A Reproduced Copy

OF

N71-36572

Reproduced for NASA

by the

NASA Scientific and Technical Information Facility

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

FFNo 672 Aug 65

N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED US BY THE SPONSORING AGENCY. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE.

17618-H180-R0-00

PROJECT TECHNICAL REPORT

TRANSIENT ANALYSIS ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL

MSC/TRW TASK 705-1

NAS 9-8166 June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

FACILITY FORM 602
N71-36572 (ACCESSION NUMBER)
142 (PAGES)
CR-115182 (NASA CR OR TMX OR AD NUMBER)
G3 (THRU)
(CODE)
00 (CATEGORY)

OFFICE OF PRIME RESPONSIBILITY

EP4

TRW SYSTEMS GROUP

CR-115162

17618-H180-R0-00

PROJECT TECHNICAL REPORT

TRANSIENT ANALYSIS ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL

MSC/TRW TASK 705-1

NAS 9-8166

June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
T. J. Walsh
R. W. Pringle
Propulsion Systems Section
Chemical and Mechanical Systems Department

Approved by: _____
P. F. Thompson, Task Manager
MSC/TRW Task 705-1

Approved by: _____
J. M. Richardson, Head
Propulsion Systems Section

Approved by: _____
D. W. Vernon, Manager
Chemical and Mechanical Systems
Department

TRW SYSTEMS GROUP

PRECEDING PAGE BLANK NOT FILMED

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
2.	PROGRAM DESCRIPTION	3
	2.1 Program Definition	3
	2.2 Method of Solution	3
3.	USER'S INFORMATION	5
	3.1 Input Description	5
	3.1.1 General Input	7
	3.1.1.1 Rules for Namelist Usage	7
	3.1.1.2 General Input and Line Input	9
	3.1.2 Accumulator Input	10
	3.1.3 Combustor and Turbopump Input	11
	3.1.4 Flow Boundary Input	15
	3.1.5 Line Junction Input	16
	3.1.6 Pressure Boundary Input	17
	3.1.7 Friction Pressure Boundary Input	18
	3.1.8 Regulator Input	19
	3.1.9 Lumped Resistance Input	20
	3.1.10 TRWPLT Package	21
	3.1.11 Sample Namelist Input	34
	3.2 Output Description	37
	3.2.1 Initialization Printout	37
	3.2.2 Detailed Printout	39
	3.2.2.1 Manifold and Thrust Chamber	39
	3.2.2.2 Turbopump	41
	3.2.2.3 Accumulators and Regulators	43
	3.2.3 Summary Printout	44
	3.2.3.1 Manifold and Thrust Chamber	44
	3.2.3.2 Turbopump	44
	3.2.3.3 Regulator and Accumulator	45
	3.2.3.4 Pressure Boundary With Friction and Valve	45
	3.2.3.5 Line	45
	3.2.4 Sample Output	46
	3.2.4.1 Initialization and Line Printout	47
	3.2.4.2 Manifold and Thrust Chamber Detailed Printout	52

TABLE OF CONTENTS (Continued)

Page

3.2.4.3 Turbopump Detailed Printout 52
3.2.4.4 Accumulator and Regulator Detailed Printout. 53
3.2.4.5 Summary Printout. 54

4. FLOW CHARTS. 58

5. PROGRAM LISTING. 77

5.1 Element Table 78

5.2 Main Program. 80

5.3 Block Data. 87

5.4 Subroutines 90

5.4.1 ACC. 90
5.4.2 CHAM 93
5.4.3 CR2TAP 99
5.4.4 FBL. 101
5.4.5 INTERP 103
5.4.6 JUNCL. 105
5.4.7 PBL. 107
5.4.8 PBLF 109
5.4.9 PIPEL. 111
5.4.10 REGL 113
5.4.11 RKINS. 116
5.4.12 VAL. 118
5.4.13 VALVEL 120
5.4.14 WRITE 122

5.5 Program Storage 132

6. REFERENCES 138

SUBROUTINE FLOW CHARTS

		PAGE
1.	TRAP GENERAL FLOW CHART	59
2.	Subroutine ACC	61
3.	Subroutine CHAM	62
4.	Subroutine CR2TAP	64
5.	Subroutine FBL	65
6.	Subroutine JUNCL	66
7.	Subroutine PBL	67
8.	Subroutine PBLF	68
9.	Subroutine INTERP	69
10.	Subroutine PIPEL	70
11.	Subroutine REGL	71
12.	Subroutine RKINS	72
13.	Subroutine VAL	73
14.	Subroutine VALVEL	74
15.	Subroutine WRITE	75

FIGURES

1.	ACPS Transient Program Demonstration Schematic	6

LIST OF TABLES

Page

1. BCD Plot Symbols 23

1.0 INTRODUCTION

This Program User's Guide was written to provide the user a set of instructions for the operation of the TRAP (Transient Analysis Program, HP014A). The guide fulfills a deliverable milestone for Task 705-1. With the exception of Section 2.2, this document is completely self contained.

PRECEDING PAGE BLANK NOT FILMED

2.0 PROGRAM DESCRIPTION

2.1 Program Definition

This program models the transient operation of auxiliary control propulsion systems (ACPS). All components that are normally associated with ACPS have been modeled and include fluid lines, valves, line junctions, regulators, orifices, combustors, manifolds, turbopumps, accumulators, pressure regulators, and tanks. These components can be connected together in an arbitary manner to simulate a variety of ACPS configurations.

2.2 Method of Solution

The theory and mathematical derivation for this program is described in Reference 1.

PRECEDING PAGE BLANK NOT FILMED

3.0 USER'S INFORMATION

3.1 Input Description

A schematic of an auxiliary propulsion system is shown in Figure 1. This particular system was simulated for the sample case presented in Sections 3.1.11 and 3.2.4.

The first step in preparing the input is to number each type of component from one to the number of the components of its type. The numbering of the components for the sample case is shown in Roman numerals. Each component described by a subroutine must be separated from another component by a fluid line; e.g., a pressure regulator cannot be connected directly to a valve. Generally, if the components are closely coupled in practice, they have been modeled together in one subroutine; for instance, the thrust chamber valve and combustor. A flow direction must be assumed in each line. If the assumption is wrong, the flowrates computed by the program will have a negative sign. Generally, it makes no difference which direction is assumed, except that combustors must always be treated as being at the downstream end of a line.

Data are input to the program on cards via the use of NAMELIST. There is no data tape input to this program. The description of the data used in operating this program is divided into sections to correspond to the different elements of the program. These sections are:

- 3.1.1 General Input and Line Input
- 3.1.2 Accumulator Input
- 3.1.3 Combustor and Turbopump Input
- 3.1.4 Flow Boundary Input
- 3.1.5 Line Junction Input
- 3.1.6 Pressure Boundary Input
- 3.1.7 Friction Pressure Boundary Input
- 3.1.8 Regulator Input
- 3.1.9 Lumped Resistance Input
- 3.1.10 TRWPLT Package

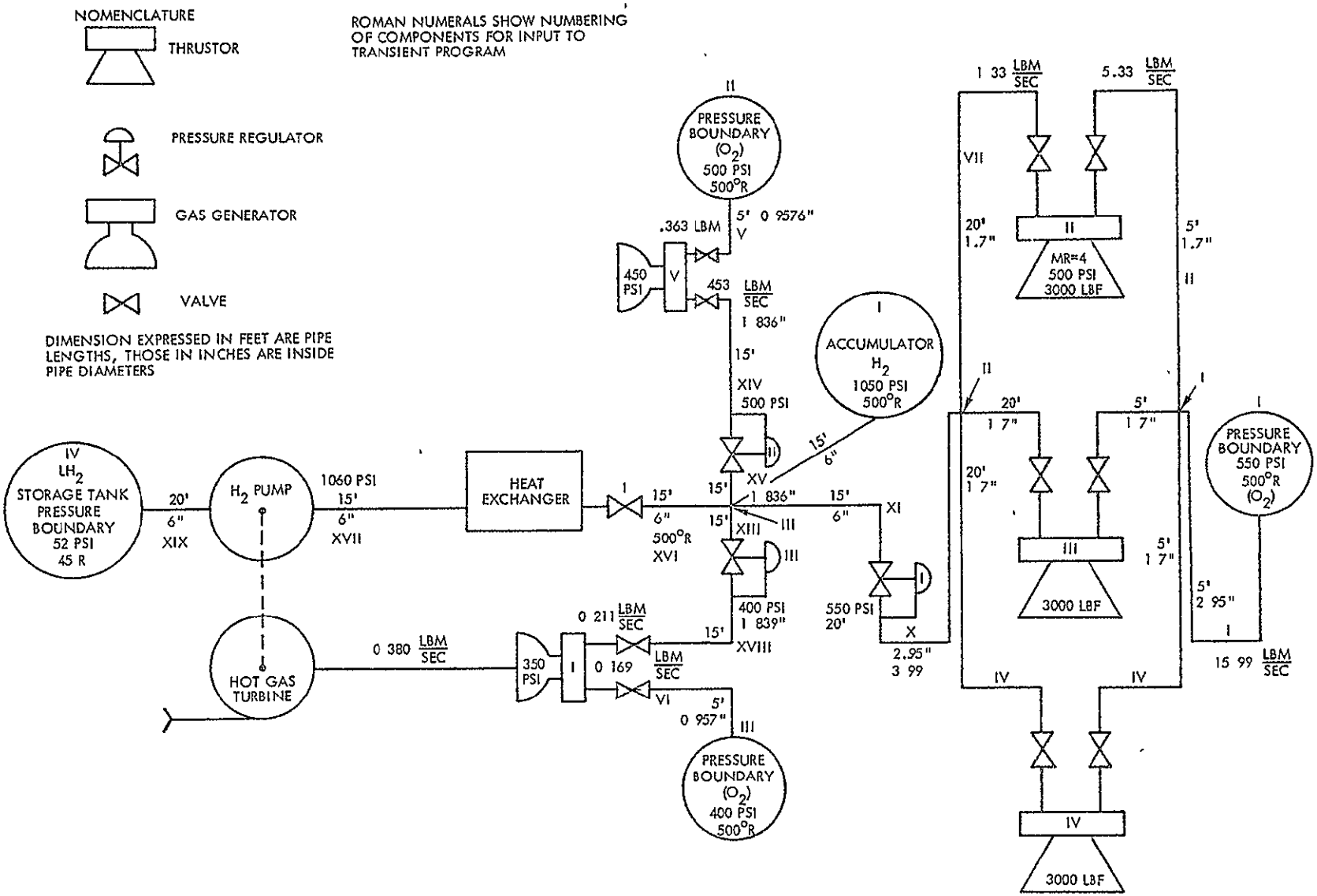


Figure 1. ACPS Transient Program Demonstration Schematic

3.1.1 General Input

This section provides a description of the general input used in the program including a description of NAMELIST and its rules.

The first card of the data deck is the NAMELIST name card which contains the characters $INDATA punched in columns 2-8. Following this card are the NAMELIST data cards. Rules for their use are given below. After the last NAMELIST data card, the NAMELIST end card must appear. This card contains the characters $END punched in columns 2-5. Following this card, a data deck end card must be present. It is a signal to TRAP to process the NAMELIST data. It contains the character DECKEND in columns 1-7. Certain data has been put into the program using the non-executable sub-program BLØCK DATA. For a list of these values and their applicability, see BLØCK DATA in the listing of the program given in Section 5.0. The values in BLØCK DATA can be overridden using NAMELIST.

3.1.1.1 Rules for Namelist Usage

1) Card column 1 may not be used. All variable names may start in card columns 2-77.

2) A variable name and its value must be on the same card; no continuations are allowed. If an array cannot be completed on one card, the array and the next location of the array to be used must be specified in the next cards.

3) A delimiter (comma or decimal point) must directly follow the numerical value; a blank between the number and delimiter may cause an incorrect interpretation of the number.

4) As many variable names and associated values as possible may be put on a single card as long as Rule (2) is not violated.

5) A comma is required after every numerical value if more values or variables are to be put on the same card.

3.1.1.2 General Input and Line Input

A description of the general input to the program and the input required for operating the line model is included in this section. See Section 3.4.2 of Reference 1 for the assumptions and equations used in modeling the line.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
ALPHA(II)	20	deg.	Angle line II makes with horizontal.
BK(I)*	8	lbf/in^2	Bulk modulus of elasticity of fluid (required only for liquid lines).
DELT	scalar	sec.	Program time increment.
DIAL(II)	20	in.	Diameter of IIth line.
EL(I)*	8	lbf/in^2	Young's modulus for lines containing liquid.
FACTØR	scalar	--	1. + the maximum Mach number expected in the line.
FRL(II)	20	--	Friction factor for line II.
G	scalar	ft/sec^2	Acceleration due to gravity.
KAY(I)	8	--	Ratio of specific heats of ith fluid (required only for gas lines)
LFLAG(I)	8	--	Type of fluid flag for speed of sound calculations. 0 = gas in line 1 = liquid in line
NPIPL	scalar	--	Number of lines in system. Presently limited to 20.
NPIPR(NN)	10	--	Integer indicating number of time-steps between printouts of Summary Output during interval NN. For example, if NPIPR(NN)22, the program will print out the summary output at every other time step starting at TIME=ØNIPR(NN) and ending at TIME=ØFFIPR(NN). See Section 3.2.3 for a list of the summary printout.
NPPLT(NN)	10	--	Same as NPIPR, but for plotted output.
NPLINE(II)	20	--	Phase flag for type of fluid in line II.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
ØFFIPR(NN)	10	--	Time to stop printing the summary printout for the NNth summary print interval.
ØNIPR(NN)	10	--	Time to start printing the summary output for the NNth summary print interval.
ØFFPLT(NN)	10	--	Same as ØFFIPR, but for plotted output.
ØNPLT(NN)	10	--	Same as ØNIPR, but for plotted output.
PZOO(II)	20	psi	Initial pressure at upstream point in line.
RHØL(I)	8	lb/ft^3	Density of fluid.
RGAS(I)*	8	ft-lbf/lbm-°R	Gas constant (not required for liquid lines)
TGAS(I)*	8	°Rankine	Temperature of gas in line (not required for liquid lines).
TH(II)	20	in.	Thickness of IIth line (not required for gas lines)
TIMEND	scalar	sec	End time of program.
XLENGL(II)	20	ft.	Length of line II
ZO(II)	20	ft.	Elevation of upstream end of line II.

*Up to eight different fluids can be handled by the program. Each line is assigned a fluid by the array NPLINE. If there is a large change in fluid properties across a device, such as across a regulator, then the lines on each side of the device should be treated as having different fluids.

3.1.2 Accumulator Input

The variables described in this section define the characteristics of the accumulators in the program. At present the program is limited to two accumulators. See Section 3.4.4.3 of Reference 1 for the assumptions and equations used in modeling the accumulator.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
IACC(I)	2	--	Index of line to which accumulator I is connected.
IACCPR	scalar	--	Debug printout will be generated IACCPRth time through the accumulator subroutine.
IENACC(I)	2	--	End of line IACC(I) to which accumulator is connected. 1 = upstream end 2 = downstream end
NACC	scalar	--	Number of accumulators in network.
NPIA(NN)	10	--	Same as NPIPR, described in Section 3.1.1.2, but for the accumulator printout. See Section 3.1.2 for a list of the accumulator printouts.
ØFFIA(NN)	10	--	Same as ØFFIPR, described in Section 3.1.1.2, but for the accumulator printout.
ØNIA(NN)	10	--	Same as ØNIPR, described in Section 3.1.1.2, but for the accumulator printout.
PACC(I)	2	ft/in^2	Pressure in accumulator I
VØLACC(I)	2	ft^3	Volume of accumulator I
XKACC(I)	2	ft^2	Effective area of accumulator I port.

3.1.3 Combustor and Turbopump Input

The following inputs are used in the combustor and turbopump subroutine. See Section 3.4.12 of Reference 1 for the assumptions and equations used in modeling the combustor and Section 3.4.14 of Reference 1 for the turbopumps. The program is limited to a total of six combustors and two turbopumps. A superscript C means combustor input and superscript T means turbopump input. If both appear together, then the variable is used by both.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
AREA(I,J)*^{CT}	(8,2)	in^2	Oxidizer and fuel thrust chamber valve effective area.
AREAC(I)^{CT}	8	in^2	Area of combustor throat.
ATDNØZ(K)^{T}	2	in^2	Effective cross-sectional area of turbine duct exit nozzle.
CEFI(K)^{T}	2	---	Coefficient in turbine efficiency curve.
CEF2(K)^{T}	2	---	Same as above. Note: ETAT(K) = CEF1(K)* U/CVEL + CEF2(K)*(U/CVEL)*
CMAN(I,J)^{CT}	(8,2)	in^2	Oxidizer and fuel injector effectiv area.

*Note: In these definitions I is the subscript for combustors and turbopumps. J is the propellant subscript with 1 being oxidizer and 2 being fuel. Turbopumps are entered in the arrays first. If no turbopumps are present, then the combustors are loaded in the first of the array. K is the subscript for variables which are used only in the turbopump portion of the routine.

CP1^{T}	scalar		Specific heat of turbopump fuel.
CP2(L)^{T}	6	---	Coefficients of polynomial giving specific heat for turbopump as a function of mixture ratio. Note: CP(I) = CP2(1) + CP2(2) * MR(I) + CP2(3) * MR(I) ** 2 + ...
CS1^{TC}	scalar	ft/sec	Characteristic velocity of pure fue

CS2(L)^{TC}	6	--	Coefficients of polynomial giving characteristic velocity of chamber gases as a function of mixture ratio.
DELTF^{TC}	scalar	sec	Time increment for combustor and turbopump.
DIAT(K)^{T}	2	in	Diameter of turbine rotor.
DTD(K)^{T}	2	in	Diameter of turbine exit duct.
GR(K)^{T}	2	--	Pump to turbine gear ratio.
ICHAM(I,J)^{TC}	(8,2)	--	Index of line oxidizer and fuel lines connected to ith combustor.
ICHAMP^{TC}	scalar	--	Combustor debug print flag. Print will occur every ICHAMPth DELTF time point.
IPUMI(K)^{T}	2	--	Index of line connected to pump inlet.
IPUMØ(K)^{T}	2	--	Index of line connected to pump outlet.
IS1^{TC}	scalar	lbf-sec/lbm	Specific impulse of fuel alone.
IS2(L)^{TC}	6	--	Same as CS2 except used for specific impulse.
MR1^{TC}	scalar	--	Mixture ratio below which combustion gas may be treated as fuel alone.
MW1^{TC}	scalar	lbm/lbm-mole	Molecular weight of fuel.
MW2(L)^{TC}	6	--	Same as CS2 except used for molecular weight.
NCHAM^{C}	scalar	--	Number of thrust chambers. Limited to six.
NCØEF^{TC}	scalar	--	Number of coefficients in the following polynomials CS2, IS2, MW2, and TC2. Must be set to the highest number of coefficients present in any one equation. Presently limited to six.
NGGTP^{T}	scalar	--	Number of turbopumps. Limited to two.

NPIC(NN)	10		Same as NPIPR described in Section 3.1.1.2, but for the combustor printout and based on the combustor time increment DELTF. See Section 3.2.2.1 for a list of the combustor printout.
NPIT(NN)	10	--	Same as NPIC, but for the turbopump output.
NPVALF(M)^{TC}	8	--	Number of points in Mth table of ØPVALF vs TMVALF.
NPVALØ(M)^{TC}	8	--	Same as above except for ØPVALØ vs TMVALØ.
ØFFIC(NN)	10	--	Same as ØFFIPR, described in Section 3.1.1.2, but for the combustor printout.
ØFFIT(NN)	10	--	Same as ØFFIC, but for the turbopump output.
ØNIC(NN)	10	--	Same as ØNIPR, described in Section 3.1.1.2, but for the combustor printout.
ØNIT(NN)	10		Same as ØNIC, but for the turbopump output.
ØPVALF(M,N)^{TC}	(8,60)	--	Tables of valve injector discharge coefficient versus time for fuel system.
ØPVALØ(M,N)$^{]}$	(8,6)	--	Same as above except for oxidizer system.
PØWO(K)^{T}	2	--	Coefficients in power vs. flowrate at design speed curve. (PØWP=PØWØ(K) + ···+ PØW3(K)*WP**3)
PØW1(K)^{T}	2	--	Same as above
PØW2(K)^{T}	2	--	Same as above
PØW3(K)^{T}	2	--	Same as above
PWO(K)^{T}	2	--	Coefficients in pressure vs. flowrate curve at design speed.
PW1(K)^{T}	2	--	Same as above
PW2(K)^{T}	2	--	Same as above

RPMPD(K)^{T}	2	rpm	Pump design speed
TCI^{TC}	scalar	^{o}R	Temperature of pure fuel
TC2(L)^{TC}	6	--	Same as CS2 except used for temperature of combustion chamber products.
TMVALF(M,N)^{TC}	(8,60)	sec	Table of time for valve discharge coefficient for fuel.
TMVALØ(M,N)^{TC}	(8,60)	sec	Same as above except for oxidizer.
VMAN(I,J)^{TC}	(8,2)	in^3	Oxidizer and fuel manifold volume
VØLC(I)^{TC}	8	in^3	Volume of ith chamber
XITP(K)^{T}	2	$lbm\text{-}in^2$	Moment of inertia of turbopump rotor.
XLTD(K)^{T}	2	ft	Length of turbine exit duct.

3.1.4 Flow Boundary Input

The following inputs impose a flowrate boundary at the end of a line. See Section 3.4.4.1 for the assumptions and equations used in modeling a flow boundary. The boundary may be varied as a function of time and at present, there can be ten flow boundaries.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
DFBL(I,J)	(10,50)	lbm/sec	Table of flow rates at boundary I. .
IFBL(I)	10	--	Index of line to which flow boundary (DFBL) is attached. If the line is downstream of the boundary, use the negative of the line index value.
NFBL	scalar	--	Number of flow boundaries.
NPFBL(I)	10	--	Number of points in table of DFBL vs. TFBL for flow boundary I.
TFBL(I,J)	(10,50)	sec	Table of times at which flow boundary I occur.

3.1.5 Line Junction Input

The variables described in this section provide the information necessary to form a junction of more than one line. See Section 3.4.8 of Reference 1 for the assumptions and equations used in modeling a junction. At present there may be ten junctions in the program, each capable of connecting up to five lines.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
IJUNCL(I,J)	(10,5)	--	Indexes of J lines which form the ith junction. If the line is downstream, input the negative of the line index value.
NJUNCL	scalar	--	Number of junctions.
NLINJU(I)	10	--	Number of lines at the ith junction.

3.1.6 Pressure Boundary Input

The pressure boundary inputs allow the program to compute a flowrate at the end of a line provided the pressure is a function of time. See Section 3.4.4.1 of Reference 1 for the assumptions and equations used in modeling a pressure boundary. There are ten possible pressure boundaries in this program.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
IEND(I)	10	--	End of line I to which pressure boundary is connected. 1=upstream end 2=downstream end
IPB(I)	10	--	Index of line to which pressure boundary I is connected.
NPBL	scalar	--	Number of pressure boundaries.
NPRBL(I)	10	--	Number of points in i^{th} table of PPRBL vs. TPRBL.
PPRBL(I,J)	(10,50)	psia	Table of time dependent pressures for pressure boundary I.
TPRBL(I,J)	(10,50)	sec	Table of times at which pressures occur for pressure boundary I.

3.1.7 Friction Pressure Boundary

This section describes the inputs used for defining the friction pressure boundaries. The program will calculate a flowrate and pressure immediately downstream of the resistance for a pressure and lumped resistance at the end of a line which are functions of time. See Section 3.4.4.2 of Reference 1 for the assumptions and equations used in modeling a friction pressure boundary. At present there can be ten such resistances.

MNEUMONIC	DIMENSION	UNITS	DESCRIPTION
IENDF(I)	10	--	End of line at which friction-pressure boundary I is connected. 1=upstream end 2=downstream end
IPBF(I)	10	--	Index of line IENDF(I) at which friction pressure boundary is connected.
NPBLF	scalar	--	Number of friction pressure boundaries.
NKPBLF(I)	10	--	Number of points in i^{th} table of XKPBLF vs. TKPBLF.
NPPBLF(I)	10	--	Number of points in i^{th} table of PPBLF vs. TPBLF.
PPBLF(I,J)	(10,50)	psia	Table of pressures at friction pressure boundary I.
TKPBLF(I,J)	(10,50)	sec	Table of times at which effective area XKPBLF occurs at friction pressure boundary I.
TPBLF(I,J)	(10,50)	sec	Table of times at which pressures PPBLF occur at friction pressure boundary I.
XKPBLF(I,J)	(10,50)	ft^2	Table of effective areas at friction pressure boundary I.

3.1.8 Regulator Input

This section presents a description of the input variables used for defining the regulator. See Section 3.4.10 of Reference 1 for the assumptions and equations used in modeling a regulator. At present, the program is limited to eight regulators.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
AREGMX(I)	8	in^2	Maximum flow area of regulator I.
AREGP(I)	8	in^2	Effective area for pressure balance for regulator I.
FREG(I)	8	lbf	Spring force acting when regulator valve is shut.
IREGPR	scalar	--	Every IREGPRth point will be printed when debug print is called for.
LREGDN(I)	8	--	Index of line to which downstream side of regulator is connected.
LREGUP(I)	8	--	Index of line to which upstream side of regulator is attached.
NREG	scalar	--	Number of regulators in system.
NPIR(NN)	10	--	Same as NPIPR, described in Section 3.1.1.2, but for the regulator printout. See Section 3.2.2.3 for the regulator printout.
ØFFIR(NN)	10	--	Same as ØFFIPR, described in Section 3.1.1.2, but for the regulator printou
ØNIR(NN)	10	--	Same as ØNIPR, described in Section 3.1.1.2, but for the regulator printou
PREF(I)	8	lbf/in^2	Regulator reference pressure.
QREG(I)	8	in^2/in	Constant relating regulator flow area to spring position.
SPREG(I)	8	lbf/in	Regulator spring constant.
TAUREG(I)	8	sec	Regulator time delay.

3.1.9 Lumped Resistance Input

This section describes the input which allows the user to form lumped resistances within the feed system. Lumped resistances may be used to describe the losses in valves, orifices, discontinuities in pipe sizes, and bends. See Section 3.4.6 of Reference 1 for the assumptions and equations used in modeling a lumped resistance. At present, the program allows ten lumped resistances to be used.

MNEMONIC	DIMENSION	UNITS	DESCRIPTION
LVDN(I)	10	--	Index of line to which downstream end of resistance is connected.
LVUP(I)	10	--	Index of line to which upstream end of resistance is connected.
NVALL	scalar	--	Number of lumped resistances.
NXKVL(I)	10	--	Number of points in i^{th} tables of XKVL versus TMVL.
TMVL(I,J)	(10,50)	sec	Independent table of times for i^{th} resistance.
XKVL(I,J)	(10,50)	ft^2	Dependent table of lumped resistances effective area for i^{th} resistance.

3.1.10 TRW Plot Package

This section is a condensed version of TRW Report No. 11176-H-594-RO-00, dated August 1970, and is included as a user's guide for operating the plot package which is a part of the ACPS transient program (HP014A). The description of this package is divided into three sections and describes the following: (1) Data tape format, (2) Data deck description, and (3) control card description.

The data tape generated by HP014A for use by the plotting program, (TRWPLT) has three record format types. A Type One record contains time and flowrate pressure data for the first and last node of each line. A Type Two record contains time and combustor turbopump data. A Type Three record contains time and regulator, accumulator, lumped resistance, and friction pressure boundary data. The order of data in each record type is as follows:

Type One Record -

Word 1 - record identifier,=1
Word 2 - number of data words in record,=4*NPIPL + 1
Word 3 - program time
Word 4 - 3+4*NPIPL - flowrate and pressure data for first and last node in each line.

Type Two Record -

Word 1 - record identifier,=2
Word 2 - number of data words in record,=1 + 14*(NCHAM+NGGTP) + 8*NGGTP
Word 3 - Combustor time
Word 4 - 3 + 14*(NCHAM+NGGTP) + 8*NGGTP - combustor and turbopump data

Type Three Record -

Word 1 - record identifier,=3
Word 2 - number of data words in record,=1 + NREG+NACC+2*NPBLF+ NVALL
Word 3 - Program time
Word 4 - NREG + NACC + 2*NPPBLF + NVALL - data from regulator, accumulator and lumped resistance and friction pressure boundary data.

The number of data records written on the tape will be 1 + 3* (TIMEND/DELT/IPLØT). The user has the option to control the number of times plot data is written through the input by variable IPLØT.

Section II: DATA DECK DESCRIPTION

Four cards are required to generate data for one plot. A description of these four cards is listed below followed by a description of various options available to the user.

1. PLØT - Specifies the variables to be plotted (must be input for each plot).

   The variables to be plotted may be specified either by BCD symbols or by the location of the variable in the record. The BCD symbols used in this program are shown in Table 1. The specification by location in the record is not given because the relative positions change depending on the construction of the network.

   A. Specification by BCD symbols:

      PLØT = XSYM, IRECX, $YSYM_1$, $IRECY_1$, $YSYM_2$, ..., $YSYM_n$, $IRECY_n$, ENDLST

      where

      XSYM denotes the BCD symbol of the abscissa variable,
      IRECX denotes the record type in which XSYM will be found,
      $YSYM_1$ denotes the BCD symbol the the ith ordinate variable ($i = 1, n$ where max $n = 10$),
      IRECY denotes the record type in which $YSYM_1$ will be found,
      ENDLST terminates the list of symbols and record types.

      The resultant graph will consist of n traces, XSYM vs. $YSYM_1$, XSYM vs. $YSYM_2$, ..., XSYM vs. $YSYM_n$.

      Examples:

      PLØT = Time, 1, P1L, 1, P2L, 1, ENDLST

      Two traces will be plotted on the graph, P1L vs. Time and P2L vs. Time

      where the data for Time is in record type 1,

TABLE 1. BCD PLOT SYMBOLS

Record Type One:

BCD	Symbol	Description
TIME		Run time
WiF,	i = 1, 20	Flowrate, line i, first node
WiL,	i = 1, 20	Flowrate, line i, last node
PiF,	i = 1, 20	Pressure, line i, first node
PiL,	i = 1, 20	Pressure, line i, last node

Record Type Two:

TIMEF		Chamber integration time
$PCHAM_i$,	i = 1, 8	Chamber pressure, $chamber_i$
$WCHAM_i$	i = 1, 8	Weight of propellant in chamber, $chamber_i$
$CSTAR_i$,	i = 1, 8	Characteristic velocity, $chamber_i$
$PMAN1_i$,	i = 1, 8	Manifold pressure, ox side, $chamber_i$
$PMAN2_i$,	i = 1, 8	Manifold pressure, fuel side, $chamber_i$
ISP_i,	i = 1, 8	Specific impulse, $chamber_i$
MR_i,	i = 1, 8	Mixture ratio, $chamber_i$
MW_i,	i = 1, 8	Molecular weight, $chamber_i$
$WFUEL_i$,	i = 1, 8	Weight fuel in chamber, $chamber_i$
$WØX_i$,	i = 1, 8	Weight x in chamber, $chamber_i$
$CV1_i$,	i = 1, 8	Ox valve discharge coefficient, $chamber_i$
$CV2_i$,	i = 1, 8	Fuel valve discharge coefficient, chamber
$WINJ1_i$,	i = 1, 8	Ox injector flowrate, $chamber_i$
$WINJ2_i$,	i = 1, 8	Fuel injector flowrate, $chamber_i$
$TIMPL_i$,	i = 1, 6	Total impulse, combustion chamber $_i$
$PØWP_i$,	i = 1, 2	Pump input power, $turbopump_i$
$PØWT_i$,	i = 1, 2	Turbine power, $turbopump_i$
$PTØ_i$,	i = 1, 2	Pressure at turbine outlet, $turbopump_i$
$RPMT_i$,	i = 1, 2	Turbine speed, turbopump, i
$TØRP_i$,	i = 1, 2	Pump torque, $turbopump_i$

$T\emptyset RT_i$,	i = 1, 2	Turbine torque, turbopump$_i$
$TT\emptyset_i$,	i = 1, 2	Turbine outlet temperature, turbopump$_i$
$WTDN\emptyset Z_i$	i = 1, 2	Flowrate through turbine duct exit nozzle, turbopump$_i$

Record Type Three:

$AREG_i$,	i = 1, 8	Regulator flow area, regulator$_i$
$PACC_i$,	i = 1, 2	Pressure in accumulator$_i$
$PBNDL_i$,		Pressure at boundary$_i$
XKP_i,		Effective flow area at pressure boundary$_i$ with friction
XK_i,		Effective flow area at lumped resistance$_i$

where the data for P1L is in record type 1, and

where the data for P2L is in record type 1.

PLØT = TIMEF, 2, CSTAR1, 2, CSTAR2, 2, CSTAR3, 2, ENDLST

Three traces will be plotted on the graph,

CSTAR1 (Record type 2) vs. TIMEF (Record type 2),

CSTAR2 (Record type 2) vs. TIMEF (Record type 2),

CSTAR3 (Record type 2) vs. TIMEF (Record type 2).

2. ENDPLT - This card marks the termination of the inputs for one plot.

3. ENDFIL - The appearance of this card marks the termination of the inputs for one file and causes that file of data to be plotted.

4. ENDRUN - This card marks the termination of all inputs, causes a wrap-up to occur and control to exit the program.

NOTE: The symbols, ENDPLT, ENDFIL, and ENDRUN must appear on a separate card from other inputs. To generate more than one plot per file, cards 1 and 2 would be repeated for as many plots as desired.

The following three cards are used to create labels on the plots. It should be noted that once these inputs are defined by the user they will be used on all subsequent plots until changed or deleted. All cards are 66 characters in length. Each symbol must be followed by = ID = which indicates any combination of characters may follow.

5. TITLE - Graph title; printed at the top of the graph.
   EX: TITLE = ID = USER'S SAMPLE GRAPH TITLE

6. XLABEL - X-axis title; printed below the independent variable axis. EX: XLABEL = ID = USER'S SAMPLE X-AXIS TITLE

7. YLABEL - Y-axis title; printed to the left of the dependent variable axis. EX: YLABEL = ID = USER'S SAMPLE Y-AXIS TITLE

TRWPLT automatically scales the data and optimizes the limits of the plots to insure that all data points are included. However, provision is made for the user to input his own scales instead of using the TRWPLT automatic logic. If the scales are user input they will continue to be utilized for each plot until changes by the addition of the following cards.

8. ISCALX - abscissa scale selector
   = 0 TRWPLT will optimize scaling
   = 1 Input limits will be used

   NOTE: If set = 1 in plot A, and set = 0 in plot B, the scales from plot A will be used in plot B also.

9. ISCALY - ordinate scale selector
   = 0 TRWPLT will do scaling
   = 1 Input limits will be used

   NOTE: The note concerning ISCALX also applies to ISCALY.

10. XLØ - lower limit for the X-axis

11. XHI - upper limit for the X-axis

12. YLØ - lower limit for the Y-axis

13. YHI - upper limit for the Y-axis

NOTE: If both XLØ and XHI are zero, then the limits will be set equal to the minimum and the maximum of the abscissa data points. If both YLØ and YHI are zero, then the limits will be set equal to the minimum and maximum of the ordinate data points. In conjunction with the note on card 8, the only way to return to automatic scaling is to set both limits, XLØ and XHI, YLØ and YHI to zero.

The next two options are very useful in multi-file and multi-reel plotting.

14. REPEAT - The card causes the next file of the data tape (or a new data tape) to be read and processed with the same inputs as in the preceding file.

NOTE: The symbol REPEAT must appear on a separate card from other inputs. No new inputs may be used with this option except for the next card.

15. KUNIT - The number of the tape unit on which the input data tape is mounted (initialized to 8). Units 2, 4, 12, and 13 are used for working storage and cannot be used.

Although the description of TRWPLT discussed in this section has not presented all of the options available to the plot program, those described will allow the user a fair degree of sophistication in plotting data from the HP014A Program.

Section III: DESCRIPTION OF CONTROL CARDS

Because of the possibility of a double execution of HP014A and TRWPLT, control cards for both programs are discussed below:

1. Control cards for HP014A

	Card Column 1 2 3 4 5 6 7 8 . . .	61-74
A.	∇ P Δ R U N Δ F1, F2, F3, F4, F5, F6, F7, F8, F9, F10	NAME
B.	∇ ASG X = αααααα	

```
C.  V     XQT   CUR
D         TRW   X
E.        IN    X
F.        TRW   X
G.  VQ    XQT   HP014A
H.        HP014A  DATA DECK
I.  V     EØF
```

Description:

A. The fields for card A are as follows:

P - Priority indicator, either A, P, or Z. A priority code must be present.

a) "A" - Special priority to be used only with approval of the MSC operations monitor or shift supervisor.

b) "P" - Standard priority to be used for EXPRESS jobs and for those groups that have been authorized priority for specific jobs.

c) "Z" - To be used for all nominal work.

F1 - Six character badge number

F2 - Division code

F3 - Building, box number

F4 - Project number (1-6 characters)

F5 - Program number (1-6 characters)

F6 - Type run (1 character)

F7 - Estimated time for run (min)

F8 - Estimated hundreds of pages output for run

F9 - Print channel

F10 - Punch channel

Name - Programmer's name

Fields F1 - F6 are always required. Fields F7 - F10 are optional. System will use 3 minutes and 100 pages for F7 and F8, respectively, if not input.

B. ααααα is the tape number of the program tape

C. Execute the complex utility routine to manipulate tapes.

D. Rewind tape X to load point

E. Read program into PCF area

F. Rewind tape X to load point

G. Execute the program

H. Data deck

I. End of file card

2. Control cards for HP014A and TRWPLT

```
     Card Column
     1 2 3 4 5 6 7 8 . . .                61-74
A.   ∇ P   R U N   F1, F2, . . ., F10     NAME
B.   ∇       ASG X = ααααα
C.   ∇       ASG Y = STRWPL
D.   ∇W      ASG F = WØRK1
E.   ∇SW     ASG P = CCP1
F.   ∇       XQT CUR
G.           TRW X
H.           IN  X
I.           TRW X
J.   ∇Q      XQT HP014A
K.           HP014A  DATA DECK
L.   ∇       XQT CUR
M.           ERS
N.           TRW Y
O.           IN  Y
P.   ∇       XQT TRWPLT
Q.           PLØT DATA DECK
R.   ∇       EØF
```

Description:

A,B. Discussed in Part 1

C. Identifier to direct the operator to allow the program to use permanent fastrand file TRWPL

D. Work tape containing the plot data for TRWPLT

E. CALCOMP plot tape

G-L. Discussed in Part 1

M. Clear the PCF area

N. Position lead head on Y to selected file

O. Read TRWPLT into PCF area

P. Execute TRWPLT

Q. TRWPLT data deck

R. Discussed in Part 1

If the user wishes to save the plot data in order to plot it at a later time, the following changes should be made.

a) Remove card C

b) Change card D to

VSW ASG F=SAVE

c) Remove cards L-Q

3. Control cards for TRWPLT

```
     Card Columns
     1 2 3 4 5 6 7 8 . . .          61-74
A.   V P   R U N   F1, . . ., F10   NAME
B.   V     ASG Y = TRWPL
C.   V     ASG F = αααα
D.   V     XQT CUR
E.         TRW Y
F.         IN  Y
G.   VQ    XQT  TRWPLT
H.         TRWPLT DATA DECK
I.   V     EØF
```

All cards necessary to use the TRWPLT subroutines have been explained except C. Card C contains the number of the data tape to be plotted.

Section IV. LISTING OF SAMPLE CASE PLOT DECK

A listing of the plot deck prepared for the sample case shown in Figure 1 is presented on the following pages.

It should be noted that the user has the ability to use this plot package to cross plot; i.e., to plot variable against variable, in addition to the variable against time. It is also possible to plot variables from one record type against variables from another record type. For examples of plotted output see Figure 39 of Reference 1.

```
*QN  XQT  TRWPLT
ICCOMP=1
KUNIT=8
ISCALX=1
XLO=0.0
DELX=0.05
PPNM=4.0
XLABEL=ID=ELAPSED  TIME    SEC
YLABEL=ID=LINE PRESSURE    LBF/SQ-IN
TITLE=ID=PIPE   1  NODE 1
PLOT=TIME,1,P1F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  1   NODE   9
PLOT=TIME,1,P1L,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  2   NODE   1
PLOT=TIME,1,P2F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  2   NODE   3
PLOT=TIME,1,P2L,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  3   NODE   1
PLOT=TIME,1,P3F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  3   NODE   4
PLOT=TIME,1,P3L,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  4   NODE   1
PLOT=TIME,1,P4F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  4   NODE   4
PLOT=TIME,1,P4L,1,ENDLST
ENDPLT
YLABEL=ID=LINE FLOW RATE   LBM/SEC
TITLE=ID=  PIPE  1   NODE   1
PLOT=TIME,1,W1F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  1   NODE   9
PLOT=TIME,1,W1L,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  2   NODE   1
```

```
PLOT=TIME,1,W2F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  2   NODE   3
PLOT=TIME,1,W2L,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  3   NODE   1
PLOT=TIME,1,W3F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  3   NODE   4
PLOT=TIME,1,W3L,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  4   NODE   1
PLOT=TIME,1,W4F,1,ENDLST
ENDPLT
TITLE=ID=  PIPE  4   NODE   4
PLOT=TIME,1,W4L,1,ENDLST
ENDPLT
YLABEL=ID=     CHAMBER  PRESSURE  LBF/SQ-IN
TITLE=ID=      CHAMBER  PRESSURE
PLOT=TIMEF,2,PCHAM1,2,ENDLST
ENDPLT
YLABEL=ID=     PROPELLANT WEIGHT IN CHAMBER  LBM
TITLE=ID=      PROPELLANT WEIGHT IN CHAMBER
PLOT=TIMEF,2,WCHAM1,2,ENDLST
ENDPLT
YLABEL=ID=     CSTAR     FT/SEC
TITLE=ID=      CSTAR
PLOT=TIMEF,2,CSTAR1,2,ENDLST
ENDPLT
YLABEL=ID=     MANIFOLD PRESSURE     LBF/SQ-IN
TITLE=ID=      MANIFOLD PRESSURE -- OX SIDE
PLOT=TIMEF,2,PMAN11,2,ENDLST
ENDPLT
TITLE=ID=      MANIFOLD PRESSURE -- FUEL SIDE
PLOT=TIMEF,2,PMAN21,2,ENDLST
ENDPLT
YLABEL=ID=     SPECIFIC IMPULSE  SEC
TITLE=ID=      SPECIFIC IMPULSE
PLOT=TIMEF,2,ISP1,2,ENDLST
ENDPLT
YLABEL=ID=     MIXTURE RATIO
```

```
TITLE=ID=       MIXTURE RATIO
PLOT=TIMEF,2,MR1,2,ENDLST
ENDPLT
YLABEL=ID=      MOLECULAR WEIGHT
TITLE=ID=       MOLECULAR WEIGHT
PLOT=TIMEF,2,MW1,2,ENDLST
ENDPLT
YLABEL=ID=      FUEL WEIGHT    LBM
TITLE=ID=       FUEL WEIGHT
PLOT=TIMEF,2,WFUEL1,2,ENDLST
ENDPLT
YLABEL=ID=      OXIDIZER WEIGHT    LBM
TITLE=ID=       OXIDIZER WEIGHT
PLOT=TIMEF,2,WOX1,2,ENDLST
ENDPLT
YLABEL=ID=      VALVE DISCHARGE COEFFICIENT
TITLE=ID=       VALVE DISCHARGE COEFFICIENT  -- OX SIDE
PLOT=TIMEF,2,CV11,2,ENDLST
ENDPLT
TITLE=ID=       VALVE DISCHARGE COEFFICIENT --  FUEL SIDE
PLOT=TIMEF,2,CV21,2,ENDLST
ENDPLT
YLABEL=ID=      MANIFOLD FLOWRATE     LBM/SEC
TITLE=ID=       MANIFOLD FLOWRATE -- OX SIDE
PLOT=TIMEF,2,WINJ11,2,ENDLST
ENDPLT
TITLE=ID=       MANIFOLD FLOWRATE -- FUEL SIDE
PLOT=TIMEF,2,WINJ21,2,ENDLST
ENDPLT
YLABEL=ID=      POWER INPUT TO PUMP      FT-LBF/SEC
TITLE=ID=       POWER INPUT TO PUMP
PLOT=TIMEF,2,POWP1,2,ENDLST
ENDPLT
YLABEL=ID=      TURBINE POWER      FT-LBF/SEC
TITLE=ID=       TURBINE POWER
PLOT=TIMEF,2,POWT1,2,ENDLST
ENDPLT
YLABEL=ID=      PRESSURE AT TURBINE OUTLET     LBF/SQ-IN
TITLE=ID=       PRESSURE AT TURBINE OUTLET
PLOT=TIMEF,2,PTO1,2,ENDLST
ENDPLT
```

```
YLABEL=ID=      TURBINE SPEED      REV/MIN
TITLE=ID=       TURBINE SPEED
PLOT=TIMEF,2,RPMT1,2,ENDLST
ENDPLT
YLABEL=ID=      PUMP TORQUE        FT-LBF
TITLE=ID=       PUMP TORQUE
PLOT=TIMEF,2,TORP1,2,ENDLST
ENDPLT
YLABEL=ID=      TURBINE TORQUE     FT-LBF
TITLE=ID=       TURBINE TORQUE
PLOT=TIMEF,2,TORT1,2,ENDLST
ENDPLT
YLABEL=ID=      TURBINE OUTLET TEMPERATURE    DEGREES R
TITLE=ID=       TURBINE OUTLET TEMPERATURE
PLOT=TIMEF,2,TTO1,2,ENDLST
ENDPLT
YLABEL=ID=      FLOW RATE THRU TURBINE DUCT EXIT NOZZLE    LBM/SEC
TITLE=ID=       FLOW RATE THRU TURBINE DUCT EXIT NOZZLE
PLOT=TIMEF,2,WTNOZ1,2,ENDLST
ENDPLT
ENDFIL
ENDRUN
'EB  PMD
' EOF                                                          FOE '
```

3.1.11 Sample Namelist Input

The following pages contain a sample listing of the input required to simulate the ACPS propulsion system shown in Figure 1.

```
CARD COL       1         2         3         4         5         6         7         8
 NO.*12345678901234567890123456789012345678901234567890123456789012345678901234567890*
  1.* $INDATA                                                                        *
  2.* DELT=.001,                                                                     *
  3.* DELTF=.0001                                                                    *
  4.* TIMEND = .3                                                                    *
  5.* ONIA(1) =0.0,                                                                  *
  6.* OFFIA(1)=.001,                                                                 *
  7.* ONIC(1) =0.0,                                                                  *
  8.* OFFIC(1)=.001,                                                                 *
  9.* ONIPR(1)=0.0,                                                                 *
 10.* OFFIPR(1)=.001,                                                               *
 11.* ONIR(1) =0.0,                                                                 *
 12.* OFFIR(1)=.001,                                                                *
 13.* ONIT(1) =0.0,                                                                 *
 14.* OFFIT(1)=.001,                                                                *
 15.* NPIA(1) =10*1,                                                                *
 16.* NPIC(1) =10*1,                                                                *
 17.* NPIPR(1)=10*1,                                                               *
 18.* NPIR(1) =10*1,                                                                *
 19.* NPIT(1) =10*1,                                                                *
 20.* IPLOT=1,                                                                      *
 21.* NPPLT=1,                                                                      *
 22.* ONPLT(1)=0.,                                                                  *
 23.* OFFPLT(1)=20.,                                                               *
 24.* FACTOR=1.2,                                                                   *
 25.* INCL(17)=1,                                                                   *
 26.* INCL(19)=1,                                                                   *
 27.* CL(17)=2500.0                                                                *
 28.* CL(19)=2500.0                                                                *
 29.* XLTD(1)=5.0,                                                                 *
 30.* NPIPL=19,                                                                     *
 31.* NGGTP=1,                                                                     *
 32.* NCHAN=4,                                                                     *
 33.* LFLAG=8*0,                                                                   *
 34.* AREAC=0.26,3*3.39,0.437.                                                    *
 35.* ICHAN(1,1)=6,  ICHAM(1,2)=18,                                               *
 36.* ICHAN(2,1)=2,  ICHAM(2,2)=7,                                                *
 37.* ICHAN(3,1)=3,  ICHAM(3,2)=8,                                                *
 38.* ICHAN(4,1)=4,  ICHAM(4,2)=9,                                                *
 39.* ICHAN(5,1)=5,  ICHAM(5,2)=14,                                               *
 40.* VOLC(1)=6.84,3*101.8,13.1,                                                  *
 41.* RGAS(1)=3*48.3,4*766.0,                                                     *
 42.* TGAS(1)=7*500.0,                                                           *
 43.* KAY(1)=3*1.495,4*1.367,                                                     *
 44.* RHOL(1)=3.28,2.98,2.30,0.376,0.207,0.188,0.1503,4.43,                      *
 45.* PZ00=4*550.,500.,400.,4*555.,3*1050.,505.,2*1050.,.50.,405.,.50.,          *
 46.* DIAL(1)=2.95,3*1.7,2*0.0576,3*1.7,2.75,3*6.0,2.950,3*6.0,1.836,6*0.,       *
 47.* XLENGL(1)=6*5.0,3*20.0,9*15.0,20.0,                                        *
 48.* VMAN(1,1)=0.684, VMAN(1,2)=2.736,                                          *
 49.* VMAN(2,1)=10.18, VMAN(2,2)=30.54,                                          *
 50.* VMAN(3,1)=10.18, VMAN(3,2)=30.54,                                          *
 51.* VMAN(4,1)=10.18, VMAN(4,2)=30.54,                                          *
 52.* VMAN(5,1)=1.310, VMAN(5,2)=3.930,                                          *
 53.* NCOEF=4,MR1=.5,MW1=2.016,TC1=500.,CS1=5161.4,IS1=300.0,CP1=3.4,            *
 54.* DIAT(1)=24.8,  RPMPD(1)=50000.,AIIP(1)=0.0457, GR(1)=1., ATONOZ(1)=19.0,   *
 55.* DTD(1)=10.613, IPUMO(1)=17,   IPUN1(1)=19,                                 *
 NO.*12345678901234567890123456789012345678901234567890123456789012345678901234567890*
```

```
CARD COL       1         2                   4         5         6         7         8
 NO.*12345678901234567890123456789012345678901234567890123456789012345678901234567890.
 56.* NJUNCL=3, NLINJU(1)=4,4,5, IJUNCL(1,1)=1,  IJUNCL(1,2)=-2, IJUNCL(1,3)=-3,      .
 57.* IJUNCL(1,4)=-4, IJUNCL(2,1)=10,  IJUNCL(2,2)=-7, IJUNCL(2,3)=-8,IJUNCL(2,4)=-9,.
 58.* IJUNCL(3,1)=16, IJUNCL(3,2)= -15, IJUNCL(3,3)=-12, IJUNCL(3,4)=-11,            .
 59.* IJUNCL(3,5)= -13,                                                              .
 60.* NACC=1,IACC(1)=12, IENACC(1)=2,VOLACC(1)=500.,PACC(1)=1000., XKACC(1)=.04575,  .
 61.* NPBL=4, IPB(1)=1,5,6,19, IEND(1)= 4*1,                                        .
 62.* PACC(1)=1050.0,                                                               .
 63.* NPRBL(1)=4*2,                                                                 .
 64.* PPRBL(1,1)= 550., PPRBL(1,2)=550., TPRBL(1,1)=0.0, TPRBL(1,2)=20.0,           .
 65.* PPRBL(2,1)= 500., PPRBL(2,2)=500., TPRBL(2,1)=0.0, TPRBL(2,2)=20.0,           .
 66.* PPRBL(3,1)= 400., PPRBL(3,2)=400., TPRBL(3,1)=0.0, TPRBL(3,2)=20.0,           .
 67.* PPRBL(4,1)=50.,   PPRBL(4,2)=50.,  TPRBL(4,1)=0.0, TPRBL(4,2)=20.0,           .
 68.* NREG=3, SPREG(1)=100.,100.,100.,      QREG(1)=2.4464, 0.27648,0.12912,        .
 69.* AREGP(1)=3*5.0,                  TAUREG(1) =0.005,0.005,0.005,                .
 70.* LREGDN(1)= 10,14,18,  LREGUP(1)=11,15, 13,  AREGMX(1)= 0.611595,0.069306,    .
 71.* AREGMX(3)= 0.0322818,                                                         .
 72.* FREG=2750.,2500.,2000.,                                                       .
 73.* NPLINE=1,1,1,1,2,3,5,5,4,5,4,4,4,6,4,4,8,7,8,                                 .
 74.* NVALL=1,                                                                      .
 75.* LVDN=16, LVUP=17,                                                            .
 76.* NXKVL=4,                                                                     .
 77.* TMVL(1,1)=0.0, TMVL(1,2)=0.25, TMVL(1,3)=0.27, TMVL(1,4)=20.0,               .
 78.* XKVL(1,1)=0.0, XKVL(1,2)=0.0,  XKVL(1,3)=0.0378675, XKVL(1,4)=0.0378675,    .
 79.* NPVALO(1)=5*3,                                                              .
 80.* NPVALF(1)=5*3,                                                              .
 81.* OPVALO(1,1)=0.0, OPVALO(1,2)=1.0, OPVALO(1,3)=1.0,                          .
 82.* TMVALO(1,1)=0.0, TMVALO(1,2)=0.2, TMVALO(1,3)=20.0,                         .
 83.* OPVALF(1,1)=0.0, OPVALF(1,2)=1.0, OPVALF(1,3)=1.0,                          .
 84.* TMVALF(1,1)=0.0, TMVALF(1,2)=0.2, TMVALF(1,3)=20.0,                         .
 85.* OPVALO(2,1)=0.0, OPVALO(2,2)=1.0, OPVALO(2,3)=1.0,                          .
 86.* TMVALO(2,1)=0.0, TMVALO(2,2)=.02, TMVALO(2,3)=20.0,                         .
 87.* OPVALF(2,1)=0.0, OPVALF(2,2)=1.0, OPVALF(2,3)=1.00,                         .
 88.* TMVALF(2,1)=0.0, TMVALF(2,2)=.02, TMVALF(2,3)=20.0,                         .
 89.* OPVALO(3,1)=0.0, OPVALO(3,2)=1.0, OPVALO(3,3)=1.0,                          .
 90.* TMVALO(3,1)=0.0, TMVALO(3,2)=.02, TMVALO(3,3)=20.0,                         .
 91.* OPVALF(3,1)=0.0, OPVALF(3,2)=1.0, OPVALF(3,3)=1.0,                          .
 92.* TMVALF(3,1)=0.0, TMVALF(3,2)=.02, TMVALF(3,3)=20.0,                         .
 93.* OPVALO(4,1)=0.0, OPVALO(4,2)=1.0, OPVALO(4,3)=1.0,                          .
 94.* TMVALO(4,1)=0.0, TMVALO(4,2)=.02, TMVALO(4,3)=20.0,                         .
 95.* OPVALF(4,1)=0.0, OPVALF(4,2)=1.0, OPVALF(4,3)=1.0,                          .
 96.* TMVALF(4,1)=0.0, TMVALF(4,2)=.02, TMVALF(4,3)=20.0,                         .
 97.* OPVALO(5,1)=0.0, OPVALO(5,2)=1.0, OPVALO(5,3)=1.0,                          .
 98.* TMVALO(5,1)=0.0, TMVALO(5,2)=0.2, TMVALO(5,3)=20.0,                         .
 99.* OPVALF(5,1)=0.0, OPVALF(5,2)=1.0, OPVALF(5,3)=1.0,                          .
100.* TMVALF(5,1)=0.0, TMVALF(5,2)=0.2, TMVALF(5,3)=20.0,                         .
101.* AREA(1,1)=.33819811E-1, AREA(1,2)=.16866662, AREA(2,1)=.9014018,            .
102.* AREA(2,2)=.8994002, AREA(3,1)=.9014018, AREA(3,2)=.8994002, AREA(4,1)=.9014018,.
103.* AREA(4,2)=.8994002, AREA(5,1)=.64541332E-1, AREA(5,2)=.32153013,            .
104.* CMAN(1,1)=.35007474E-1, CMAN(1,2)=.17462661, CMAN(2,1)=.92366926,           .
105.* CMAN(2,2)=.92171674, CMAN(3,1)=.92366926, CMAN(3,2)=.92171674,             .
106.* CMAN(4,1)=.92366926, CMAN(4,2)=.92171674, CMAN(5,1)=.66310593E-1,           .
107.* CMAN(5,2)=.33038728,                                                        .
108.* SEND                                                                        .
109.*DECKEND                                                                      .
 NO.*12345678901234567890123456789012345678901234567890123456789012345678901234567890.
```

3.2 Output Description

Program HP014A has two output capabilities and several printed output options. It also is capable of generating an output data tape that is compatible with TRWPLT as an input data tape.

The printed output consists of initial print, detailed print, and nominal print. The number of time points printed is controlled by the value of the print flags input by the user. A description of the various output options follows.

3.2.1 Initialization and Line Printout

This block of printout contains both input values and values computed by the main program in setting up the case.

AREAL(II)	Cross-sectional area of pipeline II	ft^2
BK	Bulk modulus of elasticity of fluid I	lbf/in^2
CL(II)	Speed of sound in line	ft/sec
DELT	Time increment	sec
DELTF	Combustor time increment	sec
DELXL(II)	Distance between nodes, ith fluid line	ft
DIAL(II)	Diameter of ith line	in.
FRL(II)	Friction factor, line II	
G	Acceleration due to gravity	ft/sec^2
GC	32.174	$lbm\text{-}ft/sec^2\text{-}lbf$
IEND(I)	End of line to which pressure boundary is connected 1 = upstream end 2 = downstream end	
IPB(I)	Line to which pressure boundary I is connected	

LVDN(I)	Line to which downstream end of valve is connected	
LVUP(I)	Line to which upstream end of valve is connected	
NACC	Number of accumulators	
NCHAM	Number of thrust chambers	
NFBL	Number of flow boundaries	
NGGTP	Number of gas generator turbopump combination	
NJUNCL	Number of junctions	
NJUNCL(I,J)	Lines to which junction is connected, if the line is downstream use the negative of the line index value	
NØDEL(II)	Number of nodes, ith fluid line	
NPBL	Number of pressure boundaries	
NPBLF	Number of pressure boundaries with lumped variable friction	
NPIPL	Number of line	
NPLINE(II)	Fluid in line II	
NREG	Number of regulators	
NVALL	Number of valves	
PL(II,JJ)	Pressure at jth node of the ith pipeline	psi
RHØL	Density of fluid I	lb/ft^3
SINALP(II)	Sine of ALPHA(II)	
THETA(II)	DELT/DELXL(II)	
WDØTL(II,JJ)	Flowrate at jth node of the ith line	lbm/sec
Z(II,JJ)	Elevation of node JJ in Line II	ft.

3.2.2 Detailed Printout

3.2.2.1 Manifold and Thrust Chamber

This printout block is comprised of all the variables that are used in the computation of the manifold and thrust chamber parameters.

C	Intermediate Calculations	
C1	Intermediate calculations	
C6	Intermediate calculations	
C7	Intermediate calculations	
C8	Intermediate calculations	
C9	Intermediate calculations	
C11	Intermediate calculations	
CC	Intermediate calculations	
CSTAR(I)	Characteristic exhaust velocity of ith chamber	ft/sec
CV(I,1)	Thrust chamber valve discharge coefficient, oxidizer	
CV(I,2)	Thrust chamber valve discharge coefficient, fuel	
DELP	Intermediate calculations	
DPMAN(I,1)	Derivative of oxidizer manifold pressure with respect to time	lbf/in^2-sec
DPMAN(I,2)	Derivative of fuel manifold pressure with respect to time	lbf/in^2-sec
DWFUEL(I)	Derivative of mass of fuel in chamber with respect to time	lbm/sec
DWØX(I)	Derivative of mass of oxidizer in chamber with respect to time	lbm/sec

ISP(I)	Specific impulse of gas in ith chamber	ft/sec
MR(I)	Molecular weight of gas in ith chamber	
MW(I)	Molecular weight of gas in ith chamber	
PCHAM(I)	Chamber pressure	lbf/in^2
PMAN(I,1)	Oxidizer manifold pressure	lbf/in^2
PMAN(I,2)	Fuel manifold pressure	lbf/in^2
PRAT1	Intermediate calculation	
PSØN	Intermediate calculation	
PTEMP(II,JJ)	Temporary storage	lbf/in^2
TC(I)	Temperature of gas in ith chamber	^oR
TIMEF	Time of combustor calculation	
WCHAM(I)	Mass of propellant in the ith combustion chamber	lbm
WFUEL(I)	Mass of fuel in the ith combustion chamber	lbm
WINJ(I,1)	Flowrate through oxidizer injector	lbm/sec
WINJ(I,2)	Flowrate through fuel injector	lbm/sec
WNØZ(I)	Flowrate out of combustion chamber	
WØX(I)	Mass of oxidizer in the ith combustion chamber	lbm
WTEMP(II,JJ)	Temporary storage	lbm/sec

3.2.2.2 Turbopump

The turbopump section determines the status of calculated parameters. All of the intermediate calculations are included to make system evaluation more comprehensive.

AA3	Intermediate calculation	
AA4	Intermediate calculation	
ATD(I)	Cross sectional area of turbine exit duct	ft^2
ATDNØZ(I)	Effective cross-sectional area of turbine duct exit nozzle	in^2
CP(I)	Specific heat at constant pressure of gas in I'th gas generator	$\frac{BTU}{lbm-^oR}$
CP1	Specific heat of pure fuel	
CP2(K)	Coefficients of specific heat curve	
CVEL(I)	Isentropic spouting velocity	ft/sec
DIAT(I)	Turbine rotor diameter	in
DTD(I)	Diameter of turbine exit duct	in
DRPMT(I)	Derivative of turbine speed with respect to time	rpm/sec
ETAT(I)	Turbine efficiency	
GAM(I)	Ratio of specific heats of gas in I'th gas generator	
GR(I)	Pump to turbine gear ratio	
IPUMI(I)	Line connected to pump inlet	
IPUMØ(I)	Line connected to pump outlet	
PØWT(I)	Turbine power	ft-lbf/sec
PTØ(I)	Pressure at turbine outlet	lbf/in^2
RPMP(I)	Pump speed	rpm
RPMPD(I)	Pump design speed	rpm
RPMT(I)	Turbine speed	rev/min

S	Ratio of pump speed to design speed	
TØRP(I)	Pump torque	ft-lbf
TORT(I)	Turbine torque	ft-lbf
TTEIS	Isentropic outlet temperature	^{o}R
TTØ(I)	Turbine outlet temperature	^{o}R
WNØZ(I)	Turbine flow rate	lbm/sec
WTDNØZ(I)	Flow rate through turbine duct exit nozzle	lbm/sec
XITP(I)	Moment of inertia of turbopump rotor	$lbm\text{-}in^2$
XLTD(I)	Length of turbine exit duct	ft
X1	Intermediate calculation	
X2	Intermediate calculation	

3.2.2.3 Accumulators and Regulators

As in the above sections, all parameters and intermediate calculations are printed out to facilitate system evaluation.

AREG(I,NT)	Regulator flow area	in^2
C1	Intermediate calculation	
C2	Intermediate calculation	
C3	Intermediate calculation	
C4	Intermediate calculation	
C55	Intermediate calculation	
C66	Intermediate calculation	
DPACC(I)	Change in accumulator pressure with time	lbf/in^2-sec
PACC	Pressure in accumulator I	lbf/in^2
PØ	Downstream pressure	lbf/in^2
PPPR	Intermediate calculation	
PU	Upstream pressure	lbf/in^2
WW	Regulator flowrate	lbm/sec

3.2.3 Summary Printout

The summary print consists of the current time point followed by a printout of the system parameters which include: line index number, pressure and flowrate at each node in the line, and extensive printout covering each component in the system.

A listing of the nominal print variables follows. For those not defined below, see Section 3.2.1.

3.2.3.1 Manifold and Thrust Chamber

CSTAR	PMAN	WINJ.
CV	PCHAM	WNØZ
ISP	TC	
MR	TIMEF	
MW		

3.2.3.2 Turbopump

CP	RPMT
CVEL	TØRP
ETAT	TØRT
GAM	TTØ
MW	U
PØWP	WP
PØWT	
PTØ	

3.2.3.3 Regulator and Accumulator

AREG

PACC

3.2.3.4 Pressure Boundary With Friction and Valve

Symbol	Definition	Units
PBNDL(I)	Pressure at boundary I	lbf/in^2
XKP(I)	Effective area of resistance at boundary I	ft^2
XK(I)	Effective area of valve I	ft^2

3.2.3.5 Line

WDØTL(I,J)	Flow rate in the Ith line at the Jth node	lbm/sec
PL(I,J)	Pressure in the Ith line at the Jth node	lbf/in^2
TIME	Time from start of transient	sec

3.2.4 Sample Ouptut

Selected printed output for the test case are shown on the following pages. For examples of plotted output see Figure 39 of Reference 1.

3.2.4.1 Initialization and Line Printout

```
THE FOLLOWING VARIABLES ARE INPUT CONSTANTS

THE PROGRAM DT IS EQUAL TO.....  .10000000-02
THE COMBUSTORS INTEGRATION DT IS EQUAL TO.....  .10000000-03
THE ACCELERATION DUE TO GRAVITY IS.....  .00000000
THE GRAVITATIONAL CONSTANT IS.....  .32174000+02
THE NUMBER OF ACCUMULATORS IS.....  1
THE NUMBER OF THRUST CHAMBERS IS.....  4
THE NUMBER OF FLOW BOUNDARIES IS.....  0
THE NUMBER OF TURBOPUMPS IS.....  1
THE NUMBER OF LINE JUNCTIONS IS.....  3
THE NUMBER OF INTEGRATIONS PER COMBUSTOR IS...  10
THE NUMBER OF PRESSURE BOUNDARIES IS.....  4
THE NUMBER OF PRESSURE BOUNDARIES/FRICTION IS.  0
THE NUMBER OF LINES IN THE SYSTEM IS.....  19
THE NUMBER OF REGULATORS IS.....  3
THE NUMBER OF LUMPED RESISTANCES IS.....  1


IEND   =   1   1   1   1

IPB    =   1   5   6  19

LVDN   =  16

LVUP   =  17

NPLINE =   1   1   1   1   2   3   5   5   5   5   4   4   4   6   4   4   8   7   8

IJUNCL =   1  -2  -3  -4   0  10  -7  -8  -9   0  16 -15 -12 -11 -13

XLENGL =  .50000000+01  .50000000+01  .50000000+01  .50000000+01  .50000000+01  .50000000+01  .20000000+02  .20000000+02
          .20000000+02  .15000000+02  .15000000+02  .15000000+02  .15000000+02  .15000000+02  .15000000+02  .15000000+02
          .15000000+02  .15000000+02  .20000000+02

RGAS   =  .48300000+02  .48300000+02  .48300000+02  .76600000+03  .76600000+03  .76600000+03  .76600000+03  .00000000

TGAS   =  .50000000+03  .50000000+03  .50000000+03  .50000000+03  .50000000+03  .50000000+03  .50000000+03  .00000000

BK     =  .00000000  .00000000  .00000000  .00000000  .00000000  .00000000  .00000000  .00000000

AREAI  =  .47464774-01  .15762505-01  .15762505-01  .15762505-01  .50014469-02  .50014469-02  .15762505-01  .15762505-01
          .15762505-01  .41247039-01  .19634954+00  .19634954+00  .19634954+00  .47464774-01  .19634954+00  .19634954+00
          .19634954+00  .18386385-01  .19634954+00

CL     =  .10777839+04  .10777839+04  .10777839+04  .10777839+04  .10777839+04  .10777839+04  .41042723+04  .41042723+04
          .41042723+04  .41042723+04  .41042723+04  .41042723+04  .41042723+04  .41042723+04  .41042723+04  .41042723+04
          .25000000+04  .41042723+04  .25000000+04

DIAL   =  .29500000+01  .17000000+01  .17000000+01  .17000000+01  .95760000+00  .95760000+00  .17000000+01  .17000000+01
          .17000000+01  .27500000+01  .60000000+01  .60000000+01  .60000000+01  .29500000+01  .60000000+01  .60000000+01
          .60000000+01  .18360000+01  .60000000+01
```

FRL =
.00000000 .0000n000 .00000000 .00000000 .00000000 .00000000 .00000000 .00000000
.00000000 .0000n000 .00000000 .00000000 .00000000 .00000000 .00000000 .00000000
.00000000 .0000n000 .00000000

SINAIP =
.00000000 .0000n000 .00000000 .00000000 .00000000 .00000000 .00000000 .00000000
.00000000 .0000n000 .00000000 .00000000 .00000000 .00000000 .00000000 .00000000
.00000000 .0000n000 .00000000

THETA =
.60000000-03 .6000n000-03 .60000000-03 .60000000-03 .60000000-03 .60000000-03 .20000000-03 .20000000-03
.20000000-03 .2000n000-03 .20000000-03 .20000000-03 .20000000-03 .20000000-03 .20000000-03 .20000000-03
.33333333-03 .2000n000-03 .30000000-03

DELXL =
.16666667+01 .1666n667+01 .16666667+01 .16666667+01 .16666667+01 .16666667+01 .50000000+01 .50000000+01
.50000000+01 .5000n000+01 .50000000+01 .50000000+01 .50000000+01 .50000000+01 .50000000+01 .50000000+01
.30000000+01 .5000n000+01 .33333333+01

THE FOLLOWING VARIABLES ARE INITIAL CONDITIONS

LINE INDEX NUMBER = 1

PL	=	.55000000+03	.5500n000+03	.55000000+03	.55000000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.0000u000	.0000u000

LINE INDEX NUMBER = 2

PL	=	.55000000+03	.5500n000+03	.55000000+03	.55000000+03
WDOTI	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.0000u000

LINE INDEX NUMBER = 3

PL	=	.55000000+03	.5500n000+03	.55000000+03	.55000000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 4

PL	=	.55000000+03	.5500n000+03	.55000000+03	.55000000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 5

PL	=	.50000000+03	.5000n000+03	.50000000+03	.50000000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 6

PL	=	.40000000+03	.4000n000+03	.40000000+03	.40000000+03
WDOTI	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 7

PL	=	.55500000+03	.5550n000+03	.55500000+03	.55500000+03	.55500000+03
WDOTI	=	.00000000	.0000n000	.00000000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000	.00000000

LINE INDEX NUMBER = 8

PL	=	.55500000+03	.5550n000+03	.55500000+03	.55500000+03	.55500000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000	.00000000

LINE INDEX NUMBER = 9

PL	=	.55500000+03	.5550n000+03	.55500000+03	.55500000+03	.55500000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000	.00000000

LINE INDEX NUMBER = 10

PL	=	.55500000+03	.5550n000+03	.55500000+03	.55500000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 11

PL	=	.10500000+04	.1050n000+04	.10500000+04	.10500000+04
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 12

PL	=	.10500000+04	.1050n000+04	.10500000+04	.10500000+04
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 13

PL	=	.10500000+04	.1050n000+04	.10500000+04	.10500000+04
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 14

PL	=	.50500000+03	.5050n000+03	.50500000+03	.50500000+03
WDOTL	=	.00000000	.0000n000	.00000000	.00000000
Z	=	.00000000	.0000n000	.00000000	.00000000

LINE INDEX NUMBER = 15

```
PL      =   .10500000+04  .1050n000+04  .10500000+04  .10500000+04
WDOTI   =   .00000000     .0000n000     .00000000     .00000000
Z       =   .00000000     .0000n000     .00000000     .00000000
LINE INDEX NUMBER = 16
PL      =   .10500000+04  .1050n000+04  .10500000+04  .10500000+04
WDOTL   =   .00000000     .0000n000     .00000000     .00000000
Z       =   .00000000     .0000n000     .00000000     .00000000
LINE INDEX NUMBER = 17
PL      =   .50000000+02  .5000n000+02  .50000000+02  .50000000+02  .50000000+02  .50000000+02
WDOTI   =   .00000000     .0000n000     .00000000     .00000000     .00000000     .00000000
Z       =   .00000000     .0000n000     .00000000     .00000000     .00000000     .00000000
LINE INDEX NUMBER = 18
PL      =   .40500000+03  .4050n000+03  .40500000+03  .40500000+03
WDOTL   =   .00000000     .0000n000     .00000000     .00000000
Z       =   .00000000     .0000n000     .00000000     .00000000
LINE INDEX NUMBER = 19
PL      =   .50000000+02  .5000n000+02  .50000000+02  .50000000+02  .50000000+02  .50000000+02  .50000000+02
WDOTL   =   .00000000     .0000n000     .00000000     .00000000     .00000000     .00000000     .00000000
Z       =   .00000000     .0000n000     .00000000     .00000000     .00000000     .00000000     .00000000
PACC    =   .10500000+04
XK      =   .00000000
```

3.2.4.2 Manifold and Thrust Chamber Detailed Printout

```
A1     =  .00000000     B1     =  .00000000     C      =  -.85998626+01 C1     =  .21499656+01 C6     =  .75466757-05 C7     =  .00000000
C8     =  .00000000     C9     =  .00000000     C11    =   .73172287+00 CSTAR  =  .51614000+04 Cv     =  .49999996-02 DCLP   =  .00000000
DELP   =  .00000000     DPMAN  =  .86173512+03 DWFUEL=  .90798261-03 DWOX   =  .25298356-03 I      =            1 II     =            6
IKOUNT=           0 ISP    =  .30000000+03 JJ     =            4 MR     =  .26400998+00 MW     =  .20160000+01 N      =            1
PCHAM  =  .33719701+00 PMAN   =  .46082612+00 PRATI  =  .11522969-02 PSON   =  .39991960+03 PTEMP  =  .39991960+03 TIMEF  =  .99999993-03
W      =  .10476603-06 WCHAM  =  .50159203-06 WFUEL  =  .39682600-06 WINJ   =  .36809494-03 WNOZ   =  .55112285-03 WOX    =  .10476603-06
WTEMP  =  .17285692-02

A1     =  .00000000     B1     =  .00000000     C      =  -.84054145+01 C1     =  .20754110-01 C6     =  .90372649-05 C7     =  .00000000
C8     =  .00000000     C9     =  .00000000     C11    =   .27268061+00 CSTAR  =  .51614000+04 Cv     =  .49999996-02 DCLP   =  .00000000
DELP   =  .00000000     DPMAN  =  .17940392+04 DWFUEL=  .90806685-03 DWOX   =  .25298356-03 I      =            1 II     =           18
IKOUNT=           0 ISP    =  .30000000+03 JJ     =            4 MR     =  .26400998+00 MW     =  .20160000+01 N      =            2
PCHAM  =  .33719701+00 PMAN   =  .12366006+01 PRATI  =  .30541071-02 PSON   =  .40489759+03 PTEMP  =  .40489759+03 TIMEF  =  .99999993-03
W      =  .39682600-06 WCHAM  =  .50159203-06 WFUEL  =  .39682600-06 WINJ   =  .13440783-02 WNOZ   =  .55112285-03 WOX    =  .10476603-06
WTEMP  =  .21253454-02
```


3.2.4.3 Turbopump Detailed Printout

```
AA3    = -.54426338+01 AA4    =  .60776065-02 ATD    =  .88463851+02 C1     =  .18193968+02 C2     = -.36387936+00 C3     = -.18193968+02
C4     =  .36387936+00 CP     =  .34000000+01 CV1    =  .49999996-02 CV2    =  .49999996-02 CVEL   =  .86183166+04 DPTO   =  .62788450+00
DRPMT  =  .38282171+06 ETAT   =  .71807731-02 GAM    =  .14077056+01 I      =            1 MW     =  .20160000+01 PCHAM  =  .33719701+00
POWP   =  .32683996-02 POWT   =  .45680354+01 PTO    =  .27550127-03 R      =  .13840862-02 RPMP   =  .11023434+03 RPMPD  =  .50000000+05
RPMT   =  .11023434+03 S      =  .22046867-02 TC     =  .50000000+03 TIMEF  =  .99999993-03 TORP   =  .28313269-03 TORT   =  .39571669+00
TTO    =  .49686760+03 U      =  .11928493+02 WNOZ   =  .55112285-03 WP     =  .11155041-02 WTDNOZ=  .33009066-04
X1     =  .54963271+01 X2     =  .00000000
```

3.2.4.4 Accumulator and Regulator Detailed Printout

```
AREG  =  .00000000    C1    =  .25841465+02 C2    = -.46561199-01 C3    = -.23272903+03 C4    =  .22164670+00 I     =          1
II    =            11 IPROP =            4 JJ    =            4 NT    =            1 PD    =  .55500003+03 PU    =  .10500000+04
PTEMP =  .00000000    TIME  =  .10000000-02 WW    =  .19073486-05

AREG  =  .00000000    I     =            1 N1    =            4 PD    =  .55500003+03 PTEMP =  .00000000    PU    =  .10500000+04
Q1    =  .00000000    Q2    =  .00000000    TIME  =  .10000000-02

AREG  =  .00000000    C1    =  .27057905+02 C2    = -.53580010-01 C3    = -.23272903+03 C4    =  .22164670+00 I     =          2
II    =            15 IPROP =            4 JJ    =            4 NT    =            1 PD    =  .50500003+03 PU    =  .10500000+04
PTEMP =  .00000000    TIME  =  .10000000-02 WW    =  .19073486-05

AREG  =  .00000000    I     =            2 NT    =            4 PD    =  .50500003+03 PTEMP =  .00000000    PU    =  .10500000+04
Q1    =  .00000000    Q2    =  .00000000    TIME  =  .10000000-02

AREG  =  .00000000    C1    =  .84054145+01 C2    = -.20754110-01 C3    = -.23272903+03 C4    =  .22164670+00 I     =          3
II    =            13 IPROP =            4 JJ    =            4 NT    =            1 PD    =  .40500009+03 PU    =  .10500000+04
```



```
PTEMP =  .00000000    TIME  =  .10000000-02 WW    =  .19073486-05

AREG  =  .00000000    I     =            3 NT    =            4 PD    =  .40500009+03 PTEMP =  .00000000    PU    =  .10500000+04
Q1    =  .00000000    Q2    =  .00000000    TIME  =  .10000000-02

C1    =  .00000000    C2    =  .00000000    C3    = -.23272903+03 C4    =  .22164670+00 C55   =  .10422660+02 C66   =  .00000000
DPACC =  .00000000    I     =            1 II    =           12 IPROP =            4 JJ    =            4 NNNN  =
PACC  =  .10500000+04 PPER  =  .10500000+04 PTEMP =  .00000000    TIME  =  .10000000-02 WTEMP = -.59604645-07
```

3.2.4.5 Summary Printout

```
AT RUN TIME    .10000000-02 THE [redacted]LOWING CONDITIONS WERE PRESENT ---
LINE INDEX NUMBER -  1
PL      =    .55000C00+03   .5500n000+03   .55000000+03   .54999999+03
WDOTL   =    .00000C00      .0000n000      .00000000      .19073486-05
LINE INDEX NUMBER -  2
PL      =    .54999999+03   .5500n000+03   .55000000+03   .54080522+03
WDOTL   =   -.47683716-06   .00C0n000      .00000000      .62302031+00
LINE INDEX NUMBER -  3
PL      =    .54999999+03   .5500n000+03   .55000000+03   .54080522+03
WDOTL   =   -.47683716-06   .0000n000      .00000000      .62302031+00
LINE INDEX NUMBER -  4
PL      =    .54999999+03   .5500n000+03   .55000000+03   .54080522+03
WDOTL   =   -.47683716-06   .0000n000      .00000000      .62302031+00
LINE INDEX NUMBER -  5
PL      =    .50000000+03   .5000n000+03   .50000000+03   .49980825+03
WDOTL   =    .00000000      .0000n000      .00000000      .41227238-02
LINE INDEX NUMBER -  6
PL      =    .40000000+03   .4000n000+03   .40000000+03   .39991960+03
WDOTL   =    .00000000      .0000n000      .00000000      .17285692-02
LINE INDEX NUMBER -  7
PL      =    .55500000+03   .5550n000+03   .55500000+03   .55500000+03   .54640462+03
WDOTL   =    .00000000      .0000n000      .00000000      .00000000      .15294032+00
LINE INDEX NUMBER -  8
PL      =    .55500000+03   .5550n000+03   .55500000+03   .55500000+03   .54640462+03
WDOTL   =    .00000000      .0000n000      .00000000      .00000000      .15294032+00
LINE INDEX NUMBER -  9
PL      =    .55500000+03   .5550n000+03   .55500000+03   .55500000+03   .54640462+03
WDOTL   =    .00000000      .0000n000      .00000000      .00000000      .15294032+00
LINE INDEX NUMBER -  10
```

PL = .55500003+03 .5550n000+03 .55500000+03 .55500000+03

WDOTL = .19073486-05 .0000n000 .00000000 -.23841858-06

LINE INDEX NUMBER = 11

PL = .10500000+04 .1050n000+04 .10500000+04 .10500000+04

WDOTL = -.19073486-05 .0000n000 .00000000 .19073486-05

LINE INDEX NUMBER = 12

PL = .10500000+04 .1050n000+04 .10500000+04 .10500000+04

WDOTL = -.19073486-05 .0000n000 .00000000 -.59604645-07

LINE INDEX NUMBER = 13

PL = .10500000+04 .1050n000+04 .10500000+04 .10500000+04

WDOTL = -.19073486-05 .0000n000 .00000000 .19073486-05

LINE INDEX NUMBER = 14

PL = .50500003+03 .5050n000+03 .50500000+03 .50490570+03

WDOTL = .19073486-05 .0000n000 .00000000 .50522708-02

LINE INDEX NUMBER = 15

PL = .10500000+04 .1050n000+04 .10500000+04 .10500000+04

WDOTL = -.19073486-05 .0000n000 .00000000 .19073486-05

LINE INDEX NUMBER = 16

PL = .10500000+04 .1050n000+04 .10500000+04 .10500000+04

WDOTL = .00000000 .0000n000 .00000000 .19073486-05

LINE INDEX NUMBER = 17

PL = .50003065+02 .5000n000+02 .50000000+02 .50000000+02 .50000000+02 .50000000+02

WDOTL = .11155041-02 .0000n000 .00000000 .00000000 .00000000 .00000000

LINE INDEX NUMBER = 18

PL = .40500009+03 .4050n000+03 .40500000+03 .40489759+03

WDOTL = .19073486-05 .0000n000 .00000000 .21253454-02

LINE INDEX NUMBER = 19

PL = .50000000+02 .5000n000+02 .50000000+02 .50000000+02 .50000000+02 .50000000+02 .49996933+02

WDOTL = .00000000 .0000n000 .00000000 .00000000 .00000000 .00000000 .11155041-02

AREG = .00000000 .00000000 .00000000

PACC = .10500000+04

XK = .00000000

CONDITIONS AT .10000000-02 FOR COMBUSTOR 1

OXIDIZER SYSTEM

CV = .49999996-02 PMAN = .46062612+00 WINJ = .36809494-03 CV

FUEL SIDE

= .49999996-02 PMAN = .12366006+01 WINJ = .13440783-02

COMBUSTOR CHAMBER PARAMETERS

CSTAR = .51614000+04 ISP = .30000000+03 MR = .26400998+00 MW = .20160000+01 PCHAM = .33719701+00 TC = .50000000+03

TIMPUL= .20823687-03 WNOZ = .55112285-03

CONDITIONS AT .10000000-02 FOR COMBUSTOR 2

OXIDIZER SYSTEM

CV = .49999996-01 PMAN = .99810817+01 WINJ = .19997948+00 CV

FUEL SIDE

= .49999996-01 PMAN = .11127137+02 WINJ = .60196041-01

COMBUSTOR CHAMBER PARAMETERS

CSTAR = .83362275+04 ISP = .45439612+03 MR = .34365359+01 MW = .88525141+01 PCHAM = .76837139+01 TC = .51592487+04

TIMPUL= .57596903-01 WNOZ = .10053247+00

CONDITIONS AT .10000000-02 FOR COMBUSTOR 3

OXIDIZER SYSTEM

CV = .49999996-01 PMAN = .99810817+01 WINJ = .19997948+00 CV

FUEL SIDE

= .49999996-01 PMAN = .11127137+02 WINJ = .60196041-01

COMBUSTOR CHAMBER PARAMETERS

CSTAR = .83362275+04 ISP = .45439612+03 MR = .34365359+01 MW = .88525141+01 PCHAM = .76837139+01 TC = .51592487+04

TIMPUL= .57596903-01 WNOZ = .10053247+00

CONDITIONS AT .10000000-02 FOR COMBUSTOR 4

OXIDIZER SYSTEM

CV = .49999996-01 PMAN = .99810817+01 WINJ = .19997948+00 CV

FUEL SIDE

= .49999996-01 PMAN = .11127137+02 WINJ = .60196041-01

COMBUSTOR CHAMBER PARAMETERS

CSTAR = .83362275+04 ISP = .45439612+03 MR = .34365359+01 MW = .88525141+01 PCHAM = .76837139+01 TC = .51592487+04

TIMPUL= .57596903-01 WNOZ = .10053247+00

CONDITIONS AT .10000000-02 FOR COMBUSTOR 5

OXIDIZER SYSTEM

CV = .49999996-02 PMAN = .58211368+00 WINJ = .76667382-03 CV

FUEL SIDE

= .49999996-02 PMAN = .17375019+01 WINJ = .35730024-02

COMBUSTOR CHAMBER PARAMETERS

CSTAR = .51614000+04 ISP = .30000000+03 MR = .21116029+00 MW = .20160000+01 PCHAM = .47662842+00 TC = .50000000+03

TIMPUL= .49943532-03 WNOZ = .12983713-02

CONDITIONS AT .10000000-02 FOR TURBOPUMP 1

P = .34000000+01 CVEL = .86183165+04 ETAT = .71807731-02 GAM = .14077056+01 MW = .20160000+01 POWP = .32683996-02

POWT = .45680354+01 PTO = .27550127-03 RPMT = .11023434+03 TORP = .28313269-03 TORT = .39571664+00 TTO = .49686760+03

U = .11928493+02 WTONOZ= .33009066-04

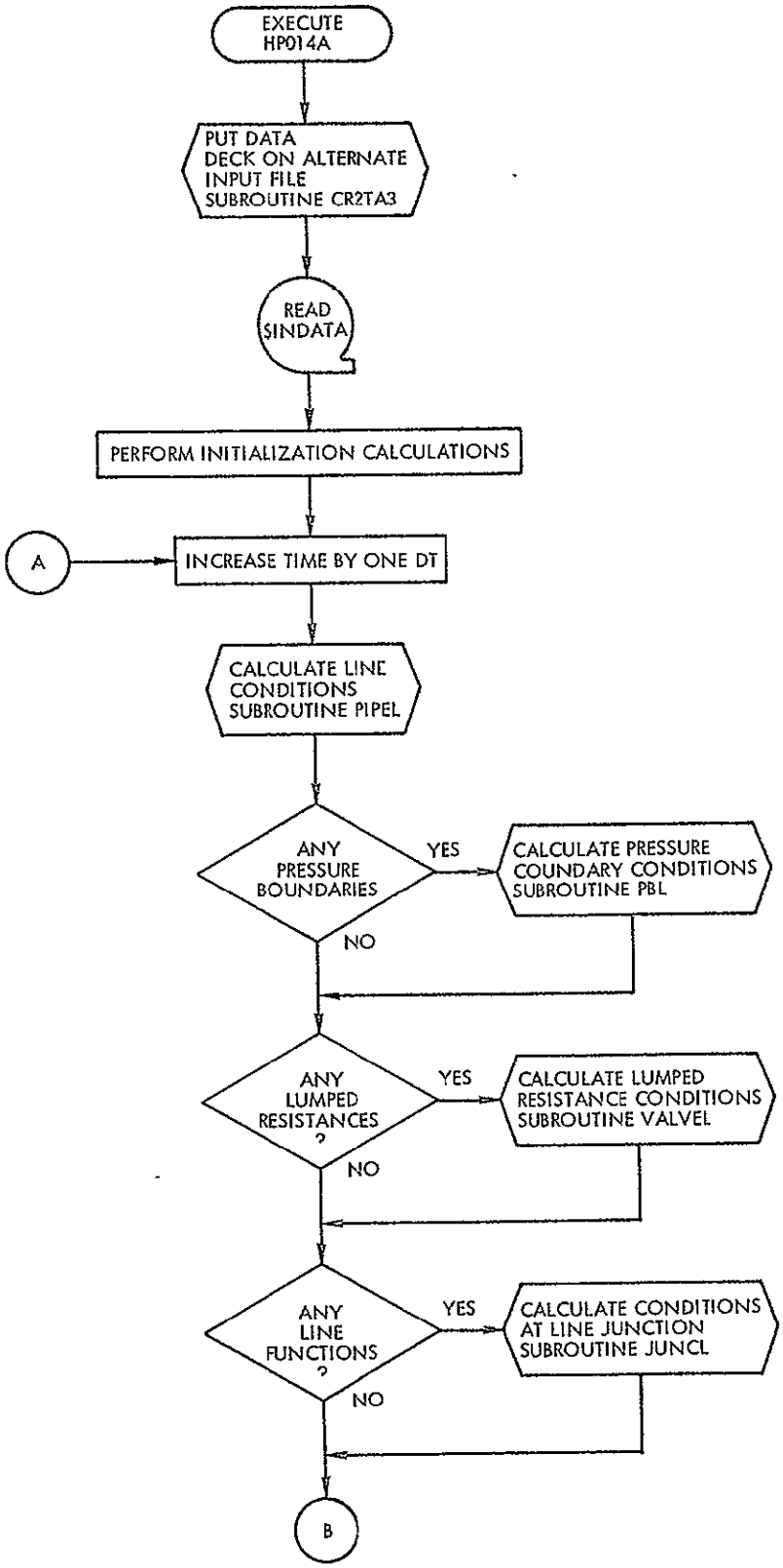
4. FLOWCHARTS FOR HP014A

The flowcharts included in this document are intended to be used as a generalized aid to anyone involved in altering the program or studying its construction. As such, the flowcharts are of a generalized nature, showing the major parts of each routine. All major logic branches and each major section of computation are shown. The flowcharts are not meant to be a line-by-line listing of the program.

4. FLOWCHARTS FOR HP014A

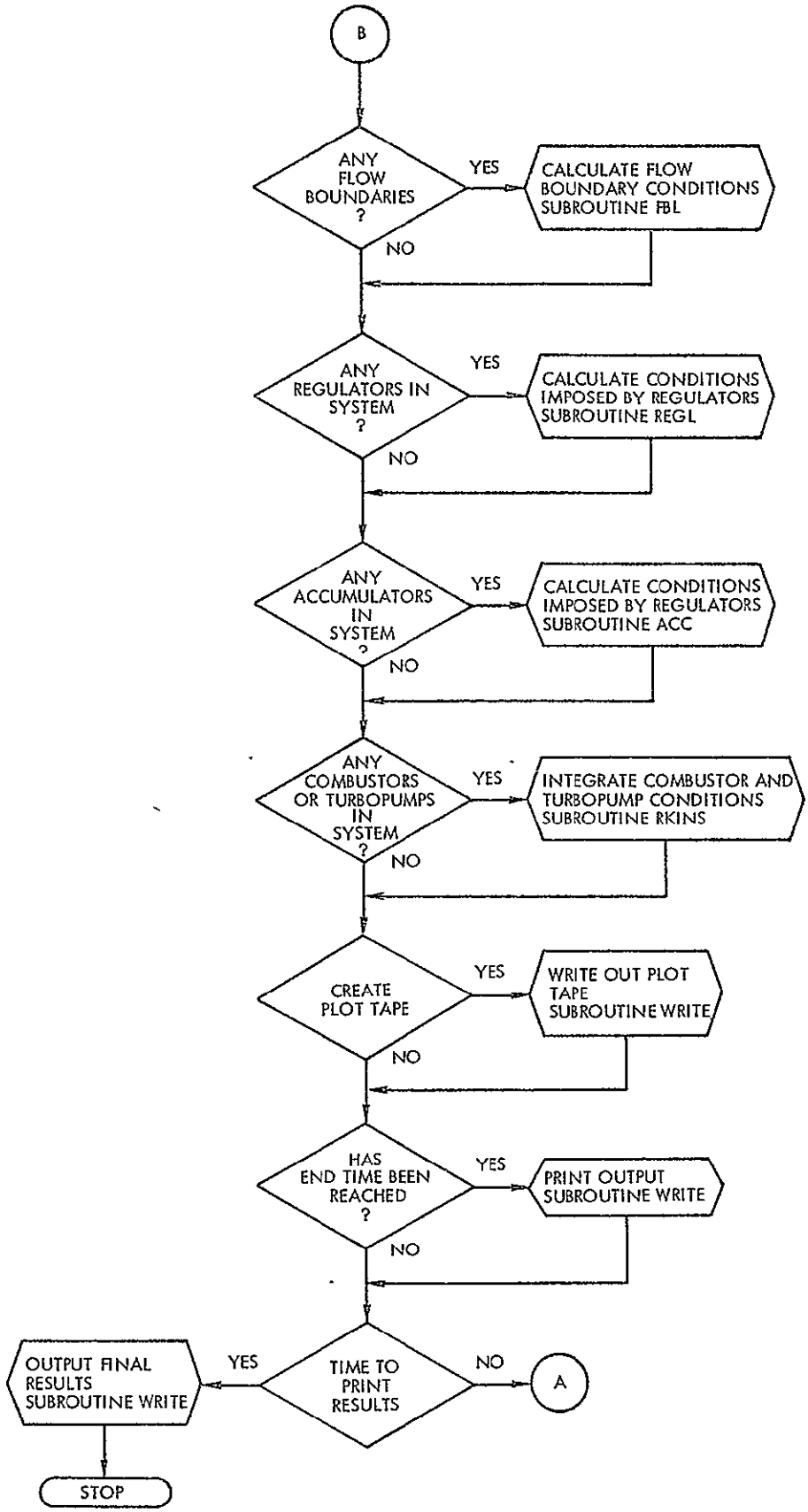
The flowcharts included in this document are intended to be used as a generalized aid to anyone involved in altering the program or studying its construction. As such, the flowcharts are of a generalized nature, showing the major parts of each routine. All major logic branches and each major section of computation are shown. The flowcharts are not meant to be a line-by-line listing of the program.

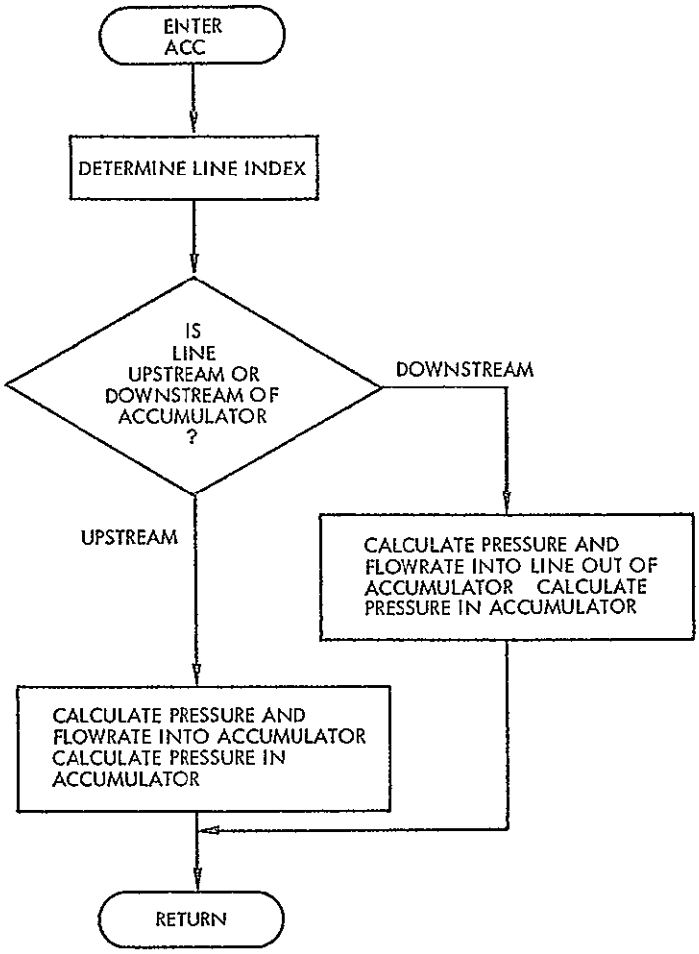
PRECEDING PAGE BLANK NOT FILMED



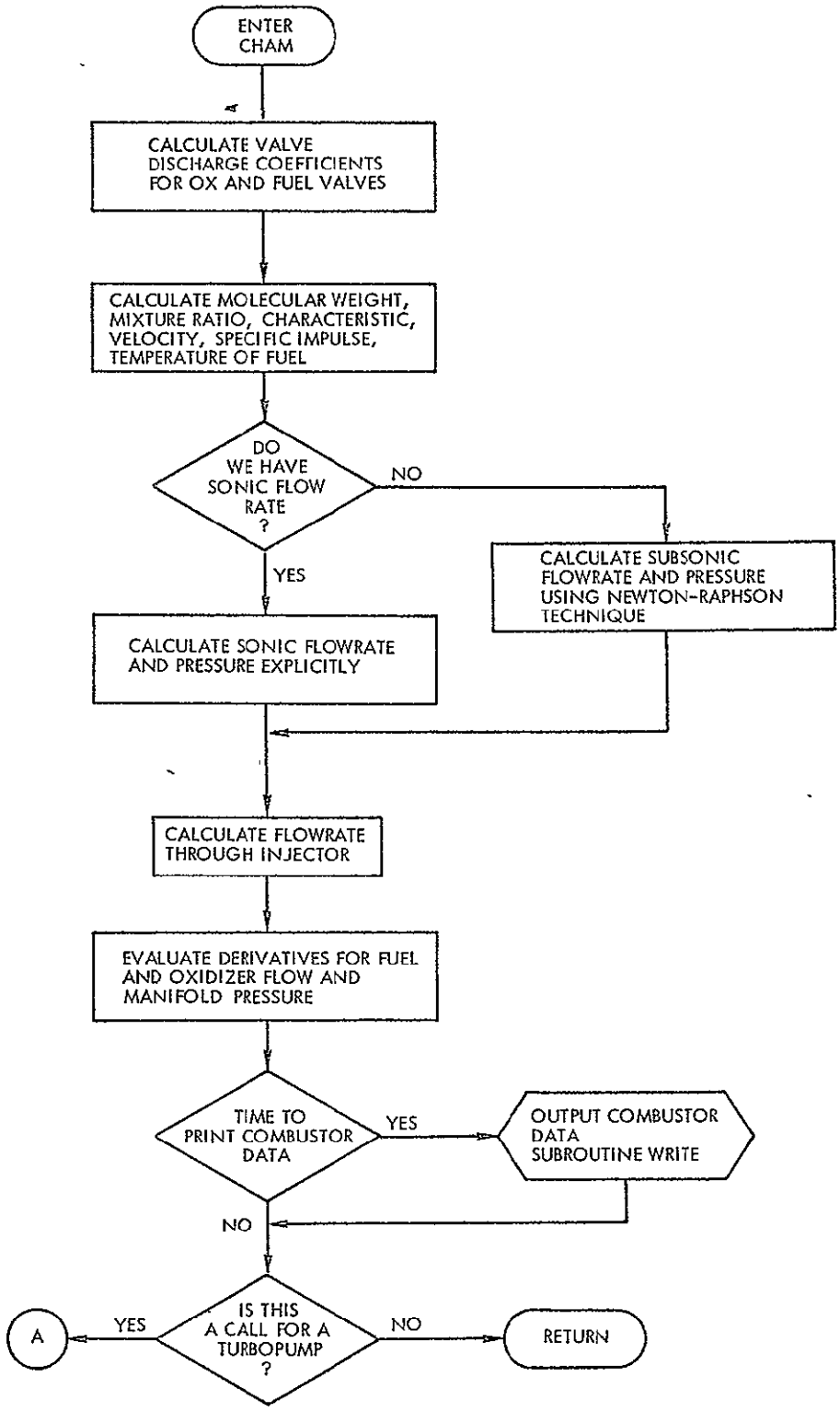
FLOW CHART 1

TRAP GENERAL FLOW CHART


B
ANY FLOW BOUNDARIES ?
YES
CALCULATE FLOW BOUNDARY CONDITIONS SUBROUTINE FBL
NO
ANY REGULATORS IN SYSTEM ?
YES
CALCULATE CONDITIONS IMPOSED BY REGULATORS SUBROUTINE REGL
NO
ANY ACCUMULATORS IN SYSTEM ?
YES
CALCULATE CONDITIONS IMPOSED BY REGULATORS SUBROUTINE ACC
NO
ANY COMBUSTORS OR TURBOPUMPS IN SYSTEM ?
YES
INTEGRATE COMBUSTOR AND TURBOPUMP CONDITIONS SUBROUTINE RKINS
NO
CREATE PLOT TAPE
YES
WRITE OUT PLOT TAPE SUBROUTINE WRITE
NO
HAS END TIME BEEN REACHED ?
YES
PRINT OUTPUT SUBROUTINE WRITE
NO
TIME TO PRINT RESULTS
YES
OUTPUT FINAL RESULTS SUBROUTINE WRITE
NO
A
STOP

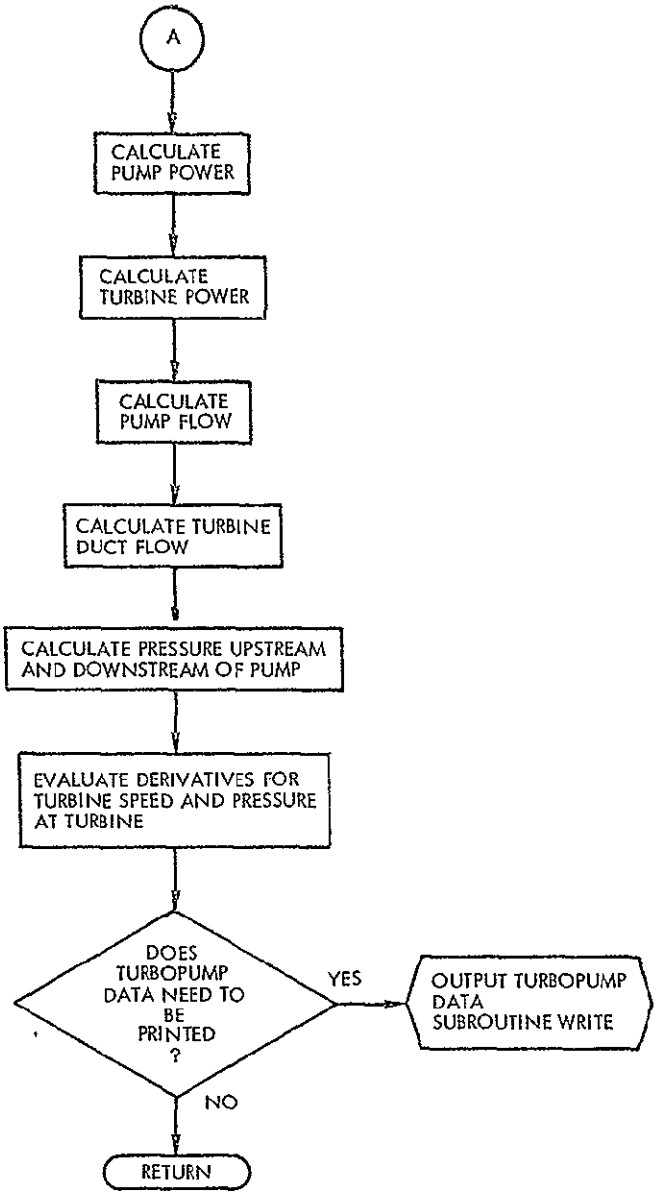


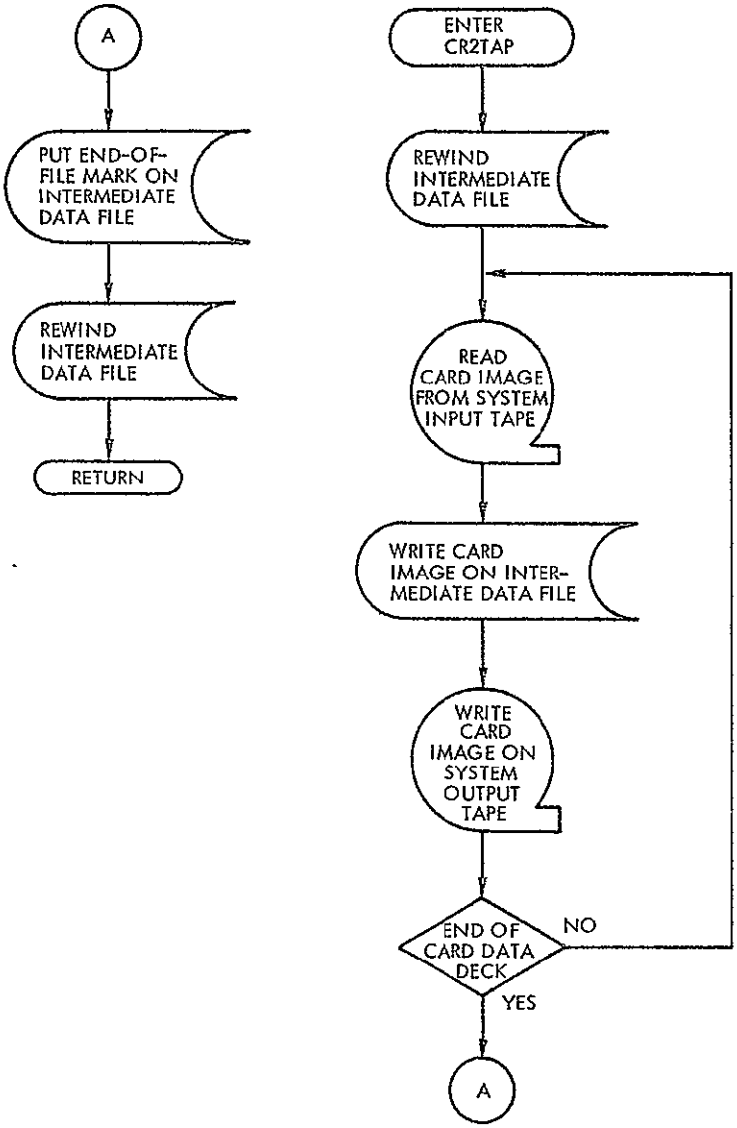
FLOW CHART 2
SUBROUTINE ACC



FLOW CHART 3

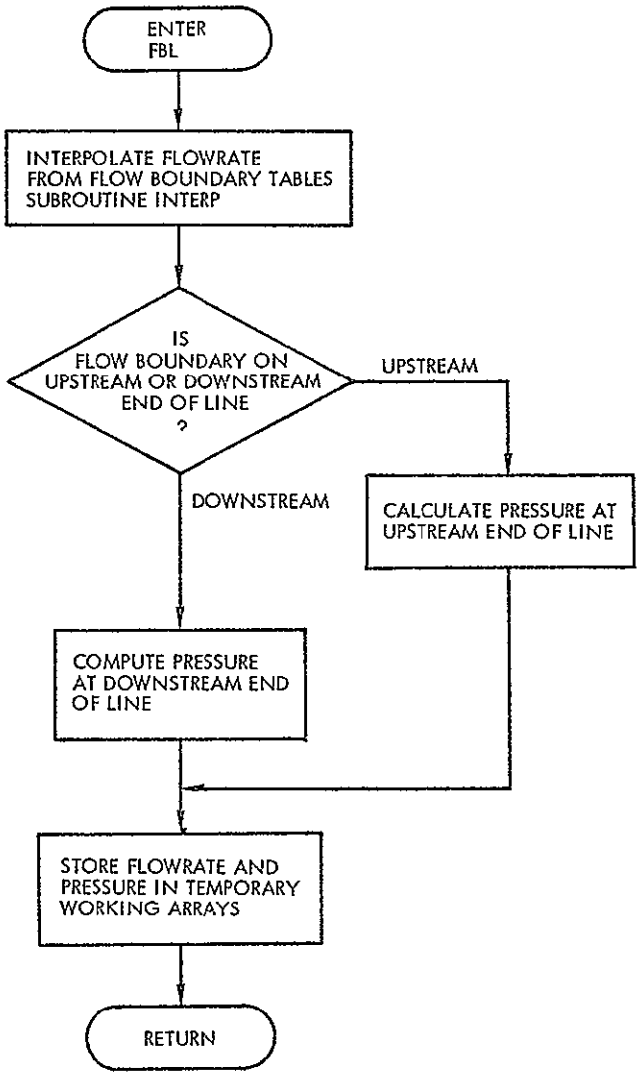
SUBROUTINE CHAM


A
CALCULATE PUMP POWER
CALCULATE TURBINE POWER
CALCULATE PUMP FLOW
CALCULATE TURBINE DUCT FLOW
CALCULATE PRESSURE UPSTREAM AND DOWNSTREAM OF PUMP
EVALUATE DERIVATIVES FOR TURBINE SPEED AND PRESSURE AT TURBINE
DOES TURBOPUMP DATA NEED TO BE PRINTED ?
YES
OUTPUT TURBOPUMP DATA SUBROUTINE WRITE
NO
RETURN



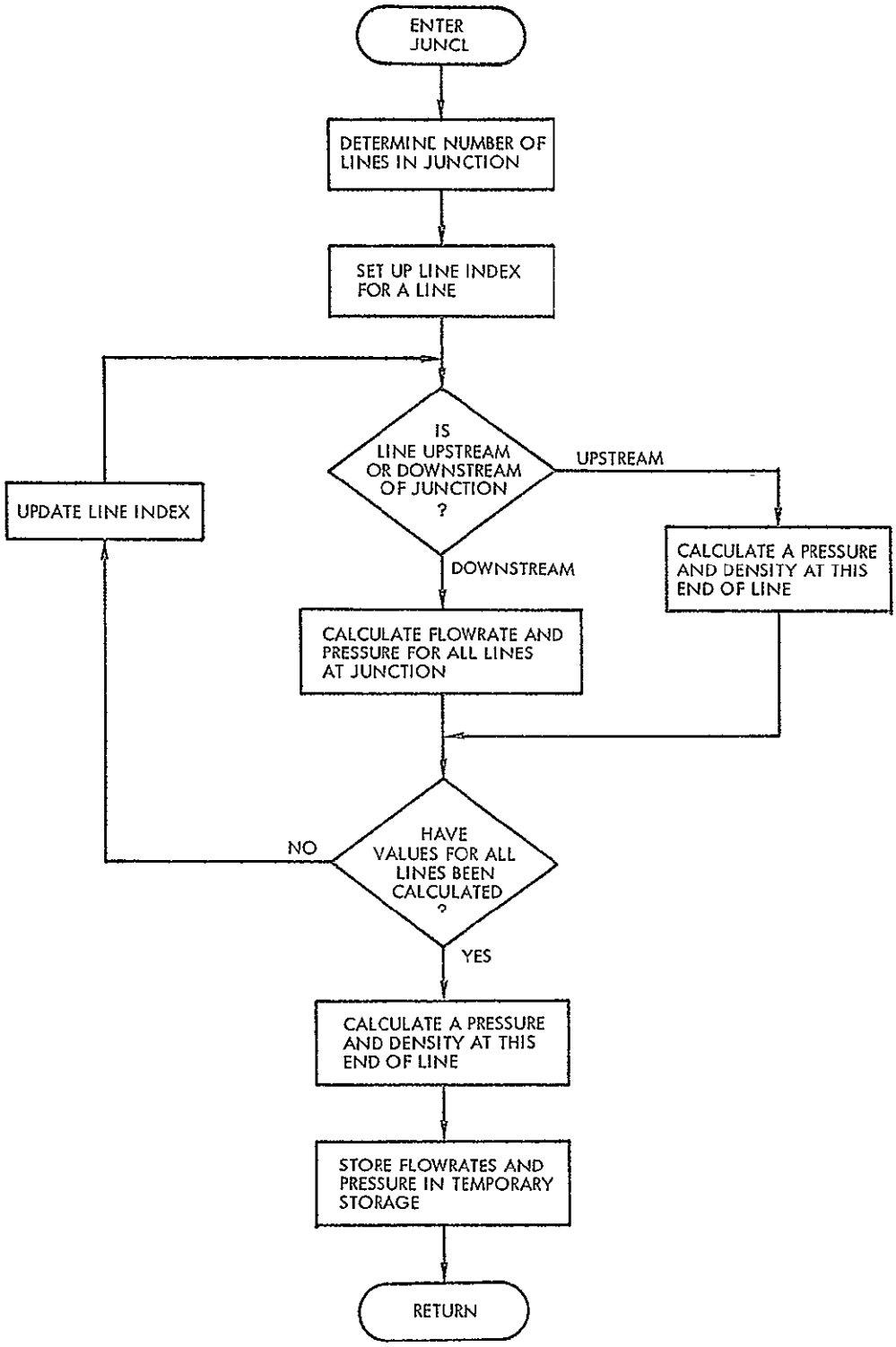
FLOW CHART 4

SUBROUTINE CR2TAP



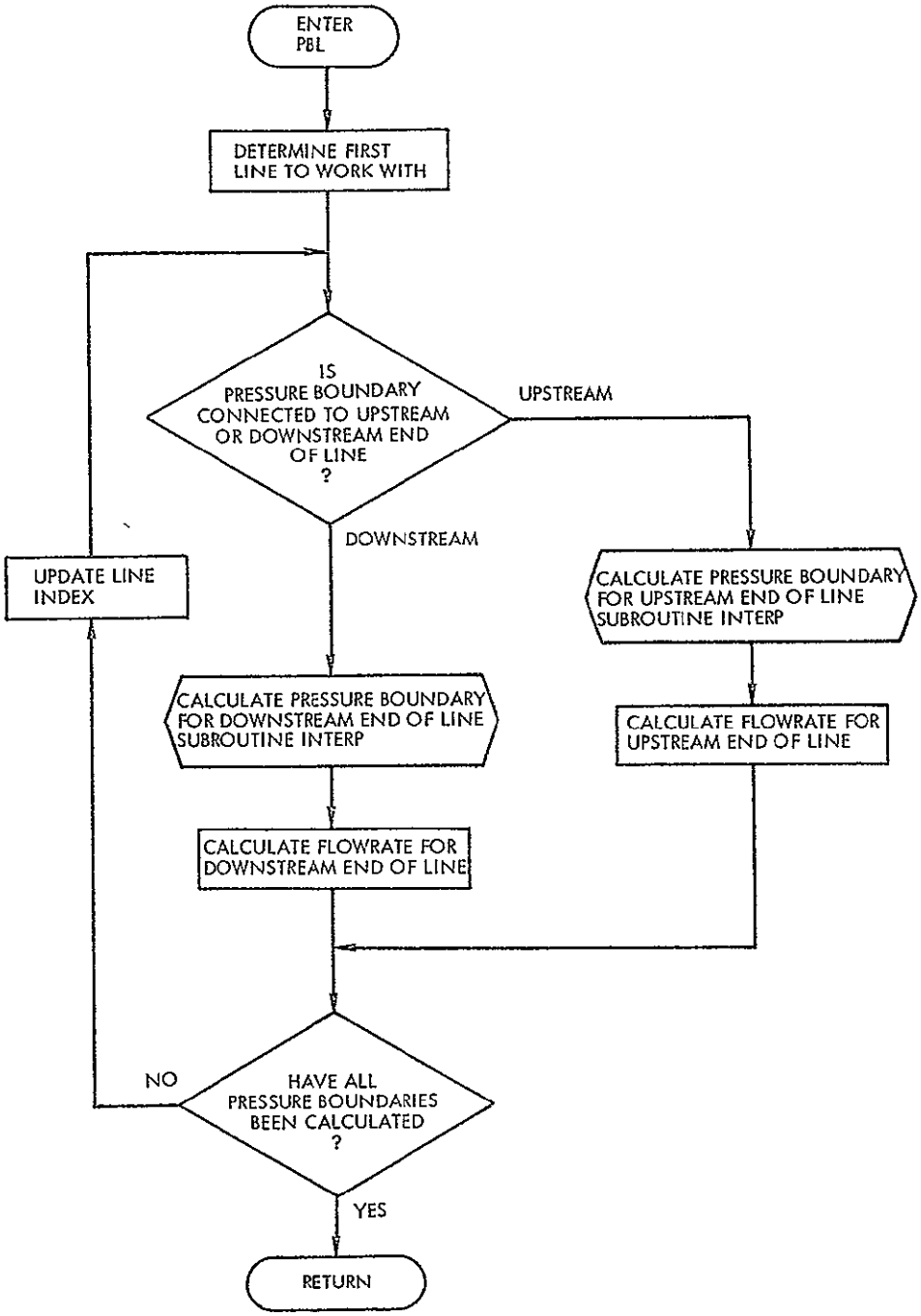
FLOW CHART 5

SUBROUTINE FBL

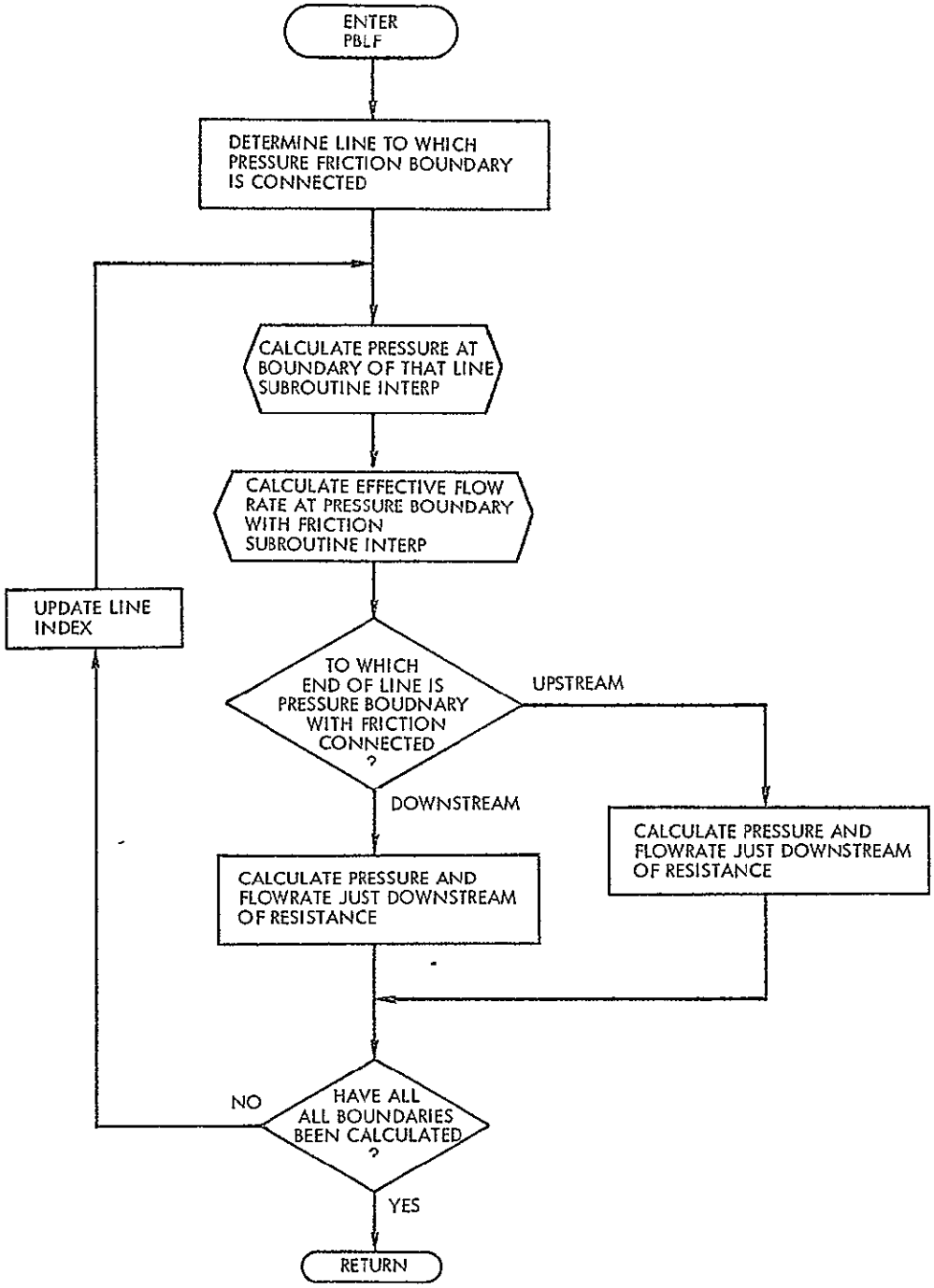


FLOW CHART 6

SUBROUTINE JUNCL

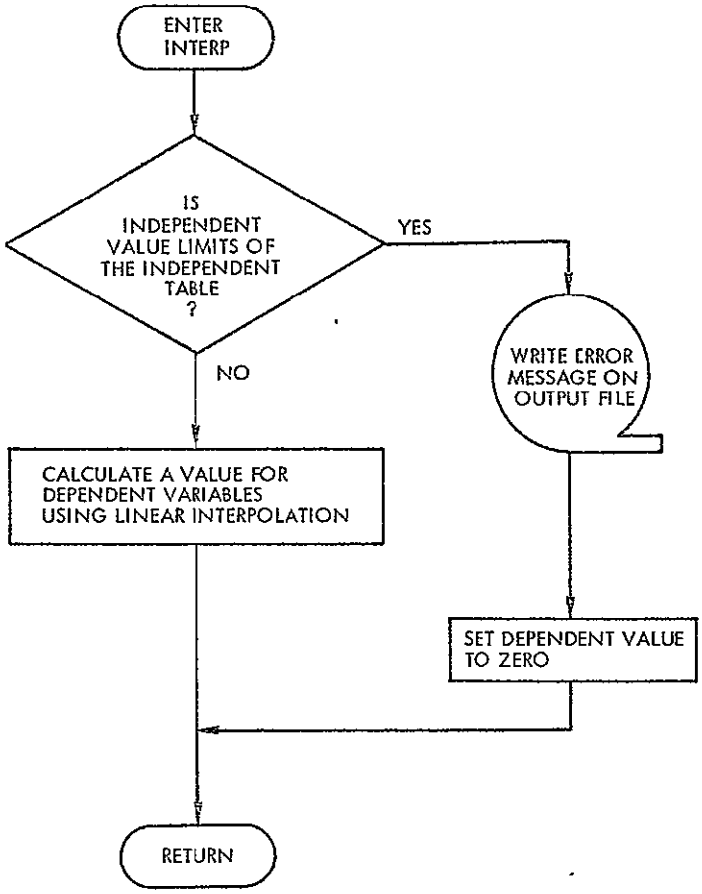


FLOW CHART 7
SUBROUTINE PBL



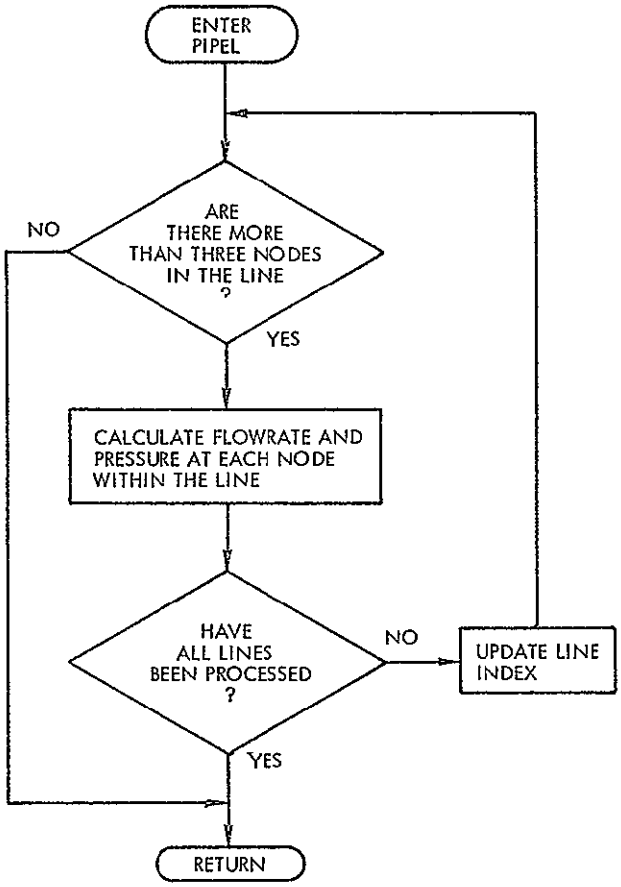
FLOW CHART 8

SUBROUTINE PBLF



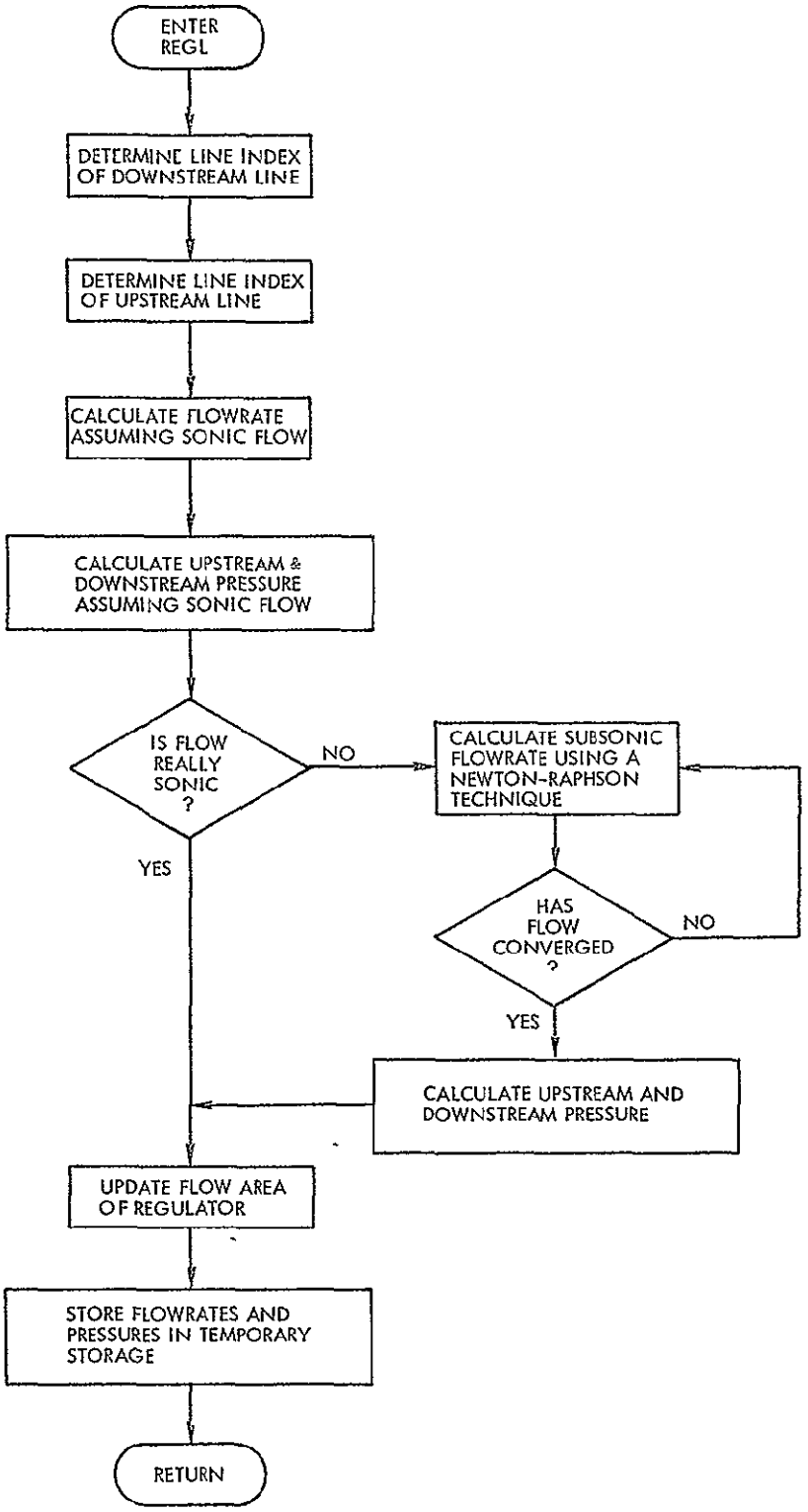
FLOW CHART 9

SUBROUTINE INTERP



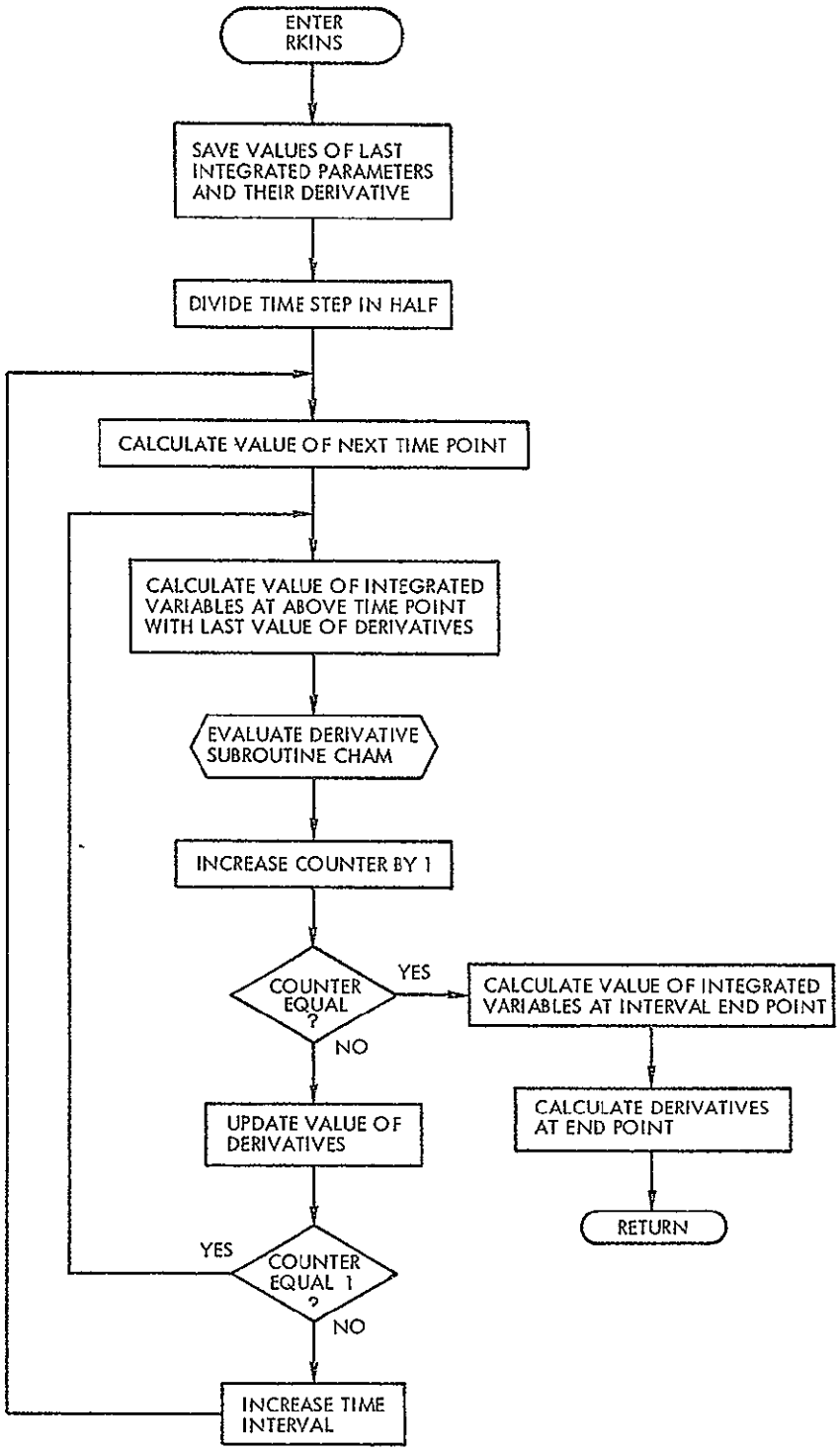
FLOW CHART 10

SUBROUTINE PIPEL

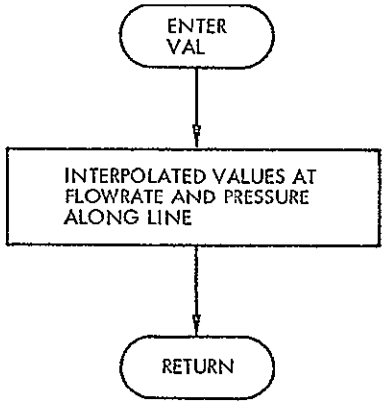


FLOW CHART 11

, SUBROUTINE REGL

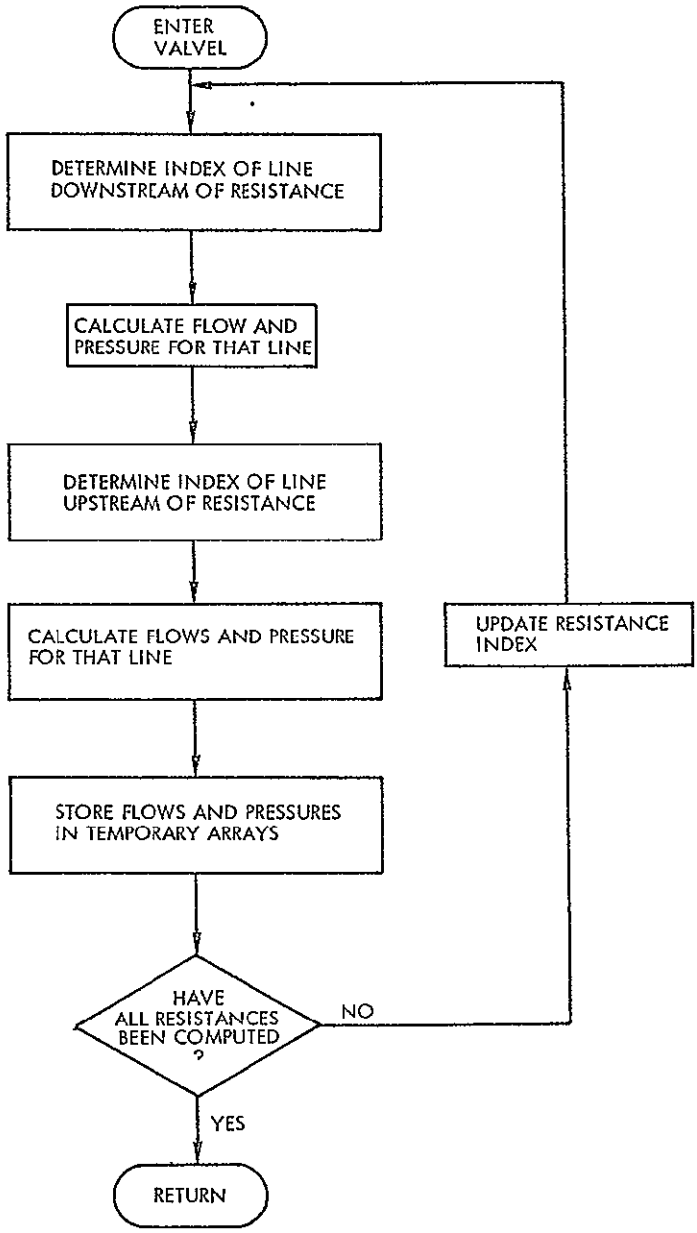


FLOW CHART 12
SUBROUTINE RKINS

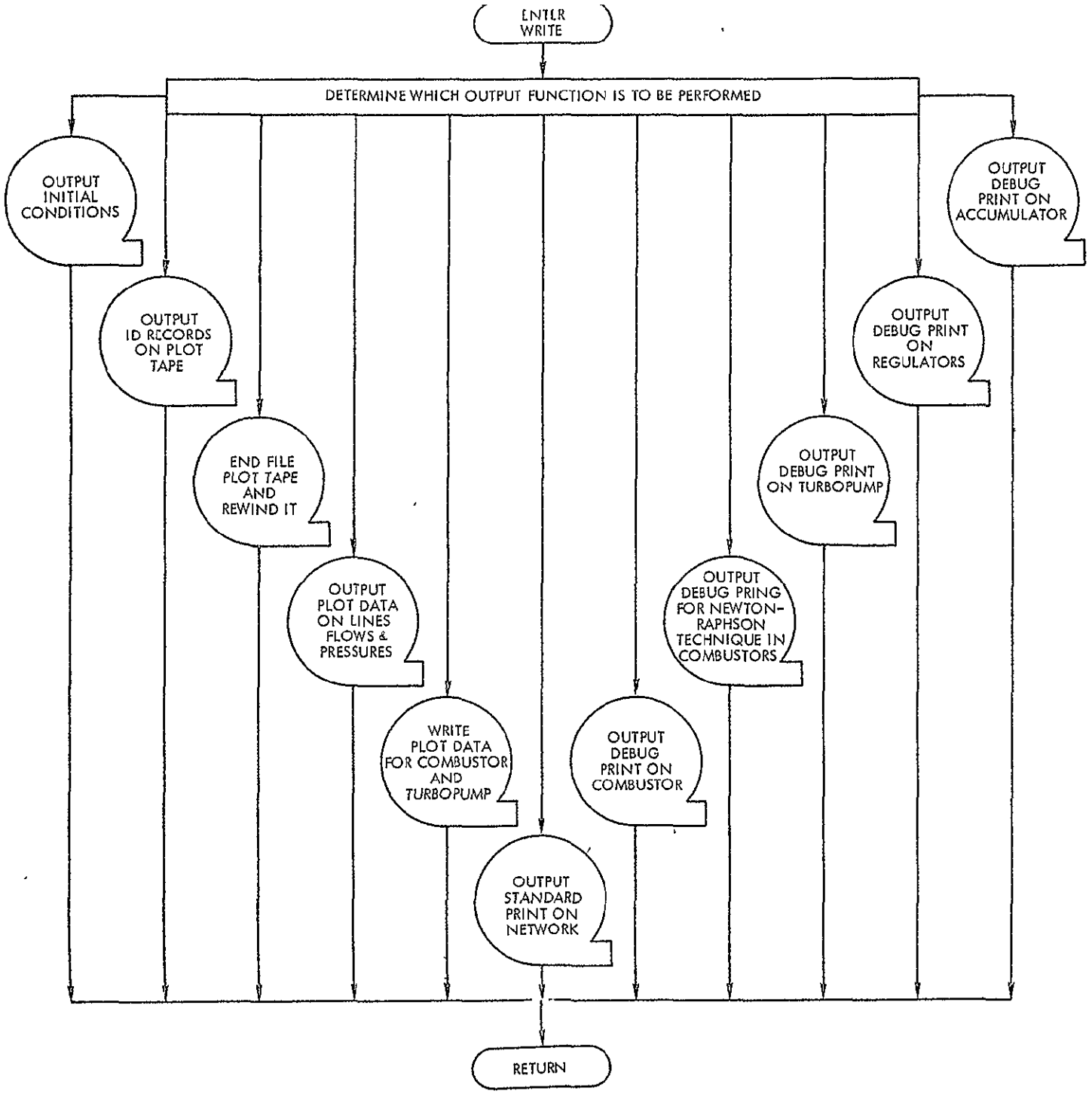


FLOW CHART 13

SUBROUTINE VAL



FLOW CHART 14
SUBROUTINE VALVEL



FLOW CHART 15
SUBROUTINE WRITE

PRECEDING PAGE BLANK NOT FILMED

5. PROGRAM LISTING

A complete listing of the TRAP computer program including the element table, subroutine listings, and program storage is shown in the following pages.

```
2. ERS
3. IN  Z

  END OF FILE -- UNIT Z
4. TRI Z
5. TOC
```

11:51:52.898
11:51:52.899

11:51:57.804
11:51:57.806

ELEMENT TABLE

ACC		SYMBOLIC	21 JUL 71	15:08:20	0	01436670	14	76
ACC	CODE	RELOCATABLE	21 JUL 71	15:08:20	1	01440740	36	1
					0	01441004	14	47
TRAP		SYMBOLIC	31 AUG 71	12:34:56	0	01442226	14	270
HP0149A		RELOCATABLE	31 AUG 71	12:34:56	1	01451532	84	1
					0	01451656	14	154
BLOCKD		SYMBOLIC	31 AUG 71	12:34:59	0	01456032	14	122
BLOCKD	CODE	RELOCATABLE	31 AUG 71	12:34:59	1	01461306	24	1
					0	01461336	14	976
CHAM		SYMBOLIC	31 AUG 71	12:35:04	0	01514076	14	255
CHAM	CODE	RELOCATABLE	31 AUG 71	12:35:04	1	01523060	48	1
					0	01523140	14	115
CR2TAP		SYMBOLIC	31 AUG 71	12:35:06	0	01526252	14	44
CR2TAP	CODE	RELOCATABLE	31 AUG 71	12:35:06	1	01527422	24	1
					0	01527452	14	18
FBL		SYMBOLIC	31 AUG 71	12:35:07	0	01530046	14	33
FBL	CODE	RELOCATABLE	31 AUG 71	12:35:07	1	01530764	36	1
					0	01531030	14	20
INTERP		SYMBOLIC	31 AUG 71	12:35:09	0	01531460	14	31
INTERP	CODE	RELOCATABLE	31 AUG 71	12:35:09	1	01532342	24	1
					0	01532372	14	24
JUNCL		SYMBOLIC	31 AUG 71	12:35:10	0	01533112	14	50
JUNCL	CODE	RELOCATABLE	31 AUG 71	12:35:10	1	01534406	36	1
					0	01534452	14	23
PBL		SYMBOLIC	31 AUG 71	12:35:12	0	01535154	14	27
PBL	CODE	RELOCATABLE	31 AUG 71	12:35:12	1	01535746	36	1
					0	01536012	14	19
PBLF		SYMBOLIC	31 AUG 71	12:35:14	0	01536424	14	48
PBLF	CODE	RELOCATABLE	31 AUG 71	12:35:14	1	01537664	36	1
					0	01537730	14	33
PIPEL		SYMBOLIC	31 AUG 71	12:35:15	0	01540646	14	22
PIPEL	CODE	RELOCATABLE	31 AUG 71	12:35:15	1	01541332	24	1
					0	01541362	14	18
REGL		SYMBOLIC	31 AUG 71	12:35:18	0	01541756	14	89
REGL	CODE	RELOCATABLE	31 AUG 71	12:35:18	1	01544314	48	1
					0	01544374	14	51
RKINS		SYMBOLIC	31 AUG 71	12:35:19	0	01545706	14	39
RKINS	CODE	RELOCATABLE	31 AUG 71	12:35:19	1	01546750	24	1
					0	01547000	14	16
VAL		SYMBOLIC	31 AUG 71	12:35:21	0	01547340	14	24
VAL	CODE	RELOCATABLE	31 AUG 71	12:35:21	1	01550060	24	1
					0	01550110	14	15
VALVEL		SYMBOLIC	31 AUG 71	12:35:23	0	01550432	14	39
VALVEL	CODE	RELOCATABLE	31 AUG 71	12:35:23	1	01551474	36	1
					0	01551540	14	27
WRITE		SYMBOLIC	31 AUG 71	12:35:30	0	01552332	14	443
WRITE	CODE	RELOCATABLE	31 AUG 71	12:35:30	1	01566424	84	1

0 01566550 14 285

ENTRY POINT TABLE

ACC	(ACC/CODE)	1 000637	CHAM	(CHAM/CODE)	1 001701	CR2TAP	(CR2TAP/CODE)	1 000157
FBL	(FBL/CODE)	1 000236	INTERP	(INTERP/CODE)	1 0002D7	JUNCL	(JUNCL/CODE)	1 000274
PBL	(PBL/CODE)	1 000233	PBLF	(PBLF/CODE)	1 000430	PIPEL	(PIPEL/CODE)	1 000221
REGL	(REGL/CODE)	1 000662	RKINS	(RKINS/CODE)	1 000170	VAL	(VAL/CODE)	1 000166
VALVEL	(VALVEL/CODE)	1 000337	WRITE	(WRITE/CODE)	1 003630			

BLOCK TABLE

ALLCOM	(BLOCKD/CODE)	34	BANK 2 DEPENDENT	CHAMBR	(BLOCKD/CODE)	34	BANK 2 DEPENDENT	
DATA3	(BLOCKD/CODE)	34	BANK 2 DEPENDENT					

COBOL LIBRARY TABLE EMPTY

PROCEDURE NAME TABLE EMPTY

END CUR LCC 1102-0038 L8

```
UNIVAC 1108 FORTRAN V LEVEL  22[redacted]18 F5C18H
THIS COMPILATION WAS DONE ON 11 SE[redacted]71 AT 08:39.48

   MAIN PROGRAM

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE    021305
      0002   *DATA    001571
      0002   *BLANK   000000
      0003   ACCCOM   001030
      0004   ALLCOM   023675
      0005   ALLCS    000050
      0006   CHAMBR   004A26
      0007   DATA2    000067
      0010   FBLCOM   001775
      0011   FLAGS    000006
      0012   JUNCLC   000075
      0013   PBLC04   002007
      0014   PBLFCM   004016
      0015   REGLCM   001401
      0016   VALUES   000010
      0017   VALVCM   002021

   EXTERNAL REFERENCES (BLOCK, NAME)

      0020   CHAM
      0021   RESET
      0022   CR2TAP
      0023   WRITF
      0024   PIPEL
      0025   PBL
      0026   VALVEL
      0027   JUNCL
      0030   FBL
      0031   REGL
      0032   ACC
      0033   VAL
      0034   RKINS
      0035   PBLF
      0036   NPWLS
      0037   NEXP6$
      0040   SQRT
      0041   SIN
      0042   NERR2$
      0043   NSTOP$

   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001  000427 179L      0001  000437 190L      0001  000464 210L      0001  000034 212G      0001  000507 230L
    0001  010157 236G      0001  000525 250L      0001  000306 263G      0001  000330 273G      0001  001061 290L
    0001  000210 301L      0001  000351 305G      0001  000344 310G      0001  001145 310L      0001  000406 320G
```

```
0001    000407 323G
0001    000610 414G
0001    001226 523G
0005 R  000142 AC3
0004 R  000000 AREAL
0006 R  000037 ATD
0006 R  000053 CEF1
0006 R  000077 CP
0006 R  000121 C52
0000 R  000715 DELX
0006 R  000152 DIAT
0003 R  000000 DPACC
0003 R  000011 DUM
0006 R  001230 ETAT
0015 R  001475 FW
0016 R  000001 GRHO
0011 I  000001 ICHAMP
0015 I  001501 IDUMJJ
0013 I  000000 IEND
0011 I  000000 IFLAG1
0014 I  000012 IPBF
0006 I  000261 IPUMO
0000 I  001134 ITIA
0000 I  001177 ITICO
0000 I  001300 ITIRN
0000 I  001401 ITPL
0000 I  000223 IY
0006 R  000312 KAY1
0006 R  000342 KAY4
0006 R  000412 KAY9
0015 I  001512 LREGUP
0006 R  000453 MW
0006 I  000472 NCHAM
0006 I  000474 NGGTP
0003 I  000020 NNNN
0010 I  000777 NPFBL
0000 I  001302 NPIR
0013 I  000025 NPRBL
0015 I  001524 NTREG
0000 R  001265 OFFIPR
0000 R  001212 ONIC
0006 R  000515 OPVALF
0015 R  001534 PO
0006 R  002455 PORT
0014 R  000063 PPBLF
0015 R  001535 PREF
0006 R  002501 PWO
0015 R  001556 Q1DUM
0006 R  002517 RPMP
0015 R  001570 TAUREG
0010 R  001011 TFBL
0006 R  002553 TIMEF
0006 R  003524 TMVALO
0013 R  001023 TPRBL
0006 R  004514 VOLC
0006 R  004552 WINJ
0006 R  004612 WTONOZ
0003 R  000026 XKACC

0001    001167 330L
0001    001072 446G
0005 R  000000 AC
0005 R  000044 AC4
0015 R  000000 AREG
0006 R  000031 ATDMOZ
0006 R  000055 CFF2
0006 R  000101 CP1
0006 R  000127 CV
0007 R  000010 DELXL
0015 R  001461 DMC1
0006 R  000154 DPMAN
0006 R  000202 DW
0000 R  000206 FACTOR
0004 R  000121 G
0000 I  000212 I
0003 I  000011 IDUM
0003 I  000012 IDUM1
0014 I  000000 IENDF
0000 I  000213 II
0011 I  000005 IPLOT
0011 I  000003 IREGPR
0000 I  001135 ITIAN
0000 I  001236 ITIP
0000 I  001301 ITIRO
0000 I  001402 ITPLN
0000 I  000224 IZ
0006 R  000422 KAY10
0006 R  000352 KAY5
0000 I  000211 KOUNT
0017 I  000000 LVON
0006 R  000463 MW1
0007 I  000034 NCMTB
0012 I  000062 NJUNCL
0000 I  000217 NNODEL
0000 I  001137 NPIA
0000 I  001343 NPIT
0006 I  000475 NPVALF
0017 I  000024 NVALL
0000 R  001326 OFFIR
0000 R  001253 ONIPR
0006 R  001455 OPVALO
0004 R  000174 PL
0006 R  002457 POW0
0003 R  000023 PPPP
0016 R  000007 PS
0006 R  002503 PW1
0015 R  001557 Q2DUM
0006 R  002520 RPMPO
0006 R  002524 TC
0006 R  002543 TGAS
0000 R  000207 TIMEND
0017 R  000037 TMVI
0006 R  004470 TTO
0006 R  004524 W
0006 R  004572 WNOZ
0004 R  014035 WTEMP
0014 R  004003 XKP

0001    000445 343G
0001    001104 453G
0005 R  000046 ACC1
0000 R  000000 ALPHA
0015 R  001440 AREGMX
0007 R  000000 BK
0020 R  000000 CHAM
0006 R  000100 CP2
0006 R  000147 CVEL
0010 R  000000 DFBL
0015 R  001461 DMC2
0006 R  000174 DPTO
0006 R  000210 DWFUEL
0000 R  001134 FLAG
0006 R  000232 GAM
0003 I  000007 IACC
0015 I  001476 IDUM1
0003 I  000013 IDUM2
0006 I  000256 IENG
0012 I  000000 IJUNCL
0011 I  000002 IPRINT
0006 R  000263 ISP
0000 I  001136 ITIAO
0000 I  001237 ITIPN
0000 I  001340 ITIT
0000 I  001403 ITPLO
0000 I  000210 IS
0006 R  000432 KAY11
0006 R  000362 KAY6
0000 I  000060 LFLAG
0017 I  000012 LVUP
0006 R  000464 MW2
0006 I  000473 NCOEF
0014 I  000024 NKPBLF
0004 I  000123 NODCL
0000 I  001200 NPIC
0004 I  000150 NPLINE
0006 I  000505 NPVALO
0017 I  000025 NXKVL
0000 R  001367 OFFIT
0000 R  001314 ONIR
0003 R  000021 PACC
0006 R  002425 PMAN
0006 R  002461 POW1
0013 R  000037 PPRBL
0004 R  004114 PTEMP
0006 R  002505 PW2
0006 R  002507 RGAS
0006 R  002522 RPMT
0006 R  002534 TC1
0000 R  000136 TH
0006 R  002554 TIMPUL
0006 R  004464 TORP
0006 R  004466 TORT
0006 R  004532 WCHAM
0006 R  004602 WOX
0015 R  001600 WW
0014 R  003017 XKPBLF

0001    001207 370L
0001    000237 50L
0005 R  000020 AC1
0004 R  000000 AREA
0015 R  001450 AREGP
0006 R  000033 CC
0004 R  000024 CL
0006 R  000110 CSTAR
0004 R  000050 DELT
0015 R  001464 DFW
0015 R  001462 DMC3
0006 R  000176 DRPMT
0006 R  000220 DWOX
0015 R  001465 FREG
0004 R  000122 GC
0011 I  000000 IACCPR
0015 I  001477 IDUMII
0003 I  000014 IDUM3
0010 I  000764 IFBL
0000 I  000034 INCL
0000 I  000214 IPROP
0006 R  000273 IS1
0000 I  001175 ITIC
0000 I  001240 ITIPO
0000 I  001341 ITITN
0011 I  000004 ITURBN
0000 I  000220 JJ
0006 R  000322 KAY2
0006 R  000372 KAY7
0000 I  000225 LL
0006 R  000442 MR
0000 I  000221 N
0000 I  000226 NE
0012 I  000063 NLINJU
0013 I  000024 NPBL
0004 I  000147 NPIPL
0014 I  000037 NPPBLF
0015 I  001522 NREG
0000 R  001163 OFFIA
0000 R  001430 OFFPLT
0000 R  001355 ONIT
0014 R  000051 PBNDL
0006 R  002445 PMR
0006 R  002463 POW2
0016 R  000004 PR
0004 R  002477 PTO
0000 R  000070 PZCO
0004 R  010034 RHOL
0004 R  010044 SINALP
0006 R  002535 TC2
0004 R  010070 THETA
0014 R  001047 TKPBLF
0006 R  004466 TORT
0006 R  004474 VMAN
0004 R  010115 WDOTL
0016 R  000002 WR
0006 R  004622 XITP
0017 R  001035 XKVL

0001    000606 411G
0001    001214 517G
0005 R  000040 AC2
0006 R  000020 AREAC
0016 R  000000 ARHO
0006 R  000043 CCC
0006 R  000057 CMAN
0006 R  000120 CS1
0006 R  000151 DELTF
0004 R  000051 DIAL
0015 R  001463 DMC4
0006 R  000200 DTD
0000 R  000024 EL
0004 R  000075 FRL
0006 R  000234 GR
0006 I  000236 ICHAM
0015 I  001500 IDUMIP
0003 I  000015 IENACC
0000 I  001134 IFLAG
0013 I  000012 IPB
0006 I  000257 IPUMI
0006 R  000274 IS2
0000 I  001176 ITICN
0000 I  001277 ITIR
0000 I  001342 ITITO
0000 I  000222 IX
0006 R  000302 KAY
0006 R  000332 KAY3
0006 R  000402 KAY8
0015 I  001502 LREGDN
0006 R  000452 MR1
0003 I  000017 NACC
0010 I  000776 NFBL
0007 I  000035 NN
0014 I  000036 NPBLF
0000 I  001241 NPIPR
0000 I  001404 NPPLT
0015 I  001523 NTDUM
0000 R  001224 OFFIC
0000 R  001151 ONIA
0000 R  001416 ONPLT
0006 R  002415 PCHAM
0006 R  002453 POWP
0006 R  002465 POW3
0006 R  002467 PRATC
0015 R  001545 PU
0015 R  001546 QREG
0000 R  000216 RNODEL
0015 R  001560 SPREG
0000 R  000114 TEMPS
0004 R  010114 TIME
0006 R  002564 TMVALF
0014 R  002033 TPBLF
0003 R  000024 VOLACC
0006 R  004542 WFUEL
0016 R  000005 WS
0017 R  001023 XK
0007 R  000036 XLENGL
```

```
00101      1*      EXTERNAL CHAM                                                    TRAP0001
00103      2*      REAL ISP,ISI,IS2,KAY,KAYI,KAY2,KAY3,KAY4,KAY5,KAY6,KAY7,KAY8,KAY9,TRAP0002
00103      3*     1KAY10,KAY11,MR,MR1,MW,MW1,MW2                                    TRAP0003
00104      4*      DIMENSION ALPHA(20),FL(8),FLAG(33,6),IFLAG(33,6),INCL(20),LFLAG(8)TRAP0004
00104      5*     1,NPIA(10),NPIC(10),NPIPR(10),NPIR(10),NPIT(10),NPPLT(10),OFFIA(10)TRAP0005
00104      6*     2,OFFIC(10),OFFIPR(10),OFFIR(10),OFFIT(10),OFFPLT(10),ONIA(10),   TRAP0006
00104      7*     3ONIC(10),ONIPR(10),ONIR(10),ONIT(10),ONPLT(10),PZ00(20),TEMPS(3,6)TRAP0007
00104      8*     4,TH(20),Z3(20)                                                   TRAP0008
00105      9*      DIMENSION IFLAG1(6)                                              TRAP0009
00106     10*      COMMON/ACCCOM/DPACC,DUM(6),IACC(2),IDUM,IDUM1,IDUM2,IDUM3,       TRAP0010
00106     11*     1IENACC(2),NACC,NNNN,PACC(2),PPPP,VOLACC(2),XKACC(2)              TRAP0011
00107     12*      COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,       TRAP0012
00107     13*     1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),     TRAP0013
00107     14*     2SMALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)   TRAP0014
00110     15*      COMMON/ALLCS/AC(8,2),AC1(8,2),AC2(2),AC3(2),AC4(2),ACC1(2)       TRAP0015
00111     16*      COMMON/CHAMBR/AREA(8,2),AREAC(8),ATD,ATDNOZ(2),CC(8),CCC(8),     TRAP0016
00111     17*     1CEF1(2),CEF2(2),CMAN(8,2),CP(2),CP1,CP2(6),CSTAR(8),CS1,CS2(6),  TRAP0017
00111     18*     2CV(8,2),CVEL(2),DELTF,DIAT(2),DPMAN(8,2),DPTO(2),DRPMT(2),DTD(2),TRAP0018
00111     19*     3DW(6),DWFUEL(8),DWOX(8),ETAT(2),GAM(2),GR(2),ICHAM(8,2),IFNG,    TRAP0019
00111     20*     4IPUMT(2),IPUMO(2),ISP(8),IS1,IS2(6),KAY(8),KAY1(8),KAY2(8),      TRAP0020
00111     21*     5KAY3(8),KAY4(8),KAY5(8),KAY6(8),KAY7(8),KAY8(8),KAY9(8),KAY10(8),TRAP0021
00111     22*     6KAY11(8),MR(8),MR1,MW(8),MW1,MW2(6),NCHAM,NCOEF,NGGTP,NPVALF(8),  TRAP0022
00111     23*     7NPVALO(8),OPVALF(8,60),OPVALO(8,60),PCHAM(8),PMAN(8,2),PMR(6),    TRAP0023
00111     24*     8POWP(2),POWT(2),POWO(2),POW1(2),POW2(2),POW3(2),PRATC(8),PTO(2),  TRAP0024
00111     25*     9PWP(2),PW1(2),PW2(2),RGAS(8),RPMP,RPMPD(2),RPMT(2),TC(8),TC1,     TRAP0025
00111     26*     *TC2(6),TGAS(8),TIMEF,TIMPUL(8),TMVALF(8,60),TMVALO(8,60),TORP(2), TRAP0026
00111     27*     ATORT(2),TTO(2),U(2),VMAN(8,2),VOLC(8),W(6),WCHAM(8),WFUFL(8),     TRAP0027
00111     28*     BWINJ(8,2),WNOZ(8),WOX(8),ATDNOZ(8),XITP(2),XLTD(2)                TRAP0028
00112     29*      COMMON/DATA2/BK(8),DELXL(20),NCMTB,NN,XLENGL(20)                  TRAP0029
00113     30*      COMMON/FRLCOM/DFRL(10,50),IFBL(10),NFBL,NPFBL(10),TFBL(10,50)     TRAP0030
00114     31*      COMMON/FLAGS/IACCPR,ICHAMP,IPRINT,IREGPR,ITURBN,IPLOT             TRAP0031
00115     32*      COMMON/JUNCLC/IJUNCL(10,5),NJUNCL,NLINJU(10)                      TRAP0032
00116     33*      COMMON/PBLCOM/IEND(10),IPB(10),NPBL,NPRBL(10),PPRBL(10,50),       TRAP0033
00116     34*     1TPRBL(10,50)                                                      TRAP0034
00117     35*      COMMON/PBLFCM/IENDF(10),IPBF(10),NKPBLF(10),NPBLF,NPPBLF(10),     TRAP0035
00117     36*     1PBNDL(10),PPBLF(10,50),TKPBLF(10,50),TPBLF(10,50),XKPBLF(10,50), TRAP0036
00117     37*     2XKP(10)                                                           TRAP0037
00120     38*      COMMON/REGLCM/AREG(8,10),AREGMX(8),AREGP(8),DMC1,DMC2,DMC3,DMC4,  TRAP0038
00120     39*     1DFA,FREG(8),FW,IDUMI,IDUMII,IDUMIP,IDUMJJ,LREGDN(8),LREGUP(8),    TRAP0039
00120     40*     2NREG,NTDUM,NTREG(8),PD,PREF(8),PU,QREG(8),QIDUM,Q2DUM,SPREG(8),   TRAP0040
00120     41*     3TAUREG(8),WW                                                      TRAP0041
00121     42*      COMMON/VALUES/ARHO,GRHO,WR,ZR,PR,WS,ZS,PS                         TRAP0042
00122     43*      COMMON/VALVCM/LVDN(10),LVUP(10),NVALL,NXKVL(10),TMVL(10,50),      TRAP0043
00122     44*     1XK(10),XKVL(10,50)                                                TRAP0044
00123     45*      EQUIVALENCE (IFLAG1(1),IACCPR)                                    TRAP0045
00124     46*      EQUIVALENCE (FLAG(1,1),IFLAG(1,1)),(ITIA,IFLAG(1,1)),(ITIAN,IFLAG(TRAP0046
00124     47*     12,1)),(ITIAO,IFLAG(3,1)),(NPIA(1),IFLAG(4,1)),(ONIA(1),FLAG(14,1))TRAP0047
00124     48*     2,(OFFIA(1),FLAG(24,1)),(ITIC,IFLAG(1,2)),(ITICN,IFLAG(2,2)),     TRAP0048
00124     49*     3(ITICO,IFLAG(3,2)),(NPIC(1),IFLAG(4,2)),(ONIC(1),FLAG(14,2)),    TRAP0049
00124     50*     4(OFFIC,FLAG(24,2)),(ITIP,IFLAG(1,3)),(ITIPN,IFLAG(2,3)),         TRAP0050
00124     51*     5(ITIPO,IFLAG(3,3)),(NPIPR(1),IFLAG(4,3)),(ONIPR(1),FLAG(14,3)),  TRAP0051
00124     52*     6(OFFIPR(1),FLAG(24,3)),(ITIR,IFLAG(1,4)),(ITIRN,IFLAG(2,4)),     TRAP0052
00124     53*     7(ITIRO,IFLAG(3,4)),(NPIR(1),IFLAG(4,4)),(ONIR(1),FLAG(14,4)),    TRAP0053
```

```
00124    54.      8(OFFIR(I),FLAG(24,4)),(ITIT,IFLAG(1,5)),(ITITN,IFLAG(2,5)),        TRAP0054
00124    55.      9(ITITO,IFLAG(3,5)),(NPIT(I),IFLAG(4,5)),(ONIT(I),FLAG(14,5)),      TRAP0055
00124    56.      *(OFFIT(I),FLAG(24,5)),(ITPL,IFLAG(1,6)),(ITPLN,IFLAG(2,6)),        TRAP0056
00124    57.      A(ITPLO,IFLAG(3,6)),(NPPLT(I),IFLAG(4,6)),(ONPLT(I),FLAG(14,6)),    TRAP0057
00124    58.      B(OFFPLT(I),FLAG(24,6))                                              TRAP0058
00125    59.       NAMELIST/INDATA/ALPHA,AREA,AREAC,AREGMX,APEGP,ATDNOZ,BK,CEF1,CEF2,TRAP0059
00125    60.      1CL,CMAN,CP1,CP2,CSTAR,CS1,CS2,DELT,DELTF,DFBL,DIAL,DIAT,DTD,EL,    TRAP0060
00125    61.      2FACTOR,FREG,FRL,G,GR,IACC,IACCPR,ICHAM,ICHAMP,IFNACC,IEND,IENDF,    TRAP0061
00125    62.      3IFBL,IJUNCL,INCL,IPB,IPRF,IPLOT,IPRINT,IPUMI,IPUMO,IREGPR,IS1,IS2,TRAP0062
00125    63.      4ITURBN,KAY,LFLAG,LREGDN,LREGUP,LVDN,LVUP,MRI,MW1,MW2,NACC,NCHAM,   TRAP0063
00125    64.      5NCOEF,NFBL,NGGTP,NJUNCL,NKPBLF,NLINJU,NPBL,NPBLF,NPFBL,NPIA,NPIC,  TRAP0064
00125    65.      6NPIPL,NPIPR,NPIR,NPIT,NPLINE,NPPBLF,NPPLT,NPRBL,NPVALF,NPVALO,     TRAP0065
00125    66.      7NREG,NVALL,NXKVL,OFFIA,OFFIC,OFFIPR,OFFIR,OFFIT,OFFPLT,ONIA,ONIC,  TRAP0066
00125    67.      8ONIPR,ONIR,ONIT,ONPLT,OPVALF,OPVALO,PACC,POW0,POW1,POW2,POW3,      TRAP0067
00125    68.      9PPBLF,PPRBL,PREF,PW0,PW1,PW2,PZ00,QREG,RGAS,RHOL,RPMPD,SPREG,      TRAP0068
00125    69.      *TAUREG,TC1,TC2,TFBL,TGAS,TH,TIMEND,TKPBLF,TMVALF,TMVALO,TMVL,      TRAP0069
00125    70.      ATPBLF,TPRBL,VMAN,VOLACC,VOLC,XITP,XKACC,XKPBLF,XKVL,XLENGL,XLTO,7DTRAP0070
00126    71.       DATA INCL/20*0/                                                     TRAP0071
00130    72.       DATA ITIA,ITIC,ITIP,ITIR,ITIT,ITPL/6*1/                             TRAP0072
00137    73.       DATA ITIAN,ITICN,ITIPN,ITIRN,ITITN,ITPLN/6*24/                      TRAP0073
00146    74.       DATA ITIAO,ITICO,ITIPO,ITIRO,ITITO,ITPLO/6*14/                      TRAP0074
00155    75.       DATA NPIA,NPIC,NPIPR,NPIR,NPIT,NPPLT/60*0/                          TRAP0075
00164    76.       DATA OFFIA,OFFIC,OFFIPR,OFFIR,OFFIT,OFFPLT/60*0.0/                  TRAP0076
00173    77.       DATA ONIA,ONIC,ONIPR,ONIR,ONIT,ONPLT/60*100.0/                      TRAP0077
00173    78.  C            RESET CLOCK ON MACHINE                                     TRAP0078
00202    79.       CALL RESET                                                          TRAP0079
00202    80.  C                 PUT DATA DECK ON SCRATCH FILE AND LIST                 TRAP0080
00203    81.       CALL CRZTAP(6HDECKEN,12,55,5,6)                                     TRAP0081
00203    82.  C                 READ PROGRAM DATA                                     TRAP0082
00204    83.       READ(12,INDATA)                                                     TRAP0083
00204    84.  C                 INITIAL CALCULATIONS                                  TRAP0084
00207    85.       NCMTB=NCHAM+NGGTP                                                   TRAP0085
00210    86.       KOUNT=0                                                             TRAP0086
00211    87.       DO 10 I=1,8                                                         TRAP0087
00214    88.       KAY1(I)=KAY(I)+1.0                                                  TRAP0088
00215    89.       KAY2(I)=KAY(I)-1.0                                                  TRAP0089
00216    90.       KAY3(I)=KAY1(I)/KAY2(I)                                             TRAP0090
00217    91.       KAY4(I)=2.0/KAY1(I)                                                 TRAP0091
00220    92.       KAY5(I)=KAY(I)/KAY2(I)                                              TRAP0092
00221    93.       KAY6(I)=(KAY(I)+1.0)/KAY(I)                                         TRAP0093
00222    94.       KAY7(I)=1.0/KAY(I)                                                  TRAP0094
00223    95.       KAY8(I)=(2.0-KAY(I))/KAY(I)                                         TRAP0095
00224    96.       KAY9(I)=2.0/KAY(I)                                                  TRAP0096
00225    97.       KAY10(I)=2.0/KAY2(I)                                                TRAP0097
00226    98.       KAY11(I)=KAY1(I)/KAY(I)                                             TRAP0098
00227    99.       CC(I)=SQRT(KAY(I)*GC/(RGAS(I)*TGAS(I))*KAY4(I)**KAY3(I))           TRAP0099
00230   100.       CCC(I)=SQRT(GC*KAY(I)/RGAS(I)/TGAS(I))                             TRAP0100
00231   101.       PRATC(I)=KAY4(I)**KAY5(I)                                           TRAP0101
00232   102.    10 CONTINUE                                                           TRAP0102
00234   103.       NN=DELT/DELTF                                                       TRAP0103
00234   104.  C                 CALCULATE SPEED OF SOUND IN EACH LINE                 TRAP0104
00235   105.       DO 90 II=1,NPIPL                                                    TRAP0105
00240   106.       IPROP=NPLINE(II)                                                    TRAP0106
00241   107.       IF (INCL(II).EQ.1) GO TO 50                                         TRAP0107
00243   108.       IF (LFLAG(IPROP).EQ.1) GO TO 30                                     TRAP0108
00245   109.       CL(II)=SQRT(KAY(IPROP)*GC*RGAS(IPROP)*TGAS(IPROP))                  TRAP0109
00246   110.       GO TO 50                                                            TRAP0110
00247   111.    30 CONTINUE                                                           TRAP0111
```

```
00250          CL(II)=SQRT(B[illegible]ROP)*GC*144.0/RHOL(IPROP)/(1.0+BK(IPROP)*DIAL(II)TRAP[illegible]
00250         1/FL(IPROP)/TH[illegible]))                                                TRAP[illegible]
00251        5 CONTINUE                                                                  TRAP0114
00252          DELX=DELT*FACTOR*CL(II)                                                   TRAP0115
00253          NODEL(II)=XLENGL(II)/DELX+1.0                                             TRAP0116
00254          RNODEL=NODEL(II)                                                          TRAP0117
00255          DELXL(II)=XLENGL(II)/(RNODEL-1.0)                                         TRAP0118
00256          AREAL(II)=3.1415927*DIAL(II)*DIAL(II)/4.0/144.0                           TRAP0119
00257          SINALP(II)=SIN(ALPHA(II)/57.295780)                                       TRAP0120
00260          THETA(II)=DELT/DELXL(II)                                                  TRAP0121
00261          NNODEL=NODEL(II)                                                          TRAP0122
00262          DO 70 JJ=1,NNODEL                                                         TRAP0123
00265          Z(II,JJ)=Z0(II)+(JJ-1)*DELXL(II)*SINALP(II)                               TRAP0124
00266       70 CONTINUE                                                                  TRAP0125
00270       90 CONTINUE                                                                  TRAP0126
00270    C                CALCULATE STARTING CONDITIONS                                  TRAP0127
00272          DO 110 II=1,NPIPL                                                         TRAP0128
00275          NNODEL=NODEL(II)                                                          TRAP0129
00276          IPROP=NPLINE(II)                                                          TRAP0130
00277          DO 110 JJ=1,NNODEL                                                        TRAP0131
00302          WDOTL(II,JJ)=0.0                                                          TRAP0132
00303          PL(II,JJ)=PZ0(II)-G/GC*RHOL(IPROP)*Z(II,JJ)                               TRAP0133
00304      110 CONTINUE                                                                  TRAP0134
00304    C                INITIALIZATION FOR REGULATOR                                   TRAP0135
00307          DO 130 I=1,NREG                                                           TRAP0136
00312          NTREG(I)=TAUREG(I)/DELT+0.0001                                            TRAP0137
00313      130 CONTINUE                                                                  TRAP0138
00313    C                INITIALIZATION FOR THRUST CHAMBERS AND GAS TURBINE             TRAP0139
00313    C                CHAMBERS                                                       TRAP0140
00315          IF (NCMTB.LE.0) GO TO 170                                                 TRAP0141
00317          DO 150 I=1,NCMTB                                                          TRAP0142
00322          DO 150 N=1,2                                                              TRAP0143
00325          II=ICHAM(I,N)                                                             TRAP0144
00326          JJ=NODEL(II)                                                              TRAP0145
00327          PTEMP(II,JJ)=PL(II,JJ)                                                    TRAP0146
00330          WTEMP(II,JJ)=WDOTL(II,JJ)                                                 TRAP0147
00331      150 CONTINUE                                                                  TRAP0148
00334      170 CONTINUE                                                                  TRAP0149
00334    C                WRITE INITIAL PLOT RECORDS IF PLOTS ARE BEING MADE.            TRAP0150
00335          IF(IPLOT.NE.0)CALL WRITE(3)                                               TRAP0151
00335    C                WRITE INITAL CONDITIONS AND INPUT CONSTANTS.                   TRAP0152
00337          CALL WRITE(1)                                                             TRAP0153
00337    C                INCREASE TIME                                                  TRAP0154
00340      190 CONTINUE                                                                  TRAP0155
00341          TIME=TIME+DELT                                                            TRAP0156
00341    C                SET PRINT AND PLOT FLAGS                                       TRAP0157
00341    C                I = 1, ACCUMULATOR PRINT FLAG                                  TRAP0158
00341    C                I = 2, COMBUSTOR PRINT FLAG                                    TRAP0159
00341    C                I = 3, NOMINAL PRINT FLAG                                      TRAP0160
00341    C                I = 4, REGULATOR PRINT FLAG                                    TRAP0161
00341    C                I = 5, TURBINE PRINT FLAG                                      TRAP0162
00341    C                I = 6, PLOT FLAG                                               TRAP0163
00342          DO 250 I=1,6                                                              TRAP0164
00342    C                SET INDEX FOR COMPUTED GO TO                                   TRAP0165
00345          IX=IFLAG(1,I)                                                             TRAP0166
00345    C                SET SUBSCRIPT FOR 'TIME TO TURN FLAG OFF' ARRAY                TRAP0167
00346          IY=IFLAG(2,I)                                                             TRAP0168
00346    C                SET SUBSCRIPT FOR 'TIME TO TURN FLAG ON' ARRAY                 TRAP0169
```

```
00347   170*          IZ=IFLAG(3,I)                                                    TRAP0170
00347   171*    C               GO TO 'TURN ON' OR 'TURN OFF' FLAG                     TRAP0171
00350   172*          GO TO (210,230),IX                                               TRAP0172
00350   173*    C               CHECK FOR TIME TO TURN FLAG ON                         TRAP0173
00351   174*      210 CONTINUE                                                         TRAP0174
00352   175*          IF (TIME.LE.FLAG(IZ,I)) GO TO 250                                TRAP0175
00352   176*    C               TURN FLAG ON, INCREASE SUBSCRIPT, CHANGE SETTING OF GO TRAP0176
00352   177*    C               TO FLAG                                                TRAP0177
00354   178*          IFLAG1(I)=IFLAG(IZ-10,I)                                         TRAP0178
00355   179*          IFLAG(3,I)=IFLAG(3,I)+1                                          TRAP0179
00356   180*          IFLAG(1,I)=2                                                     TRAP0180
00357   181*          GO TO 250                                                        TRAP0181
00357   182*    C               CHECK FOR TIME TO TURN FLAG OFF                        TRAP0182
00360   183*      230 CONTINUE                                                         TRAP0183
00361   184*          IF (TIME.LE.FLAG(IY,I)) GO TO 250                                TRAP0184
00361   185*    C               TURN FLAG OFF, INCREASE SUBSCRIPT, CHANGE SETTING OF GO TRAP0185
00361   186*    C               TO FLAG                                                TRAP0186
00363   187*          IFLAG1(I)=0                                                      TRAP0187
00364   188*          IFLAG(2,I)=IFLAG(2,I)+1                                          TRAP0188
00365   189*          IFLAG(1,I)=1                                                     TRAP0189
00366   190*      250 CONTINUE                                                         TRAP0190
00370   191*          KOUNT=KOUNT+1                                                    TRAP0191
00371   192*          CALL PIPEL                                                       TRAP0192
00372   193*          IF(NPBL.GT.0)CALL PBL                                            TRAP0193
00374   194*          IF(NVALL.GT.0)CALL VALVEL                                        TRAP0194
00376   195*          IF(NJUNCL.GT.0)CALL JUNCL                                        TRAP0195
00400   196*          IF(NFBL.GT.0)CALL FBL                                            TRAP0196
00402   197*          IF(NREG.NE.0)CALL REGL                                           TRAP0197
00404   198*          IF(NACC.NE.0)CALL ACC                                            TRAP0198
00406   199*          IF (NCMTB.LE.0) GO TO 370                                        TRAP0199
00410   200*          DO 290 I=1,NCMTB                                                 TRAP0200
00413   201*          DO 270 N=1,2                                                     TRAP0201
00416   202*          II=ICHAM(I,N)                                                    TRAP0202
00417   203*          JJ=NODEL(II)                                                     TRAP0203
00420   204*          IPROP=NPLINE(II)                                                 TRAP0204
00421   205*          CALL VAL(II,JJ,IPROP,1)                                          TRAP0205
00422   206*          AC(I,N)=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.-G*TRAP0206
00422   207*         1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+FRL(II)*WR*ABS(WR)/2.0TRAP0207
00422   208*         2/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                        TRAP0208
00423   209*          AC1(I,N)=AREAL(II)/CL(II)*144.0*GC                               TRAP0209
00424   210*      270 CONTINUE                                                         TRAP0210
00426   211*          IF (I.GT.NGGTP) GO TO 290                                        TRAP0211
00430   212*          II=IPUMI(I)                                                      TRAP0212
00431   213*          JJ=NODEL(II)                                                     TRAP0213
00432   214*          IPROP=NPLINE(II)                                                 TRAP0214
00433   215*          CALL VAL(II,JJ,IPROP,1)                                          TRAP0215
00434   216*          AC3(I)=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.0-G*TRAP0216
00434   217*         1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+FRL(II)*WR*ABS(WR)/2.0TRAP0217
00434   218*         2/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                        TRAP0218
00435   219*          AC4(I)=AREAL(II)/CL(II)*144.0*GC                                 TRAP0219
00436   220*          II=IPUMO(I)                                                      TRAP0220
00437   221*          IPROP=NPLINE(II)                                                 TRAP0221
00440   222*          CALL VAL(II,1,IPROP,2)                                           TRAP0222
00441   223*          AC2(I)=-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*TRAP0223
00441   224*         1RHOL(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)*  TRAP0224
00441   225*         2DELT/2.0/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                     TRAP0225
00442   226*          AC2(I)=-AREAL(II)/CL(II)*144.0*GC                                TRAP0226
00443   227*      290 CONTINUE                                                         TRAP0227
```

```
00445          DO 350 I=1,NCMTR                                                TRAP0228
00450          IENG=I                                                          TRAP0[illegible]
00451          TIMEF=TIME-DEL                                                  TRAP0[illegible]
00452          DO 350 LL=1,NN                                                  TRAP0231
00455          NE=4                                                            TRAP0232
00456          W(1)=WOX(I)                                                     TRAP0233
00457          W(2)=WFUEL(I)                                                   TRAP0234
00460          W(3)=PMAN(I,1)                                                  TRAP0235
00461          W(4)=PMAN(I,2)                                                  TRAP0236
00462          DW(1)=DWOX(I)                                                   TRAP0237
00463          DW(2)=DWFUEL(I)                                                 TRAP0238
00464          DW(3)=DPMAN(I,1)                                                TRAP0239
00465          DW(4)=DPMAN(I,2)                                                TRAP0240
00466          IF (I.GT.NGGTR) GO TO 310                                       TRAP0241
00470          NE=6                                                            TRAP0242
00471          W(5)=RPMT(I)                                                    TRAP0243
00472          W(6)=PTO(I)                                                     TRAP0244
00473          DW(5)=DRPMT(I)                                                  TRAP0245
00474          DW(6)=DPTO(I)                                                   TRAP0246
00475      310 CONTINUE                                                        TRAP0247
00476          CALL RKINS(TIMEF,DELTF,W,DW,CHAM,NE,TEMPS)                      TRAP0248
00477          IF (I.GT.NGGTR) GO TO 330                                       TRAP0249
00501          RPMT(I)=W(5)                                                    TRAP0250
00502          PTO(I)=W(6)                                                     TRAP0251
00503      330 CONTINUE                                                        TRAP0252
00504          WOX(I)=W(1)                                                     TRAP0253
00505          WFUEL(I)=W(2)                                                   TRAP0254
00506          PMAN(I,1)=W(3)                                                  TRAP0255
00507          PMAN(I,2)=W(4)                                                  TRAP0256
00510      350 CONTINUE                                                        TRAP0257
00513      370 CONTINUE                                                        TRAP0258
00514          IF(NPELF.GT.0)CALL PBLF                                         TRAP0259
00516          DO 390 II=1,NPIPL                                               TRAP0260
00521          NNODEL=NODEL(II)                                                TRAP0261
00522          DO 390 JJ=1,NNODEL                                              TRAP0262
00525          WDOTL(II,JJ)=WTEMP(II,JJ)                                       TRAP0263
00526          PL(II,JJ)=PTEMP(II,JJ)                                          TRAP0264
00527      390 CONTINUE                                                        TRAP0265
00532          IF(IPLOT.NE.0.AND.MOD(KOUNT,IPLOT).EQ.0)CALL WRITE(4)           TRAP0266
00534          IF(IPRINT.NE.0.AND.MOD(KOUNT,IPRINT).EQ.0)CALL WRITE(5)         TRAP0267
00534    C                CHECK FOR REACHING END CONDITION                     TRAP0268
00536          IF (TIME.LT.TIMEND) GO TO 190                                   TRAP0269
00536    C                WRAP UP PLOT TAPE AND PRINT RUN TIME                 TRAP0270
00540          CALL WRITE(8)                                                   TRAP0271
00541          STOP                                                            TRAP0272
00542          END                                                             TRAP0273

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
TRAP            SYMBOLIC                                  21 JUL 71  15:08:17   0  01436670   14   573  (DELETED)
HP014A          RELOCATABLE                               21 JUL 71  15:08:17   1  01446246   84     1  (DELETED)
                                                                                0  01446372   14   172
```

5.3 Block Data

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:01

   BLOCK DATA

   STORAGE USED (BLOCK, NAME, LENGTH)

        0003   ALLCOM  023675
        0004   CHAMBR  004626
        0005   DATA3   001200

   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0004 R 000000 AREA    0004 R 000020 AREAC   0003 R 000000 AREAL   0004 R 000030 ATD     0004 R 000031 ATDNOZ
0004 R 000033 CC      0004 R 000043 CCC     0004 R 000053 CEF1    0004 R 000055 CEF2    0003 R 000024 CL
0004 R 000057 CMAN    0004 R 000077 CP      0004 R 000101 CP1     0004 R 000102 CP2     0004 R 000110 CSTAR
0004 R 000120 CS1     0004 R 000121 CS2     0004 R 000127 CV      0004 R 000147 CVEL    0003 R 000050 DELT
0004 R 000151 DELTF   0003 R 000051 DIAL    0004 R 000152 DIAT    0004 R 000154 DPMAN   0004 R 000174 DPTO
0004 R 000176 DRPMT   0004 R 000200 DTD     0004 R 000202 DW      0004 R 000210 DWFUEL  0004 R 000220 DWOX
0004 R 000230 ETAT    0000 R 000005 FACTOR  0003 R 000075 FRL     0003 R 000121 G       0004 R 000232 GAM
0003 R 000122 GC      0004 R 000234 GR      0000 I 000002 I       0004 I 000236 ICHAM   0004 I 000256 IENG
0000 I 000004 IPLOT   0004 I 000257 IPUM1   0004 I 000261 IPUMO   0004 I 000263 ISP     0004 I 000273 IS1
0004 I 000274 IS2     0000 I 000003 IS      0004 I 000302 KAY     0004 I 000312 KAY1    0004 I 000422 KAY10
0004 I 000432 KAY11   0004 I 000322 KAY2    0004 I 000332 KAY3    0004 I 000342 KAY4    0004 I 000352 KAY5
0004 I 000362 KAY6    0004 I 000372 KAY7    0004 I 000402 KAY8    0004 I 000412 KAY9    0000 I 000001 KK
0000 I 000000 LL      0004 I 000442 MR      0004 I 000452 MR1     0004 I 000453 MW      0004 I 000463 MW1
0004 I 000464 MW2     0005 I 000000 NAMCHM  0005 I 000166 NAME    0005 I 000242 NAMEPL  0005 I 000160 NAMTMP
0004 I 000472 NCHAM   0004 I 000473 NCOEF   0004 I 000474 NGGTP   0005 I 000362 NME     0005 I 000432 NMETBN
0005 I 000452 NMOUT   0003 I 000123 NODEL   0003 I 000147 NPIPL   0003 I 000150 NPLINE  0004 I 000475 NPVALF
0004 I 000505 NPVALO  0004 R 000515 OPVALF  0004 R 001455 OPVALO  0005 R 000654 OUTDAT  0004 R 002415 PCHAM
0003 R 000174 PL      0005 R 001056 PLOTND  0004 R 002425 PMAN    0004 R 002445 PMR     0004 R 002453 POWP
0004 R 002455 POWT    0004 R 002457 POWO    0004 R 002461 POW1    0004 R 002463 POW2    0004 R 002465 POW3
0004 R 002467 PRATC   0003 R 004114 PTEMP   0004 R 002477 PTO     0004 R 002501 PWO     0004 R 002503 PW1
0004 R 002505 PW2     0004 R 002507 RGAS    0003 R 010034 RHOL    0004 R 002517 RPMP    0004 R 002520 RPMPD
0004 R 002522 RPMT    0003 R 010044 SINALP  0004 R 002524 TC      0004 R 002534 TC1     0004 R 002535 TC2
0004 R 002543 TGAS    0003 R 010070 THETA   0005 R 001176 TIM     0003 R 010114 TIME    0004 R 002553 TIMEF
0000 R 000006 TIMEND  0005 R 001177 TIMF    0004 R 002554 TIMPUL  0004 R 002564 TMVALF  0004 R 003524 TMVALO
0004 R 004464 TORP    0004 R 004466 TORT    0004 R 004470 TTO     0004 R 004472 U       0004 R 004474 VMAN
0004 R 004514 VOLC    0004 R 004524 W       0004 R 004532 WCHAM   0003 R 010115 WDOTL   0004 R 004542 WFUEL
0004 R 004552 WINJ    0004 R 004572 WNOZ    0004 R 004602 WOX     0004 R 004612 WTDNOZ  0003 R 014035 WTEMP
0004 R 004622 XITP    0004 R 004624 XLTD    0003 R 017755 Z

00101   1e      BLOCK DATA                                                    BLOC0001
00102   2e       COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,   BLOC0002
00102   3e      1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),  BLOC0003
00102   4e      2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100) BLOC0004
00103   5e       COMMON/CHAMBR/AREA(8,2),AREAC(8),ATD,ATDNOZ(2),CC(8),CCC(8),  BLOC0005
00103   6e      1CEF1(2),CEF2(2),CHAN(8,2),CP(2),CP1,CP2(6),CSTAR(8),CS1,CS2(6), BLOC0006
00103   7e      2CV(8,2),CVEL(2),DELTF,DIAT(2),DPMAN(8,2),DPTO(2),DRPMT(2),DTD(2), BLOC0007
00103   8e      3DW(6),DWFUEL(8),DWOX(8),ETAT(2),GAM(2),GR(2),ICHAM(8,2),IENG,  BLOC0008
00103   9e      4IPUM1(2),IPUMO(2),ISP(8),IS1,IS2(6),KAY(8),KAY1(8),KAY2(8),   BLOC0009
```

```
00103  10.      5KAY3(8),KAY4(8),KAY5(8),KAY6(8),KAY7(8),KAY8(8),KAY9(8),KAY10(8),  BLOCK0010
00103  11.      6KAY11(8),MR(8),MP1,NW(8),MW1,MW2(6),NCHAM,NCOEF,NGGTP,NPVALF(8),  BLOCK0011
00103  12.      7NPVALO(8),OPVALF(8,60),OPVALO(8,60),PCHAM(8),PMAN(8,2),PMR(6),  BLOC00012
00103  13.      8POWP(2),POWT(2),POW0(2),POW1(2),POW2(2),POW3(2),PRATC(8),PTO(2),  BLOC00013
00103  14.      9PWO(2),PW1(2),PW2(2),RGAS(8),RPMP,RPMPO(2),RPMT(2),TC(8),TC1,  BLOC00014
00103  15.      *TC2(6),TGAS(8),TIMEF,TIMPUL(8),TMVALF(8,60),TMVALO(8,60),TORP(2),  BLOC00015
00103  16.      ATORT(2),TTO(2),U(2),VMAN(8,2),VOLC(8),W(6),WCHAM(8),WFUEL(8),  BLOC00016
00103  17.      BWINJ(8,2),WNOZ(8),WOX(8),WTDNOZ(8),XITP(2),XLTO(2)  BLOC00017
00104  18.       COMMON/DATA3/NAMCHM(8,14),NAMTMP(6),NAME(44),NAMEPL(40,2),NME(40),  BLOC00018
00104  19.      1NMETBN(2,8),NMOUT(130),OUTDAT(130),PLOTND(80),TIM,TIMF  BLOC00019
00105  20.       DATA ((NAMEPL(LL,KK),LL=1,40),KK=1,2)/3HW1F ,3HW2F ,3HW3F ,3HW4F ,  BLOC00020
00105  21.      1    3HW5F ,3HW6F ,3HW7F ,3HW8F ,3HW9F ,4HW10F,4HW11F,4HW12F,4HW13F,  BLOC00021
00105  22.      2    4HW14F,4HW15F,4HW16F,4HW17F,4HW18F,4HW19F,4HW20F,3HP1F ,  BLOC00022
00105  23.      3    3HP2F ,3HP3F ,3HP4F ,3HP5F ,3HP6F ,3HP7F ,3HP8F ,3HP9F ,4HP10F,  BLOC00023
00105  24.      4    4HP11F,4HP12F,4HP13F,4HP14F,4HP15F,4HP16F,4HP17F,4HP18F,4HP19F,  BLOC00024
00105  25.      5    4HP20F,3HW1L ,3HW2L ,3HW3L ,3HW4L ,3HW5L ,3HW6L ,3HW7L ,3HW8L ,  BLOC00025
00105  26.      6    3HW9L ,4HW10L,4HW11L,4HW12L,4HW13L,4HW14L,4HW15L,4HW16L,4HW17L,  BLOC00026
00105  27.      7    4HW18L,4HW19L,4HW20L,3HP1L ,3HP2L ,3HP3L ,3HP4L ,3HP5L ,3HP6L ,  BLOC00027
00105  28.      8    3HP7L ,3HP8L ,3HP9L ,4HP10L,4HP11L,4HP12L,4HP13L,4HP14L,4HP15L,  BLOC00028
00105  29.      9    4HP16L,4HP17L,4HP18L,4HP19L,4HP20L/  BLOC00029
00107  30.       DATA TIM/4HTIME/,TIMF/5HTIMEF/  BLOC00030
00112  31.       DATA ((NAMCHM(LL,KK),LL=1,8),KK=1,14)/6HPCHAM1,6HPCHAM2,6HPCHAM3,  BLOC00031
00112  32.      1  6HPCHAM4,6HPCHAM5,6HPCHAM6,6HPCHAM7,6HPCHAM8,6HWCHAM1,6HWCHAM2,  BLOC00032
00112  33.      2  6HWCHAM3,6HWCHAM4,6HWCHAM5,6HWCHAM6,6HWCHAM7,6HWCHAM8,6HCSTAR1,  BLOC00033
00112  34.      3  6HCSTAR2,6HCSTAR3,6HCSTAR4,6HCSTAR5,6HCSTAR6,6HCSTAR7,6HCSTAR8,  BLOC00034
00112  35.      4  6HPMAN11,6HPMAN12,6HPMAN13,6HPMAN14,6HPMAN15,6HPMAN16,6HPMAN17,  BLOC00035
00112  36.      5  6HPMAN18,6HPMAN21,6HPMAN22,6HPMAN23,6HPMAN24,6HPMAN25,6HPMAN26,  BLOC00036
00112  37.      6  6HPMAN27,6HPMAN28,4HISP1 ,4HISP2 ,4HISP3 ,4HISP4 ,4HISP5 ,  BLOC00037
00112  38.      7  4HISP6 ,4HISP7 ,4HISP8 ,3HMR1 ,3HMR2 ,3HMR3 ,3HMR4 ,  BLOC00038
00112  39.      8  3HMR5 ,3HMR6 ,3HMR7 ,3HMR8 ,3HMW1 ,3HMW2 ,3HMW3 ,  BLOC00039
00112  40.      9  3HMW4 ,3HMW5 ,3HMW6 ,3HMW7 ,3HMW8 ,6HWFUEL1,6HWFUEL2,  BLOC00040
00112  41.      *  6HWFUEL3,6HWFUEL4,6HWFUEL5,6HWFUEL6,6HWFUEL7,6HWFUEL8,4HWOX1 ,  BLOC00041
00112  42.      A  4HWOX2 ,4HWOX3 ,4HWOX4 ,4HWOX5 ,4HWOX6 ,4HWOX7 ,4HWOX8 ,  BLOC00042
00112  43.      B  4HCV11 ,4HCV12 ,4HCV13 ,4HCV14 ,4HCV15 ,4HCV16 ,4HCV17 ,  BLOC00043
00112  44.      C  4HCV18 ,4HCV21 ,4HCV22 ,4HCV23 ,4HCV24 ,4HCV25 ,4HCV26 ,  BLOC00044
00112  45.      D  4HCV27 ,4HCV28 ,6HWINJ11,6HWINJ12,6HWINJ13,6HWINJ14,6HWINJ15,  BLOC00045
00112  46.      E  6HWINJ16,6HWINJ17,6HWINJ18,6HWINJ21,6HWINJ22,6HWINJ23,6HWINJ24,  BLOC00046
00112  47.      F  6HWINJ25,6HWINJ26,6HWINJ27,6HWINJ28/  BLOC00047
00114  48.       DATA (NAME(I),I=1,44)/      6HNODEL ,6HIFND  ,6HIPB  ,6HLVDN  ,  BLOC00048
00114  49.      1  6HLVUP  ,6HNPLINE,6HIJUNCL,6HIFBL  ,6HARFAL ,6HCL   ,6HDIAL  ,  BLOC00049
00114  50.      2  6HFRL   ,6HSINALP,6HTHETA ,6HPL   ,6HWDOTL ,6HZ    ,6HPBNDL ,  BLOC00050
00114  51.      3  6HXKP   ,6HAREG  ,6HPACC  ,6HXK   ,6HRK   ,6HCC   ,6HCCC  ,  BLOC00051
00114  52.      4  6HDELXL ,6HKAY   ,6HKAY1  ,6HKAY2  ,6HKAY3  ,6HKAY4  ,6HKAY5  ,  BLOC00052
00114  53.      5  6HKAY6  ,6HKAY7  ,6HKAY8  ,6HKAY9  ,6HKAY10 ,6HKAY11 ,6HNTREG ,  BLOC00053
00114  54.      6  6HPRATC ,6HRGAS  ,6HRHOL  ,6HTGAS  ,6HXLENGL/  BLOC00054
00116  55.       DATA ((NMETBN(LL,KK),LL=1,2),KK=1,8)/ 5HPOWP1 ,5HPOWP2 ,5HPOWT1 ,  BLOC00055
00116  56.      1  5HPOWT2 ,4HPTO1  ,4HPTO2  ,5HRPMT1 ,5HRPMT2 ,5HTORP1 ,5HTORP2 ,  BLOC00056
00116  57.      2  5HTORT1 ,5HTORT2 ,4HTTO1  ,4HTTO2  ,6HWTNOZ1,6HWTNOZ2/  BLOC00057
00120  58.       DATA (NME(I),I=1,40)/      6HAREG1 ,6HAREG2 ,6HAREG3 ,6HAREG4 ,  BLOC00058
00120  59.      1  6HAREG5 ,6HAREG6 ,6HAREG7 ,6HAREG8 ,6HPACC1 ,6HPACC2 ,6HXK1  ,  BLOC00059
00120  60.      2  6HXK2  ,6HXK3  ,6HXK4  ,6HXK5  ,6HXK6  ,6HXK7  ,6HXK8  ,  BLOC00060
00120  61.      3  6HXK9  ,6HXK10 ,6HXKP1 ,6HXKP2 ,6HXKP3 ,6HXKP4 ,6HXKP5 ,  BLOC00061
00120  62.      4  6HXKP6 ,6HXKP7 ,6HXKP8 ,6HXK9  ,6HXKP10,6HPBND1 ,6HPBND2 ,  BLOC00062
00120  63.      5  6HPBND3 ,6HPBND4 ,6HPBND5 ,6HPBND6 ,6HPBND7 ,6HPBND8 ,6HPBND9 ,  BLOC00063
00120  64.      6  6HPBND10/  BLOC00064
00122  65.       DATA NGGTP/0/,NCHAM/0/  BLOC00065
00125  66.       DATA AREAL/20*0.0/  BLOC00066
00127  67.       DATA CL/20*0.0/  BLOC00067
```

```
00131    68.          DATA DELT/.001/                                                    BLOC0068
00133    69.          DATA DIAL/20*0.0/                                                  BLOC0069
00135    70.          DATA FRL/20*0.0/                                                   BLOC0070
00137    71.          DATA G/0.0/                                                        BLOC0071
00141    72.          DATA GC/32.174/                                                    BLOC0072
00143    73.          DATA IPLOT/0/                                                      BLOC0073
00145    74.          DATA NODEL/20*0./                                                  BLOC0074
00147    75.          DATA NPIPL/0/                                                      BLOC0075
00151    76.          DATA NPLINE/20*00/                                                 BLOC0076
00153    77.          DATA PL/2000*0.0/                                                  BLOC0077
00155    78.          DATA PTEMP/2000*0.0/                                               BLOC0078
00157    79.          DATA RHOL/8*0.0/                                                   BLOC0079
00161    80.          DATA SINALP/20*0.0/                                                BLOC0080
00163    81.          DATA THETA/20*0.0/                                                 BLOC0081
00165    82.          DATA WDOTL/2000*0.0/                                               BLOC0082
00167    83.          DATA WTEMP/2000*0.0/                                               BLOC0083
00171    84.          DATA Z/2000*0.0/                                                   BLOC0084
00173    85.          DATA MW2/.19109966E1,.21066749E1,-.44042913E-2,-.606466E-2,2*0.0/  BLOC0085
00175    86.          DATA TC2/.44354884E3,.21022635E4,-.2405759SE3,.81889125E1,2*0.0/   BLOC0086
00177    87.          DATA CS2/.7017450bE4,.11752099E4,-.300917E3,.20546873E2,2*0.0/     BLOC0087
00201    88.          DATA IS2/.348339C7E3,.75678814E2,-.1712162bE2,.11873112E1,2*0.0/   BLOC0088
00203    89.          DATA CEF1/5.2,0.0/                                                 BLOC0089
00205    90.          DATA CEF2/-8.6,0.0/                                                BLOC0090
00207    91.          DATA CP2/.25917475E1,-.74177182E0,.125498n6E0,-.82476042E-2,2*0.0/BLOC0091
00211    92.          DATA PWO/.12503708E4,0.0/                                          BLOC0092
00213    93.          DATA PW1/.29354174E2,0.0/                                          BLOC0093
00215    94.          DATA PW2/-.50557429E1,0.0/                                         BLOC0094
00217    95.          DATA POWO/.29375007E6,0.0/                                         BLOC0095
00221    96.          DATA POW1/.21971513E5,0.0/                                         BLOC0096
00223    97.          DATA POW2/.50103014E3,0.0/                                         BLOC0097
00225    98.          DATA POW3/.78168831E1,0.0/                                         BLOC0098
00227    99.          DATA TIME/0.0/                                                     BLOC0099
00231   100.          DATA TIMEF/0.0/                                                    BLOC0100
00233   101.          DATA TIMPUL/8*0.0/                                                 BLOC0101
00235   102.          DATA NAMTMP/6HTIMPL1,6HTIMPL2,6HTIMPL3,6HTIMPL4,6HTIMPL5,6HTIMPL6/BLOC0102
00237   103.          DATA DELTF/0.0001/                                                 BLOC0103
00241   104.          DATA FACTOR/1.2/                                                   BLOC0104
00243   105.          DATA TIMEND/0.5/                                                   BLOC0105
00245   106.          DATA AREA/16*0.0/,AREAC/8*0.0/,ATD/0.0/,ATDNOZ/2*0.0/,CC/8*0.0/    BLOC0106
00253   107.          DATA CCC/8*0.0/,CMAN/16*0.0/,CP/2*0.0/,CP1/0.0/,CSTAR/8*0.0/       BLOC0107
00261   108.          DATA CS1/0.0/,CV/16*0.0/,CVEL/2*0.0/,DIAT/2*0.0/,DPMAN/16*0.0/     BLOC0108
00267   109.          DATA DPTO/2*0.0/,DRPMT/2*0.0/,DTO/2*0.0/,DW/6*0.0/,DWFUEL/8*0.0/   BLOC0109
00275   110.          DATA DWOX/8*0.0/,ETAT/2*0.0/,GAM/2*0.0/,GR/2*0.0/,ICHAM/16*0/      BLOC0110
00303   111.          END                                                                BLOC0111
```

Coefficients derived from least-squares fits of cubic polynomials to curves presented in Figures 24 and 25 Reference 1 for $.5 \leq MR \leq 6$.

Least-squares fit of quadratic to Figure 27, Reference 1.

See above for MW2, TC2.

Least-squares fit of quadratic to flowrate curve in Figure 26, Reference 1.

Least-squares fit of cubic to power curve in Figure 26, Reference 1.

```
      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 .DIAGNOSTIC. MESSAGE(S)
   BLOCKD          SYMBOLIC                          31 AUG 71   12:34:59    0   01456032     14    122   (DELETED)
   BLOCKD  CODE    RELOCATABLE                       31 AUG 71   12:34:59    1   01461306     24      1   (DELETED)
                                                                             0   01461336     14    976
```

5.4 Subroutines

5.4.1 ACC

01 SEP 71 0:58:49.912

```
UNIVAC 1108 FORTRAN V LEVEL   2206 [redacted] F5018H
THIS COMPILATION WAS DONE ON 01 SEP 71 AT 00:58:50


   SUBROUTINE ACC        ENTRY POINT 000637

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE    000646
         0000    *DATA    000032
         0002    *BLANK   000000
         0003    ACCCOM   000030
         0004    ALLCOM   023675
         0005    FLAGS    000006
         0006    VALUES   000010


   EXTERNAL REFERENCES (BLOCK, NAME)

         0007    VAL
         0010    WRITE
         0011    SQRT
         0012    NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000104 10L        0001    000513 110L       0001    000004 114G       0001    000536 130L       0001    000621 150L
    0001    000213 30L        0001    000232 50L        0001    000315 70L        0001    000402 90L        0004 R 000000 AREAL
    0006 R 000001 ARHO        0004 R 000024 CL          0003 R 000001 C1          0003 R 000002 C2          0003 R 000003 C3
    0003 R 000004 C4          0003 R 000005 C55         0003 R 000006 C66         0004 R 000050 DELT        0004 R 000051 DIAL
    0003 R 000000 DPACC       0003 R 000001 DUM         0004 R 000075 FRL         0004 R 000121 G           0004 R 000122 GC
    0006 R 000000 GRHO        0000 I 000003 I           0003 I 000007 IACC        0005 I 000000 IACCPR      0005 I 000001 ICHAMP
    0003 I 000011 IDUM        0003 I 000012 IDUM1       0003 I 000013 IDUM2       0003 I 000014 IDUM3       0003 I 000015 IENACC
    0003 I 000012 II          0005 I 000005 IPLOT       0005 I 000002 IPRINT      0003 I 000013 IPROP       0005 I 000003 IREGPR
    0005 I 000004 ITURBN      0000 I 000002 IS          0003 I 000011 J           0003 I 000014 JJ          0000 I 000000 KOUNT
    0003 I 000017 NACC        0003 I 000020 NNNN        0004 I 000123 NODEL       0004 I 000147 NPIPL       0004 I 000150 NPLINE
    0003 R 000021 PACC        0004 R 000174 PL          0003 R 000023 PPPP        0006 R 000004 PR          0006 R 000007 PS
    0004 R 004114 PTEMP       0004 R 010034 RHOL        0004 R 010044 SINALP      0004 R 010070 THETA       0004 R 010114 TIME
    0003 R 000024 VOLACC      0004 R 010115 WDOTL       0006 R 000002 WR          0006 R 000005 WS          0004 R 014035 WTEMP
    0003 R 000026 XKACC       0004 R 017755 Z           0006 R 000003 ZR          0006 R 000006 ZS


00101     1*        SUBROUTINE ACC                                                    ACC 0001
00103     2*        DIMENSION KOUNT(2)                                                ACC 0002
00104     3*        COMMON/ACCCOM/DPACC,DUM(6),IACC(2),IDUM,IDUM1,IDUM2,IDUM3,        ACC 0003
00104     4*       1IENACC(2),NACC,NNNN,PACC(2),PPPP,VOLACC(2),XKACC(2)               ACC 0004
00105     5*        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,        ACC 0005
00105     6*       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),      ACC 0006
00105     7*       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)   ACC 0007
00106     8*        COMMON/FLAGS/IACCPR,ICHAMP,IPRINT,IREGPR,ITURBN,IPLOT             ACC 0008
00107     9*        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                         ACC 0009
00110    10*        EQUIVALENCE (DUM(1),C1),(DUM(2),C2),(DUM(3),C3),(DUM(4),C4),      ACC 0010
```

```
00110  11*      1            (DUM(5),C55),(DUM(6),C66),(IDUM,J),(IDUM1,II),          ACC 0011
00110  12*      2            (IDUM2,IPROP),(IDUM3,JJ)                                ACC 0012
00111  13*       DATA KOUNT/2*0/                                                      ACC 0013
00113  14*       DO 150 I=1,NACC                                                      ACC 0014
00116  15*       J=I                                                                  ACC 0015
00117  16*       KOUNT(I)=KOUNT(I)+1                                                  ACC 0016
00120  17*       II=IACC(I)                                                           ACC 0017
00121  18*       IPROP=NPLINE(II)                                                     ACC 0018
00122  19*       IF (IENACC(I).EQ.2) GO TO 70                                         ACC 0019
00124  20*       JJ=1                                                                 ACC 0020
00125  21*       CALL VAL(II,1,IPROP,2)                                               ACC 0021
00126  22*       C1=-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*        ACC 0022
       1RHOL(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT*FRL(II)*WS*ABS(WS)*              ACC 0023
00126  24*       2DELT*2.0/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                        ACC 0024
00127  25*       C2=-AREAL(II)*GC*144.0/CL(II)                                        ACC 0025
00130  26*       NNNN=0                                                               ACC 0026
00131  27*    10 CONTINUE                                                             ACC 0027
00132  28*       NNNN=NNNN+1                                                          ACC 0028
00133  29*       DPACC=-CL(II)**2/GC/144.0/VOLACC(I)*WTEMP(JJ,1)                      ACC 0029
00134  30*       IF(NNNN.EQ.1)PPPP=PACC(I)+DELT*DPACC                                 ACC 0030
00136  31*       IF(NNNN.EQ.2)PPPP=(PPPP+PACC(I)+DELT*DPACC)/2.0                      ACC 0031
00140  32*       C55=XKACC(I)**2*2.0*GC*RHOL(IPROP)*144.0/C2                          ACC 0032
00141  33*       C66=XKACC(I)**2*2.0*GC*RHOL(IPROP)*144.0*(PPPP+C1/C2)                ACC 0033
00142  34*       IF (C66.LE.0.0) GO TO 30                                             ACC 0034
00144  35*       WTEMP(II,1)=C55/2.0+SQRT(C55*C55+4.0*C66)/2.0                        ACC 0035
00145  36*       GO TO 50                                                             ACC 0036
00146  37*    30 CONTINUE                                                             ACC 0037
00147  38*       WTEMP(II,1)=-C55/2.0-SQRT(C55*C55-4.0*C66)/2.0                       ACC 0038
00150  39*    50 CONTINUE                                                             ACC 0039
00151  40*       IF(NNNN.EQ.1.AND.IACCPR.NE.0.AND.MOD(KOUNT(I),IACCPR).EQ.0)CALL      ACC 0040
00151  41*      1WRITE(10)                                                            ACC 0041
00153  42*       IF (NNNN.EQ.1) GO TO 10                                              ACC 0042
00155  43*       PTEMP(II,1)=-WTEMP(II,1)/C2-C1/C2                                    ACC 0043
00156  44*       PACC(I)=PPPP                                                         ACC 0044
00157  45*       IF(IACCPR.NE.0.AND.MOD(KOUNT(I),IACCPR).EQ.0)CALL WRITE(10)          ACC 0045
00161  46*       GO TO 150                                                            ACC 0046
00162  47*    70 CONTINUE                                                             ACC 0047
00163  48*       JJ=NODEL(II)                                                         ACC 0048
00164  49*       CALL VAL(II,JJ,IPROP,1)                                              ACC 0049
00165  50*       C3=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.0-G*       ACC 0050
00165  51*      1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT*FRL(II)*WR*ABS(WR)/      ACC 0051
00165  52*      22.0/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                         ACC 0052
00166  53*       C4=AREAL(II)*GC/CL(II)*144.0                                         ACC 0053
00167  54*       NNNN=0                                                               ACC 0054
00170  55*    90 CONTINUE                                                             ACC 0055
00171  56*       NNNN=NNNN+1                                                          ACC 0056
00172  57*       DPACC=CL(II)**2/GC/144.0/VOLACC(I)*WTEMP(II,JJ)                      ACC 0057
00173  58*       IF(NNNN.EQ.1)PPPP=PACC(I)+DELT*DPACC                                 ACC 0058
00175  59*       IF(NNNN.EQ.2)PPPP=(PPPP+PACC(I)+DELT*DPACC)/2.0                      ACC 0059
00177  60*       C55=XKACC(I)**2*2.0*GC*RHOL(IPROP)*144.0/C4                          ACC 0060
00200  61*       C66=XKACC(I)**2*2.0*GC*RHOL(IPROP)*144.0*(C3/C4+PPPP)                ACC 0061
00201  62*       IF (C66.GT.0.0) GO TO 110                                            ACC 0062
00203  63*       WTEMP(II,JJ)=-C55/2.0+SQRT(C55*C55-4.0*C66)/2.0                      ACC 0063
00204  64*       GO TO 130                                                            ACC 0064
00205  65*   110 CONTINUE                                                            ACC 0065
00206  66*       WTEMP(II,JJ)=C55/2.0-SQRT(C55*C55+4.0*C66)/2.0                       ACC 0066
00207  67*   130 CONTINUE                                                            ACC 0067
00210  68*       IF(NNNN.EQ.1.AND.IACCPR.NE.0.AND.MOD(KOUNT(I),IACCPR).EQ.0)CALL      ACC 0068
```

```
                    ACC,ACC                                                    DATE  010971  PAGE

00210     69*        1WRITE(10)                                                                ACC 0
00212     70*         IF (NNNN.EQ.1) GO TO 90                                                  ACC 0070
00214     71*         PTEMP(II,JJ)=-WTEMP(II,JJ)/C4-C3/C4                                      ACC 0071
00215     72*         PACC(I)=PPPP                                                             ACC 0072
00216     73*         IF(IACCPR.NE.0.AND.MOD(KOUNT(I),IACCPR).EQ.0)CALL WRITE(10)              ACC 0073
00220     74*     150 CONTINUE                                                                 ACC 0074
00222     75*         RETURN                                                                   ACC 0075
00223     76*         END                                                                      ACC 0076

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
    ACC              SYMBOLIC                                  21 JUL 71  15:08:20   0  01453142    14    76  (DELETED)
    ACC      CODE    RELOCATABLE                               21 JUL 71  15:08:20   1  01455212    36     1  (DELETED)
                                                                                      0  01455256    14    47
@P     HDG       BLOCKD,BLOCKD
```

5.4.2 CHAM

```
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:04

   SUBROUTINE CHAM      ENTRY POINT 001701

   STORAGE USED (BLOCK, NAME, LENGTH)

       0001   *CODE   001714
       0000   *DATA   000166
       0002   *BLANK  000000
       0003   ALLCOM  023675
       0004   ALLCS   000050
       0005   CHAMBR  004626
       0006   FLAGS   000006
       0007   DATA1   000034
       0010   VALUES  000010


   EXTERNAL REFERENCES (BLOCK, NAME)

       0011   WRITE
       0012   NWDUS
       0013   NIO1S
       0014   NIO2S
       0015   NEXP5S
       0016   NEXP6S
       0017   SQRT
       0020   NERR3S
```



```
   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0000   000035 10F      0001   000105 110L     0001   000125 130L     0001   000043 142G     0001   000160 170L
 0001   000144 174G     0001   000162 190L     0001   000206 210L     0001   000226 230L     0001   000270 236G
 0001   000261 250L     0001   000325 252G     0001   000363 266G     0000   000063 30F      0001   000361 310L
 0001   000453 330L     0001   000515 350L     0001   000572 370L     0001   000761 390L     0001   000771 410L
 0001   001006 430L     0001   001042 450L     0001   001101 470L     0001   001105 490L     0001   001127 510L
 0001   001142 530L     0001   001452 590L     0001   001463 610L     0001   001661 630L     0001   000057 70L
 0001   000061 90L      0007 R 000032 AA3      0007 R 000033 AA4      0004 R 000000 AC       0004 R 000046 ACC1
 0004 R 000020 AC1      0004 R 000040 AC2      0004 R 000042 AC3      0004 R 000044 AC4      0005 R 000000 AREA
 0005 R 000020 AREAC    0003 R 000000 AREAL    0010 R 000000 ARHO     0005 R 000030 ATD      0005 R 000031 ATDNOZ
 0007 R 000000 A1       0007 R 000001 B1       0007 R 000002 C        0005 R 000033 CC       0005 R 000043 CCC
 0005 R 000053 CEF1     0005 R 000055 CEF2     0003 R 000024 CL       0005 R 000057 CMAN     0005 R 000077 CP
 0005 R 000101 CP1      0005 R 000102 CP2      0005 R 000110 CSTAR    0005 R 000120 CS1      0005 R 000121 CS2
 0005 R 000127 CV       0005 R 000147 CVEL     0007 R 000003 C1       0007 R 000010 C11      0007 R 000023 C2
 0007 R 000025 C3       0007 R 000022 C4       0007 R 000004 C6       0007 R 000005 C7       0007 R 000006 C8
 0007 R 000007 C9       0007 R 000011 DCLP     0007 R 000012 DELP     0003 R 000050 DELT     0005 R 000151 DELTF
 0003 R 000051 DIAL     0005 R 000152 DIAT     0005 R 000154 DPMAN    0005 R 000174 DPTO     0005 R 000176 DRPMT
 0005 R 000200 DTO      0005 R 000202 DW       0005 R 000210 DWFUEL   0005 R 000220 DWOX     0005 R 000230 ETAT
 0003 R 000075 FRL      0003 R 000121 G        0005 R 000232 GAM      0003 R 000122 GC       0005 R 000234 GR
 0010 R 000001 GRHO     0005 I 000256 I        0006 I 000000 IACCPR   0005 I 000236 ICHAM    0006 I 000001 ICHAMP
 0005 I 000256 IENG     0007 I 000020 II       0007 I 000013 IKOUNT   0004 I 000005 IPLOT    0006 I 000002 IPRINT
 0007 I 000014 IPROP    0005 I 000257 IPUM1    0005 I 000261 IPUMO    0006 I 000003 IREGPR   0005 R 000263 ISP
 0000 I 000020 ISUBF    0000 I 000010 ISUBO    0005 R 000273 IS1      0005 R 000274 IS2      0006 I 000004 ITURBN
```

```
0000 I 000030 IS       0007 [redacted]0021 JJ       0000 I 000033 K        0005 R 00030[redacted]      0005 R 000312 KAY1
0005 R 002422 KAY.0    0005 [redacted]0432 KAY11    0005 R 000372 KAY2     0005 R 00033[redacted]Y3    0005 R 000342 KAY4
0005 R 000352 KAY5     0005 R 000362 KAY6           0005 R 000372 KAY7     0005 R 0004D2 KAY8          0005 R 000412 KAY9
0000 I 000031 KK       0000 I 000000 KOUNT          0000 I 000032 LL       0005 R 000442 MR            0005 R 000452 MR1
0005 R 000453 MW       0005 R 000463 MW1            0005 R 000464 MW2      0007 I 000015 N             0005 I 000472 NCHAM
0005 I 000473 NCOEF    0005 I 000474 NGGTP          0003 I 000123 NODEL    0003 I 000147 NPIPL         0003 I 000150 NPLINE
0005 I 000475 NPVALF   0005 I 002505 NPVALO         0005 R 000515 OPVALF   0005 R 001455 OPVALO        0005 R 002415 PCHAM
0003 R 000174 PL       0005 R 002425 PMAN           0005 R 002445 PMR      0005 R 002453 POWP          0005 R 002455 POWT
0005 R 002457 POWO     0005 R 002461 POW1           0005 R 002463 POW2     0005 R 002465 POW3          0010 R 000004 PR
0005 R 002467 PRATC    0007 R 000016 PRAT1          0010 R 000007 PS       0007 R 000017 PSON          0003 R 004114 PTEMP
0005 R 002477 PTO      0005 R 002501 PWO            0005 R 002503 PW1      0005 R 002505 PW2           0007 R 000024 R
0005 R 002507 RGAS     0003 R 010034 RHOL           0005 R 002517 RPMP     0005 R 002520 RPMPO         0005 R 002522 RPMT
0007 R 000030 S        0003 R 010044 SINALP         0005 R 002524 TC       0005 R 002534 TC1           0005 R 002535 TC2
0005 R 002543 TGAS     0003 R 010070 THETA          0003 R 010114 TIME     0005 R 002553 TIMEF         0005 R 002554 TIMPUL
0005 R 002564 TMVALF   0005 R 003524 TMVALO         0005 R 004464 TORP     0005 R 004466 TORT          0000 R 000034 TTEIS
0005 R 004470 TTO      0005 R 004472 U              0005 R 004474 VMAN     0005 R 004514 VOLC          0005 R 004524 W
0005 R 004532 WCHAM    0003 R 010115 WDOTL          0005 R 004542 WFUEL    0005 R 004552 WINJ          0005 R 004572 WNOZ
0005 R 004602 WOX      0007 R 000031 WP             0010 R 000002 WR       0010 R 000005 WS            0005 R 004612 WTDNOZ
0003 R 014035 WTEMP    0005 R 004622 XITP           0005 R 004624 XLTD     0007 R 000026 X1            0007 R 000027 X2
0003 R 017755 Z        0010 R 000003 ZR             0010 R 000006 ZS
```



```
00101     1.          SUBROUTINE CHAM                                                                CHAM0001
00103     2.          REAL ISP,IS1,IS2,KAY,KAY1,KAY2,KAY3,KAY4,KAY5,KAY6,KAY7,KAY8,KAY9,CHAM0002
00103     3.         1KAY10,KAY11,MR,MR1,MW,MW1,MW2                                                 CHAM0003
00104     4.          DIMENSION KOUNT(8),ISUBO(8),ISUBF(8)                                           CHAM0004
00105     5.          COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,                     CHAM0005
00105     6.         1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),                  CHAM0006
00105     7.         2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)               CHAM0007
00106     8.          COMMON/ALLCS/AC(8,2),AC1(8,2),AC2(2),AC3(2),AC4(2),ACC1(2)                     CHAM0008
00107     9.          COMMON/CHAMBR/AREA(8,2),AREAC(8),ATD,ATDNOZ(2),CC(8),CCC(8),                   CHAM0009
00107    10.         1CEF1(2),CEF2(2),CMAN(8,2),CP(2),CP1,CP2(6),CSTAR(8),CS1,CS2(6),               CHAM0010
00107    11.         2CV(8,2),CVEL(2),DELTF,DIAT(2),DPMAN(8,2),DPTO(2),DRPMT(2),DTD(2),             CHAM0011
00107    12.         3DW(6),DWFUEL(8),DWOX(8),ETAT(2),GAM(2),GR(2),ICHAM(8,2),IFNG,                 CHAM0012
00107    13.         4IPUM1(2),IPUMO(2),ISP(8),IS1,IS2(6),KAY(8),KAY1(8),KAY2(8),                   CHAM0013
00107    14.         5KAY3(8),KAY4(8),KAY5(8),KAY6(8),KAY7(8),KAY8(8),KAY9(8),KAY10(8),             CHAM0014
00107    15.         6KAY11(8),MR(8),MR1,MW(8),MW1,MW2(6),NCHAM,NCOEF,NGGTP,NPVALF(8),              CHAM0015
00107    16.         7NPVALO(8),OPVALF(8,60),OPVALO(8,60),PCHAM(8),PMAN(8,2),PMR(6),                CHAM0016
00107    17.         8POWP(2),POWT(2),POWO(2),POW1(2),POW2(2),POW3(2),PRATC(8),PTO(2),              CHAM0017
00107    18.         9PWO(2),PW1(2),PW2(2),RGAS(8),RPMP,RPMPO(2),RPMT(2),TC(8),TC1,                 CHAM0018
00107    19.         *TC2(6),TGAS(8),TIMEF,TIMPUL(8),TMVALF(8,60),TMVALO(8,60),TORP(2),             CHAM0019
00107    20.         ATORT(2),TTO(2),U(2),VMAN(8,2),VOLC(8),W(6),WCHAM(8),WFUEL(8),                 CHAM0020
00107    21.         BWINJ(8,2),WNOZ(8),WOX(8),WTDNOZ(8),XITP(2),XLTD(2)                            CHAM0021
00110    22.          COMMON/FLAGS/IACCPR,ICHAMP,IPRINT,IREGPR,ITURBN,IPLOT                          CHAM0022
00111    23.          COMMON/DATA1/A1,B1,C,C1,C6,C7,C8,C9,C11,DCLP,DFLP,IKOUNT,IPROP,N,              CHAM0023
00111    24.         1PRAT1,PSON,II,JJ,C4,C2,R,C3,X1,X2,S,WP,AA3,AA4                                CHAM0024
00112    25.          COMMON/VALUES/ARHO,GRHO,WR,ZR,PR,WS,ZS,PS                                      CHAM0025
00113    26.          DATA KOUNT/8*0/                                                                CHAM0026
00115    27.          EQUIVALENCE (I,IFNG)                                                           CHAM0027
00116    28.          DATA ISUBF/8*1/                                                                CHAM0028
00120    29.          DATA ISUBO/8*1/                                                                CHAM0029
00122    30.       10 FORMAT('1TIME POINT OUTSIDE VALVE OPENING TABLE, OXIDIZER SIDE, COCHAM0030
00122    31.         1MBUSTOR',I2,' TIME POINT',E14.8/' LAST TIME POINT IN TABLE',E14.8)CHAM0031
00123    32.       30 FORMAT('1TIME POINT OUTSIDE VALVE OPENING TABLE, FUEL SIDE, COMBUSCHAM0032
00123    33.         1TOR',I2,' TIME POINT',E14.8/' LAST TIME POINT IN TABLE',E14.8)     CHAM0033
00123    34.    C               ADD ONE TO PRINT COUNTER                                            CHAM0034
```

```
00124          KOUNT(I)=KOUNT(I)+1                                                  CHAM0035
00124    C              SET UP VALUES FOR LATEST VALUES FROM INTEGRATION SCHEME     CHAM0036
00125          WOX(I)=W(1)                                                          CHAM0037
00126          WFUEL(I)=W(2)                                                        CHAM0038
00127          PMAN(I,1)=W(3)                                                       CHAM0039
00130          PMAN(I,2)=W(4)                                                       CHAM0040
00131          WCHAM(I)=W(1)+W(2)                                                   CHAM0041
00131    C              CALCULATE MIXTURE RATIO FOR I-TH COMBUSTOR                  CHAM0042
00132          MR(I)=W(1)/W(2)                                                      CHAM0043
00132    C              CALCULATE CV EVERY OTHER TIME THROUGH                       CHAM0044
00133          IF (MOD(KOUNT(I),2).EQ.0) GO TO 230                                  CHAM0045
00133    C              GET SUBSCRIPT OF STARTING PLACE IN TABLE                    CHAM0046
00135          JJ=ISUBO(I)                                                          CHAM0047
00135    C              SET NUMBER OF POINTS IN TABLE                               CHAM0048
00136          KK=NPVALO(I)                                                         CHAM0049
00136    C              DO LOOP TO FIND PLACE IN TABLE                              CHAM0050
00136    C              CHECK FOR BEING ON LOW SIDE OF TABLE                        CHAM0051
00137          IF (TIMEF.LT.TMVALO(I,1)) GO TO 70                                   CHAM0052
00141          DO 50 LL=JJ,KK                                                       CHAM0053
00144          IF (TIMEF.LE.TMVALO(I,LL)) GO TO 110                                 CHAM0054
00146       50 CONTINUE                                                             CHAM0055
00150          GO TO 90                                                             CHAM0056
00150    C              WRITE WARNING AND SET VALUE FOR CV(I,1)                     CHAM0057
00151       70 CONTINUE                                                             CHAM0058
00152          KK=1                                                                 CHAM0059
00153       90 CONTINUE                                                             CHAM0060
00154          WRITE (6,10)I,TIMEF,TMVALO(I,KK)                                     CHAM0061
00161          CV(I,1)=OPVALO(I,KK)                                                 CHAM0062
00162          GO TO 130                                                            CHAM0063
00163      110 CONTINUE                                                             CHAM0064
00163    C              SAVE POINT IN TABLE FOR THIS COMBUSTOR                      CHAM0065
00164          ISUBO(I)=LL                                                          CHAM0066
00164    C              CALCULATE VALVE OPENING, OX SIDE.                           CHAM0067
00165          CV(I,1)=(OPVALO(I,LL)-OPVALO(I,LL-1))*(TIMEF-TMVALO(I,LL-1))/        CHAM0068
00165         1(TMVALO(I,LL)-TMVALO(I,LL-1))+OPVALO(I,LL-1)                         CHAM0069
00165    C              DO SAME PROCESS FOR FUEL SIDE                               CHAM0070
00166      130 CONTINUE                                                             CHAM0071
00166    C              GET SUBSCRIPT OF STARTING PLACE IN TABLE                    CHAM0072
00167          JJ=ISUBF(I)                                                          CHAM0073
00167    C              SET NUMBER OF POINTS IN TABLE                               CHAM0074
00170          KK=NPVALF(I)                                                         CHAM0075
00170    C              CHECK FOR BEING ON LOW SIDE OF TABLE                        CHAM0076
00171          IF (TIMEF.LT.TMVALF(I,1)) GO TO 170                                  CHAM0077
00171    C              DO LOOP TO FIND PLACE IN TABLE                              CHAM0078
00173          DO 150 LL=JJ,KK                                                      CHAM0079
00176          IF (TIMEF.LE.TMVALF(I,LL)) GO TO 210                                 CHAM0080
00200      150 CONTINUE                                                             CHAM0081
00202          GO TO 190                                                            CHAM0082
00203      170 CONTINUE                                                             CHAM0083
00204          KK=1                                                                 CHAM0084
00205      190 CONTINUE                                                             CHAM0085
00205    C              WRITE WARNING AND SET VALUE FOR CV(I,2)                     CHAM0086
00206          WRITE (6,30)I,TIMEF,TMVALF(I,KK)                                     CHAM0087
00213          CV(I,2)=OPVALF(I,KK)                                                 CHAM0088
00214          GO TO 230                                                            CHAM0089
00215      210 CONTINUE                                                             CHAM0090
00215    C              SAVE STARTING POINT IN TABLE FOR THIS COMBUSTOR             CHAM0091
00216          ISUBF(I)=LL                                                          CHAM0092
```

```
00216    93.    C               CALC[illegible]TE VALVE OPENING, FUEL SIDE                          CHAMD[illegible]3
00217    94.         CV(I,2)=(OPV[illegible],LL)-OPVALF(I,LL-1))*(TIMEF-TMVALF(I,LL-1))/           CHAM[illegible]
00217    95.        1(TMVALF(I,LL)-TMVALF(I,LL-1))+OPVALF(I,LL-1)                                   CHAMD[illegible]5
00220    96.       230 CONTINUE                                                                     CHAMD096
00220    97.    C               CHECK FOR BEING IN LIMITS OF MIXTURE RATIO CURVE                    CHAMD097
00221    98.         IF (MR(I).GT.MR1) GO TO 250                                                    CHAMD098
00223    99.         MW(I)=MW1                                                                      CHAMD099
00224   100.         TC(I)=TC1                                                                      CHAMD100
00225   101.         ISP(I)=IS1                                                                     CHAMD101
00226   102.         CSTAR(I)=CS1                                                                   CHAMD102
00227   103.         ISP(I)=IS1                                                                     CHAMD103
00230   104.         IF(I.LE.NGGTP)CP(I)=CP1                                                        CHAMD104
00232   105.         GO TO 310                                                                      CHAMD105
00233   106.       250 CONTINUE                                                                     CHAMD106
00234   107.         PMR(1)=1.0                                                                     CHAMD107
00235   108.         DO 270 K=2,NCOEF                                                               CHAMD108
00240   109.         PMR(K)=MR(I)**(K-1)                                                            CHAMD109
00241   110.       270 CONTINUE                                                                     CHAMD110
00243   111.         MW(I)=0.0                                                                      CHAMD111
00244   112.         TC(I)=0.0                                                                      CHAMD112
00245   113.         ISP(I)=0.0                                                                     CHAMD113
00246   114.         CSTAR(I)=0.0                                                                   CHAMD114
00247   115.         IF(I.LE.NGGTP)CP(I)=0.0                                                        CHAMD115
00251   116.         DO 290 K=1,NCOEF                                                               CHAMD116
00254   117.         MW(I)=MW(I)+MW2(K)*PMR(K)                                                      CHAMD117
00255   118.         TC(I)=TC(I)+TC2(K)*PMR(K)                                                      CHAMD118
00256   119.         ISP(I)=ISP(I)+IS2(K)*PMR(K)                                                    CHAMD119
00257   120.         CSTAR(I)=CSTAR(I)+CS2(K)*PMR(K)                                                CHAMD120
00260   121.         IF(I.LE.NGGTP)CP(I)=CP(I)+CP2(K)*PMR(K)                                        CHAMD121
00262   122.       290 CONTINUE                                                                     CHAMD122
00264   123.       310 CONTINUE                                                                     CHAMD123
00264   124.    C               GO THROUGH LOOP TWICE, FIRST IS OX SIDE, SECOND IS FUEL             CHAMD124
00265   125.         DO 550 N=1,2                                                                   CHAMD125
00270   126.         IKOUNT=0                                                                       CHAMD126
00271   127.         II=ICHAM(I,N)                                                                  CHAMD127
00272   128.         JJ=NODEL(II)                                                                   CHAMD128
00273   129.         IPROP=NPLINE(II)                                                               CHAMD129
00274   130.         C=AC(I,N)                                                                      CHAMD130
00275   131.         C1=AC1(I,N)                                                                    CHAMD131
00275   132.    C               CHAMBER PRESSURE                                                    CHAMD132
00276   133.         PCHAM(I)=WCHAM(I)*1545.0*TC(I)/VOLC(I)*12.0/MW(I)                              CHAMD133
00277   134.         C6=CCC(IPROP)*AREA(I,N)*CV(I,N)                                                CHAMD134
00300   135.         C11=PCHAM(I)/PMAN(I,N)                                                         CHAMD135
00300   136.    C               CALCULATE A PRESSURE ASSUMING CRITICAL FLOW                         CHAMD136
00301   137.         PSON=-C/(C1+CV(I,N)*AREA(I,N)*CC(IPROP))                                       CHAMD137
00301   138.    C               CALCULATE RATIO OF MANIFOLD PRESSURE TO SONIC PRESSURE              CHAMD138
00302   139.         PRAT1=PMAN(I,N)/PSON                                                           CHAMD139
00303   140.         IF (I.LE.NGGTP) GO TO 330                                                      CHAMD140
00303   141.    C               CALCULATE NOZZLE FLOWRATE                                           CHAMD141
00305   142.         WNOZ(I)=PCHAM(I)*AREAC(I)*GC/CSTAR(I)                                          CHAMD142
00306   143.         GO TO 350                                                                      CHAMD143
00307   144.       330 CONTINUE                                                                     CHAMD144
00307   145.    C               CALCULATE TURBINE NOZZLE FLOWRATE                                   CHAMD145
00310   146.         GAM(I)=CP(I)/(CP(I)-1.9852/MW(I))                                              CHAMD146
00311   147.         WNOZ(I)=AREAC(I)*PCHAM(I)*SQRT(MW(I)/1545.0/TC(I)*GC*GAM(I)*(2.0/(CHAMD147
00311   148.        1GAM(I)+1.0))**((GAM(I)+1.0)/(GAM(I)-1.0)))                                    CHAMD148
00312   149.       350 CONTINUE                                                                     CHAMD149
00312   150.    C               CHECK TO SEE IF THE ASSUMPTION OF SONIC FLOW WAS CORRECT            CHAMD150
```

```
00313          IF (PRATI.LE.PRATC(IPROP)) GO TO 410                                  CHAM0151
00313    C              ASSUMPTION WAS INCORRECT, SOLVE FOR PRESSURE AND              CHAM0152
00313    C              FLOWRATE USING NEWTON-RAPHSON ITERATION                       CHAM0153
00315          C8=C6*SQRT(KAY10(IPROP))                                               CHAM0154
00316          A1=C8*C8*PMAN(I,N)**KAY9(IPROP)                                        CHAM0155
00317          B1=C8*C8*PMAN(I,N)**KAY11(IPROP)                                       CHAM0156
00320      370 CONTINUE                                                               CHAM0157
00321          IKOUNT=IKOUNT+1                                                        CHAM0158
00322          C9=PMAN(I,N)/PTEMP(II,JJ)                                              CHAM0159
00323          DCLP=-2.0*C*C1-2.0*C1*C1*PTEMP(II,JJ)+A1*2.0/KAY5(IPROP)*PTEMP(II,CHAM0160
00323         1JJ)**(-KAY8(IPROP))-B1/KAY5(IPROP)*PTEMP(II,JJ)**(-KAY7(IPROP))       CHAM0161
00324          C7=-C*C2-2.0*C*C1*PTEMP(II,JJ)-C1*C1*PTEMP(II,JJ)**2+A1*PTEMP          CHAM0162
00324         1(II,JJ)**(2.0/KAY5(IPROP))-B1*PTEMP(II,JJ)**(1.0/KAY5(IPROP))         CHAM0163
00325          DELP=C7/DCLP                                                           CHAM0164
00326          IF(ICHAMP.NE.0.AND.MOD(KOUNT(I),ICHAMP).EQ.0)CALL WRITE(6)             CHAM0165
00330          PTEMP(II,JJ)=PTEMP(II,JJ)-DELP                                         CHAM0166
00331          IF (ABS(DELP).LE.0.001) GO TO 390                                      CHAM0167
00333          GO TO 370                                                              CHAM0168
00334      390 CONTINUE                                                               CHAM0169
00335          WTEMP(II,JJ)=-C-C1*PTEMP(II,JJ)                                        CHAM0170
00336          GO TO 430                                                              CHAM0171
00337      410 CONTINUE                                                               CHAM0172
00340          PTEMP(II,JJ)=PSON                                                      CHAM0173
00341          WTEMP(II,JJ)=CC(IPROP)*PTEMP(II,JJ)*AREA(I,N)*CV(I,N)                  CHAM0174
00342      430 CONTINUE                                                               CHAM0175
00343          IF (PCHAM(I).GT.PMAN(I,N)) GO TO 470                                   CHAM0176
00345          IF (C11.GT.PRATC(IPROP)) GO TO 450                                     CHAM0177
00347          WINJ(I,N)=CMAN(I,N)*PMAN(I,N)*CC(IPROP)                                CHAM0178
00350          GO TO 490                                                              CHAM0179
00351      450 CONTINUE                                                               CHAM0180
00352          WINJ(I,N)=CMAN(I,N)*PMAN(I,N)*CCC(IPROP)*SQRT(KAY10(IPROP)*(C11**      CHAM0181
00352         1          KAY9(IPROP)-C11**KAY6(IPROP)))                              CHAM0182
00353          GO TO 490                                                              CHAM0183
00354      470 CONTINUE                                                               CHAM0184
00355          WINJ(I,N)=0.0                                                          CHAM0185
00356      490 CONTINUE                                                               CHAM0186
00357          IF (N.EQ.2) GO TO 510                                                  CHAM0187
00361          DWOX(I)=WINJ(I,N)-MR(I)/(MR(I)+1.0)*WNOZ(I)                            CHAM0188
00362          GO TO 530                                                              CHAM0189
00363      510 CONTINUE                                                               CHAM0190
00364          DWFUEL(I)=WINJ(I,N)-1.0/(MR(I)+1.0)*WNOZ(I)                            CHAM0191
00365      530 CONTINUE                                                               CHAM0192
00366          DPMAN(I,N)=12.0*CL(II)**2/VMAN(I,N)/GC*(WTEMP(II,JJ)-WINJ(I,N))        CHAM0193
00367          DW(1)=DWOX(I)                                                          CHAM0194
00370          DW(2)=DWFUEL(I)                                                        CHAM0195
00371          DW(3)=DPMAN(I,1)                                                       CHAM0196
00372          DW(4)=DPMAN(I,2)                                                       CHAM0197
00373          IF(ICHAMP.NE.0.AND.MOD(KOUNT(I),ICHAMP).EQ.0)CALL WRITE(7)             CHAM0198
00375      550 CONTINUE                                                               CHAM0199
00375    C              CALCUALTE TOTAL IMPULSE                                       CHAM0200
00377          TIMPUL(I)=TIMPUL(I)+ISP(I)*WNOZ(I)*DELTF                               CHAM0201
00400          IF (I.GT.NGGTP) GO TO 630                                              CHAM0202
00402          RPMT(I)=W(5)                                                           CHAM0203
00403          PTO(I)=W(6)                                                            CHAM0204
00404    *DIAGNOSTIC*  THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00404          IF(PTO(I).EQ.0.0.AND.WNOZ(I).GT.0.0)PTO(I)=1.0*DELTF                   CHAM0205
00406          IF(PTO(I).LT.0.0)PTO(I)=1.0*DELTF                                      CHAM0206
00410          W(6)=PTO(I)                                                            CHAM0207
```

```
00411  *DIAGNOSTIC*  THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00411   208.         IF(RPMT(I).EQ.0.AND.WNOZ(I).GT.0.OR.RPMT(I).EQ.0.0)  CHAM0208
00413   209.         W(5)=RPMT(I)                                          CHAM0209
00414   210.         RPMP=RPMT(I)/GR(I)                                    CHAM0210
00415   211.         TTEIS=TC(I)*(PTO(I)/PCHAM(I))**((GAM(I)-1.0)/GAM(I))  CHAM0211
00416   212.         CVEL(I)=SQRT(2.0*CP(I)*(TC(I)-TTEIS)*778.26*GC)       CHAM0212
00417   213.         U(I)=3.14159*DIAT(I)/12.0*RPMT(I)/60.0                CHAM0213
00420   214.         R=U(I)/CVEL(I)                                        CHAM0214
00421   215.         ETAT(I)=CEF2(I)*R*R+CEF1(I)*R                         CHAM0215
00422   216.         POWT(I)=ETAT(I)*778.26*CP(I)*WNOZ(I)*(TC(I)-TTEIS)   CHAM0216
00423   217.         TTO(I)=TC(I)*(1.0-ETAT(I)*(1.0-TTEIS/TC(I)))          CHAM0217
00423   218.    C              .PUMP EQUATIONS                            CHAM0218
00424   219.         C1=ACC1(I)                                            CHAM0219
00425   220.         C2=ACC2(I)                                            CHAM0220
00426   221.         C3=AC3(I)                                             CHAM0221
00427   222.         C4=AC4(I)                                             CHAM0222
00430   223.         X1=1.0/C4-1.0/C2                                      CHAM0223
00431   224.         X2=C3/C4-C1/C2                                        CHAM0224
00432   225.         S=RPMP/RPMPD(I)                                       CHAM0225
00433   226.         IF (PW2(I)) 570,590,570                               CHAM0226
00436   227.     570 CONTINUE                                              CHAM0227
00437   228.         AA3=PW1(I)*S-X1                                       CHAM0228
00440   229.         AA4=PWO(I)*S*S-X2                                     CHAM0229
00441   230.         WP=(-AA3-SQRT(AA3*AA3-4.0*PW2(I)*AA4))/(2.0*PW2(I))   CHAM0230
00442   231.         GO TO 610                                             CHAM0231
00443   232.     590 CONTINUE                                              CHAM0232
00444   233.         WP=PWO(I)*S*S/X1-X2/X1                                CHAM0233
00445   234.     610 CONTINUE                                              CHAM0234
00446   235.         II=IPUMO(I)                                           CHAM0235
00447   236.         WTEMP(II,1)=WP                                        CHAM0236
00450   237.         PTEMP(II,1)=-C1/C2*WP/C2                              CHAM0237
00451   238.         II=IPUMI(I)                                           CHAM0238
00452   239.         JJ=NODEL(II)                                          CHAM0239
00453   240.         WTEMP(II,JJ)=WP                                       CHAM0240
00454   241.         PTEMP(II,JJ)=-C3/C4-WTEMP(II,JJ)/C4                   CHAM0241
00455   242.         PORP(I)=S**3*POW0(I)+S**2*POW1(I)*WP+S*POW2(I)*WP**2+POW3(I)*WP**3CHAM0242
00456   243.         TORT(I)=POWT(I)*60.0/(2.0*3.14159*RPMT(I))            CHAM0243
00457   244.         TORP(I)=PORP(I)*60.0/(2.0*3.14159*RPMP)               CHAM0244
00460   245.         WTDNOZ(I)=ATDNOZ(I)*PTO(I)*SQRT(MW(I)/1545.0/TTO(I)*GC*GAM(I)*(2.0CHAM0245
00460   246.        1/(GAM(I)+1.0))**((GAM(I)+1.0)/(GAM(I)-1.0))           CHAM0246
00461   247.         ATD=3.14159/4.0*DTD(I)**2                             CHAM0247
00462   248.         DPTO(I)=GAM(I)*1545.0/MW(I)*TTO(I)/XLTD(I)/ATD*(WNOZ(I)-WTDNOZ(I))CHAM0248
00463   249.         DRPMT(I)=GC*144.0*60.0/2.0/3.14159/XITP(I)*(TORT(I)-TORP(I))  CHAM0249
00465   250.         DW(5)=DRPMT(I)                                        CHAM0250
00465   251.         DW(6)=DPTO(I)                                         CHAM0251
00466   252.         IF(ITURBN.NE.0.AND.MOD(KOUNT(I),ITURDN).EQ.0)CALL WRITE(9)  CHAM0252
00470   253.     630 CONTINUE                                              CHAM0253
00471   254.         RETURN                                                CHAM0254
00472   255.         END                                                   CHAM0255

        END OF UNIVAC 1108 FORTRAN V COMPILATION.   2 *DIAGNOSTIC* MESSAGE(S)

CHAM            SYMBOLIC      31 AUG 71  12:35:04   0  01514076   14   255  (DELETED)
CHAM    CODE    RELOCATABLE   31 AUG 71  12:35:04   1  01523060   48     1  (DELETED)
                                                    0  01523140   14   115
```

5.4.3 CR2TAP

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:09

   SUBROUTINE CR2TAP    ENTRY POINT 000157

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001   *CODE   000176
         0000   *DATA   000117
         0002   *BLANK  000000


   EXTERNAL REFERENCES (BLOCK, NAME)

         0003   NREWS
         0004   NWDUS
         0005   NIO1S
         0006   NIO2S
         0007   NRDUS
         0010   NWEFS
         0011   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0000   000021 10F        0000   000054 110F       0001   000016 117G       0001   000026 124G       0001   000037 130G
   0001   000010 130L       0001   000051 136G       0001   000065 145G       0001   000125 167G       0001   000110 170L
   0001   000131 190L       0000   000023 30F        0000   000027 50F        0000   000040 70F        0000   000046 90F
   0000 I 000017 I          0000 I 000000 IDATA      0000 I 000016 IK         0000 I 000020 J
```

```
00101          SUBROUTINE CR2TAP(IOPTRM,INDATA,IMAGES,INSYS,IOSYS)                CR2T0001
00103          DIMENSION IDATA(14)                                                CR2T0002
00104       10 FORMAT(13A6,A2)                                                    CR2T0003
00105       30 FORMAT(I5,2H.*,13A6,A2,1H*)                                        CR2T0004
00106       50 FORMAT(10H1 CARD COL,I7,7I10/7H   NO.*,8(10H1234567890),1H*)       CR2T0005
00107       70 FORMAT(7H   NO.*,8(10H1234567890),1H*/1H1)                         CR2T0006
00110       90 FORMAT(7H   NO.*,8(10H1234567890),1H*)                             CR2T0007
00111      110 FORMAT(3(1H0,131('*'))/1HC,30X,'THE DECKEND CARD WAS LEFT OFF THE  CR2T0008
00111         1END OF THE DATA DECK'/3(1H0,131('*')))                            CR2T0009
00111    C * * INITIALIZE CARD COUNTER.                                           CR2T0010
00112          IK=1                                                               CR2T0011
00112    C * * REWIND THE ALTERNATE INPUT DATA FILE...                            CR2T0012
00113          REWIND INDATA                                                      CR2T0013
00113    C * * WRITE PAGE EJECT AND CARD COLUMN INDICATORS.                       CR2T0014
00114      130 CONTINUE                                                           CR2T0015
00115          WRITE (IOSYS,50)(I,I=1,8)                                          CR2T0016
00123          DO 150 I=1,IMAGES                                                  CR2T0017
00123    C * * READ AN INPUT DATA CARD.                                           CR2T0018
00126          READ (INSYS,10,END=170,ERR=170)(IDATA(J),J=1,14)                   CR2T0019
00126    C * * WRITE THE IMAGE ON THE ALTERNATE DATA INPUT FILE.                  CR2T0020
00134          WRITE (INDATA,10)(IDATA(J),J=1,14)                                 CR2T0021
```

```
00134   22.   C . . WRITE OUTPUT [illegible].                                          CR2T[illegible]
00142   23.         WRITE (IOSYS,[illegible]K,(IDATA(J),J=1,14)                       CR2T[illegible]
00142   24.   C . . UPDATE CARD COUNTER.                                                CR2T0024
00151   25.         IK=IK+1                                                           CR2T0025
00151   26.   C . . IF OPERATION TERMINATOR, CEASE PROCESSING.                         CR2T0026
00152   27.         IF (IDATA(1).EQ.IOPTRM) GO TO 190                                 CR2T0027
00154   28.     150 CONTINUE                                                          CR2T0028
00154   29.   C . . WRITE TRAILER LINE.                                                CR2T0029
00156   30.         WRITE (IOSYS,90)                                                  CR2T0030
00160   31.         GO TO 130                                                         CR2T0031
00160   32.   C . . WRITE ERROR MESSAGE AND SET UP AN END CARD FOR PROGRAM CONTINUE.   CR2T0032
00161   33.     170 CONTINUE                                                          CR2T0033
00162   34.         WRITE (IOSYS,110)                                                 CR2T0034
00164   35.         WRITE (INDATA,10)IOPTRM,(IDATA(J),J=2,14)                         CR2T0035
00173   36.     190 CONTINUE                                                          CR2T0036
00173   37.   C . . OUTPUT TRAILER LINE.                                               CR2T0037
00174   38.         WRITE (IOSYS,70)                                                  CR2T0038
00174   39.   C . . END FILE ALTERNATE INPUT DATA FILE.                                CR2T0039
00176   40.         END FILE INDATA                                                   CR2T0040
00176   41.   C . . REWIND ALTERNATE INPUT DATA FILE.                                  CR2T0041
00177   42.         REWIND INDATA                                                     CR2T0042
00200   43.         RETURN                                                            CR2T0043
00201   44.         END                                                               CR2T0044

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   CR2TAP          SYMBOLIC                          31 AUG 71  12:35:06   0  01526252   14   44  (DELETED)
   CR2TAP  CODE    RELOCATABLE                       31 AUG 71  12:35:06   1  01527422   24    1  (DELETED)
                                                                           0  01527452   14   18
```

5.4.4 FBL

THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:10

```
SUBROUTINE FBL        ENTRY POINT 000236

STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000245
      0000   *DATA   000035
      0002   *BLANK  000000
      0003   ALLCOM  023675
      0004   FBLCOM  001775
      0005   VALUES  000010


EXTERNAL REFERENCES (BLOCK, NAME)

      0006   INTERP
      0007   VAL
      0010   NERR3$


STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0001    000121 10L        0001    000004 107G       0001    000220 30L        0003 R 000000 AREAL      0005 R 000001 ARHO
 0003 R 000024 CL          0000 R 000004 C1         0000 R 000005 C2         0000 R 000007 C3         0000 R 000010 C4
 0003 R 000050 DELT        0004 R 000000 DFBL       0003 R 000051 DIAL       0003 R 000075 FRL        0003 R 000121 G
 0003 R 000122 GC          0005 R 000000 GRHO       0000 I 000000 I          0004 I 000764 IFBL       0000 I 000002 II
 0000 I 000003 IPROP       0000 I 000006 JJ         0004 I 000776 NFBL       0003 I 000123 NODEL      0004 I 000777 NPFBL
 0003 I 000147 NPIPL       0003 I 000150 NPLINE     0003 R 000174 PL         0005 R 000004 PR         0005 R 000007 PS
 0003 R 004114 PTEMP       0003 R 010034 RHOL       0003 R 010044 SINALP     0004 R 001011 TFBL       0003 R 010070 THETA
 0003 R 010114 TIME        0000 R 000001 W          0003 R 010115 WDOTL      0005 R 000002 WR         0005 R 000005 WS
 0003 R 014035 WTEMP       0003 R 017755 Z          0005 R 000003 ZR         0005 R 000006 ZS
```

```
00101     1.        SUBROUTINE FBL                                                  FBL 0001
00103     2.        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,      FBL 0002
00103     3.       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),    FBL 0003
00103     4.       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100) FBL 0004
00104     5.        COMMON/FBLCOM/DFBL(10,50),IFBL(10),NFBL,NPFBL(10),TFBL(10,50)   FBL 0005
00105     6.        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                       FBL 0006
00106     7.        DO 30 I=1,NFBL                                                  FBL 0007
00111     8.        CALL INTERP(10,50,DFBL,TFBL,I,NPFBL(I),TIME,W)                  FBL 0008
00112     9.        II=IFBL(I)                                                      FBL 0009
00113    10.        IF (II.GT.0) GO TO 10                                           FBL 0010
00115    11.        II=-II                                                          FBL 0011
00116    12.        IPROP=NPLINE(II)                                                FBL 0012
00117    13.        WTEMP(II,1)=W                                                   FBL 0013
00120    14.        CALL VAL(II,1,IPROP,2)                                          FBL 0014
00121    15.        C1=-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*   FBL 0015
00121    16.       1RHOL(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)* FBL 0016
00121    17.       2DELT/2.0/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                    FBL 0017
```

```
00122      C2=-AREAL(II[illegible]C*144.0/CL(II)                                  FBL [illegible]18
00123      PTEMP(II,1)[illegible]/C2-W/C2                                         FBL [illegible]9
00124      GO TO 30                                                           FBL 0020
00125   10 CONTINUE                                                           FBL 0021
00126      IPROP=NPLINE(II)                                                   FBL 0022
00127      JJ=NODEL(II)                                                       FBL 0023
00130      WTEMP(II,JJ)=W                                                     FBL 0024
00131      CALL VAL(II,JJ,IPROP,1)                                            FBL 0025
00132      C3=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.0-G*     FBL 0026
00132     1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+FRL(II)*WR*ABS(WR)/    FBL 0027
00132     22.0/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                       FBL 0028
00133      C4=AREAL(II)*GC/CL(II)*144.0                                       FBL 0029
00134      PTEMP(II,JJ)=-C3/C4-W/C4                                           FBL 0030
00135   30 CONTINUE                                                           FBL 0031
00137      RETURN                                                             FBL 0032
00140      END                                                                FBL 0033

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   FBL              SYMBOLIC                          31 AUG 71  12:35:07   0  01530046   14   33  (DELETED)
   FBL      CODE    RELOCATABLE                       31 AUG 71  12:35:07   1  01530764   36    1  (DELETED)
                                                                             0  01531030   14   20
```

5.4.5 INTERP

THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:12

```
   SUBROUTINE INTERP     ENTRY POINT 000207

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE    000240
         0000    *DATA    000150
         0002    *BLANK   000000


   EXTERNAL REFERENCES (BLOCK, NAME)

         0003    NWDUS
         0004    NIO1$
         0005    NIO2$
         0006    NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0000   000003 10F        0001   000166 110L       0001   000070 116G       0000   000047 30F        0001   000111 50L
    0001   000117 70L        0001   000145 90L        0000 I 000000 IB         0000 I 000002 K          0000 I 000001 NP
```

103

```
00101     1*        SUBROUTINE INTERP(M,N,DEPTAB,INDTAB,I1,I2,INDP,DEPP)                    INTE0001
00103     2*        REAL INDTAB,INDP                                                        INTE0002
00104     3*        DIMENSION DEPTAB(M,N),INDTAB(M,N)                                       INTE0003
00105     4*     10 FORMAT('1THE VALUE OF THE INDEPENDENT PARAMETER IS',E14.8,'.  THE INTE0004
00105     5*       1UPPER LIMIT ON THE INDEPENDENT TABLE IS',E14.8/' THE DEPENDENT VALINTE0005
00105     6*       2UE HAS BEEN SET EQUAL TO THE UPPER LIMIT OF THE DEPENDENT TABLE WHINTE0006
00105     7*       3ICH IS',E14.8)                                                         INTE0007
00106     8*     30 FORMAT('1THE VALUE OF THE INDEPENDENT PARAMETER IS',E14.8,'.  THE INTE0008
00106     9*       1LOWER LIMIT ON THE INDEPENDENT TABLE IS',E14.8/' THE DEPENDENT VALINTE0009
00106    10*       2UE HAS BEEN SET EQUAL TO THE LOWER LIMIT OF THE DEPENDENT TABLE WHINTE0010
00106    11*       3ICH IS',E14.8)                                                         INTE0011
00107    12*        IB=I1                                                                  INTE0012
00110    13*        NP=I2                                                                  INTE0013
00111    14*        IF (INDP.LT.INDTAB(IB,1)) GO TO 90                                     INTE0014
00113    15*        IF (INDP.GT.INDTAB(IB,NP)) GO TO 70                                    INTE0015
00115    16*        DO 50 K=2,NP                                                           INTE0016
00120    17*        IF (INDP.GT.INDTAB(IB,K)) GO TO 50                                     INTE0017
00122    18*        DEPP=(DEPTAB(IB,K)-DEPTAB(IB,K-1))*(INDP-INDTAB(IB,K-1))/(INDTAB       INTE0018
00122    19*       1     (IB,K)-INDTAB(IB,K-1))+DEPTAB(IB,K-1)                            INTE0019
00123    20*        GO TO 110                                                              INTE0020
00124    21*     50 CONTINUE                                                               INTE0021
00126    22*     70 CONTINUE                                                               INTE0022
00127    23*        WRITE (6,10)INDP,INDTAB(IB,NP),DEPTAB(IB,NP)                           INTE0023
00134    24*        DEPP=DEPTAB(IB,NP)                                                     INTE0024
00135    25*        GO TO 110                                                              INTE0025
00136    26*     90 CONTINUE                                                               INTE0026
```

```
00137    27.        WRITE (6,30)[illegible] INDTAB(IB,1),DEPTAB(IB,1)                INTE[illegible]
00144    28.        DEPP=DEPTAB([illegible])                                          INTE[illegible]
00145    29.    110 CONTINUE                                                          INTE0029
00146    30.        RETURN                                                            INTE0030
00147    31.        END                                                               INTE0031

     END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   INTERP          SYMBOLIC                          31 AUG 71  12:35:09   0  01531460   14   31  (DELETED)
   INTERP  CODE    RELOCATABLE                       31 AUG 71  12:35:09   1  01532342   24    1  (DELETED)
                                                                           0  01532372   14   24
```

5.4.6 JUNCL

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:13

   SUBROUTINE JUNCL      ENTRY POINT 000274

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001    *CODE    000305
        0000    *DATA    000051
        0002    *BLANK   000000
        0003    ALLCOM   023675
        0004    JUNCLC   000075
        0005    VALUES   000010


   EXTERNAL REFERENCES (BLOCK, NAME)

        0006    VAL
        0007    NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000110 10L      0001    000004 110G     0001    000017 114G     0001    000203 141G     0001    000217 151G
    0001    000174 30L      0001    000236 70L      0001    000251 90L      0003 R 000000 AREAL     0005 R 000001 ARHO
    0000 R 000005 CD        0003 R 000024 CL        0000 R 000000 CN        0003 R 000050 DELT      0003 R 000051 DIAL
    0003 R 000075 FRL       0003 R 000121 G         0003 R 000122 GC        0005 R 000000 GRHO      0000 I 000012 I
    0000 I 000015 II        0004 I 000000 IJUNCL    0000 I 000016 IPROP     0000 I 000014 J         0000 I 000017 JJ
    0004 I 000062 NJUNCL    0004 I 000063 NLINJU    0000 I 000013 NNN       0003 I 000123 NODEL     0003 I 000147 NPIPL
    0003 I 000150 NPLINE    0000 R 000022 P         0003 R 000174 PL        0005 R 000004 PR        0005 R 000007 PS
    0003 R 004114 PTEMP     0003 R 010034 RHOL      0003 R 010044 SINALP    0003 R 010070 THETA     0003 R 010114 TIME
    0003 R 010115 WDOTL     0005 R 000002 WR        0005 R 000005 WS        0003 R 014035 WTEMP     0000 R 000021 XDEN
    0000 R 000020 XNUM      0003 R 017755 Z         0005 R 000003 ZR        0005 R 000006 ZS
```

```
00101      1.        SUBROUTINE JUNCL                                                  JUNC0001
00103      2.        DIMENSION CN(5),CD(5)                                             JUNC0002
00104      3.        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,        JUNC0003
00104      4.       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),      JUNC0004
00104      5.       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)   JUNC0005
00105      6.        COMMON/JUNCLC/IJUNCL(10,5),NJUNCL,NLINJU(10)                      JUNC0006
00106      7.        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                         JUNC0007
00107      8.        DO 110 I=1,NJUNCL                                                 JUNC0008
00112      9.        NNN=NLINJU(I)                                                     JUNC0009
00113     10.        DO 30 J=1,NNN                                                     JUNC0010
00116     11.        II=IJUNCL(I,J)                                                    JUNC0011
00117     12.        IF (II.GT.0) GO TO 10                                             JUNC0012
00121     13.        II=-II                                                            JUNC0013
00122     14.        IPROP=NPLINE(II)                                                  JUNC0014
00123     15.        CALL VAL(II,1,IPROP,2)                                            JUNC0015
00124     16.        CN(J)=-(-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*JUNC0016
00124     17.       1RHOL(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)*   JUNC0017
```

```
00124          2DELT/2.0/DI[illegible])/RHOL(IPROP)/AREAL(II)*12.0)                    JUN[illegible]8
00125          CD(J)=AREAL[illegible]*GC*144.0/CL(II)                                  JUN[illegible]9
00126          GO TO 30                                                                JUNC0020
00127       10 CONTINUE                                                                JUNC0021
00130          JJ=NODEL(II)                                                            JUNC0022
00131          CALL VAL(II,JJ,IPROP,1)                                                 JUNC0023
00132          CN(J)=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.0-G*       JUNC0024
00132         1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+ERL(II)*WR*ABS(WR)/          JUNC0025
00132         22.0/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                            JUNC0026
00133          CD(J)=AREAL(II)*GC*144.0/CL(II)                                         JUNC0027
00134       30 CONTINUE                                                                JUNC0028
00136          XNUM=0.0                                                                JUNC0029
00137          XDEN=0.0                                                                JUNC0030
00140          DO 50 J=1,NNN                                                           JUNC0031
00143          XNUM=CN(J)+XNUM                                                         JUNC0032
00144          XDEN=CD(J)+XDEN                                                         JUNC0033
00145       50 CONTINUE                                                                JUNC0034
00147          P=-XNUM/XDEN                                                            JUNC0035
00150          DO 90 J=1,NNN                                                           JUNC0036
00153          II=IJUNCL(I,J)                                                          JUNC0037
00154          IF (II.GT.0) GO TO 70                                                   JUNC0038
00156          II=-II                                                                  JUNC0039
00157          WTEMP(II,1)=CN(J)+CD(J)*P                                               JUNC0040
00160          PTEMP(II,1)=P                                                           JUNC0041
00161          GO TO 90                                                                JUNC0042
00162       70 CONTINUE                                                                JUNC0043
00163          JJ=NODEL(II)                                                            JUNC0044
00164          WTEMP(II,JJ)=-CN(J)-CD(J)*P                                             JUNC0045
00165          PTEMP(II,JJ)=P                                                          JUNC0046
00166       90 CONTINUE                                                                JUNC0047
00170      110 CONTINUE                                                                JUNC0048
00172          RETURN                                                                  JUNC0049
00173          END                                                                     JUNC0050

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   JUNCL          SYMBOLIC                          31 AUG 71  12:35:10   0  01533112    14    50  (DELETED)
   JUNCL   CODE   RELOCATABLE                       31 AUG 71  12:35:10   1  01534406    36     1  (DELETED)
                                                                          0  01534452    14    23
```

5.4.7 PBL

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:15

   SUBROUTINE PBL        ENTRY POINT 000233

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001   *CODE   000242
         0000   *DATA   000030
         0002   *BLANK  000000
         0003   ALLCOM  023675
         0004   VALUES  000010
         0005   PBLCOM  002007


   EXTERNAL REFERENCES (BLOCK, NAME)

         0006   INTERP
         0007   VAL
         0010   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000113 10L        0001    000004 107G       0001    000215 30L        0003 R 000000 AREAL      0004 R 000001 ARHO
    0003 R 000024 CL          0003 R 000050 DELT        0003 R 000051 DIAL        0003 R 000075 FRL        0003 R 000121 G
    0003 R 000122 GC          0004 R 000000 GRHO        0000 I 000000 I           0005 I 000000 IEND       0000 I 000001 II
    0005 I 000012 IPB         0000 I 000002 IPROP       0000 I 000003 JJ          0003 I 000123 NODEL      0005 I 000024 NPBL
    0003 I 000147 NPIPL       0003 I 000150 NPLINE      0005 I 000025 NPRBL       0003 R 000174 PL         0005 R 000037 PPRBL
    0004 R 000004 PR          0004 R 000007 PS          0003 R 004114 PTEMP       0003 R 010034 RHOL       0003 R 010044 SINALP
    0003 R 010070 THETA       0003 R 010114 TIME        0005 R 001023 TPRBL       0003 R 010115 WDOTL      0004 R 000002 WR
    0004 R 000005 WS          0003 R 014035 WTEMP       0003 R 017755 Z           0004 R 000003 ZR         0004 R 000006 ZS


00101     1.        SUBROUTINE PBL                                                  PBL 0001
00103     2.        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,      PBL 0002
00103     3.       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),    PBL 0003
00103     4.       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100) PBL 0004
00104     5.        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                       PBL 0005
00105     6.        COMMON/PBLCOM/IEND(10),IPB(10),NPBL,NPRBL(10),PPRBL(10,50),     PBL 0006
00105     7.       1TPRBL(10,50)                                                    PBL 0007
00106     8.        DO 30 I=1,NPBL                                                  PBL 0008
00111     9.        II=IPB(I)                                                       PBL 0009
00112    10.        IPROP=NPLINE(II)                                                PBL 0010
00113    11.        IF (IEND(I).EQ.2) GO TO 10                                      PBL 0011
00115    12.        CALL INTERP(10,50,PPRBL,TPRBL,I,NPRBL(I),TIME,PTEMP(II,1))      PBL 0012
00116    13.        CALL VAL(II,1,IPROP,2)                                          PBL 0013
00117    14.        WTEMP(II,1)=WS+AREAL(II)/CL(II)*(GC*PTEMP(II,1)*144.0+G*RHOL    PBL 0014
00117    15.       1(IPROP)*Z(II,1)-GC*PS*144.0-G*RHOL(IPROP)*ZS)+G*WS/CL(II)*SINALP PBL 0015
00117    16.       2(II)*DELT-FRL(II)*WS*ABS(WS)*DELT/2.0/ARHO/DIAL(II)*12.0        PBL 0016
00120    17.        GO TO 30                                                        PBL 0017
00121    18.     10 CONTINUE                                                        PBL 0018
```

```
00122   19.        JJ=NODEL(II)                                                    PBL [illegible]9
00123   20.        CALL INTERP[illegible]0,PPRBL,TPRBL,I,NPRBL(I),TIME,PTEMP(II,JJ))   PBL [illegible]3
00124   21.        CALL VAL(II,[illegible]IPROP,1)                                 PBL 0021
00125   22.        WTEMP(II,JJ)=WR-AREAL(II)/CL(II)*(GC*PTEMP(II,JJ)*144.0+G*RHOL  PBL 0022
00125   23.       1(IPROP)*Z(II,JJ)-GC*PR*144.0-G*RHOL(IPROP)*ZR)-G*WR/CL(II)*SINALP PBL 0023
00125   24.       2(II)*DELT-FRL(II)*WR*ABS(WR)*DELT/2.0/ARHO/DIAL(II)*12.0       PBL 0024
00126   25.     30 CONTINUE                                                       PBL 0025
00130   26.        RETURN                                                          PBL 0026
00131   27.        END                                                             PBL 0027
      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   PBL          SYMBOLIC                                  31 AUG 71  12:35:12   0  01535154   14   27  (DELETED)
   PBL    CODE  RELOCATABLE                                31 AUG 71  12:35:12   1  01535746   36    1  (DELETED)
                                                                                 0  01536012   14   19
```

5.4.8 PBLF

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:16

   SUBROUTINE PBLF      ENTRY POINT 000430

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001   *CODE   000440
         0000   *DATA   000044
         0002   *BLANK  000000
         0003   ALLCOM  023675
         0004   PBLFCM  004015
         0005   VALUES  000010


   EXTERNAL REFERENCES (BLOCK, NAME)

         0006   INTERP
         0007   VAL
         0010   SQRT
         0011   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0001    000175 10L        0001    000004 107G       0001    000411 110L       0001    000214 30L        0001    000224 50L
   0001    000355 70L        0001    000400 90L        0003 R 000000 AREAL      0005 R 000001 ARHO       0003 R 000024 CL
   0000 R 000003 C1         0000 R 000004 C2         0000 R 000010 C3         0000 R 000011 C4         0000 R 000005 C55
   0000 R 000006 C66        0003 R 000050 DELT       0003 R 000051 DIAL       0003 R 000075 FRL        0003 R 000121 G
   0003 R 000122 GC         0005 R 000000 GRHO       0000 I 000000 I          0004 I 000000 IENDF      0000 I 000001 II
   0004 I 000012 IPBF       0000 I 000002 IPROP      0000 I 000007 JJ         0004 I 000024 NKPBLF     0003 I 000123 NODEL
   0004 I 000036 NPBLF      0003 I 000147 NPIPL      0003 I 000150 NPLINE     0004 I 000037 NPPBLF     0004 R 000051 PBNDL
   0003 R 000174 PL         0004 R 000063 PPBLF      0005 R 000004 PR         0005 R 000007 PS         0003 R 004114 PTEMP
   0003 R 010034 RHOL       0003 R 010044 SINALP     0003 R 010070 THETA      0003 R 010114 TIME       0004 R 001047 TKPBLF
   0004 R 002033 TPBLF      0003 R 010115 WDOTL      0005 R 000002 WR         0005 R 000005 WS         0003 R 014035 WTEMP
   0004 R 004003 XKP        0004 R 003017 XKPBLF     0003 R 017755 Z          0005 R 000003 ZR         0005 R 000006 ZS


00101     1.        SUBROUTINE PBLF                                                  PBLF0001
00103     2.        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,       PBLF0002
00103     3.       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),     PBLF0003
00103     4.       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)  PBLF0004
00104     5.        COMMON/PBLFCM/IENDF(10),IPBF(10),NKPBLF(10),NPBLF,NPPBLF(10),    PBLF0005
00104     6.       1PBNDL(10),PPBLF(10,50),TKPBLF(10,50),TPBLF(10,50),XKPBLF(10,50), PBLF0006
00104     7.       2XKP(10)                                                          PBLF0007
00105     8.        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                        PBLF0008
00106     9.        DO 110 I=1,NPBLF                                                 PBLF0009
00111    10.        II=IPBF(I)                                                       PBLF0010
00112    11.        CALL INTERP(10,50,PPBLF,TPBLF,I,NPPBLF(I),TIME,PBNDL(I))         PBLF0011
00113    12.        CALL INTERP(10,50,XKPBLF,TKPBLF,I,NKPBLF(I),TIME,XKP(I))         PBLF0012
00114    13.        IPROP=NPLINE(II)                                                 PBLF0013
00115    14.        IF (IENDF(I).EQ.2) GO TO 50                                      PBLF0014
```

```
00117          CALL VAL(II,I[illegible]OP,2)                                          PBLF[illegible]
00120          C1=-WS-AREAL([illegible]CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*   PBLF[illegible]
00120         1RHOL(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)*  PBLF0017
00120         2DELT*2.0/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                     PBLF0018
00121          C2=-AREAL(II)*GC*144./CL(II)                                     PBLF0019
00122          C55=XKP(I)**2*2.0*GC*RHOL(IPROP)*144.0/C2                        PBLF0020
00123          C66=XKP(I)**2*2.0*GC*RHOL(IPROP)*144.0*(PBNDL(I)+C1/C2)          PBLF0021
00124          IF (C66.LE.0.0) GO TO 10                                         PBLF0022
00126          WTEMP(II,1)=C55/2.0+SQRT(C55*C55+4.0*C66)/2.0                    PBLF0023
00127          GO TO 30                                                         PBLF0024
00130       10 CONTINUE                                                         PBLF0025
00131          WTEMP(II,1)=-C55/2.0-SQRT(C55*C55-4.0*C66)/2.0                   PBLF0026
00132       30 CONTINUE                                                         PBLF0027
00133          PTEMP(II,1)=-WTEMP(II,1)/C2-C1/C2                                PBLF0028
00134          GO TO 110                                                        PBLF0029
00135       50 CONTINUE                                                         PBLF0030
00136          JJ=NODEL(II)                                                     PBLF0031
00137          CALL VAL(II,JJ,IPROP,1)                                          PBLF0032
00140          C3=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.0-G*   PBLF0033
00140         1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+FRL(II)*WR*ABS(WR)/  PBLF0034
00140         22.0/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                     PBLF0035
00141          C4=AREAL(II)*GC/CL(II)*144.                                      PBLF0036
00142          C55=XKP(I)**2*2.0*GC*RHOL(IPROP)*144.0/C4                        PBLF0037
00143          C66=XKP(I)**2*2.0*GC*RHOL(IPROP)*144.0*(C3/C4+PBNDL(I))          PBLF0038
00144          IF (C66.GT.0.0) GO TO 70                                         PBLF0039
00146          WTEMP(II,JJ)=-C55/2.0+SQRT(C55*C55-4.0*C66)/2.0                  PBLF0040
00147          GO TO 90                                                         PBLF0041
00150       70 CONTINUE                                                         PBLF0042
00151          WTEMP(II,JJ)=C55/2.0-SQRT(C55*C55+4.0*C66)/2.0                   PBLF0043
00152       90 CONTINUE                                                         PBLF0044
00153          PTEMP(II,JJ)=-WTEMP(II,JJ)/C4-C3/C4                              PBLF0045
00154      110 CONTINUE                                                         PBLF0046
00156          RETURN                                                           PBLF0047
00157          END                                                              PBLF0048

      END OF UNIVAC 1108 FORTRAN V COMPILATION.    0 *DIAGNOSTIC* MESSAGE(S)
PBLF            SYMBOLIC                                  31 AUG 71  12:35:14   0  01536424   14   48  (DELETED)
PBLF    CODE    RELOCATABLE                               31 AUG 71  12:35:14   1  01537664   36    1  (DELETED)
                                                                                 0  01537730   14   33
```

5.4.9 PIPEL

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:18

   SUBROUTINE PIPEL      ENTRY POINT 000221

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001    *CODE    000235
         0000    *DATA    000037
         0002    *BLANK   000000
         0003    ALLCOM   023675
         0004    VALUES   000010


   EXTERNAL REFERENCES (BLOCK, NAME)

         0005    VAL
         0006    NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000005 106G        0001    000030 115G        0001    000175 30L         0003 R 000000 AREAL       0004 R 000001 ARHO
    0003 R 000024 CL           0003 R 000050 DELT        0003 R 000051 DIAL        0003 R 000075 FRL         0003 R 000121 G
    0003 R 000122 GC           0004 R 000000 GRHO        0000 I 000000 II          0000 I 000001 IPROP       0000 I 000003 JJ
    0000 I 000002 NM1NOD       0003 I 000123 NODEL       0003 I 000147 NPIPL       0003 I 000150 NPLINE      0003 R 000174 PL
    0004 R 000004 PR           0004 R 000007 PS          0003 R 004114 PTEMP       0003 R 010034 RHOL        0003 R 010044 SINALP
    0003 R 010070 THETA        0003 R 010114 TIME        0003 R 010115 WDOTL       0004 R 000002 WR          0004 R 000005 WS
    0003 R 014035 WTEMP        0003 R 017755 Z           0004 R 000003 ZR          0004 R 000006 ZS
```

```
00101      1.        SUBROUTINE PIPEL                                                  PIPE0001
00103      2.        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,        PIPE0002
00103      3.       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),      PIPE0003
00103      4.       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)   PIPE0004
00104      5.        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                         PIPE0005
00105      6.        DO 30 II=1,NPIPL                                                  PIPE0006
00110      7.        IF (NODEL(II).LT.3) GO TO 30                                      PIPE0007
00112      8.        IPROP=NPLINE(II)                                                  PIPE0008
00113      9.        NM1NOD=NODEL(II)-1                                                PIPE0009
00114     10.        DO 10 JJ=2,NM1NOD                                                 PIPE0010
00117     11.        CALL VAL(II,JJ,IPROP,3)                                           PIPE0011
00120     12.        WTEMP(II,JJ)=0.5*(WR+WS+AREAL(II)/CL(II)*(GC*PR*144.0+RHOL(IPROP)*PIPE0012
00120     13.       1G*ZR-GC*PS*144.-RHOL(IPROP)*G*ZS)-G/CL(II)*DELT*SINALP(II)*(WR-WS)PIPE0013
00120     14.       2-FRL(II)*DELT/2./DIAL(II)*12./ARHO*(WR*ABS(WR)+WS*ABS(WS)))       PIPE0014
00121     15.        PTEMP(II,JJ) = 0.5*(PR+GRHO*ZR+PS+GRHO*ZS+CL(II)/GC/AREAL(II)*    PIPE0015
00121     16.       1(WR-WS)/144.-DELT*G/GC/AREAL(II)*SINALP(II)*(WR+WS)/144.-CL(II)*  PIPE0016
00121     17.       2FRL(II)*DELT/GC/2./DIAL(II)*12./ARHO/AREAL(II)*(WR*ABS(WR)-WS*    PIPE0017
00121     18.       3ABS(WS))/144.)-GRHO*Z(II,JJ)                                      PIPE0018
00122     19.     10 CONTINUE                                                          PIPE0019
00124     20.     30 CONTINUE                                                          PIPE0020
00126     21.        RETURN                                                            PIPE0021
```

```
00127    22.          END                                                                    PIPE(
    END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 .DIAGNOSTIC. MESSAGE(S)
  PIPEL            SYMBOLIC                                  31 AUG 71  12:35:15   0  01540646    14    22  (DELETED)
  PIPEL    CODE    RELOCATABLE                               31 AUG 71  12:35:15   1  01541332    24     1  (DELETED)
                                                                                    0  01541362    14    18
```

THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:20

SUBROUTINE REGL ENTRY POINT 000662

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000673
0000	*DATA	000053
0002	*BLANK	000000
0003	ALLCOM	023675
0004	CHAMBR	004626
0005	FLAGS	000006
0006	REGLCM	001601
0007	VALUES	000010

EXTERNAL REFERENCES (BLOCK, NAME)

0010	VAL
0011	WRITE
0012	NEXP6S
0013	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001		000235	10L	0001		000004	116G	0001		000623	175G	0001		000516	30L
0004	R	000000	AREA	0004	R	000020	AREAC	0003	R	000000	AREAL	0006	R	000000	AREG
0006	R	001450	AREGP	0007	R	000001	ARHO	0004	R	000030	ATD	0004	R	000031	ATDNOZ
0004	R	000043	CCC	0004	R	000053	CEF1	0004	R	000055	CEF2	0003	R	000024	CL
0004	R	000077	CP	0004	R	000101	CP1	0004	R	000102	CP2	0004	R	000110	CSTAR
0004	R	000121	CS2	0004	R	000127	CV	0004	R	000147	CVEL	0006	R	001460	C1
0006	R	001462	C3	0006	R	001463	C4	0003	R	000050	DELT	0004	R	000151	DELTF
0003	R	000051	DIAL	0004	R	000152	DIAT	0006	R	001460	DMC1	0006	R	001461	DMC2
0006	R	001463	DMC4	0004	R	000154	DPMAN	0004	R	000174	DPTO	0004	R	000176	DRPMT
0004	R	000202	DW	0004	R	000210	DWFUEL	0004	R	000220	DWOX	0004	R	000230	ETAT
0003	R	000075	FRL	0006	R	001475	FW	0003	R	000121	G	0004	R	000232	GAM
0004	R	000234	GR	0007	R	000000	GRHO	0006	I	001476	I	0005	I	000000	IACCPR
0005	I	000001	ICHAMP	0006	I	001476	IDUM1	0006	I	001477	IDUM11	0006	I	001500	IDUM1P
0004	I	000256	IENG	0006	I	001477	II	0005	I	000005	IPLOT	0005	I	000002	IPRINT
0004	I	000257	IPUM1	0004	I	000261	IPUMO	0005	I	000003	IREGPR	0004	I	000263	ISP
0004	I	000274	IS2	0005	I	000004	ITURBN	0000	I	000010	IS	0006	I	001501	JJ
0004	R	000312	KAY1	0004	R	000422	KAY10	0004	R	000432	KAY11	0004	R	000322	KAY2
0004	R	000342	KAY4	0004	R	000352	KAY5	0004	R	000362	KAY6	0004	R	000372	KAY7
0004	R	000412	KAY9	0000	I	000000	KOUNT	0006	I	001502	LREGDN	0006	I	001512	LREGUP
0004	I	000452	MR1	0004	I	000453	MW	0004	I	000463	MW1	0004	I	000464	MW2
0004	I	000473	NCOEF	0004	I	000474	NGGTP	0000	I	000011	NN	0003	I	000123	NODEL
0003	I	000150	NPLINE	0004	I	000475	NPVALF	0004	I	000505	NPVALO	0006	I	001522	NREG
0006	I	001523	NTDUM	0006	I	001524	NTREG	0004	R	000515	OPVALF	0004	R	001455	OPVALO
0006	R	001534	PD	0003	R	000174	PL	0004	R	002425	PMAN	0004	R	002445	PMR
0004	R	002455	POWT	0004	R	002457	POW0	0004	R	002461	POW1	0004	R	002463	POW2
0007	R	000004	PR	0004	R	002467	PRATC	0006	R	001535	PREF	0007	R	000007	PS
0004	R	002477	PTO	0006	R	001545	PU	0004	R	002501	PW0	0004	R	002503	PW1

0001		000532	50L												
0006	R	001440	AREGMX												
0004	R	000033	CC												
0004	R	000057	CHAN												
0004	R	000120	CS1												
0006	R	001461	C2												
0006	R	001464	DFW												
0006	R	001462	DMC3												
0004	R	000200	DTO												
0006	R	001465	FREG												
0003	R	000122	GC												
0004	I	000236	ICHAM												
0006	I	001501	IDUMJJ												
0006	I	001500	IPROP												
0004	I	000273	IS1												
0004	R	000302	KAY												
0004	R	000332	KAY3												
0004	R	000402	KAY8												
0004	I	000442	MR												
0004	I	000472	NCHAM												
0003	I	000147	NPIPL												
0006	I	001523	NT												
0004	R	002415	PCHAM												
0004	R	002453	POWP												
0004	R	002465	POW3												
0003	R	004114	PTEMP												
0004	R	002505	PW2												

```
0006 R 001546 QREG      0006 R 001556 Q1        0006 R 001556 Q1DUM     0006 R 001557 Q2        0006 R 001557 Q2DUM
0004 R 002507 RGAS      0003 R 000134 RHOL      0004 R 002517 RPMP      0004 R 002520 RPS       0004 R 002522 RPMT
0003 R 010044 SINALP    0006 R 001460 SPREG     0006 R 001570 TAUREG    0004 R 002524 TC        0004 R 002534 TC1
0004 R 002535 TC2       0004 R 002543 TGAS      0003 R 010070 THETA     0003 R 010114 TIME      0004 R 002553 TIMEF
0004 R 002554 TIMPUL    0004 R 002564 TMVALF    0004 R 003524 TMVALO    0004 R 004464 TORP      0004 R 004466 TORT
0004 R 004470 TTO       0004 R 004472 U         0004 R 004474 VMAN      0004 R 004514 VOLC      0004 R 004524 W
0004 R 004532 WCHAM     0003 R 010115 WDOTL     0004 R 004542 WFUEL     0004 R 004552 WINJ      0004 R 004572 WNOZ
0004 R 004602 WOX       0007 R 000002 WR        0007 R 000005 WS        0004 R 004612 WTDNOZ    0003 R 014035 WTEMP
0006 R 001600 WW        0004 R 004622 XITP      0004 R 004624 XLTD      0003 R 017755 Z         0007 R 000003 ZR
0007 R 000006 ZS
```

```
00101    1e        SUBROUTINE REGL                                                    REGL0001
00103    2e        REAL KAY,KAY1,KAY2,KAY3,KAY4,KAY5,KAY6,KAY7,KAY8,KAY9,KAY10,KAY11 REGL0002
00104    3e        DIMENSION KOUNT(8)                                                 REGL0003
00105    4e        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,         REGL0004
00105    5e        1NODEL(20),NPIPL,NPLINE(20),PL(20,100),P7EMP(20,100),RHOL(8),      REGL0005
00105    6e        2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)   REGL0006
00106    7e        COMMON/CHAMBR/ARCA(8,2),AREAC(8),ATD,ATDNOZ(2),CC(8),CCC(8),       REGL0007
00106    8e        1CEF1(2),CEF2(2),CMAN(8,2),CP(2),CP1,CP2(6),CSTAR(8),CS1,CS2(6),   REGL0008
00106    9e        2CV(8,2),CVEL(2),DELTF,DIAT(2),DPMAN(8,2),DPTO(2),DRPMT(2),DTD(2), REGL0009
00106    10e       3DW(6),DWFUEL(8),DWOX(8),ETAT(2),GAM(2),GR(2),ICHAM(8,2),IENG,     REGL0010
00106    11e       4IPUMI(2),IPUMO(2),ISP(8),IS1,IS2(6),KAY(8),KAY1(8),KAY2(8),       REGL0011
00106    12e       5KAY3(8),KAY4(8),KAY5(8),KAY6(8),KAY7(8),KAY8(8),KAY9(8),KAY10(8), REGL0012
00106    13e       6KAY11(8),MR1(8),MW1(8),MW2(6),NCHAM,NCOEF,NGGTP,NPVALF(8),        REGL0013
00106    14e       7NPVALO(8),OPVALF(8,60),OPVALO(8,60),PCHAM(8),PMAN(8,2),PMR(6),    REGL0014
00106    15e       8POWP(2),POWT(2),POWO(2),POW1(2),POW2(2),POW3(2),PRATC(8),PTO(2),  REGL0015
00106    16e       9PWO(2),PW1(2),PW2(2),RGAS(8),RPMP,RPMPD(2),RPMT(2),TC(8),TC1,     REGL0016
00106    17e       *TC2(6),TGAS(8),TIMEF,TIMPUL(8),TMVALF(8,60),TMVALO(8,60),TORP(2), REGL0017
00106    18e       ATORT(2),TTO(2),U(2),VMAN(8,2),VOLC(8),W(6),WCHAM(8),WFUEL(8),     REGL0018
00106    19e       BWINJ(8,2),WNOZ(8),WOX(8),WTDNOZ(8),XITP(2),XLTD(2)                REGL0019
00107    20e       COMMON/FLAGS/IACCPR,ICHAMP,IPRINT,IRCGPR,ITURBN,IPLOT              REGL0020
00110    21e       COMMON/REGLCM/AREG(8,100),AREGMX(8),AREGP(8),DMC1,DMC2,DMC3,DMC4,  REGL0021
00110    22e       1DFW,FREG(8),FW,IDUMI,IDUMII,IDUMIP,IDUMJJ,LREGDN(8),LREGUP(8),    REGL0022
00110    23e       2NREG,NTDUM,NTREG(8),PD,PREF(8),PU,QREG(8),Q1DUM,Q2DUM,SPREG(8),    REGL0023
00110    24e       3TAUREG(8),WW                                                      REGL0024
00111    25e       COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                          REGL0025
00112    26e       EQUIVALENCE (DMC1,C1),(DMC2,C2),(DMC3,C3),(DMC4,C4),(IDUM1,I),     REGL0026
00112    27e       1           (IDUMII,II),(IDUMIP,IPROP),(IDUMJJ,JJ),(NTDUM,NT),     REGL0027
00112    28e       2           (Q1DUM,Q1),(Q2DUM,Q2)                                  REGL0028
00113    29e       DATA KOUNT/8*0/                                                    REGL0029
00115    30e       DO 90 I=1,NREG                                                     REGL0030
00120    31e       KOUNT(I)=KOUNT(I)+1                                                REGL0031
00121    32e       NT=I                                                               REGL0032
00122    33e       II=LREGDN(I)                                                       REGL0033
00123    34e       IPROP=NPLINE(II)                                                   REGL0034
00124    35e       CALL VAL(II,1,IPROP,2)                                             REGL0035
00125    36e       C1=-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*RHOL  REGL0036
00125    37e       1(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)*DELT/2,REGL0037
00125    38e       2/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                              REGL0038
00126    39e       C2=-AREAL(II)*GC*144.0/CL(II)                                      REGL0039
00127    40e       II=LREGUP(I)                                                       REGL0040
00130    41e       JJ=NODEL(II)                                                       REGL0041
00131    42e       IPROP=NPLINE(II)                                                   REGL0042
00132    43e       CALL VAL(II,JJ,IPROP,1)                                            REGL0043
00133    44e       C3=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(I,JJ)-GC*PR*144.0-G*RHOLREGL0044
```

```
0006 R 001546 QREG      0006 R 001556 Q1        0006 R 001556 Q1DUM     0006 R 001557 Q2        0006 R 001557 Q2DUM
0004 R 002507 RGAS      0003 R 010034 RHOL      0004 R 002517 RPMP      0004 R 002520 RPM       0004 R 002522 RPMT
0003 R 010044 SINALP    0006 R 001560 SPREG     0006 R 001570 TAUREG    0004 R 002524 TC        0004 R 002534 TC1
0004 R 002535 TC2       0004 R 002543 TGAS      0003 R 010070 THETA     0003 R 010114 TIME      0004 R 002553 TIMEF
0004 R 002554 TIMPUL    0004 R 002564 TMVALF    0004 R 003524 TMVALO    0004 R 004464 TORP      0004 R 004466 TORT
0004 R 004470 TTO       0004 R 004472 U         0004 R 004474 VMAN      0004 R 004514 VOLC      0004 R 004524 W
0004 R 004532 WCHAM     0003 R 010115 WDOTL     0004 R 004542 WFUEL     0004 R 004552 WINJ      0004 R 004572 WNOZ
0004 R 004602 WOX       0007 R 000002 WR        0007 R 000005 WS        0004 R 004612 WTDNOZ    0003 R 014035 WTEMP
0006 R 001600 WW        0004 R 004622 XITP      0004 R 004624 XLTO      0003 R 017755 Z         0007 R 000003 ZR
0007 R 000006 ZS
```

```
00101    1*      SUBROUTINE REGL                                                  REGL0001
00103    2*      REAL KAY,KAY1,KAY2,KAY3,KAY4,KAY5,KAY6,KAY7,KAY8,KAY9,KAY10,KAY11 REGL0002
00104    3*      DIMENSION KOUNT(8)                                               REGL0003
00105    4*      COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,       REGL0004
00105    5*     1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),     REGL0005
00105    6*     2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)  REGL0006
00106    7*      COMMON/CHAMBR/AREA(8,2),ARCAC(8),ATD,ATDNOZ(2),CC(8),CCC(8),     REGL0007
00106    8*     1CEF1(2),CEF2(2),CMAN(8,2),CP(2),CP1,CP2(6),CSTAR(8),CS1,CS2(6),  REGL0008
00106    9*     2CV(8,2),CVEL(2),DELTF,DIAT(2),DPMAN(8,2),DPTO(2),DRPMT(2),DTD(2), REGL0009
00106   10*     3DW(6),DWFUEL(8),DWOX(8),ETAT(2),GAM(2),GR(2),ICHAM(8,2),IENG,    REGL0010
00106   11*     4IPUMI(2),IPUMO(2),ISP(8),IS1,IS2(6),KAY(8),KAY1(8),KAY2(8),     REGL0011
00106   12*     5KAY3(8),KAY4(8),KAY5(8),KAY6(8),KAY7(8),KAY8(8),KAY9(8),KAY10(8), REGL0012
00106   13*     6KAY11(8),MR(8),MR1,MW(8),MW1,MW2(6),NCHAM,NCOEF,NGGTP,NPVALF(8),  REGL0013
00106   14*     7NPVALO(8),OPVALF(8,60),OPVALO(8,60),PCHAM(8),PMAN(8,2),PMR(6),    REGL0014
00106   15*     8POWP(2),POWT(2),POWO(2),POW1(2),POW2(2),POW3(2),PRATC(8),PTO(2),  REGL0015
00106   16*     9PWO(2),PW1(2),PW2(2),RGAS(8),RPMP,RPMPD(2),RPMT(2),TC(8),TC1,     REGL0016
00106   17*     *TC2(6),TGAS(8),TIMEF,TIMPUL(8),TMVALF(8,60),TMVALO(8,60),TORP(2), REGL0017
00106   18*     ATORT(2),TTO(2),U(2),VMAN(8,2),VOLC(8),W(6),WCHAM(8),WFUEL(8),     REGL0018
00106   19*     BWINJ(8,2),WNOZ(8),WOX(8),WTDNOZ(8),XITP(2),XLTO(2)              REGL0019
00107   20*      COMMON/FLAGS/IACCPR,ICHAMP,IPRINT,IREGPR,ITURBN,IPLOT           REGL0020
00110   21*      COMMON/REGLCM/AREG(8,100),AREGMX(8),ARCGP(8),DMC1,DMC2,DMC3,DMC4, REGL0021
00110   22*     1DFW,FREG(8),FW,IDUMI,IDUMII,IDUMIP,IDUMJJ,LREGDN(8),LREGUP(8),   REGL0022
00110   23*     2NREG,NTDUM,NTREG(8),PD,PREF(8),PU,QREG(8),Q1DUM,Q2DUM,SPREG(8),   REGL0023
00110   24*     3TAUREG(8),WW                                                    REGL0024
00111   25*      COMMON/VALUES/GRHO,PR0,WR,ZR,PR,WS,ZS,PS                        REGL0025
00112   26*      EQUIVALENCE (DMC1,C1),(DMC2,C2),(DMC3,C3),(DMC4,C4),(IDUMI,I),  REGL0026
00112   27*     1           (IDUMII,II),(IDUMIP,IPROP),(IDUMJJ,JJ),(NTDUM,NT),   REGL0027
00112   28*     2           (Q1DUM,Q1),(Q2DUM,Q2)                                REGL0028
00113   29*      DATA KOUNT/8*0/                                                  REGL0029
00115   30*      DO 90 I=1,NREG                                                   REGL0030
00120   31*      KOUNT(I)=KOUNT(I)+1                                              REGL0031
00121   32*      NT=1                                                             REGL0032
00122   33*      II=LREGDN(I)                                                     REGL0033
00123   34*      IPROP=NPLINE(II)                                                 REGL0034
00124   35*      CALL VAL(II,1,IPROP,2)                                           REGL0035
00125   36*      C1=-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*RHOL REGL0036
00125   37*     1(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)*DELT/2, REGL0037
00125   38*     2/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                            REGL0038
00126   39*      C2=-AREAL(II)*GC*144.0/CL(II)                                    REGL0039
00127   40*      II=LREGUP(I)                                                     REGL0040
00130   41*      JJ=NODEL(II)                                                     REGL0041
00131   42*      IPROP=NPLINE(II)                                                 REGL0042
00132   43*      CALL VAL(II,JJ,IPROP,1)                                          REGL0043
00133   44*      C3=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(1,JJ)-GC*PR*144.0-G*RHOL REGL0044
```

```
00133          1(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+FRL(II)*WR*ABS(WR)/2.0/   REGL0045
00133          2DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                          REGL0046
00134           C4=AREAL(II)*GC/CL(II)*144.0                                      REGL0047
00135           PU=-C3/(AREG(I,NT)*CC(IPROP)+C4)                                  REGL0048
00136           WW=-C3-C4*PU                                                      REGL0049
00137           PD=-C1/C2-WW/C2                                                   REGL0050
00140           IF(IREGPR.NE.0.AND.MOD(KOUNT(I),IREGPR).EQ.0)CALL WRITE(11)       REGL0051
00142           IF (PD/PU.LT.PRATC(IPROP)) GO TO 50                               REGL0052
00144        10 CONTINUE                                                          REGL0053
00145           Q1=-(WW/C2+C1/C2)                                                 REGL0054
00146           Q2=-(WW/C4+C3/C4)                                                 REGL0055
00147           FW=WW*WW-(AREG(I,NT)*CCC(IPROP))**2*KAY(IPROP)*KAY4(IPROP)*(Q1**  REGL0056
00147          1KAY9(IPROP)*Q2**(KAY9(IPROP)*KAY2(IPROP))-Q1**KAY6(IPROP)*Q2**    REGL0057
00147          2(KAY2(IPROP)/KAY(IPROP)))                                         REGL0058
00150           DFW=2.0*WW-(AREG(I,NT)*CCC(IPROP))**2*KAY(IPROP)*KAY4(IPROP)*(Q2**REGL0059
00150          1(2.0/KAY5(IPROP))*KAY9(IPROP)*Q1**KAY8(IPROP)*(-1.0/C2)+Q1**KAY9  REGL0060
00150          2(IPROP)*2.0*KAY2(IPROP)/KAY(IPROP)/Q2**KAY8(IPROP)*(-1.0/C4)-Q2** REGL0061
00150          3(1.0/KAY5(IPROP))*KAY6(IPROP)*Q1**KAY7(IPROP)*(-1.0/C2)-Q1**KAY6  REGL0062
00150          4(IPROP)/KAY5(IPROP)/Q2**KAY7(IPROP)*(-1.0/C4))                    REGL0063
00151           WW=WW-FW/DFW                                                      REGL0064
00152           IF(IREGPR.NE.0.AND.MOD(KOUNT(I),IREGPR).EQ.0)CALL WRITE(12)       REGL0065
00154           IF (ABS(FW/DFW).LT.0.001) GO TO 30                                REGL0066
00156           GO TO 10                                                          REGL0067
00157        30 CONTINUE                                                          REGL0068
00160           PU=-WW/C4-C3/C4                                                   REGL0069
00161           PD=-WW/C2-C1/C2                                                   REGL0070
00162        50 CONTINUE                                                          REGL0071
00163           NT=NTREG(I)                                                       REGL0072
00164           AREG(I,NT)=AREGMX(I)-QREG(I)/SPREG(I)*((PD-PREF(I))*AREGP(I)-     REGL0073
00164          1FREG(I))                                                          REGL0074
00165           IF(AREG(I,NT).LT.0.0)AREG(I,NT)=0.0                               REGL0075
00167           IF(AREG(I,NT).GT.AREGMX(I))AREG(I,NT)=AREGMX(I)                   REGL0076
00171           NT=NTREG(I)-1                                                     REGL0077
00172           IF(IREGPR.NE.0.AND.MOD(KOUNT(I),IREGPR).EQ.0)CALL WRITE(13)       REGL0078
00174           DO 70 NN=1,NT                                                     REGL0079
00177           AREG(I,NN)=AREG(I,NN+1)                                           REGL0080
00200        70 CONTINUE                                                          REGL0081
00202           WTEMP(II,JJ)=WW                                                   REGL0082
00203           PTEMP(II,JJ)=PU                                                   REGL0083
00204           II=LREGDN(I)                                                      REGL0084
00205           WTEMP(II,1)=WW                                                    REGL0085
00206           PTEMP(II,1)=PD                                                    REGL0086
00207        90 CONTINUE                                                          REGL0087
00211           RETURN                                                            REGL0088
00212           END                                                               REGL0089

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
REGL            SYMBOLIC                          31 AUG 71  12:35:18   0  01541756   14   89  (DELETED)
REGL    CODE    RELOCATABLE                       31 AUG 71  12:35:18   1  01544314   48    1  (DELETED)
                                                                        0  01544374   14   51
```

5.4.11 RKINS

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:22

    SUBROUTINE RKINS      ENTRY POINT 000170

    STORAGE USED (BLOCK, NAME, LENGTH)

          0001    *CODE    000216
          0000    *DATA    000040
          0002    *BLANK   000000

    EXTERNAL REFERENCES (BLOCK, NAME)

          0003    NERR3$

    STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

     0001    000023 110G      0001    000112 110L      0001    000054 124G      0001    000076 136G      0001    000132 152G
     0001    000037 30L       0001    000042 50L       0000 R  000003 A         0000 R  000004 B         0000 R  000005 C
     0000 R  000005 CDP       0000 I  000002 I         0000 I  000001 K         0000 I  000000 NN

00101      1.          SUBROUTINE RKINS(XDP,HDP,VAR,DER,DAUX,N,TEMPS)                RKIN0001
00103      2.          DIMENSION VAR(1),DER(1),TEMPS(3,1),C(2)                       RKIN0002
00104      3.          EQUIVALENCE(CDP,C)                                            RKIN0003
00105      4.          NN=N                                                          RKIN0004
00106      5.          K=0                                                           RKIN0005
00107      6.          DO 10 I=1,NN                                                  RKIN0006
00112      7.          TEMPS(2,I)=VAR(I)                                             RKIN0007
00113      8.          TEMPS(3,I)=DER(I)                                             RKIN0008
00114      9.       10 CONTINUE                                                      RKIN0009
00116     10.          CDP=HDP/2.D0                                                  RKIN0010
00117     11.          A=C(1)                                                        RKIN0011
00120     12.       30 CONTINUE                                                      RKIN0012
00121     13.          XDP=XDP+CDP                                                   RKIN0013
00122     14.       50 CONTINUE                                                      RKIN0014
00123     15.          DO 70 I=1,NN                                                  RKIN0015
00126     16.          VAR(I)=TEMPS(2,I)+A*DER(I)                                    RKIN0016
00127     17.       70 CONTINUE                                                      RKIN0017
00131     18.          CALL DAUX                                                     RKIN0018
00132     19.          K=K+1                                                         RKIN0019
00133     20.          IF (K.EQ.3) GO TO 110                                         RKIN0020
00135     21.          DO 90 I=1,NN                                                  RKIN0021
00140     22.          TEMPS(3,I)=TEMPS(3,I)+2.0*DER(I)                              RKIN0022
00141     23.       90 CONTINUE                                                      RKIN0023
00143     24.          IF (K.EQ.1) GO TO 50                                          RKIN0024
00145     25.          A=HDP                                                         RKIN0025
00146     26.          GO TO 30                                                      RKIN0026
00147     27.      110 CONTINUE                                                      RKIN0027
00150     28.          A=A/6.0                                                       RKIN0028
```

```
00151    29.          DO 130 I=1,NN                                                  RKIN0029
00154    30.          C(1)=TEMPS(2,I)                                                RKIN0030
00155    31.          C(2)=TEMPS(1,I)                                                RKIN0031
00156    32.          B=(TEMPS(3,I)+DFR(I))*A                                        RKIN0032
00157    33.          CDP=CDP+B                                                      RKIN0033
00160    34.          VAR(I)=C(1)                                                    RKIN0034
00161    35.          TEMPS(1,I)=C(2)                                                RKIN0035
00162    36.      130 CONTINUE                                                       RKIN0036
00164    37.          CALL DAUX                                                      RKIN0037
00165    38.          RETURN                                                         RKIN0038
00166    39.          END                                                            RKIN0039

     END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 .DIAGNOSTIC. MESSAGE(S)
   RKINS            SYMBOLIC                                  31 AUG 71  12:35:19   0  01545706    14    39  (DELETED)
   RKINS    CODE    RELOCATABLE                               31 AUG 71  12:35:19   1  01546750    24     1  (DELETED)
                                                                                      0  01547000    14    16
```

THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:23

SUBROUTINE VAL ENTRY POINT 000166

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000175	
0000	*DATA	000015	
0002	*BLANK	000000	
0003	ALLCOM	023675	
0004	VALUES	000010	

EXTERNAL REFERENCES (BLOCK, NAME)

0005	NERR2S
0006	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000027	IOL	0001	000106	JOL	0001	000154	KOL	0003 R	000000	AREAL
0004 R	000001	ARHO	0003 R	000024	CL	0003 R	000050	DELT	0003 R	000051	DIAL
0003 R	000075	FRL	0003 R	000121	G	0003 R	000122	GC	0004 R	000000	GRHO
0003 I	000123	NODEL	0003 I	000147	NPIPL	0003 I	000150	NPLINE	0003 R	000174	PL
0004 R	000004	PR	0004 R	000007	PS	0003 R	004114	PTEMP	0003 R	010034	RHOL
0003 R	010044	SINALP	0003 R	010070	THETA	0003 R	010114	TIME	0003 R	010115	WDOTL
0004 R	000002	WR	0004 R	000005	WS	0003 R	014035	WTEMP	0003 R	017755	Z
0004 R	000003	ZR	0004 R	000006	ZS						

118

```
00101     1*        SUBROUTINE VAL (II,JJ,IPROP,IGOTO)                    VAL 0001
00103     2*        COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,  VAL 0002
00103     3*       1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),  VAL 0003
00103     4*       2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)  VAL 0004
00104     5*        COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS              VAL 0005
00105     6*        GRHO=G*RHOL(IPROP)/GC/144.0                            VAL 0006
00106     7*        ARHO=RHOL(IPROP)*AREAL(II)                             VAL 0007
00107     8*        GO TO (10,30,10),IGOTO                                 VAL 0008
00110     9*     10 CONTINUE                                               VAL 0009
00111    10*        WR=(WDOTL(II,JJ)-THETA(II)*CL(II)*(WDOTL(II,JJ)-WDOTL(II,JJ-1)))/(VAL 0010
00111    11*       1.0+THETA(II)*(WDOTL(II,JJ)-WDOTL(II,JJ-1))/RHOL(IPROP)/AREAL(II))VAL 0011
00112    12*        ZR=Z(II,JJ)-THETA(II)*(WR/ARHO+CL(II))*(Z(II,JJ)-Z(II,JJ-1))  VAL 0012
00113    13*        PR=PL(II,JJ)+GRHO*Z(II,JJ)-THETA(II)*(WR/ARHO+CL(II))*(PL(II,JJ)+ VAL 0013
00113    14*       1GRHO*Z(II,JJ)-PL(II,JJ-1)-GRHO*Z(II,JJ-1))-GRHO*ZR        VAL 0014
00114    15*        GO TO (50,50,30),IGOTO                                 VAL 0015
00115    16*     30 CONTINUE                                               VAL 0016
00116    17*        WS=(WDOTL(II,JJ)-THETA(II)*CL(II)*(WDOTL(II,JJ)-WDOTL(II,JJ+1)))/(VAL 0017
00116    18*       1.0-THETA(II)*(WDOTL(II,JJ)-WDOTL(II,JJ+1))/RHOL(IPROP)/AREAL(II))VAL 0018
00117    19*        ZS=Z(II,JJ)+THETA(II)*(WS/ARHO-CL(II))*(Z(II,JJ)-Z(II,JJ+1))  VAL 0019
00120    20*        PS=PL(II,JJ)+GRHO*Z(II,JJ)+THETA(II)*(WS/ARHO-CL(II))*(PL(II,JJ)+ VAL 0020
00120    21*       1GRHO*Z(II,JJ)-PL(II,JJ+1)-GRHO*Z(II,JJ+1))-GRHO*ZS         VAL 0021
00121    22*     50 CONTINUE                                               VAL 0022
```

```
00122    23*          RETURN                                                                  VAL 0023
00123    24*          END                                                                     VAL 0024

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   VAL              SYMBOLIC                                  31 AUG 71  12:35:21   0  01547340    14    24  (DELETED)
   VAL      CODE    RELOCATABLE                               31 AUG 71  12:35:21   1  01550060    24     1  (DELETED)
                                                                                     0  01550110    14    15
```

5.4.13 VALVEL

```
THIS COMPILATION WAS DONE ON 02 SEP 71 AT 11:52:25

SUBROUTINE VALVEL     ENTRY POINT 000337

STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000347
      0000   *DATA   000046
      0002   *BLANK  000000
      0003   ALLCOM  023675
      0004   VALUES  000010
      0005   VALVCM  002021

EXTERNAL REFERENCES (BLOCK, NAME)

      0006   INTERP
      0007   VAL
      0010   SQRT
      0011   NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0001   000251 10L      0001   000004 107G     0001   000274 30L      0003 R 000000 AREAL    0004 R 000001 ARHO
 0003 R 000024 CL       0000 R 000003 C1       0000 R 000004 C2       0000 R 000006 C3       0000 R 000007 C4
 0000 R 000010 C5       0000 R 000011 C6       0003 R 000050 DELT     0003 R 000051 DIAL     0003 R 000075 FRL
 0003 R 000121 G        0003 R 000122 GC       0004 R 000000 GRHO     0000 I 000000 I        0000 I 000001 II
 0000 I 000002 IPROP    0000 I 000005 JJ       0005 I 000000 LVDN     0005 I 000012 LVUP     0003 I 000123 NODEL
 0003 I 000147 NPIPL    0003 I 000150 NPLINE   0005 I 000024 NVALL    0005 I 000025 NXKVL    0003 R 000174 PL
 0004 R 000004 PR       0004 R 000007 PS       0003 R 004114 PTEMP    0003 R 010034 RHOL     0003 R 010044 SINALP
 0003 R 010070 THETA    0003 R 010114 TIME     0005 R 000037 TMVL     0003 R 010115 WDOTL    0004 R 000002 WR
 0004 R 000005 WS       0003 R 014035 WTEMP    0000 R 000012 WTEMPP   0005 R 001023 XK       0005 R 001035 XKVL
 0003 R 017755 Z        0004 R 000003 ZR       0004 R 000006 ZS

00101    1.      SUBROUTINE VALVEL                                                  VALV0001
00103    2.      COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,         VALV0002
00103    3.     1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),       VALV0003
00103    4.     2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100)    VALV0004
00104    5.      COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                          VALV0005
00105    6.      COMMON/VALVCM/LVDN(10),LVUP(10),NVALL,NXKVL(10),TMVL(10,50),       VALV0006
00105    7.     1XK(10),XKVL(10,50)                                                 VALV0007
00106    8.      DO 50 I=1,NVALL                                                    VALV0008
00111    9.      II=LVDN(I)                                                         VALV0009
00112   10.      IPROP=NPLINE(II)                                                   VALV0010
00113   11.      CALL INTERP(10,50,XKVL,TMVL,I,NXKVL(I),TIME,XK(I))                 VALV0011
00114   12.      CALL VAL(II,1,IPROP,2)                                             VALV0012
00115   13.      C1=-WS-AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,1)-GC*PS*144.0-G*      VALV0013
00115   14.     1RHOL(IPROP)*ZS)-G/CL(II)*WS*SINALP(II)*DELT+FRL(II)*WS*ABS(WS)*    VALV0014
00115   15.     2DELT/2.0/DIAL(II)/RHOL(IPROP)/AREAL(II)*12.0                       VALV0015
```

```
00116    16.        C2=-AREAL(II)*GC*144.0/CL(II)                                    VALV0016
00117    17.        II=LVUP(I)                                                       VALV0017
00120    18.        JJ=NODEL(II)                                                     VALV0018
00121    19.        CALL VAL(II,JJ,IPROP,1)                                          VALV0019
00122    20.        C3=-WR+AREAL(II)/CL(II)*(G*RHOL(IPROP)*Z(II,JJ)-GC*PR*144.0-G*   VALV0020
00122    21.       1RHOL(IPROP)*ZR)+G/CL(II)*WR*SINALP(II)*DELT+FRL(II)*WR*ABS(WR)/  VALV0021
00122    22.       22.0/DIAL(II)*12.0/RHOL(IPROP)/AREAL(II)*DELT                     VALV0022
00123    23.        C4=AREAL(II)*GC/CL(II)*144.0                                     VALV0023
00124    24.        C5=XK(I)**2*2.0*GC*RHOL(IPROP)*144.0*(1.0/C4-1.0/C2)             VALV0024
00125    25.        C6=2.0*GC*RHOL(IPROP)*144.0*(C3/C4-C1/C2)*XK(I)**2               VALV0025
00126    26.        IF (C6.GT.0.0) GO TO 10                                          VALV0026
00130    27.        WTEMP(II,JJ)=-C5/2.0+SQRT(C5*C5-4.0*C6)/2.0                      VALV0027
00131    28.        GO TO 30                                                         VALV0028
00132    29.     10 CONTINUE                                                         VALV0029
00133    30.        WTEMP(II,JJ)=C5/2.0-SQRT(C5*C5+4.0*C6)/2.0                       VALV0030
00134    31.     30 CONTINUE                                                         VALV0031
00135    32.        PTEMP(II,JJ)=-WTEMP(II,JJ)/C4-C3/C4                              VALV0032
00136    33.        WTEMPP=WTEMP(II,JJ)                                              VALV0033
00137    34.        II=LVDN(I)                                                       VALV0034
00140    35.        WTEMP(II,1)=WTEMPP                                               VALV0035
00141    36.        PTEMP(II,1)=-WTEMPP/C2-C1/C2                                     VALV0036
00142    37.     50 CONTINUE                                                         VALV0037
00144    38.        RETURN                                                           VALV0038
00145    39.        END                                                              VALV0039

   END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   VALVEL          SYMBOLIC                          31 AUG 71  12:35:23   0  01550432    14    39  (DELETED)
   VALVEL  CODE    RELOCATABLE                       31 AUG 71  12:35:23   1  01551474    36     1  (DELETED)
                                                                           0  01551540    14    27
```

THIS COMPILATION WAS DONE ON 02 S[redacted] AT 11:52:27

SUBROUTINE WRITE ENTRY POINT 003630

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	003646
0000	*DATA	001516
0002	*BLANK	000000
0003	ACCCOM	000030
0004	ALLCOM	023675
0005	CHAMBR	004626
0006	DATA1	000034
0007	DATA2	000062
0010	DATA3	001200
0011	FBLCOM	001775
0012	FLAGS	000006
0013	JUNCLC	000075
0014	PBLCOM	002007
0015	PBLFCM	004015
0016	REGLCM	001601
0017	VALUES	000010
0020	VALVCM	002021

EXTERNAL REFERENCES (BLOCK, NAME)

0021	CLOCK
0022	NERR2$
0023	NWDUS
0024	NIO2$
0025	NIO1$
0026	NREW$
0027	NWBUS
0030	NWEF$
0031	NERR3$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000	000014 10F	0001	001521 1006G	0001	001522 1011G	0001	001543 1024G	0001	002320 1030L		
0001	001572 1041G	0001	001620 1056G	0001	001635 1070G	0001	002335 1070L	0000	000252 110F		
0001	001652 1102G	0001	002360 1110L	0001	001667 1114G	0001	002405 1130L	0001	001727 1134G		
0001	001757 1144G	0001	002016 1163G	0001	002536 1170L	0001	002032 1173G	0001	002774 1230L		
0001	002143 1234G	0001	003060 1250L	0001	002223 1264G	0001	003214 1270L	0001	003224 1290L		
0000	000257 130F	0001	002256 1301G	0001	003240 1310L	0001	002274 1314G	0001	002311 1326G		
0001	003361 1330L	0001	002326 1340G	0001	003430 1350L	0001	002343 1352G	0001	003506 1370L		
0001	002400 1371G	0001	003545 1390L	0001	002421 1403G	0001	003607 1410L	0001	002451 1414G		
0001	002466 1423G	0001	002516 1440G	0001	002532 1447G	0001	002554 1460G	0001	002601 1470G		
0000	000443 150F	0001	002626 1500G	0001	002641 1505G	0001	002723 1536G	0000	000630 170F		
0001	003374 1754G	0000	000720 190F	0001	000111 206G	0000	000755 210F	0001	000136 216G		
0001	000163 226G	0000	001042 230F	0001	000210 236G	0001	000232 245G	0000	001120 250F		
0001	000256 255G	0001	000261 257G	0000	001157 270F	0001	000313 270G	0001	000335 277G		

```
0000    001213 290F      0000    000220 30F       0001    000356 306G      0000    001316 310F      0001    000372 315G
0001    000406 324G      0000    001404 330F      0001    000422 333G      0001    000436 342G      0000    001415 350F
0001    000452 351G      0001    000466 360G      0001    000502 367G      0000    001430 370F      0001    000516 376G
0001    000623 390L      0001    000537 407G      0001    000553 416G      0001    000567 425G      0001    001335 430L
0001    000603 434G      0001    000617 443G      0001    001336 450L      0001    000633 452G      0001    000647 461G
0001    000663 470G      0001    000677 477G      0000    000226 50F       0001    000713 506G      0001    000727 515G
0001    000743 524G      0001    000757 533G      0001    000773 542G      0001    001535 550L      0001    001007 551G
0001    001023 560G      0001    001045 570G      0001    001064 577G      0001    001552 590L      0001    001105 606G
0001    001600 610L      0001    001120 615G      0001    001150 626G      0001    001165 635G      0001    001202 644G
0001    001627 650L      0001    001226 656G      0001    001253 666G      0001    001300 676G      0001    001644 690L
0000    000235 70F       0001    001325 706G      0001    001357 724G      0001    001372 727G      0001    001661 730L
0001    001420 737G      0001    001421 742G      0001    001447 756G      0001    001704 770L      0001    001477 771G
0001    001500 774G      0001    001735 790L      0001    001735 810L      0001    002215 890L      0000    000236 90F
0001    002236 930L      0001    002262 950L      0001    002303 990L      0006 R  000032 AA3      0006 R  000033 AA4
0005 R  000000 AREA      0005 R  000020 AREAC     0004 R  000000 AREAL     0016 R  000000 AREG      0016 R  001440 AREGMX
0016 R  001450 AREGP     0017 R  000001 ARHO      0005 R  000030 ATD       0005 R  000031 ATDNO7    0006 R  000000 A1
0007 R  000000 BK        0006 R  000001 B1        0006 R  000002 C         0005 R  000033 CC        0005 R  000043 CCC
0005 R  000053 CEF1      0005 R  000055 CEF2      0004 R  000024 CL        0005 R  000057 CHAN      0005 R  000077 CP
0005 R  000101 CP1       0005 R  000102 CP2       0005 R  000110 CSTAR     0005 R  000120 CS1       0005 R  000121 CS2
0005 R  000127 CV        0005 R  000147 CVEL      0006 R  000003 C3        0006 R  000010 C11       0006 R  000023 C2
0006 R  000025 C3        0006 R  000022 C4        0006 R  000004 C6        0006 R  000005 C7        0006 R  000006 C8
0006 R  000007 C9        0006 R  000011 DCLP      0006 R  000012 DELP      0004 R  000050 DELT      0005 R  000151 DELTF
0007 R  000010 DELXL     0011 R  000000 DFBL      0016 R  001464 DFW       0004 R  000051 DIAL      0005 R  000152 DIAT
0016 R  001460 DMC1      0016 R  001461 DMC2      0016 R  001462 DMC3      0016 R  001463 DMC4      0003 R  000000 DPACC
0005 R  000154 DPMAN     0005 R  000174 DPTO      0005 R  000176 DRPMT     0005 R  000200 DTD       0003 R  000001 DUM
0005 R  000202 DW        0005 R  000210 DWFUEL    0005 R  000220 DWOX      0005 R  000230 ETAT      0016 R  001465 FREG
0004 R  000075 FRL       0016 R  001475 FW        0004 R  000121 G         0005 R  000232 GAM       0004 R  000122 GC
0005 R  000234 GR        0017 R  000000 GRHO      0005 I  000256 I         0003 I  000007 IACC      0012 I  000000 IACCPR
0005 I  000236 ICHAM     0012 I  000001 ICHAMP    0003 I  000011 IDUM       0016 I  001476 IDUM1     0016 I  001477 IDUM11
0016 I  001500 IDUMIP    0016 I  001501 IDUMJJ    0003 I  000012 IDUM1     0003 I  000013 IDUM2     0003 I  000014 IDUM3
0000 I  000000 ID1       0000 I  000001 ID2       0000 I  000002 ID3       0003 I  000015 IENACC    0014 I  000000 IEND
0015 I  000000 IENDF     0005 I  000256 IENG      0011 I  000764 IFBL      0006 I  000020 II        0013 I  000000 IJUNCL
0006 I  000013 IKOUNT    0014 I  000012 IPB       0015 I  000012 IP8F      0012 I  000005 IPLOT     0012 I  000002 IPRINT
0006 I  000014 IPROP     0005 I  000257 IPUM1     0005 I  000261 IPUMO     0012 I  000003 IREGPR    0005 R  000263 ISP
0005 R  000273 IS1       0005 R  000274 IS2       0012 I  000004 ITURBN    0000 I  000013 IS        0000 I  000006 J
0006 I  000021 JJ        0005 R  000302 KAY       0005 R  000312 KAY1      0005 R  000422 KAY10     0005 R  000432 KAY11
0005 R  000322 KAY2      0005 R  000332 KAY3      0005 R  000342 KAY4      0005 R  000352 KAY5      0005 R  000362 KAY6
0005 R  000372 KAY7      0005 R  000402 KAY8      0005 R  000412 KAY9      0000 I  000007 KK        0000 I  000011 LL
0016 I  001502 LREGDN    0016 I  001512 LREGUP     0020 I  000000 LVDN      0020 I  000012 LVUP      0005 R  000442 MR
0005 R  000452 MR1       0005 R  000453 MW        0005 R  000463 MW1       0005 R  000464 MW2       0006 I  000015 N
0003 I  000017 NACC      0010 I  000000 NAMCHM    0010 I  000166 NAME      0010 I  000242 NAMEPL     0010 I  000160 NAMTMP
0005 I  000472 NCHAM     0007 I  000034 NCMTB     0005 I  000473 NCOEF     0011 I  000776 NFBL      0005 I  000474 NGGTP
0013 I  000062 NJUNCL    0015 I  000024 NKPBLF    0013 I  000063 NLINJU    0010 I  000362 NME       0010 I  000432 NMETBN
0010 I  000452 NMOUT     0007 I  000035 NN        0003 I  000020 NNNN      0000 I  000012 NNODEL     0004 I  000123 NODEL
0014 I  000024 NPBL      0015 I  000036 NPBLF     0011 I  000777 NPFBL     0004 I  000147 NPIPL     0000 I  000010 NPIPL1
0004 I  000150 NPLINE    0015 I  000037 NPPBLF    0014 I  000025 NPRBL     0005 I  000475 NPVALF    0005 I  000505 NPVALO
0016 I  001522 NREG      0016 I  001523 NTDUM     0016 I  001524 NTREG     0020 I  000024 NVALL     0000 I  000003 NW1
0000 I  000004 NW2       0000 I  000005 NW3       0020 I  000025 NXKVL     0005 R  000515 OPVALF    0005 R  001455 OPVALO
0010 R  000654 OUTDAT    0003 R  000021 PACC      0015 R  000051 PBNDL     0005 R  002415 PCHAM     0016 R  001534 PD
0004 R  000174 PL        0010 R  001056 PLOTND    0005 R  002425 PMAN      0005 R  002445 PMR       0005 R  002453 POWP
0005 R  002455 POWT      0005 R  002457 POWC      0005 R  002461 POW1      0005 R  002463 POW2      0005 R  002465 POW3
0015 R  000063 PPBLF     0003 R  000023 PPPP      0014 R  000037 PPRBL     0017 R  000004 PR        0005 R  002467 PRATC
0006 R  000016 PRAT1     0016 R  001535 PREF      0017 R  000007 PS        0006 R  000017 PSON      0004 R  004114 PTEMP
0005 R  002477 PTO       0016 R  001545 PU        0005 R  002501 PWP       0005 R  002503 PW1       0005 R  002505 PW2
0016 R  001546 QRTG      0016 R  001556 QIDUM     0016 R  001557 QZDUM     0006 R  000024 R         0005 R  002507 RGAS
0004 R  010034 RHOL      0005 R  002517 RPMP      0005 R  002520 RPMPD     0005 R  002522 RPMT      0006 R  000030 S
0004 R  010044 SINALP    0016 R  001560 SPREG     0016 R  001570 TAUREG    0005 R  002524 TC        0005 R  002534 TC1
0005 R  002535 TC2       0011 R  001011 TFBL      0005 R  002543 TGAS      0004 R  010070 THETA     0010 R  001176 TIM
```

```
0004 R 010114 TIME      0005 R 002553 TIMEF     0010 R 001177 TIMF      0005 R 002554 TIMPUL    0015 R 001047 TKPBLF
0005 R 002564 TMVALF    0005 R 003524 TMVALO    0020 R 000037 TMVL      0005 R 004[redacted]RF  0005 R 004466 TORT
0015 R 002033 TPBLF     0014 R 001023 TPRBL     0005 R 004470 TTO       0005 R 004472 [redacted] 0005 R 004474 VMAN
0003 R 000024 VOLACC    0005 R 004514 VOLC      0005 R 004524 W         0005 R 004532 WCHAM     0004 R 010115 WDOTL
0005 R 004542 WFUEL     0005 R 004552 WINJ      0005 R 004572 WNOZ      0005 R 004602 WOX       0006 R 000031 WP
0017 R 000002 WR        0017 R 000005 WS        0005 R 004612 WTDNOZ    0004 R 014035 WTEMP     0016 R 001600 WW
0005 R 004622 XITP      0020 R 001023 XK        0003 R 000026 XKACC     0015 R 004003 XKP       0015 R 003017 XKPBLF
0020 R 001035 XKVL      0007 R 000036 XLENGL    0005 R 004624 XLTD      0006 R 000026 X1        0006 R 000027 X2
0004 R 017755 Z         0017 R 000003 ZR        0017 R 000006 ZS
```

```
00101    1*      SUBROUTINE WRITE(IGO)                                          WRITO001
00103    2*       REAL ISP,IS1,IS2,KAY,KAY1,KAY2,KAY3,KAY4,KAY5,KAY6,KAY7,KAY8,KAY9,WRITO002
00103    3*      1KAY10,KAY11,MR,MR1,MW,MW1,MW2                                 WRITO003
00104    4*       COMMON/ACCCOM/DPACC,DUM(6),IACC(2),IDUM,IDUM1,IDUM2,IDUM3,     WRITO004
00104    5*      1IENACC(2),NACC,NNNN,PACC(2),PPPP,VOLACC(2),XKACC(2)            WRITO005
00105    6*       COMMON/ALLCOM/AREAL(20),CL(20),DELT,DIAL(20),FRL(20),G,GC,     WRITO006
00105    7*      1NODEL(20),NPIPL,NPLINE(20),PL(20,100),PTEMP(20,100),RHOL(8),   WRITO007
00105    8*      2SINALP(20),THETA(20),TIME,WDOTL(20,100),WTEMP(20,100),Z(20,100) WRITO008
00106    9*       COMMON/CHAMBR/AREA(8,2),AREAC(8),ATD,ATDNOZ(2),CC(8),CCC(8),   WRITO009
00106   10*      1CEF1(2),CEF2(2),CMAN(8,2),CP(2),CP1,CP2(6),CSTAR(8),CS1,CS2(6), WRITO010
00106   11*      2CV(8,2),CVEL(2),DELTF,DIAT(2),DPMAN(8,2),DPTO(2),DRPMT(2),DTD(2),WRITO011
00106   12*      3DW(6),DWFUEL(8),DWOX(8),ETAT(2),GAM(2),GR(2),ICHAM(8,2),IENG,  WRITO012
00106   13*      4IPUMI(2),IPUMO(2),ISP(8),IS1,IS2(6),KAY(8),KAY1(8),KAY2(8),    WRITO013
00106   14*      5KAY3(8),KAY4(8),KAY5(8),KAY6(8),KAY7(8),KAY8(8),KAY9(8),KAY10(8), WRITO014
00106   15*      6KAY11(8),MR(8),MR1,MW(8),MW1,MW2(6),NCHAM,NCOEF,NGGTP,NPVALF(8), WRITO015
00106   16*      7NPVALO(8),OPVALF(8,60),OPVALO(8,60),PCHAM(8),PMAN(8,2),PMR(6),  WRITO016
00106   17*      8POWP(2),POWT(2),POWO(2),POW1(2),POW2(2),POW3(2),PRATC(8),PTO(2),WRITO017
00106   18*      9PWO(2),PW1(2),PW2(2),RGAS(8),RPMP,RPMPD(2),RPMT(2),TC(8),TC1,   WRITO018
00106   19*      $TC2(6),TGAS(8),TIMEF,TIMPUL(10),TMVALF(8,60),TMVALO(8,60),TORP(2), WRITO019
00106   20*      ATORT(2),TTO(2),U(2),VMAN(8,2),VOLC(8),W(6),WCHAM(8),WFUEL(8),   WRITO020
00106   21*      BWINJ(8,2),WNOZ(8),WOX(8),WTDNOZ(8),XITP(2),XLTD(2)              WRITO021
00107   22*       COMMON/DATA1/A1,B1,C,C1,C6,C7,C8,C9,C11,DCLP,DELP,IKOUNT,IPROP,N, WRITO022
00107   23*      1PRAT1,PSON,II,JJ,C4,C2,R,C3,X1,X2,S,WP,AA3,AA4                 WRITO023
00110   24*       COMMON/DATA2/BK(8),DELXL(20),NCMTB,NN,XLENGL(20)                WRITO024
00111   25*       COMMON/DATA3/NAMCHM(8,14),NAMTMP(6),NAME(44),NAMEPL(40,2),NME(40), WRITO025
00111   26*      1NMETBN(2,8),NMOUT(130),OUTOAT(130),PLOTND(80),TIM,TIMF          WRITO026
00112   27*       COMMON/FBLCOM/DFBL(10,50),IFBL(10),NFBL,NPFBL(10),TFBL(10,50)   WRITO027
00113   28*       COMMON/FLAGS/IACCPR,ICHAMP,IPRINT,IREGPR,ITURBN,IPLOT           WRITO028
00114   29*       COMMON/JUNCLC/IJUNCL(10,5),NJUNCL,NLINJU(10)                    WRITO029
00115   30*       COMMON/PBLCOM/IEND(10),IPB(10),NPBL,NPRBL(10),PPRBL(10,50),     WRITO030
00115   31*      1TPRBL(10,50)                                                    WRITO031
00116   32*       COMMON/PBLFCM/IENDF(10),IPBF(10),NKPBLF(10),NPBLF,NPPBLF(10),   WRITO032
00116   33*      1PBNDL(10),PPBLF(10,50),TKPBLF(10,50),TPBLF(10,50),XKPBLF(10,50), WRITO033
00116   34*      2XKP(10)                                                         WRITO034
00117   35*       COMMON/REGLCM/AREG(8,100),AREGMX(8),AREGP(8),DMC1,DMC2,DMC3,DMC4, WRITO035
00117   36*      1DFW,FREG(8),FW,IDUMI,IDUMII,IDUMIP,IDUMJJ,LREGDN(8),LREGUP(8),  WRITO036
00117   37*      2NREG,NTDUM,NTREG(8),PD,PREF(8),PU,QREG(8),Q1DUM,Q2DUM,SPREG(8),  WRITO037
00117   38*      3TAUREG(8),WW                                                    WRITO038
00120   39*       COMMON/VALUES/GRHO,ARHO,WR,ZR,PR,WS,ZS,PS                       WRITO039
00121   40*       COMMON/VALVCM/LVDN(10),LVUP(10),NVALL,NXKVL(10),TMVL(10,50),    WRITO040
00121   41*      1XK(10),XKVL(10,50)                                              WRITO041
00122   42*       EQUIVALENCE (I,IENG)                                            WRITO042
00123   43*       DATA ID1,ID2,ID3,NW1,NW2,NW3/0,0,0,0,0,0/                       WRITO043
00132   44*     1* FORMAT(      'DTHE PROGRAM DT IS EQUAL TO',20('.'),E14.8/' THE COWRITO044
00132   45*      2MBUSTORS INTEGRATION DT IS EQUAL TO.....',E14.8/' THE ACCELERATIONWRITO045
```

```
00132    46.      3 DUE TO GRAVITY IS',I2(',.'),E14.8/' THE GRAVITATIONAL CONSTANT IS',WRITT0046
00132    47.      417(',.'),E14.8/' THE NUMBER OF ACCUMULATORS IS',I7(',.'),I14/' THE NWRITT0047
00132    48.      SUMBER OF THRUST CHAMBERS IS',14(',.'),I14/' THE NUMBER OF FLOW BOUNWRITT0048
00132    49.      6DARIES IS',I4(',.'),I14/' THE NUMBER OF TURBOPUMPS IS',19(',.'),I14/WRITT0049
00132    50.      7' THE NUMBER OF LINE JUNCTIONS IS',I5(',.'),I14/' THE NUMBER OF INTWRITT0050
00132    51.      8EGRATIONS PER COMBUSTOR IS...',I14/' THE NUMBER OF PRESSURE BOUNDAWRITT0051
00132    52.      9RIES IS',I0(',.'),I14/' THE NUMBER OF PRESSURE BOUNDARIES/FRICTION WRITT0052
00132    53.      *IS.',I14/' THE NUMBER OF LINES IN THE SYSTEM IS',I0(',.'),I14/' THEWRITT0053
00132    54.      A NUMBER OF REGULATORS IS',I9(',.'),I14/' THE NUMBER OF LUMPED RESISWRITT0054
00132    55.      8TANCES IS',I1(',.'),I14//)                                        WRITT0055
00133    56.    30 FORMAT('0',A6,' = ',30I4/(10X,30I4))                              WRITT0056
00134    57.    50 FORMAT('0',A6,' = ',8E14.8/(10X,8E14.8))                          WRITT0057
00135    58.    70 FORMAT()                                                          WRITT0058
00136    59.    90 FORMAT('1AT RUN TIME ',E14.8,' THE FOLLOWING CONDITIONS WERE PRESEWRITT0059
00136    60.      1NT ---')                                                          WRITT0060
00137    61.   110 FORMAT('0LINE INDEX NUMBER -',I3)                                WRITT0061
00140    62.   130 FORMAT('0A1    =',E14.8,' B1    =',E14.8,' C     =',E14.8,' C1    WRITT0062
00140    63.      1=',E14.8,' C6    =',E14.8,' C7    =',E14.8/' C8    =',E14.8,' C9  WRITT0063
00140    64.      2  =',E14.8,' C11   =',E14.8,' CSTAR =',E14.8,' CV    =',E14.8,' DCWRITT0064
00140    65.      3LP  =',E14.8/' DELP  =',E14.8,' DPMAN =',E14.8,' DWFUEL=',E14.8,' WRITT0065
00140    66.      4DWOX  =',E14.8,' I     =',I14,' II    =',I14/' IKOUNT=',I14,' ISP WRITT0066
00140    67.      5  =',E14.8,' JJ    =',I14,' MR    =',E14.8,' MW    =',E14.8,' N   WRITT0067
00140    68.      6  =',I14/' PCHAM =',E14.8,' PMAN  =',E14.8,' PRAT1 =',E14.8,' PSONWRITT0068
00140    69.      7  =',E14.8,' PTEMP =',E14.8,' TIMEF =',E14.8/' W     =',E14.8,' WCWRITT0069
00140    70.      8HAM =',E14.8,' WFUEL =',E14.8,' WINJ  =',E14.8,' WNOZ  =',E14.8,' WRITT0070
00140    71.      9WOX   =',E14.8/' WTEMP =',E14.8)                                  WRITT0071
00141    72.   150 FORMAT('0AA3   =',E14.8,' AA4   =',E14.8,' ATD   =',E14.8,' C1    WRITT0072
00141    73.      1=',E14.8,' C2    =',E14.8,' C3    =',E14.8/' C4    =',E14.8,' CP  WRITT0073
00141    74.      2  =',E14.8,' CV1   =',E14.8,' CV2   =',E14.8,' CVEL  =',E14.8,' DP
00141    75.      3TO  =',E14.8/' DRPMT =',E14.8,' ETAT  =',E14.8,' GAM   =',E14.8,'
00141    76.      4I     =',I14,' MW    =',E14.8,' PCHAM =',E14.8/' POWP  =',E14.8,'
00141    77.      5POWT  =',E14.8,' PTO   =',E14.8,' R     =',E14.8,' RPMP  =',E14.8,
00141    78.      6' RPMPD =',E14.8/' RPMT  =',E14.8,' S     =',E14.8,' TC    =',E14.
00141    79.      78,' TIMEF =',E14.8,' TORP  =',E14.8,' TORT  =',E14.8/' TTO   =',E1
00141    80.      84.8,' U     =',E14.8,' WNOZ  =',E14.8,' WP    =',E14.8,' WTDNOZ=',
00141    81.      9E14.8/' X1    =',E14.8,' X2    =',E14.8)
00142    82.   170 FORMAT('0A1    =',E14.8,' B1    =',E14.8,' C     =',E14.8,' C1    WRITT0082
00142    83.      1=',E14.8,' C7    =',E14.8,' C8    =',E14.8/' C9    =',E14.8,' DCLPWRITT0083
00142    84.      2  =',E14.8,' DELP  =',E14.8,' I     =',I14,' II    =',I14,' IKOUNTWRITT0084
00142    85.      3=',I14/' IPROP =',I14,' JJ    =',I14,' N     =',I14,' PMAN  =',E14WRITT0085
00142    86.      4.8,' PTEMP =',E14.8,' TIMEF =',E14.8)                             WRITT0086
00143    87.   190 FORMAT(1H1,131(1H*)/27(1X,131(1H*)/),1X,34(1H*),62X,35(1H*)/1X,   WRITT0087
00143    88.      134(1H*),39HTHE EXECUTION TIME OF THIS DATA CASE IS,E14.8,9H MINUTEWRITT0088
00143    89.      2S.,35(1H*)/1X,34(1H*),62X,35(1H*)/27(1X,131(1H*)/))              WRITT0089
00144    90.   210 FORMAT('0C1    =',E14.8,' C2    =',E14.8,' C3    =',E14.8,' C4    WRITT0090
00144    91.      1=',E14.8,' C55   =',E14.8,' C66   =',E14.8/' DPACC =',E14.8,' I   WRITT0091
00144    92.      2  =',I14,' II    =',I14,' IPROP =',I14,' JJ    =',I14,' NNNN  =',IWRITT0092
00144    93.      314/' PACC  =',E14.8,' PPPR  =',E14.8,' PTEMP =',E14.8,' TIME  =',EWRITT0093
00144    94.      414.8,' WTEMP =',E14.8)                                            WRITT0094
00145    95.   230 FORMAT('0AREG  =',E14.8,' C1    =',E14.8,' C2    =',E14.8,' C3    WRITT0095
00145    96.      1=',E14.8,' C4    =',E14.8,' I     =',I14/' II    =',I14,' IPROP ='WRITT0096
00145    97.      2,I14,' JJ    =',I14,' NT    =',I14,' PD    =',E14.8,' PU    =',E14WRITT0097
00145    98.      3.8/' PTEMP =',E14.8,' TIME  =',E14.8,' WW    =',E14.8)            WRITT0098
00146    99.   250 FORMAT('0DFW   =',F14.8,' FW    =',E14.8,' II    =',I14,' IPROP ='WRITT0099
00146   100.      1,I14,' JJ    =',I14,' Q1    =',E14.8/' Q2    =',E14.8,' TIME  =',EWRITT0100
00146   101.      214.8,' WTEMP =',E14.8,' WW    =',E14.8)                          WRITT0101
00147   102.   270 FORMAT('0AREG  =',E14.8,' I     =',I14,' NT    =',I14,' PD    =',EWRITT0102
00147   103.      114.8,' PTEMP =',F14.8,' PU    =',F14.8/' Q1    =',F14.8,' Q2    ='WRITT0103
```

```
00147   104.      2,E14.8,' TIM[illegible]=',E14.8)                                          WRI[illegible]04
00150   105.    290 FORMAT('0',[illegible]'CONDITIONS AT',E14.8,' FOR COMBUSTOR',I2/26X,'OXIDWRI[illegible]05
00150   106.      1IZER SYSTEM',53X,'FUEL SIDE'/' CV    =',E14.8,' PMAN  =',E14.8,' WWRITO106
00150   107.      1INJ  =',E14.8,' CV    =',E14.8,' PMAN  =',E14.8,' WINJ  =',E14.8/7WRITO107
00150   108.      22X,'COMBUSTOR CHAMBER PARAMETERS'/' CSTAR =',E14.8,' ISP   =',E14.WRITO108
00150   109.      38,' MR    =',E14.8,' MW    =',E14.8,' PCHAM =',E14.8,' TC    =',E1WRITO109
00150   110.      44.8/' TIMPUL=',E14.8,' WNOZ  =',E14.8)                                  WRITO110
00151   111.    310 FORMAT('0',43X,'CONDITIONS AT',E14.8,' FOR TURBOPUMP',I2/'CP   =',WRITO111
00151   112.      1E14.8,' CVEL  =',E14.8,' ETAT  =',E14.8,' GAM   =',F14.8,' MW    =WRITO112
00151   113.      2',E14.8,' POWP  =',E14.8/' POWT  =',E14.8,' PTO   =',E14.8,' RPMT WRITO113
00151   114.      3 =',E14.8,' TORP  =',E14.8,' TORT  =',E14.8,' TTO   =',E14.8/' U  WRITO114
00151   115.      4   =',E14.8,' WTDNOZ=',E14.8)                                          WRITO115
00152   116.    330 FORMAT(' THE FOLLOWING VARIABLES ARE INPUT CONSTANTS')                 WRITO116
00153   117.    350 FORMAT('1THE FOLLOWING VARIABLES ARE HP014A CALCULATED CONSTANTS')     WRITO117
00154   118.    370 FORMAT('1THE FOLLOWING VARIABLES ARE INITIAL CONDITIONS')              WRITO118
00155   119.        GO TO (390,430,450,810,1130,1230,1250,1270,1310,1330,1350,1370,139WRITO119
00155   120.      *01),IGO                                                                 WRITO120
00156   121.    390 CONTINUE                                                               WRITO121
00156   122.  C                 WRITE INPUT CONSTANTS                                    WRITO122
00157   123.        WRITE (6,330)                                                          WRITO123
00161   124.        WRITE (6,10)DELT,DELTF,G,GC,NACC,NCHAM,NFBL,NGGTP,NJUNCL,NN,NPBL,NWRITO124
00161   125.      1PBLF,NPIPL,NREG,NVALL                                                   WRITO125
00202   126.        IF (NPBL.GT.0) WRITE (6,30)NAME(2),(IEND(I),I=1,NPBL)                  WRITO126
00212   127.        IF (NPBL.GT.0) WRITE (6,30)NAME(3),(IPB(I),I=1,NPBL)                   WRITO127
00222   128.        IF (NVALL.GT.0) WRITE (6,30)NAME(4),(LVON(I),I=1,NVALL)                WRITO128
00232   129.        IF (NVALL.GT.0) WRITE (6,30)NAME(5),(LVUP(I),I=1,NVALL)                WRITO129
00242   130.        WRITE (6,30)NAME(6),(NPLINE(I),I=1,NPIPL)                              WRITO130
00251   131.        IF (NJUNCL.GT.0) WRITE (6,30)NAME(7),((IJUNCL(I,J),J=1,5),I=1,NJUNWRITO131
00251   132.      1CL)                                                                     WRITO132
00264   133.        IF (NFBL.GT.0) WRITE (6,30)NAME(8),(IFBL(I),I=1,NFBL)                  WRITO133
00274   134.        WRITE (6,50)NAME(44),(XLENGL(I),I=1,NPIPL)                             WRITO134
00303   135.        WRITE (6,50)NAME(41),(RGAS(I),I=1,8)                                   WRITO135
00312   136.        WRITE (6,50)NAME(43),(TGAS(I),I=1,8)                                   WRITO136
00321   137.        WRITE (6,50)NAME(23),(BK(I),I=1,8)                                     WRITO137
00330   138.        WRITE (6,50)NAME(9),(AREAL(I),I=1,NPIPL)                               WRITO138
00337   139.        WRITE (6,50)NAME(10),(CL(I),I=1,NPIPL)                                 WRITO139
00346   140.        WRITE (6,50)NAME(11),(DIAL(I),I=1,NPIPL)                               WRITO140
00355   141.        WRITE (6,50)NAME(12),(FRL(I),I=1,NPIPL)                                WRITO141
00364   142.        WRITE (6,50)NAME(13),(SINALP(I),I=1,NPIPL)                             WRITO142
00373   143.        WRITE (6,50)NAME(14),(THETA(I),I=1,NPIPL)                              WRITO143
00373   144.  C                 WRITE PROGRAM CALCULATED VARIABLES                       WRITO144
00402   145.        WRITE (6,350)                                                          WRITO145
00404   146.        WRITE (6,50)NAME(24),(CC(I),I=1,8)                                     WRITO146
00413   147.        WRITE (6,50)NAME(25),(CCC(I),I=1,8)                                    WRITO147
00422   148.        WRITE (6,50)NAME(26),(DELXL(I),I=1,NPIPL)                              WRITO148
00431   149.        WRITE (6,50)NAME(27),(KAY(I),I=1,8)                                    WRITO149
00440   150.        WRITE (6,50)NAME(28),(KAY1(I),I=1,8)                                   WRITO150
00447   151.        WRITE (6,50)NAME(29),(KAY2(I),I=1,8)                                   WRITO151
00456   152.        WRITE (6,50)NAME(30),(KAY3(I),I=1,8)                                   WRITO152
00465   153.        WRITE (6,50)NAME(31),(KAY4(I),I=1,8)                                   WRITO153
00474   154.        WRITE (6,50)NAME(32),(KAY5(I),I=1,8)                                   WRITO154
00503   155.        WRITE (6,50)NAME(33),(KAY6(I),I=1,8)                                   WRITO155
00512   156.        WRITE (6,50)NAME(34),(KAY7(I),I=1,8)                                   WRITO156
00521   157.        WRITE (6,50)NAME(35),(KAY8(I),I=1,8)                                   WRITO157
00530   158.        WRITE (6,50)NAME(36),(KAY9(I),I=1,8)                                   WRITO158
00537   159.        WRITE (6,50)NAME(37),(KAY10(I),I=1,8)                                  WRITO159
00546   160.        WRITE (6,50)NAME(38),(KAY11(I),I=1,8)                                  WRITO160
00555   161.        WRITE (6,30)NAME(1),(NODEL(I),I=1,NPIPL)                               WRITO161
```

```
00564   162.          IF (NREG.GT.0) WRITE (6,30)NAME(39),(NTREG(I),I=1,NREG)                 WRITO162
00574   163.          WRITE (6,50)NAME(40),(PRATC(I),I=1,9)                                   WRITO163
00603   164.          WRITE (6,50)NAME(42),(RHOL(I),I=1,8)                                    WRITO164
00603   165.    C                WRITE PROGRAM INITIAL CONDITIONS                             WRITO165
00612   166.          WRITE (6,370)                                                           WRITO166
00614   167.          DO 410 II=1,NPIPL                                                       WRITO167
00617   168.          JJ=NODFL(II)                                                            WRITO168
00620   169.          WRITE (6,110)II                                                         WRITO169
00623   170.          WRITE (6,50)NAME(15),(PL(II,J),J=1,JJ)                                  WRITO170
00632   171.          WRITE (6,50)NAME(16),(WDOTL(II,J),J=1,JJ)                               WRITO171
00641   172.          WRITE (6,50)NAME(17),(Z(II,J),J=1,JJ)                                   WRITO172
00650   173.      410 CONTINUE                                                                WRITO173
00652   174.          IF (NACC.GT.0) WRITE (6,50)NAME(21),(PACC(KK),KK=1,NACC)                WRITO174
00662   175.          IF (NPBLF.GT.0) WRITE (6,50)NAME(18),(PBNDL(KK),KK=1,NPBLF)             WRITO175
00672   176.          IF (NVALL.GT.0) WRITE (6,50)NAME(22),(XK(KK),KK=1,NVALL)                WRITO176
00702   177.          IF (NPBLF.GT.0) WRITE (6,50)NAME(19),(XKP(KK),KK=1,NPBLF)               WRITO177
00712   178.          GO TO 1410                                                              WRITO178
00712   179.    C                OUTPUT COMBUSTOR DATA ON PLOT TAPE                          WRITO179
00713   180.      430 CONTINUE                                                                WRITO180
00714   181.          GO TO 1410                                                              WRITO181
00714   182.    C                SET UP BCD PLOT SYMBOLS ON PLOT TAPE                        WRITO182
00715   183.      450 CONTINUE                                                                WRITO183
00716   184.          ID1=-1                                                                  WRITO184
00717   185.          NW1=1+4*NPIPL                                                           WRITO185
00720   186.          NPIPL1=NPIPL+20                                                         WRITO186
00721   187.          REWIND 8                                                                WRITO187
00722   188.          I=1                                                                     WRITO188
00723   189.          DO 470 KK=1,2                                                           WRITO189
00726   190.          DO 470 LL=1,NPIPL                                                       WRITO190
00731   191.          NMOUT(I)=NAMEPL(LL,KK)                                                  WRITO191
00732   192.          I=I+1                                                                   WRITO192
00733   193.      470 CONTINUE                                                                WRITO193
00736   194.          DO 490 KK=1,2                                                           WRITO194
00741   195.          DO 490 LL=21,NPIPL1                                                     WRITO195
00744   196.          NMOUT(I)=NAMEPL(LL,KK)                                                  WRITO196
00745   197.      490 CONTINUE                                                                WRITO197
00750   198.          I=I-1                                                                   WRITO198
00751   199.          WRITE(8)ID1,NW1,TIM,(NMOUT(LL),LL=1,I)                                  WRITO199
00762   200.          ID1=1                                                                   WRITO200
00763   201.          ID2=-2                                                                  WRITO201
00764   202.          NW2=1+14*NCMTB+8*NGGTP+NCHAM                                            WRITO202
00765   203.          IF (NCMTB.EQ.0) GO TO 610                                               WRITO203
00767   204.          I=1                                                                     WRITO204
00770   205.          DO 510 LL=1,NCMTB                                                       WRITO205
00773   206.          DO 510 KK=1,14                                                          WRITO206
00776   207.          NMOUT(I)=NAMCHM(LL,KK)                                                  WRITO207
00777   208.          I=I+1                                                                   WRITO208
01000   209.      510 CONTINUE                                                                WRITO209
01003   210.          IF (NGGTP.EQ.0) GO TO 550                                               WRITO210
01005   211.          DO 530 LL=1,NGGTP                                                       WRITO211
01010   212.          DO 530 KK=1,8                                                           WRITO212
01013   213.          NMOUT(I)=NMETBN(LL,KK)                                                  WRITO213
01014   214.          I=I+1                                                                   WRITO214
01015   215.      530 CONTINUE                                                                WRITO215
01020   216.      550 CONTINUE                                                                WRITO216
01021   217.          IF (NCHAM.EQ.0) GO TO 590                                               WRITO217
01023   218.          DO 570 LL=1,NCHAM                                                       WRITO218
01026   219.          NMOUT(I)=NAMTMP(LL)                                                     WRITO219
```

```
01027          I=I+1                                                    WRIT[illegible]
01030      570 CONTINUE                                                 WRIT[illegible]
01032      590 CONTINUE                                                 WRIT[illegible]
01033          I=I-1                                                    WRIT0223
01034          WRITE(8)ID2,NW2,TIMF,(NMOUT(LL),LL=1,I)                  WRIT0224
01045          ID2=2                                                    WRIT0225
01046      610 CONTINUE                                                 WRIT0226
01047          IF (NREG+NACC+NPBLF+NVALL.EQ.0) GO TO 790                WRIT0227
01051          ID3=-3                                                   WRIT0228
01052          I=1                                                      WRIT0229
01053          IF (NREG.EQ.0) GO TO 650                                 WRIT0229
01055          DO 630 LL=1,NREG                                         WRIT0230
01060          NMOUT(I)=NME(LL)                                         WRIT0231
01061          I=I+1                                                    WRIT0232
01062      630 CONTINUE                                                 WRIT0233
01064      650 CONTINUE                                                 WRIT0234
01065          IF (NACC.EQ.0) GO TO 690                                 WRIT0235
01067          DO 670 LL=1,NACC                                         WRIT0236
01072          NMOUT(I)=NME(LL+8)                                       WRIT0237
01073          I=I+1                                                    WRIT0238
01074      670 CONTINUE                                                 WRIT0239
01076      690 CONTINUE                                                 WRIT0240
01077          IF (NVALL.EQ.0) GO TO 730                                WRIT0241
01101          DO 710 LL=1,NVALL                                        WRIT0242
01104          NMOUT(I)=NME(LL+10)                                      WRIT0243
01105          I=I+1                                                    WRIT0244
01106      710 CONTINUE                                                 WRIT0245
01110      730 CONTINUE                                                 WRIT0246
01111          IF (NPBLF.EQ.0) GO TO 770                                WRIT0247
01113          DO 750 LL=1,NPBLF                                        WRIT0248
01116          NMOUT(I)=NME(LL+20)                                      WRIT0249
01117          NMOUT(I+NPBLF)=NME(LL+30)                                WRIT0250
01120          I=I+1                                                    WRIT0251
01121      750 CONTINUE                                                 WRIT0252
01123          I=I+NPBLF                                                WRIT0253
01124      770 CONTINUE                                                 WRIT0254
01125          I=I-1                                                    WRIT0255
01126          NW3=I+I                                                  WRIT0256
01127          WRITE(8)ID3,NW3,TIM,(NMOUT(LL),LL=1,I)                   WRIT0257
01140          ID3=3                                                    WRIT0258
01141      790 CONTINUE                                                 WRIT0259
01141    C                 OUTPUT GENERAL LINE DATA ON PLOT TAPE        WRIT0260
01142      810 CONTINUE                                                 WRIT0261
01143          DO 830 LL=1,NPIPL                                        WRIT0262
01146          NNODEL=NODEL(LL)                                         WRIT0263
01147          PLOTND(LL)=WDOTL(LL,1)                                   WRIT0264
01150          PLOTND(LL+NPIPL)=WDOTL(LL,NNODEL)                        WRIT0265
01151          PLOTND(LL+2*NPIPL)=PL(LL,1)                              WRIT0266
01152          PLOTND(LL+3*NPIPL)=PL(LL,NNODEL)                         WRIT0267
01153      830 CONTINUE                                                 WRIT0268
01155          I=4*NPIPL                                                WRIT0269
01156          WRITE(8)ID1,NW1,TIME,(PLOTND(LL),LL=1,I)                 WRIT0270
01167          I=1                                                      WRIT0271
01170          IF (NCMTB.EQ.0) GO TO 950                                WRIT0272
01172          DO 850 KK=1,NCMTB                                        WRIT0273
01175          OUTDAT(I)=PCHAM(KK)                                      WRIT0274
01176          I=I+1                                                    WRIT0275
01177          OUTDAT(I)=WCHAM(KK)                                      WRIT0276
```

```
01200          I=I+1                                                    WRITO277
01201          OUTDAT(I)=CSTAR(KK)                                      WRITO278
01202          I=I+1                                                    WRITO279
01203          OUTDAT(I)=PMAN(KK,1)                                     WRITO280
01204          I=I+1                                                    WRITO281
01205          OUTDAT(I)=PMAN(KK,2)                                     WRITO282
01206          I=I+1                                                    WRITO283
01207          OUTDAT(I)=ISP(KK)                                        WRITO284
01210          I=I+1                                                    WRITO285
01211          OUTDAT(I)=MR(KK)                                         WRITO286
01212          I=I+1                                                    WRITO287
01213          OUTDAT(I)=WFUEL(KK)                                      WRITO288
01214          I=I+1                                                    WRITO289
01215          OUTDAT(I)=WOX(KK)                                        WRITO290
01216          I=I+1                                                    WRITO291
01217          OUTDAT(I)=CV(KK,1)                                       WRITO292
01220          I=I+1                                                    WRITO293
01221          OUTDAT(I)=CV(KK,2)                                       WRITO294
01222          I=I+1                                                    WRITO295
01223          OUTDAT(I)=WINJ(KK,1)                                     WRITO296
01224          I=I+1                                                    WRITO297
01225          OUTDAT(I)=WINJ(KK,2)                                     WRITO298
01226          I=I+1                                                    WRITO299
01227      850 CONTINUE                                                 WRITO300
01231          IF (NGGTP.EQ.0) GO TO 890                                WRITO301
01233          DO 870 KK=1,NGGTP                                        WRITO302
01236          OUTDAT(I)=POWP(KK)                                       WRITO303
01237          I=I+1                                                    WRITO304
01240          OUTDAT(I)=POWT(KK)                                       WRITO305
01241          I=I+1                                                    WRITO306
01242          OUTDAT(I)=PTO(KK)                                        WRITO307
01243          I=I+1                                                    WRITO308
01244          OUTDAT(I)=RPMT(KK)                                       WRITO309
01245          I=I+1                                                    WRITO310
01246          OUTDAT(I)=TORP(KK)                                       WRITO311
01247          I=I+1                                                    WRITO312
01250          OUTDAT(I)=TORT(KK)                                       WRITO313
01251          I=I+1                                                    WRITO314
01252          OUTDAT(I)=TTO(KK)                                        WRITO315
01253          I=I+1                                                    WRITO316
01254          OUTDAT(I)=WTDNOZ(KK)                                     WRITO317
01255          I=I+1                                                    WRITO318
01256      870 CONTINUE                                                 WRITO319
01260      890 CONTINUE                                                 WRITO320
01261          IF (NCHAM.EQ.0) GO TO 930                                WRITO321
01263          DO 910 KK=1,NCHAM                                        WRITO322
01266          OUTDAT(I)=TIMPUL(KK+NGGTP)                               WRITO323
01267          I=I+1                                                    WRITO324
01270      910 CONTINUE                                                 WRITO325
01272      930 CONTINUE                                                 WRITO326
01273          I=I-1                                                    WRITO327
01274          WRITE(8)ID2,NW2,TIMEF,(OUTDAT(KK),KK=1,I)                WRITO328
01305      950 CONTINUE                                                 WRITO329
01306          IF (ID3.EQ.0) GO TO 1410                                 WRITO330
01310          I=1                                                      WRITO331
01311          IF (NREG.EQ.0) GO TO 990                                 WRITO332
01313          DO 970 KK=1,NREG                                         WRITO333
01316          OUTDAT(I)=AREG(KK,1)                                     WRITO334
```

```
01317          I=I+1                                                          WRIT[illegible]
01320      970 CONTINUE                                                       WRI[illegible]
01322      990 CONTINUE                                                       WRIT[illegible]
01323          IF (NACC.EQ.0) GO TO 1030                                      WRIT0338
01325          DO 1010 KK=1,NACC                                              WRIT0339
01330          OUTDAT(I)=PACC(KK)                                             WRIT0340
01331          I=I+1                                                          WRIT0341
01332     1010 CONTINUE                                                       WRIT0342
01334     1030 CONTINUE                                                       WRIT0343
01335          IF (NVALL.EQ.0) GO TO 1070                                     WRIT0344
01337          DO 1050 KK=1,NVALL                                             WRIT0345
01342          OUTDAT(I)=XK(KK)                                               WRIT0346
01343          I=I+1                                                          WRIT0347
01344     1050 CONTINUE                                                       WRIT0348
01346     1070 CONTINUE                                                       WRIT0349
01347          IF (NPBLF.EQ.0) GO TO 1110                                     WRIT0350
01351          DO 1090 KK=1,NPBLF                                             WRIT0351
01354          OUTDAT(I)=XKP(KK)                                              WRIT0352
01355          OUTDAT(I+NPBLF)=PBNDL(KK)                                      WRIT0353
01356          I=I+1                                                          WRIT0354
01357     1090 CONTINUE                                                       WRIT0355
01361          I=I+NPBLF                                                      WRIT0356
01362     1110 CONTINUE                                                       WRIT0357
01363          I=I-1                                                          WRIT0358
01364          WRITE(8)ID3,NW3,TIME,(OUTDAT(KK),KK=1,I)                       WRIT0359
01375          GO TO 1410                                                     WRIT0360
01375    C                OUTPUT NOMINAL PRINT                                WRIT0361
01376     1130 CONTINUE                                                       WRIT0362
01377          WRITE (6,90)TIME                                               WRIT0363
01402          DO 1150 II=1,NPIPL                                             WRIT0364
01405          JJ=NODEL(II)                                                   WRIT0365
01406          WRITE (6,110)II                                                WRIT0366
01411          WRITE (6,50)NAME(15),(PL(II,J),J=1,JJ)                         WRIT0367
01420          WRITE (6,50)NAME(16),(WDOTL(II,J),J=1,JJ)                      WRIT0368
01427     1150 CONTINUE                                                       WRIT0369
01431          WRITE (6,70)                                                   WRIT0370
01433          IF (NPBLF.EQ.0) GO TO 1170                                     WRIT0371
01435          WRITE (6,50)NAME(18),(PBNDL(I),I=1,NPBLF)                      WRIT0372
01444          WRITE (6,50)NAME(19),(XKP(I),I=1,NPBLF)                        WRIT0373
01453     1170 CONTINUE                                                       WRIT0374
01454          IF (NREG.GT.0) WRITE (6,50)NAME(20),(AREG(KK,I),KK=1,NREG)     WRIT0375
01464          IF (NACC.GT.0) WRITE (6,50)NAME(21),(PACC(KK),KK=1,NACC)       WRIT0376
01474          IF (NVALL.GT.0) WRITE (6,50)NAME(22),(XK(KK),KK=1,NVALL)       WRIT0377
01504          DO 1190 I=1,NCMTB                                              WRIT0378
01507          WRITE (6,290)TIME,I,CV(I,1),PMAN(I,1),WINJ(I,1),CV(I,2),PMAN(I,2),WRIT0379
01507         1WINJ(I,2),CSTAR(I),ISP(I),MR(I),MW(I),PCHAM(I),TC(I),TIMPUL(I),WNOWRIT0380
01507         2Z(I)                                                           WRIT0381
01531     1190 CONTINUE                                                       WRIT0382
01533          IF (NGGTP.LE.0) GO TO 1410                                     WRIT0383
01535          DO 1210 I=1,NGGTP                                              WRIT0384
01540          WRITE (6,310)TIME,I,CP(I),CVEL(I),ETAT(I),GAM(I),MW(I),POWP(I),POWWRIT0385
01540         1T(I),PTO(I),RPMT(I),TORP(I),TORT(I),TTO(I),U(I),WTDNOZ(I)      WRIT0386
01562     1210 CONTINUE                                                       WRIT0387
01564          GO TO 1410                                                     WRIT0388
01564    C                OUTPUT DETAILED PRINT ON NEWTON-RAPHSON LOOP IN CHAM WRIT0389
01564    C                ROUTINE                                             WRIT0390
01565     1230 CONTINUE                                                       WRIT0391
01566          WRITE (6,170)A1,B1,C,C1,C7,C8,C9,DCLP,DELP,I,II,IKOUNT,IPROP,JJ,N,WRIT0392
```

```
01566   394.          1PMAN(I,N),PTEMP(II,JJ),TIMEF                                    WRITO393
01612   395.           GO TO 1410                                                      WRITO394
01612   396.     C               OUTPUT DETAILED COMBUSTOR PRINT FROM CHAM ROUTINE     WRITO395
01613   397.      1250 CONTINUE                                                        WRITO396
01614   398.           WRITE (6,130)A1,R1,C,C1,C6,C7,C8,C9,C11,CSTAR(I),CV(I,N),DCLP,DELPWRITO397
01614   399.          1,DPMAN(I,N),DWFUEL(I),DWOX(I),I,II,IKOUNT,ISP(I),JJ,MR(I),MW(I),N,WRITO398
01614   400.          2PCHAM(I),PMAN(I,N),PRATI,PSON,PTEMP(II,JJ),TIMEF,W(N),WCHAM(I),WFUWRITO399
01614   401.          3EL(I),WINJ(I,N),WNOZ(I),WOX(I),WTEMP(I,JJ)                      WRITO400
01663   402.           GO TO 1410                                                      WRITO401
01663   403.     C               WRAP UP PLOT TAPE, IF CREATED, AND PRINT EXECUTION TIME WRITO402
01664   404.      1270 CONTINUE                                                        WRITO403
01665   405.           IF (IPLOT.EQ.0) GO TO 1290                                      WRITO404
01667   406.           END FILE 8                                                      WRITO405
01670   407.           REWIND   8                                                      WRITO406
01671   408.      1290 CONTINUE                                                        WRITO407
01672   409.           TIME=0.0                                                        WRITO408
01673   410.           CALL CLOCK(TIME)                                                WRITO409
01674   411.           WRITE (6,190)TIME                                               WRITO410
01677   412.           GO TO 1410                                                      WRITO411
01677   413.     C               OUTPUT DETAILED PRINT ON TURBOPUMP                    WRITO412
01700   414.      1310 CONTINUE                                                        WRITO413
01701   415.           WRITE (6,150)AA3,AA4,ATD,C1,C2,C3,C4,CP(I),CV(I,1),CV(I,2),CVEL(I)WRITO414
01701   416.          1,DPTO(I),DRPMT(I),ETAT(I),GAM(I),I,MW(I),PCHAM(I),POWP(I),POWT(I),WRITO415
01701   417.          2PTO(I),R,RPMP,RPMPD(I),RPMT(I),S,TC(I),TIMEF,TORP(I),TORT(I),TTO(IWRITO416
01701   418.          3),U(I),WNOZ(I),WP,WTDNOZ(I),X1,X2,                             WRITO417
01750   419.           GO TO 1410                                                      WRITO418
01750   420.     C               OUTPUT DETAILED PRINT ON ACCUMULATOR                  WRITO419
01751   421.      1330 CONTINUE                                                        WRITO420
01752   422.           WRITE (6,210)DUM,DPACC,IDUM,IDUM1,IDUM2,IDUM3,NNNN,PACC(IDUM),PPPPWRITO421
01752   423.          1,PTEMP(IDUM1,IDUM3),TIME,WTEMP(IDUM1,IDUM3)                    WRITO422
01773   424.           GO TO 1410                                                      WRITO423
01773   425.     C               OUTPUT DETAILED PRINT ON LINE AND CONSTANT CALCULATIONS WRITO424
01773   426.     C               FROM REGULATOR                                        WRITO425
01774   427.      1350 CONTINUE                                                        WRITO426
01775   428.           WRITE (6,230)AREG(IDUM1,NTDUM),DMC1,DMC2,DMC3,DMC4,IDUM1,IDUM11,IDWRITO427
01775   429.          1UM1P,IDUMJJ,NTDUM,PD,PU,PTEMP(IDUM11,IDUMJJ),TIME,WW            WRITO428
02016   430.           GO TO 1410                                                      WRITO429
02016   431.     C               OUTPUT NEWTON-RAPHSON LOOP DATA FROM REGULATOR ROUTINE WRITO430
02017   432.      1370 CONTINUE                                                        WRITO431
02020   433.           WRITE (6,250)DFW,FW,IDUM11,IDUM1P,IDUMJJ,Q1DUM,Q2DUM,TIME,WTEMP(IDWRITO432
02020   434.          1UM11,IDUMJJ),WW                                                WRITO433
02034   435.           GO TO 1410                                                      WRITO434
02034   436.     C               OUTPUT FINAL REGULATOR CALCULATIONS                   WRITO435
02035   437.      1390 CONTINUE                                                        WRITO436
02036   438.           WRITE (6,270)AREG(IDUM1,NTDUM),IDUM1,NTDUM,PD,PTEMP(IDUM11,IDUMJJ)WRITO437
02036   439.          1,PU,Q1DUM,Q2DUM,TIME                                           WRITO438
02051   440.           GO TO 1410                                                      WRITO439
02052   441.      1410 CONTINUE                                                        WRITO440
02053   442.           RETURN                                                          WRITO441
02054   443.           END                                                             WRITO442

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)

    WRITE          SYMBOLIC                          31 AUG 71  12:35:30   0  01552332    14   443   (DELETED)
    WRITE   CODE   RELOCATABLE                       31 AUG 71  12:35:30   1  01566424    84     1   (DELETED)
                                                                           0  01566550    14   285
```

```
STARTING ADDRESS  014000

CORE LIMITS 014000 037556   100000 155276   163772 163777


HP014A
0    100000-101500
1    014000-015304

NSTOPS/CODE
1    015305-015322

NIERS /CODE
0    101501-101501
1    015323-015623
2    101502-101573

NFMTS /CODE
1    015624-016507
2    101574-101607

NFTVS /CODE
1    016510-016532

NCNVTS/CODE
1    016533-016742
2    101610-101673

NOTINS/CODE
1    016743-017351
2    101674-101736

FPACKS/CODE
1    017352-017415

DEPTH /******
0    101737-101744

NIOINS/CODE
1    017416-017464
2    101745-101775

NERRS /CODE
0    101776-102136
1    017465-020073
```

SINCOS/CODE
1 020074-020163
2 102137-102172

SQRT /CODE
0 102173-102227
2 102230-102271

NEXP6S/CODE
1 020164-020175
2 102272-102272

NXPAFS/CODE
1 020176-020320
2 102273-102277

NXPAXS/CODE
1 020321-020343
2 102300-102300

EXP /CODE
1 020344-020434
2 102301-102320

ALOG /CODE
1 020435-020516
2 102321-102367

MESG3 /CODE
2 102370-102377

MESG12/CODE
2 102400-102417

NLINPS/CODE
0 102420-102426
1 020517-020606
2 102427-102601

NININS/CODE
1 022107-022254
2 102602-102632

NTARS /CODE
0 102633-102746

DMSFIL/CODE
0 102767-103006
1 022255-022360

FMERR /CODE
0 103007-103010
1 022361-022371

PBLF /CODE
0 103011-103054
1 022372-023031

```
INTERP/CODE
0    103055-103224
1    023032-023271

NOUTS /CODE
0    103225-103231
1    023272-024163
2    103232-103247

NBDCVS/CODE
0    103250-103434

RKINS /CODE
0    103435-103474
1    024164-024401

VAL   /CODE
0    103475-103511
1    024402-024576

ACC   /CODE
0    103512-103543
1    024577-025444

REGL  /CODE
0    103544-103616
1    025445-026337

FBL   /CODE
0    103617-103653
1    026340-026604

JUNCL /CODE
0    103654-103724
1    026605-027111

VALVEL/CODE
0    103725-103772
1    027112-027460

PBL   /CODE
0    103773-104022
1    027461-027722

PIPEL /CODE
0    104023-104061
1    027723-030157

WRITE /CODE
0    104062-105574
1    030160-034025

NFOUTS/CODE
1    034026-034250
2    105575-105576

NBUFFS/CODE
```

```
1    034251-034272
2    105577-106607

NRWNDS/CODE
1    034273-034365

DATA3 /******
0    106610-110007

CR2TAP/CODE
0    110010-110126
1    034366-034563

NINPTS/CODE
0    110127-110130
1    034564-035503
2    110131-110163

CLOCK /CODE
0    110164-110166
1    035504-035564

CHAM  /CODE
0    110167-110354
1    035565-037500

NEXPTS/CODE
1    037501-037556
2    110355-110357

DATA1 /******
0    110360-110413

VALVCM/******
0    110414-112434

VALUES/******
0    112435-112444

REGLCM/******
0    112445-114245

PBLFCM/******
0    114246-120262

PBLCOM/******
0    120263-122271

JUNCLC/******
0    122272-122366

FLAGS /******
0    122367-122374

FBLCOM/******
0    122375-124371

DATA2 /******
```

```
  0    124372-124453

  CHAMBR/******
  0    124454-131301

  ALLCS /******
  0    131302-131351

  ALLCOM/******
  0    131352-155246

  ACCCOM/******
  0    155247-155276


END OF ALLOCATION 1103 0039A 09099
```

6.0 REFERENCES

P. F. Thompson and T. J. Walsh, "Characterization of Attitude Control Propulsion Systems," MSC/TRW Task 705-1, NAS 9-8166, TRW Systems Group, Houston, Texas, June 1971.

6.0 REFERENCES

1. P. F. Thompson and T. J. Walsh, "Characterization of Attitude Control Propulsion Systems," MSC/TRW Task 705-1, NAS 9-8166, TRW Systems Group, Houston, Texas, June 1971.

A Reproduced Copy

OF

Reproduced for NASA

by the

NASA Scientific and Technical Information Facility

FFNo 672 Aug 65