QOBVs will be opened simultaneously.

During Experiment L1-4, the secondary coolant system (SCS) will be operated with no feedwater flow and with no steam flow. During pre-LOCE operation, the steam generator water level will be controlled at the zero-power operating level as given in Table I.

TABLE I
EXPERIMENT L1-4 PRERUPTURE CONDITIONS

Item	Parameter	Value ^[a]
1.	Intact loop:	
	a. System pressure	15.5 MPa
	b. Temperature	282°C
	c. Flow rate	271 kg/s
	d. Pump ΔP	197 kPa
2.	Pressurizer:	
	a. Pressure	15.5 MPa
	b. Liquid level	1.13 m
	c. Liquid volume	0.634 m ³
3.	Steam generator liquid level (secondary side)	2.95 m
4.	Steam generator ΔP (primary side)	869 kPa
5.	Broken loop temperature	282°C
6.	Suppression Tank:	
	a. Liquid level	1.37 m
	b. Liquid temperature	83.8°C
	c. Tank pressure	9.65 kPa
7.	Emergency core cooling system:	
	a. Accumulator:	
	Temperature	32.2°C
	Pressure	4.14 MPa
	Injected water volume	1.97 m ³
	Gas volume	1.10 m ³
	b. LPIS ^[b] temperature	32.2°C
	c. HPIS ^[c] temperature	32.2°C
8.	Primary coolant system volume	7.73 m ³
9.	Break flow area (cold leg break)	
	a. Pump side	83.7 cm ²
	b. Vessel side	83.7 cm ²

[a] Only nominal parameter values are given. Refer to the EOS^[2] for acceptable experiment operating bands.

[b] Low-pressure injection system.

[c] High-pressure injection system.

TABLE II
CONDITIONS AT INITIATION OF SEMISCALE TEST S-01-4A

<u>Item</u>	<u>Parameter</u>	<u>Measured</u>	<u>Specified</u>
1.	System fluid temperature (intact loop at vessel outlet) ($^{\circ}\text{C}$)	283	282
2.	System pressure (vessel upper plenum) (MPa)	15.3	15.5
3.	Intact loop cold leg flow (l/s)	11.0	10.9
4.	Accumulator pressure (MPa)	4.14	4.14
5.	Temperature of injected coolant ($^{\circ}\text{C}$)	24.4	29.4
6.	Accumulator water volume (m^3)	0.045	0.046
7.	Accumulator gas volume (m^3)	0.031	0.031
8.	Pressurizer water volume (m^3)	0.023	0.020
9.	Steam generator secondary steam dome pressure (MPa)	6.69	6.64
10.	Steam generator secondary fluid temperature ($^{\circ}\text{C}$)	284	282
11.	Steam generator liquid level (from bottom of tube sheet) (m)	3.07	3.12
12.	Pressure suppression tank water level (m)	1.19	1.21
13.	Pressure suppression tank pressure (kPa)	119	119
14.	Pressure suppression tank water temperature ($^{\circ}\text{C}$)	68.9	68.9
15.	Primary coolant system volume (m^3)		0.241
16.	Break flow area (pump side) (cm^2)		2.43
17.	Break flow area (vessel side) (cm^2)		2.43

Electrical power to the primary system motor generator sets will be terminated within 1 second after initiation of the LOCE transient. After this time, the primary pumps will coast down on the energy supplied to the generator by the flywheel.

The LPIS, the HPIS, and the accumulator injection system will be used to inject scaled amounts of emergency core coolant (ECC) into the intact loop cold leg^[2]. For this experiment, the accumulator orifices were sized to deliver the scaled accumulator volume to the LOFT primary coolant system in the same time period as calculated for a LPWR.

The LPIS and HPIS pumps are normally started automatically when low primary system pressure coincident with low pressurizer level or high containment pressure (suppression tank pressure) trips are received. For experiment L1-4, LPIS flow will be started at 35.5 ± 2 seconds and the HPIS flow started at 22 ± 2 seconds after the QOBVs are opened. This delay equals the time required for LPIS and HPIS pumps to start in typical LPWR plants, assuming a loss of site power concurrent with the pipe rupture.

The programmable suppression tank spray, heating, and vacuum breaker systems will be operational for this experiment. The systems will be checked out and ready for initiation during the LOCE.

As outlined in EOS Volume 2, the objectives of Experiment L1-4 include, in addition to facility checkout, operator training, and procedure checkout, the following specific purposes:

- (1) To provide data for comparing delayed HPIS and LPIS injection to the cold leg and the lower plenum
- (2) To provide data reproducibility information by comparing with other related tests

- (3) To obtain data for evaluating downcomer bypass and mixing of the ECC with the primary coolant
- (4) To provide data for determining the effects of PCS operation and rapid depressurization with boric acid coolant
- (5) To test system performance with plant protection system (PPS) backup under operating procedures as similar as possible to those planned for nuclear operation
- (6) To provide system thermal-hydraulic data to compare with predictions and other experimental data for code verification purposes.

The comprehensive predictions given in Section II are discussed in relation to these objectives. The comprehensive predictions consist primarily of time histories presented on a component-by-component basis. Discussion is provided to emphasize and clarify significant points of the pretest predictions.

The detailed predictions given in Section III are presented primarily as time histories and with minimal discussion. The detailed predictions provide definitive information regarding instrument range settings and possible pretest instrument rearrangements. The LOFT instrumentation is shown in Figures 1 through 5. The instrumentation nomenclature is explained in Table III. A more thorough discussion of the LOFT system, including a detailed description of the instruments and their locations may be found in Reference 4. Comparisons between the predicted and the actual system response will be presented in the Quick Look Report for Experiment L1-4.

For the pretest predictions of Experiment L1-4, the WHAM^[5] and RELAP4^[6] computer codes are utilized. The codes and code model changes are discussed in Section IV. Input listings for these codes appear in Appendices A, B, and C. Appendix D describes how the output of the WHAM

and RELAP4 codes are used to construct the engineering units predictions for each transducer.

TABLE III
NOMENCLATURE FOR LOFT INSTRUMENTATION

The designations for the different types of transducers are as follows:

1.	TE	-	Temperature element
2.	TT	-	Temperature transmitter
3.	PE	-	Pressure transducer
4.	PT	-	Pressure transmitter
5.	PdE	-	Differential pressure element
6.	PdT	-	Differential pressure transducer
7.	LE	-	Coolant level transducer
8.	LT	-	Level transmitter
9.	FE	-	Coolant flow transducer
10.	FT	-	Flow transmitter
11.	AE	-	Accelerometer
12.	DiE	-	Displacement transducer
13.	ME	-	Momentum flux transducer
14.	SE	-	Strain gage
15.	RpE	-	Pump speed transducer
16.	DE	-	Densitometer
17.	LIT	-	Level indicating transmitter
18.	CV	-	Control valve

The designations for the different systems, except for the core, are as follows:

1.	PC	-	Primary coolant intact loop
2.	BL	-	Blowdown loop
3.	SG	-	Steam generator
4.	RV	-	Reactor vessel
5.	MTA	-	Test assembly
6.	SV	-	Suppression tank
7.	CS	-	Core simulator
8.	UP	-	Upper plenum
9.	LP	-	Lower plenum
10.	ST	-	Downcomer stalk
-

Fig. 1 LOFT major thermo-fluid measurements instrumentation.

Fig. 2 LOFT intact loop differential pressure instrumentation.

PIPING FROM LOFT REACTOR VESSEL - BROKEN LOOP COLD LEG (COLD LEG BREAK)

INEL-A-1712

Fig. 3 LOFT broken loop cold leg instrumentation.

Fig. 4 LOFT reactor vessel instrumentation.

Fig. 5 LOFT piping and instrument diagram.

II. COMPREHENSIVE TEST PREDICTIONS

This section provides pretest predictions and discussion for those parameters which are judged to be of the most general interest and, in addition, which relate to the specific objectives of Experiment L1-4 as stated in Section I. The predictions consist primarily of time histories with discussion provided to emphasize the significant points of the predictions. Comparisons are made with results of the Semiscale counterpart Test S-01-4A and the LOFT Experiment L1-3A to provide increased confidence in the validity of the predictions, and to provide a preliminary feel for the similarity of Semiscale/LOFT experimental response. The computer codes, calculational techniques, and code models discussed in Section IV were used to make predictions of the LOFT system response for Experiment L1-4.

1. SYSTEM HYDRAULIC RESPONSE DURING SUBCOOLED BLOWDOWN

The data obtained from PE-1ST-3FF (at the upper end of downcomer instrument stalk 1) in Experiment L1-3A is compared with the WHAM/MOD006 Experiment L1-4 prediction in Figure 6. Time zero on the plot is not the same for both curves. The WHAM prediction begins at the start of the subcooled blowdown transient. Time zero for the Experiment L1-3A data is set to correspond to the average of the times that the two QOBV sleeves reached 17% of full travel (0% area opening), which in Experiment L1-3A is about 7 msec after subcooled blowdown has started. Thus, the Experiment L1-4 prediction should oscillate above and below the Experiment L1-3A data instead of being mostly above the data.

The oscillations predicted by the WHAM code for Experiment L1-4 which do not appear in the Experiment L1-3A data is attributed to two modeling aspects: the first is the nodalization of the downcomer. The downcomer model employs four vertical pipes connected at the bottom of a single point and at the top to a horizontal piping network which

connects the two inlet pipes to the downcomer. The area assigned to each vertical pipe is one-fourth of the total downcomer area. This model is a coarse representation of the downcomer compared to the two- and three-dimensional modeling techniques, and would result in larger amplitude oscillations because of the coarse nodal scheme. The amplitude of the oscillations, however, was not considered to be significantly larger for the coarse downcomer representation because of the small diameter of the LOFT downcomer. Wave propagation halfway around the downcomer occurs in less than 1.0 msec which, in conjunction with the >10 msec pressure waves resulting from the QOBV opening times, means that pressure differentials around the downcomer will be very small.

The second modeling area is in the use of energy losses. The Experiment L1-3A data could support the contention that the energy losses in pressure waves are higher in the downcomer region because of the higher surface to flow area and since pressure waves entering the downcomer from the inlet pipes propagate around the downcomer as well as vertically downward. Energy losses in pressure waves are handled in the WHAM code through the use of orifices placed at the internal nodes of each pipe segment (leg) in the model. A coefficient called an energy loss coefficient is specified which effects the size of the orifices in relation to the leg areas. Ten such coefficients can be specified in the WHAM code each of which is applied to specified range of leg areas. The WHAM prediction employs only one energy loss coefficient which is applied to the entire PCS model. This value, 1.5, may be too low for the downcomer region. Larger energy loss terms tend to decrease the amplitude of pressure oscillations during subcooled blowdown while not significantly affecting the overall rate of depressurization. Additional larger energy loss terms were not used in the Experiment L1-4 prediction because the selection and use of energy loss terms is not well developed and lacks supportive experimental data at this time.

Fig. 6 Comparison of LOFT measured and WHAM predicted pressure in the reactor vessel inlet annulus during subcooled blowdown.

2. SYSTEM THERMAL-HYDRAULIC RESPONSE DURING SATURATED BLOWDOWN

Figures 7 and 8 show the RELAP4 predicted pressure response during saturated blowdown compared with the results of the Semiscale counterpart test (Test S-01-4A) and a similar LOFT experiment (Experiment L1-3A). Experiment L1-3A is essentially identical to Experiment L1-4 except that L1-3A had ECC injection in the lower plenum instead of the intact loop cold leg. In Figure 7 the agreement between the three curves is excellent up until the time of ECC injection. The Experiment L1-3A pressure data is higher than the RELAP4 data after this point, probably because there was more incomplete mixing of the ECC fluid in the lower plenum injection experiment than was observed in the cold leg injection RELAP4 run. Although more complete condensation is expected to occur in Experiment L1-4 due to the cold leg mode of ECC injection, the complete instantaneous mixing assumption in RELAP4 is expected to still be overpredicting the pressure decline. It is expected that the L1-4 experimental data will be between the RELAP4 prediction and the Experiment L1-3A data. The Semiscale pressure may be higher than Experiment L1-4 due to a slightly larger system-liquid-volume-to-break-area ratio or due to a higher piping-heat-transfer-to-system-liquid-volume ratio.

In Figure 8 the pressurizer pressure response for all three curves is similar up to the time when the pressurizer empties. The difference in time it takes the pressurizer to empty is mainly due to the difference in the initial volume of fluid in the pressurizer. In Experiment L1-3A, the pressurizer liquid volume was slightly less than the nominal value specified in the EOS for that experiment^[7].

Fig. 7 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted primary system pressure.

Fig. 8 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted pressurizer pressure.

Figure 9 shows a comparison of the intact loop cold leg densities measured upstream of the cold leg ECC injection point. The behavior of the densities is generally similar for the first 30 seconds of the test, then the Semiscale data show signs of the ECC fluid. The RELAP4 prediction shows essentially all steam flowing by this instrument location for approximately the first 52 seconds. This is caused by the steam condensation at the ECC injection point which causes steam to flow in the normal flow direction in the intact loop cold leg toward the ECC injection point. It is anticipated that this steam flow is somewhat overpredicted by the LOFT RELAP4 model. The Experiment L1-3A data show no ECC fluid, because for that experiment, the ECC fluid was injected in the lower plenum.

Fig. 9 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted intact loop cold leg density.

Figure 10 shows a comparison of the densities in the intact loop hot leg. The data show the effect of the flow reversal which occurs in the intact loop hot leg at approximately 5 seconds after blowdown. The increase in density at approximately 20 seconds after blowdown in the LOFT data and in the RELAP4 prediction can be attributed to fluid which is entrained in the steam generator inlet plenum and which later flows past the instrument location toward the reactor vessel. This phenomenon also occurs in the Semiscale data^[3], but is better seen in vertical densitometer beam GU-01-VR instead of GU-01-HZ.

Fig. 10 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted intact loop hot leg density.

Figures 11 and 12 show comparisons of densities in the broken loop cold and hot legs. The overprediction of density in the broken loop cold leg during the period up to 20 seconds after blowdown may indicate an underprediction of slip effects in the downcomer. Beyond the time of ECC injection, RELAP4 does not predict the degree of ECC bypass as observed in the Semiscale data in Figure 11. The underprediction of density in the broken loop hot leg may be an indication of an overprediction of hot leg break flow.

Fig. 11 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted broken loop cold leg density.

Fig. 12 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted broken loop hot leg density.

Figure 13 shows the comparison between the temperatures in the intact loop cold leg. The comparison is excellent until the time of ECC injected into the system. Beyond 25 seconds after blowdown, the Semiscale thermocouple may be influenced by radiation heat transfer from the intact loop piping or by stem conduction. At 24 seconds after blowdown, the RELAP4 prediction is influenced by the ECC fluid being injected into the intact loop cold leg.

Fig. 13 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted intact loop cold leg temperature.

Figures 14 and 15 show the comparison between the fluid temperatures in the broken loop hot and cold legs. All three curves in each graph closely follow the saturation temperature evaluated at the primary system pressure of each respective system. This is significant in that no curve indicated subcooled ECC fluid flowing through either the hot or cold leg in the broken loop. The density data in Figure 11 indicates that some ECC bypass occurred in the Semiscale system, however.

Fig. 14 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted broken loop cold leg temperature.

Fig. 15 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted broken loop hot leg temperature.

Figures 16 and 17 show comparisons of the fluid temperatures in the reactor vessel. The LOFT Experiment L1-3A data in Figure 17 show the effects of the ECC fluid that was injected in the lower plenum for that experiment. The remainder of the curves are essentially at saturation conditions.

Fig. 16 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted reactor vessel downcomer temperature.

Fig. 17 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted reactor vessel lower plenum temperature.

Figure 18 shows the comparison between LOFT measured and RELAP4 predicted velocity in the broken loop cold leg. The agreement is good up to the time of ECC injection. Beyond that time, the ECC fluid is causing the RELAP4 calculated primary system pressure to be lower than what is expected to occur in the test. This probably causes the cold leg velocity to be underpredicted by the LOFT RELAP4 model. Another possible contributing factor in the underprediction of velocity in the broken loop cold leg may be due to the fact that flow regime in the broken loop cold leg is stratified beyond 20 seconds after blowdown. This could cause the turbine meter, which is located in the center of the cold leg pipe, to record higher than average velocities during periods of stratified flow. Experiment L1-4 will utilize a "rake" of three vertically displaced turbine - drag disc measurements to quantify this effect.

Fig. 18 Comparison of LOFT measured and RELAP4 predicted velocity in broken loop cold leg.

Figure 19 is a comparison of the normalized LOFT predicted, LOFT measured, and Semiscale measured pump speeds. The RELAP4 predicted pump speed tends to remain fairly constant just above the primary coolant pump trip point. This is due to a large steam flow through the pump in the RELAP4 model due to ECC steam condensation which is occurring downstream of the LOFT primary coolant pumps. The Semiscale pumps also returned to a constant speed because these pumps were repowered at just after 20 seconds into the test. The LOFT pumps for Experiment L1-4 are expected to behave in much the same manner as shown for Experiment L1-3A.

Fig. 19 Comparison of LOFT measured, Semiscale measured, and RELAP4 predicted normalized pump speed.

III. DETAILED TEST PREDICTIONS

In this section, predictions are provided for each measurement transducer to be recorded during Experiment L1-4 with the exception of strain gages and those transducers for which model limitations do not allow a comparable prediction. The predictions of transducer response are based on the computer codes, calculational techniques, and code models discussed in Section IV. In order that the predicted parameters can be associated with the models utilized, the reader is referred to Appendix D. Appendix D outlines in detail how the output of the WHAM and RELAP4 codes are used to construct the engineering units prediction data for each transducer. The transducer locations are identified in Figures 1 through 5.

Predictions using the RELAP4 computer code indicate that there will be backflow from the pressure suppression tank to the primary system at the end of blowdown (refer to Figures 25 and 26). This backflow is caused by the interaction of the cold ECC fluid condensing steam in the primary system. Due to the incomplete mixing which occurs during ECC injection, this phenomenon has not been observed in any previous LOFT experiment and is not expected to occur during Experiment L1-4. Reference data tapes for the pretest prediction analysis of Experiment L1-4 are as follows:

- (1) WHAM - Tape No. T90240
- DSN 'LVTBWHM'
- (2) RELAP4 - Tape Nos. T9L219 and T9L183
- (3) Semiscale data tape - Tape No. T9B257
- DSN 'Semiscale Test MJJCSA14'
- (4) LOFT L1-3A Data - Tape No. T95454
- DSN 'LOFT.L103A01A.DQDARA'.

LI-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 20 Density in broken loop cold leg (DE-BL-1A, -1B, and -1C).

LI-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 21 Density in broken loop hot leg (DE-BL-2A, -2B, and -2C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 22 Density in intact loop cold leg (DE-PC-1A, -1B, and -1C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 23 Density in intact loop hot leg (DE-PC-2A, -2B, and -2C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 24 Density in intact loop between steam generator and primary coolant pumps (DE-PC-3A, -3B, and -3C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 25 Fluid velocity in broken loop cold leg (FE-BL-1A, -1B, and -1C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 26 Fluid velocity in broken loop hot leg (FE-BL-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 27 Fluid velocity in core simulator (FE-CS-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 28 Fluid velocity in intact loop cold leg (FE-PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 29 Fluid velocity in intact loop hot leg (FE-PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 30 Fluid velocity in intact loop between steam generator and primary coolant pumps (FE-PC-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 31 Fluid velocity in downcomer under broken loop cold leg (FE-1ST-1).

Fig. 32 Fluid velocity in downcomer under intact loop cold leg (FE-2ST-1).

Fig. 33 Flow rate in accumulator A discharge (FT-P120-36-1 and -5).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 34 Flow rate in LPIS (FT-P120-85).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 35 Flow rate in HPIS (FT-P128-104).

5

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 36 Flow rate in intact loop hot leg (FT-P139-27-1 and -3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 37 Liquid level in reactor vessel under broken loop cold leg (LE-1ST-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 38 Liquid level in reactor vessel under intact loop cold leg (FE-2ST-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 39 Liquid level in accumulator A (LIT-P120-44).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 40 Liquid level in pressurizer (LT-P139-6, -7, and -8).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 41 Liquid level in steam generator secondary side (LT-P4-8B).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 42 Momentum flux in broken loop cold leg (ME-BL-1A, -1B, and -1C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 43 Momentum flux in broken loop hot leg (ME-BL-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 44 Momentum flux in core simulator (ME-CS-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 45 Momentum flux in intact loop cold leg (ME-PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 46 Momentum flux in intact loop hot leg (ME-PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 47 Momentum flux in intact loop between steam generator and PCS pumps (ME-PC-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 48 Momentum flux in downcomer under broken loop cold leg (ME-1ST-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 49 Momentum flux in downcomer under intact loop cold leg (ME-2ST-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 50 Electrical frequency for primary system motor-generator set A (PCP-1-F).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 51 Electrical frequency for primary system motor-generator set B (PCP-2-F).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 52 Differential pressure across hot leg break plane (PdE-BL-4).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 53 Differential pressure across pump simulator (PdE-BL-5).

Fig. 54 Differential pressure across pump simulator during subcooled blowdown (PdE-BL-5).

Fig. 55 Differential pressure across steam generator outlet flange (PdE-BL-6).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 56 Differential pressure across steam generator simulator orifice plates (PdE-BL-7).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 57 Differential pressure across steam generator simulator orifice plates during subcooled blowdown(PdE-BL-7).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 58 Differential pressure across steam generator simulator inlet flange (PdE-BL-8).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 59 Differential pressure across core simulator (PdE-CS-1).

Fig. 60 Differential pressure across core simulator during subcooled blowdown (PdE-CS-1).

Fig. 61 Differential pressure across primary coolant pumps (PdE-PC-1).

Fig. 62 Differential pressure across primary coolant pumps during subcooled blowdown (PdE-PC-1).

Fig. 63 Differential pressure across primary coolant system steam generator (PdE-PC-2).

Fig. 64 Differential pressure across primary coolant system steam generator during subcooled blowdown (PdE-PC-2).

Fig. 65 Differential pressure in piping between reactor vessel outlet and pressurizer surge line inlet (PdE-PC-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 66 Differential pressure in piping between pressurizer surge line inlet and steam generator inlet (PdE-PC-4).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 67 Differential pressure in piping between primary coolant pump outlet and reactor vessel inlet (PdE-PC-5).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 68 Differential pressure between intact loop reactor vessel inlet and broken loop inlet (PdE-PC-7).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 69 Differential pressure across primary coolant pump 1 (PdE-PC-9).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 70 Differential pressure across primary coolant pump 2 (PdE-PC-10)

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 71 Differential pressure between reactor vessel and pressure suppression tank (PdE-RV-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 72 Differential pressure between reactor vessel inlet to lower downcomer (PdE-RV-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 73 Differential pressure between reactor vessel outlet to upper plenum (PdE-RV-4).

Fig. 74 Differential pressure between upper and lower downcomer (PdE-2ST-2).

Fig. 75 Differential pressure across reactor vessel (PdT-P139-30).

Fig. 76 Pressure in broken loop cold leg (PE-BL-1).

Fig. 77 Pressure in broken loop cold leg during subcooled blowdown (PE-BL-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 78 Pressure in broken loop hot leg (PE-BL-2).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 79 Pressure in broken loop hot leg during subcooled blowdown (PE-BL-2).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 80 Pressure in broken loop at pump simulator outlet during subcooled blowdown (PE-BL-3).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 81 Pressure in broken loop at cold leg spool piece inlet during subcooled blowdown (PE-BL-4).

LI-4 RELAP4/MOD5 (LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 82 Pressure in broken loop between steam generator and pump simulator (PE-BL-6).

LI-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 83 Pressure in broken loop between steam generator and pump simulator during subcooled blowdown (PE-BL-6).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 84 Pressure in core simulator (PE-CS-1A, -1B, -1FF, and -2FF).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 85 Pressure in core simulator during subcooled blowdown (PE-CS-1FF).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 86 Pressure in intact loop cold leg (PE-PC-1).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 87 Pressure in intact loop cold leg during subcooled blowdown (PE-PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 88 Pressure in intact loop hot leg (PE-PC-2).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 89 Pressure in intact loop hot leg during subcooled blowdown (PE-PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 90 Pressure in intact loop between steam generator and pump (PE-PC-3A and -3B).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 91 Pressure in intact loop between steam generator and pump during subcooled blowdown (PE-PC-3A).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 92 Pressure in pressurizer under broken loop cold leg (PE-PC-4 and PT-P139-5).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 93 Pressure in lower plenum under broken loop cold leg (PE-1ST-1A, -1B, and -1FF).

Fig. 94 Pressure in lower plenum under broken loop cold leg during subcooled blowdown (PE-1ST-1FF).

Fig. 95 Pressure in reactor vessel inlet annulus on broken loop side (PE-1ST-3A, -3B, and -3FF).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 96 Pressure in reactor vessel inlet annulus on broken loop side during subcooled blowdown (PE-1ST-3FF).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 97 Pressure in reactor vessel inlet annulus on intact loop side (PE-2ST-1A, -1B, -1FF, and -3FF).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 98 Pressure in lower plenum under intact loop cold leg during subcooled blowdown (PE-2ST-1FF).

L1-4 WHAM/MOD 6 EXPERIMENT PREDICTION

Fig. 99 Pressure in reactor vessel inlet annulus during subcooled blowdown (PE-2ST-3FF).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 100 Pressure in accumulator (PT-P120-43).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 101 Pressure in ECC line at intact loop cold leg injection point (PT-P120-61).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 102 Pressure in intact loop cold leg (PT-P139-2, -3, and -4).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 103 Pressure in steam generator secondary side (PT-P4-10A).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 104 Pump speed in intact loop operating pump 1 (RPE-PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 105 Pump speed in intact loop operating pump 2 (RPE-PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 106 Temperature in broken loop cold leg (TE-BL-1A, -1B, and -1C).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 107 Temperature in broken loop hot leg (TE-BL-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 108 Temperature at reflood assist bypass lines, cold leg side (TE-BL-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 109 Temperature in core simulator (TE-CS-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 110 Temperature in intact loop cold leg (TE-PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 111 Temperature in intact loop hot leg (TE-PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 112 Temperature in intact loop between steam generator and primary coolant pumps (TE-PC-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 113 Temperature of liquid in accumulator A (TE-P120-41).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 114 Temperature upstream of cold leg QOBV (TE-P138-62).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 115 Temperature upstream of cold leg isolation valve (TE-P138-63).

LI-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 116 Temperature upstream of hot leg isolation valve (TE-P138-65).

LI-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 117 Temperature upstream of hot leg QOBV (TE-P138-66).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 118 Temperature in pressurizer (TE-P139-19 and -20).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 119 Temperature in intact loop cold leg (TE-P139-29).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 120 Temperature in steam generator inlet plenum (TE-SG-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 121 Temperature in steam generator outlet plenum (TE-SG-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 122 Temperature in steam generator secondary side (TE-SG-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 123 Temperature in inlet annulus on broken loop side (TE-1ST-1).

LI-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 124 Temperature in reactor vessel downcomer under broken loop cold leg (TE-1ST-2 through -8 and -14).

LI-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 125 Temperature in lower plenum under broken loop cold leg (TE-1ST-9 through -13).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 126 Temperature in inlet annulus on intact loop side (TE-2ST-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 127 Temperature in downcomer on intact loop side (TE-2ST-2 through -8 and -14).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 128 Temperature in lower plenum under intact loop cold leg (TE-2ST-9 through -13).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 129 Temperature in ECC injection line to intact loop cold leg (TT-P120-62).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 130 Temperature in intact loop hot leg (TT-P139-32, 33, and -34).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 131 Enthalpy in broken loop cold leg (Station BL-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 132 Enthalpy in broken loop hot leg (Station BL-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 133 Enthalpy in intact loop cold leg (Station PC-1).

Fig. 134 Enthalpy in intact loop hot leg (Station PC-2).

Fig. 135 Enthalpy in intact loop between the steam generator outlet and the pump inlet (Station PC-3).

Fig. 136 Void fraction in broken loop cold leg (Station BL-1).

Fig. 137 Void fraction in broken loop hot leg (Station BL-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 138 Void fraction in intact loop cold leg (Station PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 139 Void fraction in intact loop hot leg (Station PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 140 Void fraction in intact loop between the steam generator outlet and the pump inlet (Station PC-3).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 141 Mass flow per system volume in broken loop cold leg (Station BL-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 142 Mass flow per system volume in broken loop hot leg (Station BL-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 143 Mass flow per system volume in intact loop cold leg (Station PC-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 144 Mass flow per system volume in intact loop hot leg (Station PC-2).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 145 Mass flow per system volume in intact loop between the steam generator outlet and pump inlet (Station PC-3).

Fig. 146 Static quality in broken loop cold leg (Station BL-1).

Fig. 147 Static quality in broken loop hot leg (Station BL-2).

Fig. 148 Static quality in intact loop cold leg (Station PC-1).

Fig. 149 Static quality in intact loop hot leg (Station PC-2).

Fig. 150 Static quality in intact loop between the steam generator outlet and the pump inlet (Station PC-3).

Fig. 151 Saturation temperature in broken loop cold leg (Station BL-1).

L1-4 RELAP4/MOD5(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 152 Saturation temperature in broken loop hot leg (Station BL-2).

(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 153 Saturation temperature in intact loop cold leg (Station PC-1).

Fig. 154 Saturation temperature in intact loop hot leg (Station PC-2).

Fig. 155 Saturation temperature in intact loop between the steam generator outlet and pump inlet (Station PC-3).

(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 156 Saturation temperature at PE-CS-1.

(LOFTSV02(73)) EXPERIMENT PREDICTION

Fig. 157 Saturation temperature at PE-1ST-1A.

Fig. 158 Saturation temperature at PE-2ST-1A.

Fig. 159 Total mass of fluid in the reactor vessel.

Fig. 160 Total ECC mass flow rate.

Fig. 161 Integral of ECC mass flow rate.

IV. CALCULATIONAL TECHNIQUES

The technical basis for generation of the pretest prediction is presented in this section of the EP document. The intent is to describe the analytical methods and models that are used to make predictions of the LOFT system response during a LOCE. Except where required for completeness, basic equations are not discussed, but references are given for complete documentation.

In order to analytically describe a LOCE, the entire transient is subdivided into sections, and the individual portions of the experiment are analyzed by appropriate computer codes or other predictive methods. For example, the subcooled depressurization portion of a LOCE may be analyzed by a different computer code than would be used to analyze the saturated portion of the blowdown transient.

The WHAM computer code^[5] is used for analyzing the hydraulic response of the LOFT system during the subcooled portion of a LOCE. Pressure-versus-time data are generated with WHAM for designated locations in the LOFT system. The version of the WHAM computer code used is WHAM/MOD006, and the code and model are described in Section 1.

The thermal-hydraulic response of the LOFT system during a LOCE is predicted by the RELAP4 computer code^[6]. RELAP4 is used to calculate flows, mass and energy inventories, pressures, temperatures, and fluid qualities that will occur during the LOCE. The RELAP4/MOD5(LOFTSV02(73)) version was used in this pretest prediction analysis. This code and input model are described in Section 2.

The analytical methods and models employed in the pretest predictions should be recognized as "best estimate" predictive tools and not the type of analysis used in safety review assessments. It is important to note that the modeling processes should be recognized as still evolving, and the codes and models described in this report should be recognized as undergoing changes. The information contained in this

section, however, will provide the basis from which future improvements in the codes and models can be made.

1. WHAM COMPUTER CODE AND MODEL

1.1 Description of the WHAM Computer Code

The WHAM computer code^[5] was developed for the purpose of analyzing single-phase pressure transients in liquid-filled systems. These systems may contain dead ends, elbows, orifices, multiple branch tees, changes of flow passage cross sections, check valves, pumps, pressurizers, and valves. The computer code lends itself to analysis of the subcooled depressurization of LOFT during a LOCE. Transient initiation may be caused by opening or closing one or more exit valves, system rupture at one or more places, or pump power failure. WHAM uses the wave superposition method of calculation. The version of the WHAM code used in this experiment prediction is a standard version of the WHAM/MOD006, and may be obtained from the Argonne Code Center.

For problem definition, the hydraulic system is segmented into parts termed "legs". Each leg is comprised of two or more nodes defined by the equation:

$$L = (n-1)ct$$

where

L = leg length

c = sonic velocity in the leg

t = calculational time increment

n = number of nodes.

The quantity "ct" is the node separation distance. Therefore, the degree of accuracy between actual hydraulic system and hydraulic model is dependent on the value of calculational time increment "t". The

maximum error in the length of a leg is $ct/2$ and, since the calculational time increment is single-valued for an entire hydraulic system model, the value of "t" is usually chosen to be less than 0.5 msec. Values of "t" of this order provide good dimensional resolution for the sonic velocity values involved (~ 915 m/s).

A leg is defined to have constant cross sectional area over its length. The initial fluid velocity and the sonic velocity must be defined for each leg. Single values of initial pressure and coolant density are specified for the entire hydraulic system. In time increments of "t", WHAM calculates the pressure and velocity at each end of each leg. In the event that calculated information is required at several locations along a straight pipe run, two or more legs may be used to model the pipe run.

1.1.1 WHAM Energy Loss Coefficient. WHAM considers only viscous energy losses in the water medium. The calculational method, however, does not introduce any significant errors since viscous energy losses are significantly larger than heat conduction losses and losses associated with molecular exchangers of energy. In cases where energy losses are to be considered, a device referred to as a "friction orifice" is employed. The procedure consists of placing a fictitious orifice at each internal node of the legs which comprise the hydraulic model. A friction coefficient or, in more general terms, an energy loss coefficient is determined and used to calculate, via an orifice, the loss in amplitude of the pressure waves passing each node point.

The loss coefficient in the WHAM computer code is a frictional coefficient based on kinematic viscosity (μ/ρ) and fluid velocity. The friction coefficient is obtained from Nikuradse's empirical relationship in the turbulent region and from the Blasius relation in the laminar regions.

The fluid velocities in LOFT steady-state operation and during subcooled blowdown are not sufficient to cause the value of the loss

coefficient to be significantly large. Differences between a typical "loss" case and a "no-loss" case are insignificant.

As reported in the literature^[8] and as observed experimentally both in Semiscale tests and in the LOFT primary coolant pump tests performed in the flow test loop at Combustion Engineering (CE), however, the energy loss in sonic pressure waves is significant. This energy loss is classified as an "excess absorption phenomenon" which occurs in many polar liquids. One theory^[9] that has been proposed to account for the excess absorption in water assumes that the absorption results from a structural relaxation directly related to the fluid volume. A non-vanishing volume coefficient of viscosity assumption has been shown to result in energy losses that are in agreement with measured values. Direct measurement of the coefficient of volume viscosity by Lieberman^[10] indicates that its magnitude is approximately three times the coefficient of shear viscosity.

The friction coefficient calculation in the WHAM computer code can be overridden, and a value of an "energy loss coefficient" can be inserted. This coefficient is used in the same manner as the friction coefficient to calculate attenuation (absorption) of sonic pressure waves. The value of the energy loss coefficient is determined from experimental data since an accepted correlation is not available. The pressure data obtained from the LOFT pump tests at CE were used to determine a value for the LOFT PCS model since pipe sizes and volumes of the CE loop are similar to those in the LOFT PCS. A preliminary study of pressure data from the CE loop and smaller diameter standoff pipes indicates that the value of the energy loss coefficient has an inverse dependence on pipe diameter.

From comparisons of WHAM predictions with CE loop pressure data, a value of 3.0 was determined to be approximately correct for an overall energy loss coefficient for the CE loop. This value was used in the LOFT model for Experiments L1-2, L1-3, and L1-3A. However, this value appeared to be slightly high as observed in data-prediction comparisons. This is thought to be due to the difference in the break opening times

in the two facilities (1 msec for the CE loop experimnts and ~ 18 msec for the LOFT experiments). The pressure disturbances propagating through the LOFT hydraulic system are not as severe as in the CE loop. A smaller loss coefficient of 1.5 is used for the L1-4 prediction.

1.1.2 WHAM Model of Valve Opening Characteristics and Pressure

Response. In a WHAM/MOD006 analysis, depressurization transients are initiated by opening exit valves. Exit conditions are calculated by the XIT subroutine which in turn uses functions defining the opening characteristics of the exits and the pressure response to the opening exits. The form that these functions take depends on the type of exit device; for example, a rupture disk or a sleeve valve.

For the LOFT pretest predictions, functions BPF, BPG, and AGF were developed specifically for the LOFT blowdown valves. Each function includes operation of two distinct blowdown valves, thus providing for separation of opening characteristics and pressure wave responses for the two blowdown valves in the LOFT system. Input parameters describing each valve must be specified separately.

1.2 LOFT Model Description for WHAM

1.2.1 LOFT Hydraulic Model. Because the $P(t)$ data generated by the WHAM computer code is used as the forcing function input for the dynamic loading and structural response analysis of the system components, the hydraulic model is defined with close correspondence to the actual system and with the detail required for structural response analysis.

The hydraulic model consists of 244 legs. The model of the primary coolant loop (including steam generator and pumps) is shown in Figures 162, 163, 164, and 165. The model is defined in Table IV.

Fig. 162 Intact loop hydraulic model.

NOTE : 1. Underlined Numbers Are Leg Numbers

2. Circled Numbers Are Junction Numbers

Fig. 163 Steam generator hydraulic model.

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Fig. 164 Reactor vessel hydraulic model (without core simulator).

1. Solid Lines Indicate No Change From Nuclear Core Model.
2. Dashed Line Indicate Changed Designation For Core Simulator.
3. Flow Area Between Simulator Barrel And Core Filler. Four Identical And Separate Legs Extending From Simulator Lower Plate To Center Of Simulator Barrel Outlet Holes
4. Flow Area Between Simulator Barrel And Flow Skirt Above Barrel Outlet Holes Divided Into Two Equal Parts.

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Fig. 165 Core simulator hydraulic model.

TABLE IV
HYDRAULIC MODEL DEFINITION OF REACTOR VESSEL
AND PRIMARY COOLANT LOOP

<u>Item</u>	<u>Leg Number</u>	<u>Description</u>
1.	41	Reactor vessel primary inlet nozzle
2.	42 through 45	Reactor vessel inlet plenum (peripheral flow)
3.	46	Reactor vessel blowdown inlet nozzle
4.	47 through 58	Annulus above reactor vessel inlet plenum between vessel and upper filler block
5.	59 through 62	Annulus above reactor vessel inlet plenum between upper filler block and core support barrel
6.	63 and 64	Inner annulus to outer annulus at reactor vessel inlet
7.	65 through 92	Downcomer annulus between vessel and lower filler block
8.	93 through 116	Downcomer annulus between lower filler block and the core support structure
9.	117 and 118	Plenum at bottom of reactor vessel
10.	119	Lower core support structure
11.	120	Outlet of lower support structure to center of diffuser plate
12.	121	Center of diffuser plate to center of lower core support plate
13.	122 through 125	Lower core support plate to core simulator bottom structure
14.	126	Flow area around core simulator bottom structure
15.	127	Core simulator lower plate to bottom structure

TABLE IV (contd.)

Item	Leg Number	Description
16.	128	Core simulator lower plate
17.	129	Inner plate to lower plate
18.	130	Core simulator inner plate
19.	131	Inner plate to center of simulator barrel outlet holes
20.	132 through 134	Simulator lower plate to center of simulator barrel outlet holes
21.	135 through 152	Bypass
22.	153	Same as Item 20
23.	154	Center of simulator barrel outlet holes to top of core simulator
24.	155 and 156	Top of core simulator to vessel upper head
25.	157	Flow down to bottom of core simulator bottom structure
26.	153 through 177	Outlet nozzles to reactor vessel upper head
27.	178 through 181	Hot leg piping from reactor vessel outlet nozzle to pressurizer junction
28.	182 through 189	Pressurizer junction to pressurizer
29.	190 through 194	Hot leg piping from pressurizer junction to steam generator inlet
30.	195 through 211	Steam generator inlet to steam generator outlet
31.	212 through 232	Cold leg piping from steam generator outlet to reactor vessel nozzle

For Experiment L1-4, the blowdown system is assembled to simulate an inlet pipe break. The hydraulic model of the blowdown piping system is shown in Figure 166. The model includes the pump simulator and steam generator simulator models. The blowdown piping model is connected to the reactor vessel model at the two indicated junctions. The model is shown to exclude the check valve - blowdown valve geometry. The reason for this model feature is discussed in Section 1.2.2.

The pump simulator design^[4] includes 10 plates 19.0 mm thick and spaced 5.1 mm apart. The plates are perforated with 11.75-mm diameter holes on a 19.0-mm pitch. The plate thickness and spacing dimensions are considerable less than the node separation length of 83.8 mm for the cold leg break configuration ($c = 838.2$ m/s, $t = 0.0001$ s). The pump simulator was modeled by specifying a single leg to represent the plate assembly. The area is equal to the area calculated from the length of the plate assembly and the water volume in the plate assembly.

Sharp-edged orifices were used to represent the orifice plates in the steam generator simulator. A loss coefficient of 30.0 was used for each plate in the previous experiment predictions. This value has proven to be excessively high, which is thought to be caused by the long break opening time. The resulting pressure disturbances are long in duration which results in sufficient time for pressure recovery close to each orifice plate. The loss coefficient was reduced to 1.0 for Experiment L1-4 which would provide only a small loss at each orifice plate. A complete listing of WHAM computer code input that describes the LOFT hydraulic model in detail is given in Appendix A.

1.2.2 Characterization of LOFT Hydraulic System Rupture. Correct characterization of the transient initiation is a most important aspect in theoretical analyses, such as contained in WHAM. Theoretical calculations can be compared with experimental results only if the initial conditions and the transient initiation of theory and experiment are within acceptable limits. The following discussion will characterize the model of hydraulic system rupture.

Fig. 166 Blowdown piping cold leg break hydraulic model.

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The blowdown valve is a 0.3-m OD (12-inch) sleeve-type valve that is designed to open to an equivalent 0.3-m OD (12-inch, Schedule 160) pipe area in a minimum time of 10 msec. The sleeve travel is 62.2 mm after leaving the huddle chamber (22.5 mm long) for full open area. Experimental measurements indicate an approximate linear rate of opening. The slight deviation observed in the data from a linear rate of opening will not cause significant differences in predicated results. The linear opening rate is used as a basis to calculate the pressure function at the break plane.

The break plane is defined as the location (s) in a hydraulic piping system where exit from the system occurs and which provides control of the acoustic wave depressurization phenomena. In a LPWR, the location of the break in the pipe is the break plane. In LOFT, however, the simulated break by the blowdown valves does not constitute the break plane. The blowdown valves open a 0.3-m OD (12-inch, Schedule 160) pipe. Upstream of the 0.3-m OD pipe geometry for one blowdown valve there is a reduction in area to a 0.20-m OD (8-inch, Schedule 160) pipe, followed by a further reduction to a 0.125-m OD (5-inch double-extra-strong) pipe area. For the other blowdown valve, there is a reduction in area to a 0.125-m OD (5-inch double-extra-strong) pipe.

The coolant volume occupied by the isolation valve and blowdown valve will act as a coolant volume separate from the rest of the primary coolant system. The decompression waves resulting from opening the blowdown valves are reflected in like sense at the area reductions. Thus, the coolant volumes in the valves will rapidly reach saturation pressure and, as a result, will be separated from the rest of the system by a large reduction in sonic velocity as the coolant changes from subcooled, or single phase, to two phase. The effective break plane in the system becomes the 0.125-m OD (5-inch double-extra-strong) pipe areas.

2. RELAP4 COMPUTER CODE AND MODEL

2.1 Description of the RELAP4 Computer Code

RELAP4 is a computer code that has been released as the current calculational method for predicting the thermal and hydraulic transient phenomena that occur in water-cooled nuclear reactor systems during postulated accidents such as loss of coolant, pump failure, or power transients. RELAP4 is a comprehensive program that predicts the inter-related effects of coolant thermal-hydraulics, system heat transfer, core kinetics, and system component interactions. Since features that describe the nuclear reactor are optional, the code can be applied to analysis of experimental water-reactor simulators such as is the case for the LOFT nonnuclear Test Series L1.

RELAP4 represents the reactor system as a set of connected fluid volumes (control volumes) that describe the system piping, plenums, heat exchangers, pressurizers, pumps, and other auxiliary equipment, such as an accumulator injection system. Any fluid volume may be chosen independently to represent a region of the physical system associated with a heat sink or a heat source. Fluid volumes are connected by junctions which are used to transfer fluid into and out of the fluid volumes. A junction may be specified as a normal junction connecting two control volumes, a leak junction, or a fill junction.

The fluid dynamics portion of the RELAP4 computer code solves the fluid mass, energy, and momentum equations for the system model. In order to provide for a reasonable degree of versatility in RELAP4, a choice of the following basic forms of the momentum equation is provided:

- (1) Compressible single-stream flow with momentum flux

(2) Compressible two-stream flow with one-dimensional momentum mixing

(3) Incompressible single-stream flow without momentum flux.

The momentum equation for compressible two-stream flow with one-dimensional momentum mixing has four specialized forms which represent different transient flow patterns between the mixing streams.

The RELAP4 fluid conservation equations include approximations of all terms contained in the theoretical derivations for one-dimensional, homogeneous, thermal equilibrium flow. The solution to the conservation equations describing the flow of energy and momentum of the coolant includes the kinetic and potential energy terms and an optional one-dimensional momentum flux description of area and density changes. Including these terms allows for a description of the incompressible Bernoulli effect as well as the compressible fluid flow phenomena. Additionally, flow choking can be calculated from the conservation equations. Vertical and horizontal slip models allowing unequal steam-water velocities are available options in the RELAP4 model.

Several critical (choked) flow models are available in RELAP4. The calculation of the critical flow rate is by either the compressible flow equations, Moody's critical flow model^[11], Henry's critical flow model^[12], a modified Burnell model, or the Homogenous Equilibrium Model (HEM)^[6]. It is possible to specify combinations of the above flow models for the subcooled and saturated regions. For example the RSR Prescription^[6] uses a modified Burnell model in the subcooled region with a transition into the HEM in the saturated region. The Henry-Fauske-HEM model uses the extended Henry tables in the subcooled region with a transition into the HEM model in the saturated region.

In RELAP4 a pump is considered to be in a fluid volume. Single-phase pump characteristic curves are supplied to describe pump head and torque performance. An option is available to simulate two-phase effects on pump performance. If this option is used, two-phase curves

in the form of single-phase minus two-phase values for both pump head torque must be supplied in addition to a table of head and torque multipliers versus void fraction.

A bubble rise model is available in RELAP4 to estimate junction enthalpy as a function of vertical elevation within a flow-source volume modified for either horizontal or vertical junction flow areas. In the model, the bubble gradient can be varied between the maximum gradient possible within the permissible physical constraints and the gradient representing a homogeneous mixture. Another quantity associated with the steam-water phase separation model is the velocity of the escaping steam bubbles relative to the mixture interface. If the velocity is zero, no separation occurs, although a bubble-density gradient may still exist in the fluid volume.

In RELAP4, a heat conductor (sometimes referred to as heat slab) can be described to represent one or more materials which conduct heat into the fluid of a volume or between the fluids in two different volumes. Thus, a heat slab may represent core fuel pins, piping, or flat plates separating two volumes. The heat conduction model is based on the method of HEAT-1, a one-dimensional numerical solution of the heat conduction equations. Both the heat transfer correlations used at conductor surfaces and the method of determining which correlation to use are essentially taken from THETA1-B^[13]. The RELAP4 computer code contains correlations for calculating the critical heat flux (CHF), pre-CHF heat transfer, and post-CHF heat transfer.

Internal heat generation may be specified for those conductors which represent core fuel pins. Available options for describing internal power generation include user-supplied normalized power versus time data and program solution of the space-independent reactor kinetics equations with or without radioactive decay heat.

The RELAP4 code that is used in the experiment prediction for LOFT Experiment L1-4 is designated as RELAP4/MOD5(LOFTSV02(73)), and it differs from RELAP4/MOD5(Update 2) in three respects:

- (1) It has a variable - inertia pump model
- (2) It has an accumulator nitrogen (air, in RELAP4) expansion model which calculates the accumulator pressure according to an adiabatic polytropic expansion of the accumulator nitrogen
- (3) It contains a natural convection heat transfer model which is used to model heat transfer to the steam generator secondary.

The code differences are discussed further in Section 2.2 in relation to how these code differences affect modeling of specific components. The update cards which create RELAP4/MOD5(LOFTSV02(73)) from the standard released version of RELAP4/MOD5(Update 2) may be found in Appendix B.

Although RELAP4 is a comprehensive computer program, it has approximations which must be recognized. These approximations include the use of (a) a point reactor kinetics model, (b) homogeneous fluid equations with the phases in thermodynamic equilibrium, (c) air volumes to provide work without allowing the air to mix or flow, (d) one-dimensional fluid and heat conduction transport equations, and (e) steady-state empirical correlations to estimate heat transfer coefficients, critical heat fluxes, two-phase Fanning friction factors, and critical mass fluxes.

2.2 RELAP4 Model Description

The RELAP4 model of the LOFT thermal-hydraulic system is defined with close correspondence to the actual system and with the detail required to provide best-estimate pretest predictions for the LOFT nonnuclear Test Series L1. For example, junctions in the model generally correspond to changes in flow cross-sectional area and instrument locations. The basic philosophy used to develop the system model was that the model should have sufficient nodalization such that an increase in the number of nodes would not significantly alter

analytical results. Previously developed RELAP4 models were utilized in preparing the pretest predictions model.

A schematic of the LOFT system model for Experiment L1-4 is given in Figure 167. The model consists of 53 control volumes and 59 junctions. A brief description of each control volume is given in Table V. Geometric data for the control volumes are given in Table VI. The model junctions are described in Table VII. The critical flow model specified for the junctions was the Henry-Fauske-HEM model, which uses the extended Henry tables in the subcooled region with a transition into the HEM model in the saturated region at 0.25% quality. Static pressure properties were used as inputs into the critical flow models. An input listing and a zero time output listing may be found in Appendix C.

2.2.1 Modeling of Physical Components. Model representations for several of the physical components of the LOFT system are discussed in this section. These components are especially important to the behavior of the LOCE transient. The components discussed are the pressurizer, steam generator, primary coolant pumps, reactor vessel and core simulator, ECCS, broken loop pump simulator, broken loop steam generator simulator, and pressure suppression system.

The pressurizer, the pressurizer surge line, and the section of the hot leg into which the pressurizer empties are modeled with three nodes. Control Volumes 40 and 41 represent the pressurizer surge line and the pressurizer, respectively. The pressurizer model includes a steam head above the initially saturated liquid contained in the pressurizer. Phase separation is included by use of the RELAP4 bubble-rise model.

The surge line is modeled as being completely filled with subcooled liquid prior to initiation of the LOCE transient. The pressurizer model does not include a heat slab to account for heat transfer from the pressurizer metal to the component fluid. A contraction coefficient of 0.75 was used at the pressurizer surge line outlet junction. A two-phase multiplier was applied to the single-phase form loss coefficient in order to properly account for two-phase effects in the bends of the

Fig. 167 RELAP4 model schematic for LOFT cold leg break configuration.

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pressurizer surge line. The single-phase form loss coefficient was then incremented to account for the difference in Fanning losses between smooth and rough tubing.

In order to model vena contracta effects, it was necessary to apply contraction coefficients to three junctions for the HEM critical flow model. These junctions are the pressurizer surge line outlet (Junction 45), the hot leg break plane (Junction 40), and the cold leg break plane (Junction 48). A 0.75 contraction coefficient was used for the first two junctions, and 0.848 was used at the third junction. The 0.75 contraction coefficient was taken from Reference 14, which deals with sonic single phase compressible flow in elbows. The 0.848 contraction coefficient was an arithmetic average of contraction coefficients for single-phase flow for similar piping arrangements^[15,16].

TABLE V
CONTROL VOLUME DESCRIPTION

Control Volume	Description
1	Upper plenum
2	Volume occupied by flushing filter cartridges from core simulator inlet to the core simulator orifice plate
3	Intact loop hot leg outlet nozzle
4	Hot leg piping between flow device at Junction 4 and the throat of the venturi in the hot leg
5	Hot leg piping between venturi throat and the 14-to-16-inch (0.35-to-0.40-m OD) expansion
6	16-inch (0.40-m OD) piping leading into steam generator
7 and 11	Steam generator inlet plenum and outlet plenum
8 and 10	Straight sections of steam generator tubes
9	Curved section of steam generator tubes
12	Steam generator outlet piping to the 16-to-14-inch (0.40-to-0.35-m OD) contraction
13	14-inch (0.35-m OD) piping leading to the tee preceeding the coolant pumps
14	Piping from tee to primary coolant pumps
15 and 16	Primary coolant pumps
17 and 18	10-inch (0.25-m OD) piping between pumps and 14-inch (0.35-m OD) cold leg piping
19	14-inch (0.35-m OD) piping preceeding the intact loop cold leg flow measuring device
20 and 50	Cold leg piping between flow measuring device and reactor vessel

TABLE V (contd.)

<u>Control Volume</u>	<u>Description</u>
	<u>Reactor Vessel</u>
21 and 51	Upper annular region of the vessel inlet region
22 and 52	Downcomer region
23, 48, and 53	Lower plenum
24	Region of the reactor vessel that would be occupied by nuclear core
25	14-inch (0.35-m OD) piping from reactor vessel cold leg nozzle to the 14 x 14 x 10-inch (0.35 x 0.35 x 0.25-m OD) tee
26 and 47	Cold leg piping from the 14 x 14 x 10-inch (0.35 x 0.35 x 0.25-m OD) tee to 14 x 5-inch (0.35 x 0.125-m OD) reducer
27	8-inch (0.20-m OD) spool piece
28	14-inch (0.35-m OD) piping from reactor vessel outlet nozzle to the 14 x 14 x 10-inch (0.35 x 0.35 x 0.25-m OD) tee
29	Hot leg piping from the 14 x 14 x 10-inch (0.35 x 0.35 x 0.25-m OD) tee to the inlet piping of the steam generator simulator
30	Inlet piping to steam generator simulator
31, 32, and 33	Steam generator simulator
34	Outlet piping from steam generator simulator
35	Pump simulator
36	Piping from pump simulator outlet to 14 x 5-inch (0.35 x 0.125-m OD) reducer
37	Blowdown header and pressure suppression tank
38 and 39	Reflood assist bypass piping
40	Pressurizer surge line

TABLE V (contd.)

<u>Control Volume</u>	<u>Description</u>
41	Pressurizer
42	Secondary side of steam generator
43	ECC accumulator
44	Between 12-inch (0.30-m OD) gate valve and the inlet side of the cold leg QOBV
45	Between 12-inch (0.30-m OD) gate valve and the inlet side of the hot leg QOBV
46	ECC injection line
47	Drag disc - turbine meter flange to cold leg break plane
49	Volume between core support plates

TABLE VI

GEOMETRIC DESCRIPTION OF LOFT MODEL CONTROL VOLUMES

Control Volume	Volume (m ³)	Flow Area (m ²)
1	0.462	0.233
2	0.119	0.231
3	0.225	0.063
4	0.130	0.063
5	0.091	0.063
6	0.082	0.084
7	0.317	0.738
8	0.311	0.151
9	0.156	0.151
10	0.311	0.151
11	0.317	0.738
12	0.059	0.084
13	0.125	0.063
14	0.127	0.063
15	0.108	0.036
16	0.108	0.036
17	0.054	0.036
18	0.020	0.036
19	0.178	0.063
20	0.045	0.063
21	0.142	0.121
22	0.323	0.093
23	0.289	0.465
24	0.855	0.304
25	0.102	0.063
26	0.042	0.063
27	0.023	0.023
28	0.212	0.063
29	0.065	0.063
30	0.008	0.008

TABLE VI (contd.)

<u>Control Volume</u>	<u>Volume (m³)</u>	<u>Flow Area (m²)</u>
31	0.130	0.098
32	0.283	0.108
33	0.130	0.098
34	0.011	0.008
35	0.048	0.063
36	0.017	0.008
37	104.59	0.894
38	0.232	0.039
39	0.167	0.039
40	0.011	0.002
41	0.983	0.558
42	7.974	1.589
43	2.803	1.263
44	0.093	0.052
45	0.093	0.052
46	0.153	0.006
47	0.023	0.063
48	0.125	0.186
49	0.181	0.347
50	0.045	0.063
51	0.071	0.060
52	0.161	0.047
53	0.062	0.093

TABLE VII
RELAP4 MODEL JUNCTION DESCRIPTION

Junction	Volumes		Flow Area (m ²)	Loss Form Coefficients	
	From	To		Forward	Reverse
1	2	1	0.045	0.65	0.65
2	1	3	0.063	0.91	0.91
3	1	28	0.063	0.31	0.47
4	3	4	0.061	0.05	0.05
5	4	5	0.033	0.02	0.09
6	5	6	0.063	0.67	0.67
7	6	7	0.052	1.53	1.78
8	7	8	0.151	0.36	0.63
9	8	9	0.151	0.0	0.0
10	9	10	0.151	0.06	0.06
11	10	11	0.151	0.63	0.36
12	11	12	0.052	1.38	1.6
13	12	13	0.063	0.20	0.21
14	13	14	0.063	1.10	1.25
15	14	15	0.036	0.22	0.22
16	14	16	0.036	0.23	0.23
17	15	17	0.036	0.15	0.15
18	16	18	0.036	0.22	0.22
19	17	19	0.036	0.66	0.69
20	18	19	0.036	2.93	1.20
21	19	20	0.061	0.20	0.20
22	50	51	0.063	1.24	0.80
23	21	22	0.080	0.20	0.30
24	22	48	0.080	0.75	0.55
25	49	24	0.098	0.26	0.26
26	24	2	0.073	0.56	0.56
27	21	25	0.063	0.80	1.90
28	25	26	0.063	0.10	0.10
29	26	27	0.054	6.55	14.05
30	27	44	0.023	0.30	0.25

TABLE VII (contd.)

Junction	Volumes		Flow Area (m ²)	Loss Form Coefficients	
	From	To		Forward	Reverse
31	44	37	0.051	0.0	0.0
32	28	29	0.063	0.10	0.10
33	29	30	0.008	0.39	0.75
34	30	31	0.008	0.94	0.94
35	31	32	0.019	5.82	5.82
36	32	33	0.019	5.82	5.82
37	33	34	0.008	0.23	0.23
38	34	35	0.008	4.23	4.23
39	35	36	0.008	8.47	8.47
40	36	45	0.008	0.95	0.44
41	45	37	0.051	0.0	0.0
42	29	39	0.039	1.25	0.46
43	26	38	0.039	1.25	0.46
44	43	46	0.006	22.00	22.00
45	40	4	0.002	1.0	8.62
46	41	40	0.002	16.24	8.62
47	46	20	0.006	12.25	12.25
48	47	27	0.008	0.42	0.29
49	48	23	0.743	0.02	0.02
50	23	49	0.098	0.52	0.6
51	51	52	0.040	0.20	0.3
52	52	53	0.040	0.75	0.55
53	53	23	0.372	0.02	0.02
54	51	21	0.065	1.26	1.26
55	52	22	0.289	23.40	23.40
56	53	48	0.186	0.10	0.10
57	20	50	0.061	0.20	0.20
58	0	46	0.0	0.0	0.0
59	0	46	0.0	0.0	0.0

Both the primary and secondary sides of the LOFT steam generator are represented in the RELAP4 system model. The primary side model includes control volumes representing the steam generator inlet plenum (Volume 7), the outlet plenum (Volume 11), and three tube bundle sections (Volumes 8, 9, and 10). The steam generator secondary side is represented by a single control volume (Volume 42). For the nonnuclear Test Series L1, the steam generator will be operated in the "hot standby" condition. Therefore, the secondary side model does not include a feedwater inlet, steam outlet, or relief valve junction. The secondary side volume includes the RELAP4 phase separation bubble rise model. Heat conduction from the primary coolant to the secondary coolant is by means of three heat slabs, one for each tube sheet control volume. The natural convection heat transfer option in RELAP4/MOD5(LOFTSV02(73)) was used for the heat slabs connected to Volume 42.

In the LOFT system model, the primary coolant pumps are represented by control Volumes 15 and 16. Both single-phase and two-phase pump operating performance is described by the pump model. Single-phase performance is estimated by the homologous head and torque curves shown in Figure 168; the solid curves being the head curves for the LOFT pumps, and the dashed curves being the torque curves. Each segment of the curves is identified by three letters such as HAN, H denoting the head ratio ($H=h/h_r$, where h_r is rated head), A indicating division of the ratio by α^2 , where α is the speed ratio ($\alpha=N/N_r$), and N denoting operation of the pump in the normal speed zone (as apposed to reverse flow operation or turbine operation).

Performance of the LOFT pumps in the two-phase region is based on the two-phase performance of the Semiscale pump. When the pumps are operating under two-phase conditions, the head ratio is calculated as

$$H = \frac{h(1\phi)}{h_r} - \frac{m[h(1\phi) - h(2\phi)]}{h_r}$$

Fig. 168 Single-phase homologous head and torque curves for LOFT pump model.

where

- $h(1\phi)$ = single-phase head
- $h(2\phi)$ = two-phase head
- h_r = rated head
- m = head multiplier as a function of void fraction.

The head difference homologous curves (single-phase minus two-phase head) are shown in Figure 169. The head multiplier as a function of void fraction is shown in Figure 170. The single-phase homologous torque data for the LOFT pumps are also used for the torque difference curve with the torque ratio "B" for two-phase pump operation being calculated as

$$B = \frac{T}{T_r} (1-M)$$

where

- T = pump torque
- T_r = rated pump torque
- M = torque multiplier as a function of void fraction.

The fluid torque multiplier versus void fraction, shown in Figure 171, is based on the Semiscale pump. The pump motor losses are included into the model by use of a retarding torque equation.

$$T_{ret} = a_1 + a_2 S + a_3 S^2$$

where

- T_{ret} = primary motor assembly retarding torque (N-m)
- S = pump speed/rated speed
- a_1 = 0.004 N-m
- a_2 = 19.60 N-m
- a_3 = 207.43 N-m.

Pump motor losses are not included implicitly in the pump model. The model uses an effective pump moment of inertia, however, which

Fig. 169 Homologous head difference curve for LOFT pump model.

Fig. 170 Head multiplier curve for LOFT pump model.

Fig. 171 Torque multiplier curve for LOFT pump model.

includes pump motor and generator losses as a function of pump speed. Specifically, the pump inertia is calculated as follows:

$$\begin{aligned} &\text{If pump speed} \geq 750 \text{ rpm,} \\ &I = 40.98 S + 16.31 S^2 - 74.88 S^3 \\ &\text{If pump speed} < 750 \text{ rpm,} \\ &I = 1.43 \end{aligned}$$

where

$$I = \text{pump inertia in kg-m}^2.$$

In the RELAP4 LOFT system model, the LOFT core simulator assembly is represented by control Volume 2. In LOFT, the assembly extends upward into the upper plenum region of the reactor vessel (control Volume 1 of Figure 167). Approximately two-thirds of the pressure drop is across the core simulator orifice plates located in a plane just below the reactor vessel outlet nozzles; the remainder of the core simulator pressure drop being across the orifice in the lower bulkhead. The inlet annulus, downcomer, and the annular portion of the lower portion of the lower plenum immediately below the downcomer were each split in two volumes in the ratio of two to one, with the larger of the two volumes being on the broken loop side of the reactor vessel. This was done for several reasons: (a) to allow a realistic penetration of ECC fluid to the downcomer and lower plenum, (b) to minimize the volumes occupied by the ECC fluid to better predict the system pressure response during the ECC injection phase of the experiment, and (c) to allow separate predictions of instruments located on the two downcomer instrument stalks.

The RELAP4 model of the ECCS includes the accumulator injection system, the LPIS, and the HPIS. For Experiment L1-4, the ECC is injected directly into the intact loop cold leg through a flow line connected to the accumulator, HPIS, and LPIS. The LPIS and HPIS are represented by fill junctions (Junctions 49 and 50, respectively) for which flow rates are determined by tables in the RELAP4 input which describes flow as a function of discharge pressure or flow as a function

of time. Tabular data for each specific test are taken from the EOS^[2]. The accumulator model utilizes the phase separation bubble rise model of RELAP4. The nitrogen gas present in the LOFT accumulator is modeled as an air head, with a polytropic adiabatic expansion model.

The LOFT pump and steam generator simulators consist of a series of multihole orifice plates inserted in a pipe representative of the appropriate scaled volume and flow area. The orifice plate assemblies were chosen such that the flow resistance for each component would approximate that of a LPWR. In the steam generator, seven orifice plates are located on each side of the U-tube design. In the steam generator simulator model, a single orifice with an appropriate form loss coefficient is placed at the inlet and outlet junctions of the control volume representing the U-tube design (Junction 35 and 36). The pump simulator consists of 10 closely spaced orifice plates. One-third of the orifice plate assembly resistance is placed at the pump simulator inlet junction (Junction 38), and two-thirds is placed on the outlet junction (Junction 39). The flow resistance is split between the junctions to give a better approximation of the two-phase effects on pressure drop. The resistance of the steam generator simulator and the pump simulator were determined from transient single-phase experiments (accumulator blowdowns) that were performed before and after LOFT Experiment L1-1.

The LOFT pressure suppression system consists of a header pipe, four downcomer pipes, and a pressure suppression tank. In the system model, the pressure suppression system is represented by control Volume 37. A single control volume is used for the pressure suppression system because phenomena occurring within this system are not of primary interest in the RELAP4 analysis. For LOCE L1-4, the pressure in the suppression tank will be controlled by the suppression tank control system. Therefore, the RELAP4 model includes time-dependent suppression tank conditions, the pressure curves being taken from the EOS^[2].

The LOFT system model includes a series of one-dimensional heat conduction slabs which account for heat transfer from the metal structures to the system fluid during blowdown. The location of each heat slab with respect to the system control volumes is shown in Figures 172 through 174. Heat slab geometric data is given in Table VIII. In order to improve the precision of the heat conduction calculations, increased nodalization is used at locations within the heat slabs where thermal gradients are expected to be significantly large.

A complete listing of the RELAP4 input data for Experiment L1-4 is given in Appendix C.

Fig. 172 Intact loop heat slabs.

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Fig. 173 Broken loop heat slabs.

Fig. 174 Reactor vessel heat slabs.

TABLE VIII
HEAT SLAB DESCRIPTIVE DATA

Heat Slab	Volume Transferring Energy		Heat Transfer Area (m ²)		Metal Volumes (m ²)
	Right	Left	Right	Left	
1	[a]	53		2.16	0.025
2		1		2.15	0.025
3		2		0.98	0.011
4		24		5.00	0.147
5		36		0.32	0.008
6		35		0.68	0.008
7	21		1.84		0.067
8		21		2.23	0.623
9	52		3.10		0.195
10		52		3.76	1.05
11		34		0.85	0.192
12		33		1.51	0.076
13		32		3.04	0.153
14		31		1.51	0.076
15		30		0.63	0.014
16		53		1.35	0.372
17	42	8	129.64	104.23	0.377
18	42	9	75.04	60.33	0.085
19	42	10	129.64	104.23	0.144
20		44		1.22	0.040
21		45		1.22	0.040
22		25		1.42	0.057
23		26		0.92	0.037
24		3		1.44	0.057
25		4		1.81	0.076
26		5		1.27	0.051
27		6		1.00	0.045
28		7		1.39	0.150
29		11		1.48	0.150

TABLE VIII (contd.)

Heat Slab	Volume Transferring Energy		Heat Transfer Area (m ²)		Metal Volumes (m ²)
	Right	Left	Right	Left	
30		12		0.72	0.034
31		13		1.77	0.071
32		14		1.79	0.071
33		19		2.51	0.102
34		20		0.64	0.025
35		28		1.27	0.051
36		29		0.92	0.037
37		27		0.54	0.014
38		46		1.52	0.246
39		50		0.64	0.025
40	22		66.9		0.388
41		22		7.53	2.11
42		48		4.34	0.051
43		48		2.68	0.753
44		49		2.67	0.031
45		49		1.65	0.464
46	51		9.9		0.034
47		51		1.11	0.311

[a] Indicates that surface is an adiabatic boundary.

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APPENDIX A

LISTING OF WHAM COMPUTER CODE INPUT FOR
EP ANALYSIS OF EXPERIMENT L1-4

WHAM/MOD 006/ 7-01-75 / VT8 DATE 02/02/77
 WHAM6 EXPERIMENTAL MODEL OF THE LOFT PCS COLD LEG BREAK

SATURATION PRESSURE(P SIG)V-1 = 900.0
 KINEMATIC VISCOSITY(FT.SQ./SEC) = 0.0
 TOTAL NUMBER OF LEGS = 244
 SATURATION PRESSURE(P SIG)V-2 = 850.0

HYDRAULIC MODEL DESCRIPTION

J	A	UD	PD	C	W	NO	NND1	NND2	LEG1	LEG2	OK
1	0.6827	0.0	2250.00	3700.	47.21	3	10	9	1	2	0.0
2	0.6827	0.0	2250.00	3700.	47.21	3	9	9	2	3	0.0
3	0.6827	0.0	2250.00	3600.	47.21	2	9	9	3	4	0.0
4	0.6827	0.0	2250.00	3500.	47.21	3	9	3	4	5	0.0
5	0.6827	0.0	2250.00	3416.	47.21	6	3	2	5	6	0.21
6	0.6827	0.0	2250.00	3416.	47.21	7	2	4	6	227	0.0
7	0.6827	0.0	2250.00	3416.	47.21	11	4	3	226	7	0.0
8	0.6827	0.0	2250.00	3450.	47.21	10	3	2	7	8	0.0
9	0.0900	0.0	2250.00	3475.	47.21	6	2	9	8	9	0.0
10	0.0900	0.0	2250.00	3475.	47.21	4	9	2	9	10	0.21
11	0.0900	0.0	2250.00	3475.	47.21	7	2	2	10	11	0.0
12	1.0600	0.0	2250.00	3500.	47.21	9	2	2	11	12	1.00
13	1.0600	0.0	2250.00	3500.	47.21	3	2	2	12	13	1.00
14	1.0600	0.0	2250.00	3500.	47.21	3	2	2	13	14	1.00
15	1.0600	0.0	2250.00	3500.	47.21	3	2	2	14	15	1.00
16	1.0600	0.0	2250.00	3500.	47.21	3	2	2	15	16	1.00
17	1.0600	0.0	2250.00	3500.	47.21	3	2	2	16	17	1.00
18	1.0600	0.0	2250.00	3525.	47.21	3	2	2	17	18	1.00
19	1.0600	0.0	2250.00	3525.	47.21	6	2	2	18	19	0.21
20	1.0600	0.0	2250.00	3525.	47.21	10	2	2	19	20	0.21
21	1.0600	0.0	2250.00	3550.	47.21	6	2	2	20	21	1.00
22	1.0600	0.0	2250.00	3550.	47.21	3	2	2	21	22	1.00
23	1.0600	0.0	2250.00	3550.	47.21	3	2	2	22	23	1.00
24	1.0600	0.0	2250.00	3550.	47.21	3	2	2	23	24	1.00
25	1.0600	0.0	2250.00	3575.	47.21	3	2	2	24	25	1.00
26	1.0600	0.0	2250.00	3575.	47.21	3	2	2	25	26	1.00
27	1.0600	0.0	2250.00	3575.	47.21	3	2	2	26	27	1.00
28	1.0600	0.0	2250.00	3575.	47.21	9	2	2	27	28	0.0
29	0.0900	0.0	2250.00	3600.	47.21	12	2	2	28	29	0.0
30	0.2964	0.0	2250.00	3600.	47.21	3	2	2	29	30	0.0

31	0.6827	0.0	2250.00	3600.	47.21	6	2	2	30	31	0.0
32	0.1012	0.0	2250.00	3650.	47.21	4	2	2	31	32	0.0
33	0.2000	0.0	2250.00	3650.	47.21	2	2	2	32	33	0.0
34	0.0900	0.0	2250.00	3650.	47.21	5	2	2	33	34	0.21
35	0.0900	0.0	2250.00	3675.	47.21	7	2	9	34	35	0.0
36	0.0900	0.0	2250.00	3700.	47.21	6	9	9	35	36	0.0
37	0.0900	0.0	2250.00	3700.	47.21	5	9	10	36	37	0.0
38	0.3941	0.0	2250.00	3500.	47.21	9	3	9	7	38	0.0
39	0.3941	0.0	2250.00	3550.	47.21	10	9	2	38	39	0.21
40	0.3941	0.0	2250.00	3575.	47.21	7	2	3	39	40	0.0
41	0.6827	0.0	2250.00	3416.	47.21	4	4	5	43	44	0.0
42	0.7292	0.0	2250.00	3416.	47.21	7	5	5	44	45	0.0
43	0.7292	0.0	2250.00	3416.	47.21	7	5	5	45	46	0.0
44	0.7292	0.0	2250.00	3416.	47.21	7	5	5	46	47	0.0
45	0.7292	0.0	2250.00	3416.	47.21	7	5	5	47	48	0.0
46	0.6827	0.0	2250.00	3416.	47.21	4	5	4	46	227	0.0
47	0.0782	0.0	2250.00	3416.	47.21	3	4	9	43	48	0.0
48	0.0782	0.0	2250.00	3416.	47.21	3	9	2	48	49	0.0
49	0.0392	0.0	2250.00	3416.	47.21	5	2	1	49	50	0.0
50	0.0782	0.0	2250.00	3416.	47.21	3	3	9	51	52	0.0
51	0.0782	0.0	2250.00	3416.	47.21	3	9	2	52	53	0.0
52	0.0392	0.0	2250.00	3416.	47.21	5	2	1	53	54	0.0
53	0.0782	0.0	2250.00	3416.	47.21	3	3	9	55	56	0.0
54	0.0782	0.0	2250.00	3416.	47.21	3	9	2	56	57	0.0
55	0.0392	0.0	2250.00	3416.	47.21	5	2	1	57	58	0.0
56	0.0782	0.0	2250.00	3416.	47.21	3	4	9	227	59	0.0
57	0.0782	0.0	2250.00	3416.	47.21	3	9	2	59	60	0.0
58	0.0392	0.0	2250.00	3416.	47.21	5	2	1	60	61	0.0
59	0.6979	0.0	2250.00	3416.	47.21	4	5	1	44	62	0.0
60	0.6979	0.0	2250.00	3416.	47.21	4	5	1	47	63	0.0
61	0.6979	0.0	2250.00	3416.	47.21	4	5	1	45	64	0.0
62	0.6979	0.0	2250.00	3416.	47.21	4	5	1	46	65	0.0
63	0.6827	0.0	2250.00	3416.	47.21	4	5	3	47	51	0.0
64	0.6827	0.0	2250.00	3416.	47.21	4	5	3	45	55	0.0
65	0.0782	0.0	2250.00	3416.	47.21	10	4	9	43	66	0.0
66	0.0782	0.0	2250.00	3416.	47.21	10	9	9	66	67	0.0
67	0.0782	0.0	2250.00	3416.	47.21	10	9	9	67	68	0.0
68	0.0782	0.0	2250.00	3416.	47.21	10	9	9	68	69	0.0
69	0.0782	0.0	2250.00	3416.	47.21	7	9	9	69	70	0.0
70	0.0782	0.0	2250.00	3416.	47.21	9	9	9	70	71	0.0
71	0.0782	0.0	2250.00	3416.	47.21	5	9	5	71	90	0.0
72	0.0782	0.0	2250.00	3416.	47.21	10	3	9	55	72	0.0
73	0.0782	0.0	2250.00	3416.	47.21	10	9	9	72	73	0.0
74	0.0782	0.0	2250.00	3416.	47.21	10	9	9	73	74	0.0
75	0.0782	0.0	2250.00	3416.	47.21	10	9	9	74	75	0.0
76	0.0782	0.0	2250.00	3416.	47.21	7	9	9	75	76	0.0
77	0.0782	0.0	2250.00	3416.	47.21	9	9	9	76	77	0.0

78	0.0782	0.0	2250.00	3416.	47.21	5	9	5	77	90	0.0
79	0.0782	0.0	2250.00	3416.	47.21	10	4	9	227	78	0.0
80	0.0782	0.0	2250.00	3416.	47.21	10	9	9	78	79	0.0
81	0.0782	0.0	2250.00	3416.	47.21	10	9	9	79	80	0.0
82	0.0782	0.0	2250.00	3416.	47.21	10	9	9	80	81	0.0
83	0.0782	0.0	2250.00	3416.	47.21	7	9	9	81	82	0.0
84	0.0782	0.0	2250.00	3416.	47.21	9	9	9	82	83	0.0
85	0.0782	0.0	2250.00	3416.	47.21	5	9	5	83	90	0.0
86	0.0782	0.0	2250.00	3416.	47.21	10	3	9	51	84	0.0
87	0.0782	0.0	2250.00	3416.	47.21	10	9	9	84	85	0.0
88	0.0782	0.0	2250.00	3416.	47.21	10	9	9	85	86	0.0
89	0.0782	0.0	2250.00	3416.	47.21	10	9	9	86	87	0.0
90	0.0782	0.0	2250.00	3416.	47.21	7	9	9	87	88	0.0
91	0.0782	0.0	2250.00	3416.	47.21	9	9	9	88	89	0.0
92	0.0782	0.0	2250.00	3416.	47.21	5	9	5	89	90	0.0
93	0.3816	0.0	2250.00	3416.	47.21	10	5	9	44	91	0.0
94	0.3816	0.0	2250.00	3416.	47.21	9	9	2	91	92	0.0
95	0.3259	0.0	2250.00	3416.	47.21	4	2	2	92	93	0.0
96	0.3816	0.0	2250.00	3416.	47.21	11	2	9	93	94	0.0
97	0.3816	0.0	2250.00	3416.	47.21	11	9	2	94	95	0.0
98	0.3259	0.0	2250.00	3416.	47.21	2	2	6	95	111	0.0
99	0.3816	0.0	2250.00	3416.	47.21	10	5	9	45	96	0.0
100	0.3816	0.0	2250.00	3416.	47.21	9	9	2	96	97	0.0
101	0.3259	0.0	2250.00	3416.	47.21	4	2	2	97	98	0.0
102	0.3816	0.0	2250.00	3416.	47.21	11	2	9	98	99	0.0
103	0.3816	0.0	2250.00	3416.	47.21	11	9	2	99	100	0.0
104	0.3259	0.0	2250.00	3416.	47.21	2	2	6	100	111	0.0
105	0.3816	0.0	2250.00	3416.	47.21	10	5	9	46	101	0.0
106	0.3816	0.0	2250.00	3416.	47.21	9	9	2	101	102	0.0
107	0.3259	0.0	2250.00	3416.	47.21	4	2	2	102	103	0.0
108	0.3816	0.0	2250.00	3416.	47.21	11	2	9	103	104	0.0
109	0.3816	0.0	2250.00	3416.	47.21	11	9	2	104	105	0.0
110	0.3259	0.0	2250.00	3416.	47.21	2	2	6	105	111	0.0
111	0.3816	0.0	2250.00	3416.	47.21	10	5	9	47	106	0.0
112	0.3816	0.0	2250.00	3416.	47.21	9	9	2	106	107	0.0
113	0.3259	0.0	2250.00	3416.	47.21	4	2	2	107	108	0.0
114	0.3816	0.0	2250.00	3416.	47.21	11	2	9	108	109	0.0
115	0.3816	0.0	2250.00	3416.	47.21	11	9	2	109	110	0.0
116	0.3259	0.0	2250.00	3416.	47.21	2	2	6	110	111	0.0
117	6.6800	0.0	2250.00	3416.	47.21	7	5	6	90	111	0.0
118	6.6800	0.0	2250.00	3416.	47.21	2	5	2	111	112	0.0
119	1.6110	0.0	2250.00	3416.	47.21	2	2	4	112	113	0.0
120	4.2800	0.0	2250.00	3416.	47.21	2	4	2	113	114	9.84
121	4.2800	0.0	2250.00	3416.	47.21	2	2	2	114	115	0.0
122	1.9800	0.0	2250.00	3416.	47.21	2	2	2	115	116	6.94
123	2.8300	0.0	2250.00	3416.	47.21	10	2	9	116	117	0.0
124	2.8300	0.0	2250.00	3416.	47.21	9	9	9	117	118	0.0

125	2.8300	0.0	2250.00	3416.	47.21	9	9	2	118	119	0.0
126	1.7700	0.0	2250.00	3416.	47.21	3	2	3	119	120	0.0
127	2.8300	0.0	2250.00	3416.	47.21	3	3	2	120	121	0.0
128	0.7850	0.0	2250.00	3416.	47.21	2	2	2	121	122	0.0
129	2.5400	0.0	2250.00	3416.	47.21	5	2	2	122	123	0.0
130	0.5620	0.0	2250.00	3416.	47.21	2	2	2	123	124	0.0
131	2.5400	0.0	2250.00	3416.	47.21	4	2	4	124	125	0.0
132	0.1310	0.0	2250.00	3416.	47.21	9	6	1	135	126	0.0
133	0.1310	0.0	2250.00	3416.	47.21	9	6	1	135	127	0.0
134	0.1310	0.0	2250.00	3416.	47.21	9	6	1	226	128	0.0
135	0.2700	0.0	2250.00	3416.	47.21	5	4	9	113	129	0.0
136	0.2700	0.0	2250.00	3416.	47.21	5	9	9	129	130	0.0
137	0.2700	0.0	2250.00	3416.	47.21	10	9	9	130	131	0.0
138	0.2700	0.0	2250.00	3416.	47.21	10	9	9	131	132	0.0
139	0.2700	0.0	2250.00	3416.	47.21	10	9	9	132	133	0.0
140	0.2700	0.0	2250.00	3416.	47.21	7	9	9	133	134	0.0
141	0.2700	0.0	2250.00	3416.	47.21	4	9	6	134	135	0.0
142	0.6827	0.0	2250.00	3416.	47.21	5	4	6	125	135	0.0
143	0.2700	0.0	2250.00	3416.	47.21	5	4	9	113	159	0.0
144	0.2700	0.0	2250.00	3416.	47.21	5	9	9	159	160	0.0
145	0.2700	0.0	2250.00	3416.	47.21	10	9	9	160	161	0.0
146	0.2700	0.0	2250.00	3416.	47.21	10	9	9	161	162	0.0
147	0.2700	0.0	2250.00	3416.	47.21	10	9	9	162	163	0.0
148	0.2700	0.0	2250.00	3416.	47.21	7	9	9	163	164	0.0
149	0.2700	0.0	2250.00	3416.	47.21	4	9	6	164	226	0.0
150	0.6827	0.0	2250.00	3416.	47.21	5	4	6	125	226	0.0
151	0.7500	0.0	2250.00	3416.	47.21	8	6	3	226	137	0.0
152	0.7500	0.0	2250.00	3416.	47.21	8	6	3	135	136	0.0
153	0.1310	0.0	2250.00	3416.	47.21	9	6	1	226	138	0.0
154	2.5400	0.0	2250.00	3416.	47.21	10	4	2	125	139	0.0
155	0.5620	0.0	2250.00	3416.	47.21	3	2	2	139	140	0.0
156	3.5500	0.0	2250.00	3416.	47.21	6	2	1	140	141	0.0
157	1.0600	0.0	2250.00	3416.	47.21	3	3	1	120	142	0.0
158	0.2340	0.0	2250.00	3416.	47.21	3	3	9	137	143	0.0
159	0.2340	0.0	2250.00	3416.	47.21	3	9	2	143	144	0.0
160	0.3760	0.0	2250.00	3416.	47.21	3	2	2	144	145	0.0
161	0.0744	0.0	2250.00	3416.	47.21	2	2	3	145	146	0.0
162	0.2340	0.0	2250.00	3416.	47.21	3	3	9	137	147	0.0
163	0.2340	0.0	2250.00	3416.	47.21	3	9	2	147	148	0.0
164	0.3760	0.0	2250.00	3416.	47.21	3	2	2	148	149	0.0
165	0.0744	0.0	2250.00	3416.	47.21	2	2	3	149	150	0.0
166	0.2340	0.0	2250.00	3416.	47.21	3	3	9	136	155	0.0
167	0.2340	0.0	2250.00	3416.	47.21	3	9	2	155	156	0.0
168	0.3760	0.0	2250.00	3416.	47.21	3	2	2	156	157	0.0
169	0.0744	0.0	2250.00	3416.	47.21	2	2	3	157	158	0.0
170	0.2340	0.0	2250.00	3416.	47.21	3	3	9	136	151	0.0
171	0.2340	0.0	2250.00	3416.	47.21	3	9	2	151	152	0.0

172	0.3760	0.0	2250.00	3416.	47.21	3	2	2	152	153	0.0
173	0.3744	0.0	2250.00	3416.	47.21	2	2	3	153	154	0.0
174	0.0013	0.0	2250.00	3416.	47.21	11	3	3	146	150	0.0
175	0.0013	0.0	2250.00	3416.	47.21	11	3	3	150	158	0.0
176	0.0013	0.0	2250.00	3416.	47.21	11	3	3	158	154	0.0
177	0.0013	0.0	2250.00	3416.	47.21	11	3	3	154	146	0.0
178	0.6827	0.0	2250.00	3416.	47.21	9	6	9	135	165	0.0
179	0.6827	0.0	2250.00	3416.	47.21	9	9	2	165	166	0.50
180	0.6827	0.0	2250.00	3416.	47.21	9	2	2	166	167	0.10
181	0.6827	0.0	2250.00	3416.	47.21	5	2	3	167	168	0.0
182	0.0156	0.0	2250.00	3416.	47.21	7	3	2	168	169	0.17
183	0.0156	0.0	2250.00	3416.	47.21	10	2	2	169	170	0.17
184	0.0156	0.0	2250.00	3416.	47.21	8	2	2	170	171	0.17
185	0.0156	0.0	2250.00	3416.	47.21	6	2	2	171	172	0.17
186	0.0156	0.0	2250.00	3416.	47.21	9	2	2	172	173	0.17
187	0.0156	0.0	2250.00	3416.	47.21	14	2	2	173	174	0.17
188	0.0156	0.0	2250.00	3416.	47.21	7	2	2	174	175	0.17
189	0.0156	0.0	2250.00	3416.	47.21	7	2	7	175	176	0.0
190	0.6827	0.0	2250.00	3416.	47.21	9	3	2	168	177	0.50
191	0.6827	0.0	2250.00	3416.	47.21	13	2	2	177	178	0.10
192	0.6827	0.0	2250.00	3416.	47.21	9	2	2	178	179	0.0
193	0.8956	0.0	2250.00	3416.	47.21	9	2	2	179	180	5.56
194	0.8956	0.0	2250.00	3416.	47.21	2	2	2	180	181	0.0
195	4.0000	0.0	2250.00	3416.	47.21	9	2	6	181	182	0.0
196	0.3083	0.0	2250.00	3416.	47.21	22	6	2	182	183	4.50
197	0.3083	0.0	2250.00	3416.	47.96	16	2	2	183	184	4.50
198	0.3083	0.0	2250.00	3416.	47.21	21	2	6	184	185	0.0
199	0.3200	0.0	2250.00	3416.	47.21	22	6	2	182	186	4.20
200	0.3200	0.0	2250.00	3416.	47.96	13	2	2	186	187	4.20
201	0.3200	0.0	2250.00	3416.	47.21	21	2	6	187	185	0.0
202	0.3345	0.0	2250.00	3416.	47.21	22	6	2	182	188	4.00
203	0.3345	0.0	2250.00	3416.	47.96	9	2	2	188	189	4.00
204	0.3345	0.0	2250.00	3416.	47.21	21	2	6	189	185	0.0
205	0.3263	0.0	2250.00	3416.	47.21	22	6	2	182	190	3.70
206	0.3263	0.0	2250.00	3416.	47.96	7	2	2	190	191	3.70
207	0.3263	0.0	2250.00	3416.	47.21	21	2	6	191	185	0.0
208	0.3390	0.0	2250.00	3416.	47.21	22	6	2	182	192	3.50
209	0.3390	0.0	2250.00	3416.	47.96	4	2	2	192	193	3.50
210	0.3390	0.0	2250.00	3416.	47.21	21	2	6	193	185	0.0
211	4.0000	0.0	2250.00	3416.	47.21	10	6	2	185	194	0.0
212	0.8956	0.0	2250.00	3416.	47.21	2	2	2	194	195	8.32
213	0.8956	0.0	2250.00	3416.	47.21	7	2	2	195	196	0.0
214	0.6827	0.0	2250.00	3416.	47.21	5	2	2	196	197	0.50
215	0.6827	0.0	2250.00	3416.	47.21	7	2	2	197	198	0.17
216	0.6827	0.0	2250.00	3416.	47.21	13	2	3	198	199	0.0
217	0.6827	0.0	2250.00	3416.	47.21	7	3	2	199	200	0.17
218	0.6827	0.0	2250.00	3416.	47.21	6	2	2	200	201	0.0

219	0.3941	0.0	2250.00	3416.	47.21	8	2	11	201	202	0.0
220	0.3941	0.0	2250.00	3416.	47.21	9	11	2	202	203	0.10
221	0.3941	0.0	2250.00	3416.	47.21	12	2	2	203	204	0.0
222	0.6827	0.0	2250.00	3416.	47.21	12	2	3	204	205	0.0
223	0.6827	0.0	2250.00	3416.	47.21	7	3	2	199	206	0.17
224	0.6827	0.0	2250.00	3416.	47.21	6	2	2	206	207	0.0
225	0.3941	0.0	2250.00	3416.	47.21	8	2	11	207	208	0.0
226	0.3941	0.0	2250.00	3416.	47.21	8	11	2	208	209	0.17
227	0.3941	0.0	2250.00	3416.	47.21	6	2	3	209	205	0.0
228	0.6827	0.0	2250.00	3416.	47.21	12	3	2	205	210	0.17
229	0.6827	0.0	2250.00	3416.	47.21	8	2	2	210	211	0.10
230	0.6827	0.0	2250.00	3416.	47.21	10	2	2	211	212	0.50
231	0.6827	0.0	2250.00	3416.	47.21	9	2	9	212	213	0.0
232	0.6827	0.0	2250.00	3416.	47.21	5	9	4	213	43	0.0
233	0.3941	0.0	2250.00	3500.	47.21	7	3	2	5	214	0.21
234	0.3941	0.0	2250.00	3500.	47.21	5	2	2	214	215	0.21
235	0.3941	0.0	2250.00	3525.	47.21	11	2	9	215	216	0.0
236	0.3941	0.0	2250.00	3550.	47.21	10	9	3	216	217	0.0
237	0.3941	0.0	2250.00	3550.	47.21	10	3	2	217	218	0.21
238	0.3941	0.0	2250.00	3600.	47.21	7	2	1	218	219	0.0
239	0.3941	0.0	2250.00	3575.	47.21	10	3	2	217	220	0.21
240	0.3941	0.0	2250.00	3600.	47.21	7	2	1	220	221	0.0
241	0.3941	0.0	2250.00	3600.	47.21	10	3	2	40	222	0.21
242	0.3941	0.0	2250.00	3600.	47.21	7	2	1	222	223	0.0
243	0.3941	0.0	2250.00	3600.	47.21	10	3	2	40	224	0.21
244	0.3941	0.0	2250.00	3600.	47.21	7	2	1	224	225	0.0

INPUT WAVEFORM IS CALCULATED INTERNALLY.

CASE NO	=	1
VALVE INPUT WAVE DURATION(SECS)V-1	=	0.01000
VALVE INPUT WAVE DURATION(SECS)V-2	=	0.01000
VALVE PASSAGE AREA(FT.SQ.)V-1	=	0.09000
VALVE PASSAGE AREA(FT.SQ.)V-2	=	0.09000
DISCHARGE COEFFICIENT,CD	=	1.00000

VALVE OPENING TIME(SECS) V-1	=	0.0001000
VALVE OPENING TIME(SECS) V-2	=	0.00010
VALVE AREA OPENING DELAY(SECS)V-1	=	0.0
VALVE AREA OPENING DELAY(SECS)V-2	=	0.0
VALVE INITIATION DELAY(SECS)V-1	=	0.0
VALVE INITIATION DELAY(SECS)V-2	=	0.0

SYSTEM ENERGY LOSS FACTORS SUPPLIED EXTERNALLY.

LOSS FACTOR LEG DIAMETER RANGE (FT)

1.50 0 TO 10.0000

TIME INCREMENTS(SECS) = 0.0001000

END TIME(SECS) = 0.1010

RESULTS PRINTED AFTER EVERY 50 TIME INCREMENTS

MINIMUM FLUID VELOCITY ABOVE WHICH CHECK VALVES STAY OPEN (FT/SEC) = 0.0

PRESSURIZER PRESSURE STAYS CONSTANT.

PUMP 1 PRESENCE IGNORED.

PUMP 2 PRESENCE IGNORED.

WHAM-6 PUMP MODEL IS USED.

P(T) AND V(T) ON TAPE FOR 244 LEGS

DATA RECORDED EVERY 1 TIME STEPS

LEGS STORED ON TAPE:

1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31 32 33 34 35 36

37 38 39 40 41 42 43 44 45 46 47 48

49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153	154	155	156
157	158	159	160	161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192

~~193 194 195 196 197 198 199 200 201 202 203 204~~

205 206 207 208 209 210 211 212 213 214 215 216

217 218 219 220 221 222 223 224 225 226 227 228

~~229 230 231 232 233 234 235 236 237 238 239 240~~

241 242 243 244

WHAM/MOD 006/ 7-01-75 / VTB DATE 02/02/77
WHAM6 EXPERIMENTAL MODEL OF THE LOFT PCS COLD LEG BREAK
THE MODEL IS INCLUSIVE OF THE PCS OUT TO THE QOBV SLEEVE IN EACH LEG

APPENDIX B

UPDATE LISTING TO CREATE RELAP4/MOD5 [LOFTSV02(73)]
FROM RELAP4/MOD5 (UPDATE 2)

DATA ITL /4HEXP*,
DATA ITL /4HEXPO,

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1      4HP4/C, 4H E 0, 4H8/25, 4H/76, 4H(73),
1      4HP4/C, 4H E 0, 4HLOFT, 4HVC02, 4H(73),
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
1      PQUITL, PQUITH, TQUITL, TQUITH)
1      PQUITL, PQUITH, TQUITL, TQUITH, IAMBLO(I), TAIR(I), VAIR(I)
LENGT(J)=6*MAXVOL*NLFLT + MAXVOL*NLINT
LENGT(J)=8*MAXVOL*NLFLT + MAXVOL*NLINT
2      MS, MM, MN, MT, DT, GL, GR)
2      MS, MM, MN, MT, DT, GL, GR, ISWKK)
8      LEVEL 2, ISWKK
      DIMENSION ISWKK(1)
3      GL, GR, L, IEMHI, IEMPS, IEMEC, IDEBUG)
3      GL, GR, L, IEMHI, IEMPS, IEMEC, IDEBUG, ISWKK)
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
*      PQUITL, PQUITH, TQUITL, TQUITH)
1      PQUITL, PQUITH, TQUITL, TQUITH, IDUM, DUM1, DUM2)
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
*      VSTIDX(75), SATIDX(75), PHASE(75)
*      VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
1      GR, ISIDE, LL, II)
1      GR, ISIDE, LL, II, ISWKK)
8      LEVEL 2, GL, GR
8      LEVEL 2, GL, GR, ISWKK
      LOGICAL ERR
      LOGICAL ERR, KATS
      DIMENSION ISWKK(1)
      KATS = .FALSE.
      IF (ISWKK(LL).EQ.0) GO TO 9
      KATS = .TRUE.
      XXL = 0.
      XLFRAC = 0.
      XXL = ZTOP(LL)-ZBOT(LL)
      IF (XXL.LE.0.) GO TO 9
      XLFRAC = (ZM(1)-ZBOT(LL))/XXL
      XLFRAC = AMIN1(XLFRAC,1.)
      XLFRAC = AMAX1(XLFRAC,0.)
9      CONTINUE
2      IHTREG, J, LPOOL, ITS)
2      IHTREG, J, LPOOL, ITS, XXL, XLFRAC, KATS)
2      1, J, LPOOL, ITS)
2      1, J, LPOOL, ITS, XXL, XLFRAC, KATS)
2      2, J, LPOOL, ITS)
2      2, J, LPOOL, ITS, XXL, XLFRAC, KATS)
2      2, J, LPOOL, ITS)

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RMAN0036 DELETED
RMAN0036 INSERTED
RMAN0037 DELETED
RMAN0037 INSERTED
MAIN3600 DELETED
MAIN3600 INSERTED
BAL01210 DELETED
BAL01210 INSERTED
BAL02571 DELETED
BAL02571 INSERTED
COML2340 DELETED
COML2340 INSERTED
CONDC020 DELETED
CONDC020 INSERTED
CONDC053 DELETED
CONDC053 INSERTED
CONDC084 DELETED
CONDC084 INSERTED
CONDC0845 DELETED
CONDC0845 INSERTED
ECCA1090 DELETED
ECCA1090 INSERTED
FLO81610 DELETED
FLO81610 INSERTED
FLO82352 DELETED
FLO82352 INSERTED
FLUR0990 DELETED
FLUR0990 INSERTED
FLOS1990 DELETED
FLOS1990 INSERTED
HEAD0670 DELETED
HEAD0670 INSERTED
HTRC0011 DELETED
HTRC0011 INSERTED
HTRC0014 DELETED
HTRC0014 INSERTED
HTRC0841 DELETED
HTRC0841 INSERTED
HTRC0843 DELETED
HTRC0843 INSERTED
HTRC1122 DELETED
HTRC1122 INSERTED
HTRC1321 DELETED
HTRC1321 INSERTED
HTRC1720 DELETED
HTRC1720 INSERTED
HTRC1880 DELETED
HTRC1880 INSERTED
HTRC1910 DELETED
HTRC1910 INSERTED
HTRC2080 DELETED
HTRC2080 INSERTED

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2,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2080 INSERTED
3,J,LPOOL,ITS) HTRC2130 DELETED
3,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2130 INSERTED
2,J,LPOOL,ITS) HTRC2170 DELETED
2,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2170 INSERTED
3,J,LPOOL,ITS) HTRC2220 DELETED
3,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2220 INSERTED
9,J,LPOOL,ITS) HTRC2314 DELETED
9,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2314 INSERTED
4,J,LPOOL,ITS) HTRC2460 DELETED
4,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2460 INSERTED
5,J,LPOOL,ITS) HTRC2490 DELETED
5,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2490 INSERTED
9,J,LPOOL,ITS) HTRC2540 DELETED
9,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2540 INSERTED
6,J,LPOOL,ITS) HTRC2762 DELETED
6,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2762 INSERTED
7,J,LPOOL,ITS) HTRC2770 DELETED
7,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2770 INSERTED
9,J,LPOOL,ITS) HTRC2852 DELETED
9,J,LPOOL,ITS,XX,XLFRAC,KATS) HTRC2852 INSERTED
* VSTIDX(75), SATIDX(75), PHASE(75) ICTR(266) DELETED
* VSTIOX(75), SATIOX(75), PHASE(75), TAIR(75), VAIR(75) ICTR(266) INSERTED
* VSTIDX(75), SATIDX(75), PHASE(75) INJ22834 DELETED
* VSTIOX(75), SATIOX(75), PHASE(75), TAIR(75), VAIR(75) INJ22834 INSERTED
COMMON /FLOUO/, BFFF, CORCHL, DELTO(12), DTSUB, CZ, EN, ENO, EN1, EN2, INSLC935 INSERTED
1 ENOLD, HC1, HC2, HCOOT, HLCD, HRAD, HTK(12), QMAXFD, OTOTF, INIT, INSERTED
2 TKRK(12), TPKRK(12), TOGENH, TO, TSKRK(12), VOLQ, XMOLO, TENT, IFLAG(12), INSERTED
3 IHM, ISWKK(50), JUNIN, JNOUT, JUNSSL, JUNSLS, NAL, NCVOL, INSERTED
4 ADCVOL, NIPVOL, NSGVCL(12), NSGV, NUPVO, INSERTED
LEVEL 2, BFFF INSERTED
B DIMENSION L3B2(9) INSLC952 INSERTED
DATA L3B2 /400201,-400299, 0, 12, 0, 1, 2, C, C, / INSLC967 INSERTED
C READ DATA FOR USE OF STEAM GENERATOR SECONDARY MODE BE-EM ONLY INSL1816 INSERTED
C INPUT ON CARD NUMBER 4002YY YY=1,12 INSERTED
L3B2(6) = 1 INSERTED
CALL INP2 (DATA,FA,L3B2,IA) INSERTED
NSGV = L3B2(6) INSERTED
IF (NSGV.LE.0) GO TO 54 INSERTED
DC 52 K=1,NSGV INSERTED
A 52 NSGVOL(K) = IA(2,K) INSERTED
B 52 NSGVCL(K) = IA(K) INSERTED
54 CONTINUE INSERTED
* VSTIDX(75), SATIDX(75), PHASE(75) INV01020 DELETED
* VSTIOX(75), SATIOX(75), PHASE(75), TAIR(75), VAIR(75) INV01020 INSERTED
$NLOCAL INV0307C
IF(IAMBLC(I).NE.-1) GO TO 87 INV03072 INSERTED
TAIR(I) = TEMP(I) INV03074 INSERTED
VAIR(I) = V(I)*(ZVOL(I)-ZM(I))/ZVCL(I) INV03076 INSERTED
GO TO 86 INV03078 INSERTED
87 CONTINUE INV03080 INSERTED
WRITE (6,617) INV03082 INSERTED
159 VAIR=SPVA*SISVOL INV03084 IS NOW INV03082
159 VAIRX=SPVA*SISVOL INV04843 DELETED
VGVA=VSUBG/VAIR INV04844 INSERTED
INV04844 DELETED

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      VGVA=VSUBG/VAIRX
      DVADP=VAIR/(APRES+GAMMA)
      DVADP=VAIRX/(APRES+GAMMA)
$NLGCL INVO6660
      DO 301 I = 1, J
      IF(IAMBLO(I).GE.0) GO TO 301
      IF(IAMBLO(I).EQ.-1.AND.ARMAS(I).LE.0.) WRITE(6,651) I
      IF(IAMBLO(I).EQ.-1.AND.ARMAS(I).GT.0.) WRITE(6,650) I
      CONTINUE
$NLGCL INVO717C
      C
      C 300 GET ICE CONDENSER DATA
      CALL INICE (INVO, DATA, FA, NOGO)
      C
      C 650 FORMAT(10X,56H** ADIABATIC AIR EXPANSION MODEL WILL BE USED FOR VOI
      1LUME,14,3H**)
      651 FORMAT(10X,9H** VOLUME,14,37H HAS NO AIR, IAMBLO =-1 IS IGNORED **
      1)
$DELETE MIXFO0208620
      670 FORMAT(47H0**** ERROR ON FOLLOWING CARD. VALUE FOR WORD, 13,
      1 22H OUT OF RANGE. VALUE, 10X, 7HLIMIT 1,8X,7HLIMIT 2, 4X,
      2 24H**** EXECUTION DELETED.)
      671 FORMAT(56X,3I15)
      672 FORMAT(63X,1P3E15.6)
      699 FORMAT(100X, 27H***** EXECUTION DELETED.)
      701 FORMAT ( 36HVOL BUBL TIME PRESSURE
      * 40HTEMPERATURE HUMIDITY VOLUME
      A IMPLICIT REAL*8 (A-H,O-Z)
      C
      C CALLED BY PREW
      C
      C CALCULATE VOLUME DEPENDENT FLOW QUANTITIES
      C
      C NJUN = NUMBER OF JUNCTIONS
      C NVOL = NUMBER OF VOLUMES
      C IC = INITIAL CONDITION INDEX, 0=TRANSIENT, 1=IC
      C MAXJUN = MAXIMUM NUMBER OF JUNCTIONS
      C MAXVOL = MAXIMUM NUMBER OF VOLUMES
      C DT = TIME STEP SIZE
      C IEMFG = EVALUATION MODEL CALCULATION FLAG
      C IDEBUG = DEBUG PRINT FLAG
      C
      C COMMON / ENYAJ / FLOWA(75),FLOWL(75),FLOWRA(75),WVBAR(75),
      1 WVBARO(75),SPVZ(75),SPVZO(75),AINERV(75),CMAS(75),DIAMV(75),
      2 FANING(75),ELOD(75),TPMV(75),CMACHV(75),JTPMV(75),
      3 IFAN(75),JVISC(75),IAMBLO(75),IIN(75),IOUT(75)
      C
      C FLOWA = VOLUME FLOW AREA (FT2), INPUT
      C FLOWL = VOLUME FLOW PATH LENGTH (FT)
      C FLOWRA = 1/(144*GC*F.DW4**2)
      C WVBAR = AVERAGE VOLUME FLOW (LBM/SEC)
      C WVBARO = PREVIOUS TIME STEP VALUE OF WVBAR
      C SPVZ = VOLUME AVERAGE SPECIFIC VOLUME (FT3/LBM)
      C SPVZO = PREVIOUS TIME STEP VALUE OF SPVZ
      C AINERV = HALF-VOLUME INERTIA (L/(2*A*144*GC))

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      INVO4844 INSERTED
      INVO4854 DELETED
      INVO4854 INSERTED
      INVO6662 INSERTED
      INVO6664 INSERTED
      INVO6666 INSERTED
      INVO6668 INSERTED
      INVO6670 INSERTED
      INVO6662 IS NOW INVO6672
      INVO6663 IS NOW INVO6674
      INVO6664 IS NOW INVO6676
      INVO6670 IS NOW INVO6678
      INVO7172 INSERTED
      INVO7174 INSERTED
      INVO7176 INSERTED
      INVO7178 INSERTED
      INVO7171 IS NOW INVO7180
      INVO7172 IS NOW INVO7182
      INVO7173 IS NOW INVO7184
      INVO7174 IS NOW INVO7186
      INVO7175 IS NOW INVO7188
      INVO7178 IS NOW INVO7190
      INVO7180 IS NOW INVO7192
      INVO7190 IS NOW INVO7194
      MIXFC020 DELETED
      MIXFC021 DELETED
      MIXFC022 DELETED
      MIXFC023 DELETED
      MIXFC024 DELETED
      MIXFC025 DELETED
      MIXFC026 DELETED
      MIXFC027 DELETED
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      MIXFC177 DELETED
      MIXFC178 DELETED
      MIXFC179 DELETED
      MIXFC180 DELETED
      MIXFC181 DELETED
      MIXFC182 DELETED
      MIXFC183 DELETED
      MIXFC184 DELETED
      MIXFC185 DELETED
      MIXFC186 DELETED
      MIXFC187 DELETED
      MIXFC188 DELETED
      MIXFC189 DELETED
      MIXFC190 DELETED
      MIXFC191 DELETED
      MIXFC192 DELETED
      MIXFC193 DELETED
      MIXFC194 DELETED
      MIXFC195 DELETED
      MIXFC196 DELETED
      MIXFC197 DELETED
      MIXFC198 DELETED
      MIXFC199 DELETED
      MIXFC200 DELETED
      MIXFC201 DELETED
      MIXFC202 DELETED
      MIXFC203 DELETED
      MIXFC204 DELETED
      MIXFC205 DELETED
      MIXFC206 DELETED
      MIXFC207 DELETED
      MIXFC208 DELETED
      MIXFC209 DELETED
      MIXFC210 DELETED
      MIXFC211 DELETED
      MIXFC212 DELETED
      MIXFC213 DELETED
      MIXFC214 DELETED
      MIXFC215 DELETED
      MIXFC216 DELETED
      MIXFC217 DELETED
      MIXFC218 DELETED
      MIXFC219 DELETED
      MIXFC220 DELETED
      MIXFC221 DELETED
      MIXFC222 DELETED
      MIXFC223 DELETED
      MIXFC224 DELETED
      MIXFC225 DELETED
      MIXFC226 DELETED
      MIXFC227 DELETED
      MIXFC228 DELETED
      MIXFC229 DELETED
      MIXFC230 DELETED
      MIXFC231 DELETED
      MIXFC232 DELETED
      MIXFC233 DELETED
      MIXFC234 DELETED
      MIXFC235 DELETED
      MIXFC236 DELETED
      MIXFC237 DELETED
      MIXFC238 DELETED
      MIXFC239 DELETED
      MIXFC240 DELETED

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CMAS = CENTER OF MASS HEIGHT MIXF0250 DELETED
 DIAMV = EQUIVALENT DIAMETER OF FLOW AREA MIXF0260 DELETED
 FANING = FANNING FRICTION FACTOR MIXF0270 DELETED
 ELDD = $(L/D)/(144*GC*4**2)$ MIXFC280 DELETED
 TPMV = TWO-PHASE MULTIPLIER FOR FANNING FRICTION TERMS MIXFC290 DELETED
 CMACHV = MACH NUMBER SQUARED FOR AVERAGE VOLUME FLOW MIXF0300 DELETED
 JTPMV = INDEX FOR TWO-PHASE FRICT ON 0=NO, 1=YES MIXF0310 DELETED
 IFAN = MEMORY INDEX FOR FANNING FRICTION CALCULATION MIXF0320 DELETED
 JVIS = MEMORY INDEX FOR VISCOSITY CALCULATION MIXF0330 DELETED
 IAMBLO = INDEX FOR DETERMINING WHETHER TO CALCULATE LIQUID LEVE MIXF0340 DELETED
 IIN,IOUT = PRIMARY INLET AND OUTLET JUNCTION NUMBERS MIXF0342 DELETED
 MIXF0350 DELETED
 COMMON / GITTER / PSTAR(100,2), PARTLD(100,2), ENERGR(100,2), MIXF0480 DELETED
 1 SPVSTR(100,2), BWSQR(100,2) MIXF0490 DELETED
 SECOND INDEX 1=OUTLET, 2=INLET SIDE OF NORMAL FLOW MIXF0500 DELETED
 MIXF0510 DELETED
 PSTAR = UNMIXED PRESSURE MIXF0520 DELETED
 PARTLD = DV/DP AND DV/DH MIXF0530 DELETED
 ENERGR = KINETIC ENERGY MIXF0540 DELETED
 SPVSTR = SPECIFIC VOLUME AT JUNCTION MIXF0550 DELETED
 BWSQR = COEFFICIENT OF WJ**2 FROM MACH SUBROUTINE MIXF0560 DELETED
 AND FANNING FRICTION COEFFICIENT OF W**2 MIXF0570 DELETED
 NUMBER OF JUNCTIONS SHOULD BE # OR * TO NUMBER OF VOLUMES MIXF0580 DELETED
 MIXF0590 DELETED
 COMMON / JUNEJ / DELA(100), DELE(100), DELF(100), FL(100), XP(100) MIXF0600 DELETED
 MIXF0610 DELETED
 DELA = PRESSURE DIFFERENTIAL - ACCELERATION MIXF0620 DELETED
 DELE = PRESSURE DIFFERENTIAL - ELEVATION MIXF0630 DELETED
 DELF = PRESSURE DIFFERENTIAL - FRICTION MIXF0640 DELETED
 FL = PUMP SPEED, STORED HERE FOR EDIT PURPOSES MIXF0650 DELETED
 XP = JUNCTION QUALITY MIXF0660 DELETED
 MIXF0670 DELETED
 COMMON / JUNER / HP(100), WP(100), WSLIP(100), WTP(100), VSLIP, MIXF0680 DELETED
 * FMFRAC(100), IJ(100), IK(100), IPUMP(100), IVALVE(100), MIXF0690 DELETED
 2 IHOCOR(100), IVAP(100), IW(100,2), ISTAGP MIXF0700 DELETED
 MIXF0710 DELETED
 HP = JUNCTION FLUID ENTHALPY MIXF0720 DELETED
 WP = JUNCTION WEIGHT FLOW MIXF0730 DELETED
 WSLIP = JUNCTION WEIGHT FLOW OF WATER FROM SLIP FLOW MIXF0740 DELETED
 WTP = THE JUNCTION WEIGHT FLOW OF THE TWO PHASE MIXTURE OR STEAM MIXF0750 DELETED
 VSLIP = SLIP VELOCITY FOR VOLUMES DIRECTLY ABOVE EACH OTHER MIXF0760 DELETED
 FMFRAC = MASS FRACTION OF WATER IN JUNCTION FLOW MIXF0770 DELETED
 IJ = MIXING JUNCTION NUMBER MIXF0780 DELETED
 IK = MIXING VOLUME NUMBER MIXF0790 DELETED
 IPUMP = PUMP CURVE NUMBER MIXF0800 DELETED
 IVALVE = VALVE NUMBER MIXF0810 DELETED
 IVAP = JUNCTION VAPOR PRESSURE INDEX MIXF0820 DELETED
 IW(K,1) = JUNCTION INLET MIXF0830 DELETED
 IW(K,2) = JUNCTION OUTLET MIXF0840 DELETED
 WTP = THE JUNCTION WEIGHT FLOW OF THE TWO PHASE MIXTURE OR STEAM MIXF0850 DELETED
 MIXF0860 DELETED
 COMMON / JUNES / AJUN(100), ELEV(75), INERTA(100), MIXF0870 DELETED
 1 SRCOS(100), ZJUN(100), ZVOL(75), KCHOKE(100) MIXF0880 DELETED
 A REAL*8 INERTA MIXF0890 DELETED
 B REAL INERTA MIXF0891 DELETED

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C      AJUN  = JUNCTION FLOW AREA
C      ELEV  = VOLUME ELEVATION
C      INERTA = JUNCTION INERTIA
C      SRCOS = SQUARE ROOT OF THE COS OF ANGLE BETWEEN VOLUMES CONNECTED
C      ZJUN  = JUNCTION ELEVATION
C      ZVOL  = VOLUME HEIGHT
C      KCHOK = CHOKING INDICATOR (0=UNCHOKED)
C
C      COMMON / RETALS / FJUNF(100), FJUNR(100), HKIN(100), SPVJ(100),
1     SPVJO(100), RESDK(100), AJUNT(100), DIAMJ(100), TPMJ(100),
2     CMACHJ(100), PBJ(100),
3     KMACH(100), JVERTL(100), JCHOK(100), JCALCI(100), MVMIX(100)
C
C      FJUNF  = SPECIFIC ENERGY LOSS COEFFICIENT FOR FORWARD FLOW
C      FJUNR  = SPECIFIC ENERGY LOSS COEFFICIENT FOR REVERSE FLOW
C      HKIN   = JUNCTION KINETIC ENERGY, (V**2)/2 BTU/LBM
C      SPVJ   = JUNCTION SPECIFIC VOLUME, FT3/LBM
C      SPVJO  = JUNCTION SPECIFIC VOLUME FOR PREVIOUS TIME STEP, FT3/LBM
C      RESDK  = RESIDUAL JUNCTION FRICTION FACTOR FOR STEADY STATE
C      AJUNT  = TIME DEPENDENT JUNCTION AREA
C      DIAMJ  = JUNCTION DIAMETER
C      TPMJ   = TWO-PHASE FRICTION MULTIPLIER FOR FORM-LOSS
C      CMACHJ = JUNCTION SONIC VELOCITY SQUARED
C      KMACH  = MACH TABLE MEMORY INDEX
C      JVERTL = VERTICAL JUNCTION CONTROL INDEX
C      JCHOK  = JUNCTION CHOKING INDEX
C      JCALCI = INITIAL CONDITION CALCULATION TYPE CONTROL INDEX
C      MVMIX  = MOMENTUM MIXING INDEX
C
C      COMMON/SLPVEL/VSLA(100), VLIQA(100), VVAPA(100), XLW(100), XWG(100),
*      HLOUT(100), HLIN(100), HGOUT(100), HGIN(100),
*      RL(100), RG(100),
*      SLVAMX, SLVELZ, SLVPR, SLVSL1, SLVDPF,
*      WALSC1, WALSC2, WALSC3, WALSC4, WALSC5, WALSC6,
*      DTDOWN, DNGAP, JCNDWN, IDWNEM, ISLIP
C
B     LEVEL 2, VSLA
C     VSLA  = SLIP VELOCITY TIMES SORT OF COSINE OF CON. ANGLE
C     VLIQA = LIQUID VELOCITY
C     VVAPA = VAPOR VELOCITY
C     XLW   = LIQUID PHASE JUNCTION MASS FLOW
C     XWG   = GAS PHASE JUNCTION MASS FLOW
C     HLOUT = OUTLET LIQUID PHASE JUNCTION ENTHALPY
C     HLIN  = INLET LIQUID PHASE JUNCTION ENTHALPY
C     HGOUT = OUTLET GAS PHASE JUNCTION ENTHALPY
C     HGIN  = INLET GAS PHASE JUNCTION ENTHALPY
C     RL    = PARTIAL LIQUID JUNCTION DENSITY
C     RG    = PARTIAL GAS JUNCTION DENSITY
C     ISLIP = 0 FOR NO SLIP, = POSITIVE IF SOME JUNCTION REQUIRES SLIP
C     SLVNS = SLIP VELOCITY PARAMETERS
C     WALSCS = WALLIS AND DOWN FLOODING SLIP PARAMETERS
C     DTDOWN = DOWNCOMER DIAMETER (FT)
C     JCNDWN = DOWNCOMER JUNCTION INDEX
C
C      MIXFC900 DELETED
C      MIXFC910 DELETED
C      MIXFC920 DELETED
C      MIXFC930 DELETED
C      MIXFC940 DELETED
C      MIXFC950 DELETED
C      MIXFC960 DELETED
C      MIXFC970 DELETED
C      MIXFC980 DELETED
C      MIXF1160 DELETED
C      MIXF1162 DELETED
C      MIXF1164 DELETED
C      MIXF1166 DELETED
C      MIXF1190 DELETED
C      MIXF1200 DELETED
C      MIXF1210 DELETED
C      MIXF1220 DELETED
C      MIXF1230 DELETED
C      MIXF1235 DELETED
C      MIXF1240 DELETED
C      MIXF1250 DELETED
C      MIXF1260 DELETED
C      MIXF1270 DELETED
C      MIXF1280 DELETED
C      MIXF1290 DELETED
C      MIXF1300 DELETED
C      MIXF1310 DELETED
C      MIXF1320 DELETED
C      MIXF1330 DELETED
C      MIXF1340 DELETED
C      MIXF1341 DELETED
C      MIXF1342 DELETED
C      MIXF1343 DELETED
C      MIXF1344 DELETED
C      MIXF1345 DELETED
C      MIXF1346 DELETED
C      MIXF1347 DELETED
C      MIXF1348 DELETED
C      MIXF1349 DELETED
C      MIXF1350 DELETED
C      MIXF1351 DELETED
C      MIXF1352 DELETED
C      MIXF1353 DELETED
C      MIXF1354 DELETED
C      MIXF1355 DELETED
C      MIXF1356 DELETED
C      MIXF1357 DELETED
C      MIXF1358 DELETED
C      MIXF1359 DELETED
C      MIXF1360 DELETED
C      MIXF1361 DELETED
C      MIXF1362 DELETED
C      MIXF1363 DELETED
C      MIXF1364 DELETED
C      MIXF1365 DELETED

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B-5

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C DOWNGAP = DOWNCOMER OUTER - INNER RADIUS
C IDWNEM = EVALUATION MODEL DOWNCOMER FLAG, 0 FOR R4, 1 FOR EM
C
C COMMON/SPECIAL/ HSPIN(100), HSPOUT(100), QSPL(75), WQ(75)
C
C HSPIN = EQUIVALENT JUNCTION INLET ENTHALPY
C HSPOUT = EQUIVALENT JUNCTION OUTLET ENTHALPY
C QSPL = VOLUME HEAT SOURCE
C WQ = VOLUME POWER INTO COOLANT (QSPL - K.E.)
C
C COMMON /VOLDER/ SOUND2(75), SATUF(75), SATUG(75), UW(75),
C * VSTIDX(75), SATIDX(75), PHASE(75)
C INTEGER PHASE
C LOGICAL FKGEOM, JC
C
C SOUND2 = ISENTROPIC SONIC VELOCITY SQUARED, DP/DR)RHO
C SATUF = SATURATED LIQUID SPECIFIC INTERNAL ENERGY U(TSAT)
C SATUG = SATURATED GAS SPECIFIC INTERNAL ENERGY UG(TSAT)
C UW = SPECIFIC INTERNAL ENERGY
C VSTIDX = MEMORY INDEX FOR VOLUME STATE PROPERTIES
C SATIDX = MEMORY INDEX FOR SATURATED STATE PROPERTIES
C PHASE = PHASE OF WATER IN VOLUME
C
C COMMON/ XUNITS / ALARG, BTUMWH, CFMGPS, FOOT, FPBTU,
C 1 GAMMA, GRAVITY, G120PI, PI, ROTENG, SECHR, SQINCH
C
C DATA ZERO, DP5, ONE / 0., .5, 1./
C
C MIXED FLOWS
C
C IRET = 2
C PEK = ZERO
C PEL = ZERO
C K = IW(1,1)
C L = IW(1,2)
C IF( K.GT.0 ) PEK = (ZJUN(I) - ELEV(K) - CMAS(K)) / FPBTU
C IF( L.GT.0 ) PEL = (ZJUN(I) - ELEV(L) - CMAS(L)) / FPBTU
C MIXVL = IK(I)
C MV = IABS(MIXVL)
C J = IABS(IJ(I))
C RVJ1 = ZERO
C RVJ2 = ZERO
C RVJ = ZERO
C IF( J.LE.0 ) GO TO 254
C MVJ = IABS(IK(J))
C INDX = 0
C IF( MVJ.NE.MV ) GO TO 254
C AJ = AJUNT(J)
C WJ = WP(J)
C
C MIXF1366 DELETED
C MIXF1367 DELETED
C MIXF1368 DELETED
C MIXF1369 DELETED
C MIXF1370 DELETED
C MIXF1371 DELETED
C MIXF1372 DELETED
C MIXF1373 DELETED
C MIXF1374 DELETED
C MIXF1375 DELETED
C MIXF1376 DELETED
C MIXF1377 DELETED
C MIXF1378 DELETED
C MIXF1379 DELETED
C MIXF1380 DELETED
C MIXF1381 DELETED
C MIXF1390 DELETED
C MIXF1400 DELETED
C MIXF1410 DELETED
C MIXF1420 DELETED
C MIXF1430 DELETED
C MIXF1440 DELETED
C MIXF1450 DELETED
C MIXF1460 DELETED
C MIXF1465 DELETED
C MIXF1466 DELETED
C MIXF1467 DELETED
C MIXF1468 DELETED
C MIXF1469 DELETED
C MIXF1740 DELETED
C MIXF1770 DELETED
C MIXF1800 DELETED
C MIXF3830 DELETED
C MIXF3840 DELETED
C MIXF3850 DELETED
C MIXF3867 DELETED
C MIXF3870 DELETED
C MIXF3875 DELETED
C MIXF3877 DELETED
C MIXF3879 DELETED
C MIXF3881 DELETED
C MIXF3883 DELETED
C MIXF3885 DELETED
C MIXF3887 DELETED
C MIXF3890 DELETED
C MIXF3900 DELETED
C MIXF3910 DELETED
C MIXF3920 DELETED
C MIXF3930 DELETED
C MIXF3940 DELETED
C MIXF3950 DELETED
C MIXF3960 DELETED
C MIXF3970 DELETED
C MIXF3980 DELETED
C MIXF3990 DELETED

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AMIX = AJ+AI
RAM = ONE/AMIX
VJ1 = SPVSTR(J,1)
VJ2 = SPVSTR(J,2)
VJ = SPVJ(J)
IF( J.GT.I .AND. WJ.GE.ZERO ) SPVSTR(J,2) = VI
IF( J.GT.I .AND. WJ.LT.ZERO ) SPVSTR(J,1) = VI
VJMIN = VJ
IF( J.LT.I .AND. WJ.GE.ZERO ) VJMIN = SPVSTR(I,2)
IF( J.LT.I .AND. WJ.LT.ZERO ) VJMIN = SPVSTR(I,1)
JV1 = IW(J,1)
JV2 = IW(J,2)
CJ = CMACH(J)
IF( JV1.EQ.0 ) CJ = SGUND2(JV2)
RAJ1 = ZERO
RAJ2 = ZERO
IF( JV1.GT.0 ) RAJ1 = ONE/FLOWA(JV1)
IF( JV2.GT.0 ) RAJ2 = ONE/FLOWA(JV2)
RAJ = ZERO
IF( AJ.GT.ZERO ) RAJ = ONE/AJ
IF( JC ) GO TO 252
IF( WJ.GE.ZERO ) VJ2 = VJ1
IF( WJ.LT.ZERO ) VJ1 = VJ2
VJ = VJ1
251 IF( VJ1.GT.ZERO ) RVJ1 = ONE/VJ1
IF( VJ.GT.ZERO ) RVJ = ONE/VJ
IF( VJ2.GT.ZERO ) RVJ2 = ONE/VJ2
GO TO 253
252 CONTINUE
IF( J.LT.I ) GO TO 251
CALL MACH(WJ,RAJ1,RAJ,RAJ2,VJ1,VJ,VJ2,CJ,RVJ1,RVJ,RVJ2)
1 KC,CMACH(J)
253 CONTINUE
DIJ = ZERO
A AIN = DMINI(AINERV(MV),INERTA(J)*DP5)
B AIN = AMINI(AINERV(MV),INERTA(J)*DP5)
IF( INERTA(J).GT.ZERO ) DIJ = AIN*DELA(J)/INERTA(J)
A IF( DSIGN(ONE,WJ)*DSIGN(ONE,WJ).LT.ZERO ) DIJ = ZERO
B IF( SIGN(ONE,WJ)*SIGN(ONE,WJ).LT.ZERO ) DIJ = ZERO
IF( IJ(I) ) 255,254,265
254 WRITE(6,900) I,IJ(I),J,IJ(J),IK(I),IK(J),INDX
900 FORMAT(1H,47H**** FAIL IN PREW. MIX JUNCTIONS INCORRECT./
1 1H, 3HJUNCTION,13,11H MIXED WITH,13,13H AND JUNCTION,13,
2 11H MIXED WITH, 13,11H IN VOLUMES,14,4H AND,14,
1 19H WITH PATTERN INDEX,14)
CALL FAIL
GO TO 810
C REVERSED LEAK FLOW
255 WJ = -WJ
VJ2 = VJ1
RVJ2 = RVJ1
VJ1 = SPVSTR(J,2)
RVJ1 = ZERO
IF( VJ1.GT.ZERO ) RVJ1 = ONE/VJ1
DIJ = -DIJ

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MIXF4000 DELETED
MIXF4010 DELETED
MIXF4020 DELETED
MIXF4030 DELETED
MIXF4040 DELETED
MIXF4042 DELETED
MIXF4044 DELETED
MIXF4045 DELETED
MIXF4046 DELETED
MIXF4046 DELETED
MIXF4050 DELETED
MIXF4060 DELETED
MIXF4060 DELETED
MIXF4090 DELETED
MIXF4092 DELETED
MIXF4100 DELETED
MIXF4110 DELETED
MIXF4120 DELETED
MIXF4130 DELETED
MIXF4140 DELETED
MIXF4150 DELETED
MIXF4160 DELETED
MIXF4170 DELETED
MIXF4180 DELETED
MIXF4190 DELETED
MIXF4200 DELETED
MIXF4210 DELETED
MIXF4220 DELETED
MIXF4230 DELETED
MIXF4240 DELETED
MIXF4245 DELETED
MIXF4250 DELETED
MIXF4260 DELETED
MIXF4270 DELETED
MIXF4280 DELETED
MIXF4290 DELETED
MIXF4291 DELETED
MIXF4300 DELETED
MIXF4305 DELETED
MIXF4306 DELETED
MIXF4310 DELETED
MIXF4320 DELETED
MIXF4330 DELETED
MIXF4340 DELETED
MIXF4350 DELETED
MIXF4360 DELETED
MIXF4370 DELETED
MIXF4380 DELETED
MIXF4390 DELETED
MIXF4400 DELETED
MIXF4410 DELETED
MIXF4420 DELETED
MIXF4430 DELETED
MIXF4440 DELETED
MIXF4450 DELETED
MIXF4460 DELETED

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      GO TO 275
265 IF( IJ(J) ) 270,254,275
270 CONTINUE
      GO TO 255
275 WMIX = W + WJ
      PSTAR(I,1) = FSTAR(I,1) - DIJ
      IF( W.EQ.ZERO .OR. WJ.EQ.ZERO ) GO TO 813
      IF( WMIX.EQ.ZERO ) GO TO 650
      IS = DSIGN(ONE,W)
      JS = DSIGN(ONE,WJ)
      MS = DSIGN(ONE,WMIX)
      INDX = (IS+2*JS+4*MS+9)/2
      IF( INDX.LE.0 .OR. INDX.GT.8 ) GO TO 254
      IF( MIXVL ) 280,254,285

      MIXED ON INLET TO VOLUME L
280 GO TO (310,540,480,810,810,410,600,370), INDX
      MIXED ON OUTLET OF VOLUME K
285 GO TO (320,570,400,810,810,450,510,300), INDX

      FLOWS ALL POSITIVE AT OUTLET SIDE OF MIXING VOLUME, NO MIXING
300 CONTINUE
      IF( JC ) GO TO 302
      VI = VII
      VI2 = VII
      PST = DP5*(VI2*(RAL*W)**2 - VII*(WMIX*RAK)**2)
      GO TO 306
302 VI2 = VI
      CALL MACH(WMI,RAK,RAM,RAM,VII,VI,VDUM,C2,RVI,RVI,RVD,
1 KC,KMACH(I))
      CALL MACH(W,RAI,RAL,RAL,VI,VI2,VDUM,C2,RVI,RVI2,RVD,
1 KCHOKE(I),KMACH(I))
      KCHOKE(I) = KCHOKE(I) + KC
      PST = C2*(RVI2-RVI)-VII*(WMIX*RAK)**2+VI2*(W*RAL)**2
306 VE = HKE+(WMIX*RAK*VII)**2
      IF( .NOT.FKGEOM ) GO TO 800
      CALL FRICN(FF,FR,RAI,RAM,RAM,MVMI(I))
      CALL FRICN(FJUNF(I),FJUNR(I),RAI,FAI,RAL,MVMIX(I))
      BW = -FF*VII*WMIX**2
      GO TO 300

      FLOWS ALL NEGATIVE AT INLET SIDE OF MIXING VOLUME, NO MIXING
310 CONTINUE

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MIXF4470 DELETED
MIXF4480 DELETED
MIXF4490 DELETED
MIXF4500 DELETED
MIXF4510 DELETED
MIXF4520 DELETED
MIXF4530 DELETED
MIXF4540 DELETED
MIXF4550 DELETED
MIXF4551 DELETED
MIXF4560 DELETED
MIXF4561 DELETED
MIXF4570 DELETED
MIXF4571 DELETED
MIXF4580 DELETED
MIXF4590 DELETED
MIXF4600 DELETED
MIXF4610 DELETED
MIXF4620 DELETED
MIXF4630 DELETED
MIXF4640 DELETED
MIXF4650 DELETED
MIXF4660 DELETED
MIXF4670 DELETED
MIXF4680 DELETED
MIXF4690 DELETED
MIXF4700 DELETED
MIXF4710 DELETED
MIXF4720 DELETED
MIXF4725 DELETED
MIXF4730 DELETED
MIXF4735 DELETED
MIXF4740 DELETED
MIXF4745 DELETED
MIXF4750 DELETED
MIXF4760 DELETED
MIXF4762 DELETED
MIXF4765 DELETED
MIXF4770 DELETED
MIXF4775 DELETED
MIXF4780 DELETED
MIXF4782 DELETED
MIXF4790 DELETED
MIXF4795 DELETED
MIXF4800 DELETED
MIXF4805 DELETED
MIXF4810 DELETED
MIXF4815 DELETED
MIXF4820 DELETED
MIXF4822 DELETED
MIXF4825 DELETED
MIXF4830 DELETED
MIXF4840 DELETED
MIXF4845 DELETED
MIXF4850 DELETED

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IF( JC ) GO TO 312
VI = VI2
V11 = VI2
PST = DP5*(VI2*(WMIX*RAL)**2 - V11*(W*RAK)**2)
GO TO 316
312. V11 = VI
CALL MACH(WMIX, RAM, RAM, RAL, VDUM, VI, VI2, C2, RVD, RVI, RV12,
1 KC, KMACH(I))
CALL MACH(W, RAK, RAK, RAI, VDUM, V11, VI, C2, RVD, RV11, RVI,
1 KCHOKE(I), KMACH(I))
KCHOKE(I) = KCHOKE(I) + KC
PST = VI2*(WMIX*RAL)**2 + C2*(RV12-RV11) - V11*(W*RAK)**2
316 VE = HKE*(WMIX*RAL*VI2)**2
IF( .NOT. FKGEOM ) GO TO 800
CALL FRICIN(FJUNF(I), FJUNR(I), RAK, RAI, RAI, MVMIX(I))
CALL FRICIN(FF, FR, RAM, RAM, RAL, MVMIX(I))
BW = FR*VI2*WMIX**2
GO TO 800

```

C
C
C
C
C

FLows ALL NEGATIVE AT OUTLET SIDE OF MIXING VOLUME, MIXING

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320. CONTINUE
ANG1 = ONE
ANG2 = ONE
IF( JC ) GO TO 330
VM = (W*VI+WJ*VJ)/WMIX
PST = DP5*(VM*(RAM**2 - RAK**2)*WMIX**2 + VI*(RAL**2 + RAI**2)*W**2)
1 -VI*RAM*RAI*ANG1*W**2 - VJ*FAM*RAJ*ANG2*WJ**2
GO TO 350
A 330 V11 = DMAX1(VI, VJMIN)
B 330 V11 = AMAX1(VI, VJMIN)
CALL MACH(W, RAI, RAI, RAL, VDUM, VI, VI2, C2, RVD, RVI, RV12, KC, KMACH(I))
VM = (W*VI+WJ*VJ)/WMIX
A C = DMIN1(CJ, C2)
B C = AMIN1(CJ, C2)
CALL MACH(WMIX, RAK, RAK, RAM, VDUM, V11, VM, C, RVD, RV11, RV12,
1 KCHOKE(I), KMACH(I))
KCHOKE(I) = KCHOKE(I) + KC
PST = C*(RV11-RV12) + C2*(RV12-RV11) + VM*(RAM*WMIX)**2
1 +VI2*(RAL*W)**2 - V11*(WMIX*RAK)**2
2 -VI*RAM*RAI*ANG1*W**2 - VJ*FAM*RAJ*ANG2*WJ**2
350 VE = HKE*(W*RAL*VI2)**2
IF( .NOT. FKGEOM ) GO TO 800
CALL FRICIN(FJUNF(I), FJUNR(I), RAI, RAI, RAL, MVMIX(I))
CALL FRICIN(FF, FR, RAM, RAM, RAL, MVMIX(I))
BW = FR*VM*WMIX**2
GO TO 800

```

C
C
C
C
C

FLows ALL POSITIVE AT INLET SIDE OF MIXING VOLUME, MIXING

370. CONTINUE

MIXF4855 DELETED
MIXF4860 DELETED
MIXF4865 DELETED
MIXF4870 DELETED
MIXF4880 DELETED
MIXF4882 DELETED
MIXF4885 DELETED
MIXF4890 DELETED
MIXF4895 DELETED
MIXF4900 DELETED
MIXF4902 DELETED
MIXF4910 DELETED
MIXF4915 DELETED
MIXF4920 DELETED
MIXF4925 DELETED
MIXF4930 DELETED
MIXF4932 DELETED
MIXF4934 DELETED
MIXF4938 DELETED
MIXF4940 DELETED
MIXF4950 DELETED
MIXF4952 DELETED
MIXF4954 DELETED
MIXF4960 DELETED
MIXF4970 DELETED
MIXF4980 DELETED
MIXF4990 DELETED
MIXF5000 DELETED
MIXF5010 DELETED
MIXF5020 DELETED
MIXF5040 DELETED
MIXF5050 DELETED
MIXF5051 DELETED
MIXF5080 DELETED
MIXF5090 DELETED
MIXF5100 DELETED
MIXF5101 DELETED
MIXF5130 DELETED
MIXF5140 DELETED
MIXF5150 DELETED
MIXF5170 DELETED
MIXF5175 DELETED
MIXF5180 DELETED
MIXF5185 DELETED
MIXF5190 DELETED
MIXF5200 DELETED
MIXF5210 DELETED
MIXF5220 DELETED
MIXF5240 DELETED
MIXF5250 DELETED
MIXF5260 DELETED
MIXF5270 DELETED
MIXF5272 DELETED
MIXF5274 DELETED
MIXF5280 DELETED

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ANG1 = ONE
ANG2 = ONE
IF( JC ) GO TO 380
VM = (W*VI+WJ*VJ)/WMIX
PST = DP5*(VM*(RAL**2-RAM**2)*WMIX**2-VI*(RAI**2+RAK**2)*W**2)
1 +VI*RAM*RAI*ANG1*W**2 + VJ*RAM*RAJ*ANG2*WJ**2
GO TO 390
A 380 VI2 = DMAX1(VI,VJMIN)
B 380 VI2 = AMAX1(VI,VJMIN)
CALL MACH(W,RAK,RAI,RAI,VI1,VI,VDUM,C2,RV11,RVI,RVD,KC,KMACH(1))
VM = (W*VI+WJ*VJ)/WMIX
A C = DMIN1(CJ,C2)
B C = AMIN1(CJ,C2)
CALL MACH(WMIX,RAM,RAL,RAL,VM,VI2,VDUM,C,RVM,RV12,RVD,
1 KCHOKE(1),KMACH(1))
KCHOKE(1) = KCHOKE(1) + KC
PST = C*(RV12-RVM) + C2*(RVI-RV11) - VM*(RAM*WMIX)**2
1 +VI2*(RAL*WMIX)**2 - VI1*(W*RAK)**2
2 + VI*RAM*RAI*ANG1*W**2 + VJ*RAM*RAJ*ANG2*WJ**2
390 VE = HKE*(W*RAK*VI1)**2
IF( .NOT.FKGEOM ) GO TO 800
CALL FRICTN(FJUNF(1),FJUNR(1),RAK,RAI,RAI,MVMIX(1))
CALL FRICTN(FF,FR,RAI,RAM,RAL,MVMIX(1))
BW = -FF*VM*WMIX**2
GO TO 800

CCCC
WMIX.LT.O, W.LT.O, WJ.GT.O, MIXING VOLUME OUTLET SIDE

400 CONTINUE
RAMS = RAI*W/WMIX
IF( JC ) GO TO 402
VI = VI2
VI1 = VI2
PST = DP5*(VI2*(W*RAL)**2 - VI1*(WMIX*RAK)**2)
GO TO 406
402 VM = VI
CALL MACH(W,RAI,RAI,RAL,VDUM,VI,VI2,C2,RVD,RVI,RV12,
1 KC,KMACH(1))
CALL MACH(WMIX,RAK,RAI,RAMS,VI1,VM,VI,C2,RV11,RVM,RVI,
1 KCHOKE(1),KMACH(1))
KCHOKE(1) = KCHOKE(1) + KC
PST = C2*(RV12-RV11) - VI1*(WMIX*RAK)**2 + VI2*(RAL*W)**2
406 VE = HKE*(W*RAL*VI2)**2
IF( .NOT.FKGEOM ) GO TO 800
CALL FRICTN(FF,FR,RAI,RAM,RAMS,MVMIX(1))
CALL FRICTN(FJUNF(1),FJUNR(1),RAI,RAI,RAL,MVMIX(1))
BW = FR*VI*WMIX**2
GO TO 800

CCCC
WMIX.GT.O, W.GT.O, WJ.LT.O, MIXING VOLUME INLET SIDE

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MIXF5290 DELETED
MIXF5300 DELETED
MIXF5310 DELETED
MIXF5320 DELETED
MIXF5330 DELETED
MIXF5340 DELETED
MIXF5360 DELETED
MIXF5370 DELETED
MIXF5371 DELETED
MIXF5400 DELETED
MIXF5410 DELETED
MIXF5420 DELETED
MIXF5421 DELETED
MIXF5450 DELETED
MIXF5460 DELETED
MIXF5470 DELETED
MIXF5490 DELETED
MIXF5495 DELETED
MIXF5500 DELETED
MIXF5505 DELETED
MIXF5510 DELETED
MIXF5520 DELETED
MIXF5530 DELETED
MIXF5540 DELETED
MIXF5560 DELETED
MIXF5570 DELETED
MIXF5580 DELETED
MIXF5590 DELETED
MIXF5600 DELETED
MIXF5610 DELETED
MIXF5620 DELETED
MIXF5625 DELETED
MIXF5630 DELETED
MIXF5635 DELETED
MIXF5640 DELETED
MIXF5650 DELETED
MIXF5655 DELETED
MIXF5657 DELETED
MIXF5660 DELETED
MIXF5665 DELETED
MIXF5670 DELETED
MIXF5675 DELETED
MIXF5680 DELETED
MIXF5690 DELETED
MIXF5695 DELETED
MIXF5700 DELETED
MIXF5705 DELETED
MIXF5710 DELETED
MIXF5715 DELETED
MIXF5720 DELETED
MIXF5730 DELETED
MIXF5740 DELETED
MIXF5750 DELETED
MIXF5760 DELETED
MIXF5770 DELETED

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B-10

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410 CONTINUE
RAMS = RAI*W/WMIX
IF( JC ) GO TO 412
VI = VI1
VI2 = VI1
PST = DP5*(VI2*(WMIX*RAL)**2 - VI1*(RAK*W)**2)
GO TO 416
412 VM = VI
CALL MACH(W,RAK,RAI,RAI,VI1,VI,VDUM,C2,RVI1,RVI,RVD,
1 KC,KMACH(I))
CALL MACH(WMIX,RAMS,RAM,RAL,VI,VM,VI2,C2,RVI,RVM,RVI2,
1 KCHOKE(I),KMACH(I))
KCHOKE(I) = KCHOKE(I) + KC
PST = C2*(RVI2-RVI1) + VI2*(WMIX*RAL)**2 - VI1*(RAK*W)**2
416 VE = HKE*(W*RAK*VI1)**2
IF( .NOT. FKGEUM ) GO TO 800
CALL FRICTN(FF,FR,RAMS,RAM,RAL,MVMIX(I))
CALL FRICTN(FJUNF(I),FJUNK(I),RAK,RAI,RAI,MVMIX(I))
BW = -FF*VI*WMIX**2
GO TO 800

CCCC
WMIX.GT.O, W.GT.O, WJ.LT.O, MIXING VOLUME OUTLET SIDE

450 CONTINUE
IF( JC ) GO TO 460
VI = (WMIX*VI1-WJ*VJ)/W
VM = VI1
VI2 = VI
RAMS = RAI*W*VI/(WMIX*VM)
PST = DP5*(VI*(RAL**2+(ONE-VI*RVI1)*RAI**2)*W**2
1 -VI1*(RAK*WMIX)**2)
GO TO 470
460 VM = VI1
VJ = VJ2
DO 465 LL = 1,3
AMS = AI*WMIX*VM/(WMIX*VM-WJ*VJ)
RAMS = ONE/AMS
RAJS = ONE/(AI-AMS)
VMD = VI
CALL MACH(WMIX,RAK,RAM,RAMS,VI1,VMD,VM,C2,RVI1,RVMD,RVM,
1 KC,KMACH(I))
VJ = VJMIN
CALL MACH(WJ,RAJS,RAJ,RAJ2,VJD,VJ,VJ2,CJ,RVJD,RVJ,RVJ2,
1 KC2,KMACH(J))
465 CONTINUE
A VI2 = DMAX1(VI,VJMIN)
B VI2 = AMAX1(VI,VJMIN)
VI = (WMIX*VM-WJ*VJ)/W
A CBAR = DMIN1(C2,CJ)
B CBAR = AMIN1(C2,CJ)
CALL MACH(W,RAI,RAI,RAL,VI,VI2,VDUM,CBAR,RVI,RVI2,RVD,
1 KC2,KMACH(I))
KCHOKE(I) = KC + KC2

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MIXF5780 DELETED
MIXF5785 DELETED
MIXF5790 DELETED
MIXF5795 DELETED
MIXF5800 DELETED
MIXF5810 DELETED
MIXF5815 DELETED
MIXF5817 DELETED
MIXF5820 DELETED
MIXF5825 DELETED
MIXF5830 DELETED
MIXF5835 DELETED
MIXF5840 DELETED
MIXF5850 DELETED
MIXF5855 DELETED
MIXF5860 DELETED
MIXF5865 DELETED
MIXF5870 DELETED
MIXF5875 DELETED
MIXF5880 DELETED
MIXF5890 DELETED
MIXF5900 DELETED
MIXF5910 DELETED
MIXF5920 DELETED
MIXF5930 DELETED
MIXF5940 DELETED
MIXF5950 DELETED
MIXF5960 DELETED
MIXF5970 DELETED
MIXF5980 DELETED
MIXF5990 DELETED
MIXF6000 DELETED
MIXF6010 DELETED
MIXF6020 DELETED
MIXF6025 DELETED
MIXF6028 DELETED
MIXF6030 DELETED
MIXF6032 DELETED
MIXF6034 DELETED
MIXF6036 DELETED
MIXF6038 DELETED
MIXF6040 DELETED
MIXF6050 DELETED
MIXF6051 DELETED
MIXF6052 DELETED
MIXF6054 DELETED
MIXF6056 DELETED
MIXF6058 DELETED
MIXF6059 DELETED
MIXF6060 DELETED
MIXF6080 DELETED
MIXF6081 DELETED
MIXF6090 DELETED
MIXF6100 DELETED
MIXF6110 DELETED

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PST = C2*(RVM-RV11) + CBAR*(RV12-RV11)
1 -VI1*(WMIX*RAK)**2 + VI2*(W*RAL)**2
C2 = CBAR
470 VE = HKE*(WMIX*(WMIX*RAK*VI1)**2-WJ*(WJ*RAJ2*VJ2)**2)/W
HP(I) = (WMIX*HP(I) - WJ*HP(J))/W
HSPOUT(I) = (WMIX*HSPOUT(I) - WJ*HSPOUT(J))/W
HSPIN(I) = HSPOUT(I)
XP(I) = (WMIX*XP(I) - WJ*XP(J))/W
RL(I) = (ONE-XP(I)) * FMFRAC(I) / VI
RG(I) = (ONE-FMFRAC(I)) * (ONE-XP(I)) / VI
VLIOA(I) = W*RA1 / (RL(I)+RG(I))
VVAPA(I) = VLIOA(I)
XWL(I) = VLIOA(I)*RL(I)*AJUNT(I)
XWG(I) = VVAPA(I)*RG(I)*AJUNT(I)
HLIN(I) = (WMIX*HLIN(I) - WJ*HLIN(J))/W
HLOUT(I) = HLIN(I) - PEK + PEL
AH = W*HP(I)
AL = XWL(I) * HLIN(I)
RXWG = ZERO
IF( XWG(I).NE.ZERO ) RXWG = ONE/XWG(I)
HGIN(I) = (AH-AL) * RXWG
HGOUT(I) = HGIN(I) - PEK + PEL
475 IF( .NOT.FKGEOM ) GO TO 800
CALL FRICIN(FJUNF(I),FJUNR(I),RA1,RAI,FAL,MVMIX(I))
CALL FRICIN(FF,FR,RAK,RAM,RAMS,MVMIX(I))
BW = -FF*VI1*WMIX**2
GO TO 800

WMIX.LT.O, W.LT.O, WJ.GT.C, MIXING VOLUME INLET SIDE

480 CONTINUE
IF( JC ) GO TO 490
VI = (WMIX*VI2-WJ*VJ)/W
VI1 = VI
VM = VI2
RAMS = RA1*W*VI/(WMIX*VM)
PST = DP5*(VI2*(RAL*WMIX)**2
1 -VI*(RAK**2+(ONE-VI*RV12)*RAI**2)*W**2)
GO TO 500
490 VM = VI2
VJ = VJ1
DO 495 LL = 1,3
AMS = AI*WMIX*VM/(WMIX*VM-WJ*VJ)
RAMS = ONE/AMS
RAJS = ONE/(AI-AMS)
VMD = VI
CALL MACH(WMIX,RAMS,RAM,RAL,VM,VMD,VI2,C2,RVM,RVD,RV12)
1 KC,KMACH(I)
VJ = VJMIN
CALL MACH(WJ,RAJ1,RAJ,RAJS,VJ1,VJ,VJD,CJ,RVJ1,RVJ,RVJD)
1 KC2,KMACH(J)
495 CONTINUE
A VI1 = DMAX1(VI,VJMIN)

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MIXF6120 DELETED
MIXF6130 DELETED
MIXF6135 DELETED
MIXF6190 DELETED
MIXF6192 DELETED
MIXF6194 DELETED
MIXF6195 DELETED
MIXF6197 DELETED
MIXF6198 DELETED
MIXF6199 DELETED
MIXF6200 DELETED
MIXF6201 DELETED
MIXF6202 DELETED
MIXF6203 DELETED
MIXF6204 DELETED
MIXF6205 DELETED
MIXF6206 DELETED
MIXF6207 DELETED
MIXF6208 DELETED
MIXF6209 DELETED
MIXF6210 DELETED
MIXF6211 DELETED
MIXF6212 DELETED
MIXF6214 DELETED
MIXF6215 DELETED
MIXF6218 DELETED
MIXF6220 DELETED
MIXF6230 DELETED
MIXF6240 DELETED
MIXF6250 DELETED
MIXF6260 DELETED
MIXF6270 DELETED
MIXF6280 DELETED
MIXF6290 DELETED
MIXF6300 DELETED
MIXF6310 DELETED
MIXF6320 DELETED
MIXF6330 DELETED
MIXF6340 DELETED
MIXF6350 DELETED
MIXF6360 DELETED
MIXF6365 DELETED
MIXF6370 DELETED
MIXF6372 DELETED
MIXF6374 DELETED
MIXF6376 DELETED
MIXF6378 DELETED
MIXF6380 DELETED
MIXF6390 DELETED
MIXF6391 DELETED
MIXF6392 DELETED
MIXF6394 DELETED
MIXF6396 DELETED
MIXF6398 DELETED

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B. V11 = AMAX1(VI,VJMIN)
VI = (WMIX*VM-WJ*VJ)/W
A. CBAR = DMIN1(CJ,C2)
B. CBAR = AMIN1(CJ,C2)
CALL MACH(W,RAK,RAI,VDUM,V11,VI,CBAR,RVO,RV11,RVI,
1 KC2,KMACH(I))
KCHOKE(I) = KC + KC2
PST = CBAR*(RV1-RV11) + C2*(1-VI2-RVM)
1 +VI2*(WMIX*RAL)**2 - V11*(RAK*W)**2
C2 = CBAR
500 VE = HKE*(WMIX*(WMIX*VI2*RAL)**2-WJ*(WJ*RAJ1*VJ1)**2)/W
HP(I) = (WMIX*HP(I) - WJ*HP(J))/W
HSPIN(I) = (WMIX*HSPIN(I) - WJ*HSPIN(J))/W
HSPOUT(I) = HSPIN(I)
XP(I) = (WMIX*XP(I) - WJ*XP(J))/W
RL(I) = (ONE-XP(I)) * FMRAC(I) / VI
RG(I) = (ONE-FMRAC(I)) * (ONE-XP(I)) / VI
VLIQA(I) = W*RAI / (RL(I)+RG(I))
VVAPA(I) = VLIQA(I)
XWL(I) = VLIQA(I)*RL(I)*AJUNT(I)
XWG(I) = VVAPA(I)*RG(I)*AJUNT(I)
HLOUT(I) = (WMIX*HLOUT(I) - WJ*HLOUT(J))/W
AH = W*HP(I)
AL = XWL(I) + HLOUT(I)
RXWG = ZERO
IF(XWG(I).NE.ZERO) RXWG = ONE/XWG(I)
HGOUT(I) = (AH-AL) * RXWG
HLIN(I) = HLOUT(I) - PEL + PEK
HGIN(I) = HGOUT(I) - PEL + PEK
505 IF(.NOT.FKGEUM) GO TO 800
CALL FRICTN(FJUNF(I),FJUNK(I),RAK,RAI,RAI,MVMIX(I))
CALL FRICTN(FE,FR,RAMS,RAI,RAI,MVMIX(I))
BW = FR*VI2*WMIX**2
GO TO 800

C
C
C
C
WMIX.GT.0, W.LT.0, WJ.GT.0, MIXING VOLUME OUTLET SIDE
510 CONTINUE
IF(JC) GO TO 520
VJ = (WMIX*V11-W*VI2)/WJ
VM = V11
RVM = RV11
RAIS = -RAJ*VJ*WJ*RV1/W
RAMS = RAJ*VJ*WJ*RVM/WMIX
PST = DP5*(RV12-RV11)*(RAJ*VJ*WJ)**2
1 -V11*(WMIX*RAK)**2 + VI2*(W*RAL)**2
GO TO 530
520 VMS = V11
VIS = VI2
VIMIN = VI
C = CJ
DO 525 LL = 1,3
AMS = AJ*WMIX*VMS/(WMIX*VMS-W*VIS)

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MIXF6399 DELETED
MIXF6400 DELETED
MIXF6420 DELETED
MIXF6421 DELETED
MIXF6430 DELETED
MIXF6440 DELETED
MIXF6450 DELETED
MIXF6460 DELETED
MIXF6470 DELETED
MIXF6475 DELETED
MIXF6520 DELETED
MIXF6522 DELETED
MIXF6524 DELETED
MIXF6525 DELETED
MIXF6527 DELETED
MIXF6529 DELETED
MIXF6531 DELETED
MIXF6533 DELETED
MIXF6535 DELETED
MIXF6537 DELETED
MIXF6539 DELETED
MIXF6541 DELETED
MIXF6543 DELETED
MIXF6545 DELETED
MIXF6547 DELETED
MIXF6549 DELETED
MIXF6551 DELETED
MIXF6553 DELETED
MIXF6555 DELETED
MIXF6557 DELETED
MIXF6558 DELETED
MIXF6559 DELETED
MIXF6560 DELETED
MIXF6561 DELETED
MIXF6570 DELETED
MIXF6580 DELETED
MIXF6590 DELETED
MIXF6600 DELETED
MIXF6610 DELETED
MIXF6620 DELETED
MIXF6630 DELETED
MIXF6640 DELETED
MIXF6650 DELETED
MIXF6660 DELETED
MIXF6665 DELETED
MIXF6670 DELETED
MIXF6680 DELETED
MIXF6690 DELETED
MIXF6700 DELETED
MIXF6705 DELETED
MIXF6710 DELETED
MIXF6715 DELETED
MIXF6720 DELETED
MIXF6722 DELETED
MIXF6724 DELETED

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RAMS = ONE/AMS
RAIS = ONE/(AJ-AMS)
VM = VJMIN
CALL MACH(WMIX,RAK,RAI,RAIS,VM,VMS,C,RV11,RVM,RVMS,
1 KC,KMACH(I))
VI = VIMIN
CALL MACH(W,RAI,RAI,RAIS,VI,VI2,C2,RVIS,RVI,RV12,
1 KC2,KMACH(I))
525 CONTINUE
KCHOKE(I) = KC + KC2
VJ = (WMIX*VMS-W*VIS)/WJ
PST = C*(RVMS-RV11) + C2*(RV12-RVIS)
1 -V11*(WMIX*RAK)**2 + VI2*(W*RAL)**2
530 CONTINUE
VE = HKE*(W*RAL*VI2)**2
IFI .NOT. FKGEJM ) GO TO 800
CALL FRICIN(FI,FR,RAI,RAI,RAIS,RAI,RAI,MVMIX(I))
CALL FRICIN(FI,FR1,RAI,RAI,RAI,RAI,MVMIX(I))
BW = FR1*VI**2 + F*V11*WMIX**2
CALL FRICIN(FJUNF(I),FJUNK(I),RAI,RAI,RAI,MVMIX(I))
GO TO 800

C
C
C
WMIX.LT.0, W.3T.0, WJ.LT.0, MIXING VOLUME INLET SIDE
C
C
540 CONTINUE
IFI JC ) GO TO 550
VJ = (WMIX*VI2-W*V11)/WJ
VM = VI2
RVM = RV12
RAIS = -RAJ*VJ*WJ*RV11/W
RAMS = RAJ*VJ*WJ*RVM/WMIX
PST = DP5*((RV12-RV11)*(VJ*WJ*RAJ)**2
1 +VI2*(WMIX*RAL)**2 - V11*(RAK*W)**2)
GO TO 560
550 VMS = VI2
VJS = V11
VIMIN = VI
C = CJ
DO 555 LL = 1,3
AMS = AJ*WMIX*VMS/(WMIX*VMS-W*VIS)
RAMS = ONE/AMS
RAIS = ONE/(AJ-AMS)
VM = VJMIN
CALL MACH(WMIX,RAI,RAI,RAIS,VM,VI2,C,RVMS,RVM,RV12,
1 KC,KMACH(I))
VI = VIMIN
CALL MACH(W,RAI,RAI,RAIS,VI,VI2,C2,RV11,RVI,RVIS,
1 KC2,KMACH(I))
555 CONTINUE
KCHOKE(I) = KC + KC2
VJ = (WMIX*VMS-W*VIS)/WJ
PST = C*(RV12-RVMS) + C2*(RV11-RVIS)
1 + VI2*(WMIX*RAL)**2 - V11*(RAK*W)**2

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MIXF6726 DELETED
MIXF6728 DELETED
MIXF6729 DELETED
MIXF6730 DELETED
MIXF6740 DELETED
MIXF6750 DELETED
MIXF6760 DELETED
MIXF6770 DELETED
MIXF6775 DELETED
MIXF6780 DELETED
MIXF6790 DELETED
MIXF6820 DELETED
MIXF6830 DELETED
MIXF6840 DELETED
MIXF6850 DELETED
MIXF6860 DELETED
MIXF6875 DELETED
MIXF6880 DELETED
MIXF6885 DELETED
MIXF6890 DELETED
MIXF6910 DELETED
MIXF6920 DELETED
MIXF6930 DELETED
MIXF6940 DELETED
MIXF6950 DELETED
MIXF6960 DELETED
MIXF6970 DELETED
MIXF6980 DELETED
MIXF6990 DELETED
MIXF7000 DELETED
MIXF7010 DELETED
MIXF7015 DELETED
MIXF7020 DELETED
MIXF7030 DELETED
MIXF7040 DELETED
MIXF7050 DELETED
MIXF7055 DELETED
MIXF7060 DELETED
MIXF7065 DELETED
MIXF7070 DELETED
MIXF7072 DELETED
MIXF7074 DELETED
MIXF7076 DELETED
MIXF7078 DELETED
MIXF7079 DELETED
MIXF7080 DELETED
MIXF7090 DELETED
MIXF7100 DELETED
MIXF7110 DELETED
MIXF7120 DELETED
MIXF7125 DELETED
MIXF7130 DELETED
MIXF7140 DELETED
MIXF7170 DELETED
MIXF7180 DELETED

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560 CONTINUE
VE = HKE*(W*RAK*V11)**2
IF( .NOT.FKGEOM ) GO TO 800
CALL FRICTN(FF,FR,RAK,RAI,RAI,MVMIX(I))
CALL FRICTN(FF1,FR1,RAI,RAI,RAI,MVMIX(I))
BW = -FF1*V11**2 - FR*V12*MIX**2
CALL FRICTN(FJUNF(I),FJUNR(I),RAK,RAI,RAI,MVMIX(I))
GO TO 800

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WMIX.LT.O, W.GT.O, WJ.LT.O, MIXING VOLUME OUTLET SIDE

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570 CONTINUE
RAIS = -RAJ*WJ/W
RAMS = RAJ*WJ/WMIX
IF( JC ) GO TO 580
VI = VJ
VM = VJ
PST = DP5*VJ*((W*RAL)**2-(WMIX*RAK)**2)
GO TO 590
580 CONTINUE
VI = VJMIN
C2 = CJ
CALL MACH(W,RAIS,RAI,RAI,VJ,VI,VI2,C2,RVJ,RVI,RVI2,
1 KC,KMACH(I))
VM = VJMIN
C2 = CJ
CALL MACH(WMIX,RAK,RAI,RAI,VM,VJ,C2,RV1,RV1,RV1,
1 KC2,KMACH(I))
KCHOKE(I) = KC + KC2
PST = C2*(RV12-RV11) + VI2*(RAL*W)**2 - V11*(WMIX*RAK)**2
590 CONTINUE
HP(I) = HP(J)
HSPOUT(I) = HSPOUT(J)
HSPIN(I) = HSPOUT(J)
XP(I) = XP(J)
RL(I) = RL(J)
RG(I) = RG(J)
VLIQA(I) = W*RAI / (RL(I)+RG(I))
VVAPA(I) = VLIQA(I)
XWL(I) = VLIQA(I)*RL(I)*AJUNT(I)
XWG(I) = VVAPA(I)*RG(I)*AJUNT(I)
HLIN(I) = HLIN(J)
AH = W*HP(I)
AL = XWL(I) + HLIN(I)
RXWG = ZERO
IF( XWG(I).NE.ZERO ) RXWG = ONE/XWG(I)
HGIN(I) = (AH-AL) * RXWG
HLOUT(I) = HLIN(I) - PEK + P=L
HGOUT(I) = HGIN(I) - PEK + P=L
VE = HKE*(WJ*RAJ2*VJ2)**2
IF( .NOT.FKGEOM ) GO TO 800
CALL FRICTN(FF,FR,RAK,RAI,RAI,MVMIX(I))
CALL FRICTN(FF1,FR1,RAIS,RAI,RAI,MVMIX(I))

```

```

MIXF719C DELETED
MIXF7200 DELETED
MIXF7210 DELETED
MIXF7225 DELETED
MIXF7230 DELETED
MIXF7235 DELETED
MIXF7240 DELETED
MIXF7260 DELETED
MIXF7270 DELETED
MIXF7280 DELETED
MIXF7290 DELETED
MIXF7300 DELETED
MIXF7310 DELETED
MIXF7320 DELETED
MIXF7330 DELETED
MIXF7340 DELETED
MIXF7352 DELETED
MIXF7354 DELETED
MIXF7360 DELETED
MIXF7370 DELETED
MIXF7400 DELETED
MIXF7410 DELETED
MIXF7412 DELETED
MIXF7414 DELETED
MIXF7420 DELETED
MIXF7430 DELETED
MIXF7435 DELETED
MIXF7440 DELETED
MIXF7450 DELETED
MIXF7460 DELETED
MIXF7470 DELETED
MIXF7500 DELETED
MIXF7520 DELETED
MIXF7572 DELETED
MIXF7574 DELETED
MIXF7576 DELETED
MIXF7578 DELETED
MIXF7579 DELETED
MIXF7580 DELETED
MIXF7581 DELETED
MIXF7582 DELETED
MIXF7583 DELETED
MIXF7584 DELETED
MIXF7585 DELETED
MIXF7586 DELETED
MIXF7587 DELETED
MIXF7588 DELETED
MIXF7589 DELETED
MIXF7590 DELETED
MIXF7591 DELETED
MIXF7592 DELETED
MIXF7593 DELETED
MIXF7594 DELETED
MIXF7595 DELETED
MIXF7596 DELETED

```

BW = -FF1*VI*W**2 - FR*VJ*WMIX**2
 CALL FRICTN(FJUNF(I),FJUNR(I),RAI,RAI,RAL,MVMIX(I))
 GO TO 800

WMIX.GT.O, W.LT.O, WJ.GT.O, MIXING VOLUME INLET SIDE

600 CONTINUE
 RAIS = -RAJ*WJ/W
 RAMS = RAJ*WJ*WMIX
 IF(JC) GO TO 610
 VI = VJ
 VM = VJ
 PST = DP5*VJ*((WMIX*RAL)**2 - (W*RAK)**2)
 GO TO 620
 610 CONTINUE
 VI = VJMIN
 C2 = CJ
 CALL MACH(W,RAH,RAI,RAIS,VI1,VI,VJ,C2,RV11,RVI,RVJ,
 1 KC,KMACH(I))
 VM = VJMIN
 C2 = CJ
 CALL MACH(WMIX,RAMS,RAH,RAI,RAIS,VI1,VI,VJ,C2,RV11,RVI,RVJ,
 1 KC2,KMACH(I))
 KCHECKE(I) = KC + KC2
 620 CONTINUE
 HP(I) = HP(J)
 HSPIN(I) = HSPOUT(J)
 HSPGUT(I) = HSPGUT(J)
 XP(I) = XP(J)
 RL(I) = RL(J)
 RG(I) = RG(J)
 VLIQA(I) = W*RAI / (RL(I)+RG(I))
 VVAPA(I) = VLIQA(I)
 XWL(I) = VLIQA(I)*RL(I)*AJUNT(I)
 XWG(I) = VVAPA(I)*RG(I)*AJUNT(I)
 HLOUT(I) = HLEUT(J)
 AH = W*HP(I)
 AL = XWL(I) + HLOUT(I)
 RXWG = ZERO
 IF(XWG(I).NE.ZERO) RXWG = ONE/XWG(I)
 HGOUT(I) = (AH-AL) * RXWG
 HLIN(I) = HLOUT(I) - DEL + PEK
 HGIN(I) = HGOUT(I) - DEL + PEK
 VE = HKE*(WJ*RAJ1*VJ1)**2
 IF(.NOT.EKGE1) GO TO 800
 CALL FRICTN(FF,FR,RAH,RAI,RAI,RAIS,MVMIX(I))
 CALL FRICTN(FF1,FR1,RAI,RAI,RAIS,MVMIX(I))
 BW = FR1*VI*W**2 + FF*VJ*WMIX**2
 CALL FRICTN(FJUNF(I),FJUNR(I),RAK,RAI,RAI,MVMIX(I))
 GO TO 800

MIXF7597 DELETED
 MIXF7598 DELETED
 MIXF7599 DELETED
 MIXF7600 DELETED
 MIXF7610 DELETED
 MIXF7620 DELETED
 MIXF7630 DELETED
 MIXF7640 DELETED
 MIXF7650 DELETED
 MIXF7660 DELETED
 MIXF7670 DELETED
 MIXF7680 DELETED
 MIXF7684 DELETED
 MIXF7690 DELETED
 MIXF7700 DELETED
 MIXF7730 DELETED
 MIXF7740 DELETED
 MIXF7742 DELETED
 MIXF7744 DELETED
 MIXF7750 DELETED
 MIXF7760 DELETED
 MIXF7765 DELETED
 MIXF7770 DELETED
 MIXF7780 DELETED
 MIXF7790 DELETED
 MIXF7800 DELETED
 MIXF7830 DELETED
 MIXF7850 DELETED
 MIXF7902 DELETED
 MIXF7904 DELETED
 MIXF7906 DELETED
 MIXF7908 DELETED
 MIXF7909 DELETED
 MIXF7910 DELETED
 MIXF7911 DELETED
 MIXF7912 DELETED
 MIXF7913 DELETED
 MIXF7914 DELETED
 MIXF7915 DELETED
 MIXF7916 DELETED
 MIXF7917 DELETED
 MIXF7918 DELETED
 MIXF7919 DELETED
 MIXF7920 DELETED
 MIXF7921 DELETED
 MIXF7922 DELETED
 MIXF7923 DELETED
 MIXF7924 DELETED
 MIXF7925 DELETED
 MIXF7926 DELETED
 MIXF7927 DELETED
 MIXF7928 DELETED
 MIXF7929 DELETED
 MIXF7930 DELETED
 MIXF7940 DELETED

```

C      MIX FLOW IS ZERO
C
C      650 IF( MIXVL ) 660,710,710
C      MIXING VOLUME INLET SIDE
C      660 IF( W.GE.ZERO ) GO TO 670
C      NEGATIVE = LOW
C      VE = HKE*(W*RAJ1*VJ1)**2
C      IF( JC ) GO TO 665
C      VI = VJ
C      GO TO 680
C      665 C2 = CJ
C      VI = VJMIN
C      GO TO 690
C      POSITIVE = LOW
C      670 VE = HKE*(W*RAK*V11)**2
C      680 IF( JC ) GO TO 690
C      VI = V11
C      PST = -DP5*VI*(RAK**2 + RAI**2)*W**2
C      GO TO 700
C      690 CONTINUE
C      VDUM = VI
C      CALL MACH(W,RAK,RAI,RAI,V11,VI,VDUM,C2,RV11,RVI,RVD,
C      1 KCHOKE(I),KMACH(I))
C      PST = C2*(RVI-RV11) - V11*(RAK*W)**2
C      700 HP(I) = HP(J)
C      HSPOUT(I) = HSPOUT(J)
C      HSPIN(I) = HSPOUT(I)
C      XP(I) = XP(J)
C      RL(I) = RL(J)
C      RG(I) = RG(J)
C      VLIQA(I) = W*RAI / (RL(I)+RG(I))
C      VVAPA(I) = VLIQA(I)
C      XWL(I) = VLIQA(I)*RL(I)*AJUN(I)
C      XWG(I) = VVAPA(I)*RG(I)*AJUN(I)
C      HLOUT(I) = HLOUT(J)
C      AH = W*HP(I)
C      AL = XWL(I) + HLOUT(I)
C      RXWG = ZERO
C      IF( XWG(I).NE.ZERO ) RXWG = ONE/XWG(I)
C      HGOUT(I) = (AH-AL) * RXWG
C      HLIN(I) = HLOUT(I) - PEL + PEK
C      HGIN(I) = HGOUT(I) - PEL + PEK
C      IF( .NOT.FKGEUM ) GO TO 800
C      CALL FRICFN(FJUNF(I),FJUNR(I),RAK,RAI,RAI,MVMIX(I))
C      GO TO 800
C      MIXING VOLUME OUTLET SIDE
C      710 IF( W.LT.ZERO ) GO TO 720
C      POSITIVE FLOW
C      VE = HKE*(W*RAJ2*VJ2)**2
C      IF( JC ) GO TO 715

```

```

MIXF7950 DELETED
MIXF7960 DELETED
MIXF7970 DELETED
MIXF7980 DELETED
MIXF7990 DELETED
MIXF8000 DELETED
MIXF8010 DELETED
MIXF8020 DELETED
MIXF8030 DELETED
MIXF8032 DELETED
MIXF8040 DELETED
MIXF8050 DELETED
MIXF8070 DELETED
MIXF8072 DELETED
MIXF8074 DELETED
MIXF8076 DELETED
MIXF8080 DELETED
MIXF8090 DELETED
MIXF8110 DELETED
MIXF8115 DELETED
MIXF8120 DELETED
MIXF8130 DELETED
MIXF8140 DELETED
MIXF8150 DELETED
MIXF8160 DELETED
MIXF8170 DELETED
MIXF8180 DELETED
MIXF8190 DELETED
MIXF8192 DELETED
MIXF8194 DELETED
MIXF8196 DELETED
MIXF8198 DELETED
MIXF8200 DELETED
MIXF8202 DELETED
MIXF8204 DELETED
MIXF8206 DELETED
MIXF8208 DELETED
MIXF8210 DELETED
MIXF8212 DELETED
MIXF8214 DELETED
MIXF8216 DELETED
MIXF8218 DELETED
MIXF8220 DELETED
MIXF8222 DELETED
MIXF8224 DELETED
MIXF8226 DELETED
MIXF8228 DELETED
MIXF8230 DELETED
MIXF8240 DELETED
MIXF8250 DELETED
MIXF8260 DELETED
MIXF8270 DELETED
MIXF8280 DELETED
MIXF8282 DELETED
MIXF8290 DELETED

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<pre> V1 = VJ GO TO 730 175 C2 = CJ VI = VJMIN GO TO 740 C NEGATIVE FLOW 720 VE = HKE*(W*RAL*VI2)**2 730 IF(JC) GO TO 740 VI = VI2 PST = DP5*VI*(RAL**2 + RAI**2)*W**2 GO TO 750 740 CONTINUE VDUM = VI CALL MACH(W,RAI,RAI,RAL,VDUM,VI,VI2,C2,RVC,RVI,RVI2, 1.KCHCKE(I),KMACH(I)) PST = C2*(RVI2-RVI) + VI2*(W*RAL)**2 750 HP(I) = HP(J) HSPIN(I) = HSPIN(J) HSPOUT(I) = HSPIN(I) XP(I) = XP(J) RL(I) = RL(J) RG(I) = RG(J) VLIOA(I) = W*RAI + (RL(I)+RG(I)) VVAPA(I) = VLIOA(I) XWL(I) = VLIOA(I)+RL(I)*AJUNT(I) XWG(I) = VVAPA(I)+RG(I)*AJUNT(I) HLIN(I) = HLIN(J) AH = W*HP(I) AL = XWL(I) * HLIN(I) RXWG = ZERO IF(XWG(I).NE.ZERO) RXWG = ONE/XWG(I) HGIN(I) = (AH-AL) * RXWG HGBUT(I) = HLIN(I) - PEK + PEL HGBUT(I) = HGIN(I) - PEK + PEL IF(.NOT.FKGEOM) GO TO 800 CALL FRIC(TN(FJUNF,I),FJUNK(I),RAM,RAI,RAL,MVMIX(I)) GO TO 800 C C C 810 CONTINUE IRET = 3 GO TO 800 813 IRET = 1 800 CONTINUE * VSTIDX(75), SATIDX(75), PHASE(75) * VSTIDX(75),SATIDX(75),PHASE(75),TAIR(75),VAIR(75) * VSTIDX(75), SATIDX(75), PHASE(75) * VSTIDX(75),SATIDX(75),PHASE(75),TAIR(75),VAIR(75) * VSTIDX(75), SATIDX(75), PHASE(75) * VSTIDX(75),SATIDX(75),PHASE(75),TAIR(75),VAIR(75) \$NLOCAL PUMS010C C THE FOLLOWING DEFINITIONS ARE APPLICABLE TO AN UPDATE TO PERMIT C A SPEED VARIABLE PUMP INERTIA FOR THE LOFT PUMP. CODED BY C GWJ, JAN. 1977 PER WHITE-19-76. </pre>	<pre> MIXF8300 DELETED MIXF8320 DELETED MIXF8322 DELETED MIXF8324 DELETED MIXF8326 DELETED MIXF8330 DELETED MIXF8340 DELETED MIXF8360 DELETED MIXF8365 DELETED MIXF8370 DELETED MIXF8380 DELETED MIXF8390 DELETED MIXF8400 DELETED MIXF8410 DELETED MIXF8420 DELETED MIXF8430 DELETED MIXF8440 DELETED MIXF8442 DELETED MIXF8444 DELETED MIXF8446 DELETED MIXF8448 DELETED MIXF8450 DELETED MIXF8452 DELETED MIXF8454 DELETED MIXF8456 DELETED MIXF8458 DELETED MIXF8460 DELETED MIXF8462 DELETED MIXF8464 DELETED MIXF8466 DELETED MIXF8468 DELETED MIXF8470 DELETED MIXF8472 DELETED MIXF8474 DELETED MIXF8476 DELETED MIXF8478 DELETED MIXF8480 DELETED MIXF8490 DELETED MIXF8500 DELETED MIXF8510 DELETED MIXF8530 DELETED MIXF8590 DELETED MIXF8600 DELETED MIXF8610 DELETED MIXF8620 DELETED PLTA2945 DELETED PLTA2945 INSERTED PREW1426 DELETED PREW1426 INSERTED PULL5680 DELETED PULL5680 INSERTED PUMS0102 INSERTED PUMS0104 INSERTED PUMS0106 INSERTED </pre>
--	--

```

C
C PINVAR = EFFECTIVE PUMP INERTIA (LBM-FT2)
C PK0,PK1,PK2,PK3 = EQUATION CONSTANTS
C WTRIP = PUMP SPEED ABOVE WHICH INERTIA IS A CUBIC FUNCT. OF SPEED
$NLOCAL PUMS1463
C INPUT
C DATA PK0,PK1,PK2,PK3,WTRIP/0.0,972.694,386.971,-1777.01,750.0/
$NLOCAL PUMS264C
C CALL TIMEL(ZDELTA)
C ZTIMEA(NZSUBC) = ZTIMEA(NZSUBC) + ZDELTA
C IZCALL(NZSUBN) = IZCALL(NZSUBN) + 1
C NZSUBS = NZSUBC
C NZSUBC = NZSUBN
C CALCULATE LOFT PUMP INERTIA IF SPEED EXCEEDS WTRIP
C
C PINVAR = PK0 + S*(PK1 + S*(PK2 + S*PK3))
C IF(POMGA(N).LT.WTRIP) PINVAR = PINKTA(N)
C POMGA(N) = POMGA(N) - G120PI * T * DT / PINRTA(N)
C POMGA(N) = POMGA(N) - G120PI * T * DT / PINVAR
C 2 IH, J, L, ITS)
C 2 IH, J, L, ITS, XXL, *LFRAC, KATS)
C LOGICAL ERR
C LOGICAL ERR, KATS
C DATA GC, XLIMIT / 4.169748E08, 1.0E09 /
C DATA TO, SIK, SIPR, SISVOL, ENCP / 459.67, 0.55556, 6894.757293,
C 1 6.242796E-2, 2.388458966E-4 /
C IF (.NOT. KATS) GO TO 900
C IF(XXL.LE.0.) GO TO 900
C TAVG = (TSUR+T)/2.
C TAVGK = (TAVG + TC) * SIK
C DTAVG = TAVG - TSAT
C HBARG = 0.
C HBARG = 0.
C PROP(1)=TAVGK
C IF(XLFRAC.GE.1.) GO TO 610
C COMPUTE H TO VAPOR
C ITTEST = 2
C IF(DTAVG.GT.0.) GO TO 621
C AVG TEMP IS AT OR BELOW SATURATION
C PROP(9)=1.
C N = 22
C M = 18
C CALL STH201(LFA(IW),PROP,ERR)
C IF(.NOT.ERR) GO TO 650
C WRITE(6,611) TAVG
C CALL FAIL
C AVG TEMP IS ABOVE SATURATION
C 621 IT = 3
C PROP(2)=PR*SIPR
C N = 8
C M = 6
C CALL STH203(LFA(IW),PROP,IT,ERR)
C IF(.NOT.ERR) GO TO 650
C WRITE(6,612) TAVG

```

```

PUMS0108 INSERTED
PUMS0110 INSERTED
PUMS0112 INSERTED
PUMS0114 INSERTED
PUMS0116 INSERTED
PUMS0110 IS NOW PUMS0118
PUMS1465 INSERTED
PUMS1464 IS NOW PUMS1467
PUMS1465 IS NOW PUMS1469
PUMS1466 IS NOW PUMS1471
PUMS1467 IS NOW PUMS1473
PUMS1468 IS NOW PUMS1475
PUMS2642 INSERTED
PUMS2644 INSERTED
PUMS2646 INSERTED
PUMS2648 INSERTED
PUMS2650 DELETED
PUMS2650 INSERTED
QDOT0030 DELETED
QDOT0030 INSERTED
QDOT0620 DELETED
QDOT0620 INSERTED
QDOT0820 INSERTED
QDOT0981 INSERTED

```

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```

00 = OFREC
HC=HBAR
TS = TS2
611 FORMAT(//,10X,18H***** TAVG = ,E10.3,30HDEGF OUTSIDE LIMITS F
10R STH201)
612 FORMAT(//,10X,18H***** TAVG = ,E10.3,30HDEGF OUTSIDE LIMITS F
10R STH203)
$DELETE SINI1867
IF (IPROGM .NE. 2) GO TO 7
CALL HTRC (IEMHT, IEMPS, IEMEC, IDEBUG, ZERO, FLUX, TLS, GL, GR, IS1, L, II)
CALL HTRC (IEMHT, IEMPS, IEMEC, IDEBUG, ZERO, FLUX, TLS, GL, GR,
1 IS1, L, II, ISWKK)
CALL HTRC (IEMHT, IEMPS, IEMEC, IDEBUG, ZERO, FLUX, TRS, GL, GR, IS2, L, II)
CALL HTRC (IEMHT, IEMPS, IEMEC, IDEBUG, ZERO, FLUX, TRS, GL, GR,
1 IS2, L, II, ISWKK)
CALL HTRC (IEMHT, IEMPS, IEMEC, IDEBUG, ZERO, FLUX, TRS, GL, GR, IS2, L, II)
CALL HTRC (IEMHT, IEMPS, IEMEC, IDEBUG, ZERO, FLUX, TRS, GL, GR,
1 IS2, L, II, ISWKK)
1 II)
1 II, ISWKK)
1 II)
1 II, ISWKK)
1 L, II)
1 L, II)
1 L, II, ISWKK)
1 L, II)
1 L, II, ISWKK)
2 GL, GR, L, PHLSEC, PHRSEC)
2 GL, GR, L, PHLSEC, PHRSEC, ISWKK)
1 L, II)
1 L, II, ISWKK)
1 L, II)
1 L, II, ISWKK)
2 GL, GR, L, DUM1, DUM2)
2 GL, GR, L, DUM1, DUM2, ISWKK)
1 L, II)
1 L, II, ISWKK)
1 L, II)
1 L, II, ISWKK)
1 L, II)
1 L, II, ISWKK)
2 MS, MM, MN, MT, DT, GL, GR)
2 MS, MM, MN, MT, DT, GL, GR, ISWKK)
1 PQUITL, PQUITH, TQUITL, TQUITH)
1 PQUITL, PQUITH, TQUITL, TQUITH, IFLAG, TA, VA)
$NLOCAL STAT1108
C ALPHA = GAMMA - 1
DATA ALPHA/ 0.401/
$NLOCAL STAT1530
C
IF (IFLAG.NE.-1) GO TO 10
TAIRP = SIK*(TA + T0)
UAIRP = AIRM * CVAIR * TAIRP
VAIRP = SIV * VA
10 CONTINUE
$NLOCAL STAT1620

```

INSERTED
INSERTED
INSERTED
INSERTED
INSERTED
INSERTED
INSERTED

SINI1867 DELETED
SINI2140 DELETED
SINI2140 INSERTED
SINI2462 DELETED
SINI2462 INSERTED
SINI2470 DELETED
SINI2470 INSERTED
SINI2545 DELETED
SINI2545 INSERTED
SINI2552 DELETED
SINI2552 INSERTED
SINI2561 DELETED
SINI2561 INSERTED
SINI2577 DELETED
SINI2577 INSERTED
SINI2890 DELETED
SINI2890 INSERTED
SINI2932 DELETED
SINI2932 INSERTED
SINI2954 DELETED
SINI2954 INSERTED
SINI2985 DELETED
SINI2985 INSERTED
SINI3038 DELETED
SINI3038 INSERTED
SINI3134 DELETED
SINI3134 INSERTED
SLAB1747 DELETED
SLAB1747 INSERTED
SLAB2526 DELETED
SLAB2526 INSERTED
STAT0012 DELETED
STAT0012 INSERTED

STAT1110 INSERTED
STAT1112 INSERTED

STAT1110 IS NOW STAT1114
STAT1532 INSERTED
STAT1534 INSERTED
STAT1536 INSERTED
STAT1538 INSERTED
STAT1540 INSERTED

```

320 DELTP = TNEW - TT
    TT = TNEW
    DERVT = .FALSE.
    IF (ISW.EQ.9) GO TO 395
    IF (IFLAG.EQ.-1) DELTAU = UTOT - WM*UBAR - VAIRP*(VAIRP/(WM*QUAL*VS
    1UBG))*ALPHA
$NLOCAL STAT2740
    IF (ITER.EQ.1) GO TO 310
    IF (IFLAG.EQ.-1) PAIR = AIRM*GCON*TAIRP*(VAIRP/(WM*QUAL*VSUBG))*AL
    1PHA/(WM*QUAL*VSUBG)
    2 IEMHT, IEMPS, IEMEC, IDEBUG)
    2 IEMHT, IEMPS, IEMEC, IDEBUG, ISWKK)
    B. LEVEL 2, ISWKK
    DIMENSION ISWKK(1)
    1. IS2, LL, II)
    1 IS2, LL, II, ISWKK)
    1 HL, HR, S, V, Q, TK, A, T, B, GL, GR, LL, FLP, FRP)
    1 HL, HR, S, V, Q, TK, A, T, B, GL, GR, LL, FLP, FRP, ISWKK)
    LEVEL 2, ISWKK
    C.
    DIMENSION ISWKK(1)
    CALL HTRC(IEMHT, IEMPS, IEMEC, IDB, AA, BB, TSUR, GL, GR, IS2, LL, II)
    CALL HTRC(IEMHT, IEMPS, IEMEC, IDB, AA, BB, TSUR, GL, GR, IS2, LL, II,
    1 ISWKK)
    * VSTIDX(75), SATIDX(75), PHASE(75)
    * VSTIDX(75), SATIDX(75), PHASE(75), TAIR(75), VAIR(75)
***** END OF INPUT STREAM.
***** END OF OLD MASTER FILE.
***** UPDATE-SUCCESSFUL.

```

```

STAT1535 IS NOW STAT1542
STAT1540 IS NOW STAT1544
STAT1545 IS NOW STAT1546
STAT1547 IS NOW STAT1548
STAT1622 INSERTED
STAT1624 INSERTED
STAT1625 IS NOW STAT1626
STAT2742 INSERTED
STAT2744 INSERTED
TEMP0025 DELETED
TEMP0025 INSERTED
TEMP0036 INSERTED
TEMP0433 INSERTED
TEMP1122 DELETED
TEMP1122 INSERTED
TEMPZ0020 DELETED
TEMPZ0020 INSERTED
TEMPZ0036 INSERTED
TEMPZ0320 DELETED
TEMPZ0320 INSERTED
TEMPZ0890 DELETED
TEMPZ0890 INSERTED
WPAC0836 DELETED
WPAC0836 INSERTED

```

B-22

APPENDIX C

LISTING OF RELAP4 COMPUTER CODE INPUT AND ZERO TIME OUTPUT FOR EP ANALYSIS OF EXPERIMENT L1-4

LISTING OF INPUT DATA FOR CASE 1

```

1  =LOFT L145-A10 L1-4 PRETEST ANALYSIS
2  0100001 -2 9 7 6 53 3 1 59 2 2 1 2 47 14 1 0 0 0
3  0100002 C.G. 1.3
4  0200000 JW 51 JW 50 JW 24 AP 2 JW 25 JW 56 AP 23 ML 41 PR 15
5  0300010 50 2 2 0 0.0002 C.00001 0.1 2500
6  0300020 20 10 1 0 0.0005 C.00005 0.8
7  0300030 10 20 1 0 0.001 C.0001 2.0
8  0300040 5 10 4 0 0.01 C.0005 7.0
9  0300050 5 20 4 0 0.01 C.0005 22.0
10 0300060 5 40 4 0 0.010 C.0005 32.0
11 0300070 5 80 2 0 0.01 C.0005 100.0
12 0400010 1 1 0 0 0.001 0
13 0400020 2 1 0 0 0.0 0 * BREAK OPENING TRIP
14 0400030 3 1 0 0 1.0 0.0 * PUMP TRIP
15 0400040 4 1 0 0 22.0 C.C. * HPIS TRIP
16 0400050 5 -5 43 0 0.01 0.0 * ACCUMULATOR
17 0400060 6 1 0 0 35.5 C.C. * LPIS
18 *
19 * W1 W2 W3 W4 W5 W6
20 * IRUB IRFAD PRESSURE TEMP QUAL VOLUME
21 0500011 0 0 2267.6613526 540. -1. 16.28172 7.5 7.5
22 0500021 0 0 2270.8855505 540. -1. 4.196 1.865 1.865
23 0500031 0 0 2264.6420275 540.0 -1. 7.95126
24 0500041 0 0 2264.4601464 540.0 -1. 4.550411903
25 0500051 0 0 2264.2322533 540.0 -1. 3.189863350
26 0500061 0 0 2263.5216586 540.0 -1. 2.878222427
27 0500071 0 0 2260.203702 540.0 -1. 11.18238868
28 0500081 0 0 2257.807184 540.0 -1. 10.97689826
29 0500091 0 0 2255.663432 540.0 -1. 5.447793949
30 0500101 0 0 2256.391488 540.0 -1. 10.97689826
31 0500111 0 0 2257.550178 540.0 -1. 11.18238868
32 0500121 0 0 2253.213797 540.0 -1. 2.057288386
33 0500131 0 0 2253.107000 540.0 -1. 4.437981240
34 0500141 0 0 2251.368005 540. -1. 4.493459374
35 0500151 0 0 2265.473010 540. -1. 3.785608924
36 0500161 0 0 2266.978540 540.0 -1. 3.785608924
37 0500171 0 0 2278.436788 540. -1. 1.895801523
38 0500181 0 0 2281.356447 540. -1. 0.6933519742
39 0500191 0 0 2275.744782 540. -1. 6.288527277
40 0500201 0 0 2275.280640 540. -1. 1.61431
41 0500211 0 0 2272.322712 540. -1. 4.9664
42 0500221 0 0 2274.700245 540. -1. 11.37773334
43 0500231 0 0 2276.5528711 540. -1. 10.153205
44 0500241 0 0 2273.5389403 540. -1. 30.249
45 0500251 0 0 2272.11 540.0 -1. 3.569594146
46 0500261 0 0 2272.11 540. -1. 1.5334
47 0500271 0 0 2272.11 540.0 -1. 0.8175129257
48 0500281 0 0 2268.23 540.0 -1. 7.54979
49 0500291 0 0 2268.23 540. -1. 2.304446
50 0500301 0 0 2267.69 540.0 -1. 0.2896469032
51 0500311 0 0 2266.73 540.0 -1. 4.582558229
52 0500321 0 0 2265.32 540.0 -1. 10.03573817
53 0500331 0 0 2266.73 540.0 -1. 4.582558229
54 0500341 0 0 2268.23 540.0 -1. 0.4089180585
55 0500351 0 0 2269.33 540.0 -1. 1.709604034
56 0500361 0 0 2268.88 540.0 -1. 0.5786674095
57 0500371 0 1 22.6 -272. 0. 3693.45495
58 0500381 0 0 2271.615 540.0 -1. 8.170456642
59 0500391 0 0 2267.8724 540.0 -1. 5.875465929
60 0500401 0 0 2263.69023 540.0 -1. 0.3623659179

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60	050411	3	0	2262.537025	-1.0	0.	34.75215344
61	050421	1	0	0.0	540.0	0.	281.5
62	050431	1	0	612.6	90.0	104.8734	
63	050441	0	0	2272.10	540.0	-1.	3.275254839
64	050451	0	0	2263.22	540.0	-1.	3.275254839
65	050461	0	0	2278.13	210.0	-1.	5.37
66	050471	0	0	2272.11	540.0	-1.	0.7741
67	050481	0	0	2276.648192	540.0	-1.	4.397863
68	050491	0	0	2275.5837636	540.0	-1.	6.392
69	050501	0	0	2274.867521	540.0	-1.	1.61431
70	050511	0	0	2272.8583154	540.0	-1.	2.4832
71	050521	0	0	2274.9275233	540.0	-1.	5.66886667
72	050531	0	0	2276.6494212	540.0	-1.	2.198932
73	*						
74	*						
75	050012	0	0	2.512	1.788	-0.973	
76	050022	0	0	2.491	1.314	-2.838	0
77	050032	0	0	0.9323333333	0.9323333333	0	0.6827037757
78	050042	0	0	0.9323333333	0.9323333333	0	0.6827037757
79	050052	0	0	0.9323333333	0.9323333333	0	0.6827037757
80	050062	2	0	2.121562792	2.421562792	0	0.8955644145
81	050072	2	0	2.500000000	2.500000000	0	7.941248101
82	050082	6	0	6.750000000	6.750000000	0	1.626207149
83	050092	2	0	2.052063333	2.052063333	0	1.626207149
84	050102	6	0	6.750000000	6.750000000	0	1.626207149
85	050112	2	0	2.500000000	2.500000000	0	7.941248101
86	050122	2	0	2.375082491	2.375082491	0	0.8455644145
87	050132	3	0	3.808666667	3.808666667	0	0.6827037757
88	050142	2	0	2.174500000	2.174500000	0	0.6827037757
89	050152	2	0	2.475770200	2.475770200	0	0.3940626203
90	050162	2	0	2.475770200	2.475770200	0	0.3940626203
91	050172	0	0	0.7083333333	0.7083333333	0	0.3940626203
92	050182	0	0	0.7083333333	0.7083333333	0	0.3940626203
93	050192	0	0	0.9323333333	0.9323333333	0	0.6827037757
94	050202	0	0	0.9323333333	0.9323333333	0	0.6827037757
95	050212	3	0	3.435	3.435	0	1.30748
96	050222	11	0	11.61191667	11.61191667	0	1.018108
97	050232	1	0	1.889422	1.889422	0	5.
98	050242	9	0	9.422	9.422	0	3.265
99	050252	0	0	0.9323333333	0.9323333333	0	0.6827037757
100	050262	0	0	0.9323333333	0.9323333333	0	0.6827037757
101	050272	0	0	0.5677500000	0.5677500000	0	0.2531652931
102	050282	0	0	0.9323333333	0.9323333333	0	0.6827037757
103	050292	0	0	0.9323333333	0.9323333333	0	0.6827037757
104	050302	2	0	2.440125000	2.440125000	0	0.9003700370
105	050312	4	0	4.582500000	4.582500000	0	1.060795302
106	050322	4	0	4.547083333	4.547083333	0	1.161015380
107	050332	4	0	4.582500000	4.582500000	0	1.060795302
108	050342	4	0	4.541666667	4.541666667	0	0.9003700370
109	050352	2	0	2.174500000	2.174500000	0	0.6827037757
110	050362	4	0	4.317750000	4.317750000	0	0.9003700370
111	050372	16	0	16.0937499	16.0937499	0	9.6211275
112	050382	2	0	2.065083333	2.065083333	0	0.4175836592
113	050392	2	0	2.895833333	2.895833333	0	0.4175836592
114	050402	4	0	4.035000000	4.035000000	0	0.1559179400
115	050412	6	0	6.713541667	6.713541667	0	6.007260513
116	050422	27	0	27.45	27.45	0	17.1
117	050432	7	0	7.29207	7.29207	0	13.57001
118	050442	0	0	0.8411458333	0.8411458333	0	0.55925
119	050452	0	0	0.8411458333	0.8411458333	0	0.55925
120	050462	3	0	3.66185	3.66185	0	0.06447

121	050472	0.932333	0.932333	0	0.682704	0.2000	-0.466167
122	050482	2.4464	2.4464	0	2.	0.33333	
123	050492	1.7036	1.7036	0	3.743294584	2.183142	
124	050502	0.932333333	0.932333333	0	0.6827038	0.932333	
125	050512	3.435	3.435	0	0.653740	0.583333	
126	050522	11.61191667	11.61191667	0	0.509054	0.33333	
127	050532	2.4464	2.4464	0	1.	0.33333	
128	*	W12	W13				
129	*	ELEVATION	IAMBLO				
130	050033	-0.4661666670	*				
131	050043	-0.4661666670	*				
132	050053	-0.4661666670	*				
133	050063	-0.3339166650	*				
134	050073	0.3121933630	*				
135	050083	2.812193363	*				
136	050093	9.562193363	*				
137	050103	2.812193363	*				
138	050113	0.3121933630	*				
139	050123	-4.4874368560	*				
140	050133	-4.2966103530	*				
141	050143	-4.2966103530	*				
142	050153	-2.121603530	*				
143	050163	-2.121603530	*				
144	050173	-1.3541666670	*				
145	050183	-1.3541666670	*				
146	050193	-0.4661666670	*				
147	050203	-0.466166667	*				
148	050213	-2.35166667	*				
149	050223	-12.96358334	*				
150	050233	-15.842022	*				
151	050243	-12.260000001	*				
152	050253	-0.4661666670	*				
153	050263	-0.466166667	*				
154	050273	-2.2838750000	*				
155	050283	-0.4661666670	*				
156	050293	-0.466166667	*				
157	050303	-0.1692916670	*				
158	050313	2.270833333	*				
159	050323	6.853333333	*				
160	050333	2.270833334	*				
161	050343	-2.270833330	*				
162	050353	-4.445333330	*				
163	050363	-4.146453330	*				
164	050373	-13.5104167	*				
165	050383	0.4661666667	*				
166	050393	-0.3645233330	*				
167	050403	0.4661666667	*				
168	050413	4.02	*				
169	050423	1.59	*				
170	050433	3.37797	-1				
171	050443	-4.005729170	*				
172	050453	-4.005729170	*				
173	050463	-0.26388	*				
174	050473	-16.4	*				
175	050483	-13.9636	*				
176	050493	-0.466166667	*				
177	050503	-2.35166667	*				
178	050513	-13.96358334	*				
179	050523	-16.4	*				
180	060011	0.8	3.0	*			BUBBLE
181	060021	0.8	1000000.0	*			

		W1	W2	W3	W4	W5	W6	W7
		IN	OUT	PUMP	VALVE	FLOW	FLOW AREA	ELEVATION
182	060031	0.8	2.0					
183	070100	11						
184	070101	10.	35.9	100.	1.E-6	16.09374999		
185	070102	15.	44.5	100.	1.E-6	16.09374999		
186	070103	22.	45.3	100.	1.E-6	16.09374999		
187	070104	25.	44.6	100.	1.E-6	16.09374999		
188	070105	40.	43.2	100.	1.E-6	16.09374999		
189	070106	75.	40.6	100.	1.E-6	16.09374999		
190	070107	100.	39.0	100.	1.E-6	16.09374999		
191	070108	125.	38.1	100.	1.E-6	16.09374999		
192	070109	150.	37.6	100.	1.E-6	16.09374999		
193	070110	200.	37.1	100.	1.E-6	16.09374999		
194	*							
195	*							
196	080011	2	1	0	597.2222	0.480	-0.973	0.0
197	080021	1	3	0	597.2222	0.6827	0.0	5.173
198	080031	1	2	0	0.0	0.6827	0.0	4.741
199	080041	3	4	0	597.2222	0.6608871661	0.0	0.0
200	080051	4	5	0	597.2222	0.3588196284	0.0	0.0
201	080061	5	6	0	597.2222	0.682704	0.0	0.0
202	080071	6	7	0	597.2222	0.556		1.510110030
203	080081	7	8	0	597.2222	1.626207149		2.812193363
204	080091	8	9	0	597.2222	1.626207149		9.562193363
205	080101	9	10	0	597.2222	1.626207149		9.562193363
206	080111	10	11	0	597.2222	1.626207149		2.812193363
207	080121	11	12	0	597.2222	0.556		1.510110030
208	080131	12	13	0	597.2222	0.6827037757		-4.874368670
209	080141	13	14	0	597.2222	0.6827037757		-3.82993870
210	080151	14	15	0	300.6570	0.3940626203		-2.121603530
211	080161	14	16	0	296.5652	0.3940626203		-2.121603530
212	080171	15	17	0	300.6570	0.3940626203		0.0
213	080181	16	18	0	296.5652	0.3940626203		0.0
214	080191	17	19	0	300.6570	0.3940626203		0.0
215	080201	18	19	0	296.5652	0.3940626203		0.0
216	080211	19	20	0	597.2222	0.660887	0.0	
217	080221	20	21	0	597.2222	0.682704	0.0	
218	080231	21	22	0	287.2222	0.86996	-2.35166667	
219	080241	22	23	0	372.2222	0.86996	-13.9635833	
220	080251	49	24	0	597.2222	1.056	-12.26	
221	080261	24	25	0	597.2222	0.7854	-2.838	
222	080271	21	25	0	0.0	0.682704	0.0	
223	080281	25	26	0	0.0	0.6827037757	0.0	
224	080291	26	27	0	0.0	0.5814228	0.0	
225	080301	27	28	0	0.0	0.25316	0.0	
226	080311	44	37	0	0.0	0.55925	0.0	
227	080321	28	29	0	0.0	0.6827037757	0.0	
228	080331	29	30	0	0.0	0.55925	0.0	
229	080341	30	31	0	0.0	0.90037003700-01	2.270833333	
230	080351	31	32	0	0.0	0.2060339789	6.853333333	
231	080361	32	33	0	0.0	0.2060339789	6.853333333	
232	080371	33	34	0	0.0	0.90037003700-01	2.270833333	
233	080381	34	35	0	0.0	0.90037003700-01	2.270833333	
234	080391	35	36	0	0.0	0.90037003700-01	-3.979166670	
235	080401	36	37	0	0.0	0.090037	0.0	
236	080411	45	37	0	0.0	0.55925	0.0	
237	080421	29	39	0	0.0	0.4175	0.0	19.338
238	080431	26	38	0	0.0	0.417583592	0.466166667	0.4576
239	080441	43	46	0	0.0	0.06447	3.37797	
240	080451	40	4	0	0.0	0.15559179000-01	0.466166666	
241	080461	41	40	0	0.0	0.15559179000-01	4.225	
242	080471	46	20	0	0.0	0.06447	0.0	

243	080481	47	27	0	0	0.0	0.09037	0.0					
244	080491	48	23	0	0	372.2222	8.	-15.84					
245	080501	23	49	0	0	597.2222	1.05597	-13.5536					
246	080511	51	57	0	0	310.0	0.43498	-2.35166667					
247	080521	52	53	0	0	225.0	0.43498	-13.9635833					
248	080531	53	23	0	0	225.0	4.	-15.84					
249	080541	51	21	0	0	287.2222	C.7	-8.6341667					
250	080551	52	22	0	0	85.0	3.	-8.15762					
251	080561	53	46	0	0	0.	2.	-15.121011					
252	080571	20	50	0	0	597.2222	0.66087	0.					
253	080581	0	46	1	0	0.	1.	0.					
254	080591	0	46	2	0	0.	1.	0.					
255	*												
256	*												
257	080012	C	5	2	0	0.9323	C.C	0.0	1.0	C			
258	080022	1	5	0	0	0.9323	C.0	0	0	0			
259	080032	1	5	0	0	0.9323	C.0	0	0	0			
260	080042	8.	744846992			0.0514		0.0514		1	5	C	0
261	080052	8.	303511660			0.02278		0.02278		1	5	C	0
262	080062	5.	216303368			0.6722		0.6722		1	5	C	0
263	080072	1.	882983179			1.53061		1.7764		1	5	C	0
264	080082	2.	164041222			0.3584		0.6312		0	5	C	0
265	080092	3.	105345439			0.0113		0.0313		0	5	C	0
266	080102	3.	105385439			0.0572		0.0572		0	5	C	0
267	080112	2.	164741222			0.6225		0.357		0	5	C	0
268	080122	1.	371201641			1.3794		1.6317		1	5	C	0
269	080132	6.	043461482			0.19658		0.2265		0	5	C	0
270	080142	6.	581354520			1.0994		1.25		1	5	C	0
271	080152	17.	00563668			0.21566		0.21566		0	5	C	0
272	080162	17.	00563668			0.2315		0.2315		0	5	C	0
273	080172	18.	293452297			0.12237		0.12237		0	5	C	0
274	080182	14.	421711118			0.21838		0.21838		0	5	C	0
275	080192	12.	65037548			0.66128		0.69		1	5	C	0
276	080202	8.	978633689			2.93098		1.20		1	5	C	0
277	080212	5.	10484			0.20375		0.20375	1	5	0	0	
278	080222	3.	947755			1.23785		0.8040	1	5	0	3	
279	080232	C.				0.200828		C.	0	5	2	3	
280	080242	0.				0.754335		0.55	0	5	2	3	
281	080252	C.				0.26046		0.26046	0	5	2	0	
282	080262	0.				0.5591795		0.55918	0	5	2	0	
283	080272	3.	916834			0.804		1.895	1	5	0	3	
284	080282	5.	4708			0.1005		0.1005		1	5	0	0
285	080292	11.	11			6.545		14.05	1	5	0	0	
286	080302	11.	61547			0.29956		0.24629		1	5	0	0
287	080312	25.	2554003			1.037		0.537		1	5	0	0
288	080322	5.	0742			0.1005		0.1005		1	5	0	0
289	080332	20.	3298			0.3965		0.75263	1	5	0	0	
290	080342	19.	90104223			0.43596		0.43596		0	5	0	0
291	080352	5.	758749039			5.81834		5.81834		0	5	0	0
292	080362	5.	758748039			5.81834		5.81834		0	5	0	0
293	080372	27.	25728546			0.23025		0.23025		0	5	0	0
294	080382	27.	05511851			4.234		4.234		0	5	0	0
295	080392	37.	52436243			8.468		8.468		1	5	0	0
296	080402	40.	91397			0.94883		0.43834		1	5	0	0
297	080412	25.	25554003			1.037		0.537		1	5	0	0
298	080422	0	5	0	3	0.7083		0.0	0	0	0	0	
299	080432	24.	22295744			1.247		0.4576		0	5	0	3
300	080442	C.				22.0		22.0		0	5	2	0
301	080452	75.	32990961			1.0		8.62		0	5	0	3
302	080462	74.	88990673			16.24		8.62		0	5	0	0
303	080472	0.				12.25		12.25		0	5	2	0

		W15	W16	W17	W18	W19	W20
	JUN. DIAM.	CONC	ICHOKE	ENTH	SRCOS	IADJUN	
304	0804432	15.18	0.415	0.290			1 5 0 0
305	0804432	2.	0.019814	0.019814	0	5	3
306	0805102	0.	0.52259	0.6	0	5	3
307	0805112	0.	0.2009	0.3	0	5	3
308	0805222	0.	0.754335	0.55	0	5	3
309	0805322	5.	0.02	0.02	0	5	3
310	0805422	4.	1.261	1.261	0	5	3
311	0805522	1.1	23.4	23.4	0	5	3
312	0805622	1.	0.1	0.1	0	5	3
313	0805722	5.10484	0.20375	0.20375	1	5	3
314	0805822	0.	1.0	1.0	0	5	3
315	0805922	0.	1.0	1.0	0	5	3
316	*						
317	*						
318	080043	0.9323333333	0.0	0	0	*	
319	080053	0.6759166667	0.0	0	0	*	
320	080063	0.9323333333	0.0	0	0	*	
321	080073	0.90167	0.0	0	0	*	
322	080083	1.438941017	0.0	0	0	*	
323	080093	1.438941017	0.0	0	0	*	
324	080103	1.438941017	0.0	0	0	*	
325	080113	1.438941017	0.0	0	0	*	
326	080123	0.90167	0.0	0	0	*	
327	080133	0.9323333333	0.0	0	0	*	
328	080143	0.9323333333	0.0	0	0	*	
329	080153	0.7083333333	0.0	0	0	*	
330	080163	0.7083333333	0.0	0	0	*	
331	080173	0.7083333333	0.0	0	0	*	
332	080183	0.7083333333	0.0	0	0	*	
333	080193	0.7083333333	0.0	0	0	*	
334	080203	0.7083333333	0.0	0	0	*	
335	080213	0.9323333333	0.0	0	0	*	
336	080223	0.9323333333	0.0	0	0	*	
337	080233	0.911145	0.0	0	0	*	
338	080243	1.2689	0.0	0	0	*	
339	080253	2.038	0.0	0	0	*	
340	080263	1.0	0.0	0	0	*	
341	080273	0.9323333333	0.0	0	0	*	
342	080283	0.9323333333	0.0	0	0	*	
343	080293	0.3386	0.0	0	0	*	
344	080303	0.56775	1.0	0	0	*	
345	080313	0.843833	1.0	0	0	*	
346	080323	0.9323333333	0.0	0	0	*	
347	080333	0.	1.0	0	0	*	
348	080343	0.3594166667	0.0	0	0	*	
349	080353	0.5278189198	0.0	0	0	*	
350	080363	0.5278189198	0.0	0	0	*	
351	080373	0.3594166667	0.0	0	0	*	
352	080383	0.3594166667	0.0	0	0	*	
353	080393	0.3594166667	0.0	0	0	*	
354	080403	0.33858	0.75	0	0	*	
355	080413	0.843833	1.0	0	0	*	
356	080423	0.7083333333	0.0	0	0	*	
357	080433	0.2865	0.0	0	0	*	
358	080443	0.1407500000	0.75	0	0	*	
359	080453	0.1407500000	0.0	0	0	*	
360	080463	0.29167	0.0	0	0	*	
361	080473	0.3386	0.848	0	0	*	
362	080483	0.	0.0	0	0	*	
363	080493	1.26557	0.0	0	0	*	
364	080503	0.091145	0.0	0	0	*	

426	104011	1	1	7	0	0	.1	.83	.2	1.09	.5	1.02	.7	1.01	.9	.94	1.	1.
427	104021	1	2	8	0	0	.1	.84	.2	1.09	.5	1.02	.7	1.01	.9	.94	1.	1.
428	104031	1	3	9	0	0	.1	.85	.2	1.09	.5	1.02	.7	1.01	.9	.94	1.	1.
429	104032	1	3	10	0	0	.1	.86	.2	1.09	.5	1.02	.7	1.01	.9	.94	1.	1.
430	104041	1	4	10	0	0	.1	.87	.2	1.09	.5	1.02	.7	1.01	.9	.94	1.	1.
431	104042	1	4	11	0	0	.1	.88	.2	1.09	.5	1.02	.7	1.01	.9	.94	1.	1.
432	104051	1	5	6	0	0	.2	.34	.4	.65	.6	.93	.8	1.19	1.	1.47		
433	104061	1	6	10	0	0	.11	.13	.25	.15	.4	.13	.5	.07	.6	-.04	.7	-.23
434	104062	1	6	11	0	0	.11	.13	.25	.15	.4	.13	.5	.07	.6	-.04	.7	-.23
435	104071	1	7	2	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
436	104081	1	8	2	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
437	104091	2	1	5	0	0	.6932		.1930	.6325		.393		.7369				
438	104092	2	1	6	0	0	.8331		.79782	.9229		1.		.9672				
439	104101	2	2	7	0	0	.67		.4	.25		.5		.15				
440	104102	2	2	8	0	0	.737255		.526586	.768049		.606594		.86725		.74366		
441	104103	2	2	9	0	0	.4672		.4	.25		.5		.15				
442	104111	2	3	6	0	0	1.9843		-.80096	1.394		-.60658		1.0975				
443	104112	2	3	7	0	0	.822		-.19928	.6648		0.		.6032				
444	104121	2	4	8	0	0	1.9843		-.62234	1.8308		-.63371		1.6824				
445	104122	2	4	9	0	0	1.9843		-.62234	1.8308		-.63371		1.6824				
446	104123	2	4	10	0	0	1.9843		-.62234	1.8308		-.63371		1.6824				
447	104131	2	5	4	0	0	1.3481		0.	1.23361		0.		0.				
448	104132	2	5	5	0	0	1.3481		0.	1.23361		0.		0.				
449	104141	2	6	10	0	0	1.23361		.090643	1.1965		.188569		1.1096				
450	104142	2	6	11	0	0	.27347		1.0416	.458669		.8958		.57448		.7807		
451	104143	2	6	12	0	0	.73816		.6134	.76852		.5849		.870057		.4877		
452	104144	2	6	13	0	0	.3569		0.	0.		0.		0.		0.		
453	104151	2	7	4	0	0	1.		-.3	-.9		-.1		-.5				
454	104152	2	7	5	0	0	1.		-.3	-.9		-.1		-.5				
455	104161	2	8	4	0	0	1.		-.3	-.9		-.1		-.5				
456	104162	2	8	5	0	0	1.		-.3	-.9		-.1		-.5				
457	110010	-2	1	0	0	0	0		0	0		0		0		0		
458	110020	25	0	0	0	0	0		0	0		0		0		0		
459	120100	-3	2	0	0	0	0		0	0		0		0		0		
460	130100	6	2	13	4	0	0		0	0		0		0		0		
461	130101	0	172	20	167	40	160		60	150		80		141		100		132
462	130102	120	120	140	107	160	91		180	72		200		47				
463	130103	220	17	228	0	0	0		0	0		0		0		0		
464	130200	4	2	2	4	0	0		0	0		0		0		0		
465	130201	0.1	17.2	3000	0	0	17.2		0	0		0		0		0		
466	150011	53	0	1	0	0	0		23.333	0.0		0.9093		1.744		0.0		
467	150012	1.744	0.0	5.1384	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
468	150021	1.0	0.0	0.0	0.0	0.0	0.0		23.054	0.0		0.9829		1.788		0.0		
469	150022	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
470	150031	2.0	0.0	0.0	0.0	0.0	0.0		10.477	0.0		0.4467		1.314		0.0		
471	150032	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
472	150041	24	0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
473	150042	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
474	150051	36	0	11	0	0	0		3.42	0.0		0.2533		0.3386		0.0		
475	150052	0.3386	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
476	150061	35	0	8	0	0	0		7.33	0.0		0.9674		0.932		0.0		
477	150062	0.932	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
478	150071	0	21	4	0	0	0		19.7840	2.3606		0.		0.5833		0.0		
479	150072	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		0.0		0.0		
480	150081	21	0	5	0	0	0		23.985	0.		22.036		.5833		0.		
481	150082	0.	0.	3.435	0.	0.	0.		0.	0.		0.		0.		0.		
482	150091	0	52	4	0	0	0		33.4367	6.8520		0.		0.3333		0.		
483	150092	0.	0.	0.	0.	0.	0.		0.	0.		0.		0.		0.		
484	150101	52	0	5	0	0	0		40.539	0.		37.2457		0.3333		0.		
485	150102	0.	0.	0.	0.	0.	0.		0.	0.		0.		0.		0.		
486	150111	34	0	11	0	0	0		9.19	0.0		0.6807		0.3386		0.0		


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548 150421 48 0 1 0 0 0 0 46.6667 0. 1.8187 1.744 0.
549 150422 1.744 0. 5.1384 0. 0. 0.
550 150431 48 0 5 0 0 0 28.9427 0. 26.5913 2.892 0.
551 150432 2.892 0. 4.145 0. 0. 0.
552 150441 49 0 1 0 0 0 28.735 0. 1.1198 1.744 0.0
553 150442 1.744 0. 7.158 0. 0. 0.
554 150451 49 0 5 0 0 0 17.821 0. 16.374 2.892 0.0
555 150452 2.892 0. 1.702 0. 0. 0.
556 150461 0 51 4 0 0 0 9.8920 1.1803 0. 0.5833
557 150462 0. 0. 0. 3.435 0. 0.
558 150471 51 0 5 0 0 0 11.9927 0. 11.018 0.5833 0.
559 150472 0. 0. 0. 3.435 0. 0.
560 170181 1 2 1 4 0.0 0.01299 0.0
561 170182 0 1 4 0.02597 0.0
562 170201 2 2 1 4 0.894 0.0208 0.0
563 170202 0 1 4 0.0208 0.0
564 170301 2 2 1 4 1.019 0.0417 0.0
565 170302 0 1 4 0.0417 0.0
566 170401 2 2 1 4 1.25 0.0625 0.0
567 170402 0 1 4 0.0625 0.0
568 170501 2 2 1 4 1.667 0.25 0.0
569 170502 0 1 4 0.5 0.0
570 170601 2 2 1 4 0.01675 0.00204 0.0
571 170602 0 1 4 0.00204 0.0
572 170701 2 2 1 4 0.354 0.031 0.0
573 170702 0 1 4 0.063 0.0
574 170801 2 2 1 4 0.466 0.039 0.0
575 170802 0 1 4 0.078 0.0
576 170901 2 2 1 4 0.5339 0.0443 0.0
577 170902 0 1 4 0.0885 0.0
578 171001 2 2 1 4 2.25 0.0208 0.0
579 171002 0 1 4 0.2709 0.0
580 171101 2 2 1 4 0.1693 0.0208 0.0
581 171102 0 1 4 0.0417 0.0
582 171201 2 2 1 4 0.2639 0.0252 0.0
583 171202 0 1 4 0.0503 0.0
584 171301 2 2 1 4 0.6016 0.0495 0.0
585 171302 0 1 4 0.0989 0.0
586 171401 2 3 1 8 3.14583 0.08333 0.0
587 171402 0 1 5 0.58333 0.0
588 171403 0 1 3 0.10417 0.0
589 180101 -2
590 180102 212. 9.574 2372. 19.294
591 190101 -13
592 190102 170. 44.46081 250. 44.32964 400. 44.48722
593 190103 600. 45.39201 800. 46.90938 1000. 48.84151
594 190104 1200. 50.99056 1400. 53.15869 1600. 55.14808
595 190105 1800. 56.76090 2000. 57.79932 2200. 58.06550
596 190106 2400. 57.36101
597 400201 42 42 42
598

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MISCELLANEOUS PROBLEM CONTROL DATA.

TAPE	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	NUM	PRO-
DUMP	EDIT	TIME	TRIP	VOL	BUB	TIME	JUN	PUMP	CHK	LEAK	FILL	HEAT	SLAB	SLAB	CORE	HEAT	GRAM		
0=NO	VAR	SETS	SGNL		SETS	VOL		SETS	VALV	CURV	CURV	SLAB	GEOM.	MAT.	SECT	EXCH	FLAG		
-2	9	7	6	53	3	1	59	2	2	1	2	47	14	1	0	0	0		

EXPDP4/C. E. OLOFTSWO2(73)

EXPERIMENTAL RELAP4 TYPE PROGRAM. CONFIGURATION. CONTROL: YES

INITIAL POWER (MEGAWATTS)	IMPLICIT- EXPLICIT FACTOR	LOW PRESSURE LIMIT (PSI)	HIGH PRESSURE LIMIT (PSI)	LOW TEMPERATURE LIMIT (F)	HIGH TEMPERATURE LIMIT (F)
0.	1.000000E+00	8.860000E-02	3.626000E+03	3.210000E+01	8.540312E+03

EDIT IDENTIFICATION NUMBERS

1	2	3	4	5	6	7	8	9
JW 51	JW 50	JW 24	AP 2	JW 23	JW 56	AP 23	ML 41	PR 15

DATA FOR 7 TIME STEP SETS.

SET NUM	T S PER	BRF PER	LRG PER	T S CNT	TIME STEP	MIN T S SIZE	END OF INT-RVAL
1	50	2	2	0	.200000E-03	.100000E-04	.100000E+00
2	20	10	1	0	.500000E-03	.500000E-04	.800000E+00
3	10	20	1	0	.100000E-02	.100000E-03	.200000E+01
4	5	10	4	0	.100000E-01	.500000E-03	.700000E+01
5	5	20	4	0	.100000E-01	.500000E-03	.220000E+02
6	5	40	4	0	.100000E-01	.500000E-04	.320000E+02
7	5	80	2	0	.100000E-01	.500000E-03	.100000E+03

ENDCPU = 2.50000E+03

GENERALIZED TRIP PARAMETERS FOR 6 SIGNALS.

TRIP NO.	TRIP ID	SIG ID	INDX 1	INDX 2	ACTION	TRIP SIGNAL	SET POINT	DELAY TIME
1	1	1	0	0	END	ELAPSED TIME	.100000E-02	0.
2	2	1	0	0	GEN TRIP ELAPSED TIME	0.	0.	0.
3	3	1	0	0	GEN TRIP ELAPSED TIME	.100000E+01	0.	0.
4	4	1	0	0	GEN TRIP ELAPSED TIME	.220000E+02	0.	0.
5	5	-5	43	0	GEN TRIP LOW MIX LEV	.100000E-01	0.	0.

GENERALIZED TRIP PARAMETERS FOR 5 SIGNALS.

TRIP NO.	TRIP ID	SIG ID	INDX 1	INDX 2	ACTION	TRIP SIGNAL	SET POINT	DELAY TIME
1	1	1	0	0	END	ELAPSED TIME	.100000E-02	0.
2	2	1	0	0	GEN TRIP	ELAPSED TIME	.100000E-02	0.
3	3	1	0	0	GEN TRIP	ELAPSED TIME	.100000E+01	0.
4	4	1	0	0	GEN TRIP	ELAPSED TIME	.220000E+02	0.
5	5	-5	43	0	GEN TRIP	LOW MIX LEV	.100000E-01	0.
6	6	1	0	0	GEN TRIP	ELAPSED TIME	.355000E+02	0.

INPUT DATA FOR 53 VOLUMES.

VOL NUM	BUBL INDX	TIME DEP	PRESSURE (PSIA)	TEMPERATURE (DEG F)	HUMIDITY (OR QUALITY)	VOLUME (FT**3)	HEIGHT (FT)	MIXTURE LEVEL (FT)
VOL NUM	2-PH FRIC		FLOW AREA (FT**2)	EQUIVALENT DIAMETER (FT)	ELEVATION (FT)	VOL. BELOW		
1	0	0	.225736E+04	.540000E+03	-.100000E+00	.102817E+C2	.750000E+01	.750000E+01
2	0	0	.225120E+04	.540000E+03	-.100000E+00	.4.9600E+C1	.186500E+C1	.186500E+01
3	0	0	.227089E+04	.540000E+03	-.100000E+00	.4.9600E+C1	.186500E+C1	.186500E+01
4	0	0	.249109E+04	.131400E+01	-.283000E+01	.793126E+C1	.932333E+00	.932333E+00
5	0	0	.226469E+04	.540000E+03	-.100000E+00	.455041E+C1	.932333E+00	.932333E+00
6	0	0	.682704E+00	.932333E+00	-.466167E+00	.3.8986E+C1	.932333E+00	.932333E+00
7	0	0	.226446E+04	.540000E+03	-.100000E+00	.455041E+C1	.932333E+00	.932333E+00
8	0	0	.682704E+00	.932333E+00	-.466167E+00	.3.8986E+C1	.932333E+00	.932333E+00
9	0	0	.226423E+04	.540000E+03	-.100000E+00	.455041E+C1	.932333E+00	.932333E+00
10	0	0	.682704E+00	.932333E+00	-.466167E+00	.3.8986E+C1	.932333E+00	.932333E+00
11	0	0	.226352E+04	.540000E+03	-.100000E+00	.2.7822E+C1	.242156E+01	.242156E+01
12	0	0	.895564E+00	.106783E+01	-.533917E+00	.1.1824E+C2	.250000E+01	.250000E+01
13	0	0	.226020E+04	.540000E+03	-.100000E+00	.1.1824E+C2	.250000E+01	.250000E+01
14	0	0	.794125E+01	.146150E+01	-.312193E+00	.1.1824E+C2	.250000E+01	.250000E+01
15	0	0	.225781E+04	.540000E+03	-.100000E+00	.1.1824E+C2	.250000E+01	.250000E+01
16	0	0	.162621E+C1	.335000E-01	.281219E+01	.675000E+01	.675000E+01	.675000E+01
17	0	0	.225566E+04	.540000E+03	-.100000E+00	.544779E+C1	.200521E+01	.200521E+01
18	0	0	.162621E+C1	.335000E-01	.281219E+01	.675000E+01	.675000E+01	.675000E+01
19	0	0	.225639E+04	.540000E+03	-.100000E+00	.1.1824E+C2	.250000E+01	.250000E+01
20	0	0	.162621E+C1	.335000E-01	.281219E+01	.675000E+01	.675000E+01	.675000E+01
21	0	0	.225755E+04	.540000E+03	-.100000E+00	.1.1824E+C2	.250000E+01	.250000E+01
22	0	0	.794125E+01	.146150E+01	-.312193E+00	.1.1824E+C2	.250000E+01	.250000E+01
23	0	0	.225321E+04	.540000E+03	-.100000E+00	.205729E+C1	.237508E+01	.237508E+01
24	0	0	.895564E+00	.106783E+01	-.533917E+00	.1.1824E+C2	.250000E+01	.250000E+01
25	0	0	.225311E+04	.540000E+03	-.100000E+00	.443798E+01	.380867E+01	.380867E+01
26	0	0	.682704E+00	.932333E+00	-.429610E+01	.449346E+C1	.217450E+01	.217450E+01
27	0	0	.225137E+04	.540000E+03	-.100000E+00	.449346E+C1	.217450E+01	.217450E+01
28	0	0	.682704E+00	.932333E+00	-.429610E+01	.449346E+C1	.217450E+01	.217450E+01
29	0	0	.226547E+04	.540000E+03	-.100000E+00	.378561E+C1	.247577E+01	.247577E+01
30	0	0	.394063E+00	.394063E+00	-.212160E+01	.0	.0	.0

16	0	0	.226698E+04	.540000E+03	-.100000E+01	.378561E+01	.247577E+01	.247577E+01
16	0	0	.394053E+00	.394060E+00	-.212160E+01	0	0	0
17	0	0	.227844E+04	.540000E+03	-.100000E+01	.189580E+01	.708333E+00	.708333E+00
17	0	0	.394053E+00	.708333E+00	-.354167E+00	0	0	0
18	0	0	.228136E+04	.540000E+03	-.100000E+01	.693352E+00	.708333E+00	.708333E+00
18	0	0	.394053E+00	.708333E+00	-.354167E+00	0	0	0
19	0	0	.227574E+04	.540000E+03	-.100000E+01	.628653E+01	.932333E+00	.932333E+00
19	0	0	.682704E+00	.932333E+00	-.466167E+00	0	0	0
20	0	0	.227528E+04	.540000E+03	-.100000E+01	.161431E+01	.932333E+00	.932333E+00
20	0	0	.682704E+00	.932333E+00	-.466167E+00	0	0	0

VOL NUM	BUBL INOX	TIME DEP	PRESSURE (PSIA)	TEMPERATURE (DEG F)	HUMIDITY (OR QUALITY)	VOLUME (FT**3)	HEIGHT (FT)	MIXTURE LEVEL (FT)
VOL NUM	2-PH FRIC		FLOW AREA (FT**2)	EQUIVALENT DIAMETER (FT)	ELEVATION (FT)	VOL. BELOW		
21	0	0	.227232E+04	.540000E+03	-.100000E+01	.496640E+01	.343500E+01	.343500E+01
21	0	0	.130748E+01	.563333E+00	-.235167E+01	0	0	0
22	0	0	.227470E+04	.540000E+03	-.100000E+01	.113777E+02	.116119E+02	.116119E+02
22	0	0	.101811E+01	.333333E+00	-.139636E+02	0	0	0
23	0	0	.227655E+04	.540000E+03	-.100000E+01	.101532E+02	.188942E+01	.188942E+01
23	0	0	.500000E+01	.100000E+02	-.158420E+02	0	0	0
24	0	0	.227354E+04	.540000E+03	-.100000E+01	.302490E+02	.942200E+01	.942200E+01
24	0	0	.326500E+01	.231300E+01	-.122600E+02	0	0	0
25	0	0	.227211E+04	.540000E+03	-.100000E+01	.356959E+01	.932333E+00	.932333E+00
25	0	0	.682704E+00	.932333E+00	-.466167E+00	0	0	0
26	0	0	.227211E+04	.540000E+03	-.100000E+01	.153040E+01	.932333E+00	.932333E+00
26	0	0	.682704E+00	.932333E+00	-.466167E+00	0	0	0
27	0	0	.227211E+04	.540000E+03	-.100000E+01	.817513E+00	.567750E+00	.567750E+00
27	0	0	.253165E+00	.567750E+00	-.283875E+00	0	0	0
28	0	0	.226823E+04	.540000E+03	-.100000E+01	.754979E+01	.932333E+00	.932333E+00
28	0	0	.682704E+00	.932333E+00	-.466167E+00	0	0	0
29	0	0	.226823E+04	.540000E+03	-.100000E+01	.230445E+01	.932333E+00	.932333E+00
29	0	0	.682704E+00	.932333E+00	-.466167E+00	0	0	0
30	0	0	.226789E+04	.540000E+03	-.100000E+01	.289649E+00	.244013E+01	.244013E+01
30	0	0	.900370E-01	.338580E+00	-.169292E+00	0	0	0
31	0	0	.226673E+04	.540000E+03	-.100000E+01	.458256E+01	.458250E+01	.458250E+01
31	0	0	.106080E+01	.121583E+01	-.227083E+01	0	0	0
32	0	0	.226532E+04	.540000E+03	-.100000E+01	.100357E+02	.404708E+01	.404708E+01
32	0	0	.116102E+01	.121583E+01	.685333E+01	0	0	0
33	0	0	.226673E+04	.540000E+03	-.100000E+01	.458256E+01	.458250E+01	.458250E+01
33	0	0	.106080E+01	.121583E+01	-.227083E+01	0	0	0
34	0	0	.226823E+04	.540000E+03	-.100000E+01	.408918E+00	.454167E+01	.454167E+01
34	0	0	.900370E-01	.338580E+00	-.227083E+01	0	0	0
35	0	0	.226933E+04	.540000E+03	-.100000E+01	.170960E+01	.217450E+01	.217450E+01
35	0	0	.682704E+00	.932333E+00	-.444533E+01	0	0	0
36	0	0	.226888E+04	.540000E+03	-.100000E+01	.578667E+00	.431775E+01	.431775E+01
36	0	0	.900370E-01	.338580E+00	-.414844E+01	0	0	0
37	0	0	.226000E+02	.272000E+03	0	.369345E+04	.160937E+02	.160937E+02
37	0	0	.962113E+01	.350000E+01	-.135104E+02	0	0	0
38	0	0	.227162E+04	.540000E+03	-.100000E+01	.817046E+01	.206508E+01	.206508E+01
38	0	0	.417584E+00	.125000E+01	-.466167E+00	0	0	0
39	0	0	.226787E+04	.540000E+03	-.100000E+01	.587547E+01	.289583E+01	.289583E+01
39	0	0	.417584E+00	.125000E+01	-.364583E+00	0	0	0
40	0	0	.226369E+04	.540000E+03	-.100000E+01	.362366E+00	.403500E+01	.403500E+01
40	0	0	.155592E-01	.140750E+00	-.466167E+00	0	0	0

VOL NUM	BUBL INX	TIME DEP	PRESSURE (PSIA)	TEMPERATURE (DEG F)	HUMIDITY (OR QUALITY)	VOLUME (FT**3)	HEIGHT (FT)	MIXTURE LEVEL (FT)
VOL NUM	2-PH FRIC		FLOW AREA (FT**2)	EQUIVALENT DIAMETER (FT)	ELEVATION (FT)	VOL. BELOW		
41	3	0	.226254E+04	-.100000E+01	0.	.347522E+02	.671354E+01	.432720E+01
41	0		.600726E+01	.276560E+01	.402000E+01	0		
42	1	0	.171000E+02	.467000E+01	.199000E+01	.281600E+02	.274500E+02	.117000E+02
42	0		.612630E+03	.900000E+02	0.	0		
43	1	0	.135700E+02	.415667E+01	.337797E+01	.104873E+02	.729207E+01	.458032E+01
43	0		.227210E+04	.540000E+03	-.100000E+01	0		
44	0	0	.559250E+00	.843833E+00	-.400573E+00	.327625E+01	.841146E+00	.841146E+00
44	0		.226822E+04	.540000E+03	-.100000E+01	0		
45	0	0	.559250E+00	.843833E+00	-.400573E+00	.327625E+01	.841146E+00	.841146E+00
45	0					0		
46	0	0	.227813E+04	.210000E+03	-.100000E+01	.537000E+01	.366185E+01	.366185E+01
46	0		.644750E+01	.100000E+05	-.283880E+00	0		
47	0	0	.227211E+04	.540000E+03	-.100000E+01	.774100E+01	.932333E+00	.932333E+00
47	0		.682734E+00	.200000E+00	-.466167E+00	0		
48	0	0	.227665E+04	.540000E+03	-.100000E+01	.439786E+01	.244640E+01	.244640E+01
48	0		.200000E+01	.333330E+00	-.164000E+02	0		
49	0	0	.227558E+04	.540000E+03	-.100000E+01	.639200E+01	.170360E+01	.170360E+01
49	0		.374329E+01	.218314E+01	-.139636E+02	0		
50	0	0	.227487E+04	.540000E+03	-.100000E+01	.161431E+01	.932333E+00	.932333E+00
50	0		.682704E+00	.932333E+00	-.466167E+00	0		
51	0	0	.227286E+04	.540000E+03	-.100000E+01	.248320E+01	.343500E+01	.343500E+01
51	0		.653740E+00	.583333E+00	-.235167E+01	0		
52	0	0	.227493E+04	.540000E+03	-.100000E+01	.568887E+01	.116119E+02	.116119E+02
52	0		.509054E+00	.333330E+00	-.139636E+02	0		
53	0	0	.227655E+04	.540000E+03	-.100000E+01	.219893E+01	.244640E+01	.244640E+01
53	0		.100000E+01	.333330E+00	-.164000E+02	0		

VOLUME DATA ACTUALLY BEING USED.

VOL NUM	BUBL INDX	TIME DEP	PRESSURE (PSIA)	ENTHALPY	VOLUME (FT**3)	HEIGHT (FT)	MIXTURE LEVEL (FT)	ELEVATION (FT)
1	0	0	.226706E+04	.534894E+03	.162817E+02	.750000E+01	.750000E+01	-.973000E+00
2	0	0	.227139E+04	.534889E+03	.419600E+01	.185500E+01	.186500E+01	-.283800E+01
3	0	0	.226469E+04	.534897E+03	.795126E+01	.932333E+00	.932333E+00	-.466167E+00
4	0	0	.226446E+04	.534897E+03	.455041E+01	.932333E+00	.932333E+00	-.466167E+00
5	0	0	.226423E+04	.534897E+03	.318966E+01	.932333E+00	.932333E+00	-.466167E+00
6	0	0	.226352E+04	.534898E+03	.287822E+01	.242156E+01	.242156E+01	-.533917E+00
7	1	0	.226020E+04	.534902E+03	.111824E+02	.250000E+01	.250000E+01	.312193E+00
8	0	0	.225781E+04	.534905E+03	.109769E+02	.675000E+01	.675000E+01	.281219E+01
9	0	0	.225566E+04	.534905E+03	.544779E+01	.200521E+01	.200521E+01	-.956219E+01
10	0	0	.225639E+04	.534907E+03	.109769E+02	.675000E+01	.675000E+01	.281219E+01
11	0	0	.225755E+04	.534905E+03	.111824E+02	.250000E+01	.250000E+01	.312193E+00
12	0	0	.225321E+04	.534911E+03	.255729E+01	.237508E+01	.237508E+01	-.487437E+00
13	0	0	.225311E+04	.534911E+03	.443798E+01	.380867E+01	.380867E+01	-.429610E+01
14	0	0	.225137E+04	.534913E+03	.449346E+01	.217450E+01	.217450E+01	-.429610E+01
15	0	0	.226547E+04	.534896E+03	.378561E+01	.247577E+01	.247577E+01	-.212160E+01
16	0	0	.226698E+04	.534894E+03	.378561E+01	.247577E+01	.247577E+01	-.212160E+01
17	0	0	.227844E+04	.534880E+03	.189580E+01	.708333E+00	.708333E+00	-.354167E+00
18	0	0	.228136E+04	.534876E+03	.693352E+00	.708333E+00	.708333E+00	-.354167E+00
19	0	0	.227574E+04	.534883E+03	.628853E+01	.932333E+00	.932333E+00	-.466167E+00
20	0	0	.227528E+04	.534884E+03	.151431E+01	.932333E+00	.932333E+00	-.466167E+00
21	0	0	.227232E+04	.534887E+03	.496640E+01	.343500E+01	.343500E+01	-.235167E+01
22	0	0	.227470E+04	.534884E+03	.113777E+02	.116119E+02	.116119E+02	-.139636E+02
23	0	0	.227655E+04	.534882E+03	.101532E+02	.188442E+01	.168442E+01	-.158420E+02
24	0	0	.227354E+04	.534886E+03	.302490E+02	.942200E+01	.942200E+01	-.122600E+02
25	0	0	.227211E+04	.534887E+03	.356959E+01	.932333E+00	.932333E+00	-.466167E+00
26	0	0	.227211E+04	.534887E+03	.153040E+01	.932333E+00	.932333E+00	-.466167E+00
27	0	0	.227211E+04	.534887E+03	.817513E+00	.567750E+00	.567750E+00	-.283875E+00
28	0	0	.226823E+04	.534892E+03	.754979E+01	.932333E+00	.932333E+00	-.466167E+00
29	0	0	.226823E+04	.534892E+03	.230445E+01	.932333E+00	.932333E+00	-.466167E+00
30	0	0	.226784E+04	.534893E+03	.289649E+00	.244013E+01	.244013E+01	-.169292E+00
31	0	0	.226673E+04	.534894E+03	.458256E+01	.458250E+01	.458250E+01	.227083E+01
32	0	0	.226532E+04	.534896E+03	.100357E+02	.404708E+01	.404708E+01	.685333E+01
33	0	0	.226673E+04	.534894E+03	.458256E+01	.458250E+01	.458250E+01	.227083E+01
34	0	0	.226823E+04	.534892E+03	.408918E+00	.454167E+01	.454167E+01	-.227083E+01
35	0	0	.226933E+04	.534891E+03	.170960E+01	.217450E+01	.217450E+01	-.444533E+01
36	0	0	.226886E+04	.534891E+03	.578667E+00	.431775E+01	.431775E+01	-.414846E+01
37	0	1	.226000E+02	.202911E+03	.369345E+04	.160937E+02	.160937E+02	-.135104E+02
38	0	0	.227162E+04	.534888E+03	.617046E+01	.206508E+01	.206508E+01	.466167E+00
39	0	0	.226787E+04	.534893E+03	.587547E+01	.289583E+01	.289583E+01	-.364583E+00
40	0	0	.226369E+04	.534898E+03	.362366E+00	.403500E+01	.403500E+01	.466167E+00

VOLUME DATA ACTUALLY BEING USED.

VOL NUM	BUHL INDX	TIME DEP	PRESSURE (PSIA)	ENTHALPY	VOLUME (FT**3)	HEIGHT (FT)	MIXTURE LEVEL (FT)	ELEVATION (FT)
41	3	0	.226254E+04	.739058E+03	.347522E+02	.671354E+C1	.432723E+01	.402000E+01
42	1	0	.962790E+03	.575262E+03	.281600E+C3	.274500E+C2	.117000E+C2	.199000E+01
43	1	0	.612600E+03	.600984E+02	.104873E+C3	.729207E+C1	.458032E+C1	.337797E+01
44	0	0	.227210E+04	.534887E+03	.327625E+C1	.841146E+C0	.841146E+C0	.400573E+00
45	0	0	.225522E+04	.534892E+03	.327625E+C1	.841146E+C0	.841146E+C0	.400573E+00
46	0	0	.227813E+04	.183219E+03	.537000E+01	.366185E+01	.366185E+C1	.283880E+00
47	0	0	.227211E+04	.534887E+C3	.774100E+C0	.932333E+C0	.932333E+C0	.466167E+00
48	0	0	.227665E+04	.534882E+C3	.439786E+01	.244640E+C1	.244640E+C1	.164000E+02
49	0	0	.227558E+04	.534883E+C3	.639200E+C1	.170360E+01	.170360E+01	.139636E+02
50	0	0	.227487E+04	.534884E+C3	.161431E+01	.932333E+C0	.932333E+C0	.466167E+00
51	0	0	.227286E+04	.534887E+C3	.248320E+01	.343500E+01	.343500E+C1	.235167E+01
52	0	0	.227493E+04	.534884E+C3	.568887E+C1	.116119E+C2	.116119E+C2	.139636E+C2
53	0	0	.227665E+04	.534882E+C3	.219893E+01	.244640E+C1	.244640E+C1	.164000E+02

VOLUME DATA ACTUALLY BEING USED.

VOL NUM	2-PH FRIC	FLOW AREA (FT**2)	EQUIVALENT DIAMETER (FT)	LENGTH (FT)	L/2A (FT**1)	HORIZ. AREA (FT**2)	TEMPERATURE (F)	SATURATION TEMP. (F)	VOL. BELOW
1	0	.251200E+01	.178000E+01	.648158E+01	.129012E+01	.217090E+C1	.540000E+C3	.653797E+03	0
2	0	.249100E+C1	.131400E+01	.168140E+01	.338110E+C0	.224987E+C1	.540000E+C3	.654042E+C3	0
3	0	.682704E+00	.932333E+C0	.116167E+02	.852985E+01	.852834E+C1	.540000E+C3	.653645E+03	0
4	0	.682704E+00	.932333E+C0	.666538E+C1	.438153E+C1	.488067E+01	.540000E+C3	.653630E+03	0
5	0	.682704E+00	.932333E+C0	.467240E+C1	.342198E+C1	.342138E+C1	.540000E+C3	.653616E+03	0
6	0	.895564E+C0	.106783E+01	.321386E+C1	.179432E+01	.118858E+01	.540000E+C3	.653570E+03	0
7	0	.794125E+01	.146150E+C1	.140314E+C1	.886599E-01	.447296E+C1	.540000E+C3	.653357E+C3	0
8	0	.162621E+01	.335000E-01	.675000E+01	.207538E+01	.162621E+01	.540000E+C3	.653203E+C3	0
9	0	.162621E+01	.335000E-01	.335000E+01	.103000E+01	.171682E+01	.540000E+C3	.653205E+C3	0
10	0	.162621E+01	.335000E-01	.675000E+01	.207538E+01	.262621E+01	.540000E+C3	.653112E+C3	0
11	0	.794125E+01	.146150E+01	.140314E+01	.886599E-01	.447296E+01	.540000E+C3	.653186E+03	0
12	0	.895564E+00	.106783E+C1	.229723E+C1	.128254E+C1	.866196E+C0	.540000E+C3	.652907E+03	0
13	0	.682704E+00	.932333E+C0	.650060E+01	.476092E+01	.116523E+01	.540000E+C3	.652900E+C3	0
14	0	.682704E+00	.932333E+C0	.658188E+01	.43203E+01	.206643E+01	.540000E+C3	.652788E+03	0
15	0	.394063E+00	.394060E+00	.960562E+01	.121892E+02	.152906E+01	.540000E+C3	.653695E+03	0
16	0	.394063E+00	.394060E+00	.960562E+01	.121892E+02	.152906E+01	.540000E+C3	.653792E+03	0
17	0	.394063E+00	.708833E+C0	.481191E+01	.610425E+01	.267643E+C1	.540000E+C3	.654525E+03	0
18	0	.394063E+00	.708833E+C0	.175450E+01	.223251E+01	.972850E+00	.540000E+C3	.654711E+03	0
19	0	.682704E+00	.932333E+C0	.92112E+01	.674612E+01	.674493E+01	.540000E+C3	.654353E+C3	0
20	0	.682704E+00	.932333E+C0	.236458E+01	.173178E+01	.173147E+01	.540000E+C3	.654323E+C3	0
21	0	.130748E+01	.563333E+C0	.379545E+01	.145259E+01	.144582E+01	.540000E+C3	.654134E+03	0
22	0	.101811E+01	.333333E+C0	.111754E+C2	.548830E+C1	.979832E+C0	.540000E+C3	.654286E+03	0
23	0	.500000E+01	.100000E+C2	.203064E+01	.203064E+00	.537371E+01	.540000E+C3	.654404E+03	0
24	0	.326500E+C1	.231000E+01	.926462E+01	.141878E+01	.321046E+C1	.540000E+C3	.654212E+03	0
25	0	.682704E+00	.932333E+C0	.522867E+01	.382934E+01	.382867E+C1	.540000E+C3	.654120E+C3	0
26	0	.682704E+00	.932333E+C0	.224167E+01	.164176E+01	.164147E+01	.540000E+C3	.654120E+03	0
27	0	.213165E+C0	.567150E+00	.322317E+01	.637759E+01	.143992E+01	.540000E+C3	.654120E+03	0
28	0	.682704E+00	.932333E+C0	.110587E+02	.809917E+01	.809774E+01	.540000E+C3	.653872E+03	0
29	0	.682704E+00	.932333E+C0	.337547E+01	.247213E+01	.247170E+01	.540000E+C3	.653872E+03	0
30	0	.900370E+C1	.338180E+C0	.321700E+01	.178649E+02	.115702E+00	.540000E+C3	.653850E+03	0

31	0	.106080E+01	.121563E+01	.431993E+01	.203617E+01	.100001E+01	.540000E+03	.653776E+03	0
32	0	.116102E+01	.121583E+01	.864393E+01	.372257E+01	.247975E+01	.540000E+03	.653685E+03	0
33	0	.106080E+01	.121583E+01	.431993E+01	.203617E+01	.100001E+01	.540000E+03	.653776E+03	0
34	0	.900370E-01	.338580E+00	.642700E+01	.356909E+02	.134021E+00	.540000E+03	.653914E+03	0
35	0	.682704E+00	.932333E+00	.250417E+01	.183401E+01	.786206E+00	.540000E+03	.653942E+03	0
36	0	.900370E-01	.338580E+00	.642700E+01	.356909E+02	.134021E+00	.540000E+03	.653914E+03	0
37	0	.962113E+01	.350000E+01	.383890E+03	.199504E+02	.229496E+03	.234528E+03	.234528E+03	0
38	0	.417584E+00	.125000E+01	.195660E+02	.234277E+02	.395648E+01	.540000E+03	.654089E+03	0
39	0	.417584E+00	.125000E+01	.140702E+02	.168471E+02	.202894E+01	.540000E+03	.653849E+03	0
40	0	.155592E-01	.140750E+00	.232895E+02	.748418E+03	.898057E-01	.540000E+03	.653581E+03	0

VOLUME DATA ACTUALLY BEING USED.

VOL	2-PH	FLOW AREA	EQUIVALENT	LENGTH	L/2A	HORIZ. AREA	TEMPERATURE	SATURATION	VOL. BELOW
NUM	FRIC	(FT**2)	DIAMETER (FT)	(FT)	(FT**1)	(FT**2)	(F)	TEMP. (F)	
41	0	.500726E+01	.276550E+01	.578503E+01	.481503E+00	.517643E+01	.653507E+03	.653507E+03	0
42	0	.171000E+02	.467000E+01	.154678E+02	.481516E+00	.102587E+02	.540000E+03	.540000E+03	0
43	0	.135700E+02	.415667E+01	.772832E+01	.284757E+00	.143818E+02	.900000E+02	.900000E+02	-1
44	0	.559250E+00	.843833E+00	.585830E+01	.523764E+01	.389499E+01	.540000E+03	.654120E+03	0
45	0	.559250E+00	.843833E+00	.585830E+01	.523764E+01	.389499E+01	.540000E+03	.653871E+03	0
46	0	.644700E-01	.100000E+05	.832946E+02	.645995E+03	.146647E+01	.210000E+03	.654505E+03	0
47	0	.682704E+00	.200000E+00	.113387E+01	.830428E+00	.830283E+00	.540000E+03	.654120E+03	0
48	0	.200000E+01	.333330E+00	.219893E+01	.549733E+00	.179769E+01	.540000E+03	.654410E+03	0
49	0	.374320E+01	.218314E+01	.170759E+01	.228086E+00	.375205E+01	.540000E+03	.654342E+03	0
50	0	.682704E+00	.932333E+00	.236458E+01	.173178E+01	.173147E+01	.540000E+03	.654297E+03	0
51	0	.653740E+00	.583333E+00	.379845E+01	.290517E+01	.722911E+00	.540000E+03	.654168E+03	0
52	0	.509054E+00	.333330E+00	.111754E+02	.109766E+02	.489916E+00	.540000E+03	.654300E+03	0
53	0	.100000E+01	.333330E+00	.219893E+01	.109947E+01	.898844E+00	.540000E+03	.654410E+03	0

** ADIABATIC AIR EXPANSION MODEL WILL BE USED FOR VOLUME 43 **

INPUT FOR 3 SETS OF BUBBLE CONSTANTS

SET NO.	SLOPE PARAMETER	BUBBLE VELOCITY	(BUILT-IN DATA)
0	0.	0.	
1	.800000E+00	.300000E+01	
2	.800000E+00	.100000E+07	
3	.800000E+00	.200000E+01	

TIME DEPENDENT TABLES FOR 1 VOLUMES.

SET NUM	NUM PTS	TIME (SECONDS)	PRESSURE (PSIA)	TEMPERATURE (DEG F)	MIXTURE QUALITY	MIXTURE LEVEL (FEET)	
1		0.	.226000E+02	.234528E+03	0.	.160937E+02	(VOL 37)
11		.100000E+02	.389000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.150000E+02	.445000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.200000E+02	.453000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.250000E+02	.448000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.400000E+02	.432000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.750000E+02	.406000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.100000E+03	.390000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.125000E+03	.381000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.150000E+03	.376000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.
		.200000E+03	.371000E+02	.100000E+03	.100000E-05	.160937E+02	P IS NOT USED, PSAT USED.

DESCRIPTIONS OF 59 JUNCTIONS.

JUN NUM	FROM VOL	TO VOL	PUMP LEAK FILL	CHKV VALV	INITIAL FLG4 (LBM/SEC)	JUNCTION FLG AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION INERTIA (FT*-1)	SP. ENERGY LOSS COEF. (FORWARD)	SP. ENERGY LOSS COEF. (REVERSE)
	VERT JUN INDX	CHKV -ING INDX	IC CALC INDX	MOM FO. INDX	JUNCTION DIAMETER (FT)	CONTRACTION COEFFICIENT	SUBCOOL CHOKE	ENTHALPY INDEX	COSINE	IADJUN
1	2	1	0	0	.597222E+03	.480000E+00	-.973000E+00	0.	.648100E+00	.648100E+00
11	0	5	0	0	.901000E+00	0.	0.	0.	.100000E+01	0.
2	1	5	0	0	.597222E+03	.682700E+00	0.	.517300E+01	.913400E+00	.913400E+00
3	1	2	0	0	.932300E+00	0.	0.	0.	0.	0.
3	1	5	0	0	0.	.682700E+00	0.	.474100E+01	.309500E+00	.473200E+00
4	3	5	0	0	.932300E+00	0.	0.	0.	0.	0.
4	1	5	0	0	.597222E+03	.660887E+00	0.	.874485E+01	.514000E-01	.514000E-01
5	4	5	0	0	.932333E+00	0.	0.	0.	0.	0.
5	1	5	0	0	.597222E+03	.358820E+00	0.	.830351E+01	.227800E-01	.912000E-01
5	1	5	0	0	.675917E+00	0.	0.	0.	0.	0.
6	5	6	0	0	.597222E+03	.682704E+00	0.	.521630E+01	.672200E+00	.672200E+00
6	1	5	0	0	.932333E+00	0.	0.	0.	.100000E+01	0.
7	6	7	0	0	.597222E+03	.556000E+00	.151011E+01	.188298E+01	.153061E+01	.177640E+01
7	1	5	0	0	.901670E+00	0.	0.	0.	0.	0.
8	7	8	0	0	.597222E+03	.162621E+01	.281219E+01	.216404E+01	.358400E+00	.631200E+00
8	1	5	0	0	.143894E+01	0.	0.	0.	0.	0.
9	8	9	0	0	.597222E+03	.162621E+01	.956219E+01	.310539E+01	.130000E-02	.130000E-02
9	1	5	0	0	.143894E+01	0.	0.	0.	.100000E+01	0.
10	9	10	0	0	.597222E+03	.162621E+01	.956219E+01	.310539E+01	.572000E-01	.572000E-01
10	1	5	0	0	.143894E+01	0.	0.	0.	.100000E+01	0.

11	10	11	0	0	.597222E+03	.162621E+01	.211219E+01	.216404E+01	.632500E+00	.357000E+00
11	0	5	0	0	.143894E+01	0.	0	1	0	0
12	11	12	0	0	.597222E+03	.556000E+00	.151011E+01	.137120E+01	.137940E+01	.160170E+01
12	1	5	0	0	.901670E+00	0.	0	0	0	0
13	12	13	0	0	.597222E+03	.682704E+00	-.467437E+00	.604346E+01	.196580E+00	.206500E+00
13	0	5	0	0	.932333E+00	0.	0	0	.100000E+01	0
14	13	14	0	0	.597222E+03	.682704E+00	-.382994E+01	.958135E+01	.109940E+01	.125000E+01
14	1	5	0	0	.932333E+00	0.	0	0	0	0
15	14	15	-1	0	.300657E+03	.394063E+00	-.212160E+01	.170096E+02	.215660E+00	.215660E+00
15	0	5	0	0	.708333E+00	0.	0	0	0	0

JUN NUM	FROM VOL	TO VOL	PUMP LEAK FILL	CHKV VALV	INITIAL FLOW (L3M/SEC)	JUNCTION FLOW AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION INERTIA (FT*-1)	SP. ENERGY LOSS COEF. (FORWARD)	SP. ENERGY LOSS COEF. (REVERSE)
	VERT JUN INDX	CHOK -ING INDX	IC CALC INDX	MDM FO. INDX	JUNCTION DIAMETER (FT)	CONTRACTION COEFFICIENT	SUBCOOL CHOKE INDEX	ENTHALPY INDEX	COSINE	IADJUN
16	14	16	-2	0	.296565E+03	.394063E+00	-.212160E+01	.170096E+02	.231500E+00	.231500E+00
16	0	5	0	0	.708333E+00	0.	0	0	0	0
17	15	17	1	0	.300657E+03	.394063E+00	0.	.182935E+02	.152237E+00	.152237E+00
17	0	5	0	0	.708333E+00	0.	0	0	0	0
18	16	18	2	0	.296565E+03	.394063E+00	0.	.144217E+02	.218380E+00	.218380E+00
18	0	5	0	0	.708333E+00	0.	0	0	0	0
19	17	19	0	0	.300657E+03	.394063E+00	0.	.128504E+02	.661280E+00	.690000E+00
19	1	5	0	0	.708333E+00	0.	0	0	0	0
20	18	20	0	0	.296565E+03	.394063E+00	0.	.897863E+01	.293098E+01	.120000E+01
20	1	5	0	0	.708333E+00	0.	0	0	0	0
21	19	20	0	0	.597222E+03	.660887E+00	0.	.510484E+01	.203750E+00	.203750E+00
21	1	5	0	0	.932333E+00	0.	0	0	0	0
22	50	51	0	0	.597222E+03	.682704E+00	0.	.394776E+01	.123785E+01	.804000E+00
22	1	5	0	3	.932333E+00	0.	0	0	0	0
23	21	22	0	0	.287222E+03	.869960E+00	-.235167E+01	0.	.200828E+00	.300000E+00
23	0	5	2	3	.911450E+00	0.	0	0	.100000E+01	0
24	22	48	0	0	.372222E+03	.869960E+00	-.139636E+02	0.	.754335E+00	.550000E+00
24	0	5	2	3	.128840E+01	0.	0	0	.100000E+01	0
25	49	24	0	0	.597222E+03	.105600E+01	-.122600E+02	0.	.260460E+00	.260460E+00
25	0	5	2	0	.203800E+01	0.	0	0	.100000E+01	0
26	24	2	0	0	.597222E+03	.785400E+00	-.283800E+01	0.	.559180E+00	.559180E+00
26	0	5	2	0	.100000E+01	0.	0	0	.100000E+01	0
27	21	25	0	0	0.	.682704E+00	0.	.391683E+01	.804000E+00	.189500E+01
27	1	5	0	3	.932333E+00	0.	0	0	0	0
28	25	26	0	0	0.	.682704E+00	0.	.547080E+01	.100500E+00	.100500E+00
28	1	5	0	3	.932333E+00	0.	0	0	0	0
29	26	47	0	0	0.	.581423E+00	0.	.111100E+02	.654500E+01	.140500E+02
29	1	5	0	0	.338600E+00	0.	0	0	0	0
30	27	44	0	0	0.	.253160E+00	0.	.116155E+02	.299560E+00	.246290E+00
30	1	5	0	0	.567750E+00	.100000E+01	0	0	0.	0

JUN NUM	FROM VOL	TO VOL	PUMP LEAK FILL	CHKV VALV	INITIAL FLOW (LBM/SEC)	JUNCTION FLOW AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION INERTIA (FT*-1)	SP. ENERGY LOSS COEF. (FORWARD)	SP. ENERGY LOSS COEF. (REVERSE)
VERT JUN INDX	CHKV -ING INDX	IC CALC INDX	MM ED. INDX	JUNCTION DIAMETER (FT)	CONTRACTION COEFFICIENT	SUBCOOL CHOKE	ENTHALPY INDEX	COSINE	IADJUN	
31	44	37	0	1	C.	.559250E+00	0.	.252555E+02	.103700E+01	.537000E+00
31	1	5	0	0	.843833E+00	.100000E+01	0.	0.	0.	0.
32	28	29	0	0	0.	.682704E+00	0.	.527420E+01	.100500E+00	.100500E+00
32	1	5	0	0	.932333E+00	0.	0.	0.	0.	0.
33	29	30	0	0	0.	.900370E-01	0.	.253298E+02	.396050E+00	.753630E+00
33	1	5	0	0	0.	.100000E+01	0.	0.	0.	0.
34	30	31	0	0	0.	.900370E-01	.227083E+01	.199010E+02	.935960E+00	.935960E+00
34	0	5	0	0	.359417E+00	0.	0.	.100000E+01	0.	0.
35	31	32	0	0	0.	.206034E+00	.685333E+01	.575875E+01	.581834E+01	.581834E+01
35	0	5	0	0	.527819E+00	0.	0.	.100000E+01	0.	0.
36	32	33	0	0	0.	.206034E+00	.685333E+01	.575875E+01	.581834E+01	.581834E+01
36	0	5	0	0	.527819E+00	0.	0.	.100000E+01	0.	0.
37	33	34	0	0	0.	.900370E-01	.227083E+01	.272573E+02	.230250E+00	.230250E+00
37	0	5	0	0	.359417E+00	0.	0.	.100000E+01	0.	0.
38	34	35	0	0	0.	.900370E-01	.227083E+01	.272551E+02	.423400E+01	.423400E+01
38	0	5	0	0	.359417E+00	0.	0.	.100000E+01	0.	0.
39	35	36	0	0	0.	.900370E-01	.397917E+01	.375249E+02	.846800E+01	.846800E+01
39	1	5	0	0	.359417E+00	0.	0.	0.	0.	0.
40	36	45	0	0	0.	.900370E-01	0.	.407140E+02	.948830E+00	.438340E+00
40	1	5	0	0	.338580E+00	.700000E+00	0.	0.	0.	0.
41	45	37	0	1	0.	.559250E+00	0.	.252555E+02	.103700E+01	.537000E+00
41	1	5	0	0	.843833E+00	.100000E+01	0.	0.	0.	0.
42	29	30	0	0	0.	.417500E+00	0.	.193380E+02	.124700E+01	.457600E+00
42	0	5	0	0	.708300E+00	0.	0.	0.	0.	0.
43	26	38	0	0	0.	.417584E+00	.466167E+00	.252230E+02	.124700E+01	.457600E+00
43	0	5	0	0	.708333E+00	0.	0.	.100000E+01	0.	0.
44	43	46	0	2	0.	.644700E-01	.337797E+01	0.	.220000E+02	.220000E+02
44	0	5	0	0	.286500E+00	0.	0.	0.	0.	0.
45	40	4	0	3	0.	.155592E-01	.466167E+00	.753299E+02	.100000E+01	.862000E+01
45	0	5	0	3	.140750E+00	.750000E+00	0.	0.	0.	0.

JUN NUM	FROM VOL	TO VOL	PUMP LEAK FILL	CHKV VALV	INITIAL FLOW (LBM/SEC)	JUNCTION FLOW AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION INERTIA (FT**4)	SP. ENERGY LOSS COEF. (FORWARD)	SP. ENERGY LOSS COEF. (REVERSE)
VERT JUN INDX	CHKV -ING INDX	IC CALC INDX	MOM EQ. INDX	JUNCTION DIAMETER (FT)	CONTRACTION COEFFICIENT	SUBCOOL CHOKE	ENTHALPY INDEX	COSINE	IADJUN	
46	41	40	0	0	0.	.155592E-01	.422500E+01	.748899E+02	.162400E+02	.862000E+01
46	0	5	0	0	.140750E+00	0.	0.	0.	0.	0.
47	46	20	0	0	0.	.644700E-01	0.	0.	.122500E+02	.122500E+02
47	0	5	0	0	.291670E+00	0.	0.	0.	0.	0.
48	47	27	0	0	0.	.900370E-01	0.	.151800E+02	.415000E+00	.290000E+00
48	1	5	0	0	.338600E+00	.848600E+00	0.	0.	0.	0.
49	48	23	0	0	.372222E+03	.000000E+01	-.158400E+02	.200000E+01	.198140E-01	.198140E-01
49	0	5	0	0	0.	0.	0.	0.	0.	0.
50	23	49	0	3	.597222E+03	.105597E+01	-.139536E+02	0.	.522590E+00	.600000E+00
50	0	5	2	3	.126557E+01	0.	0.	0.	.100000E+01	0.
51	51	52	0	0	.310000E+03	.434980E+00	-.235167E+01	0.	.200900E+00	.300000E+00
51	0	5	2	3	.911400E-01	0.	0.	0.	.100000E+01	0.
52	52	53	0	0	.225000E+03	.434980E+00	-.139636E+02	0.	.754336E+00	.550000E+00
52	0	5	2	3	.128890E+01	0.	0.	0.	.100000E+01	0.
53	53	23	0	0	.225000E+03	.400000E+01	-.158400E+02	.500000E+01	.200000E-01	.200000E-01
53	0	5	0	0	0.	0.	0.	0.	0.	0.
54	51	21	0	0	.287222E+03	.700000E+00	-.634167E+00	.400000E+01	.126100E+01	.126100E+01
54	0	5	3	0	0.	0.	0.	0.	0.	0.
55	52	22	0	0	.850000E+02	.300000E+01	-.815762E+01	.110000E+01	.234000E+02	.234000E+02
55	0	5	0	3	0.	0.	0.	0.	0.	0.
56	53	48	0	0	0.	.200000E+01	-.161210E+02	.100000E+01	.100000E+00	.100000E+00
56	0	5	0	0	0.	0.	0.	0.	0.	0.
57	20	50	0	0	.597222E+03	.660870E+00	0.	.510484E+01	.203750E+00	.203750E+00
57	1	5	0	0	.932333E+00	0.	0.	0.	0.	0.
58	0	46	1	3	0.	.100000E+01	0.	0.	.100000E+01	.100000E+01
58	0	5	2	3	.286500E+00	0.	0.	0.	0.	0.
59	0	46	2	0	0.	.100000E+01	0.	0.	.100000E+01	.100000E+01
59	0	5	2	3	.286500E+00	0.	0.	0.	0.	0.

DIAL VALUES FOR FAUSKE-HEM CRITICAL FLOW MODEL

DLHEM = .1000E+01
DLHRY = .1000E+01
DLEHRY = .1000E+01
DLXTFE = .2500E-02

INPUT DATA FOR 2 PUMPS.

NUMBER OF PUMP CURVES TO BE READ FOR EACH CURVE SET.

16 0 0 16

PMP NUM	CRV SET	TRP ID	REV	DEG	RATED SPEED (REV/MIN)	SPEED RATIO	RATED FLOW (GAL/MIN)	RATED HEAD (FT)	RATED TORQUE (FT-LBF)	MOM OF INERTIA (LBM-FT**2)
1	1	3	0	1	.53000E+04	.488993E+00	.500000E+04	.408950E+03	.465000E+03	.340000E+02
	0				.87500E+02	.152994E+03	0.	.30000E-02	.14550E+02	0.
					STOP PUMP AT 0.	SEC. OK IF SPEED IS GT	0.0 RPM OR LT.	0.0 RPM.	(NO STOP ON OPTION IF 0.0)	
2	1	3	0	1	.53000E+04	.500000E+00	.500000E+04	.408950E+03	.465000E+03	.340000E+02
	0				.87500E+02	.152994E+03	0.	.30000E-02	.14550E+02	0.
					STOP PUMP AT 0.	SEC. OK IF SPEED IS GT	0.0 RPM OR LT.	0.0 RPM.	(NO STOP ON OPTION IF 0.0)	

PUMP HEAD MULTIPLIER CURVE

SET	HEAD	TYPE	NUM	X	Y	SET	HEAD	TYPE	NUM	X	Y
-11	0.					0.					
	.240000E+00			.800000E+00	.100000E+00	0.	.960000E+00			.150000E+00	.500000E-01
	.500000E+00			.970000E+00	.800000E+00	0.	.900000E+00			.400000E+00	.980000E+00
	.960000E+00			.500000E+00	.100000E+01	0.				.500000E+00	.800000E+00

PUMP TORQUE MULTIPLIER CURVE

SET	TORQUE	TYPE	NUM	X	Y	SET	TORQUE	TYPE	NUM	X	Y
-7	0.					0.					
	.240000E+00			.560000E+00	.100000E+00	0.	.560000E+00			.150000E+00	.500000E-01
	.100000E+01				.800000E+00	0.				.960000E+00	.450000E+00

PUMP CURVE SET NUMBER 1 HAS 16 CURVES TO BE READ.

SET	HEAD	TYPE	NUM	X	Y	SET	HEAD	TYPE	NUM	X	Y
1	1	1	6			1	1	1	6		
	FLOW/SPEED			HEAD/SPEED**2			FLOW/SPEED			HEAD/SPEED**2	
	0.			.44360E+01	.190610E+00		0.			.136360E+01	.389630E+00
	.593900E+00			.22328E+01	.790200E+00		.113360E+01			.100000E+01	.100780E+01
1	1	2	8			1	1	2	8		
	SPEED/FLOW			HEAD/FLOW**2			SPEED/FLOW			HEAD/FLOW**2	
	0.			.670000E+00	.260000E+00		0.			.500000E+00	.400000E+00
	.575540E+00			.632600E+00	.100000E+01		.744320E+00			.258300E+00	.377800E+00
	.863130E+00						.100780E+01				

1	1	3	6	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				-.100000E+01	.247220E+01	-.805740E+00	.204740E+01	-.606900E+00	.183100E+01
				-.406830E+00	.162400E+01	-.20011E+00	.147050E+01	0.	.140360E+01
1	1	4	8	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				-.100000E+01	.247220E+01	-.822970E+00	.199800E+01	-.633320E+00	.158970E+01
				-.455340E+00	.132790E+01	-.271090E+00	.119490E+01	-.177160E+00	.106650E+01
				-.907300E-01	.101560E+01	0.	.934279E+00		
1	1	5	7	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				0.	.250000E+00	.200000E+00	.280000E+00	.400000E+00	.340000E+00
				.411800E+00	.276800E+00	.597630E+00	.458400E+00	.793467E+00	.699200E+00
				.100000E+01	.946500E+00				
1	1	6	10	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				0.	.934279E+00	.910990E-01	.922900E+00	.186509E+00	.895300E+00
				.271752E+00	.875000E+00	.455872E+00	.843300E+00	.574406E+00	.835500E+00
				.740576E+00	.846600E+00	.766619E+00	.846900E+00	.871471E+00	.863800E+00
				.100000E+01	.946500E+00				
1	1	7	6	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				-.100000E+01	-.100000E+01	-.800000E+00	-.600000E+00	-.600000E+00	-.300000E+00
				-.400000E+00	-.500000E-01	-.200000E+00	.150000E+00	0.	.250000E+00
1	1	8	6	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				-.100000E+01	-.100000E+01	-.800000E+00	-.570000E+00	-.600000E+00	-.950000E+00
				-.400000E+00	-.880000E+00	-.200000E+00	-.800000E+00	0.	-.670000E+00
1	2	1	6	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
				0.	.603200E+00	.193000E+00	.632500E+00	.393000E+00	.736900E+00
				.595520E+00	.833100E+00	.797820E+00	.922900E+00	.100000E+01	.967200E+00
1	2	2	7	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
				0.	-.670000E+00	.400000E+00	-.250000E+00	.500000E+00	.150000E+00
				.737250E+00	.526586E+00	.768049E+00	.606594E+00	.867230E+00	.743660E+00
				.100000E+01	.967200E+00				
1	2	3	6	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
				-.100000E+01	.198430E+01	-.800960E+00	.139400E+01	-.606380E+00	.109750E+01
				-.406860E+00	.822000E+00	-.199280E+00	.664800E+00	0.	.603200E+00
1	2	4	8	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
				-.100000E+01	.198430E+01	-.822340E+00	.183080E+01	-.633710E+00	.168240E+01
				-.458530E+00	.157700E+01	-.267023E+00	.143620E+01	-.176107E+00	.138790E+01
				-.893100E-01	.134810E+01	0.	.123361E+01		
1	2	5	4	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
				0.	.450000E+00	.400000E+00	-.250000E+00	.500000E+00	0.
				.100000E+01	.356900E+00				
1	2	6	10	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
				0.	.123361E+01	.906430E-01	.119650E+01	.188569E+00	.110960E+01
				.273470E+00	.104160E+01	.458669E+00	.895000E+00	.574480E+00	.780700E+00
				.738160E+00	.613400E+00	.768520E+00	.584900E+00	.870057E+00	.487700E+00
				.100000E+01	.356900E+00				
1	2	7	4	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
				-.100000E+01	-.100000E+01	-.300000E+00	-.900000E+00	-.100000E+00	-.500000E+00
				0.	-.450000E+00				

PUMP CURVE SET NUMBER 1 TORQUE CURVES FOLLOW.

SET NUM	HEAD OR TORQ	TYPE	NUM DAT PTS	X	Y	X	Y	X	Y
1	2	1	6	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2
0.	.60320E+00	.19300E+00	.63250E+00	.39300E+00	.73590E+00	.59552E+00	.83310E+00	.79782E+00	.92290E+00
1	2	2	7	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
0.	.67000E+00	.40000E+00	.25000E+00	.50000E+00	.15000E+00	.73725E+00	.52658E+00	.76804E+00	.60659E+00
1	2	3	6	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2
0.	.10000E+01	.19843E+01	.80960E+00	.13940E+01	.10975E+01	-.40686E+00	.82200E+00	-.19928E+00	.66480E+00
1	2	4	8	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
0.	.10000E+01	.19843E+01	.80960E+00	.13940E+01	.10975E+01	-.40686E+00	.82200E+00	-.19928E+00	.66480E+00
1	2	5	4	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2
0.	.10000E+01	.19843E+01	.80960E+00	.13940E+01	.10975E+01	-.40686E+00	.82200E+00	-.19928E+00	.66480E+00
1	2	6	10	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
0.	.10000E+01	.19843E+01	.80960E+00	.13940E+01	.10975E+01	-.40686E+00	.82200E+00	-.19928E+00	.66480E+00
1	2	7	4	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2	FLW/SPEED	TORQ/SPEED**2
0.	.10000E+01	.19843E+01	.80960E+00	.13940E+01	.10975E+01	-.40686E+00	.82200E+00	-.19928E+00	.66480E+00
1	2	8	4	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
0.	.10000E+01	.19843E+01	.80960E+00	.13940E+01	.10975E+01	-.40686E+00	.82200E+00	-.19928E+00	.66480E+00

PUMP CURVE SET NUMBER 4 HAS 16 CURVES TO BE READ.

SET NUM	HEAD OR TORQ	TYPE	NUM DAT PTS	X	Y	X	Y	X	Y
4	1	1	7	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				0.	0.	.100000E+00	.830000E+00	.200000E+00	.160000E+01
				.500000E+00	.102000E+01	.700000E+00	.101000E+01	.900000E+00	.940000E+00
				.100000E+01	.103000E+01				
4	1	2	8	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				0.	0.	.100000E+00	-.400000E-01	.200000E+00	0.
				.300000E+00	.105000E+00	.400000E+00	.210000E+00	.800000E+00	.670000E+00
				.900000E+00	.800000E+00	.100000E+01	.100000E+01		
4	1	3	10	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				0.	0.	-.900000E+00	-.124000E+01	-.800000E+00	-.177000E+01
				-.700000E+00	-.235000E+01	-.600000E+00	-.279000E+01	-.500000E+00	-.291000E+01
				-.400000E+00	-.267000E+01	-.250000E+00	-.169000E+01	-.100000E+00	-.500000E+00
				0.	0.				
4	1	4	10	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				0.	0.	-.900000E+00	-.780000E+00	-.800000E+00	-.500000E+00
				-.700000E+00	-.310000E+00	-.600000E+00	-.170000E+00	-.500000E+00	-.800000E-01
				-.350000E+00	0.	-.200000E+00	.500000E-01	-.100000E+00	.800000E-01
				0.	.100000E+00				
4	1	5	6	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				0.	0.	.200000E+00	-.340000E+00	.400000E+00	-.650000E+00
				.600000E+00	-.950000E+00	.800000E+00	-.119000E+01	.100000E+01	-.147000E+01
4	1	6	10	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				0.	0.	.100000E+00	.130000E+00	.250000E+00	.150000E+00
				.400000E+00	.130000E+00	.500000E+00	.700000E-01	.600000E+00	-.400000E-01
				.700000E+00	-.230000E+00	.800000E+00	-.510000E+00	.900000E+00	-.910000E+00
				.100000E+01	-.147000E+01				
4	1	7	2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
				0.	0.	0.	0.	0.	0.
4	1	8	2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2	SPEED/FLOW	HEAD/FLOW**2
				0.	0.	0.	0.	0.	0.
4	2	1	5	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
				0.	.622200E+00	.193000E+00	.632500E+00	.393000E+00	.736900E+00
				.595520E+00	.833100E+00	.797820E+00	.922900E+00	.100000E+01	.967200E+00
4	2	2	7	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
				0.	-.670000E+00	.400000E+00	-.250000E+00	.500000E+00	.150000E+00
				.757255E+00	.526366E+00	.768049E+00	.606594E+00	.867230E+00	.743660E+00
				.100000E+01	.967200E+00				
4	2	3	6	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
				0.	.198430E+01	-.800960E+00	.139400E+01	-.606380E+00	.109750E+01
				-.466860E+00	.822200E+00	-.199280E+00	.664800E+00	0.	.603200E+00
4	2	4	8	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2	SPEED/FLOW	TORQ/FLOW**2
				0.	.198430E+01	-.822340E+00	.183080E+01	-.633710E+00	.168240E+01
				-.458530E+00	.155700E+01	-.267023E+00	.143620E+01	-.176107E+00	.138790E+01
				-.393100E-01	.134610E+01	0.	.123361E+01		

4	2	5	4	0.	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2	FLOW/SPEED	TORQ/SPEED**2
4	2	6	10	0.	.100000E+01	-.450000E+00	.400000E+00	-.250000E+00	.500000E+00	0.
4	2	7	4	0.	.273470E+00	.123361E+01	.986432E-01	.119650E+01	.188569E+00	.110960E+01
4	2	8	4	0.	.738160E+00	.104160E+01	.458669E+00	.895800E+00	.574480E+00	.780700E+00
4	2	9	4	0.	.100000E+01	.613400E+00	.768520E+00	.584900E+00	.870057E+00	.487700E+00
4	2	10	4	0.	.100000E+01	.356900E+00				
4	2	11	4	0.	.100000E+01	.100000E+01	.300000E+00	.900000E+00	.100000E+00	.500000E+00
4	2	12	4	0.	.100000E+01	.100000E+01	.250000E+00	.900000E+00	.100000E+00	.500000E+00
4	2	13	4	0.	.100000E+01	.100000E+01	.250000E+00	.900000E+00	.100000E+00	.500000E+00
4	2	14	4	0.	.100000E+01	.100000E+01	.250000E+00	.900000E+00	.100000E+00	.500000E+00
4	2	15	4	0.	.100000E+01	.100000E+01	.250000E+00	.900000E+00	.100000E+00	.500000E+00

PUMP CURVE SET NUMBER 4 HEAD CURVES FOLLOW.

SET NUM	HEAD OR TORQ	TYPE	NUM DAT PTS	X	Y	X	Y	X	Y	
4	1	1	7	0.	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2	FLOW/SPEED	HEAD/SPEED**2
4	1	2	8	0.	.500000E+00	.102000E+01	.700000E+00	.101000E+01	.900000E+00	.940000E+00
4	1	3	10	0.	.100000E+01	.100000E+01	.100000E+00	.400000E-01	.200000E+00	.670000E+00
4	1	4	10	0.	.300000E+00	.100000E+00	.400000E+00	.210000E+00	.800000E+00	.670000E+00
4	1	5	6	0.	.900000E+00	.600000E+00	.100000E+01	.100000E+01	.100000E+00	.100000E+00
4	1	6	10	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	7	2	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	8	2	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	9	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	10	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	11	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	12	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	13	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	14	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	15	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	16	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	17	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	18	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	19	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	20	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	21	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	22	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	23	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	24	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	25	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	26	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	27	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01
4	1	28	4	0.	.700000E+00	.236000E+01	.600000E+00	.279000E+01	.500000E+00	.291000E+01
4	1	29	4	0.	.400000E+00	.267000E+01	.250000E+00	.169000E+01	.100000E+00	.500000E+00
4	1	30	4	0.	.100000E+01	.116000E+01	.900000E+00	.124000E+01	.800000E+00	.177000E+01

PUMP CURVE SET NUMBER 4 TORQUE CURVES FOLLOW.

SET NUM	HEAD OR TORQ	TYPE	NUM DAT PTS	X	Y	X	Y	X	Y
4	2	1	5	0.	FLOW/SPEED .595520E+00	TORQ/SPEED**2 .603200E+00 .533100E+00	0.	FLOW/SPEED .193000E+00 .797820E+00	TORQ/SPEED**2 .632500E+00 .922900E+00
4	2	2	7	0.	SPEED/FLOW .737255E+00 .100000E+01	TORQ/FLOW**2 .270000E+00 .225566E+00 .467200E+00	0.	SPEED/FLOW .400000E+00 .768049E+00	TORQ/FLOW**2 -.250000E+00 .606594E+00
4	2	3	6	0.	FLOW/SPEED -.100000E+01 -.406850E+00	TORQ/SPEED**2 .198430E+01 .222000E+00	0.	FLOW/SPEED -.800960E+00 -.199280E+00	TORQ/SPEED**2 .139400E+01 .664800E+00
4	2	4	8	0.	SPEED/FLOW -.100000E+01 -.458530E+00 -.893100E+01	TORQ/FLOW**2 .198430E+01 .155700E+01 .334810E+01	0.	SPEED/FLOW -.822340E+00 -.267023E+00 0.	TORQ/FLOW**2 .183030E+01 .143620E+01 .123361E+01
4	2	5	4	0.	FLOW/SPEED .100000E+01	TORQ/SPEED**2 -.550000E+00 .556900E+00	0.	FLOW/SPEED .400000E+00	TORQ/SPEED**2 -.250000E+00
4	2	6	10	0.	SPEED/FLOW .273470E+00 .738160E+00 .100000E+01	TORQ/FLOW**2 .233010E+01 .04160E+01 .513400E+00 .356900E+00	0.	SPEED/FLOW .906430E-01 .458669E+00 .768520E+00	TORQ/FLOW**2 .119650E+01 .895600E+00 .584900E+00
4	2	7	4	0.	FLOW/SPEED -.100000E+01 0.	TORQ/SPEED**2 -.60000E+01 -.50000E+00	0.	FLOW/SPEED -.300000E+00 -.900000E+00	TORQ/SPEED**2 -.900000E+00 -.100000E+00
4	2	8	4	0.	SPEED/FLOW -.100000E+01 0.	TORQ/FLOW**2 -.100000E+01 -.50000E+00	0.	SPEED/FLOW -.250000E+00 -.800000E-01	TORQ/FLOW**2 -.900000E+00 -.800000E+00

PARAMETERS FOR 2 CHECKVALVES.

VALV NUM.	TRIP ID	AREA TARL	LATCH FL16	BACK FOR CLOSING	PRESSURE FRIC. COEFF.	FORWARD FRIC. COEFF.	OPEN REVERSE FRIC. COEFF.	CLOSED REVERSE FRIC. COEFF.
1	-2	1	0	0.	0.	0.	0.	0.
2	25	0	0	0.	0.	0.	0.	0.

PARAMETERS FOR 1 LEAKS.

LEAK NUM	DATA PTS	TRIP ID	SINK PRESSURE	TIME OR ANGLE	AREA	TIME OR ANGLE	AREA	TIME OR ANGLE	AREA
1	-3	2	.430000E+02	0.	0.	.175000E-01	.100000E+01	.200000E+03	.100000E+01

DATA FOR 2 FILL SYSTEMS

FILL TYPE	TRIP ID	FILL PRESS (PSI)	FILL ENTHALPY (BTU/LB)	AIR FRACTION
2	6	1.000000E+02	5.828412D+01	0.

** FILL TABLE **

N	PRESSURE (PSI)	FLOW RATE (LB/SEC-FT2)	N	PRESSURE (PSI)	FLOW RATE (LB/SEC-FT2)	N	PRESSURE (PSI)	FLOW RATE (LB/SEC-FT2)
1	0.	2.381403D+01	6	1.000000E+02	1.827588D+01	10	1.800000E+02	9.968664D+00
2	2.000000E+01	2.312176D+01	7	1.200000E+02	1.661444D+01	11	2.000000E+02	6.507322D+00
3	4.000000E+01	2.215259D+01	8	1.400000E+02	1.461454D+01	12	2.200000E+02	2.200000E+02
4	6.000000E+01	2.076805D+01	9	1.600000E+02	1.259928D+01	13	2.260000E+02	0.
5	8.000000E+01	1.952197D+01						

FILL TYPE	TRIP ID	FILL PRESS (PSI)	FILL ENTHALPY (BTU/LB)	AIR FRACTION
2	4	1.000000E+02	5.828412D+01	0.

** FILL TABLE **

N	PRESSURE (PSI)	FLOW RATE (LB/SEC-FT2)	N	PRESSURE (PSI)	FLOW RATE (LB/SEC-FT2)	N	PRESSURE (PSI)	FLOW RATE (LB/SEC-FT2)
1	1.000000E+01	2.381403D+00	2	3.000000E+03	2.381403D+00			

*** WARNING *** POSSIBLE INITIAL ENTHALPY IMBALANCE
 THE JUNCTION ENTHALPY CALCULATED LIES OUTSIDE THE RANGE OF THE TWO VOLUMES IT CONNECTS.
 J VOL.A VOL.B H(J) H(VOL.A) H(VOL.B)
 9 8 9 5.34910E+02 5.34905E+02 5.34908E+02

*** WARNING *** POSSIBLE INITIAL ENTHALPY IMBALANCE
 THE JUNCTION ENTHALPY CALCULATED LIES OUTSIDE THE RANGE OF THE TWO VOLUMES IT CONNECTS.
 J VOL.A VOL.B H(J) H(VOL.A) H(VOL.B)
 10 9 10 5.34906E+02 5.34908E+02 5.34907E+02

*** WARNING *** POSSIBLE INITIAL ENTHALPY IMBALANCE
 THE JUNCTION ENTHALPY CALCULATED LIES OUTSIDE THE RANGE OF THE TWO VOLUMES IT CONNECTS.
 J VOL.A VOL.B H(J) H(VOL.A) H(VOL.B)
 11 10 11 5.34908E+02 5.34907E+02 5.34905E+02

JUNCTION DATA ACTUALLY BEING USED.

JUN NUM	FROM VOL	TO VOL	PUMP LEAK FILL	CHK VALV	INITIAL FLOW (LBM/SEC)	JUNCTION FLOW AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION DIAMETER (FT)	LEAK CONTRACTION COEFFICIENT
1	2	3	0	0	.597222E+C3	.480000E+00	-.973000E+00	.901000E+00	.100000E+C1
2	1	3	0	0	.597222E+C3	.682704E+00	0.	.932333E+00	.100000E+C1
3	1	28	0	0	.597222E+C3	.682704E+00	0.	.932333E+00	.100000E+C1
4	3	4	0	0	.597222E+C3	.660887E+00	0.	.932333E+00	.100000E+C1
5	4	5	0	0	.597222E+C3	.358820E+00	0.	.675917E+00	.100000E+C1
6	5	6	0	0	.597222E+C3	.682704E+00	0.	.932333E+00	.100000E+C1
7	6	7	0	0	.597222E+C3	.556000E+00	.151011E+01	.901670E+00	.100000E+C1
8	7	8	0	0	.597222E+C3	.162621E+01	.261219E+01	.143894E+01	.100000E+C1
9	8	9	0	0	.597222E+C3	.162621E+01	.956219E+01	.143894E+01	.100000E+C1
10	9	10	0	0	.597222E+C3	.162621E+01	.956219E+01	.143894E+01	.100000E+C1
11	10	11	0	0	.597222E+C3	.162621E+01	.261219E+01	.143894E+01	.100000E+C1
12	11	12	0	0	.597222E+C3	.556000E+00	.151011E+01	.901670E+00	.100000E+C1
13	12	13	0	0	.597222E+C3	.682704E+00	-.487437E+00	.932333E+00	.100000E+C1
14	13	14	0	0	.597222E+C3	.682704E+00	-.362994E+01	.932333E+00	.100000E+C1
15	14	15	-1	0	.300657E+03	.394063E+00	-.212160E+01	.708333E+00	.100000E+C1
16	14	15	-2	0	.296565E+03	.394063E+00	-.212160E+01	.708333E+00	.100000E+C1
17	15	16	1	0	.300657E+03	.394063E+00	0.	.708333E+00	.100000E+C1
18	16	17	2	0	.296565E+03	.394063E+00	0.	.708333E+00	.100000E+C1
19	17	18	0	0	.300657E+03	.394063E+00	0.	.708333E+00	.100000E+C1
20	18	19	0	0	.296565E+03	.394063E+00	0.	.708333E+00	.100000E+C1
21	19	20	0	0	.597222E+C3	.660887E+00	0.	.932333E+00	.100000E+C1
22	20	21	0	0	.597222E+C3	.682704E+00	0.	.932333E+00	.100000E+C1
23	21	22	0	0	.287222E+03	.864960E+00	-.235167E+01	.911450E+00	.100000E+C1
24	22	23	0	0	.372222E+03	.864960E+00	-.139636E+02	.128890E+01	.100000E+C1
25	23	24	0	0	.597222E+C3	.105600E+01	-.122600E+02	.203800E+01	.100000E+C1
26	24	25	0	0	.597222E+C3	.785400E+00	-.283800E+01	.100000E+01	.100000E+C1
27	25	26	0	0	0.	.682704E+00	0.	.932333E+00	.100000E+C1
28	26	27	0	0	0.	.682704E+00	0.	.932333E+00	.100000E+C1
29	27	28	0	0	0.	.581423E+00	0.	.938000E+00	.100000E+C1
30	28	29	0	0	0.	.253160E+00	0.	.567750E+00	.100000E+C1
31	29	30	0	1	0.	0.	0.	.843833E+00	.100000E+C1
32	30	31	0	0	0.	.682704E+00	0.	.932333E+00	.100000E+C1
33	31	32	0	0	0.	.900370E-01	0.	.338883E+00	.100000E+C1
34	32	33	0	0	0.	.900370E-01	.227083E+01	.359417E+00	.100000E+C1
35	33	34	0	0	0.	.206034E+00	.685333E+01	.527819E+00	.100000E+C1
36	34	35	0	0	0.	.206034E+00	.685333E+01	.527819E+00	.100000E+C1
37	35	36	0	0	0.	.900370E-01	.227083E+01	.359417E+00	.100000E+C1
38	36	37	0	0	0.	.900370E-01	.227083E+01	.359417E+00	.100000E+C1
39	37	38	0	0	0.	.900370E-01	.227083E+01	.359417E+00	.100000E+C1
40	38	39	0	0	0.	.900370E-01	.227083E+01	.359417E+00	.100000E+C1

JUNCTION DATA ACTUALLY BEING USED.

JUN NUM	FRGM VOL	TO PUMP VOL	LEAK FILL	CHK VALV	INITIAL FLOW (LBM/SEC)	JUNCTION FLOW AREA (FT*2)	JUNCTION ELEVATION (FT)	JUNCTION DIAMETER (FT)	LEAK CONTRACTION COEFFICIENT
41	45	37	0	1	0.	0.	0.	843833E+00	.100000E+01
42	29	39	0	0	0.	.417500E+00	0.	.708300E+00	.100000E+01
43	26	38	0	0	0.	.417584E+00	.466167E+00	.708333E+00	.100000E+01
44	43	46	0	2	0.	.644700E-01	.337797E+01	.286500E+00	.100000E+01
45	40	4	0	0	0.	.155592E-01	.466167E+00	.140750E+00	.750000E+00
46	41	40	0	0	0.	.155592E-01	.422500E+01	.140750E+00	.100000E+01
47	46	20	0	0	0.	.644700E-01	0.	.291670E+00	.100000E+01
48	47	27	0	0	0.	.900370E-01	0.	.338600E+00	.848000E+00
49	48	23	0	0	.372222E+03	.600000E+01	-.158400E+02	.319154E+01	.100000E+01
50	23	29	0	0	.597222E+03	.105597E+01	-.139536E+02	.126557E+01	.100000E+01
51	51	52	0	0	.310000E+03	.434980E+00	-.235167E+01	.911450E-01	.100000E+01
52	52	53	0	0	.225000E+03	.434980E+00	-.139636E+02	.128890E+01	.100000E+01
53	53	23	0	0	.225000E+03	.400000E+01	-.158400E+02	.225676E+01	.100000E+01
54	51	21	0	0	.287222E+03	.700000E+00	-.634167E+00	.944070E+00	.100000E+01
55	52	22	0	0	.850000E+02	.300000E+01	-.815762E+01	.195441E+01	.100000E+01
56	53	48	0	0	0.	.200000E+01	-.161210E+02	.159577E+01	.100000E+01
57	20	50	0	0	.597222E+03	.660870E+00	0.	.932333E+00	.100000E+01
58	0	46	1	0	0.	0.	0.	.286500E+00	.100000E+01
59	0	46	2	0	0.	0.	0.	.286500E+00	.100000E+01

JUNCTION DATA ACTUALLY BEING USED.

JUN NUM	VERT JUN INDX	CHOK -ING INDX	IC CALC INDX	MOM EQ. INDX	JUNCTION INERTIA	SP. ENERGY LOSS COEFF. (FORWARD)	SP. ENERGY LOSS COEFF. (REVERSE)	RESIDUAL LOSS COEFF. (NON-DIR)	RESIDUAL DELTA P (PSIA)	ENTHALPY TRANS INLET OUTLET	ANGLE
1	0	5	2	0	.162823E+01	.648100E+00	.648100E+00	.344025E-06	.120937E-05	NO NO	.100000E+01
2	1	5	0	0	.517306E+01	.913400E+00	.913400E+00	.696997E-06	.121129E-05	NO NO	0.
3	1	5	0	0	.474100E+01	.305500E+00	.473200E+00	0.	0.	NO NO	0.
4	1	5	0	0	.874435E+01	.514000E-01	.514000E-01	.535535E-05	.993171E-05	NO NO	0.
5	1	5	0	0	.830351E+01	.227800E-01	.912000E-01	.497581E-05	.313042E-04	NO NO	0.
6	1	5	0	0	.521630E+01	.672200E+00	.672200E+00	.124263E-05	.215958E-05	NO NO	.100000E+01
7	1	5	0	0	.188298E+01	.153061E+01	.177640E+01	.544768E-05	.142744E-04	NO NO	0.
8	0	5	0	0	.216404E+01	.358400E+00	.631200E+00	.928041E-05	.284270E-05	NO YES	0.
9	0	5	0	0	.310539E+01	.130000E-02	.130000E-02	.216697E-04	.663795E-05	YES YES	.100000E+01
10	0	5	0	0	.310539E+01	.572000E-01	.572000E-01	.115635E-03	.354226E-04	YES YES	.100000E+01
11	0	5	0	0	.216404E+01	.632500E+00	.357000E+00	.938123E-04	.287375E-04	YES NO	0.
12	1	5	0	0	.137120E+01	.137940E+01	.160170E+01	.239915E-04	.628695E-04	NO NO	0.
13	0	5	0	0	.604346E+01	.196580E+00	.206700E+00	.220961E-04	.384068E-04	NO NO	.100000E+01
14	1	5	0	0	.958135E+01	.109940E+01	.125000E+01	.436110E-05	.758036E-05	NO NO	0.
15	0	5	0	0	.175096E+02	.215660E+00	.215660E+00	.630623E-05	.833837E-05	NO NO	0.
16	0	5	0	0	.170000E+02	.231500E+00	.231500E+00	.185226E-05	.238292E-05	NO NO	0.
17	0	5	0	0	.182935E+02	.152237E+00	.152237E+00	.102270E-05	.135199E-05	NO NO	0.
18	0	5	0	0	.144217E+02	.218580E+00	.218580E+00	.149642E-05	.192473E-05	NO NO	0.
19	1	5	0	0	.128504E+02	.661280E+00	.690000E+00	.329308E-05	.435264E-05	NO NO	0.
20	1	5	0	0	.897663E+01	.293098E+01	.120000E+01	.605173E-04	.776234E-04	NO NO	0.
21	1	5	0	0	.510484E+01	.203750E+00	.203750E+00	.886749E-05	.164427E-04	NO NO	0.
22	1	5	0	3	.394776E+01	.123785E+01	.804000E+00	.414636E-04	.720497E-04	NO NO	0.
23	0	5	2	3	.694089E+01	.200828E+00	.300000E+00	.239855E-06	.593690E-07	NO NO	.100000E+01
24	0	5	2	3	.603804E+01	.754335E+00	.550000E+00	.187307E-06	.778603E-07	NO NO	.100000E+01
25	0	5	2	0	.164686E+01	.260460E+00	.260460E+00	.285399E-05	.207277E-05	NO NO	.100000E+01
26	0	5	2	0	.175689E+01	.559180E+00	.559180E+00	.919206E-07	.120689E-06	NO NO	.100000E+01
27	1	5	0	3	.391683E+01	.804000E+00	.189500E+01	0.	0.	NO NO	0.
28	1	5	0	0	.547080E+01	.130500E+00	.100500E+00	0.	0.	NO NO	0.
29	1	5	0	0	.111100E+02	.654500E-01	.140500E+02	0.	0.	NO NO	0.
30	1	5	0	0	.116159E+02	.299560E+00	.246290E+00	0.	0.	NO NO	0.
31	1	5	0	0	.252555E+02	0.	0.	0.	0.	NO NO	0.
32	1	5	0	0	.507420E+01	.100500E+00	.100500E+00	0.	0.	NO NO	0.
33	1	5	0	0	.203298E+02	.398500E+00	.753630E+00	0.	0.	NO NO	0.
34	0	5	0	0	.199010E+02	.935960E+00	.935960E+00	0.	0.	NO NO	.100000E+01
35	0	5	0	0	.575875E+01	.581834E+01	.581834E+01	0.	0.	NO NO	.100000E+01
36	0	5	0	0	.575875E+01	.581834E+01	.581834E+01	0.	0.	NO NO	.100000E+01
37	0	5	0	0	.272573E+02	.230250E+00	.230250E+00	0.	0.	NO NO	.100000E+01
38	0	5	0	0	.270551E+02	.423400E+01	.423400E+01	0.	0.	NO NO	.100000E+01
39	1	5	0	0	.375249E+02	.846800E+01	.846800E+01	0.	0.	NO NO	0.
40	1	5	0	0	.409140E+02	.948830E+00	.438340E+00	0.	0.	NO NO	0.
41	1	5	0	0	.252555E+02	0.	0.	0.	0.	NO NO	0.

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JUNCTION DATA ACTUALLY BEING USED.

JUN NUM	VERT JUN	CHOK -ING	IC CALC	MDM FO.	JUNCTION INERTIA	SP. ENERGY LOSS COEF. (FORWARD)	SP. ENERGY LOSS COEF. (REVERSE)	RESIDUAL LOSS COEF. (NON-DIR)	RESIDUAL DELTA P (PSIA)	ENTHALPY TRANS INLET OUTLET	ANGLE
42	0	5	C	3	.193380E+02	.124700E+01	.457600E+00	0.	0.	NO NO	0.
43	0	5	C	3	.242230E+02	.124700E+01	.457600E+00	0.	0.	NO NO	.100000E+01
44	0	5	2	0	.646279E+03	.220000E+02	.220000E+02	0.	0.	NO NO	0.
45	0	5	C	3	.753299E+02	.100000E+01	.862000E+01	0.	0.	NO NO	0.
46	0	5	C	0	.746899E+02	.162400E+02	.862000E+01	0.	0.	NO NO	0.
47	0	5	2	0	.647726E+03	.122500E+02	.122500E+02	0.	0.	NO NO	0.
48	1	5	0	0	.151800E+02	.415000E+00	.290000E+00	0.	0.	NO NO	0.
49	0	5	0	3	.200000E+01	.198140E-01	.198140E-01	.943855E-06	.463957E-08	NO NO	0.
50	0	5	2	3	.431150E+00	.522590E+00	.600000E+00	.537653E-05	.390498E-05	NO NO	.100000E+01
51	0	5	2	3	.138618E+02	.200000E+00	.300000E+00	.233719E-05	.269557E-05	NO NO	.100000E+01
52	0	5	2	3	.120761E+02	.754336E+00	.350000E+00	.217191E-06	.131956E-06	NO NO	.100000E+01
53	0	5	0	3	.500000E+01	.200000E-01	.200000E-01	.446410E-04	.320720E-06	NO NO	0.
54	0	5	0	3	.400000E+01	.126100E+01	.126100E+01	.106328E-03	.406499E-04	NO NO	0.
55	0	5	0	3	.110000E+01	.234000E+02	.234000E+02	.205965E-01	.375448E-04	NO NO	0.
56	0	5	0	3	.100000E+01	.100000E+00	.100000E+00	0.	0.	NO NO	0.
57	1	5	0	0	.510484E+01	.203750E+00	.203750E+00	.849703E-05	.157566E-04	NO NO	0.
58	0	5	2	3	.645995E+03	0.	0.	0.	0.	NO NO	0.
59	0	5	2	3	.645995E+03	0.	0.	0.	0.	NO NO	0.

*** WARNING *** THE FOLLOWING JUNCTIONS HAVE LARGER AREAS THAN THOSE OF ONE OF THE ASSOCIATED VOLUMES:

22 49 53 54 55 56

PARAMETERS IN JUNCTION MATRIX
 NUMBER OF CHAINS (MS) = 7
 NUMBER OF CHAIN JUNCTIONS (NTRI) = 32
 NUMBER OF NON-CHAIN JUNCTIONS (NO) = 25
 INDEX OF FIRST CRITICAL JUNCTION (MPP) = 58
 TOTAL NUMBER OF JUNCTIONS (NTOT1) = 59

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DATA FOR 47 HEAT CONDUCTING SLABS.

SLAB NUM	L VOL	R VOL	GEOM NUM	STK IND	LEFT SURFACE AREA, FT**2	RIGHT SURFACE AREA, FT**2	VOLUME FT**3	LEFT HYDRAULIC DIAMETER, FT	RIGHT HYDRAULIC DIAMETER, FT	MAJOR L IN L OUT	JUNCTIONS R IN R OUT	
	LOC	X	L	C	R	C	LEFT HEATED FO DIAMETER, FT	RHT HEATED FO DIAMETER, FT	LEFT CHANNEL LENGTH, FT	RIGHT CHANNEL LENGTH, FT	BOT HEIGHT IN R (L) VOL, FT	TOP HEIGHT IN R (L) VOL, FT
1	53	C	1	C	C	.233330E+02 .174400E+01	0. 0.	.909300E+00 .513840E+01	.174400E+01 0.	0. 0.	52 53	0 0
2	17	0	2	C	C	.230540E+02 C.	0. 0.	.982900E+00 .410300E+01	.178800E+01 0.	0. 0.	1 2	0 0
3	2	0	2	0	0	.104770E+02 C.	0. 0.	.446700E+00 .186500E+01	.131400E+01 0.	0. 0.	26 1	0 0
4	24	0	3	C	C	.603180E+02 C.	0. 0.	.523600E+01 .942200E+01	.231300E+01 0.	0. 0.	25 26	0 0
5	36	0	11	C	C	.342000E+01 .338600E+00	0. 0.	.253300E+00 .321700E+01	.338600E+00 0.	0. 0.	39 40	0 0
6	35	0	8	0	0	.733000E+01 .932000E+00	0. C.	.967400E+00 .250400E+01	.932000E+00 0.	0. 0.	38 39	0 0
7	0	21	4	0	0	0. C.	.197840E+02 0.	.236060E+01 0.	.343500E+01 0.	.583300E+00 0.	0 0	54 23
8	21	0	5	0	C	.239850E+02 C.	0. 0.	.220360E+02 .343500E+01	.583300E+00 0.	0. 0.	54 23	0 0
9	0	52	4	0	0	0. C.	.334367E-02 0.	.685200E+01 0.	.116110E+02 0.	.333300E+00 0.	0 0	51 52
10	52	0	5	0	0	.405390E+02 C.	0. 0.	.372457E+02 0.	.333300E+00 .387500E+01	0. 0.	51 52	0 0
11	34	0	11	0	0	.919000E+01 .338600E+00	0. 0.	.680700E+00 .864300E+01	.338600E+00 0.	0. 0.	37 38	0 0
12	33	0	13	0	0	.163200E+02 .120300E+01	0. 0.	.272200E+01 .431900E+01	.120300E+01 0.	0. 0.	36 37	0 0
13	32	0	13	0	0	.326700E+02 .120300E+01	0. 0.	.544700E+01 .864300E+01	.120300E+01 0.	0. 0.	35 36	0 0
14	31	0	13	0	0	.163200E+02 .120300E+01	0. 0.	.272200E+01 .431900E+01	.120300E+01 0.	0. 0.	34 35	0 0
15	30	0	11	0	0	.683000E+01 .338600E+00	0. 0.	.506100E+00 .642700E+01	.338600E+00 0.	0. 0.	33 34	0 0
16	53	0	5	0	0	.144713E+02 .289200E+01	0. 0.	.132957E+02 .414500E+01	.289200E+01 0.	0. 0.	52 53	0 0
17	8	42	6	0	0	.112192E+04 .335003E-01	.139542E+04 .466700E+01	.513900E+01 .579000E+01	.335000E-01 .579000E+01	.466700E+01 .830000E+00	8 9 .757000E+01	0 0
18	9	42	6	0	0	.649380E+03 .335000E-01	.807600E+03 .466700E+01	.297500E+01 .335000E+01	.335000E-01 .335000E+01	.466700E+01 .757300E+01	9 10 .957300E+01	0 0

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19	10	42	6	C	.112192E+04	.139542E+04	.513900E+01	.335000E-01	.466700E+01	10	11	0	0
			0	0	.335000E-01	.466700E+01	.579000E+01	.579000E+01	.830000E+00	.757000E+01			
20	44	0	7	0	.130630E+02	0.	.139100E+01	.932000E+00	0.	30	31	0	0
		0	0	0	.932000E+00	0.	.589500E+01	0.	0.	0.			
21	45	0	7	0	.130630E+02	0.	.139100E+01	.932000E+00	0.	40	41	0	0
		0	0	0	.932000E+00	0.	.589500E+01	0.	0.	0.			
22	25	0	8	0	.153100E+02	0.	.202000E+01	.932000E+00	0.	27	28	0	0
		0	0	0	.932000E+00	0.	.522800E+01	0.	0.	0.			
23	26	0	8	0	.988000E+01	0.	.130400E+01	.932000E+00	0.	28	29	0	0
		0	0	0	.932000E+00	0.	.337500E+01	0.	0.	0.			
24	3	0	8	0	.154500E+02	0.	.203800E+01	.932000E+00	0.	2	4	0	0
		0	0	0	.932000E+00	0.	.521100E+01	0.	0.	0.			
25	24	0	8	0	.195200E+02	0.	.257500E+01	.932000E+00	0.	4	5	0	0
		0	0	0	.932000E+00	0.	.666500E+01	0.	0.	0.			
26	5	0	8	0	.136800E+02	0.	.184500E+01	.932000E+00	0.	5	6	0	0
		0	0	0	.932000E+00	0.	.467200E+01	0.	0.	0.			
27	6	0	9	0	.107800E+02	0.	.160920E+01	.106780E+01	0.	6	7	0	0
		0	0	0	.106780E+01	0.	.321300E+01	0.	0.	0.			
28	7	0	10	0	.150000E+02	0.	.526700E+01	.146150E+01	0.	7	8	0	0
		0	0	0	.146150E+01	0.	.250000E+01	0.	0.	0.			
29	11	0	10	0	.159000E+02	0.	.526700E+01	.146150E+01	0.	11	12	0	0
		0	0	0	.146150E+01	0.	.250000E+01	0.	0.	0.			
30	12	0	9	0	.770000E+01	0.	.115020E+01	.106780E+01	0.	12	13	0	0
		0	0	0	.106780E+01	0.	.229700E+01	0.	0.	0.			
31	13	0	8	0	.190400E+02	0.	.251100E+01	.932000E+00	0.	13	14	0	0
		0	0	0	.932000E+00	0.	.650000E+01	0.	0.	0.			
32	14	0	8	0	.192700E+02	0.	.254300E+01	.932000E+00	0.	14	15	0	0
		0	0	0	.932000E+00	0.	.658100E+01	0.	0.	0.			
33	19	0	8	0	.269700E+02	0.	.355800E+01	.932000E+00	0.	19	21	0	0
		0	0	0	.932000E+00	0.	.921100E+01	0.	0.	0.			
34	20	0	8	0	.692500E+01	0.	.914000E+00	.932000E+00	0.	21	57	0	0
		0	0	0	.932000E+00	0.	.472900E+01	0.	0.	0.			
35	28	0	8	0	.137200E+02	0.	.181100E+01	.932000E+00	0.	3	32	0	0
		0	0	0	.932000E+00	0.	.468600E+01	0.	0.	0.			
36	29	0	8	0	.988000E+01	0.	.130400E+01	.932000E+00	0.	32	33	0	0
		0	0	0	.932000E+00	0.	.337500E+01	0.	0.	0.			
37	27	0	12	0	.575000E+01	0.	.492700E+00	.567800E+00	0.	48	30	0	0
		0	0	0	.567800E+00	0.	.322900E+01	0.	0.	0.			
38	46	0	14	0	.164000E+02	.475400E+02	.869000E+01	.833330E+00	0.	44	47	0	0
		0	0	0	0.	.800000E+00	.181600E+02	.181600E+02	0.	0.			

39	50	0	8	0	0	.69250E+01	0.	.91400E+00	.93200E+00	0.	57	22	0	0
		0	0	0	0	.93200E+00	0.	.47290E+01	0.	0.	0.	0.	0.	0.
40	0	22	4	0	0	0.	.668733E+02	.137040E+02	0.	.33330E+00	0.	0	0	23 24
		0	0	0	0	0.	0.	0.	.116110E+02	0.	0.	0.	0.	0.
41	22	0	5	0	0	.810737E+02	0.	.744913E+02	.33330E+00	0.	23	24	0	0
		0	0	0	0	0.	0.	0.	.387500E+01	0.	0.	0.	0.	0.
42	48	0	1	0	0	.466667E+02	0.	.181870E+01	.174400E+01	0.	24	49	0	0
		0	0	0	0	.174400E+01	0.	.513840E+01	0.	0.	0.	0.	0.	0.
43	48	0	5	0	0	.289427E+02	0.	.265913E+02	.289200E+01	0.	24	49	0	0
		0	0	0	0	.289200E+01	0.	.414500E+01	0.	0.	0.	0.	0.	0.
44	49	0	1	0	0	.287350E+02	0.	.111980E+01	.174400E+01	0.	50	25	0	0
		0	0	0	0	.174400E+01	0.	.715800E+01	0.	0.	0.	0.	0.	0.
45	49	0	5	0	0	.178210E+02	0.	.163740E+02	.289200E+01	0.	50	25	0	0
		0	0	0	0	.289200E+01	0.	.170200E+01	0.	0.	0.	0.	0.	0.
46	0	51	4	0	0	0.	.989200E+01	.118030E+01	0.	.583300E+00	0.	0	0	22 51
		0	0	0	0	0.	0.	0.	.343500E+01	0.	0.	0.	0.	0.
47	51	0	5	0	0	.119927E+02	0.	.110180E+02	.583300E+00	0.	22	51	0	0
		0	0	0	0	0.	0.	.343500E+01	0.	0.	0.	0.	0.	0.

AXIAL STACKS OF HEAT SLABS -

1	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
2	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
3	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
4	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
5	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
6	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
7	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
8	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
9	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
10	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
11	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
12	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
13	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
14	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
15	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
16	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
17	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
18	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
19	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
20	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
21	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
22	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
23	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
24	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
25	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
26	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
27	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
28	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
29	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
30	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
31	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
32	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER
33	THROUGH	1	1	DIMENSIONAL	HEAT	TRANSFER

34	THROUGH	34	1	DIMENSIONAL HEAT TRANSFER
35	THROUGH	35	1	DIMENSIONAL HEAT TRANSFER
36	THROUGH	36	1	DIMENSIONAL HEAT TRANSFER
37	THROUGH	37	1	DIMENSIONAL HEAT TRANSFER
38	THROUGH	38	1	DIMENSIONAL HEAT TRANSFER
39	THROUGH	39	1	DIMENSIONAL HEAT TRANSFER
40	THROUGH	40	1	DIMENSIONAL HEAT TRANSFER
41	THROUGH	41	1	DIMENSIONAL HEAT TRANSFER
42	THROUGH	42	1	DIMENSIONAL HEAT TRANSFER
43	THROUGH	43	1	DIMENSIONAL HEAT TRANSFER
44	THROUGH	44	1	DIMENSIONAL HEAT TRANSFER
45	THROUGH	45	1	DIMENSIONAL HEAT TRANSFER
46	THROUGH	46	1	DIMENSIONAL HEAT TRANSFER
47	THROUGH	47	1	DIMENSIONAL HEAT TRANSFER

DATA FOR 14 HEAT SLAB GEOMETRIES

GEOM TYPE	REG NO	GAP IND	MAT NO	NO DX	XO TO N=1	REGION WIDTH	POWER FRAC
1	1	0	1	4	0.	.129900E-01	0.
2	1	0	1	4	0.	.259700E-01	0.

SUM OF POWER FRACTIONS IS 0.

GEOM TYPE	REG NO	GAP IND	MAT NO	NO DX	XO TO N=1	REGION WIDTH	POWER FRAC
2	1	0	1	4	.894000E+00	.208000E-01	0.
2	1	0	1	4		.208000E-01	0.

SUM OF POWER FRACTIONS IS 0.

GEOM TYPE	REG NO	GAP IND	MAT NO	NO DX	XO TO N=1	REGION WIDTH	POWER FRAC
2	1	0	1	4	.101900E+01	.417000E-01	0.
2	1	0	1	4		.417000E-01	0.

SUM OF POWER FRACTIONS IS 0.

GEOM TYPE	REG NO	GAP IND	MAT NO	NO DX	XO TO N=1	REGION WIDTH	POWER FRAC
2	1	0	1	4	.125000E+01	.625000E-01	0.
2	1	0	1	4		.625000E-01	0.

SUM OF POWER FRACTIONS IS 0.

GEOM TYPE	REG NO	GAP IND	MAT NO	NO DX	XO TO N=1	REGION WIDTH	POWER FRAC
2	1	0	1	4	.166700E+01	.250000E+00	0.
2	1	0	1	4		.500000E+00	0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .167500E-01 .204000E-02 0.
2 2 0 1 4 .204000E-02 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .354000E+00 .310000E-01 0.
2 2 0 1 4 .630000E-01 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .466000E+00 .390000E-01 0.
2 2 0 1 4 .780000E-01 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .533900E+00 .443000E-01 0.
2 2 0 1 4 .685000E-01 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .225000E+01 .208000E-01 0.
2 2 0 1 4 .270900E+00 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .169300E+00 .208000E-01 0.
2 2 0 1 4 .417000E-01 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .283900E+00 .252000E-01 0.
2 2 0 1 4 .503000E-01 0.

SUM OF POWER FRACTIONS IS 0.

GEOM REG GAP MAT NO XC TO N=1 REGION WIDTH POWER FRAC
TYPE NO IND NO DX

2 1 1 4 .601600E+00 .495000E-01 0.
2 2 0 1 4 .989000E-01 0.

SUM OF POWER FRACTIONS IS 0.

GEOM TYPE	REG NO	GAP IND	MAT NO	NO DX	XO TO N=1	REGION WIDTH	POWER FRAC
2	1	1	8		.145830E+00	.833300E-01	0.
2	2	1	5			.833300E-01	0.
3	3	1	3			.164170E+00	0.

SUM OF POWER FRACTIONS IS 0.

PROPERTIES FOR HEAT CONDUCTING MATERIAL NUMBER 1

THERMAL CONDUCTIVITY (BTU/FT-HR-F) VS TEMPERATURE (T(1),K(1),----)

FE-2 POINTS .212000E+03 .957400E+01 .237200E+04 .192940E+02

VOL HEAT CAPACITY (BTU/FT**3-F) VS TEMPERATURE (T(1),C(1),----)

FE-13 POINTS .170000E+03 .444608E+02 .250000E+03 .443296E+02 .400000E+03 .444872E+02
.500000E+03 .453920E+02 .800000E+03 .469094E+02 .100000E+04 .488415E+02
.120000E+04 .509906E+02 .140000E+04 .531587E+02 .160000E+04 .551481E+02
.180000E+04 .567609E+02 .200000E+04 .577993E+02 .220000E+04 .586655E+02
.240000E+04 .573616E+02

EXPOP4/C E CLOFTSV02(73) LOFT L145-A10 L1-4 PRETEST ANALYSIS EXPERIMENTAL RELAP4 TYPE PROGRAM CONFIGURATION CONTROL: YES 03/03/77

CPU TIME 1.25 STANDARD TIME STEP NUMBER 0. ACTUAL TIME STEP NUMBER 0. TIME = 0. SEC. LAST DT = C. SEC.

TOTAL SYSTEM QUANTITIES	NORM POWR (MW)	POWR (MW)	HEAT REM (BTU/HR)	ENGY LEAK (BTU)	MASS LEAK (LB)	ENGY BAL (BTU)	MASS BAL (LB)	TOT. REAC (S)	REAC SEC.	T
	1.00000E+00	0.	0.	0.	0.	6.20650E+07	2.42247E+05	0.	0.	

VOLUME NUMBER	AVG. PRES PSIA	TOT. MASS (LB) H2O	AVG. ENTH (BTU/LB)	AVG. DENS (LB/FT3)	AVG. TFMP (F)	AVG. QUAL	BUBB MASS (LB)	MIXT LEVL (FT)	LIO. MASS (LB)
1	2.26706E+03	7.73746E+02	5.34894E+02	4.75224E+01	5.40000E+02	0.	0.	7.50000E+00	7.73746E+02

2	2.27088E+03	1.99414E+02	5.34889E+02	4.75248E+01	5.40000E+02	0.	0.	1.66500E+00	1.99414E+02
3	2.26469E+03	3.77851E+02	5.34897E+02	4.75209E+01	5.40000E+02	0.	0.	9.32333E-01	3.77851E+02
4	2.26446E+03	2.16239E+02	5.34897E+02	4.75207E+01	5.40000E+02	0.	0.	9.32333E-01	2.16239E+02
5	2.26423E+03	1.51584E+02	5.34897E+02	4.75206E+01	5.40000E+02	0.	0.	9.32333E-01	1.51584E+02
6	2.26352E+03	1.36773E+02	5.34898E+02	4.75201E+01	5.40000E+02	0.	0.	2.42156E+00	1.36773E+02
7	2.26020E+03	5.31365E+02	5.34902E+02	4.75188E+01	5.40000E+02	0.	0.	2.50000E+00	5.31365E+02
8	2.25781E+03	5.21583E+02	5.34905E+02	4.75165E+01	5.40000E+02	0.	0.	6.75000E+00	5.21583E+02
9	2.25566E+03	2.58852E+02	5.34908E+02	4.75151E+01	5.40000E+02	0.	0.	2.00521E+00	2.58852E+02
10	2.25563E+03	5.21573E+02	5.34907E+02	4.75156E+01	5.40000E+02	0.	0.	6.75000E+00	5.21573E+02
11	2.25759E+03	5.31346E+02	5.34905E+02	4.75163E+01	5.40000E+02	0.	0.	2.50000E+00	5.31346E+02
12	2.25321E+03	4.77490E+01	5.34911E+02	4.75135E+01	5.40000E+02	0.	0.	2.37508E+00	4.77490E+01
13	2.25311E+03	2.10864E+02	5.34911E+02	4.75134E+01	5.40000E+02	0.	0.	3.80867E+00	2.10864E+02
14	2.25137E+03	2.13495E+02	5.34913E+02	4.75123E+01	5.40000E+02	0.	0.	2.17450E+00	2.13495E+02
15	2.26547E+03	1.79897E+02	5.34896E+02	4.75214E+01	5.40000E+02	0.	0.	2.47577E+00	1.79897E+02
16	2.26698E+03	1.79897E+02	5.34894E+02	4.75223E+01	5.40000E+02	0.	0.	2.47577E+00	1.79901E+02
17	2.27844E+03	9.01068E+01	5.34880E+02	4.75297E+01	5.40000E+02	0.	0.	7.08333E-01	9.01068E+01
18	2.28126E+03	3.29561E+01	5.34876E+02	4.75315E+01	5.40000E+02	0.	0.	7.08333E-01	3.29561E+01
19	2.27574E+03	2.98881E+02	5.34883E+02	4.75288E+01	5.40000E+02	0.	0.	9.32333E-01	2.98881E+02
20	2.27528E+03	7.67244E+01	5.34884E+02	4.75277E+01	5.40000E+02	0.	0.	9.32333E-01	7.67244E+01
21	2.27232E+03	2.36032E+02	5.34887E+02	4.75258E+01	5.40000E+02	0.	0.	3.43500E+00	2.36032E+02
22	2.27470E+03	5.40753E+02	5.34884E+02	4.75273E+01	5.40000E+02	0.	0.	1.16114E+01	5.40753E+02
23	2.27655E+03	4.82566E+02	5.34882E+02	4.75285E+01	5.40000E+02	0.	0.	1.88942E+00	4.82566E+02
24	2.27314E+03	1.43763E+03	5.34886E+02	4.75265E+01	5.40000E+02	0.	0.	9.42200E+00	1.43763E+03
25	2.27211E+03	1.69647E+02	5.34887E+02	4.75256E+01	5.40000E+02	0.	0.	9.32333E-01	1.69647E+02
26	2.27211E+03	7.27332E+01	5.34887E+02	4.75256E+01	5.40000E+02	0.	0.	9.32333E-01	7.27332E+01
27	2.27211E+03	3.88528E+01	5.34887E+02	4.75256E+01	5.40000E+02	0.	0.	5.67750E-01	3.88528E+01
28	2.26823E+03	3.58790E+02	5.34892E+02	4.75231E+01	5.40000E+02	0.	0.	9.32333E-01	3.58790E+02
29	2.26823E+03	1.09515E+02	5.34892E+02	4.75231E+01	5.40000E+02	0.	0.	9.32333E-01	1.09515E+02
30	2.26779E+03	1.37650E+01	5.34893E+02	4.75229E+01	5.40000E+02	0.	0.	2.44013E+00	1.37650E+01
31	2.26673E+03	2.17773E+02	5.34894E+02	4.75222E+01	5.40000E+02	0.	0.	4.58250E+00	2.17773E+02
32	2.26532E+03	4.76911E+02	5.34896E+02	4.75213E+01	5.40000E+02	0.	0.	4.04708E+00	4.76911E+02
33	2.26673E+03	2.17773E+02	5.34894E+02	4.75222E+01	5.40000E+02	0.	0.	4.58250E+00	2.17773E+02
34	2.26823E+03	1.94331E+01	5.34892E+02	4.75231E+01	5.40000E+02	0.	0.	4.54167E+00	1.94331E+01
35	2.26933E+03	8.12470E+01	5.34891E+02	4.75238E+01	5.40000E+02	0.	0.	2.17450E+00	8.12470E+01
36	2.26888E+03	2.75003E+01	5.34891E+02	4.75238E+01	5.40000E+02	0.	0.	4.31775E+00	2.75003E+01
37	2.26000E+01	2.18762E+05	5.34891E+02	5.92297E+01	2.34528E+02	5.27002E-12	1.15288E-06	1.60937E+01	2.18762E+05
38	2.27162E+03	3.88303E+02	5.34888E+02	4.75253E+01	5.40000E+02	0.	0.	2.06508E+00	3.88303E+02
39	2.26787E+03	2.79219E+02	5.34893E+02	4.75229E+01	5.40000E+02	0.	0.	2.89583E+00	2.79219E+02
40	2.26369E+03	1.72197E+01	5.34898E+02	4.75202E+01	5.40000E+02	0.	0.	4.03500E+00	1.72197E+01
41	2.26256E+03	9.07990E+02	7.39058E+02	2.61276E+01	6.53506E+02	8.75185E-C2	1.43759E-03	4.32722E+00	8.28524E+02
42	9.62790E+02	5.94351E+03	5.71262E+02	2.11068E+01	5.40000E+02	5.84661E-C2	3.62677E-07	1.17000E+01	5.59601E+03
43	6.12600E+02	4.09199E+03	5.80392E+01	4.01358E+01	9.00000E+01	2.03596E-C5	0.	4.58032E+00	4.09190E+03
44	2.27210E+03	1.55706E+02	5.34887E+02	4.75256E+01	5.40000E+02	0.	0.	8.41146E-01	1.55706E+02
45	2.26822E+03	1.55598E+02	5.34892E+02	4.75231E+01	5.40000E+02	0.	0.	8.41146E-01	1.55698E+02
46	2.27813E+03	3.23936E+02	1.83219E+02	6.03233E+01	2.10000E+02	0.	0.	3.66185E+00	3.23936E+02
47	2.27211E+03	3.67896E+01	5.34887E+02	4.75256E+01	5.40000E+02	0.	0.	9.32333E-01	3.67896E+01
48	2.27665E+03	2.09024E+02	5.34882E+02	4.75285E+01	5.40000E+02	0.	0.	2.44640E+00	2.09024E+02

49	2.27553E+03	3.03798E+02	5.34683E+02	4.75278E+01	5.40000E+02	0.	0.	1.70360E+00	3.03798E+02
50	2.27487E+03	7.67239E+01	5.34884E+02	4.75274E+01	5.40000E+02	0.	0.	9.32333E-01	7.67239E+01
51	2.27286E+03	1.18017E+02	5.34687E+02	4.75261E+01	5.40000E+02	0.	0.	3.43500E+00	1.18017E+02
52	2.27493E+03	2.70377E+02	5.34884E+02	4.75274E+01	5.40000E+02	0.	0.	1.16119E+01	2.70377E+02
53	2.27665E+03	1.04512E+02	5.34682E+02	4.75285E+01	5.40000E+02	0.	0.	2.44640E+00	1.04512E+02

VOLUME	AIR MASS
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	0.
10	0.
11	0.
12	0.
13	0.
14	0.
15	0.
16	0.
17	0.
18	0.
19	0.
20	0.
21	0.
22	0.
23	0.
24	0.
25	0.
26	0.
27	0.
28	0.
29	0.
30	0.
31	0.
32	0.
33	0.
34	0.
35	0.
36	0.
37	0.
38	0.
39	0.
40	0.
41	0.
42	0.
43	1.17195E+02
44	0.
45	0.
46	0.
47	0.
48	0.
49	0.
50	0.
51	0.
52	0.
53	0.

VOLUME PUMP SPEED PUMP NORM
NUMBER (RPM) TORQUE
15 1.72615E+03 2.4078E-01
16 1.76500E+03 3.82610E-01

HEAT NUMBER	SLAB	VOL NUM	HEAT MODE	TRAN	SURF FLUX (BTU/HR/FT2)	CRIT FLUX (BTU/HR/FT2)	H.T. COEF (BTU/H/F2/F)	SURF TEMP (F)	AVG. QUAL	POWR H2O (BTU/HR)
1	LEFT	53			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
2	LEFT	1			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
3	LEFT	2			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
4	LEFT	24			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
5	LEFT	36			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
6	LEFT	39			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
7	RIGHT	21			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
8	RIGHT	21			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
9	RIGHT	32			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
10	LEFT	32			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
11	LEFT	33			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
12	LEFT	33			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
13	LEFT	32			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
14	LEFT	31			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
15	LEFT	30			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
16	LEFT	53			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
17	RIGHT	8			0.	7.73812E+05	5.00000E+00	5.40000E+02	0.	0.
18	RIGHT	42			0.	7.74572E+05	5.00000E+00	5.40000E+02	5.84661E-02	0.
19	RIGHT	42			0.	7.74313E+05	5.00000E+00	5.40000E+02	5.84661E-02	0.
20	LEFT	44			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
21	LEFT	45			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
22	LEFT	25			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
23	LEFT	26			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
24	LEFT	3			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
25	LEFT	4			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
26	LEFT	5			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
27	LEFT	6			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
28	LEFT	7			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
29	LEFT	11			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
30	LEFT	12			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
31	LEFT	13			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
32	LEFT	14			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
33	LEFT	19			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
34	LEFT	20			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
35	LEFT	29			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
36	LEFT	29			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
37	LEFT	27			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
38	LEFT	46			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
39	RIGHT	50			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
40	RIGHT	22			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
41	LEFT	22			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
42	LEFT	48			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
43	LEFT	48			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
44	LEFT	40			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
45	LEFT	49			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
46	RIGHT	51			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.
47	LEFT	51			0.	9.00000E+04	5.00000E+00	5.40000E+02	0.	0.

CONTROL: YES
03/03/77

JUNCTION NUMBER	CONNECTING VOLUMES	CHKE	JCT. FLOW (LBS/SEC)	JCT. ENTH (BTU/LB)	JCT. SPVL (FT/3/LB)	P K E S	U R E	D I C F F	E R E	N T	I A L S
1	2	0	5.972222E+02	5.972222E+02	5.972222E+02	3.826336E+00	-1.545332E+00	-2.281044E+00	2.490666E-14	0.000000E+00	0.000000E+00
2	3	0	5.972222E+02	5.972222E+02	5.972222E+02	7.597733E+00	-9.164556E+00	-1.677014E+00	2.133633E-14	0.000000E+00	0.000000E+00
3	4	0	5.972222E+02	5.972222E+02	5.972222E+02	1.114223E+01	-9.164556E+00	-1.677014E+00	2.554433E-03	0.000000E+00	0.000000E+00
4	5	0	5.972222E+02	5.972222E+02	5.972222E+02	2.318770E+01	-9.474556E+00	-2.318770E+00	8.881788E-16	0.000000E+00	0.000000E+00
5	6	0	5.972222E+02	5.972222E+02	5.972222E+02	7.786270E+00	-2.311144E+00	-2.278888E+00	8.881788E-16	0.000000E+00	0.000000E+00
6	7	0	5.972222E+02	5.972222E+02	5.972222E+02	1.438599E+00	-2.231144E+00	-1.215222E+00	2.131133E-14	0.000000E+00	0.000000E+00
7	8	0	5.972222E+02	5.972222E+02	5.972222E+02	3.150203E+00	-2.421158E+00	-4.022888E+00	7.105433E-14	0.000000E+00	0.000000E+00
8	9	0	5.972222E+02	5.972222E+02	5.972222E+02	4.433033E+00	-1.522615E+00	-5.768888E+00	0.000000E+00	0.000000E+00	0.000000E+00
9	10	0	5.972222E+02	5.972222E+02	5.972222E+02	1.437373E+00	-1.444449E+00	-6.992444E+00	5.20417E-18	0.000000E+00	0.000000E+00
10	11	0	5.972222E+02	5.972222E+02	5.972222E+02	2.240000E+00	1.444447E+00	-7.164221E+00	1.110222E-16	0.000000E+00	0.000000E+00
11	12	0	5.972222E+02	5.972222E+02	5.972222E+02	8.652009E+00	1.522611E+00	-6.609000E+00	5.329077E-15	0.000000E+00	0.000000E+00
12	13	0	5.972222E+02	5.972222E+02	5.972222E+02	3.339007E+00	2.644451E+00	-3.623333E+00	4.618533E-14	0.000000E+00	0.000000E+00
13	14	0	5.972222E+02	5.972222E+02	5.972222E+02	2.12811E+01	1.020181E+00	-3.968897E+00	0.000000E+00	0.000000E+00	0.000000E+00
14	15	0	5.972222E+02	5.972222E+02	5.972222E+02	1.738911E+01	2.696655E+00	-2.608552E+00	2.131633E-14	0.000000E+00	0.000000E+00
15	16	0	3.006657E+02	3.006657E+02	3.006657E+02	1.239088E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
16	17	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
17	18	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
18	19	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
19	20	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
20	21	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
21	22	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
22	23	0	3.006657E+02	3.006657E+02	3.006657E+02	1.473877E+01	-7.672408E+00	-4.791716E+00	0.000000E+00	0.000000E+00	0.000000E+00
23	24										

55	52 TD	22	C	0	8.50000E+01	5.34884E+02	2.10400E-02	2.27278E-01	-5.04989E-12	-2.27278E-01	6.66134E-16	0.
56	53 TD	48	C	0	0.	5.34883E+02	2.10400E-02	1.23520E-03	5.17556E-39	-7.08792E-03	-5.85271E-03	0.
57	20 TD	50	C	0	5.97222E+02	5.34884E+02	2.10400E-02	4.13100E-01	-9.16429E-16	-4.13100E-01	5.32907E-15	0.
58	0 TD	46	C	0	0.	1.83221E+02	0.	0.	0.	0.	0.	0.
59	0 TD	46	C	0	0.	1.83221E+02	0.	0.	0.	0.	0.	0.

EXPOP4/C E GLOF1SV02(73) PRETEST ANALYSIS EXPERIMENTAL RELAP4 TYPE PROGRAM CONFIGURATION CONTROL: YES.
LOFT L145-A10 L1-4 03/03/77

CPU TIME = 1.33

C-44

JUNCTION NUMBER	SLIP VEL. (FT/SEC)	LIQUID VEL. (FT/SEC)	VAPOR VEL. (FT/SEC)	JCT. FLOW-L (LBM/SEC)	JCT. FLOW-G (LBM/SEC)	SAT. H-L (BTU/LBM)	SAT. H-G (BTU/LBM)	FLOW-WEIGHTED H. (BTU/LBM)
1	0.	2.61803E+01	2.61803E+01	5.97222E+02	0.	5.34889E+02	0.	5.34889E+02
2	0.	1.84080E+01	1.84080E+01	5.97222E+02	0.	5.34894E+02	0.	5.34894E+02
3	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	1.90162E+01	1.90162E+01	5.97222E+02	0.	5.34903E+02	0.	5.34903E+02
5	0.	3.50249E+01	3.50249E+01	5.97222E+02	0.	5.34904E+02	0.	5.34904E+02
6	0.	1.54086E+01	1.54086E+01	5.97222E+02	0.	5.34904E+02	0.	5.34904E+02
7	0.	2.26039E+01	2.26039E+01	5.97222E+02	0.	5.34902E+02	0.	5.34902E+02
8	0.	7.72862E+00	7.72862E+00	5.97222E+02	0.	5.34902E+02	0.	5.34902E+02
9	0.	7.72887E+00	7.72887E+00	5.97222E+02	0.	5.34915E+02	0.	5.34915E+02
10	0.	7.72909E+00	7.72909E+00	5.97222E+02	0.	5.34906E+02	0.	5.34906E+02
11	0.	7.72902E+00	7.72902E+00	5.97222E+02	0.	5.34905E+02	0.	5.34905E+02
12	0.	2.26057E+01	2.26057E+01	5.97222E+02	0.	5.34906E+02	0.	5.34906E+02
13	0.	1.84114E+01	1.84114E+01	5.97222E+02	0.	5.34915E+02	0.	5.34915E+02
14	0.	1.84114E+01	1.84114E+01	5.97222E+02	0.	5.34918E+02	0.	5.34918E+02
15	0.	1.60583E+01	1.60583E+01	3.00657E+02	0.	5.34920E+02	0.	5.34920E+02
16	0.	1.58398E+01	1.58398E+01	2.96565E+02	0.	5.34920E+02	0.	5.34920E+02
17	0.	1.60552E+01	1.60552E+01	3.00657E+02	0.	5.34901E+02	0.	5.34901E+02
18	0.	1.58364E+01	1.58364E+01	2.96565E+02	0.	5.34899E+02	0.	5.34899E+02
19	0.	1.60524E+01	1.60524E+01	3.00657E+02	0.	5.34885E+02	0.	5.34885E+02
20	0.	1.58334E+01	1.58334E+01	2.96565E+02	0.	5.34881E+02	0.	5.34881E+02
21	0.	1.90134E+01	1.90134E+01	5.97222E+02	0.	5.34890E+02	0.	5.34890E+02
22	0.	1.84080E+01	1.84080E+01	5.97222E+02	0.	5.34891E+02	0.	5.34891E+02
23	0.	6.94668E+00	6.94668E+00	2.87222E+02	0.	5.34888E+02	0.	5.34888E+02
24	0.	9.00243E+00	9.00243E+00	5.72222E+02	0.	5.34885E+02	0.	5.34885E+02
25	0.	1.18994E+01	1.18994E+01	5.97222E+02	0.	5.34883E+02	0.	5.34883E+02
26	0.	1.59996E+01	1.59996E+01	5.97222E+02	0.	5.34886E+02	0.	5.34886E+02
27	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	9.78944E-01	9.78944E-01	3.72222E+02	0.	5.34882E+02	0.	5.34882E+02

EXPOP4/C E OLDHISV02(73)
LOFT L145-A10 L1-4

PRETEST ANALYSIS

EXPERIMENTAL RELAP4 TYPE PROGRAM CONFIGURATION CONTROL: YES
03/03/77

CPU TIME = 1.35

JUNCTION NUMBER	SLIP VEL. (FT/SEC)	LIQUID VEL. (FT/SEC)	VAPOR VEL. (FT/SEC)	JCT. FLOW-L (LBM/SEC)	JCT. FLOW-G (LBM/SEC)	SAT. H-L (BTU/LBM)	SAT. H-G (BTU/LBM)	FLOW-WEIGHTED H (BTU/LBM)
50	0.	1.18996E+01	1.18996E+01	5.97222E+02	0.	5.34882E+02	0.	5.34882E+02
51	0.	1.49955E+01	1.49955E+01	3.10000E+02	0.	5.34894E+02	0.	5.34894E+02
52	0.	1.08835E+01	1.08835E+01	2.25000E+02	0.	5.34887E+02	0.	5.34887E+02
53	0.	1.18350E+00	1.18350E+00	2.25000E+02	0.	5.34882E+02	0.	5.34882E+02
54	0.	8.63352E+00	8.63352E+00	2.87222E+02	0.	5.34894E+02	0.	5.34894E+02
55	0.	5.96147E-01	5.96147E-01	8.50000E+01	0.	5.34887E+02	0.	5.34887E+02
56	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	1.90140E+01	1.90140E+01	5.97222E+02	0.	5.34890E+02	0.	5.34890E+02
58	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.

PLOT RECORD NUMBER = 0

RESTART NUMBER = 0

APPENDIX D

ENGINEERING UNITS CONVERSION OF WHAM AND
RELAP4 PREDICTED DATA

APPENDIX D
ENGINEERING UNITS CONVERSION OF WHAM
AND RELAP4 PREDICTED DATA

This section of the report describes in detail how the data output from the WHAM and RELAP4 computer codes is converted to an engineering units prediction for a specific instrument. This allows the reader of the report to associate the predicted engineering units data to the computer code model which is utilized in making the prediction.

Table D-I lists specific transducers and associated location identifiers for the transducers for which there is a WHAM prediction. The location identifier for WHAM is in the form XXXY where XXX is the leg number in the WHAM model, and Y is either the upper leg end (U) or the lower leg end (L). For example, the pressure in the upper leg end of leg 113 would be identified as 113U. As another example, the differential pressure prediction for PDE-BL-5 is calculated by subtracting the pressure at 33U from the pressure at 29U.

The algorithms that are used to calculate the RELAP4 predictions are given in Table D-II. The location identifiers are explained at the end of this table.

After the engineering units data for the WHAM and RELAP4 predictions have been made for each transducer, the data are converted to SI units and plotted. The conversion constants used are presented in Table D-III.

TABLE D-1

ENGINEERING UNITS CONVERSION OF THE WHAM DATA

Transducer Identification	Location Identification	Engineering Units
PdE-BL-5	29U-33U	psid
PdE-BL-7	12U-28U	psid
PdE-CS-1	118U-130U	psid
PdE-PC-1	216U-228U	psid
PdE-PC-2	192U-215U	psid
PE-BL-1	5U	psig
PE-BL-2	7U	psig
PE-BL-3	33U	psig
PE-BL-4	2L	psig
PE-BL-6	29U	psig
PE-CS-1	154U	psig
PE-PC-1	230U	psig
PE-PC-2	179U	psig
PE-PC-3A	213U	psig
PE-1ST-1FF	103L	psig
PE-2ST-1FF	115L	psig
PE-1ST-3FF	43L	psig
PE-2ST-3FF	44U	psig

TABLE D-II
ENGINEERING UNITS CONVERSION OF THE RELAP4 DATA

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
DE-BL-1A, -B, and -C	$1.0 \div JV29$	lbm/ft ³
DE-BL-1A, -B, and -C	$1.0 \div JV33$	lbm/ft ³
DE-PC-1A, -B, and -C	$1.0 \div JV21$	lbm/ft ³
DE-PC-2A, -B, and -C	$1.0 \div JV4$	lbm/ft ³
DE-PC-3A, -B, and -C	$1.0 \div JV13$	lbm/ft ³
FE-BL-1A, -B, and -C	$FV29 \times 1.115367$	ft/sec
FE-BL-2	$FV33 \times 0.154862$	ft/sec
FE-CS-1	$FV1 \times 3.70833$	ft/sec
FE-PC-1	$FV21$	ft/sec
FE-PL-2	$FV4$	ft/sec
FE-PC-3	$FV13$	ft/sec
FE-1ST-1	$FV24$	ft/sec

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
FE-2ST-1	FV52	ft/sec
FT-P120-36-1 and -5	JF44 x 448.8312	gpm
FT-P120-85	JW58 x 7.48052	gpm
FT-P128-104	JW59 x 7.48052	gpm
FT-P139-27-1 and -3	JW5 x 0.0036	mlbm/hr
LE-1ST-1	$(28.026 \times WM48 \div TM48 +$ $(133.024 \times WM22 \div TM22) +$ $(39.339 \times WM21 \div TM21)$	inches
LE-2ST-1	$(28.026 \times WM53 \div TM53) +$ $(133.024 \times WM52 \div TM52) +$ $(39.339 \times WM51 \div TM51)$	inches
LIT-P120-44	12.0 x ML43	inches
LIT-P139-6, -7, and -8	10.2835 x ML43	inches
LT-P4-8B	9.91453 x ML42 - 116.0	inches
ME-BL-1A, -B, and -C	$(0.001 \div JV29) \times$ $(\text{absolute value of FV29}) \times$ $FV29 \times 1.24404$	klbm/ft-sec ²

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
ME-BL-2	$(0.001 \div JV33) \times$ $(\text{absolute value of FV33}) \times$ $FV33 \times 0.023982$	klbm/ft-sec ²
ME-CS-1	$(0.001 \div JV1) \times$ $(\text{absolute value of FV1}) \times$ $FV1 \times 13.75171$	klbm/ft-sec ²
ME-PC-1	$(0.001 \div JV21) \times$ $(\text{absolute value of FV21}) \times$ $FV21$	klbm/ft-sec ²
ME-PC-2	$(0.001 \div JV4) \times$ $(\text{absolute value of FV4}) \times$ $FV4$	klbm/ft-sec ²
ME-PC-3	$(0.001 \div JV13) \times$ $(\text{absolute value of FV13}) \times$ $FV13$	klbm/ft-sec ²
ME-1ST-1	$(0.001 \div JV24) \times$ $(\text{absolute value of FV24}) \times$ $FV24$	klbm/ft-sec ²
ME-2ST-1	$(0.001 \div JV52) \times$ $(\text{absolute value of FV52}) \times$ $FV52$	klbm/ft-sec ²
PCP-1-F	PR15 x 0.016667	Hz
PCP-2-F	PR16 x 0.016667	Hz

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
PdE-BL-4	AP36 - AP45	psid
PdE-BL-5	AP34 - AP36	psid
PdE-BL-6	AP33 - AP34	psid
PdE-BL-7	AP31 - AP33	psid
PdE-BL-8	AP30 - AP31	psid
PdE-CS-1	AP23 - AP2	psid
PdE-PC-1	AP19 - AP13	psid
PdE-PC-2	AP6 - AP12	psid
PdE-PC-3	AP3 - AP4	psid
PdE-PC-4	AP4 - AP6	psid
PdE-PC-5	AP19 - AP20	psid
PdE-PC-7	AP20 - AP25	psid
PdE-PC-9	AP17 - AP14	psid
PdE-PC-10	AP18 - AP14	psid
PdE-RV-1	AP23 - AP37	psid
PdE-RV-3	AP20 - AP52	psid

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
PdE-RV-4	AP1 - AP3	psid
PdE-2ST-2	AP51 - AP52	psid
PdT-P139-30	AP20 - AP3	psid
PE-BL-1	AP25 - 12.6	psig
PE-BL-2	AP28 - 12.6	psig
PE-BL-6	AP34 - 12.6	psig
PE-CS-1A, -1B, -1FF, and -2FF	AP2 - 12.6	psig
PE-PC-1	AP19 - 12.6	psig
PE-PC-2	AP3 - 12.6	psig
PE-PC-3A and -3B	AP13 - 12.6	psig
PE-PC-4	AP41 - 12.6	psig
PE-1ST-1A, -1B, and -1FF	AP48 - 12.6	psig
PE-1ST-3A, -3B, and -3FF	AP21 - 12.6	psig
PE-2ST-1A, -1B, and -1FF	AP53 - 12.6	psig

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
PE-2ST-3FF	AP51 - 12.6	psig
PT-P120-43	AP43 - 12.6	psig
PT-P120-61	AP46 - 12.6	psig
PT-P139-2, -3, and -4	AP5 - 12.6	psig
PT-P139-5	AP41 - 12.6	psig
PT-P4-10A	AP42 - 12.6	psig
RPE-PC-1	PR15	rpm
RPE-PC-2	PR16	rpm
TE-BL-1A, -B, and -C	AT26	deg F
TE-BL-2	AT29	deg F
TE-BL-3	AT38	deg F
TE-CS-1	AT2	deg F
TE-PC-1	AT20	deg F
TE-PC-2	AT3	deg F
TE-PC-3	AT13	deg F

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
TE-P120-41	AT43	deg F
TE-P138-62	AT44	deg F
TE-P138-63	AT27	deg F
TE-P138-65	AT36	deg F
TE-P138-66	AT45	deg F
TE-P139-19, and -20	AT41	deg F
TE-P139-29	AT20	deg F
TE-SG-1	AT7	deg F
TE-SG-2	AT11	deg F
TE-SG-3	AT42	deg F
TE-1ST-1	AT21	deg F
TE-1ST-2, -3, -4, -5, -6, -7, and -8	AT22	deg F
TE-1ST-9, -10, -11, -12, and -13	AT48	deg F

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
TE-1ST-14	AT22	deg F
TE-2ST-1	AT51	deg F
TE-2ST-2, -3, -4, -5, -6, -7, and -8	AT52	deg F
TE-2ST-9, -10, -11, -12, and -13	AT53	deg F
TE-2ST-14	AT52	deg F
TT-P120-62	AT46	deg F
TT-P120-32, -33, and -34	AT5	deg F
Enthalpy at BL-1	AH26	Btu/lbm
Enthalpy at BL-2	AH29	Btu/lbm
Enthalpy at PC-1	AH20	Btu/lbm
Enthalpy at PC-2	AH3	Btu/lbm
Enthalpy at PC-3	AH13	Btu/lbm
Void fraction at BL-1	$1.0 - WM26 \div TM26$	fraction

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
Void fraction at BL-2	$1.0 - WM29 \div TM29$	fraction
Void fraction at PC-1	$1.0 - WM20 \div TM20$	fraction
Void fraction at PC-2	$1.0 - WM3 \div TM3$	fraction
Void fraction at PC-3	$1.0 - WM13 \div TM13$	fraction
Mass flow/system volume at BL-1	$JW29 \div 273$	$lbm/sec-ft^3$
Mass flow/system volume at BL-2	$JW33 \div 273$	$lbm/sec-ft^3$
Mass flow/system volume at PC-1	$JW21 \div 273$	$lbm/sec-ft^3$
Mass flow/system volume at PC-2	$JW4 \div 273$	$lbm/sec-ft^3$
Mass flow/system volume at PC-3	$JW13 \div 273$	$lbm/sec-ft^3$
Static quality at BL-1	AX26	fraction
Static quality at BL-2	AX29	fraction

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
Static quality at PC-1	AX20	fraction
Static quality at PC-2	AX3	fraction
Static quality at PC-3	AX13	fraction
Saturation temperature at BL-1	TS26	deg F
Saturation temperature at BL-2	TS29	deg F
Saturation temperature at PC-1	TS20	deg F
Saturation temperature at PC-2	TS3	deg F
Saturation temperature at PC-3	TS13	deg F
Saturation temperature at CS-1	TS2	deg F
Saturation temperature at PE-1ST-1A	TS48	deg F
Saturation temperature at PE-2ST-1A	TS53	deg F

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
Total mass of liquid in reactor vessel	TM51 + TM52 + TM53 + TM21 + TM22 + TM48 + TM23 + TM49 + TM24 + TM2 + TM1	lbm
Total ECC mass flow rate	JW44 + JW58 + JW59	lbm/sec
Integrated ECC mass flow rate	$\int_0^t (JW44 + JW58 + JW59) dt$	lbm

where

JVXX is the junction specific volume in junction XX

FVXX is the junction velocity in junction XX

JFXX is the junction volumetric flow in junction XX

JWXX is the junction mass flow in junction XX

AHXX is the junction enthalpy in junction XX

MLYY is the mixture level in volume YY

WMYY is the liquid mass in volume YY

TMY Y is the total mass in volume YY

TABLE D-II (contd.)

<u>Transducer Identification</u>	<u>Calculation Method</u>	<u>Engineering Units</u>
--------------------------------------	---------------------------	------------------------------

PRYY is the pump speed in volume YY

APYY is the average pressure in volume YY

ATYY is the average temperature in volume YY

AXYY is the average quality in volume YY

TSYY is the saturation temperature in volume YY

TABLE D-III

ENGLISH TO SI UNITS CONVERSION CONSTANTS

TYPE MEASUREMENT	ENGLISH UNITS	SI UNITS	CONVERSION FACTOR
ACCELERATION	G	M/S ²	9.806650E+00
CURRENT RMS	AMPS RMS	AMPS RMS	1.000000E+00
INSTANTANEOUS CURRENT	AMPS	AMPS	1.000000E+00
DENSITY	LB/FT ³	MG/M ³	1.601846E-02
AVERAGE DENSITY	LB/FT ³	MG/M ³	1.601846E-02
ENTHALPHY	BTU/LBM	KJ/KG	2.326000E+00
EXTENSIONMETER	INCHES	M	2.540000E-02
FLOWRATE	KLBM/HR	KG/S	1.259979E-01
FLOWRATE	GPM	L/S	6.309020E-02
FLOW FILTERED	GPM	L/S	6.309020E-02
VOLUMETRIC FLOW RATE	GPM	L/S	6.309020E-02
WATER HORSEPOWER	HORSEPOWER	MEGAWATTS	7.460430E-04
INTERGRAL MASS FLOW	LBM	KG	4.535924E-01
FLOW QUALITY			1.000000E+00
FREQUENCY	HERTZ	HERTZ	1.000000E+00
LIQUID LEVEL	INCHES	M	2.540000E-02
COOLANT LEVEL	INCHES	M	2.540000E-02
MASS FLOW/SYSTEM VOL	LBM/FT ³ S	KG/(S-M ³)	16.01846E+00
MASS FLOW RATE	LBM/SEC	KG/S	4.535924E-01
MASS FLOWRATE	MLBM/HR	KG/S	1.259979E+02
MOMENTUM FLUX	KLBM/FS ²	MG/(M-S ²)	1.488164E+00
MOMENTUM FLUX FILTER	KLBM/FS ²	MG/(M-S ²)	1.488164E+00
VALVE POSITION	PCT	PCT	1.000000E+00
PRESSURE	PSIG	MPA	6.894757E-03
PRESSURE	PSIA	MPA	6.894757E-03
COOLANT PRESSURE	PSIG	MPA	6.894757E-03
DELTA PRESSURE	PSID	MPA	6.894757E-03
DELTA PRESSURE	IN H ₂ O	PA	2.488400E+02
STRAIN	UIN/IN	UM/M	1.000000E+00
STRESS	LBF	NEWTONS	4.448222E+00
STRESS	KLBF	NEWTONS	4.448222E+03
PUMP SPEED	RPM	RPM	1.000000E+00
PUMP RPM	RPM	RPM	1.000000E+00
SLIP			1.000000E+00
STATIC QUALITY			1.000000E+00
STEAM QUALITY			1.000000E+00
VELOCITY	FT/SEC	M/S	3.048000E-01
VELOCITY FILTERED	FT/SEC	M/S	3.048000E-01
S.LIQUID VELOCITY	FT/SEC	M/S	3.048000E-01
LIQUID PHAS VELOCITY	FT/SEC	M/S	3.048000E-01
VAPOR PHASE VELOCITY	FT/SEC	M/S	3.048000E-01
COOLANT VELOCITY	FT/SEC	M/S	3.048000E-01
RMS VOLTS	VOLTS RMS	VOLTS RMS	1.000000E+00
INSTANTANEOUS VOLTS	VOLTS	VOLTS	1.000000E+00
VOID FRACTION			1.000000E+00

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