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PRELIMINARY INFRARED RADIATION EMISSIONS PROGRAM (PIREP)

Volume II - User Manual

Aircraft Engine Group
General Electric Company
Cincinnati, Ohio 45215

15 November 1976

USER MANUAL

Distribution limited to U.S. Government agencies only; report contains test and evaluation information, November 1976. Other requests for this document must be referred to ASD/XRH, Wright-Patterson Air Force Base, Ohio 45433.

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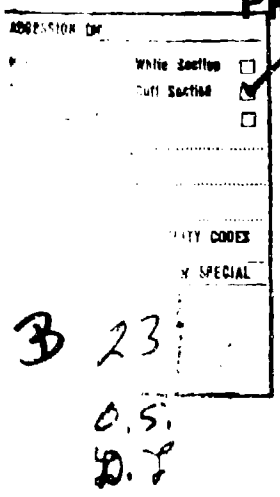
A-77, A-79, A-81, A-83

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ASD/XR-TR-76-26, USER MANUAL - Volume II

PRELIMINARY INFRARED RADIATION EMISSIONS PROGRAM (PIREP)

ASD/XR-TR-76-26



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This report will be superceded by a JTCG/AS report after review and incorporation of any needed supplementary material.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aircraft Survivability	Preliminary IR Analysis
IR Aircraft Configuration	PIREP
IR Emissions Control	IRCM Requirements

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

PIREP (Preliminary Infrared Radiation Emissions Predictions) is a computer routine for providing preliminary IR signature estimates for turbojet, turbofan and turboshaft engines. The peak plume and hot parts infrared emissions can be made available as part of the output for each and every engine, cycle, and flight condition at low cost to the user. In this way estimates of susceptability to missile threats can be included as an integral factor in preliminary engine design and realistic efforts can be made to select cycles which present low IR signatures to specific threat environments.

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Extended PIREP can also evaluate the suppression potential of several candidate engines or missions for relatively low cost during the early selection of phases of engine designs. The user can judge the potential of more advanced missiles and calculate lockon ranges for use in survivability studies or for comparison of different cycle/engine designs. Quick estimates are available to judge whether a candidate cycle can possibly meet given IR specifications before more expensive detailed studies are initiated.

FOREWORD

This report is the product of a jointly planned and corrdinated effort under cognizance of the Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS), Naval Air Systems Command, Code 5204J, Washington, D. C. 20361. The JTCG/AS is a chartered activity under the aegis of the Joint AMC/NMC/AFLC/JTCG/AS-CM-6-01." This effort was managed by USAF Aeronautical Systems Division, Deputy for Development Planning, ASD/XRHP, S. E. Tate, WPAFB, Ohio 45433.

The development of this program and the preparation of the report was performed by the Aircraft Engine Group of the General Electric Company, Cincinnati, Ohio.

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Publication of this technical report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Terrell E. Horne

TERRELL E. HORNE
Colonel, USAF
Deputy for Development Planning

SUMMARY

A new design tool, the Preliminary Infrared Radiation Emissions Program (PIREP) has been developed to bring the infrared emissions considerations into the realm of configuration definition and preliminary design of aircraft.

This development sponsored by the Air Force has been achieved through the cooperation of USN/ONR code 211 and USAF/ASD/XRH in a series of studies to compile, organize, and manage the existing extensive data base of infrared knowledge and related influences on aeronautical systems survivability.

Little knowledge of IR countermeasures (IRCM) technology is necessary for the use of PIREP in comparing one engine against another or in preliminary suppression evaluations. As a design engineer becomes increasingly conversant with the problems involved, it is expected that he will increasingly utilize the options available in PIREP.

It must be emphasized that the IR signatures estimated by PIREP are good approximations; useful, quick estimates for early study purposes to identify design parameters, to develop data and to identify gross disparities between types to engine cycles. Once the designs have been reduced to a few candidate designs, then it may be desirable to apply the highly sophisticated and more accurate IR signature analysis programs.

PIREP consists of three sections; the basic module, extension I for lockon range and extension II for spectral studies. All three sections are capable of dual mode operation; attached to engine performance decks or initiated by an independent executor program which contains the input and output (I/O) functions.

It is envisioned that the basic PIREP will eventually be an integral part of engine performance decks while the extensions will be applied to independent analyses of details.

USER MANUAL

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1. INTRODUCTION

During concept definition (CD) and preliminary design (PD) activity many tens or a few hundred configurations of engine cycles and components as well as airframe components must be tentatively evaluated to evolve a desirable few candidate designs. One of these candidates then becomes designated a baseline for additional design and mission capability comparison. Obviously, many (IR emission) critical decisions have already been made at this stage. If IR emissions are to be successfully managed in aerospace systems design, it must be integrated into the CD and PD activity.

A new data management scheme, developed in this effort, is specifically tailored to make IR knowledge available for CD and PD. The Preliminary Infrared Radiation Emissions Program (PIREP), a quick inexpensive computer routine for evaluating IR emissions, was designed to be an attachment for customer engine performance decks to produce IR emission parameters along with all other engine performance parameters. PIREP is suitable, also, for inclusion in engine performance parametric decks, or it can be operated independently for more detailed or parametric studies. PIREP was developed for the U.S. Air Force under contract F33615-76-C-0117.

PIREP was initiated as a result of the IR Handbook program sponsored by the USN, Office of Naval Research (Ref. 1), a program which has concentrated on gathering current methodology, organizating the extensive data base of infrared knowledge, and increasing survivability through improvement of analytical tools.

A technique for utilizing data correlation analysis, Plume Cycle IR Parameter (PCIR) was developed under Contract N00014-74-C-0074, as a cooperative venture between USN, Office of Naval Research and USAF/ASD-XR (Ref. 1). This technique represents peak plume emissions in two wavelength bands (1.8-2.7μm and 3.9-4.8μm defined as functions of engine cycle parameters. A companion effort developed under the same contract (C-0074) provides an algorithm for engine Hot Parts Emissions, the Cycle IR Parameter (CIR).

PIREP represents the next logical step; to develop a computer routine to express these prediction methods.

II. GENERAL DESCRIPTION

A. PIREP System

PIREP is a computer program for rapidly generating turbine engine IR emissions intensities and distribution for use with aircraft engine performance decks used by the government. The program operates in two independent modes: in connection with and attached to engine performance decks used by the Government or supported by a self-standing independent executor program. Each initiator will provide the input and output (I/O) functions. As a minimum, input will require some description of engine and exhaust system, aircraft configuration, observing system and scenerio. Typical input data will include: T5, turbine discharge temperature, °R; T7, exhaust exit temperature, °R; A8, exhaust throat area, in^2; P8 exhaust total pressure psia; PAMB, ambient pressure, psia; TAMB, ambient temperature, °R; V19, secondary flow velocity, ft/sec; XM, flight Mach number; ALT, altitude, K ft.; and FAR, fuel air ratio at the exhaust exit plane. The cycle parameter information is transmitted to the basic PIREP which computes the preliminary source IR numbers and feeds the results back to the initiator for output. The parameter END, also in the calling sequence, determines whether or not the program proceeds to the extended routines for additional studies.

PIREP is composed of three main sections: (a) Basic PIREP, (b) Range Extension (I), and (c) Spectra Extension (II). These sections, represented in the flow chart of Figure 1, are discussed in more detail below. The Range Extension (I) of PIREP facilitates a quick study of lockon ranges for nominal IR seeking missiles, and evaluation of candidate IR emission management schemes. The Spectra Extension (II) facilitates spectral analysis for consideration of specific missiles, special filters, or more refined IR emission management schemes. It is envisioned that the Basic PIREP will eventually be an integral part of engine performance decks, but the two PIREP extensions will continue to be utilized for detailed independent design analysis.

B. Basic PIREP with Cycle Deck

The Basic PIREP uses less than 1K (octal) storage. It computes the preliminary cycle IR numbers for plume(PCIR1, PCIR2) and hot parts (CIR1, CIR2) where 1 and 2 refer to the wavelength bands, 1 -2.7μm and 3.9-4.8μm respectively. These are representative of bands for hot parts and plume seeking missiles. The hot parts numbers are the source radiations near tail-on to the aircraft which usually are the maximum hot-part IR emissions available to a missile. The plume numbers are source radiations normal to the exhaust system centerline and are usually the maximum plume emissions available to a missile.

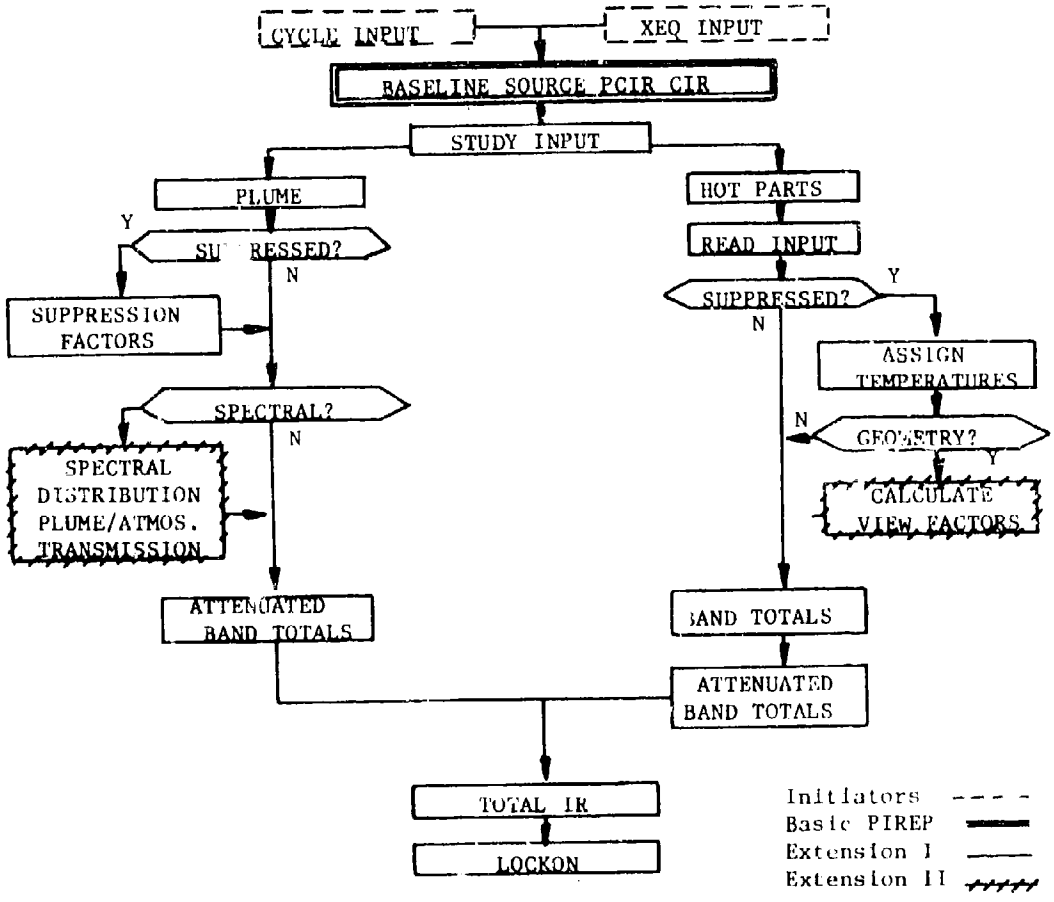


Figure 1. Schematic Diagram of PIREP System

To use PIREP in an engine cycle deck, some routine of the deck itself must be modified to "Call PIREP" at the end of each cycle point evaluation. This is most conveniently added in the output or print routine. In addition, a write statement and format statement must be added to the output routine for presenting the PCIR numbers. The specific statements to be included into a cycle deck are:

```
      CALL PIREP(ARG1,ARG2,ARG3,ARG4,ARG5,ARG6,ARG7,
     + ARG8,ARG9,ARG10,CIR1,CIR2,PCIR1,PCIR2,END)

      WRITE(6,XXXX) PCIR1,PCIR2,CIR1,CIR2

XXXX  FORMAT(//20X,10HIR INDICESS//
     + 15X,8H1.8-2.7,4X,7H3.9-4.8//
     + 2X,5HPLUME,2X,2F12.0/
     + 2X,7HHOT PTS,2F12.0)
```

where

ARG1 = exhaust total temperature, °R
ARG2 = turbine discharge temperature, °R
ARG3 = exhaust throat area, in^2
ARG4 = total pressure at exhaust exit, psia
ARG5 = ambient pressure, psia
ARG6 = ambient temperature, °R
ARG7 = secondary flow velocity, ft/sec.
ARG8 = flight Mach number
ARG9 = fuel-to-air ratio
ARG10 = altitude, K ft.

If basic PIREP only is being used ARG9 and ARG10 are not used.

C. Basic PIREP with Executor

The executor routine operates in two modes:

- Since it provides cycle data input directly, it may be used to compute basic cycle IR parameters for a number of cycles in sequence. For this purpose the parameter, END, need not be supplied initially and the program will keep returning for additional cycle information until END is input equal to -1.

- END must be set equal to 99 if the PIREP extensions are to be used. END = 99 also accesses the extension routines directly from the cycle deck.

The basic CIR parameters are restricted to source emissions for hot parts near tail-on and plume at 90° aspect angle for two specific wavelength bands: 1.8-2.7μm and 3.9-4.8μm

D. Range Extension I

Extension I is restricted to the same two wavelength bands mentioned above. For these bands, it can calculate atmospheric attenuated radiation, the effect of nozzle shape on plume emissions, simple 2-element cooling or coating emissions for hot parts suppression, and lockon ranges for typical missiles in both wavelength bands. This permits limited studies for the evaluation of suppression concepts applied to specific engine cycles and for comparison of vulnerability envelopes.

E. Spectra Extension II

Extension II provides for approximate spectral distribution of plume emissions and plume/atmospheric transmissivities and for evaluation of a 6-element nozzle exhaust system with centerbody. It also enables the user to evaluate roughly the effects of partial surface coatings, of coolants, and of blockage on vulnerability to advanced missile threats.

III. INPUT/OUTPUT

A. Discussion

A series of seven sample problems have been prepared to exercise all of the options available in basic PIREP and its extensions. The sample problems are grouped according to the PIREP model being employed and in a sequence that might be used in actual practice. The completed exercise involves:

- o Sample 1. Comparison of two different engines at several flight conditions.
- o Sample 2. Evaluation of preliminary signature and lock-on for one engine and one flight condition (I-2).
- o Sample 3. Evaluation of plume suppressor capabilities with special lockon options also for the I-2 case.
- o Sample 4. Preliminary study of hot parts suppression.
- o Sample 5. Evaluation of two engine configurations for the I-2 case of sample 1 with different cooling and coating schemes.
- o Sample 6. Study of spectral IR signature and lockon for the I-2 case.
- o Sample 7. Evaluation of lockon for an advanced missile including airframe emissions external to the exhaust system.

Each of these exercises has been handled as if it were part of a real problem in evaluation of engines and cycles during preliminary design

The information pertaining to each operational mode of PIREP should be thoroughly digested before any attempt is made to use that portion of the program in an actual situation.

The input sheets to be used with PIREP are discussed in the following section prior to the presentation of the sample problems.

B. Input Sheets

There are 4 pages of input for use with PIREP. The input parameters used are briefly defined on each page. Namelist input is used throughout. A general description of the input sheets follows.

1. Executor Input

The input to the executor routine is an alternative to input derived directly from a cycle deck. It provides the necessary engine information

to define the engine and cycle conditions for plume and hot parts IR source missions and subsequent studies as requested.

2. Title - General Information

Two lines of alphanumeric title identify the case being analyzed. This input is not namelist but is formatted for 60 spaces of alphanumeric characters per line.

Observer Location

A parametric study of observer locations indicated by ranges, azimuth angles, and elevation angles may be specified.

Plume Suppression

Plume suppression is restricted to nozzle shape and engine exhaust gas variations. Nozzle shape investigations consist of altering the exhaust shape from round to rectangular shapes of specified aspect ratios.

3. Missile Description

Lockon studies may be performed for missiles with typical characteristics or for missiles with characteristics supplied by the user. In addition, spectral output and IR emissions in specified wavelength bands may be obtained without requesting lockon ranges.

4. Hot Parts Suppression

Hot parts suppression can be achieved by cooling, coating or blockage. Simple parametric studies involving these suppression techniques for assymetric bodies can be specified. An estimated of external aircraft surface area, emissivity and temperature can also be supplied.

EXECUTOR INPUT

$ CYCLE

T5 = _____, T7 = _____, A8 = _____, P8 = _____,

PAMB = _____, TAMB = _____, XM = _____, V19 = _____,

ALT = _____, FAR = _____, END = _____, $

Mnemonic	Description	Units
T5	Turbine Discharge Temperature	°R
T7	Exhaust Exit Temperature	°R
A8	Throat Area	in^2
PAMB	Ambient pressure	psia
TAMB	Ambient temperature	°R
V19	Secondary flow velocity	ft/sec
XM	Flight Mach number	--
ALT	Altitude	K feet
FAR	Fuel-air ratio at exit	
END	Extension Option	
	≠ 99 calculate PCIR parameters and return	
	= 99 calculate PCIR parameters, continue into extensions and stop	
	= -1 stop calculations (for use with executor routine only)	

GENERAL INPUT FOR EXTENSIONS

COLUMN 2		DESCRIPTION	UNITS	NOTES	MANDITORY OPTION
_____		Two lines		Formatted Input (10A6)	(M)
_____		of title			(M)
$INPUT					(M)
Observer Locations					(M)
ASP =	_____, _____, _____, _____, _____, _____, _____, _____, _____, _____,	Tail azimuth angles relative to exhaust centerline. Tail-on=0	degrees	Max=10	(M)
RANGE =	_____ (0), _____, _____, _____, _____,	Range to Observer	feet	Max=5	(M)
THTA =	_____ (0), _____, _____, _____, _____,	Elevation angle to observer	degrees	Max=5	(O)
Plume Suppression:					
ASPR =	_____ (1.0), _____, _____, _____, _____,	Aspect ratio for Rectangular exhaust shape (except that 1.0=round)		Max=5	(O)

Note: Initialized values are noted in parenthesis under the space allotted for the input value.

Extension I	Description	Units	Notes	Manditory/ Optional
NLOCK = _____, (1) (1.8-2.7)(4.0-4.8)	=2 for lockon calculation specified bands			(0)
SN = _____, _____,	Signal to Noise Ratio	-	Input if NLOCK =2	(0)
BSNS = _____, _____,	band sensitivity			
NEI = _____, _____,	noise equivalent irradiance	Watts/cm^2		

Extension II				
AMI = _____, _____, _____, _____, _____,	Initial and final wavelength defining missile band	Microns		(0)
AME = _____, _____, _____, _____, _____,				(0)
SN = _____, _____, _____, _____, _____,	signal-to-noise ratio	Microns	Max=5	(0)
BSNS = _____, _____, _____, _____, _____,	band sensitivity		Max=5	(0)
NEI = _____, _____, _____, _____, _____,	Noise equivalent input	Watts/cm^2	Max=5	(0)
NLOCK = _____, (1)	=2 will use reference characteristics as 2 of 5 permissible bands.			
SPEC. = _____, (0)	=1 will calculate spectrally but not print =0 will print spectral output, if spectral results are calculated =2 will calculate spectrally and print even if spectral results are not used.			

	Description	Units	Notes
NE = _____$	Number of exhaust configurations		
$ENGINE			
TM = _____, EM _____,	Temperature/Emissivity	°R	data for a surface external to the exhaust
AR = _____, _____, _____, _____, _____, _____,	Area for each aspect angle		
Extension I:			
TW = _____, _____,	Temperature	°R	
EMS = _____, _____,	Emissivity		
XI = _____, _____, _____, _____, _____, _____,	Portion of exhaust area associated with TW(1) for each aspect angle	in^2	
Extension II:			
TW = _____, _____, _____, _____, _____, _____, _____,	Surface Temperature	°R	*
EMS = _____, _____, _____, _____, _____, _____,	Surface emissivity		*
XI = _____, _____, _____, _____, _____, _____, _____,	Coordinates of exhaust flow outer boundary	in	*
YI = _____, _____, _____, _____, _____, _____, _____,			
XC = _____, _____, _____, _____, _____, _____,	Coordinates of exhaust flow inner boundary	in	*
YC = _____, _____, _____, _____, _____, _____,			

$

* Note: Surfaces and temperatures must be input in order of outer flow boundary from turbine to exit plane; then inner flow boundary from turbine to end of centerbody. A maximum of six surfaces may be specified. One additional temperature may be input to represent the turbine if different from T5 input on page 1.

IV. SAMPLE PROBLEMS

A. TEST PROBLEM 1 - Engine/Cycle Comparisons (EXECUTOR ONLY)

Objective: To compare the IR emissions from a mixed flow engine to a separated flow engine at 3 flight conditions: sea level static; sea level, M=1.0; and M= 2 at 50K feet altitude.

1. Discussion of Input - For this study, it is assumed that both engines have been sized to give the same thrust at sea level static condition. The cycle data is available from independent sources and presented in Table 1. Use will be made of the executor routine and the basic PIREP routine only. Input cards are listed in the Table II.

2. Input Instructions - (for card listing see Figure 2)

a. Executor: Cycle values are input for all parameters for each engine/flight condition being evaluated.

b. General Input: Not applicable

c. Missile Description: Not applicable

d. Hot Parts Suppression: Not applicable

3. Description of Output: The PIREP printout is presented in Appendix A-I. There is one set of output for each case submitted. The output consists of a tabulation of the input quantities and the IR indices. These numbers estimate peak source radiation in the 1.8-2.7μm and 3.9-4.6μm bands for plume and hot parts.

4. Discussion of Results: The results of Test Problem I are summarized in Table I.

As expected engine I with a mixed flow cycle exhibits higher hot parts emissions (because the exhaust area is larger) but lower plume emissions (because the exhaust gas mixed temperature is lower). This comparison is true here for both wavelength bands and for all three flight conditions.

For our sample problem, it will be easier to suppress hot parts than plume and engine I is therefore selected for further studies. In addition, condition 2 will be selected for further studies because it is more representative of the threat environment. (These are arbitrary decisions for our sample problems; a different selection might be made for a different application.)

```
$CYCLE
T5=1992,T7=1415,A8=511.3,P8=42.53,
PAMB=14.7,TAMB=520,XM=0,V19=0,
ALT=0,FAR=.0126$
$CYCLE
T5=2008,T7=1388,A8=534.6,P8=56.82,
PAMB=14.7,TAMB=520,XM=1.,V19=0,
ALT=0,FAR=.0108$
$CYCLE
T5=2031,T7=1402,A8=529.8,P8=20.64,
PAMB=1.682,TAMB=380,XM=2.,V19=0,
ALT=50,FAR=.0099$
$CYCLE
T5=1992,T7=1992,A8=320.7,P8=42.696,
PAMB=14.7,TAMB=520,XM=0,V19=1540.7,
ALT=0,FAR=.0252$
$CYCLE
T5=2008,T7=2008,A8=311.9,P8=55.36,
PAMB=14.7,TAMB=520,XM=1,V19=1805.7,
ALT=0,FAR=.0243$
$CYCLE
T5=2031,T7=2031,A8=298.1,P8=19.77,
PAMB=1.682,TAMB=380,XM=2,V19=2353.1,
ALT=0,FAR=.02356$
$CYCLE END=-1$
```

Figure 2. Listing of Input Cards for Test Problem 1.

Table 1. Cycle Data Input and Peak IR Emissions Output for Problem 1.

Input Conditions

	ENGINE 1			ENGINE 2		
Condition	1	2	3	1	2	3
T7	1415	1388.3	1401.8	1992	2008.1	2031.4
T5	1992	2003.1	2031.4	1992.	2008.1	2031.4
Tamb	520.	520.	380.	520.	529.	380.
P8	42.53	56.82	20.64	42.696	55.36	19.774
Pamb	14.7	14.7	1.682	14.7	14.7	1.682
A8	511.3	534.59	529.8	320.7	311.9	298.1
XM	0	1.0	2.0	0	1.0	2.0
V19	0	0	-	1540.7	1805.7	2353.1
FAR	.0126	.01080	.0099	.0252	.0243	.02356
ALT	0	0	50	0	0	50
RESULTS						
PCIR1	25.	17.	1.0	205	241	17
PCIR2	362	349	107	1028	1410	671
CIR1	1836	2010	2127	1151	1171	1197
CIR2	1211	1298	1334	759	757	750

B. TEST PROBLEM II: Signature and Lockon (Extension 1)

Objective: To determine the IR signature and lockon ranges for engine I at condition 2.

1. Discussion of Input: The IR characteristics for cycle 1-2 will be evaluated for aspect angles 0, 30, 60, 90, 130 and 170 degrees at ranges of 0, 5000, 50,000, and 100,000 feet at zero elevation only (horizontal to the aircraft). Aspect angles are relative to the exhaust system centerline with tail-On equal to zero degrees.

2. Input Instructions: (For card listing, See Figure 3)

a. Executor: Cycle values are input for selected engine/flight conditions (1-2). END is set to 99 to signal extension calculations.

b. General Input:

Specify (1) 2 lines of title
(2) aspect angles (ASP)
(3) range (RANGE)
THTA, ASPI not applicabl

c. Missile Description: Set NLOCK=2 to signal lockon calculation using internally supplied missile characteristics.

No other input applicable.

d. Hot Parts Suppression: Use NE-1 one engine only. Use basic unsuppressed engine assumptions. No additional input needed.

```
$CYCLE
T5=2008,T7=1388,A8=534.6,P8=56.82,
PAMB=14.7,TAMB=520,V19=0,XM=1,ALT=0,
FAR=.0108,END=99$
                PIREP TEST PROBLEM  2
                SIGNATURE AND LOCKON
$INPUT
ASP=0,30,60,90,130,170,
RANGE=0,5000,50000,100000,
NLOCK=2,NE=1$
$ENGINE $
```

Figure 3: Listing of Input Cards for Test Problem 2.

3. Description of Output

Page - Cycle input and PCIR numbers, as described in the Test Problem 1 are given in addition to the following missile characteristics:

(1) The missile number for later reference
(2) The wavelength band associated with the missile (microns)
(3) The sensitivity of the missile over the entire band. This is dimensionless number relating to the degradation of the signal near the perimeter. There is a spectral sensitivity associated with each missile which is accounted for in this program by cutting off the wavelength bands at the 50% sensitivity.
(4) NEI is the noise equivalent input of the missile internal system (watts/cm^2)
(5) S/N is the ratio of the signal-to-noise necessary to achieve lockon for the given missile.

Page - The input values pertaining to the case being calculated are listed.

Page - Exhaust hot parts output includes:

(1) The projected areas for each node at each aspect angle. For the simplest case there is one node at exhaust exit temperature and area.
(2) The total emissions for each aspect angle and wavelength band are listed. The plume and hot parts IR totals are given for each wavelength band

Pages - Input values and output totals for both cases.

Page -

Lockon range in feet for each missile, each angle.

4. Discussion of Results: A summary of the results of the output for problem II are presented in Table 2. The major areas of vulnerability are plume emissions near broadside in the 3.9-4.8 m band and hot parts emissions from tail-on to broadside in both bands as expected.

Suppression studies will be conducted for the plume by using rectangular shaped nozzles for hot parts by using coating, cooling and shielding schemes.

Table 2: Signature and Lockon Ranges for Basic Cycle

Aspect Angle	Distance (K ft)	1.8-2.7μm Plume Watts/Steradian	1.8-2.7μm Hot Parts Watts/Steradian	3.9-4.8μm Plume Watts/Steradian	3.9-4.8μm Hot Parts Watts/Steradian
0°	0	1.4	2010	30.4	1298
	5	.02	828	1.25	664
	50	.003	424	.113	426
	100	.003	303	.074	353
Lockon Range (K Ft)		30.508		118.20	
30°	0	8.3	1741	175	1124
	5	.14	717	7.18	575
	50	.02	367	.65	368
	100	.015	262	.43	305
Lockon Range (K ft)		28.7		111.3	
60°	0	14.4	1005	303	649
	5	.24	414	12.4	332
	50	.031	212	1.12	212
	100	.026	151	.736	176
Lockon Range (K ft)		22.7		86.9	
90°	0	16.6	0	349	0
	5	.27	0	14.4	0
	50	.035	0	1 30	0
	100	.030	0	.85	0
Lockon Range (K ft)		2.3		12.9	
130°	0	12.7	0	268	0
	5	.21	0	11.0	0
	50	.03	0	.99	0
	100	.02	0	.65	0
Lockon Range (K ft)		2.2		119.	
170°	0	2.9	0	60.7	0
	5	.05	0	2 49	0
	50	.01	0	.23	0
	100	.005	0	.15	0
Lockon Range (K ft)		1.8		7.5	

C. TEST PROBLEM III - Plume Suppression

Objective: To determine the effect of nozzle shaping on the plume emissions for engine/cycle I-2.

1. Discussion of Input - For the engine cycle I-2, aspect ratios of 4 to 10 are compared to the round jet (aspect ratio = 1) for 3 elevation angles (0, 45, 90) and 2 ranges (0, 50K feet). For this study, use only the 90° aspect angle where peak plume emissions occur.

To exercise the options, the lockon ranges will be evaluated for modified less sensitive missile characteristics in the basic bands with characteristics specified in Table 3.

Table 3. Modified Missile Characteristics

Wavelength Band	Band Sensitivity	NEI	S/N
1.8-2.7	.5	3×10^{-9}	4
3.9-4.8	.7	8×10^{-10}	1.0

2. Input Instructions (For card listing see figure 4)

a. Executor: same as in Test Problem II

b. General Input

Specify: (1) 2 lines of title
(2) aspect angle (ASP)
(3) range (RANGE)
(4) Elevation angle (THTA)
(5) Aspect Ratio (ASPI)

c. Missile Description

Specify: SN, NEI, BSNS and NLOCK = 2

d. Hot Parts Suppression

Same as Test Problem II

```
$CYCLE
T5=2008,T7=1388,A8=534.6,P8=56.82,
PAMB=14.7,TAMB=520,V19=0,XM=1,
ALT=0,FAR=.0108,END=99$
                    PIREP TEST PROBLEM 3
                    PLUME SUPPRESSION
$INPUT
ASP=90,
RANGE=0,50000,
THTA=0,45,90,
ASPI=1,4,10,
NE=1,NLOCK=2,
SN=4,1,BSNS=.5,.7,
NEI=3.E-10,8.E-10$
$ENGINE $
```

Figure 4: Listing of Input Cards for Test Problem 3

Description of Output (Appendix A-III)

The output is similar to that of test problem II except that the missile characteristics on page one conform now to the input values and since all cases were at 90° aspect, there is not hot parts output.

Discussion of Results

The plume suppression results are summarized in Table 4. The lockon range for the plume seeking missile has been decreased from 12.4K feet to 8.1 K feet for the broadside view (θ=0°) and to 5.9 K feet for the narrow side view (θ=90°) at an aspect ratio of 10. This is an 86% reduction of plume emissions viewed from the broadside and a 97% reduction viewed from the narrow side. One must conclude that significant plume IR reductions can be achieved with nozzle shaping. However, the lessened vulnerability is not without cost. Part of the reduction is caused by increased mixing in the flowfield induced by eddies off the corners of the rectangular exhausts, which increase drag and decrease performance. Also, a rectangular nozzle is heavier than an equivalent round nozzle. The advantages must, therefore, be weighed against the disadvantages for a given mission/threat environment.

Table 4. Plume Suppression Results

A. 1.8 - 2.7μm

Elevation Angle	Aspect Ratio	Emissions at 0 Feet (Watts/Ster.)	Emissions at 50K Feet (Watts/Ster.)	Lockon Range (K Ft.)
0	1.0	17	0.03	1.4
	4.0	6.6	0.01	1.0
	10.0	2.3	0.005	0.7
45°	1.0	17	0.03	1.4
	4.0	5.7	0.01	1.0
	10.0	1.8	0.004	0.7
90°	1.0	17	0.03	1.4
	4.0	3.7	0.008	0.9
	10.0	0.51	0.001	0.5

B. 3.9-4.8μm

0	1.0	349.0	1.3	12.4
	4.0	167.0	0.62	9.7
	10.0	95.0	0.35	8.1
45°	1.0	349.0	1.3	12.4
	4.0	152.0	0.56	9.4
	10.0	78.3	0.29	7.6
90°	1.0	349.0	1.3	12.4
	4.0	114.7	0.43	8.6
	10.0	37.2	0.14	5.9

TEST PROBLEM IV - Hot Parts Suppression I

Objective: To make a quick study of potential for suppression by cooling of hot parts.

1. Input Discussions: The nominal temperature for hot parts was 2008°R, the exhaust exit total temperature. For this study assume cooling of hot parts can be achieved such that

a) 1/4 the area is cooled to 1500°R
b) 1/2 the area is cooled to 1500°R
c) all the area is cooled to 1500°R

The emissions are evaluated for 0° and 30° only at ranges of 0 and 50K feet. No lockon is calculated.

2. Input Instructions: (For card listing see Figure 5)

a) Executor - Same as test problem II
b) General Input
Specify (1) 2 lines of title
(2) aspect angles
(3) ranges
no other input is applicable.
c) Missile Description
No input applicable

d) Hot Parts Suppression: Number of exhaust systems being studied is 3.

For each case, surface temperatures are 2008°R and 1500°R. The emissivities are assumed to equal 1. The portions of the surface associated with temperature 1, 2008°R, and .75, .5 and 0, respectively.
No other input is applicable

NOTE: A separate $ENGINE namelist must be supplied for each variation of exhaust system.

3. Description of Output: The description of output for this problem is identical to that for problem II except for the exhaust hot parts output. Here, since two nodes (or areas) are involved, the output has been separated so that the emissions from each node can be studied separately. Column headings are not particularly meaningful for this problem and so will be discussed fully under TEST PROBLEM V.

4. Discussion of Results: The results of this study are summarized in Table 5. A significant reduction in hot parts IR emissions (~85%) will be achieved if the source temperature can be reduced to 1500°R. Even this much reduction will not be sufficient to achieve a desirable degree of invulnerability. A more detailed study is necessary to discover whether a realistic level can be achieved.

```
$CYCLE
T5=2008,T7=1388,A8=534.6,P8=56.82,
PAMB=14.7,TAMB=519,VI9=0,XM=1,
P8=56.82,
ALT=0,FAR=.0108,END=99$
                PIREP TEST PROBLEM  4
                HOT PARTS SUPPRESSION I
$INPUT
ASP=0,30,
RANGE=0,50000,
NE=3$
$ENGINE
TW=1500,2008,
EMS=1,1,
XI=.25,.25$
$ENGINE
TW=1500,2008,
XI=.5,.5$
$ENGINE
TW=1500,XI=1,1$
```

Figure 5: Listing of Input Cards for Test Problem 4

Table 5. Hot Parts Emissions for Various Exhaust Configurations (Watts/Ster.)

Configuration Range (K ft.)	0° 1.8 - 2.7 / 0	0° 1.8 - 2.7 / 50	0° 3.9 - 4.8 / 0	0° 3.9 - 4.8 / 50	30° 1.8 - 2.7 / 0	30° 1.8 - 2.7 / 50	30° 3.9 - 4.8 / 0	30° 3.9 - 4.8 / 50
X = 0.0	2010	424	1298	426	1741	367	1124	368
X = 0.25	1533	333	1118	356	1378	289	1117	309
X = .5	1153	242	908	287	1006	210	934	248
X = 1.0	324	59	487	149	263	51	570	130
A-1	2237	473	1416	463	839	176	684	224
A-2	1125	238	759	248	784	165	678	222
A-3	1439	305	909	297	746	157	559	183
A-4	1138	241	730	239	691	146	529	173
B-0	1851	560	1253	560	2016	425	1314	429
B-1	100	21	201	66	449	94	386	126
B-2	66	14	148	48	420	89	341	117
B-3	27	5	138	45	388	82	331	108

TEST PROBLEM V - Hot Parts Suppression II

Objective: To study in detail suppression concepts for engine configurations having the same cycle conditions.

1. Discussion of Input: Two candidate configurations will be evaluated in both unsuppressed and suppressed modes. Schematics of the basic configurations are shown in Figure . Each is the same length, turbine area, throat area, and exit area. Configuration B has a plug centerbody to hide the hot turbine emissions.

The study suppressed configurations will follow the schedule of Table 6. Cooling of a surface is assumed when the temperature is lowered; coating of the surface is assumed when the emissivity is changed.

Configuration A-0 is a schematic representation of the baseline unsuppressed exhaust system. The visible interior surfaces are at 2008°R (EGT), the nozzle flap is cooled to 1388°R and the turbine runs about 5% higher at turbine discharge temperature, TDT = 2108°R. The surface emissivities are given nominal values (.65) which is in the normal range for exhaust system applications. The system is represented by five surfaces:

(1) the upstream center exhaust flowpath boundary
(2) the downstream outer exhaust flow boundary surface
(3) the nozzle flap
(4) the centerbody
(5) the turbine exit plane

Configuration B-0 is a schematic of a plug nozzle configuration with the same A8 and A9. The purpose of the plug is to hide the hot parts of the inner exhaust system from view. Some plug configurations extend beyond the exit plane and provide additional hot parts emissions from side aspects. This is not a large factor in our problem because the plug ends at the exhaust plane and at the off tail-on angles. The aerodynamics associated with this particular configuration would be so bad as to prohibit its use but for IR considerations only; it is representative of a real solution. Configuration B is also cooled and coated according to the schedule in Table VI. There are 6 surfaces to consider in this system:

(1) internal exhaust surface
(2) nozzle flap
(3 + 4) internal centerbody surface
(5) visible centerbody surface
(6) turbine exit plane

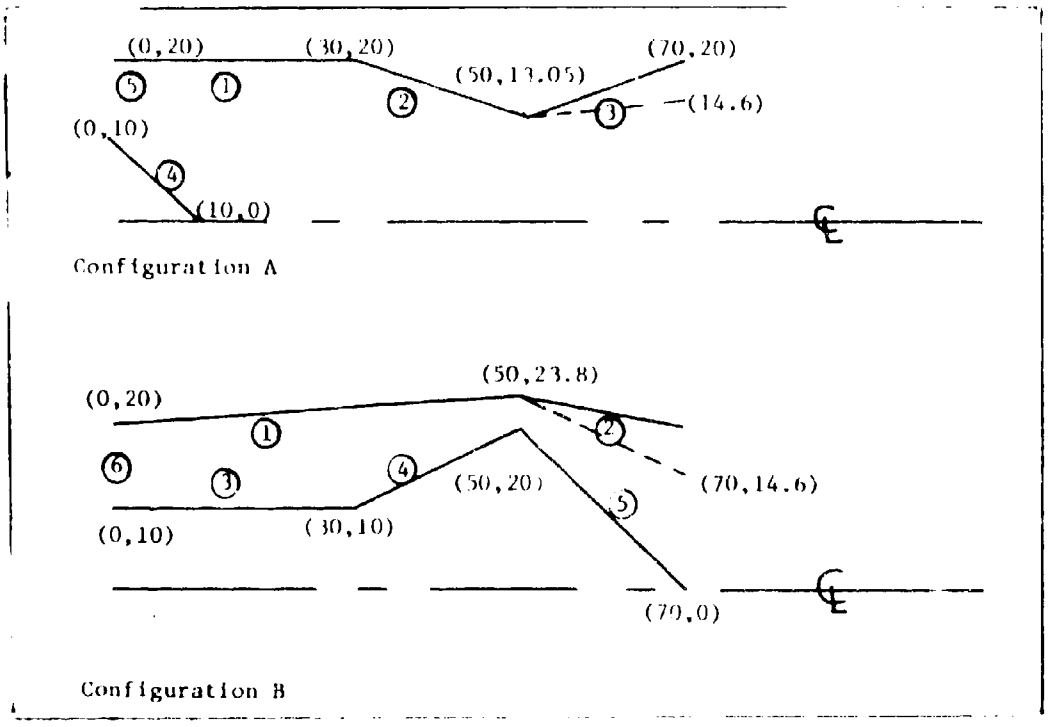


Figure 6. Schematics of Basic Exhaust Configurations.

Table 6. Schedule for Surface Temperatures and Emissivities for Suppressed Exhaust Configurations

Temperature (°R)/Emissivity

Surface No.	A - 0	A-1	A-2	A-3
1	2008/.65	→	→	→
2	1388/.65	→	→	→
3	1388/.65	→	1100/.65	1100/.65
4	2008/.65	1100/.65	→	1100/.95
5	2108/1.0	→	→	→
	B - 0	**B-1**	**B-2**	**B-3**
1	2008/.65	→	→	→
2	1388/.65	→	1100/.65	1100/.95
3-4	2008/.65	→	→	→
5	2008/.65	1100/.65	→	1100/.95
6	2108/.65	→		→

2. Input Instructions (For card listing see Figure 7)

a. Executor
Same as Test Problem II

b. General Input
Same as Test Problem IV

c. Missile Descriptions
Not input appliable

d. Hot Parts Suppression
The number of exhaust systems to be studied is 8.

For each configuration specify:

(1) The X-Y coordinates of the outer flowpath surface from the turbine exit plane to the exhaust plane. (X1, Y1)

(2) The X-Y coordinates of the centerbody from the turbine exit plane to the end of the centerbody. (XC, YC)

The nodes supplied in this manner will be numbered internally in sequence. An additional node will be added to represent the turbine exit plane. Temperatures (Tw) and emissivities (EMS) must be supplied for each of these nodes.

The $ENGINE namelist must be used 8 times (once for each configuration) and all the input must be supplied in full each time.

No other input applies.

3. Description of Output: The description of output for this problem is the same as that of problem II except for the exhaust hot parts output.

For this case the coordinates of the exhaust surface and the centerbody are printed out. The internal view factors calculated by the system are given for each node along with the area. One additional node representing the nozzle exit plane is printed out for completeness. The total of all the viewfactors for a node should equal one. The percent error is an indication of the accuracy of the calculation. The temperatures and visible projected areas are printed for each aspect angle specified in the input. In addition to the total hot parts emissions, a breakdown of the emissions by node is printed for each aspect angle and wavelength band.

This is provided by giving

(a) the direct emissions from each node that are visible to the observer

```
$CYCLE
T5=2008,T7=1388,AB=534.6,P8=56.82,
PAMB=14.7,TAMB=519,VI9=0,XM=1,
P8=56.82,
ALT=0,FAR=.0108,END=99$
                PIREP TEST PROBLEM  5
                HOT PARTS  UPPRESSION II
$INPUT
ASP=0,30,
RANGE=0,50000,
NE=8$
$ENGINE
TW=2008,1388,1388,2008,2108,
EMS=.65,.65,.65,.65,1,
X1=0,30,50,70,
Y1=20,20,13.05,14.6,
XC=0,10,
YC=10,0$
$ENGINE
TW=2008,1388,1388,1100,2108,
X1=0,30,50,70,
Y1=20,20,13.05,14.6,
XC=0,10,
YC=10,0$
$ENGINE
TW=2008,1388,1100,1100,2108,
EMS=.65,.65,.65,.65,1,
X1=0,30,50,70,
Y1=20,20,13.05,14.6,
XC=0,10,
YC=10,0$
$ENGINE
TW=2008,1388,1100,1100,2108,
EMS=.65,.65,.95,.95,1,
X1=0,30,50,70,
Y1=20,20,13.05,14.6,
XC=0,10,
YC=10,0$
$ENGINE
TW=2008,1388,2008,2008,2008,2108,
EMS=5*.65,1,
X1=0,50,70,
Y1=20,23.8,14.6,
XC=0,30,50,70,
YC=10,10,20,0,
$
$ENGINE
TW=2008,1388,2008,2008,1100,2108,
EMS=5*.65,1,
X1=0,50,70,
Y1=20,23.8,14.6,
XC=0,30,50,70,
YC=10,10,20,0,
$
$ENGINE
TW=2008,1100,2008,2008,1100,2108,
EMS=5*.65,1,
X1=0,50,70,
Y1=20,23.8,14.6,
XC=0,30,50,70,
YC=10,10,20,0,
$
$ENGINE
TW=2008,1100,2008,2008,1100,2108,
EMS=.65,.95,.65,.65,.95,1,
X1=0,50,70,
Y1=20,23.8,14.6,
XC=0,30,50,70,
YC=10,10,20,0,
$
```

Figure 7. Listing of Input Cards for Test Problem 5.

(b) the reflected emissions from each node that are visible
(c) the total visible emissions from each node and
(d) the cumulative emissions which is the emissions initiated from the node and reaching the observer either directly or via reflections off other nodes is also given for each node.

The cumulative emissions will be reduced directly with the cooling of the given node. The reflections will be reduced by increasing the emissivity of the node although the direct emissions will be simultaneously increased.

Consider, for example, the output for case 1 reproduced in Table 2 for an aspect angle of 0° and wavelength band 1.8-2.7. Although node 1 is not visible (area = 0) the emissions from node 1 escaping to the obersver is 289 watts/steradian. If this were the only emission to be considered, one might reduce the temperature of the node 1 or increase the emissivity of the node 4 to eliminate the source of emissions.

4. Discussion of Results: A summary of the emissions for the various configurations is presented in Table 5, page 21.

The detailed output from Configuration A-1 which corresponds to the base case is somewhat higher at tail-on (0° aspect) than the PCIR predictions because the hotter turbine is directly visible and this is not usually the case. At 30° aspect the nozzle flaps have already been cooled to 1388°R so the emissions are less than those obtained from the PCIR numbers. Each change in configuration A reduced the emissions but the results were still too high.

Configuration B is especially effective at tail-on because the turbine and hot surfaces are completely hidden from view by the colder plug surface. Reflections keep the 30° aspect from being reduced quite as effectively, but there is a definite improvement.

Configuration B-2 is selected for more detailed evaluation.

TEST PROBLEM 6 - Spectral Signatures and Lockon

Objective: To determine the spectral plume signature, the effect of plume attenuation on the hot parts emissions and to reassess lockon range.

1. Input Discussion: A specific engine configuration has been selected. It is now worthwhile to examine it in some detail and estimate the reduced vulnerability by looking at the lockon ranges and comparing these with the initial unsuppressed configuration results. Since our final model is only hot parts suppressed, aspect angles of 0°, 30° and 60° only will be evaluated. Ranges of 5K and 50K should adequately bracket the lockon range for this case.

2. Input Instructions: (For card listing see Figure 8)

a. Executor same as problems 2 through 5
b. General Input

Specify: (1) 2 lines of title
(2) aspect angles (ASP) (degrees)
(3) ranges (ft)
THTA and ASPI not applicable

```
$CYCLE
T5=2008,T7=1388,A8=534.6,P8=56.82,
PAMB=14.7,TAMB=519,V19=0,XM=1,
P8=56.82,
ALT=0,FAR=.0108,END=99$
                PIREP TEST PROBLEM  6
                SPECTRAL SIGNATURE AND LOCKON
$INPUT
ASP=0,30,60,
RANGE=5000,50000,
SPEC=1,NLOCK=2,
NE=1$
$ENGINI
TW=2008,1100,2008,2008,1100,2108,
EMS=5*.65,1,
X1=0,50,70,
Y1=20,23.8,14.6,
XC=0,20,50,70,
YC=10,10,20,0,
$
```

Figure 8. Listing of Input Cards for Test Problem 6

c. Missile Description

NLOCK = 2 to specify lockon calculations
SPEC = 2. to print spectral plume emissions

d. Hot Parts Suppression

Select engine configuration B-2 from previous case.

3. Description of Output (Appendix A-VI):

Page 1 - A table defining the atmospheric conditions through which the plume and atmosphere is attenuated has been added to the output. Otherwise it is identical to previous cases.

Page 3 - Irradiance and plume/atmosphere transmissivity is output as a function of wavelength. Note the "blue spike" CO_2 peak of 9.9676 watts/ster/micron at 4.8μ and the water vapor band from 2.08-2 4μm and the CO_2 band from 4.19-4.375μm.

4. Discussion of Results: A comparison of the lockon ranges for the unsuppressed engine configurations is given in Table 7. The lockon envelopes have been reduced to less than ½ the former range in most cases. Nevertheless the attempt at invulnerability has probably been successful. The minimum lockon range is about 1 mile and the maximum is 10 miles. To accurately assess the missile capability, an analysis needs to make a much more elaborate study including the kinematic boundaries and tracking rates of the missile.

Table 7: Comparison of Lockon Ranges for Suppressed and Unsuppressed Configurations

	Test Problem 2 Unsuppressed		Test Problem 6 Suppressed	
Missile Numbers	1	2	1	2
Aspect Angle				
0	30.5	116.2	8.2	39.5
30	28.7	111.3	18.5	56.4
60	22.7	86.9	9.5	34.6

The design engineer will normally have no use for the radiation spectral distributions. However, if they are desired they can be obtained.

The spectral distributions of plume emissions printed for 60° at the two ranges has been plotted in Figure 9. These results are not untypical of plume emissions. The CO_2 (3.9-4.8μm) emissions are completely absorbed in the band center leaving emissions on the wings only. The 4.18μm wing is commonly referred to as the blue spike and the 4.4-4.8μm wing, as the red spike. CO_2 emissions are normally much higher than water vapor emissions because of absorption in the atmosphere. The area between the solid line and the dashed line represents the amount of absorption between 5K and 50K feet.

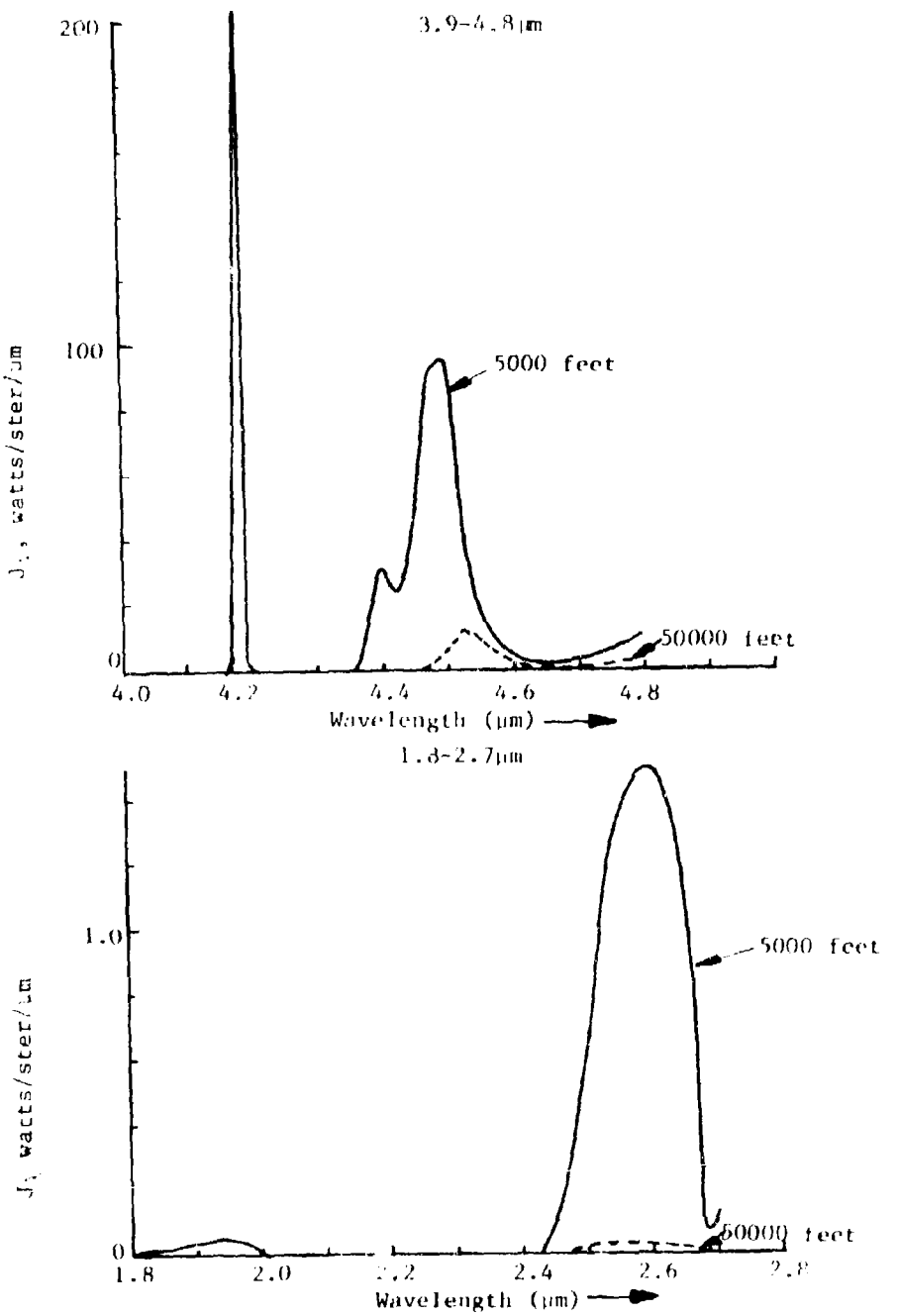


Figure 9 : Spectral Distribution of Plume Emission at 60° Aspect Angle, 5000 feet and 50000 feet.

TEST PROBLEM 7 - Missile Specifications with Airframe Emissions

Objective: To determine the lockon range of an installed engine for advanced missile threats.

1. Input Discussion: As plume/exhaust system signatures are more and more suppressed, the airframe itself or heated surface on the airframe may become a significant contributor to the IR, especially at nose-on aspects. For this problem, a surface has been heated to 1900°R and is observable at all aspect angles. The specific areas to be entered are 450, 300, and 210 at angles of 0, 30 and 170° respectively.

A specific missile of the future will probably not have as broad a wavelength band as those built into PIREP. A specific missile might be sensitive to radiation from the blue spike (4.17-4.25μm) or the red spike (4.4-4.6μm) in order to achieve a higher target to background contrast. These advanced missiles will have a much smaller noise equivalent input and be able to discriminate and lockon at a lower S/N ratio.

2. Input Instructions (For card input see figure 10)

a. Executor Input
Same as Test Problem II

b. General Input
Same as Test Problem II for 0, 30 and 170° only at 0, 5K and 50K feet

c. Missile Description
Specify AMI, AME the wavelength bands; SN, BSNS, NEI the characteristics of the two new missiles as given below.

Missile Number	(1)	(2)
Wavelength 4.6 to	4.25μm	4.4-4.6μm
Band Intensity	1.0	1.0
Signal-to-Noise Ratio	.7	.7
NEI (watts/in^2)	.4 x 10^{-10}	.4 x 10^{-10}

```
$CYCLE
T5=2008,T7=1388,A8=534.6,P8=56.82,
PAMB=14.7,TAMB=519,V19=0,XM=1,
P8=56.82,
ALT=0,FAR=.0108,END=99$
                PIREP TEST PROBLEM 7
                SPECTRAL SIGNATURE AND SPECIFIC MISSILES
$INPUT
ASP=0,30,170,
RANGE=0,5000,50000,
NLOCK=2,SN=.7,.7,
BSNS=1,1,NEI=4.E-11,4.E-11,
AMI=4.17,4.4,AME=4.25,4.6,
NE=1$
$ENGINE TM=1900,AR=750,500,350,EM=.6$
```

Figure 10: Listing of Input Cards for Test Problem 7.

d. Hot Parts Suppression: For this case, consider the original unsuppressed emissions in Case II for the internal system but add the hot surface temperature, TM, emissivity, EM, and missile areas, AR, for each of the angles specified on page 1 of the input.

3. Description of Output: The output format is the same as for Test Problem II except that there are 4 missiles. The missile numbers assigned on page 1 are those referred to on the last page with the lockon ranges even though the intermediate IR results are in a different sequence.

4. Discussion of Results: The particular advanced missiles defined in this problem are actually less of a threat than the basic missiles already considered. In actual practice, it is unlikely that one would be so lucky.

The addition of hot emissions in the nose-on aspect has dramtically increased the vulnerability to the threat from that direction. The temperature selected is much hotter than a normal airframe surface. In this case it represents a flange or extension of the exhaust system itself that operated as a plume shield from above but as an emitter from below and to the side.

It would be effective as a plume shield if the specific threat were only from the upper hemisphere, but not, as demonstrated here, if our aircraft can be approached from below.

VIII. SUMMARY

Little knowledge ir IR/countermeasures technology is necessary to use PIREP for comparing one engine/cycle against another for preliminary suppression evaluations. As a design engineer becomes more conversant with the problem involved, it is expected he will use more and more options available in the PIREP program and his knowledge and judgment will further increase.

Preliminary studies and evaluations will be made without reference to the IR expert. In this regard it is important to understand that PIREP provides preliminary estimates only. Before any final decision or commitment on achievable IR levels is made, a detailed study of the IR problem should be performed by more sophisticated techniques and more knowledgeable personnel. These studies, however, fall into the final selection phases and in no way diminish the importance of the preliminary evaluations.

PROGRAM DESCRIPTION

An overall flow chart depicting the subroutines used in PIREP is presented in Figure 11 following the general outline previously presented in Figure 1. Each of these subroutines and their function or purpose is listed in Table 8. A flow chart listing of each subroutine is presented in Appendix B.

The analysis of the various subroutines is presented either in the final report for this contract, Reference 2, or is available in Reference 2, which is the analysis volume of the SCORPIO IIIA computer program from which a number of these routines were extracted.

The parameters used in the subroutines newly developed for PIREP are defined in Table 9.

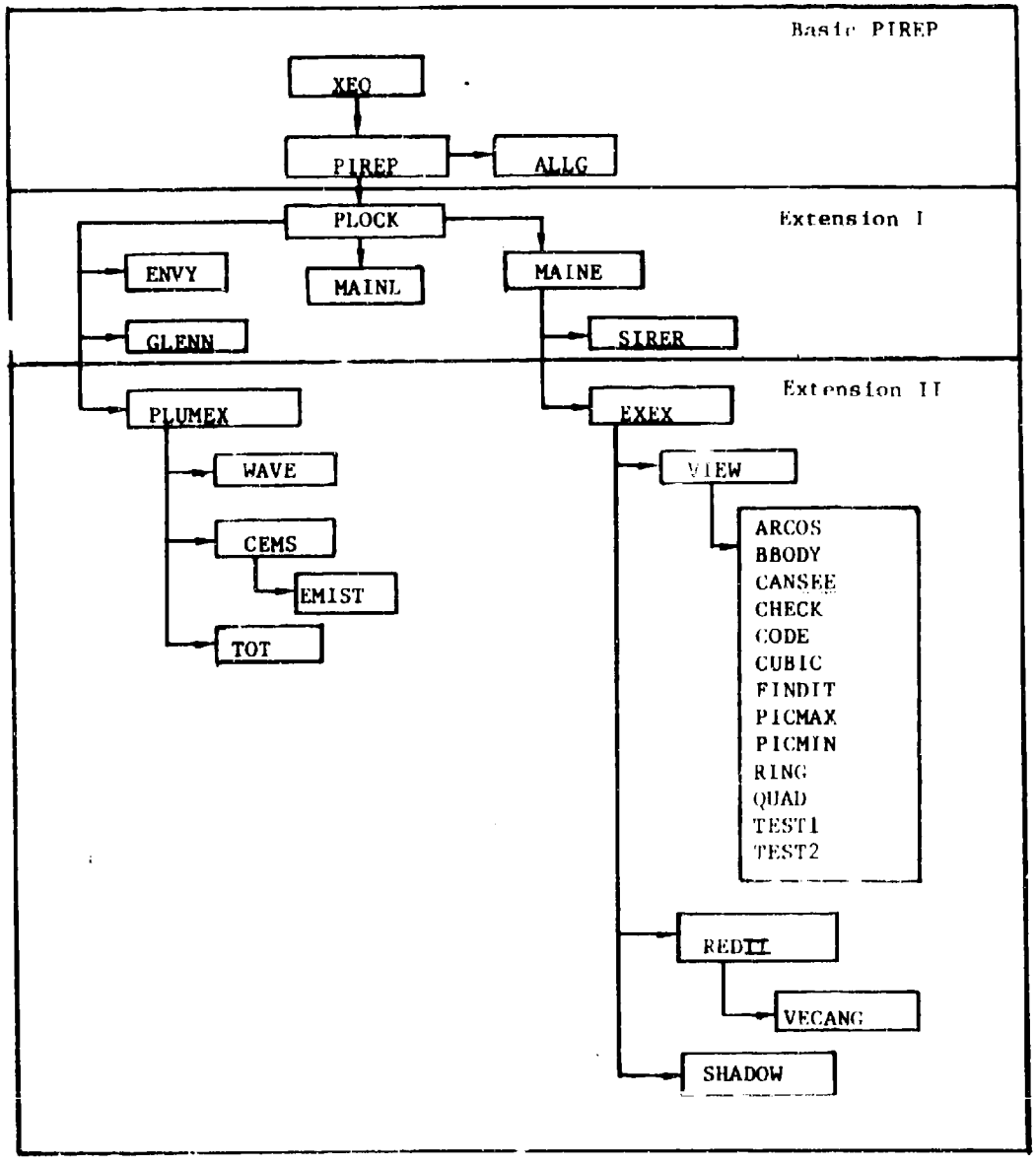


Figure 11: Flow Chart of PIREP Subroutines

TABLE 8: Listing of PIREP Subroutines and Their Functions

SUBROUTINE	PURPOSE	CALLED BY	EXTENSION	PAGE No.
ALLG	To test for zero argument before taking logarithm	PIREP	Basic	B6
ARCCOS	To calculate the angle in radians between 0 and π/2 for a given cosine value	VIEW	II	B138
BODY	To check whether the line of sight between points on two nodes is tangent to a shadowing body	BODY RING	II	B141
CANSEE	Checks the visibility between two nodes to determine if shadowing may occur	VIEW	II	B147
CEMS	Determine spectral gaseous emissions/transmission along a ray	PLUMEX	II	B63
CHECK	Checks the data routine in BODY for extraneous solutions	BODY	II	B154
CODE	Analyses results of FINDIT to describe the nature of shadowing between two nodes	VIEW	II	B157
CUBIC	Determine the real roots of a third order equation	BODY	II	B162
EMIST	Calculates transmissivity for a ray segment and accumulates band parameters	CEMS	II	B66
ENVY	Determines atmospheric conditions away from target	PLOCK	I	B53
EXEX	Controls flow of extension II hot parts suppression	MAINE	II	B91
FINDIT	Locates the axial positions of two nodes with respect to the axial positions of the configuration surfaces	VIEW	II	B174
GLENN	Determines the amount of plume suppression associated with the nozzle shaping and flight condition	PLOCK	I	B22

Table 8 (Cont'd)

SUBROUTINE	PURPOSE	CALLED BY	EXTENSION	PAGE NO.
MAINE	Reads engine input and relocates data for further calculations	PLOCK	I	B24
MAINL	Interpolates calculated signatures for lockon ranges	PLOCK	I	B39
PIREP	Calculates basic PCIR numbers	XEQ	Basic	B3
PLOCK	Controls all extension calculations	PIREP	I	B7
PICMAX	Determines maximum value of an array	VIEW	II	B176
PICMIN	Determines minimum value of an array	VIEW	II	B178
PLUMEX	Organizes data for plume spectral calculations	PLOCK VIEW	II	B43
QUAD	Determines the roots of a second order equation	CUBIC	II	B180
REDII	Computes and prints geometric view factors for a detector as a function of engine off-axis angle	EXEX	II	B194
RING	Determines the intersection of a shadowing body with the "cone of vision" that a point on one node sees of another node	VIEW	II	B183
SHADOW	Describes the surfaces used in VIEW in a manner compatible for RED II	EXEX	II	B190
SIREF	Computes internal radiation interchange factors and direct reflected and cumulative emissions for each surface	MAINE	I	B30
TEST 1	Tests the possibility of one node being shadowed by a second node which has the same axial location	VIEW	II	B186

Table 8 (Cont'd)

SUBROUTINE	PURPOSE	CALLED BY	EXTENSION	PAGE NO.
TEST 2	Determines whether a point lies between two other points	VIEW BODY CANSEE	II	B188
TOT	Integrates plume emissions and averages transmissivity over the specified wavelength bands	PLUMEX	II	B87
VECANG	Calculates the angle of a node relative to configuration centerline	REDII	II	B201
VIEW	Calculates and prints internal geometric view factors	EXEX	II	B96
WAVE	Determines the specific wavelengths for which calculations are to be made from the prescribed wavelength bands	PLUMEX	II	B59
XEQ	Executor Routine - Substitutes for cycle deck	---	Basic	B2

TABLE 10: PROGRAM PARAMETER DEFINITIONS

SYMBOL	DEFINITION	UNITS
A	Coefficient in equation for lockon interpolation	
A1	Coefficient for CO_2 line parameter strength	
A1, A2	Ray spectral correction factors adjusting to PCIR totals for each aspect angle	
A8	Throat Area	in^2
A9	Exit Area	in^2
A9Q8	A9/A8	
AA(10)	Dummy storage location	
AE(20) AI(20)	Wavelength intervals corresponding to the value of wavelength just beyond the band limit for the end and the beginning respectively of each band.	Microns
AI	Ray Emissions	watts/ster/ster.
AL(9)	Integrated absorption coefficients for H_2O	
AL	Altitudes in thousands of feet at which atmosphere changes characteristics. Defines altitude intervals	
AL	Wavelength interpolation factor for transmissivity	
AL1,AL2	Ray spectral correction factors adjusted to PCIR totals	
ALT,ALT1	Altitude	K Feet
AM	Wavelength	Microns
AME	Final Wavelength for each band interval	Microns
AMF	Final Wavelength	Microns
AMI	Initial wavelength of each band interval	Microns
AMO	First wavelength to be computed	Microns

TABLE 10 (CONT'D)

SYMBOL	DEFINITION	UNITS
AMR	Visible distance	Feet
AMX	Final wavelength	Microns
AMX	Just less than final wavelength	Microns
AN, AN1	Wave number	cm^{-1}
AN	Wave number	cm^{-1}
ANC	Fundamental vibrations for CO_2	cm
ANC	Number of increments for which atmospheric values are to be tabulated	
ANEI	Noise equivalent for reference missiles	cm^2
ANG	Current aspect angle	Degrees
ANO	Band centers for CO_2	cm^{-1}
ANU	Fundamental vibrations for H_2O	cm^{-1}
AP	Integrated absorption coefficients for CO_2	
AP	Projected areas	in^2
AR	Projected area of hot parts internal to exhaust system for each aspect angle	in^2
AREA	Area of exhaust system node surfaces	in^2
AQ	Determines whether wave number is above or below band center	
AQ	Sign of altitude differences	
ASP	Aspect angle from exhaust system centerline	Degrees
ASPI	Aspect ratios for rectangular exhaust shapes	
AT	Temperature difference for given altitude interval	°R
ATMS	Number of atmosphere segments in ray table	

TABLE 10 (CONT'D)

SYMBOL	DEFINITION	UNITS
ATOT	Total attenuated IR emissions for specified range	Watts/Sr.
ATST	Angle of diagonal for rectangular shaped exhaust	Degrees
AX,AXI	Current aspect ratio for rectangular exhahst shape	
B	Fundamental temperature - vibration factor	
B	Coefficient in equation for lockon calculation	
BB	Dummy storage	
BBEP	Black body emissive power	W/Sr.
BE	Molecular function for CO_2	
BI	Blackbody emissive power	Watts/Sr.
BL	Temperature factor for determining saturation concentration	
BL	Integrated absorption coefficients for CO, N_2O, and N_2	
BNU	Band centers for CO, N_2O and N_2	cm^{-1}
BSNS	Missile band sensitivity	
BTS	= 999. indicates no data has been supplied	
BUF4	Location of radiances to be integrated over wavelength bands	
BUF1	List of wavelengths for which correlations were made	Microns
BX,BZ	Molecular functions for CO, N_2O, and N_2	
C	Coefficient in equation for lockon calculation	
C1,C2	Constants in Planck's blackbody equation	
CA,CB	Temporary storage during graybody totalling	

TABLE 10 (CONT'D)

CASE	Number assigned internally to each different calculation set	
CDR	Conversion factor from radians to degrees	
CE(20), CI(20)	Wavelength intervals corresponding to the value of wavelength just inside the band limit for the end and beginning respectively of each band	
CIR1, CIR2	Hot parts cycle IR numbers	Watts/Sr.
CS	Cosine of aspect angle	
CX	Temporary storage location	
D	Log of (range + 250 feet)	
DA	Distance or range entries in atmospheric table	Feet
DAN	Wavenumber difference	cm^{-1}
DDM	Wavelength difference	Microns
DEL (2)	Wavelength increment used in graybody emission totalling	Microns
DH	Increment in altitude	K feet
DH	Location of CO_2 band head from band center	cm^{-1}
DL	Correction factor for CO_2 degeneracy	
DLL	Wavelength increment	Microns
DM	Wavelength interval associated with the given wavelength	Microns
DMN	Lockon range for each missile and aspect angle	Feet
DNX, DNY	Distance from band center for equivalent asymmetric mode	cm^{-1}
DNU	Distance from band center	cm^{-1}
DST	Range + 250 feet	Feet

TABLE 10 (CONT'D)

DXX	Plume core segment of ray	Feet
DZ1	Saved value of DNU	cm^{-1}
E	Emissivity	
EM	External Surface emissivity	
EMS	Exhaust Surface emissivity	
END,ENDA	Parameter to signal end or continuation of calculation	
EPS	A small quantity (0.00001)	
EXF	External flow plume suppression factor	
F	Proportion of initial altitude interval to be calculated	
F	View factors between exhaust system node surfaces	
F	Plume suppression factors: F(1) Broad/Round 1.8-2.7 F(2) Broad/Round 3.9-4.8 F(3) Narrow/Broad 1.8-2.7 F(4) Narrow/Broad 3.9-4.8	
F1,F2	Plume suppression factors	
F9	Ratio of A9/A8	
FAR,FAR8	Fuel-to-air ratio	
FE	Projected area	in^2
FIRST	Indicates initial calculation for specific engine configuration	
FS,FX	Temperature dependent effects for partially overlapped lines	
FX	Angle pattern factor for hot parts	
FXF	External flow plume suppression factor	

TABLE 10 (CONT'D)

G	Planck's spectral blackbody function	
GD,GDD	Natural p s collision halfwidth functions	
GNU	H_2O Band centers	cm^{-1}
GX	Constant $\pi/10$	
H	Current altitude for table	K feet
HC2,HDH, HRA,HRX	Empirical functions for H_2O	
HSG,HSX	H_2O integrated line parameters	
HPTOT	Hot parts source emissions	Watts/Str
HTOT	Hot parts attenuated emissions	Watts/Str.
IA,IAA	Counts current aspect angle	
IE	Counts current exhaust configuration	
IR	Counts the number of range being calculated	
ISURF	Surface number	
IT	Counts elevation angle being calculated	
IX	Counts aspect ratio being calculated	
K	Locates totals in BUFFER4	
K	Locates interval in XST table	
LA	Order of missile characteristics related to wavelength bands after sequencing	
LK	Determines whether a new step size interval is being encountered	
M	Locates initial band wavelength in AMI table band	
M	Locates storage for totals	

TABLE 10 (CONT'D)

MC1,MC2	Limits for CO_2 calculation loop
MDM	Determines whether step sizes are to be larger or smaller than suggested values
MH1,MH2	Limits for H_2O calculation loop
MO	Locates end of original buffer storage
MX	Signals whether reference missile characteristics are to be used
N	Number of exhaust surfaces
N	Locates terminal band wavelength in AME table
N	Locates radiation per micron in buffer for each wavelength
N1,N2	Denotes whether PIREP wavelength bands are reentered with input bands
NAI	Number of wavelengths to be computed
NAS	Number of aspect angles to be calculated for hot parts
NB	Number of altitude intervals to be computed
NC1,NC2, NC3	H_2O vibration quantum numbers
NL	Counter in PL array
NLOCK	Signals whether locon calculations are to be made
NNN	Number of inlet + exit nodes
NNNN	Signals centerline node
NODE	Node number
NPG	Case number being calculated
NPRINT	Signal for atmospheric or plume spectral computation

TABLE 10 (CONT'D)

		UNITS
NSPEC	Number of wavelength intervals	
NSS	Number of missiles to be evaluated	
NTOT1	Total number of nodal surfaces in exhaust system	
NTR	Signals whether aspect ratio calculations are to be made	
NTT	Printout counter for spectral emissions	
NX	Number of wavelengths to be calculated spectrally	
NX1 NX2	Counters to properly printout spectral results	
NXY	Location of spectral emission in AA array	
NXX	Location of band totals in AA array	
P,PX,PSAV	Pressure	Atmos.
PB	Integrated pressure-path length	Atmos/Ft
PH,PHD	Halfwidth functions	
PS,PX	Temperature dependent function for calculation of partially overlapping line effects	
P8	Exhaust gas total pressure	psia
PA	Pressure entries in atmospheric table	atms.
P8QAMB	Exhaust gas total to ambient pressure ratio	
PA	Pressure entries in atmospheric table	atms
PAMB	Atmospheric pressure	psia
PC	Storage for adjusted PCIR, CIR numbers	Watts/Str.
PC1,PC2	Storage for reference plume emissions after adjustment for attenuation factors	Watts/Str.
PCIR1,PCIR2	Plume IR numbers	Watts/Str.

TABLE 10 (CONT'D)

PL	Saturation concentration as a function of ground level temperature from 443°R by increments of 10°R	
PR	$(P8/PA)^{0.25}$	
PTOT	Plume IR emissions for each wavelength band	Watts/Ster.
PV	Partial pressure for current input	
PX	Atmospheric transmissivity factor pressure entries in ray table	Atmos.
QS	Scattering function	
RANGE	Range to observer	Feet
RF	Radial coordinates of exhaust surface	in.
RG	(range + 250)/1000	
RH	Reflection coefficients	
RX1	Plume through atmosphere	
RX2	Transmission factors for reference wavelength bands	
S1	CO_2 optical depth	
S1-S7	Logarithms of PCIR variables	
SA	Aspect angle pattern factor	
SCS	Signal for computing wavelength dependent value of scattering	
SD, SG, SK, SDX, SXQ	Molecular functions for H_2O local line parameters	
SGH, SXH	CO_2 integrated line parameters	
SKIP	Initialization indicator for emissivity calculations	
SN	Missile signal-to-noise ratio for lockon	
SNR	Signal to noise ratio for reference missiles	

TABLE 10 (CONT'D)

SPEE	Signals whether spectral calculations are to be made	
SS	Sine of aspect angle	
SW	Storage location for current wavelength during graybody totalling	
T	Temperature entries in ray table	°R
T5	Turbine discharge temperature	°R
T7	Exhaust gas exit temperature	°R
TA	Temperature entries in atmospheric tables	°R
TAK	Transmissivity	
TAMB	Ambient temperature	°R
TB	Hot parts source tempe ature effect in H_2O band transmissivity test	
TB, TBX	Temperature ratio functions	
TEST	Calculation limit for each band	cm^{-1}
THA	Aspect Angles	Degrees
THTA	Elevation angles to be calculated	Degrees
THT	Current elevation angle	Degrees
TM	Temperature of hot parts external to exhaust system	°R
TR	Averaged transmissivity of hot parts through atmospheric or plume/atmosphere	
TS	Static temperature	°R
TSC, TSK	Scattering factors	
TW	Exhaust system surface temperatures	°R
U	Exponential fundamental vibration factor	
V19	Secondary flow velocity	ft./sec.

TABLE 10 (CONT'D)

VE	External flow velocity	ft/sec
VECT	Normal vector for exhaust system surfaces (+ is inward)	
VR	Visible range	(K,km)
W	Initial wavelengths of specified	Microns
WRA	Cumulative emissions for each node surface	W/S
WV	Specific wavelengths for spectral calculation	Microns
X1,X2	Axial coordinates of exhaust surface	In.
X1	Optical depth, H_2O	Feet
XC	Axial coordinates defining exhaust system centerbody	in.
XC	CO_2 concentration entries in ray table	
XH	Water vapor concentration entries in ray table	
XHA	Water vapor concentration entries in atmospheric table	
XM	Flight Mach number	
XMC,XMH	CO_2, H_2O concentration in core stream	
XS	Segment length entries in ray table	
XST	Wavelength demarkation for changes in step size	Microns
XX	Storage area for suppression factors (F(1)-F(4)	
Y1,Y2	Radial coordinates of exhaust surface	In.
Y1	Portion of exit area associated with TW(1)	
YC	Radial coordinates defining exhaust system centerbody	In.
YF	Axial coordinates of exhaust system	in.
Z	Transmissivity	
ZT	Temperature factor	

REFERENCES

1. Draft PIREP Final Report (to be Published)

2. Wilton, M.E., "Spectral Calculation of Infrared Radiation from a Turbine Propulsion System as Intercepted by an Observer - Volume II - Analysis", General Electric Company R73AEG322, September 1973.

APPENDIX A

OUTPUT FOR TEST PROBLEMS

		Page
A-I	Test Problem 1	A2
A-II	Test Problem 2	A5
A-III	Test Problem 3	A19
A-IV	Test Problem 4	A29
A-V	Test Problem 5	A39
A-VI	Test Problem 6	A71
A-VII	Test Problem 7	A86

BEST AVAILABLE COPY

CASE NO. 1.0

T7	1415.00	T5	1992.00
P8	42.53	A8	511.30
PAMB	14.70	XM	0.
VC19	0.		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	20.	299.
HOT PTS	1836.	1211.

CASE NO. 2.0

T7	1388.00	T5	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	309.
HOT PTS	2010.	1298.

CASE NO. 3.0

TT	1402.00	TS	2031.00
P8	20.64	A8	529.80
PAMB	1.68	XM	2.00
VC19	0.		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	1.	107.
HOT PTS	2127.	1334.

CASE NO. 4.0

TT	1992.00	TS	1992.00
P8	42.70	A8	320.70
PAMB	14.70	XM	0.
VC19	1540.70		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	205.	10[illegible]8.
HOT PTS	1151.	[illegible]39.

CASE NO. 5.0

T7	2008.00	T5	2008.00
P8	55.36	A8	311.90
PAMB	14.70	XM	1.00
VC19	1805.70		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	241.	1410.
HOT PTS	1173.	757.

CASE NO. 6.0

T7	2031.00	T5	2031.00
P8	19.77	A8	298.10
PAMB	1.68	XM	2.00
VC19	2353.10		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	671.
HOT PTS	1197.	750.

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 1

** PIREP OUTPUT **

T7	1388.00	TS	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.	ALT	0.
EAR	0.01		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	349.
HOT PTS	2010.	1298.

* * * * * * * * * * * * * * * * * * * *

MISSILE PARAMETERS

* * * * * * * * * * * * * * * * * * * *

NO.	WAVELENGTH BAND (MICRONS)	SENSITIVITY	NEI (WATTS/CM**2)	S/N
1	1.80 -.700	1.0	0.2000E-09	3.0
2	3.90 -.800	1.0	0.4000E-10	0.7

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 1

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXHAUST GAS PLUME [ ] STATISTICS

SIDE NUMBER	TEMPERATURE (K)	PROJECTED AREAS (I-2) AT EACH ASPECT ANGLE 0.	30.0	60.0
1	2004.0	530.6	465.0	267.3

ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 2010.13

ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 1298.23

ASP = 30.00DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 1740.83

ASP = 30.00DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 1124.30

ASP = 60.00DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 1005.07

ASP = 60.00DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 649.12

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1,4492 WATTS
FROM 3.90 TO 4.80 MICRONS = 30,4436 WATTS

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 2010.1341 WATTS
FROM 3.90 TO 4.80 MICRONS = 1298.2283 WATTS

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 2

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 5000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0237	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1.2522	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	827.6779	WT/ST
FROM 3.90 TO 4.80	MICRONS =	663.7175	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 3

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	424.2439	WT/ST
FROM 3.90 TO 4.80	MICRONS =	424.5750	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 4

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 100000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0026	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.0741	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	302.7981	WT/ST
FROM 3.90 TO 4.80	MICRONS =	352.5859	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 5

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3138	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6505	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1740.8292	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1124.3000	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 6

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 5000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.1361	WT/ST
FROM 3.90 TO 4.80	MICRONS =	7.1839	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	716.7909	WT/ST
FROM 3.90 TO 4.80	MICRONS =	574.7969	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 7

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	367.4064	WT/ST
FROM 3.90 TO 4.80	MICRONS =	367.6932	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 9

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 60.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	14.3999	WT/ST
FROM 3.90 TO 4.80	MICRONS =	302.5041	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1005.0741	WT/ST
FROM 3.90 TO 4.80	MICRONS =	649.1187	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 8

PIREP EXTENSION STUDY

E EVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 50.00 DEGREES
RANGE = 100000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0151	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.4251	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	262.2312	WT/ST
FROM 3.90 TO 4.80	MICRONS =	305.3487	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 10

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 60.00 DEGREES
RANGE = 5000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.2358	WT/ST
FROM 3.90 TO 4.80	MICRONS =	12.4428	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	413.8419	WT/ST
FROM 3.90 TO 4.80	MICRONS =	331.8611	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 11

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 60.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0305	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1.1222	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	212.1234	WT/ST
FROM 3.90 TO 4.80	MICRONS =	212.2890	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 12

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 60.00 DEGREES
RANGE = 100000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0262	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.7363	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	151.4001	WT/ST
FROM 3.90 TO 4.80	MICRONS =	176.2942	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 13

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	16.6276	WT/ST
FROM 3.90 TO 4.80	MICRONS =	349.3025	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 14

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 5000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.2723	WT/ST
FROM 3.90 TO 4.80	MICRONS =	14.3678	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 15

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0352	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1.2958	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 17

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 130.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	12.7374	WT/ST
FROM 3.90 TO 4.80	MICRONS =	267.5805	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 16

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 100000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0303	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.8502	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 18

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 130.00 DEGREES
RANGE = 5000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.2086	WT/ST
FROM 3.90 TO 4.80	MICRONS =	11.0063	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 19

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 130.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0270	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.9926	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 20

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 130.00 DEGREES
RANGE = 100000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0232	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6513	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 21

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2.8873	WT/ST
FROM 3.90 TO 4.80	MICRONS =	60.6555	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 22

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 5000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0473	WT/ST
FROM 3.90 TO 4.80	MICRONS =	2.4949	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 23

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0061	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.2250	WT/ST

PIREP TEST PROBLEM 2
SIGNATURE AND LOCKON

CASE 24

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 100000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 0.0053 WT/ST
FROM 3.90 TO 4.80 MICRONS = 0.1476 WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
0.	30508.	11804.
30.00	28709.	111251.
60.00	22720.	86837.
90.00	2299.	12930.
130.00	2210.	11878.
170.00	1836.	7530.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 1

** PIREP OUTPUT **

TT	1388.00	T5	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.	ALT	0.
FAR	0.01		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	349.
HOT PTS	2010.	1298.

* * * * * * * * * * * * * * * * * * * *

MISSILE PARAMETERS

* * * * * * * * * * * * * * * * * * * *

NO.	WAVELENGTH BAND (MICRONS)	SENSITIVITY	NEI (WATTS/CM**2)	S/N
1	1.80 -.700	0.5	0.2000E-09	5.0
2	3.90 -.800	0.7	0.4000E-10	0.7

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 1

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	16.6276	WT/ST
FROM 3.90 TO 4.80	MICRONS =	349.3025	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 2

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0352	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1.2958	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	MISSILE NUMBER 2
90.00	1413.	12372.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 3

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 4.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	3.5956	WT/ST
FROM 3.90 TO 4.80	MICRONS =	167.0830	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 4

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 4.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0140	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6198	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	MISSILE NUMBER 2
90.00	1055.	9719.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 5

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 10.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2.3279	WT/ST
FROM 3.90 TO 4.80	MICRONS =	95.3596	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 6

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 10.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0049	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.3530	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
90.00	759.	8089.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 7

PIREP EXTENSION STUDY

ELEVATION ANGLE= 45.0 DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	16.6276	WT/ST
FROM 3.90 TO 4.80	MICRONS =	349.3025	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 8

PIREP EXTENSION STUDY

ELEVATION ANGLE= 45.0 DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0352	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1.2958	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	MISSILE NUMBER 2
90.00	1413.	12372.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 9

PIREP EXTENSION STUDY

ELEVATION ANGLE= 45.0 DEGREES
ASPECT RATIO = 4.00
ASPECT ANGLE = 90.0 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	5.7456	WT/ST
FROM 3.90 TO 4.80 MICRONS =	151.7494	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 10

PIREP EXTENSION STUDY

ELEVATION ANGLE= 45.0 DEGREES
ASPECT RATIO = 4.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	0.0122	WT/ST
FROM 3.90 TO 4.80 MICRONS =	0.5629	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
90.00	10 0.	9417.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 11

PIREP EXTENSION STUDY

ELEVATION ANGLE= 45.0 DEGREES
ASPECT RATIO = 10.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1.7960	WT/ST
FROM 3.90 TO 4.80	MICRONS =	78.3223	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 12

PIREP EXTENSION STUDY

ELEVATION ANGLE= 45.0 DEGREES
ASPECT RATIO = 10.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0038	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.2906	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
90.00	699.	7564.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 13

PIREP EXTENSION STUDY

ELEVATION ANGLE= 90.0 DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 16.6276 WT/ST
FROM 3.90 TO 4.80 MICRONS = 349.3025 WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 14

PIREP EXTENSION STUDY

ELEVATION ANGLE= 90.0 DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 0.0352 WT/ST
FROM 3.90 TO 4.80 MICRONS = 1.2958 WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
90.00	1413.	12572.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 15

PIREP EXTENSION STUDY

ELEVATION ANGLE= 90.0 DEGREES
ASPECT RATIO = 4.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	3.6936	WT/ST
FROM 3.90 TO 4.80	MICRONS =	114.7307	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 16

PIREP EXTENSION STUDY

ELEVATION ANGLE= 90.0 DEGREES
ASPECT RATIO = 4.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0078	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.4256	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
90.00	878.	8594.

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 17

PIREP EXTENSION STUDY

ELEVATION ANGLE= 90.0 DEGREES
ASPECT RATIO = 10.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	0.5121	WT/ST
FROM 3.90 TO 4.80 MICRONS =	37.1906	WT/ST

PIREP TEST PROBLEM 3
PLUME SUPPRESSION

CASE 18

PIREP EXTENSION STUDY

ELEVATION ANGLE= 90.0 DEGREES
ASPECT RATIO = 10.00
ASPECT ANGLE = 90.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	0.0011	WT/ST
FROM 3.90 TO 4.80 MICRONS =	0.1380	WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
90.00	470.	5944.

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 1

** PIREP OUTPUT **

T7	1388.00	T5	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.	ALT	0.
FAR	0.01		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	349.
HOT PTS	2010.	1298.

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 1

PIREP EXTENSION STUDY

ELEVATION ANGLE =	0.	DEGREES
ASPECT RATIO =	1.00	
ASPECT ANGLE =	0.	DEGREES
RANGE =	0.	FEET

EXHAUST HOT PARTS [ ]

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (IN^2) AT EACH ASPECT ANGLE 0.	30.0
1	1500.0	133.6	115.7
2	2000.0	401.0	347.2

NODE	AREA (SQ.INCHES),	DIRECT EMISSIONS	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
	ASP = 0. DEGREES,	WAVELENGTH BAND	1.8 - 2.7	TOTAL EMISSIONS =	1581.16
1	0.13365E 03	0.73093E 02	0.73010E-02	0.73011E 02	0.73011E 02
2	0.40095E 03	0.15076E 04	0.15077E 00	0.15078E 04	0.15078E 04
	ASP = 0. DEGREES,	WAVELENGTH BAND	3.9 - 4.1	TOTAL EMISSIONS =	1087.84
1	0.13365E 03	0.11406E 03	0.11407E-01	0.11407E 03	0.11407E 03
2	0.40095E 03	0.97367E 03	0.97382E-01	0.97377E 03	0.97377E 03
	ASP = 30.00DEGREES,	WAVELENGTH BAND	1.8 - 2.7	TOTAL EMISSIONS =	1369.33
1	0.11574E 03	0.63569E 02	0.63577E-02	0.63578E 02	0.63576E 02
2	0.34723E 03	0.13056E 04	0.13058E 00	0.13058E 04	0.13058E 04
	ASP = 30.00DEGREES,	WAVELENGTH BAND	3.9 - 4.2	TOTAL EMISSIONS =	942.10
1	0.11574E 03	0.98777E 02	0.98791E-02	0.98780E 02	0.98780E 02
2	0.34723E 03	0.84322E 03	0.84335E-01	0.84331E 03	0.84331E 03

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.4491 -1/SR
FROM 3.90 TO 4.80 MICRONS = 30.4918 -1/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1581.1612 -1/SR
FROM 3.90 TO 4.80 MICRONS = 1087.8332 -1/SR

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION 1

CASE 2

PIREP EXTENSION STUDY

ELEVATION ANGLE= [illegible] DEGREES
ASPECT RATIO = [illegible]
ASPECT ANGLE = [illegible] DEGREES
RANGE = [illegible] FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = [illegible] WT/ST
FROM 3.90 TO 4.80 MICRONS = [illegible] WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 333.2284 WT/ST
FROM 3.90 TO 4.80 MICRONS = 355.7683 WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION 1

CASE 3

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 8.3132 WT/ST
FROM 3.90 TO 4.80 MICRONS = 174.6405 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1369.3280 WT/ST
FROM 3.90 TO 4.80 MICRONS = 942.0958 WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 4

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	288.5846	WT/ST
FROM 3.90 TO 4.80	MICRONS =	306.1048	WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 5

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXHAUST HOT PARTS INSULATION

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREA (IN**2) AT EACH ASPECT ANGLE 0.	30.0
1	1500.0	267.3	231.5
2	2000.0	267.3	231.5

NODE	AREA (SQ.INCHES),	DIRECT EMISSIONS	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS

ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 1151.99

1	0.26730E 03	0.19683E 03	0.19683E-01	0.19952E 03	0.19952E 03
2	0.26730E 03	0.10052E 00	0.10052E 00	0.10052E 00	0.10052E 00

ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 877.32

1	0.26730E 03	0.22811E 03	0.22814E-01	0.22819E 03	0.22819E 03
2	0.26730E 03	0.64991E 03	0.64991E-01	0.64991E 03	0.64991E 03

ASP = 30.0000DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 997.65

1	0.23149E 03	0.12718E 03	0.12715E-01	0.12715E 03	0.12715E 03
2	0.23149E 03	0.87041E 03	0.87051E-01	0.87050E 03	0.87050E 03

ASP = 30.0000DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 759.78

1	0.23149E 03	0.19755E 03	0.19758E-01	0.19757E 03	0.19757E 03
2	0.23149E 03	0.56221E 03	0.56221E-01	0.56221E 03	0.56221E 03

PLUME IR TOTALS

FROM 1.90 TO 2.70 MICRONS = 1.0001 WATTS
FROM 3.90 TO 4.80 MICRONS = 30.0016 WATTS

ATTENUATED HOT PARTS IR TOTALS

FROM 1.90 TO 2.70 MICRONS = 1151.9987 WATTS
FROM 3.90 TO 4.80 MICRONS = 877.3165 WATTS

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 6

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	242.1330	WT/ST
FROM 3.90 TO 4.80	MICRONS =	286.9192	WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 7

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	997.6527	WT/ST
FROM 3.90 TO 4.80	MICRONS =	759.7791	WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 8

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	209.6936	WT/ST
FROM 3.90 TO 4.80	MICRONS =	248.4796	WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 9

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (FT2) AT EACH ASPECT ANGLE 0.	30.0
1	1500.0	539.6	463.6

ASP = 0. DEGREES. WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 293.61

ASP = 0. DEGREES. WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 856.23

ASP = 30.00DEGREES. WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 254.28

ASP = 30.00DEGREES. WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 395.11

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.4441 MT/ST
FROM 3.90 TO 4.80 MICRONS = 30.8418 MT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 293.6130 MT/ST
FROM 3.90 TO 4.80 MICRONS = 456.2249 MT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 10

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	58.8667	WT/ST
FROM 3.90 TO 4.80	MICRONS =	149.2060	WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 11

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	254.2766	WT/ST
FROM 3.90 TO 4.80	MICRONS =	395.1063	WT/ST

PIREP TEST PROBLEM 4
HOT PARTS SUPPRESSION I

CASE 12

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	50.9801	WT/ST
FROM 3.90 TO 4.80	MICRONS =	129.2163	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 1

** PIREP OUTPUT **

T7	1388.00	T5	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.	ALT	0.
FAR	0.01		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	349.
HOT PTS	2010.	1298.

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 1

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	30.00	50.00	70.00
20.00	20.00	13.05	14.60

CENTERBODY COORDINATES, IN.

0.	10.00
10.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)=	0.50261	F(1, 1)=	0.50261
F(1, 2)=	0.20569	F(2, 1)=	0.35272
F(1, 3)=	0.02801	F(3, 1)=	0.06060
F(1, 4)=	0.08432	F(4, 1)=	0.71547
F(1, 5)=	0.18228	F(5, 1)=	0.72914
F(1, 6)=	0.01707	F(6, 1)=	0.09611
AREA(1)=	3769.91 SQ. IN.		

F(2, 1)=	0.35272	F(1, 2)=	0.20569
F(2, 2)=	0.41534	F(2, 2)=	0.41534
F(2, 3)=	0.11355	F(3, 2)=	0.14326
F(2, 4)=	0.03289	F(4, 2)=	0.16277
F(2, 5)=	0.07807	F(5, 2)=	0.18211
F(2, 6)=	0.02086	F(6, 2)=	0.06847
AREA(2)=	2198.40 SQ. IN.		

F(3, 1)=	0.06060	F(1, 3)=	0.02801
F(3, 2)=	0.14326	F(2, 3)=	0.11355
F(3, 3)=	0.50482	F(3, 3)=	0.50482
F(3, 4)=	0.00373	F(4, 3)=	0.01463
F(3, 5)=	0.01039	F(5, 3)=	0.01922
F(3, 6)=	0.31813	F(6, 3)=	0.02781
AREA(3)=	1742.51 SQ. IN.		

F(4, 1)=	0.71547	F(1, 4)=	0.08432
F(4, 2)=	0.16277	F(2, 4)=	0.03289
F(4, 3)=	0.01463	F(3, 4)=	0.00373
F(4, 4)=	0.	F(4, 4)=	0.
F(4, 5)=	0.07829	F(5, 4)=	0.03690
F(4, 6)=	0.02894	F(6, 4)=	0.01920
AREA(4)=	444.29 SQ. IN.		

F(5, 1)=	0.72914	F(1, 5)=	0.18228
F(5, 2)=	0.18211	F(2, 5)=	0.07807
F(5, 3)=	0.01922	F(3, 5)=	0.01039
F(5, 4)=	0.03690	F(4, 5)=	0.07829
F(5, 5)=	0.	F(5, 5)=	0.
F(5, 6)=	0.03411	F(6, 5)=	0.04801
AREA(5)=	942.48 SQ. IN.		

F(6, 1)=	0.09611	F(1, 6)=	0.01707
F(6, 2)=	0.06847	F(2, 6)=	0.02086
F(6, 3)=	0.82781	F(3, 6)=	0.31813
F(6, 4)=	0.01920	F(4, 6)=	0.02894
F(6, 5)=	0.04801	F(5, 6)=	0.03411
F(6, 6)=	0.	F(6, 6)=	0.
AREA(6)=	669.66 SQ. IN.		

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2008.0	0.	176.8
2	1388.0	0.	76.6
3	1388.0	138.6	331.2
4	2008.0	313.8	0.
5	2188.0	216.8	0.

NODE	AREA (SQ.INCHES),	DIRECT EMISSIONS	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
ASP = 0. DEGREES,		WAVELENGTH BAND 1.8 - 2.7		TOTAL EMISSIONS =	2237.31
1	0.	0.	0.	0.	0.26170E 03
2	0.	0.	0.	0.	0.78877E 01
3	0.13864E 03	0.27879E 02	0.30526E 02	0.57605E 02	0.33909E 02
4	0.31381E 03	0.76769E 03	0.34064E 03	0.11077E 04	0.17647E 03
5	0.21677E 03	0.10719E 04	0.63156E-01	0.10720E 04	0.11573E 04
ASP = 0. DEGREES,		WAVELENGTH BAND 3.9 - 4.8		TOTAL EMISSIONS =	1416.50
1	0.	0.	0.	0.	0.16901E 03
2	0.	0.	0.	0.	0.10148E 02
3	0.13864E 03	0.55439E 02	0.30397E 02	0.85836E 02	0.69416E 02
4	0.31381E 03	0.69548E 03	0.22351E 03	0.71891E 03	0.58146E 03
5	0.21677E 03	0.61171E 03	0.42305E-01	0.61175E 03	0.66044E 03
ASP = 30.00DEGREES,		WAVELENGTH BAND 1.8 - 2.7		TOTAL EMISSIONS =	839.23
1	0.17688E 03	0.43019E 03	0.19719E 03	0.62738E 03	0.60443E 03
2	0.76637E 02	0.14969E 02	0.59269E 02	0.74218E 02	0.20429E 02
3	0.33123E 03	0.44696E 02	0.72931E 02	0.11763E 03	0.80442E 02
4	0.	0.	0.	0.	0.22959E 02
5	0.	0.	0.	0.	0.19697E 03
ASP = 30.00DEGREES,		WAVELENGTH BAND 3.9 - 4.8		TOTAL EMISSIONS =	683.86
1	0.17688E 03	0.27783E 03	0.12810E 03	0.40593E 03	0.39035E 03
2	0.76637E 02	0.38645E 02	0.82231E 02	0.72078E 02	0.54100E 02
3	0.33123E 03	0.13245E 03	0.72623E 02	0.20507E 03	0.10669E 03
4	0.	0.	0.	0.	0.14820E 02
5	0.	0.	0.	0.	0.59903E 02

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.6491 WT/ST
FROM 3.90 TO 4.80 MICRONS = 50.8418 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 2237.3072 WT/ST
FROM 3.90 TO 4.80 MICRONS = 1416.6957 WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 2

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	473.2798	WT/ST
FROM 3.90 TO 4.80	MICRONS =	463.2534	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 3

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	839.2278	WT/ST
FROM 3.90 TO 4.80	MICRONS =	683.8834	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 4

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	176.3745	WT/ST
FROM 3.90 TO 4.80	MICRONS =	223.6585	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 5

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	30.00	50.00	70.00
20.00	20.00	13.05	14.60

CENTERBODY COORDINATES, IN./

0.	10.00
10.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)= 0.50261	F(1, 1)= 0.50261
F(1, 2)= 0.20569	F(2, 1)= 0.35272
F(1, 3)= 0.02801	F(3, 1)= 0.06060
F(1, 4)= 0.08432	F(4, 1)= 0.71547
F(1, 5)= 0.18228	F(5, 1)= 0.72914
F(1, 6)= 0.01707	F(6, 1)= 0.09611
AREA(1)= 3769.91 SQ. IN.	

F(2, 1)= 0.35272	F(1, 2)= 0.20569
F(2, 2)= 0.41534	F(2, 2)= 0.41534
F(2, 3)= 0.11355	F(3, 2)= 0.14326
F(2, 4)= 0.03289	F(4, 2)= 0.16277
F(2, 5)= 0.07807	F(5, 2)= 0.18211
F(2, 6)= 0.02086	F(6, 2)= 0.06847
AREA(2)= 2198.40 SQ. IN.	

F(3, 1)= 0.06060	F(1, 3)= 0.02801
F(3, 2)= 0.14326	F(2, 3)= 0.11355
F(3, 3)= 0.50482	F(3, 3)= 0.50482
F(3, 4)= 0.00373	F(4, 3)= 0.01463
F(3, 5)= 0.01039	F(5, 3)= 0.01922
F(3, 6)= 0.31813	F(6, 3)= 0.82781
AREA(3)= 1742.51 SQ. IN.	

F(4, 1)= 0.71547	F(1, 4)= 0.08432
F(4, 2)= 0.16277	F(2, 4)= 0.03289
F(4, 3)= 0.01463	F(3, 4)= 0.00373
F(4, 4)= 0.	F(4, 4)= 0.
F(4, 5)= 0.07829	F(5, 4)= 0.03690
F(4, 6)= 0.02894	F(6, 4)= 0.01920
AREA(4)= 444.29 SQ. IN.	

F(5, 1)= 0.72914	F(1, 5)= 0.18228
F(5, 2)= 0.18211	F(2, 5)= 0.07807
F(5, 3)= 0.01922	F(3, 5)= 0.01039
F(5, 4)= 0.03690	F(4, 5)= 0.07829
F(5, 5)= 0.	F(5, 5)= 0.
F(5, 6)= 0.03411	F(6, 5)= 0.04801
AREA(5)= 942.48 SQ. IN.	

F(6, 1)= 0.09611	F(1, 6)= 0.01707
F(6, 2)= 0.06847	F(2, 6)= 0.02086
F(6, 3)= 0.82781	F(3, 6)= 0.31813
F(6, 4)= 0.01920	F(4, 6)= 0.02894
F(6, 5)= 0.04801	F(5, 6)= 0.03411
F(6, 6)= 0.	F(6, 6)= 0.
AREA(6)= 669.66 SQ. IN.	

EXHAUST HOT PARTS DISTRIBUTION

NODE NUMBER	TEMPERATURE (F)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2605.0	0.	176.0
2	1384.0	0.	76.6
3	1308.0	132.6	351.2
4	1100.0	313.8	0.
5	210A.0	216.8	0.

NODE	AREA (SQ.INCHES),	DIRECT EMISSIONS	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 1125.53					
1	0.	0.	0.	0.	0.14705E 00
2	0.	0.	0.	0.	0.33199E-02
3	0.13864E 03	0.41656E 02	0.65989E-02	0.41663E 02	0.41659E 02
4	0.31381E 03	0.11762E 02	0.98255E-01	0.11860E 02	0.11762E 02
5	0.21677E 03	0.10719E 04	0.60776E-01	0.10720E 04	0.10720E 04
ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 759.07					
1	0.	0.	0.	0.	0.94969E-01
2	0.	0.	0.	0.	0.67967E-02
3	0.13864E 03	0.85282E 02	0.80032E-02	0.85290E 02	0.85287E 02
4	0.31381E 03	0.61971E 02	0.69888E-01	0.62038E 02	0.61971E 02
5	0.21677E 03	0.61171E 03	0.41229E-01	0.61175E 03	0.61171E 03
ASP = 30.00DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 784.39					
1	0.17600E 03	0.66174E 03	0.50430E-01	0.66181E 03	0.66181E 03
2	0.76637E 02	0.23026E 02	0.14352E-01	0.23041E 02	0.23030E 02
3	0.33123E 03	0.99522E 02	0.15766E-01	0.99538E 02	0.99526E 02
4	0.	0.	0.	0.	0.69707E-04
5	0.	0.	0.	0.	0.20532E-01
ASP = 30.00DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 670.45					
1	0.17600E 03	0.42739E 03	0.33367E-01	0.42743E 03	0.42743E 03
2	0.76637E 02	0.47142E 02	0.10796E-01	0.47152E 02	0.47149E 02
3	0.33123E 03	0.20375E 03	0.19121E-01	0.20377E 03	0.20376E 03
4	0.	0.	0.	0.	0.36728E-03
5	0.	0.	0.	0.	0.11716E-01

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.4491 WT/ST
FROM 3.90 TO 4.80 MICRONS = 30.4418 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1125.5320 WT/ST
FROM 3.90 TO 4.80 MICRONS = 759.0747 WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 6

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	238.3871	WT/ST
FROM 3.90 TO 4.80	MICRONS =	248.2492	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 7

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	784.3929	WT/ST
FROM 3.90 TO 4.80	MICRONS =	678.3499	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 8

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 30000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	164.5011	WT/ST
FROM 3.90 TO 4.80	MICRONS =	221.8488	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 9

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	30.00	50.00	70.00
20.00	20.00	13.05	14.60

CENTERBODY COORDINATES, IN./

0.	10.00
10.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)=	0.50261	F(1, 1)=	0.50261
F(1, 2)=	0.20569	F(2, 1)=	0.35272
F(1, 3)=	0.02801	F(3, 1)=	0.06060
F(1, 4)=	0.08432	F(4, 1)=	0.71547
F(1, 5)=	0.18228	F(5, 1)=	0.72914
F(1, 6)=	0.01707	F(6, 1)=	0.09611

AREA(1)= 3769.91 SQ. IN.

F(2, 1)=	0.35272	F(1, 2)=	0.20569
F(2, 2)=	0.41534	F(2, 2)=	0.41534
F(2, 3)=	0.11355	F(3, 2)=	0.14326
F(2, 4)=	0.03289	F(4, 2)=	0.16277
F(2, 5)=	0.07807	F(5, 2)=	0.18211
F(2, 6)=	0.02086	F(6, 2)=	0.06847

AREA(2)= 2198.40 SQ. IN.

F(3, 1)=	0.06060	F(1, 3)=	0.02801
F(3, 2)=	0.14326	F(2, 3)=	0.11355
F(3, 3)=	0.50482	F(3, 3)=	0.50482
F(3, 4)=	0.00373	F(4, 3)=	0.01463
F(3, 5)=	0.01039	F(5, 3)=	0.01922
F(3, 6)=	0.31813	F(6, 3)=	0.82781

AREA(3)= 1742.51 SQ. IN.

F(4, 1)=	0.71547	F(1, 4)=	0.08432
F(4, 2)=	0.16277	F(2, 4)=	0.03289
F(4, 3)=	0.01463	F(3, 4)=	0.00373
F(4, 4)=	0.	F(4, 4)=	0.
F(4, 5)=	0.07829	F(5, 4)=	0.03690
F(4, 6)=	0.02894	F(6, 4)=	0.01920

AREA(4)= 444.29 SQ. IN.

F(5, 1)=	0.72914	F(1, 5)=	0.18228
F(5, 2)=	0.18211	F(2, 5)=	0.07807
F(5, 3)=	0.01922	F(3, 5)=	0.01039
F(5, 4)=	0.03690	F(4, 5)=	0.07829
F(5, 5)=	0.	F(5, 5)=	0.
F(5, 6)=	0.03411	F(6, 5)=	0.04801

AREA(5)= 942.48 SQ. IN.

F(6, 1)=	0.09611	F(1, 6)=	0.01707
F(6, 2)=	0.06847	F(2, 6)=	0.02086
F(6, 3)=	0.82781	F(3, 6)=	0.31813
F(6, 4)=	0.01920	F(4, 6)=	0.02894
F(6, 5)=	0.04801	F(5, 6)=	0.03411
F(6, 6)=	0.	F(6, 6)=	0.

AREA(6)= 669.66 SQ. IN.

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (°F)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2028.0	0.	176.0
2	1388.0	0.	76.6
3	1100.0	136.6	331.2
4	1100.0	313.8	0.
5	2100.0	216.8	0.

NODE	AREA (SQ.INCHES),	DIRECT EMISSIONS	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
	ASP = 0. DEGREES,	WAVELENGTH BAND	1.8 - 2.7		TOTAL EMISSIONS = 1439.02
1	0.	0.	0.	0.	0.26179E 03
2	0.	0.	0.	0.	0.78945E 01
3	0.13684E 03	0.33779E 01	0.24195E 02	0.27573E 02	0.42299E 01
4	0.31381E 03	0.76459E 01	0.33179E 03	0.33944E 03	0.77398E 01
5	0.21677E 03	0.10719E 04	0.59347E-01	0.10720E 04	0.11574E 04
	ASP = 0. DEGREES,	WAVELENGTH BAND	3.9 - 4.8		TOTAL EMISSIONS = 908.75
1	0.	0.	0.	0.	0.16907E 03
2	0.	0.	0.	0.	0.10162E 02
3	0.13684E 03	0.17798E 02	0.21489E 02	0.39266E 02	0.22287E 02
4	0.31381E 03	0.40285E 02	0.21748E 03	0.25772E 03	0.40780E 02
5	0.21677E 03	0.61171E 03	0.39856E-01	0.61175E 03	0.66045E 03
	ASP = 30.0 DEGREES,	WAVELENGTH BAND	1.8 - 2.7		TOTAL EMISSIONS = 746.57
1	0.17600E 03	0.43019E 03	0.18004E 03	0.61063E 03	0.60464E 03
2	0.76637E 02	0.14964E 02	0.54898E 02	0.69862E 02	0.20441E 02
3	0.33123E 03	0.80703E 01	0.57806E 02	0.65876E 02	0.10036E 02
4	0.	0.	0.	0.	0.22894E 00
5	0.	0.	0.	0.	0.10503E 03
	ASP = 30.0 DEGREES,	WAVELENGTH BAND	3.9 - 4.8		TOTAL EMISSIONS = 5[illegible].65
1	0.17600E 03	0.27703E 03	0.11780E 03	0.39052E 03	0.39050E 03
2	0.76637E 02	0.36445E 02	0.33851E 02	0.69996E 02	0.54133E 02
3	0.33123E 03	0.42521E 02	0.51339E 02	0.93860E 02	0.52857E 02
4	0.	0.	0.	0.	0.12[illegible]2E 01
5	0.	0.	0.	0.	0.59[illegible]5E 02

PLUME IR TOTALS

FROM 1.60 TO 2.70 MICRONS = 1.4441 WT/ST
FROM 3.90 TO 4.80 MICRONS = 30.8818 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.60 TO 2.70 MICRONS = 1439.0193 WT/ST
FROM 3.90 TO 4.80 MICRONS = 908.7539 WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 10

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80 MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	304.8907	WT/ST
FROM 3.90 TO 4.80 MICRONS =	297.2006	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 11

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80 MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	746.3737	WT/ST
FROM 3.90 TO 4.80 MICRONS =	558.6503	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 12

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	157.3289	WT/ST
FROM 3.90 TO 4.80	MICRONS =	182.7020	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 13

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	30.00	50.00	70.00
20.00	20.00	13.05	14.60

CENTERBODY COORDINATES, IN./

0.	10.00
10.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)= 0.50261	F(1, 1)= 0.50261
F(1, 2)= 0.20569	F(2, 1)= 0.35272
F(1, 3)= 0.02801	F(3, 1)= 0.06060
F(1, 4)= 0.08432	F(4, 1)= 0.71547
F(1, 5)= 0.18228	F(5, 1)= 0.72914
F(1, 6)= 0.01707	F(6, 1)= 0.09611
AREA(1)= 769.91 SQ. IN.	

F(2, 1)= 0.35272	F(1, 2)= 0.20569
F(2, 2)= 0.41534	F(2, 2)= 0.41534
F(2, 3)= 0.11355	F(3, 2)= 0.14326
F(2, 4)= 0.03289	F(4, 2)= 0.16277
F(2, 5)= 0.07807	F(5, 2)= 0.18211
F(2, 6)= 0.02086	F(6, 2)= 0.06847
AREA(2)= 2198.40 SQ. IN.	

F(3, 1)= 0.06060	F(1, 3)= 0.02801
F(3, 2)= 0.14326	F(2, 3)= 0.11355
F(3, 3)= 0.50482	F(3, 3)= 0.50482
F(3, 4)= 0.00373	F(4, 3)= 0.01463
F(3, 5)= 0.01039	F(5, 3)= 0.01922
F(3, 6)= 0.31813	F(6, 3)= 0.82781
AREA(3)= 1742.51 SQ. IN.	

F(4, 1)= 0.71547	F(1, 4)= 0.08432
F(4, 2)= 0.16277	F(2, 4)= 0.03289
F(4, 3)= 0.01463	F(3, 4)= 0.00373
F(4, 4)= 0.	F(4, 4)= 0.
F(4, 5)= 0.07829	F(5, 4)= 0.03690
F(4, 6)= 0.02894	F(6, 4)= 0.01920
AREA(4)= 444.29 SQ. IN.	

F(5, 1)= 0.72914	F(1, 5)= 0.18228
F(5, 2)= 0.18211	F(2, 5)= 0.07807
F(5, 3)= 0.01922	F(3, 5)= 0.01039
F(5, 4)= 0.03690	F(4, 5)= 0.07829
F(5, 5)= 0.	F(5, 5)= 0.
F(5, 6)= 0.03411	F(6, 5)= 0.04801
AREA(5)= 942.48 SQ. IN.	

F(6, 1)= 0.09611	F(1, 6)= 0.01707
F(6, 2)= 0.06847	F(2, 6)= 0.02086
F(6, 3)= 0.82781	F(3, 6)= 0.31813
F(6, 4)= 0.01920	F(4, 6)= 0.02894
F(6, 5)= 0.04801	F(5, 6)= 0.03411
F(6, 6)= 0.	F(6, 6)= 0.
AREA(6)= 669.[illegible] SQ. IN.	

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2006.0	0.	176.0
2	1380.0	0.	76.6
3	1100.0	176.4	331.2
4	1100.0	313.8	0.
5	2100.0	216.0	0.

NODE	AREA (SQ.INCHES)	DIRECT EMISSIONS (WATTS/STERADIAN)	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7					TOTAL EMISSIONS = 1438.90
1	0.	0.	0.	0.	0.26170E 03
2	0.	0.	0.	0.	0.78877E 01
3	0.13868E 03	0.33779E 01	0.24081E 02	0.27459E 02	0.42295E 01
4	0.31381E 03	0.76459E 01	0.33179E 03	0.33943E 03	0.77398E 01
5	0.21677E 03	0.10719E 04	0.59387E-01	0.10720E 04	0.11573E 04
ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8					TOTAL EMISSIONS = 908.67
1	0.	0.	0.	0.	0.16901E 03
2	0.	0.	0.	0.	0.1614ME 02
3	0.13868E 03	0.17798E 02	0.21407E 02	0.39205E 02	0.22265E 02
4	0.31381E 03	0.40285E 02	0.21743E 03	0.25772E 03	0.40779E 02
5	0.21677E 03	0.61171E 03	0.39856E-01	0.61175E 03	0.66044E 03
ASP = 30.0DEGREES, WAVELENGTH BAND 1.8 - 2.7					TOTAL EMISSIONS = 746.09
1	0.17600E 03	0.13019E 03	0.18044E 03	0.61063E 03	0.80845E 03
2	0.76637E 02	0.14969E 02	0.54892E 02	0.69861E 02	0.26425E 02
3	0.33123E 03	0.80703E 01	0.57533E 02	0.65604E 02	0.19034E 02
4	0.	0.	0.	0.	0.22885E 00
5	0.	0.	0.	0.	0.10497E 03
ASP = 30.0DEGREES, WAVELENGTH BAND 3.9 - 4.8					TOTAL EMISSIONS = 558.44
1	0.17600E 03	0.27743E 03	0.11745E 03	0.39529E 03	0.39038E 03
2	0.76637E 02	0.30645E 02	0.38805E 02	0.69491E 02	0.54100E 02
3	0.33123E 03	0.42521E 02	0.51184E 02	0.93665E 02	0.52870E 02
4	0.	0.	0.	0.	0.12058E 01
5	0.	0.	0.	0.	0.59903E 02

PLUME IR TOTALS

FROM 1.80 TO 2.90 MICRONS = 1.0401 WT/ST
FROM 3.90 TO 4.80 MICRONS = 10.0414 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.90 MICRONS = 1438.9002 WT/ST
FROM 3.90 TO 4.80 MICRONS = 908.6671 WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 14

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	304.8656	WT/ST
FROM 3.90 TO 4.80	MICRONS =	297.1722	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 15

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	746.0902	WT/ST
FROM 3.90 TO 4.80	MICRONS =	558.4434	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 16

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	157.2692	WT/ST
FROM 3.90 TO 4.80	MICRONS =	182.6344	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 17

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	50.00	70.00
20.00	23.80	14.60

CENTERBODY COORDINATES, IN./

0.	30.00	50.00	70.00
10.00	10.00	20.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)=	0.44018		F(1, 1)=	0.44018
F(1, 2)=	0.03966		F(2, 1)=	0.10526
F(1, 3)=	0.22935		F(3, 1)=	0.05758
F(1, 4)=	0.26879		F(4, 1)=	0.09495
F(1, 5)=	0.		F(5, 1)=	0.
F(1, 6)=	0.12445		F(6, 1)=	0.03195
F(1, 7)=	0.00473		F(7, 1)=	0.04978

AREA(1)= 7048.19 SQ. IN.

F(2, 1)=	0.10526		F(1, 2)=	0.03966
F(2, 2)=	0.21116		F(2, 2)=	0.21116
F(2, 3)=	0.00856		F(3, 2)=	0.01206
F(2, 4)=	0.02969		F(4, 2)=	0.03762
F(2, 5)=	0.47502		F(5, 2)=	0.70986
F(2, 6)=	0.01402		F(6, 2)=	0.03699
F(2, 7)=	0.11498		F(7, 2)=	0.45568

AREA(2)= 2655.77 SQ. IN.

F(3, 1)=	0.05758		F(1, 3)=	0.22935
F(3, 2)=	0.01206		F(2, 3)=	0.00856
F(3, 3)=	0.		F(3, 3)=	0.
F(3, 4)=	0.00981		F(4, 3)=	0.00878
F(3, 5)=	0.		F(5, 3)=	0.
F(3, 6)=	0.12331		F(6, 3)=	0.21697
F(3, 7)=	0.		F(7, 3)=	0.

AREA(3)= 1884.96 SQ. IN.

F(4, 1)=	0.09495		F(1, 4)=	0.26879
F(4, 2)=	0.03762		F(2, 4)=	0.02969
F(4, 3)=	0.00878		F(3, 4)=	0.00981
F(4, 4)=	0.		F(4, 4)=	0.
F(4, 5)=	0.		F(5, 4)=	0.
F(4, 6)=	0.03259		F(6, 4)=	0.06410
F(4, 7)=	0.		F(7, 4)=	0.

AREA(4)= 2107.44 SQ. IN.

F(5, 1)=	0.		F(1, 5)=	0.
F(5, 2)=	0.70986		F(2, 5)=	0.47502
F(5, 3)=	0.		F(3, 5)=	0.
F(5, 4)=	0.		F(4, 5)=	0.
F(5, 5)=	0.		F(5, 5)=	0.
F(5, 6)=	0.		F(6, 5)=	0.
F(5, 7)=	0.16628		F(7, 5)=	0.44128

AREA(5)= 1777.15 SQ. IN.

F(6, 1)=	0.03195		F(1, 6)=	0.12645
F(6, 2)=	0.03699		F(2, 6)=	0.01402
F(6, 3)=	0.21697		F(3, 6)=	0.12331
F(6, 4)=	0.06410		F(4, 6)=	0.03259
F(6, 5)=	0.		F(5, 6)=	0.
F(6, 6)=	0.		F(6, 6)=	0.
F(6, 7)=	0.		F(7, 6)=	0.

AREA(6)= 1071.28 SQ. IN.

F(7, 1)=	0.04978		F(1, 7)=	0.00473
F(7, 2)=	0.45568		F(2, 7)=	0.11498
F(7, 3)=	0.		F(3, 7)=	0.
F(7, 4)=	0.		F(4, 7)=	0.
F(7, 5)=	0.44128		F(5, 7)=	0.16628
F(7, 6)=	0.		F(6, 7)=	0.
F(7, 7)=	0.		F(7, 7)=	0.

AREA(7)= 669.66 SQ. IN.

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (K)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2008.0	0.	96.0
2	1388.8	0.	33.1
3	2008.0	0.	0.
4	2008.0	0.	0.
5	2008.0	705.7	446.9
6	2108.0	0.	0.

NODE	AREA (SQ.INCHES)	DIRECT EMISSIONS (WATTS/STERADIAN)	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY (WATTS/STERADIAN)	CUMULATIVE EMISSIONS
ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 1851.30					
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.41035E 02
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	0.70568E 03	0.17249E 04	0.12641E 03	0.18513E 04	0.18103E 04
6	0.	0.	0.	0.	0.
ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 1253.16					
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.44010E 02
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	0.70568E 03	0.11148E 04	0.13915E 03	0.12532E 04	0.11691E 04
6	0.	0.	0.	0.	0.
ASP = 30.00DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 1574.23					
1	0.96361E 02	0.23553E 03	0.14234E 03	0.37787E 03	0.29790E 03
2	0.33107E 02	0.64742E 01	0.17424E 02	0.23999E 02	0.33746E 02
3	0.	0.	0.	0.	0.24749E 02
4	0.	0.	0.	0.	0.28782E 02
5	0.44692E 03	0.10924E 04	0.80058E 02	0.11725E 04	0.11626E 04
6	0.	0.	0.	0.	0.26840E 02
ASP = 30.00DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 1062.01					
1	0.96361E 02	0.15212E 03	0.89980E 02	0.24206E 03	0.19248E 03
2	0.33107E 02	0.13255E 02	0.13652E 02	0.26907E 02	0.69087E 02
3	0.	0.	0.	0.	0.15584E 02
4	0.	0.	0.	0.	0.18548E 02
5	0.44692E 03	0.70552E 03	0.88125E 02	0.79365E 03	0.75088E 03
6	0.	0.	0.	0.	0.15088E 02

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.4491 WT/ST
FROM 3.90 TO 4.80 MICRONS = 30.8410 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1851.3023 WT/ST
FROM 3.90 TO 4.80 MICRONS = 1253.1561 WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 18

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	560.0208	WT/ST
FROM 3.90 TO 4.80	MICRONS =	560.4628	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 19

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2016.0279	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1313.7351	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 20

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	425.4550	WT/ST
FROM 3.90 TO 4.80	MICRONS =	429.6464	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 21

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	50.00	70.00
20.00	23.80	14.60

CENTERBODY COORDINATES, IN./

0.	30.00	50.00	70.00
10.00	10.00	20.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)= 0.000[illegible]	F(1, 1)= 0.000[illegible]
F(1, 2)= 0.03966	F(2, 1)= 0.10526
F(1, 3)= 0.22935	F(3, 1)= 0.85798
F(1, 4)= 0.26879	F(4, 1)= 0.99895
F(1, 5)= 0.	F(5, 1)= 0.
F(1, 6)= 0.12445	F(6, 1)= 0.83195
F(1, 7)= 0.00473	F(7, 1)= 0.04978
AREA(1)= 7048.19 SQ. IN.	

F(2, 1)= 0.10526	F(1, 2)= 0.03966
F(2, 2)= 0.21116	F(2, 2)= 0.21116
F(2, 3)= 0.00856	F(3, 2)= 0.01206
F(2, 4)= 0.02969	F(4, 2)= 0.03742
F(2, 5)= 0.47502	F(5, 2)= 0.70986
F(2, 6)= 0.01492	F(6, 2)= 0.03699
F(2, 7)= 0.11490	F(7, 2)= 0.45568
AREA(2)= 2655.77 SQ. IN.	

F(3, 1)= 0.85798	F(1, 3)= 0.22935
F(3, 2)= 0.01206	F(2, 3)= 0.00856
F(3, 3)= 0.	F(3, 3)= 0.
F(3, 4)= 0.00981	F(4, 3)= 0.00878
F(3, 5)= 0.	F(5, 3)= 0.
F(3, 6)= 0.12331	F(6, 3)= 0.21697
F(3, 7)= 0.	F(7, 3)= 0.
AREA(3)= 1884.96 SQ. IN.	

F(4, 1)= 0.99895	F(1, 4)= 0.26879
F(4, 2)= 0.03742	F(2, 4)= 0.02969
F(4, 3)= 0.00878	F(3, 4)= 0.00981
F(4, 4)= 0.	F(4, 4)= 0.
F(4, 5)= 0.	F(5, 4)= 0.
F(4, 6)= 0.0325	F(6, 4)= 0.06410
F(4, 7)= 0.	F(7, 4)= 0.
AREA(4)= 2107.44 SQ. IN.	

F(5, 1)= 0.	F(1, 5)= 0.
F(5, 2)= 0.70986	F(2, 5)= 0.47502
F(5, 3)= 0.	F(3, 5)= 0.
F(5, 4)= 0.	F(4, 5)= 0.
F(5, 5)= 0.	F(5, 5)= 0.
F(5, 6)= 0.	F(6, 5)= 0.
F(5, 7)= 0.166[illegible]	F(7, 5)= 0.44128
AREA(1777.15 SQ. IN.	

F(6, 1)= 0.83195	F(1, 6)= 0.12445
F(6, 2)= 0.03699	F(2, 6)= 0.01492
F(6, 3)= 0.21697	F(3, 6)= 0.12331
F(6, 4)= 0.06410	F(4, 6)= 0.0325
F(6, 5)= 0.	F(5, 6)= 0.
F(6, 6)= 0.	F(6, 6)= 0.
F(6, 7)= 0.	F(7, 6)= 0.
AREA(6)= 1071.28 SQ. IN.	

F(7, 1)= 0.04978	F(1, 7)= 0.00473
F(7, 2)= 0.45568	F(2, 7)= 0.11490
F(7, 3)= 0.	F(3, 7)= 0.
F(7, 4)= 0.	F(4, 7)= 0.
F(7, 5)= 0.44128	F(5, 7)= 0.16628
F(7, 6)= 0.	F(6, 7)= 0.
F(7, 7)= 0.	F(7, 7)= 0.
AREA(7)= 669.[illegible] SQ. IN.	

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (F)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2008.0	0.	93.8
2	1308.0	0.	33.1
3	2008.0	0.	0.
4	2008.0	0.	0.
5	1100.0	705.7	446.9
6	2108.0	0.	0.

NODE	AREA (SQ.INCHES)	DIRECT EMISSIONS (WATTS/STERADIAN)	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
ASP = 0. DEGREES,		WAVELENGTH BAND 1.8 - 2.7			TOTAL EMISSIONS = 100.60
1	0.	0.	0.	0.	0.25111E 02
2	0.	0.	0.	0.	0.36745E 02
3	0.	0.	0.	0.	0.34917E 01
4	0.	0.	0.	0.	0.74090E 01
5	0.705688E 03	0.1 4E 02	0.83407E 02	0.100608E 03	0.17997E 02
6	0.	0.	0.	0.	0.78465E 01
ASP = 0. DEGREES,		WAVELENGTH BAND 3.9 - 4.8			TOTAL EMISSIONS = 201.88
1	0.	0.	0.	0.	0.14218E 02
2	0.	0.	0.	0.	0.79323E 02
3	0.	0.	0.	0.	0.22551E 01
4	0.	0.	0.	0.	0.47850E 01
5	0.705688E 03	0.405990E 02	0.11129E 03	0.201888E 03	0.40823E 02
6	0.	0.	0.	0.	0.40776E 01
ASP = 30.0DEGREES,		WAVELENGTH BAND 1.8 - 2.7			TOTAL EMISSIONS = 469.17
1	0.93A22E 02	0.22933E 03	0.14029E 03	0.369628 03	0.31046E 03
2	0.33299E 02	0.65039E 01	0.93370E 01	0.158418 02	0.32301E 02
3	0.	0.	0.	0.	0.26230E 02
4	0.	0.	0.	0.	0.33486E 02
5	0.446692E 03	0.10889E 02	0.52823E 02	0.637128 02	0.11559E 02
6	0.	0.	0.	0.	0.55136E 02
ASP = 30.0DEGREES,		WAVELENGTH BAND 3.9 - 4.8			TOTAL EMISSIONS = 386.19
1	0.93A22E 02	0.18811E 03	0.89056E 02	0.23717E 03	0.20051E 03
2	0.33299E 02	0.13315E 02	0.70215E 01	0.211378 02	0.66130E 02
3	0.	0.	0.	0.	0.16994E 02
4	0.	0.	0.	0.	0.21627E 02
5	0.446692E 03	0.57372E 02	0.70483E 02	0.127868 03	0.60062E 02
6	0.	0.	0.	0.	0.20048E 02

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.8891 WT/ST
FROM 3.90 TO 4.80 MICRONS = 30.0418 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 100.6004 WT/ST
FROM 3.90 TO 4.80 MICRONS = 201.0816 WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 24

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	20.5016	WT/ST
FROM 3.90 TO 4.80	MICRONS =	66.0237	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 25

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	449.1727	WT/ST
FROM 3.90 TO 4.80	MICRONS =	386.1573	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 24

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	94.4395	WT/ST
FROM 3.90 TO 4.80	MICRONS =	126.2896	WT/ST

CASE 25

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	50.00	70.00
20.00	23.80	14.60

CENTERBODY COORDINATES, IN./

0.	30.00	50.00	70.00
10.00	10.00	20.00	0.

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)= 0.4 018	F(1, 1)= 0.44018		
F(1, 2)= 0.03966	F(2, 1)= 0.10526		
F(1, 3)= 0.22935	F(3, 1)= 0.05758		
F(1, 4)= 0.26879	F(4, 1)= 0.09895		
F(1, 5)= 0.	F(5, 1)= 0.		
F(1, 6)= 0.12645	F(6, 1)= 0.03195		
F(1, 7)= 0.00473	F(7, 1)= 0.04978		

AREA(1)= 7048.19 SQ. IN.

F(2, 1)= 0.10526	F(1, 2)= 0.03966		
F(2, 2)= 0.21116	F(3, 2)= 0.21116		
F(2, 3)= 0.00856	F(3, 2)= 0.01286		
F(2, 4)= 0.02969	F(4, 2)= 0.03742		
F(2, 5)= 0.07502	F(5, 2)= 0.70986		
F(2, 6)= 0.01492	F(6, 2)= 0.03699		
F(2, 7)= 0.11490	F(7, 2)= 0.85506		

AREA(2)= 2655.77 SQ. IN.

F(3, 1)= 0.05758	F(1, 3)= 0.22935		
F(3, 2)= 0.01286	F(2, 3)= 0.00856		
F(3, 3)= 0.	F(3, 3)= 0.		
F(3, 4)= 0.00981	F(4, 3)= 0.00878		
F(3, 5)= 0.	F(5, 3)= 0.		
F(3, 6)= 0.12331	F(6, 3)= 0.21697		
F(3, 7)= 0.	F(7, 3)= 0.		

AREA(3)= 1884.96 SQ. IN.

F(4, 1)= 0.09895	F(1, 4)= 0.26879		
F(4, 2)= 0.03742	F(2, 4)= 0.02969		
F(4, 3)= 0.00878	F(3, 4)= 0.00981		
F(4, 4)= 0.	F(4, 4)= 0.		
F(4, 5)= 0.	F(5, 4)= 0.		
F(4, 6)= 0.03259	F(6, 4)= 0.06410		
F(4, 7)= 0.	F(7, 4)= 0.		

AREA(4)= 2107.66 SQ. IN.

F(5, 1)= 0.	F(1, 5)= 0.		
F(5, 2)= 0.70986	F(2, 5)= 0.07502		
F(5, 3)= 0.	F(3, 5)= 0.		
F(5, 4)= 0.	F(4, 5)= 0.		
F(5, 5)= 0.	F(5, 5)= 0.		
F(5, 6)= 0.	F(6, 5)= 0.		
F(5, 7)= 0.16628	F(7, 5)= 0.44128		

AREA(5)= 1777.15 SQ. IN.

F(6, 1)= 0.03195	F(1, 6)= 0.12645		
F(6, 2)= 0.03699	F(2, 6)= 0.01492		
F(6, 3)= 0.21697	F(3, 6)= 0.12331		
F(6, 4)= 0.06410	F(4, 6)= 0.03259		
F(6, 5)= 0.	F(5, 6)= 0.		
F(6, 6)= 0.	F(6, 6)= 0.		
F(6, 7)= 0.	F(7, 6)= 0.		

AREA(6)= 1071.28 SQ. IN.

F(7, 1)= 0.04978	F(1, 7)= 0.00473		
F(7, 2)= 0.45568	F(2, 7)= 0.11490		
F(7, 3)= 0.	F(3, 7)= 0.		
F(7, 4)= 0.	F(4, 7)= 0.		
F(7, 5)= 0.44128	F(5, 7)= 0.16628		
F(7, 6)= 0.	F(6, 7)= 0.		
F(7, 7)= 0.	F(7, 7)= 0.		

AREA(7)= 669.66 SQ. IN.

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2008.0	0.	93.8
2	1108.0	0.	33.1
3	2008.0	0.	0.
4	2008.0	0.	0.
5	1108.0	705.7	846.9
6	2108.0	0.	0.

NODE	AREA (SQ.INCHES),	DIRECT EMISSIONS (WATTS/STERADIAN)	REFLECTED EMISSIONS	RADIOSITY	CUMULATIVE EMISSIONS
	ASP = 0. DEGREES,		WAVELENGTH BAND 1.8 - 2.7		TOTAL EMISSIONS = 66.69
1	0.	0.	0.	0.	0.251111E 02
2	0.	0.	0.	0.	0.48331E 01
3	0.	0.	0.	0.	0.349171E 01
4	0.	0.	0.	0.	0.749090E 01
5	0.705680E 03	0.171948E 02	0.490995E 02	0.666888E 02	0.179978E 02
6	0.	0.	0.	0.	0.784665E 01
	ASP = 0. DEGREES,		WAVELENGTH BAND 3.9 - 4.8		TOTAL EMISSIONS = 148.84
1	0.	0.	0.	0.	0.102188E 02
2	0.	0.	0.	0.	0.254065E 02
3	0.	0.	0.	0.	0.225551E 01
4	0.	0.	0.	0.	0.478504E 01
5	0.705680E 03	0.900590E 02	0.574634E 02	0.148802E 03	0.944823E 02
6	0.	0.	0.	0.	0.447706E 01
	ASP = 30.30DEGREES,		WAVELENGTH BAND 1.8 - 2.7		TOTAL EMISSIONS = 420.94
1	0.938228E 02	0.329335E 03	0.139946E 03	0.389278E 03	0.510406E 03
2	0.332996E 02	0.811308E 00	0.858806E 01	0.948001E 01	0.402693E 01
3	0.	0.	0.	0.	0.262308E 02
4	0.	0.	0.	0.	0.533606E 02
5	0.846692E 03	0.108899E 02	0.313466E 02	0.422355E 02	0.115599E 02
6	0.	0.	0.	0.	0.551326E 02
	ASP = 30.30DEGREES,		WAVELENGTH BAND 3.9 - 4.8		TOTAL EMISSIONS = 341.26
1	0.938228E 02	0.488116E 03	0.886894E 02	0.236606E 03	0.490051E 03
2	0.332996E 02	0.127466E 01	0.863346E 01	0.109088E 02	0.4 230E 02
3	0.	0.	0.	0.	0.144446E 02
4	0.	0.	0.	0.	0.414427E 02
5	0.846692E 03	0.457372E 02	0.303746E 02	0.937468E 02	0.809902E 02
6	0.	0.	0.	0.	0.490488E 02

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.4491 WT/ST
FROM 3.90 TO 4.80 MICRONS = 30.4410 WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 46.6881 WT/ST
FROM 3.90 TO 4.80 MICRONS = [illegible] WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 26

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.80	MICRONS =	13.7402	WT/ST
FROM 3.90 TO 4.80	MICRONS =	48.4099	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 27

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.80	MICRONS =	520.9008	WT/ST
FROM 3.90 TO 4.80	MICRONS =	341.2573	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 28

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.90	MICRONS =	88.6950	WT/ST
FROM 3.90 TO 4.80	MICRONS =	111.6054	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 29

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	50.00	70.00
20.00	23.80	14.60

CENTERBODY COORDINATES, IN./

0.	30.00	50.00	70.00
10.00	10.00	20.00	0.

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0
1	2000.0	0.	93.6
2	1100.0	0.	33.3
3	2000.0	0.	0.
4	2000.0	0.	0.
5	1100.0	305.7	466.9
6	2100.0	0.	0.

NODE	AREA (SQ.INCHES)	DIRECT EMISSIONS	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 20.85					
1	0.	0.	0.	0.	0.45796E 00
2	0.	0.	0.	0.	0.90231E 00
3	0.	0.	0.	0.	0.63690E-01
4	0.	0.	0.	0.	0.13525E 00
5	0.789680E 01	0.29142E 02	0.17230E 01	0.20853E 02	0.25150E 02
6	0.	0.	0.	0.	0.14312E 00
ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 137.77					
1	0.	0.	0.	0.	0.49577E 00
2	0.	0.	0.	0.	0.47541E 01
3	0.	0.	0.	0.	0.41138E-01
4	0.	0.	0.	0.	0.87389E-01
5	0.789680E 01	0.13240E 03	0.51730E 01	0.13777E 03	0.13251E 03
6	0.	0.	0.	0.	0.81673E-01
ASP = 30.00DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 388.08					
1	0.938822E 02	0.22933E 03	0.13945E 03	0.36878E 03	0.24038E 03
2	0.332999E 02	0.11057E 01	0.11059E 01	0.22917E 01	0.10370E 01
3	0.	0.	0.	0.	0.23449E 02
4	0.	0.	0.	0.	0.47586E 02
5	0.466092E 03	0.15913E 03	0.10917E 01	0.17004E 02	0.15958E 02
6	0.	0.	0.	0.	0.28865E 02
ASP = 30.00DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 330.73					
1	0.938822E 02	0.14811E 03	0.80227E 02	0.23634E 03	0.18754E 03
2	0.332999E 02	0.62475E 01	0.89564E 00	0.71431E 01	0.96767E 01
3	0.	0.	0.	0.	0.15144E 02
4	0.	0.	0.	0.	0.17816E 02
5	0.466092E 03	0.83851E 02	0.34028E 01	0.87254E 02	0.84081E 02
6	0.	0.	0.	0.	0.10472E 02

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 1.0000 WATTS
FROM 3.90 TO 4.80 MICRONS = 39.4419 WATTS

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 26.8527 WATTS
FROM 3.90 TO 4.80 MICRONS = 137.7733 WATTS

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 30

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	4.9254	WT/ST
FROM 3.90 TO 4.80	MICRONS =	45.0576	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 31

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/ST
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	388.0783	WT/ST
FROM 3.90 TO 4.80	MICRONS =	330.7339	WT/ST

PIREP TEST PROBLEM 5
HOT PARTS SUPPRESSION II

CASE 32

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0176	WT/ST
FROM 3.90 TO 4.80	MICRONS =	0.6479	WT/ST

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	81.7324	WT/ST
FROM 3.90 TO 4.80	MICRONS =	108.1638	WT/ST

PIREP TEST PROBLEM 6
SPECTRAL SIGNATURE AND LOCKU

CASE 1

** PIREP OUTPUT **

T7	1388.00	T5	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.	ALT	0.
FAR	0.01		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	349.
HOT PTS	2010.	1298.

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MISSILE PARAMETERS

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NO.	WAVELENGTH BAND (MICRONS)	SENSITIVITY	NEI (WATTS/CM**2)	S/N
1	1.80 -.700	1.0	0.2000E-09	3.0
2	3.90 -.800	1.0	0.4000E-10	0.7

PLUME TEST PROBLEM 6
SPECTRAL SIGNATURE AND LOCKON

CASE 1

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 5000.00 FEET

ATMS/			
519.0000	1.0000	0.	0.
519.0000	1.0000	0.	00000.0000

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.7257	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.5686	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0237	WT/SR
FROM 3.90 TO 4.80	MICRONS =	1.2522	WT/SR

EXTENDED HOT PARTS GEOMETRY

EXHAUST SURFACE COORDINATES, IN.

0.	50.00	70.00
20.00	23.80	14.60

CENTERBODY COORDINATES,IN./

0.	30.00	50.00	70.00
10.00	10.00	20.00	0.

WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STERA/(CRON)	TRANSMISSIVITY	WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STERA/(CRON)	TRANSMISSIVITY
1.6800	0.0020	0.7529	2.6800	0.1128	0.4844
1.6900	0.0029	0.6838	2.6900	0.1205	0.5524
1.7000	0.0038	0.4549	2.7000	0.0060	0.0000
1.7100	0.0035	0.8968	2.7100	0.0107	0.0103
1.7200	0.0041	0.6756	3.9000	0.0001	0.9517
1.7300	0.0045	0.6745	4.0000	0.0000	0.9866
1.7400	0.0055	0.8052	4.1000	0.0000	0.8815
1.7500	0.0061	0.6918	4.1100	-0.0000	0.8151
1.7600	0.0061	0.6591	4.1200	-0.0000	0.7945
1.7700	0.0055	0.7483	4.1300	-0.0000	0.7715
2.0000	0.0065	0.5619	4.1400	0.0000	0.7828
2.0200	0.0055	0.7321	4.1500	-0.0000	0.7255
2.0400	0.0013	0.6770	4.1600	-0.0000	0.7283
2.0600	0.0023	0.8146	4.1700	1.5759	0.6556
2.0800	0.0012	0.8406	4.1800	0.9076	0.9518
2.1000	0.0001	0.8952	4.1900	0.0083	0.0001
2.1500	0.0000	0.8945	4.2000	0.0000	0.0000
2.2000	0.0000	0.9013	4.2250	0.0000	0.0000
2.2500	0.0000	0.9019	4.2500	0.0000	0.0000
2.3000	-0.0000	0.9004	4.2750	0.0000	0.0000
2.3200	0.0000	0.0069	4.3000	0.0000	0.0000
2.3300	0.0000	0.9016	4.3250	0.0000	0.0000
2.3600	0.0000	0.9015	4.3500	0.0000	0.0000
2.3800	0.0001	0.9007	4.3750	0.3425	0.9004
2.4000	0.0006	0.9006	4.4000	1.0614	0.3013
2.4200	0.0035	0.9037	4.4250	1.8484	0.0177
2.4400	0.0137	0.8809	4.4500	4.1513	0.3671
2.4600	0.0344	0.7292	4.4750	9.2592	0.2197
2.4800	0.0586	0.7530	4.5000	11.1985	0.4779
2.5000	0.0797	0.6681	4.5250	6.9065	0.6948
2.5200	0.0967	0.5741	4.5500	2.9577	0.8120
2.5400	0.1049	0.4939	4.5750	1.0776	0.8662
2.5600	0.1164	0.4126	4.6000	0.3746	0.8914
2.5800	0.1209	0.3955	4.7000	0.0203	0.9150
2.6000	0.1221	0.3967	4.8000	1.6956	0.8854
2.6200	0.1211	0.4122	4.8000	1.6956	0.8854

SYSTEM INTERNAL VIEW FACTORS

F(1, 1)= 0.44018	F(1, 1)= 0.44018
F(1, 2)= 0.03966	F(2, 1)= 0.10526
F(1, 3)= 0.22935	F(3, 1)= 0.85758
F(1, 4)= 0.26879	F(4, 1)= 0.89805
F(1, 5)= 0.	F(5, 1)= 0.
F(1, 6)= 0.12645	F(6, 1)= 0.83195
F(1, 7)= 0.00473	F(7, 1)= 0.44978

AREA(1)= 7049.19 SQ. IN.

F(2, 1)= 0.10526	F(1, 2)= 0.03966
F(2, 2)= 0.21116	F(2, 2)= 0.21116
F(2, 3)= 0.00856	F(3, 2)= 0.01206
F(2, 4)= 0.02969	F(4, 2)= 0.03762
F(2, 5)= 0.47502	F(5, 2)= 0.70986
F(2, 6)= 0.01492	F(6, 2)= 0.03699
F(2, 7)= 0.11490	F(7, 2)= 0.45568

AREA(2)= 2655.77 SQ. IN.

1)= 0.85758	F(1, 3)= 0.22935
2)= 0.01206	F(2, 3)= 0.00856
3)= 0.	F(3, 3)= 0.
F(3, 4)= 0.00981	F(4, 3)= 0.00878
F(3, 5)= 0.	F(5, 3)= 0.
F(3, 6)= 0.12331	F(6, 3)= 0.21697
F(3, 7)= 0.	F(7, 3)= 0.

AREA(3)= 1088.96 SQ. IN.

F(4, 1)= 0.89805	F(1, 4)= 0.26879
F(4, 2)= 0.03762	F(2, 4)= 0.02969
F(4, 3)= 0.00878	F(3, 4)= 0.00981
F(4, 4)= 0.	F(4, 4)= 0.
F(4, 5)= 0.	F(5, 4)= 0.
F(4, 6)= 0.03259	F(6, 4)= 0.06410
F(4, 7)= 0.	F(7, 4)= 0.

AREA(4)= 2107.88 SQ. IN.

F(5, 1)= 0.	F(1, 5)= 0.
F(5, 2)= 0.70986	F(2, 5)= 0.47502
F(5, 3)= 0.	F(3, 5)= 0.
F(5, 4)= 0.	F(4, 5)= 0.
F(5, 5)= 0.	F(5, 5)= 0.
F(5, 6)= 0.	F(6, 5)= 0.
F(5, 7)= 0.10626	F(7, 5)= 0.44128

AREA(5)= 1777.15 SQ. IN.

F(6, 1)= 0.83195	F(1, 6)= 0.12645
F(6, 2)= 0.03699	F(2, 6)= 0.01492
F(6, 3)= 0.21697	F(3, 6)= 0.12331
F(6, 4)= 0.06410	F(4, 6)= 0.03259
F(6, 5)= 0.	F(5, 6)= 0.
F(6, 6)= 0.	F(6, 6)= 0.
F(6, 7)= 0.	F(7, 6)= 0.

AREA(6)= 1071.28 SQ. IN.

F(7, 1)= 0.44978	F(1, 7)= 0.00473
F(7, 2)= 0.45568	F(2, 7)= 0.11490
F(7, 3)= 0.	F(3, 7)= 0.
F(7, 4)= 0.	F(4, 7)= 0.
F(7, 5)= 0.44128	F(5, 7)= 0.10626
F(7, 6)= 0.	F(6, 7)= 0.
F(7, 7)= 0.	F(7, 7)= 0.

AREA(7)= 887.80 SQ. IN.

EXHAUST HOT PARTS INPUT/OUTPUT

NODE NUMBER	TEMPERATURE (R)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0	60.0
1	2000.0	0.	93.8	0.
2	1100.0	0.	33.3	866.1
3	2000.0	0.	0.	0.
4	2000.0	0.	0.	0.
5	1100.0	705.7	446.0	64.6
6	2100.0	0.	0.	0.

NODE	AREA (SQ.INCHES)	DIRECT EMISSIONS (WATTS/STERADIAN)	REFLECTED EMISSIONS (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS
ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7					TOTAL EMISSIONS = 66.69
1	0.	0.	0.	0.	0.25111E 02
2	0.	0.	0.	0.	0.88131E 01
3	0.	0.	0.	0.	0.34917E 01
4	0.	0.	0.	0.	0.74090E 01
5	0.70568E 03	0.17194E 02	0.49495E 02	0.66608E 02	0.17997E 02
6	0.	0.	0.	0.	0.78865E 01
ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8					TOTAL EMISSIONS = 146.02
1	0.	0.	0.	0.	0.10218E 02
2	0.	0.	0.	0.	0.25465E 02
3	0.	0.	0.	0.	0.22551E 01
4	0.	0.	0.	0.	0.47850E 01
5	0.70568E 03	0.16990E 02	0.57434E 02	0.14802E 03	0.94823E 02
6	0.	0.	0.	0.	0.44776E 01
ASP = 30.00DEGREES, WAVELENGTH BAND 1.8 - 2.7					TOTAL EMISSIONS = 420.99
1	0.91822E 02	0.22933E 03	0.13998E 03	0.34027E 03	0.31006E 03
2	0.33299E 02	0.41130E 00	0.65808E 01	0.94001E 01	0.80293E 01
3	0.	0.	0.	0.	0.26236E 02
4	0.	0.	0.	0.	0.53480E 02
5	0.44693E 03	0.12089E 02	0.31340E 02	0.42235E 02	0.11559E 02
6	0.	0.	0.	0.	0.35132E 02
ASP = 30.00DEGREES, WAVELENGTH BAND 3.9 - 4.8					TOTAL EMISSIONS = 341.26
1	0.91822E 02	0.10811E 03	0.68494E 02	0.23660E 03	0.20051E 03
2	0.33299E 02	0.42706E 01	0.66334E 01	0.10908E 02	0.21230E 02
3	0.	0.	0.	0.	0.16944E 02
4	0.	0.	0.	0.	0.21627E 02
5	0.44692E 03	0.97372E 02	0.36374E 02	0.93746E 02	0.60902E 02
6	0.	0.	0.	0.	0.20048E 02
ASP = 60.00DEGREES, WAVELENGTH BAND 1.8 - 2.7					TOTAL EMISSIONS = 81.23
1	0.	0.	0.	0.	0.40413E 02
2	0.26613E 03	0.54641E 01	0.68644E 02	0.75128E 02	0.77785E 01
3	0.	0.	0.	0.	0.56176E 01
4	0.	0.	0.	0.	0.11024E 02
5	0.68561E 02	0.15730E 01	0.65201E 01	0.61011E 01	0.28662E 01
6	0.	0.	0.	0.	0.12628E 02
ASP = 60.00DEGREES, WAVELENGTH BAND 3.9 - 4.8					TOTAL EMISSIONS = 100.72
1	0.	0.	0.	0.	0.66101E 01
2	0.26613E 03	0.34169E 02	0.53016E 02	0.87183E 02	0.40983E 02
3	0.	0.	0.	0.	0.36294E 01
4	0.	0.	0.	0.	0.77014E 01
5	0.68561E 02	0.98 [illegible]E 01	0.32545E 01	0.13582E 02	0.15[illegible]E 02
6	0.	0.	0.	0.	0.7206[illegible] 01

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 65.7596 WT/ST
FROM 3.90 TO 4.80 MICRONS = [illegible] WT/ST

PIREP TEST PROBLEM 6
SPECTRAL SIGNATURE AND LUCKON

CASE 2

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.2740	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.2498	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.0031	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.1129	WT/SR

WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY	WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY
1.8000	0.0002	0.2255	2.6400	0.0157	0.2322
1.8200	0.0003	0.2088	2.6600	0.0151	0.2311
1.8400	0.0003	0.2029	2.6800	0.0000	0.0000
1.8600	0.0003	0.2194	2.7000	0.0000	0.0000
1.8800	0.0004	0.2160	3.9000	0.0000	0.6032
1.9000	0.0004	0.2190	4.0000	0.0000	0.5783
1.9200	0.0005	0.2191	4.1000	0.0000	0.2369
1.9400	0.0006	0.2312	4.1100	-0.0000	0.2016
1.9600	0.0003	0.1218	4.1200	0.0000	0.1711
1.9800	0.0005	0.2628	4.1300	-0.0000	0.1455
2.0000	0.0001	0.0537	4.1400	0.0000	0.1245
2.0200	0.0002	0.1392	4.1500	0.0000	0.1077
2.0400	0.0001	0.3113	4.1600	0.0000	0.0946
2.0600	0.0001	0.1981	4.1700	0.1583	0.0808
2.0800	0.0001	0.3129	4.1800	0.0003	0.0012
2.1000	0.0000	0.3320	4.1900	0.0000	0.0000
2.1500	0.0000	0.3431	4.2000	0.0000	0.0000
2.2000	-0.0000	0.3537	4.2250	0.	0.
2.2500	-0.0000	0.3641	4.2500	0.	0.
2.3000	-0.0000	0.3742	4.2750	0.	0.
2.3200	0.0000	0.3784	4.3000	0.0000	0.
2.3400	0.0000	0.3794	4.3250	0.0000	0.0000
2.3600	0.0000	0.3831	4.3500	0.0000	0.0000
2.3800	0.0000	0.3887	4.3750	0.0000	0.0000
2.4000	0.0001	0.3933	4.4000	0.0002	0.0000
2.4200	0.0004	0.3941	4.4250	0.0003	0.0000
2.4400	0.0018	0.3876	4.4500	0.0005	0.0003
2.4600	0.0045	0.3679	4.4750	0.0811	0.0063
2.4800	0.0077	0.3349	4.5000	0.5610	0.0524
2.5000	0.0105	0.2995	4.5250	1.1537	0.1481
2.5200	0.0129	0.2610	4.5500	0.4208	0.2023
2.5400	0.0146	0.2263	4.5750	0.3531	0.3536
2.5600	0.0158	0.1997	4.6000	0.1227	0.3988
2.5800	0.0164	0.1880	4.7000	0.0956	0.4758
2.6000	0.0168	0.1812	4.8000	0.3828	0.4090
2.6200	0.0168	0.1946	4.8000	0.3828	0.4090

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 17.2764 WT/ST
FROM 3.90 TO 4.80 MICRONS = 36.9781 WT/ST

PIREP TEST PROBLEM A
SPECTRAL SIGNATURE AND LUMEN

CASE 3

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 5000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.8055	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.5669	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.1361	WT/SR
FROM 3.90 TO 4.80	MICRONS =	7.1634	WT/SR

WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY	WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY
1.8000	0.0073	0.8398	2.6400	0.6987	0.7179
1.8200	0.0135	0.8092	2.6600	0.6280	0.7637
1.8400	0.0169	0.7955	2.6800	0.0415	0.0136
1.8600	0.0198	0.8174	2.7000	0.0058	0.0257
1.8800	0.0194	0.8077	3.9000	0.0002	0.9507
1.9000	0.0216	0.8079	4.0000	0.0000	0.9466
1.9200	0.0268	0.8039	4.1000	0.0000	0.8815
1.9400	0.0277	0.8182	4.1100	-0.0000	0.8191
1.9600	0.0229	0.7633	4.1200	-0.0000	0.7955
1.9800	0.0167	0.8593	4.1300	-0.0000	0.7715
2.0000	0.0150	0.6439	4.1400	0.0000	0.7478
2.0200	0.0113	0.7919	4.1500	-0.0000	0.7255
2.0400	0.0026	0.8887	4.1600	-0.0000	0.7053
2.0600	0.0047	0.8572	4.1700	0.3287	0.6826
2.0800	0.0022	0.8894	4.1800	108.2596	0.2045
2.1000	0.0001	0.8956	4.1900	0.9287	0.0009
2.1500	0.0000	0.8985	4.2000	0.0000	0.0000
2.2000	0.0000	0.9013	4.2250	0.0000	0.0000
2.2500	0.0000	0.9039	4.2500	0.0000	0.0000
2.3000	-0.0000	0.9064	4.2750	0.0000	0.0000
2.3200	0.0000	0.9069	4.3000	0.0000	0.0000
2.3400	0.0000	0.9074	4.3250	0.0001	0.0000
2.3600	0.0000	0.9085	4.3500	0.1602	0.0001
2.3800	0.0041	0.9098	4.3750	0.7498	0.0053
2.4000	0.0012	0.9108	4.4000	10.5865	0.0259
2.4200	0.0068	0.9105	4.4250	13.1 98	0.0432
2.4400	0.0300	0.9064	4.4500	26.0876	0.1257
2.4600	0.0980	0.8927	4.4750	52.6164	0.3466
2.4800	0.2303	0.8632	4.5000	55.3235	0.6257
2.5000	0.3969	0.8193	4.5250	29.9855	0.7816
2.5200	0.5485	0.7688	4.5500	12.0355	0.8877
2.5400	0.6681	0.7200	4.5750	4.2810	0.8787
2.5600	0.7562	0.6808	4.6000	1.4767	0.8956
2.5800	0.8122	0.6545	4.7000	1.6541	0.9199
2.6000	0.8392	0.6488	4.8000	0.9392	0.9055
2.6200	0.8053	0.6668	4.8000	0.9392	0.9055

ATTENUATED HOT PARTS IN TOTALS

FROM 1.80 TO 2.70 MICRONS = 327.8493 WT/ST
FROM 3.90 TO 4.80 MICRONS = 200.3010 WT/ST

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PIREP TEST PROBLEM 6
SPECTRAL SIGNATURE AND LOCKON

CASE 4

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70 MICRONS =	0.3052	WT/SR
FROM 3.90 TO 4.80 MICRONS =	0.2517	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS =	0.0176	WT/SR
FROM 3.90 TO 4.80 MICRONS =	0.6479	WT/SR

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permit fully legible reproduction

WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY	WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY
1.8000	0.0000	0.2517	2.6400	0.0960	0.3414
1.8200	0.0012	0.2467	2.6600	0.0746	0.3178
1.8400	0.0015	0.2465	2.6800	0.0000	0.0000
1.8600	0.0013	0.2574	2.7000	0.0000	0.0000
1.8800	0.0018	0.2583	3.9000	0.0002	0.6032
1.9000	0.0020	0.2625	4.0000	0.0000	0.5783
1.9200	0.0026	0.2649	4.1000	0.0000	0.2349
1.9400	0.0027	0.2738	4.1100	-0.0000	0.2016
1.9600	0.0012	0.1404	4.1200	0.0000	0.1711
1.98[illegible]	0.0016	0.2879	4.1300	-0.0000	0.[illegible]5
2.0000	0.0003	0.0585	4.1400	0.0000	0.1245
2.0200	0.0004	0.1472	4.1500	0.0000	0.1077
2.0400	0.0003	0.3154	4.1600	0.0000	0.0946
2.0600	0.0002	0.1980	4.1700	0.8678	0.0837
2.0800	0.0002	0.3169	4.1800	0.5083	0.0023
2.1000	0.0000	0.3322	4.1900	0.0000	0.0000
2.1500	0.0000	0.3431	4.2000	0.0000	0.0000
2.2000	-0.0000	0.3537	4.2250	0.	0.
2.2500	-0.0000	0.3641	4.2500	0.	0.
2.3000	-0.0000	0.3742	4.2750	0.	0.
2.3200	0.0000	0.3764	4.3000	0.0000	0.0000
2.3400	0.0000	0.3798	4.3250	0.0000	0.0000
2.3600	0.0000	0.3831	4.3500	0.0000	0.0000
2.3800	0.0000	0.3868	4.3750	0.0000	0.0000
2.4000	0.0001	0.3938	4.4000	0.0012	0.0000
2.4200	0.0000	0.3972	4.4250	0.0017	0.0000
2.4400	0.0038	0.3988	4.4500	0.0282	0.0004
2.4600	0.0126	0.3961	4.4750	0.5041	0.0077
2.4800	0.0298	0.3862	4.5000	3.4457	0.0613
2.5000	0.0517	0.3695	4.5250	6.8267	0.1857
2.5200	0.0720	0.3495	4.5500	4.6318	0.2943
2.5400	0.0885	0.3299	4.5750	1.9473	0.3586
2.5600	0.1009	0.3140	4.6000	0.6718	0.4005
2.5800	0.1092	0.3045	4.7000	0.5152	0.4772
2.6000	0.1127	0.3039	4.8000	2.1148	0.4146
2.6200	0.1099	0.3148	4.8000	2.1148	0.4146

ATTENUATED HOT PARTS TO TOTALS

FROM 1.80 TO 2.70 MICRONS = 124.2083 MT/ST
FROM 3.90 TO 4.80 MICRONS = 85.8866 MT/ST

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PIREP TEST PROBLEM 6
SPECTRAL SIGNATURE AND LUCKON

CASE 5

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 60.00 DEGREES
RANGE = 5000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.8213	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.5893	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS	0.2354	WT/SR
FROM 3.90 TO 4.80	MICRONS	12.4421	WT/SR

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WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY	WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MIC N)	TRANSMISSIVITY
1.8000	0.0103	0.8527	2.6800	1.2400	0.7691
1.8200	0.0205	0.8321	2.6600	1.0391	0.8053
1.8400	0.0247	0.8223	2.6800	0.0709	0.0136
1.8600	0.0224	0.8389	2.7000	0.1124	0.0292
1.8800	0.0300	0.8122	3.9000	0.0004	0.9507
1.9000	0.0336	0.8128	4.0000	0.0000	0.9466
1.9200	0.0429	0.8102	4.1000	0.0000	0.8415
1.9400	0.0421	0.8411	4.1100	-0.0000	0.8191
1.9600	0.0328	0.7797	4.1200	-0.0000	0.7955
1.9800	0.0224	0.8695	4.1300	0.0000	0.7715
2.0000	0.0196	0.6527	4.1400	0.0000	0.7478
2.0200	0.0146	0.7978	4.1500	-0.0000	0.7255
2.0400	0.0033	0.8498	4.1600	-0.0000	0.7053
2.0600	0.0060	0.8392	4.1700	10.4468	0.6847
2.0800	0.0028	0.8902	4.1800	202.2225	0.2403
2.1000	0.0002	0.8956	4.1900	1.8402	0.0012
2.1500	0.0000	0.8985	4.2000	0.0014	0.0000
2.2000	0.0000	0.9013	4.2250	0.0000	0.0000
2.2500	0.0000	0.9039	4.2500	0.0000	0.0000
2.3000	-0.0000	0.9064	4.2750	0.0000	0.0000
2.3200	0.0000	0.9069	4.3000	0.0000	0.0000
2.3400	0.0000	0.9076	4.3250	0.0002	0.0000
2.3600	0.0000	0.9085	4.3500	0.3305	0.0001
2.3800	0.0002	0.9098	4.3750	13.3642	0.0072
2.4000	0.0015	0.9109	4.4000	30.8932	0.0306
2.4200	0.0087	0.9111	4.4250	22.9591	0.0471
2.4400	0.0389	0.9091	4.4500	45.0001	0.1337
2.4600	0.1310	0.9019	4.4750	89.9080	0.3626
2.4800	0.3339	0.8817	4.5000	93.1346	0.6421
2.5000	0.6282	0.8497	4.5250	49.8319	0.7902
2.5200	0.9306	0.8108	4.5500	19.8801	0.8510
2.5400	1.1787	0.7702	4.5750	7.0558	0.8790
2.5600	1.3604	0.7369	4.6000	2.4321	0.8960
2.5800	1.4748	0.7155	4.7000	2.7255	0.9203
2.6000	1.5136	0.7106	4.8000	11.4698	0.9073
2.6200	1.4574	0.7262	4.8000	11.4698	0.9073

ATTENUATED HOT PARTS IN TOTALS

FROM 1.80 TO 2.70 MICRONS = 64.1709 WT/ST
FROM 3.90 TO 4.80 MICRONS = 59.3588 WT/ST

PIREP TEST PROBLEM 6
SPECTRAL SIGNATURE AND LOCKON

CASE 6

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 60.00 DEGREES
RANGE = 50000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70 MICRONS = 0.3115 WT/SR
FROM 3.90 TO 4.80 MICRONS = 0.2519 WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70 MICRONS = 0.0305 WT/SR
FROM 3.90 TO 4.80 MICRONS = 1.1221 WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.90 MICRONS = 24.3427 WT/ST
FROM 3.90 TO 4.80 MICRONS = 25.3670 WT/ST

* *

LOCKON RANGE, FEET

* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2
0.	8226.	30481.
30.00	18504.	56403.
60.00	9469.	34642.

WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY	WAVELENGTH (MICRONS)	IRRADIANCE (WATTS/STER/MICRON)	TRANSMISSIVITY
1.8000	0.0000	0.2917	2.6400	0.1697	0.3657
1.8200	0.0010	0.2537	2.6600	0.1233	0.3150
1.8400	0.0024	0.2548	2.6800	0.0000	0.0000
1.8600	0.0020	0.2841	2.7000	0.0000	0.0000
1.8800	0.0028	0.2861	3.9000	0.0003	0.0032
1.9000	0.0031	0.2703	4.0000	0.0000	0.5783
1.9200	0.0040	0.2715	4.1000	0.0000	0.2369
1.9400	0.0041	0.2811	4.1100	-0.0000	0.2316
1.9600	0.0017	0.1833	4.1200	0.3009	0.1711
1.9800	0.0022	0.2913	4.1300	-0.0000	0.1455
2.0000	0.0003	0.0590	4.1400	0.0000	0.1245
2.0200	0.0006	0.1468	4.1500	0.0000	0.1077
2.0400	0.0003	0.3158	4.1600	0.0000	0.0946
2.0600	0.0003	0.1904	4.1700	1.5432	0.0839
2.0800	0.0003	0.3163	4.1800	0.9142	0.0025
2.1000	0.0000	0.3522	4.1900	0.0000	0.0000
2.1500	0.0000	0.3631	4.2000	0.0000	0.0000
2.2000	-0.0000	0.3537	4.2250	0.	0.
2.2500	-0.0000	0.3691	4.2500	0.	0.
2.3000	-0.0000	0.3742	4.2750	0.	0.
2.3200	-0.0000	0.3764	4.3000	0.0000	0.0000
2.3400	0.0000	0.3794	4.3250	0.0000	0.0000
2.3600	0.0000	0.3831	4.3500	0.0000	0.0000
2.3800	0.0000	0.3868	4.3750	0.0001	0.0000
2.4000	0.0002	0.3939	4.4000	0.0821	0.0000
2.4200	0.0011	0.3975	4.4250	0.0031	0.0000
2.4400	0.0049	0.4000	4.4500	0.0491	0.0004
2.4600	0.0168	0.3998	4.4750	0.4792	0.0078
2.4800	0.0429	0.3995	4.5000	0.0033	0.0621
2.5000	0.0816	0.3932	4.5250	11.8521	0.1874
2.5200	0.1218	0.3683	4.5500	8.0059	0.2954
2.5400	0.1558	0.3529	4.5750	5.3505	0.3590
2.5600	0.1808	0.3403	4.6000	1.1572	0.4006
2.5800	0.1975	0.3329	4.7000	0.8888	0.4773
2.6000	0.2083	0.3330	4.8000	3.6497	0.4151
2.6200	0.1980	0.3428	4.8000	3.6497	0.4151

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 1

** PIREP OUTPUT **

T7	1388.00	TS	2008.00
P8	56.82	A8	534.60
PAMB	14.70	XM	1.00
VC19	0.	ALT	0.
FAR	0.01		

IR INDICES

	1.8-2.7	3.9-4.8
PLUME	17.	349.
HOT PTS	2010.	1298.

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MISSILE PARAMETERS

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NO.	WAVELENGTH BAND (MICRONS)	SENSITIVITY	NEI (WATTS/CM**2)	S/N
1	4.17 -.250	1.0	0.4000E-10	0.7
2	4.40 -.600	1.0	0.4000E-10	0.7
3	1.80 -.700	1.0	0.2000E-09	3.0
4	3.90 -.800	1.0	0.4000E-10	0.7

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 1

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 0. FEET

ATMS/			
519.0000	1.0000	0.	0.
519.0000	1.0000	0.	00000.0000

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.8168	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.6581	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0722	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.5941	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1.4491	WT/SR
FROM 3.90 TO 4.80	MICRONS =	30.4418	WT/SR
FROM 4.17 TO 4.25	MICRONS =	4.1843	WT/SR
FROM 4.40 TO 4.60	MICRONS =	16.7383	WT/SR

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EXHAUST UNIT PARTS (OUTPUT/OUTPUT)

NODE NUMBER	TEMPERATURE (K)	PROJECTED AREAS (IN2) AT EACH ASPECT ANGLE 0.	30.0	120.0
1	2000.0	530.0	403.0	0.
2	1000.0	458.0	388.0	210.0

NODE	AREA (SQ.INCHES)	DIRECT EMISSIONS (WATTS/STERADIAN)	REFLECTED EMISSION (WATTS/STERADIAN)	RADIOSITY	CUMULATIVE EMISSIONS

ASP = 0. DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 3930.95

1	0.534e+01 03	0.701e+01 00	0.261e-03 00	0.701e+01 00	0.701e+01 00
2	0.458e+01 03	0.122e-05 00	0.124e-07 00	0.122e-05 00	0.122e-05 00

ASP = 0. DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 2217.67

1	0.534e+01 03	0.129e+02 00	0.129e+00 00	0.129e+01 00	0.129e+01 00
2	0.458e+01 03	0.914e-05 03	0.914e-01 03	0.914e-01 03	0.914e-01 03

ASP = 0. DEGREES, WAVELENGTH BAND 4.2 - 4.3 TOTAL EMISSIONS = 207.53

1	0.534e+01 03	0.121e+02 03	0.121e+00 03	0.121e+01 03	0.121e+01 03
2	0.458e+01 03	0.855e-05 02	0.855e-01 02	0.855e-01 02	0.855e-01 02

ASP = 0. DEGREES, WAVELENGTH BAND 4.8 - 4.8 TOTAL EMISSIONS = 459.86

1	0.534e+01 03	0.269e+02 03	0.269e+00 03	0.269e+01 03	0.269e+01 03
2	0.458e+01 03	0.190e-04 03	0.190e-00 03	0.190e-01 03	0.190e-01 03

ASP = 30.0DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 2554.75

1	0.462e+01 03	0.178e+02 03	0.178e+00 03	0.178e+01 03	0.178e+01 03
2	0.396e+01 03	0.813e-05 03	0.813e-01 03	0.813e-01 03	0.813e-01 03

ASP = 30.0DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 1733.95

1	0.462e+01 03	0.112e+02 00	0.112e+00 00	0.112e+01 00	0.112e+01 00
2	0.396e+01 03	0.809e-05 03	0.809e-01 03	0.809e-01 03	0.809e-01 03

ASP = 30.0DEGREES, WAVELENGTH BAND 4.2 - 4.3 TOTAL EMISSIONS = 167.67

1	0.462e+01 03	0.105e+02 03	0.105e+00 03	0.105e+01 03	0.105e+01 03
2	0.396e+01 03	0.570e-05 02	0.570e-01 02	0.570e-01 02	0.570e-01 02

ASP = 30.0DEGREES, WAVELENGTH BAND 4.8 - 4.8 TOTAL EMISSIONS = 460.23

1	0.462e+01 03	0.233e+02 03	0.233e+00 03	0.233e+01 03	0.233e+01 03
2	0.396e+01 03	0.127e-04 03	0.127e-00 03	0.127e-01 03	0.127e-01 03

ASP = 120.0DEGREES, WAVELENGTH BAND 1.8 - 2.7 TOTAL EMISSIONS = 569.82

1	0.	0.	0.	0.	0.
2	0.218e+01 03	0.569e-05 03	0.569e-01 03	0.569e-01 03	0.569e-01 03

ASP = 120.0DEGREES, WAVELENGTH BAND 3.9 - 4.8 TOTAL EMISSIONS = 426.68

1	0.	0.	0.	0.	0.
2	0.218e+01 03	0.426e-05 03	0.426e-01 03	0.426e-01 03	0.426e-01 03

ASP = 120.0DEGREES, WAVELENGTH BAND 4.2 - 4.3 TOTAL EMISSIONS = 19.94

1	0.	0.	0.	0.	0.
2	0.218e+01 03	0.199e-05 02	0.199e-01 02	0.199e-01 02	0.199e-01 02

ASP = 120.0DEGREES, WAVELENGTH BAND 4.8 - 4.8 TOTAL EMISSIONS = 89.01

1	0.	0.	0.	0.	0.
2	0.218e+01 03	0.890e-05 02	0.890e-01 02	0.890e-01 02	0.890e-01 02

ATTENUATED UNIT PARTS (W TOTALS)

PIRLP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 5000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.7257	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.5686	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0476	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.4504	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1.0430	WT/SR
FROM 3.90 TO 4.80	MICRONS =	5.8848	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.5078	WT/SR
FROM 4.40 TO 4.60	MICRONS =	4.5150	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2264.6422	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1258.0987	WT/ST
FROM 4.17 TO 4.25	MICRONS =	9.3882	WT/ST
FROM 4.40 TO 4.60	MICRONS =	207.1352	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 3

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 0. DEGREES
RANGE = 50000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.2740	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.2406	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0852	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.1328	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.4604	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.6413	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0079	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.4309	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	855.0206	WT/ST
FROM 3.90 TO 4.80	MICRONS =	552.7515	WT/ST
FROM 4.17 TO 4.25	MICRONS =	1.0778	WT/ST
FROM 4.40 TO 4.60	MICRONS =	61.0724	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECTRAL RADIANCE
CASE 4

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 0. FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.9185	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.7251	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.1371	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.4263	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	8.3132	WT/SR
FROM 3.90 TO 4.80	MICRONS =	174.6405	WT/SR
FROM 4.17 TO 4.25	MICRONS =	30.4460	WT/SR
FROM 4.40 TO 4.60	MICRONS =	56.7684	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2268.0696	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1257.2842	WT/ST
FROM 4.17 TO 4.25	MICRONS =	22.3034	WT/ST
FROM 4.40 TO 4.60	MICRONS =	297.6496	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 5

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 5000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.8055	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.5869	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0683	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.5137	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	4.8208	WT/SR
FROM 3.90 TO 4.80	MICRONS =	9.7619	WT/SR
FROM 4.17 TO 4.25	MICRONS =	1.5289	WT/SR
FROM 4.40 TO 4.60	MICRONS =	6.8767	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1988.3616	WT/ST
FROM 3.90 TO 4.80	MICRONS =	1017.7415	WT/ST
FROM 4.17 TO 4.25	MICRONS =	11.1124	WT/ST
FROM 4.40 TO 4.60	MICRONS =	185.0670	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 6

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 30.00 DEGREES
RANGE = 50000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.3052	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.2517	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0055	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.1385	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2.1578	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.7659	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0113	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.5236	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	753.2820	WT/ST
FROM 3.90 TO 4.80	MICRONS =	436.3955	WT/ST
FROM 4.17 TO 4.25	MICRONS =	0.8982	WT/ST
FROM 4.40 TO 4.60	MICRONS =	49.8961	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 7

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 0. FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.9055	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.7278	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.1408	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.8322	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	2.8872	WT/SR
FROM 3.90 TO 4.80	MICRONS =	60.6520	WT/SR
FROM 4.17 TO 4.25	MICRONS =	12.2827	WT/SR
FROM 4.40 TO 4.60	MICRONS =	17.4096	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	495.9608	WT/ST
FROM 3.90 TO 4.80	MICRONS =	310.5170	WT/ST
FROM 4.17 TO 4.25	MICRONS =	5.6238	WT/ST
FROM 4.40 TO 4.60	MICRONS =	74.0816	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 8

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 5000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.7955	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.5875	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0696	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.5154	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	1.7277	WT/SR
FROM 3.90 TO 4.80	MICRONS =	3.1410	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.4706	WT/SR
FROM 4.40 TO 4.60	MICRONS =	2.2271	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	435.6969	WT/ST
FROM 3.90 TO 4.80	MICRONS =	250.6656	WT/ST
FROM 4.17 TO 4.25	MICRONS =	2.7802	WT/ST
FROM 4.40 TO 4.60	MICRONS =	45.8746	WT/ST

PIREP TEST PROBLEM 7
SPECTRAL SIGNATURE AND SPECIFIC MISSILES
CASE 9

PIREP EXTENSION STUDY

ELEVATION ANGLE= 0. DEGREES
ASPECT RATIO = 1.00
ASPECT ANGLE = 170.00 DEGREES
RANGE = 50000.00 FEET

AVERAGE PLUME/ATMOSPHERE TRANSMISSIVITY

FROM 1.80 TO 2.70	MICRONS =	0.3009	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.2517	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0055	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.1388	WT/SR

PLUME IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	0.7719	WT/SR
FROM 3.90 TO 4.80	MICRONS =	0.2470	WT/SR
FROM 4.17 TO 4.25	MICRONS =	0.0035	WT/SR
FROM 4.40 TO 4.60	MICRONS =	0.1653	WT/SR

ATTENUATED HOT PARTS IR TOTALS

FROM 1.80 TO 2.70	MICRONS =	164.8217	WT/ST
FROM 3.90 TO 4.80	MICRONS =	107.4119	WT/ST
FROM 4.17 TO 4.25	MICRONS =	0.2213	WT/ST
FROM 4.40 TO 4.60	MICRONS =	12.3516	WT/ST

* *

LOCKON RANGE, FEET

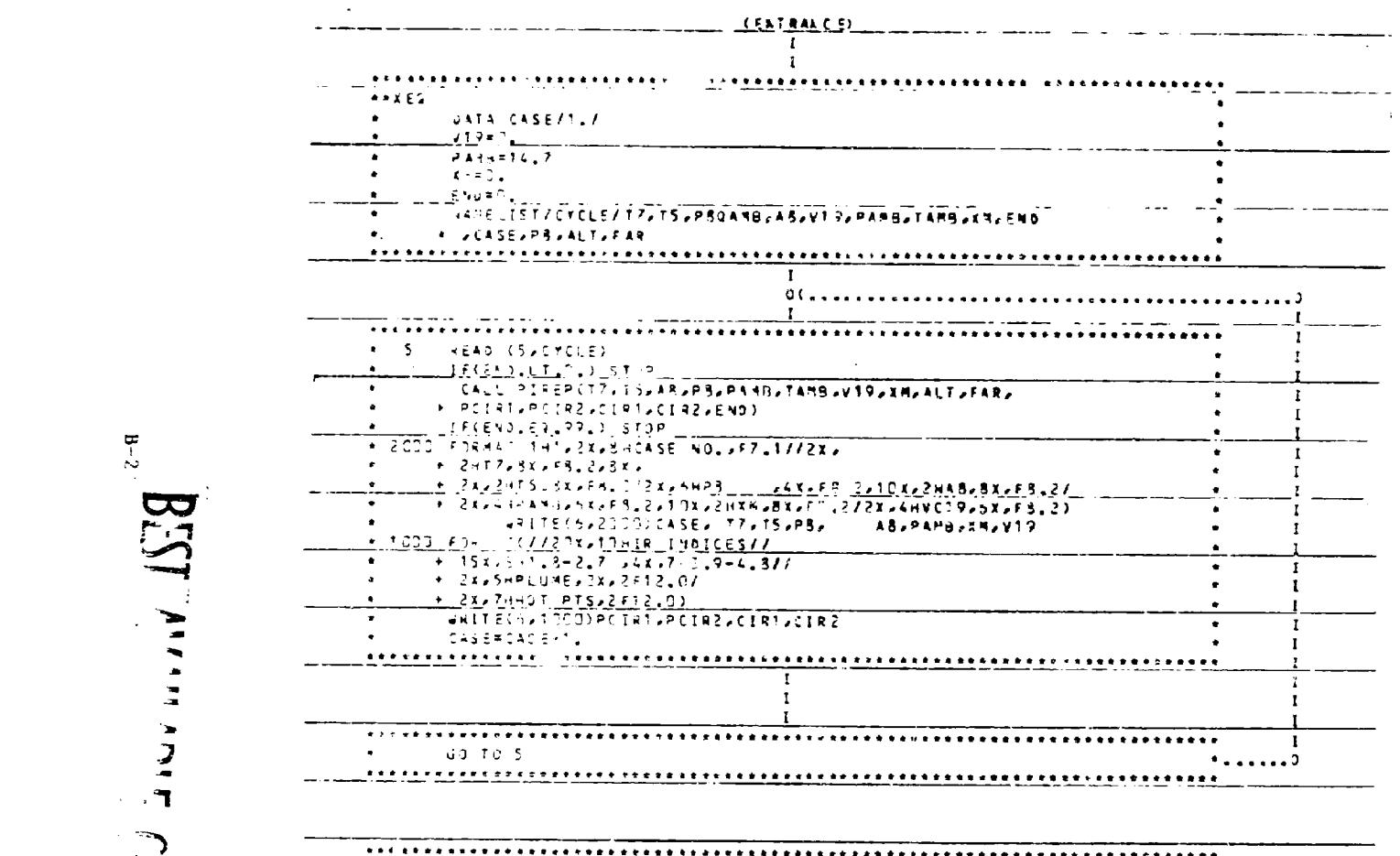
* *

ASPECT ANGLE (DEG)	MISSILE NUMBER 1	2	3	4
0.	14127.	49095.	41639.	113245.
30.00	14005.	45743.	39686.	104718.
170.00	8819.	27538.	21847.	61089.

APPENDIX B

FLOW CHARTS FOR

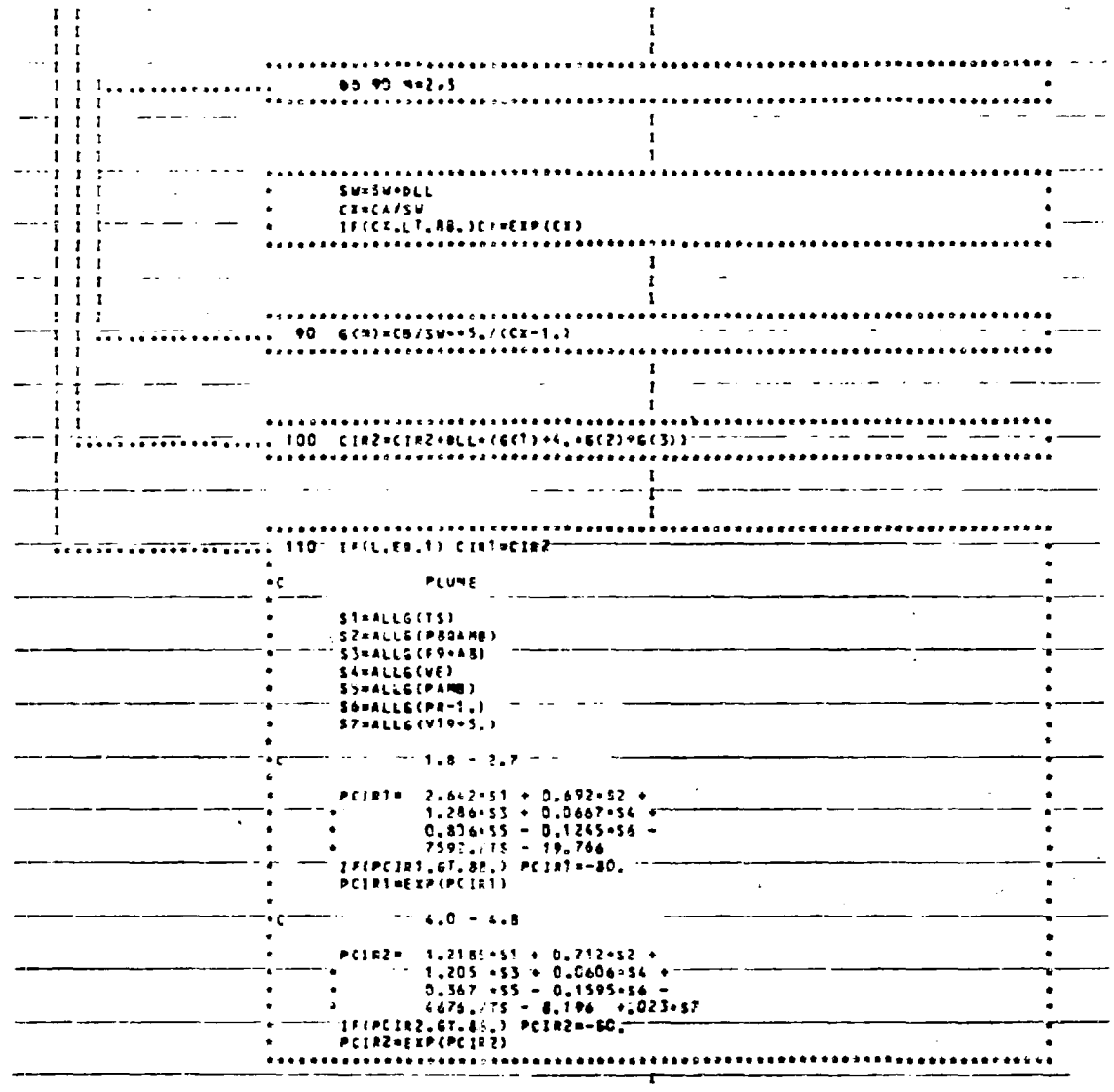
PIREP SUBROUTINES



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```
      85 90 =2.5

      SW=SW*DLL
      CX=CA/SW
      IF(CX.LT.88.)CX=EXP(CX)

   90 G(M)=G5/SW**5./(CX-1.)

  100 CIR2=CIR2+DLL*(G(1)+4.*G(2)+G(3))

  110 IF(L.EQ.1) CIR1=CIR2

C             PLUME

      S1=ALLG(TS)
      S2=ALLG(PBQAMB)
      S3=ALLG(F9+AB)
      S4=ALLG(VE)
      S5=ALLG(PAMB)
      S6=ALLG(PB-1.)
      S7=ALLG(V19+5.)

C             1.8 - 2.7

      PCIR1=  2.642*S1 + 0.692*S2 +
     *        1.286*S3 + 0.0667*S4 +
     *        0.836*S5 - 0.1265*S6 -
     *        7592./TS - 19.766
      IF(PCIR1.GT.88.) PCIR1=-80.
      PCIR1=EXP(PCIR1)

C             4.0 - 4.8

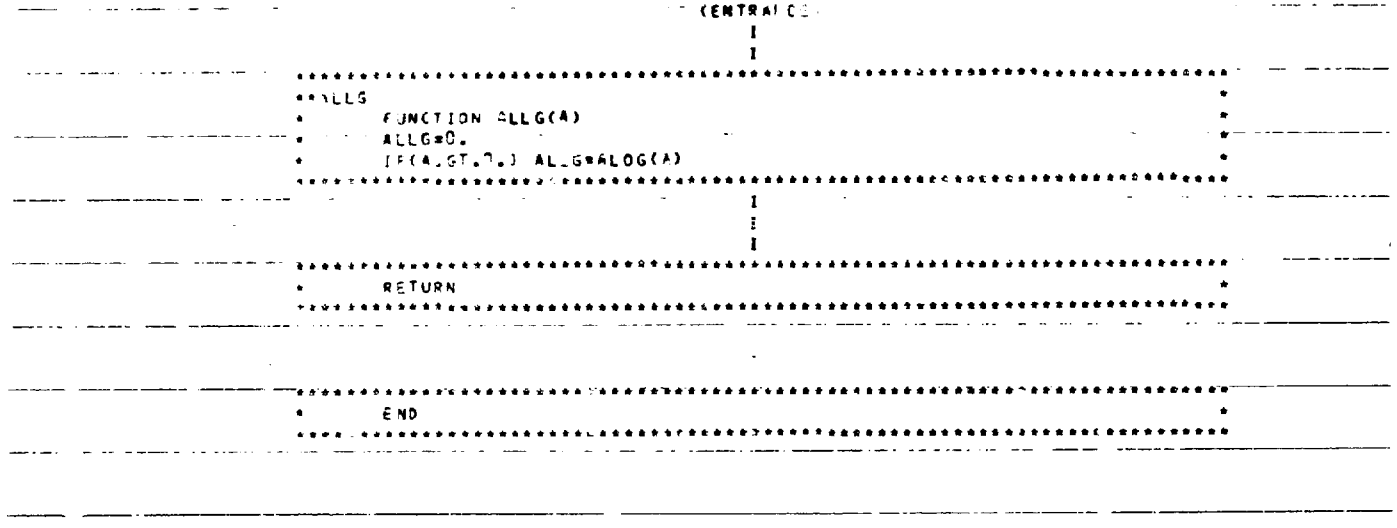
      PCIR2=  1.218*S1 + 0.712*S2 +
     *        1.205 *S3 + 0.0606*S4 +
     *        0.367 *S5 - 0.1595*S6 -
     *        4676./TS - 8.196  +.023*S7
      IF(PCIR2.GT.88.) PCIR2=-80.
      PCIR2=EXP(PCIR2)
```

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```
      IF(END.NE.99)GO TO 900
      PC(1)=PCIR1
      PC(2)=PCIR2
      PC(3)=CIR1
      PC(4)=CIR2
      AA(1)=T7
      AA(2)=T5
      AA(3)=A3
      AA(4)=P3
      AA(5)=PAMB
      AA(6)=TAMB
      AA(7)=V19
      AA(8)=XM
      AA(9)=ALT
      AA(10)=FAP
      END=END
      CALL PLCCK
  900 RETURN
      END
```

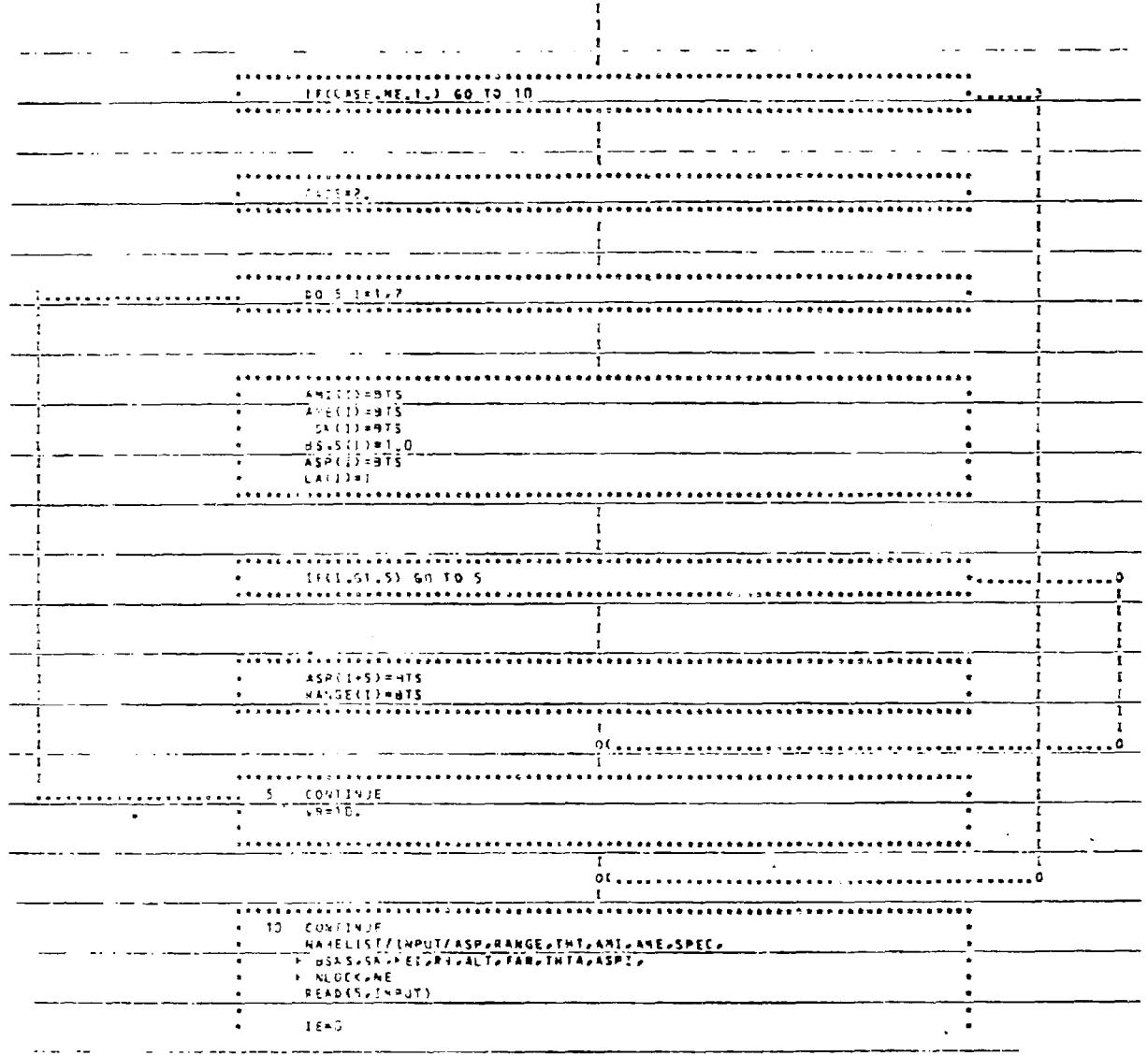

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(ENTRAL C
ALLG
FUNCTION ALLG(A)
ALLG=0.
IF(A.GT.0.) ALLG=ALOG(A)
RETURN
END

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permit fully legible reproduction

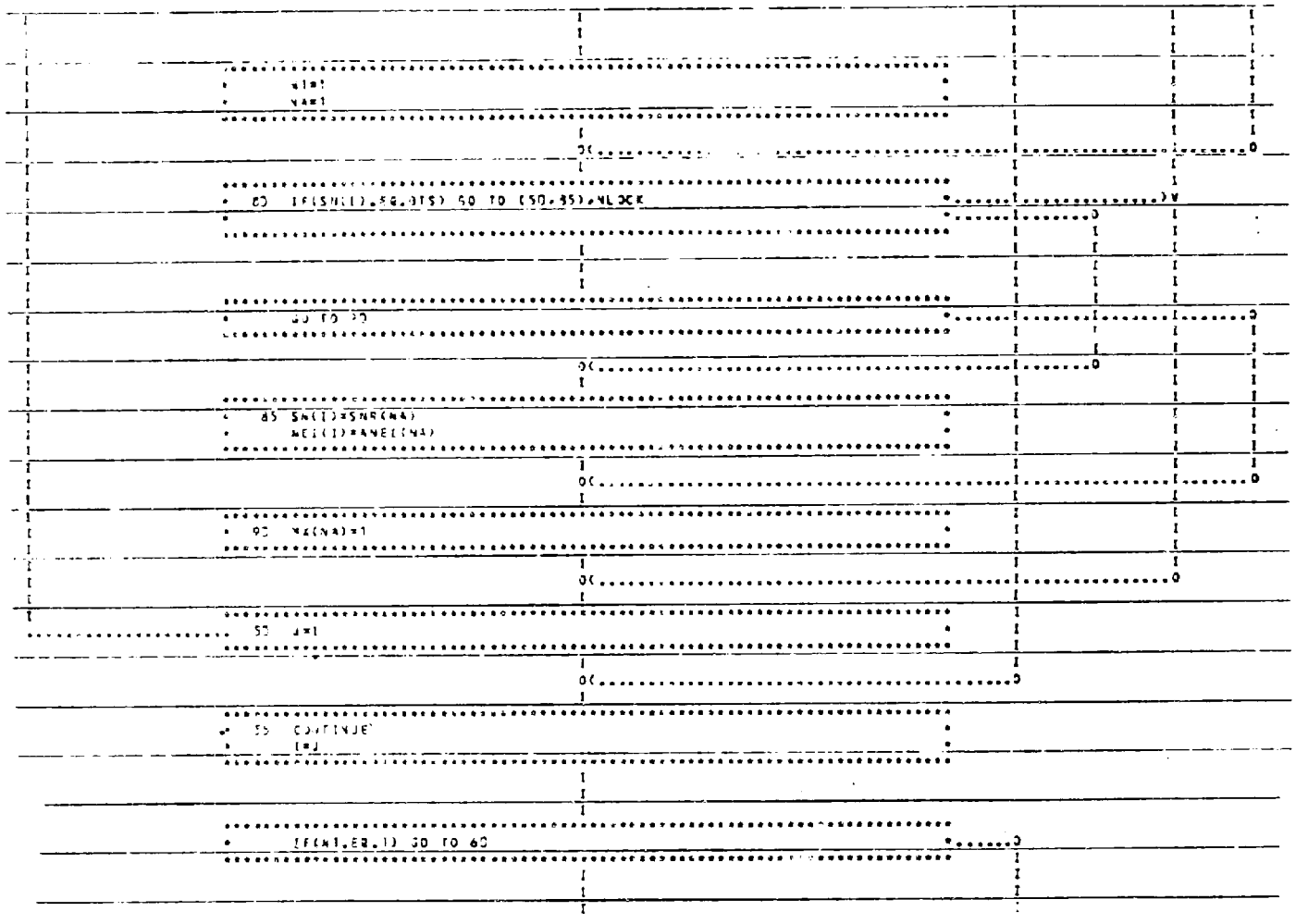
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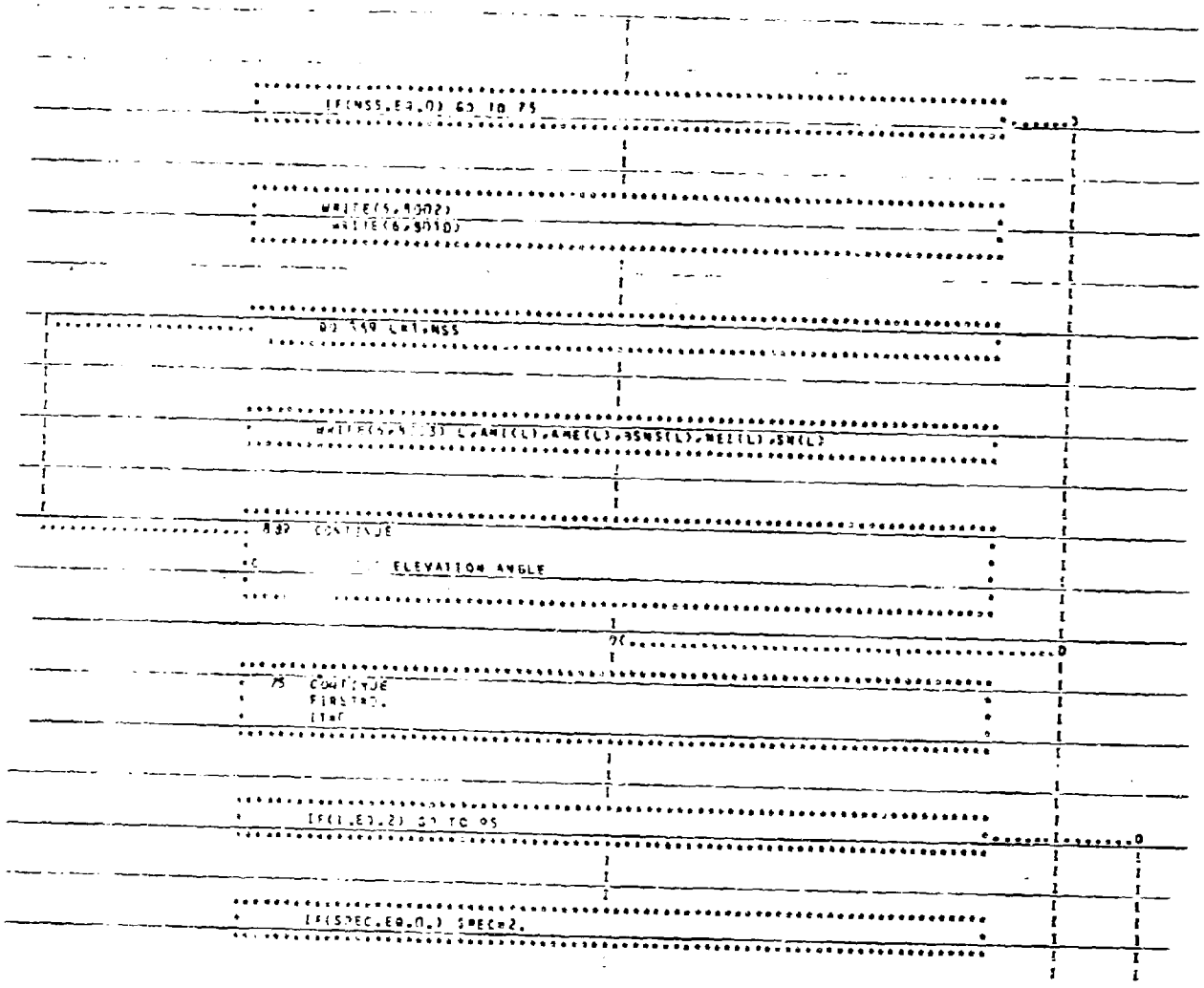
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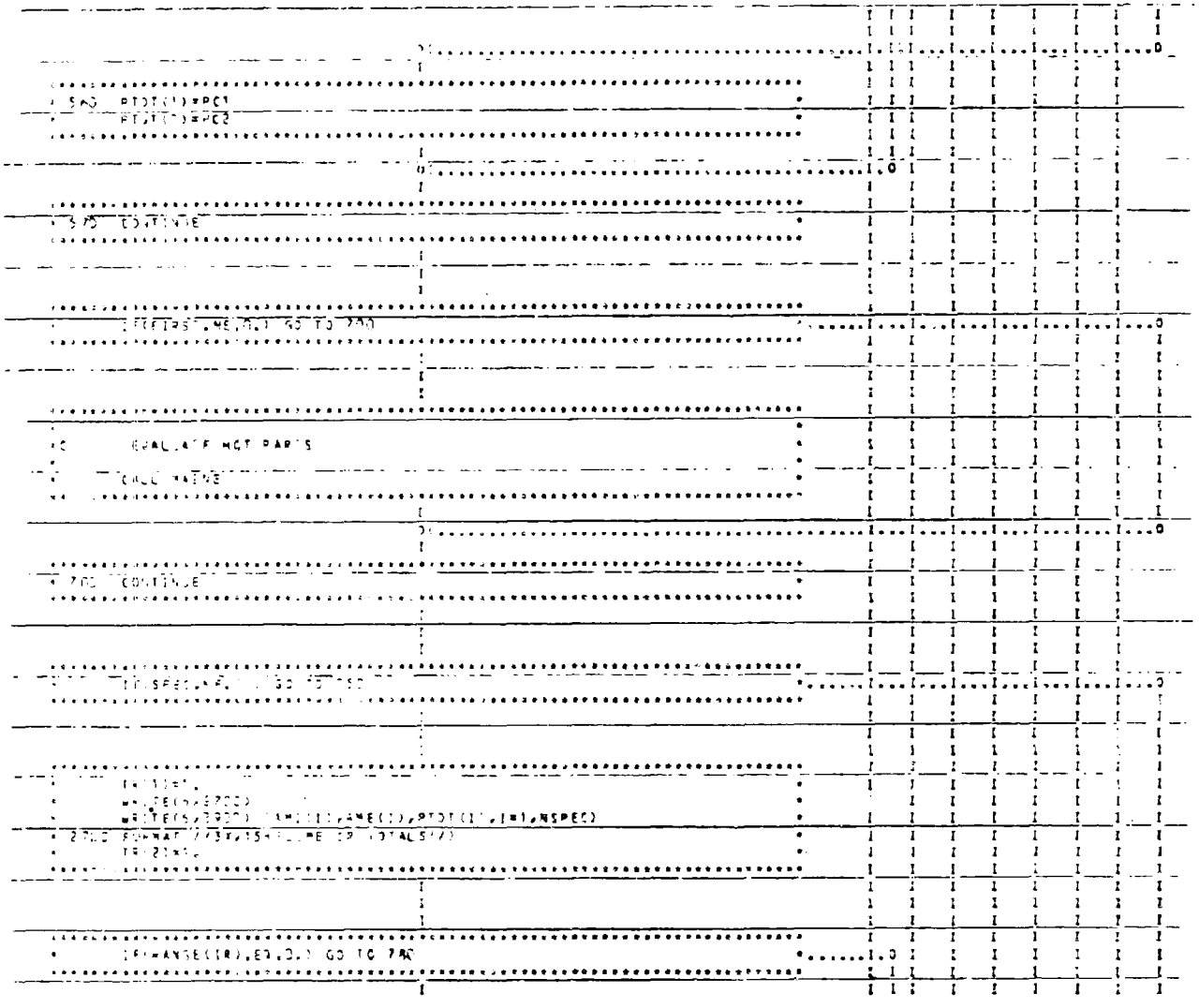


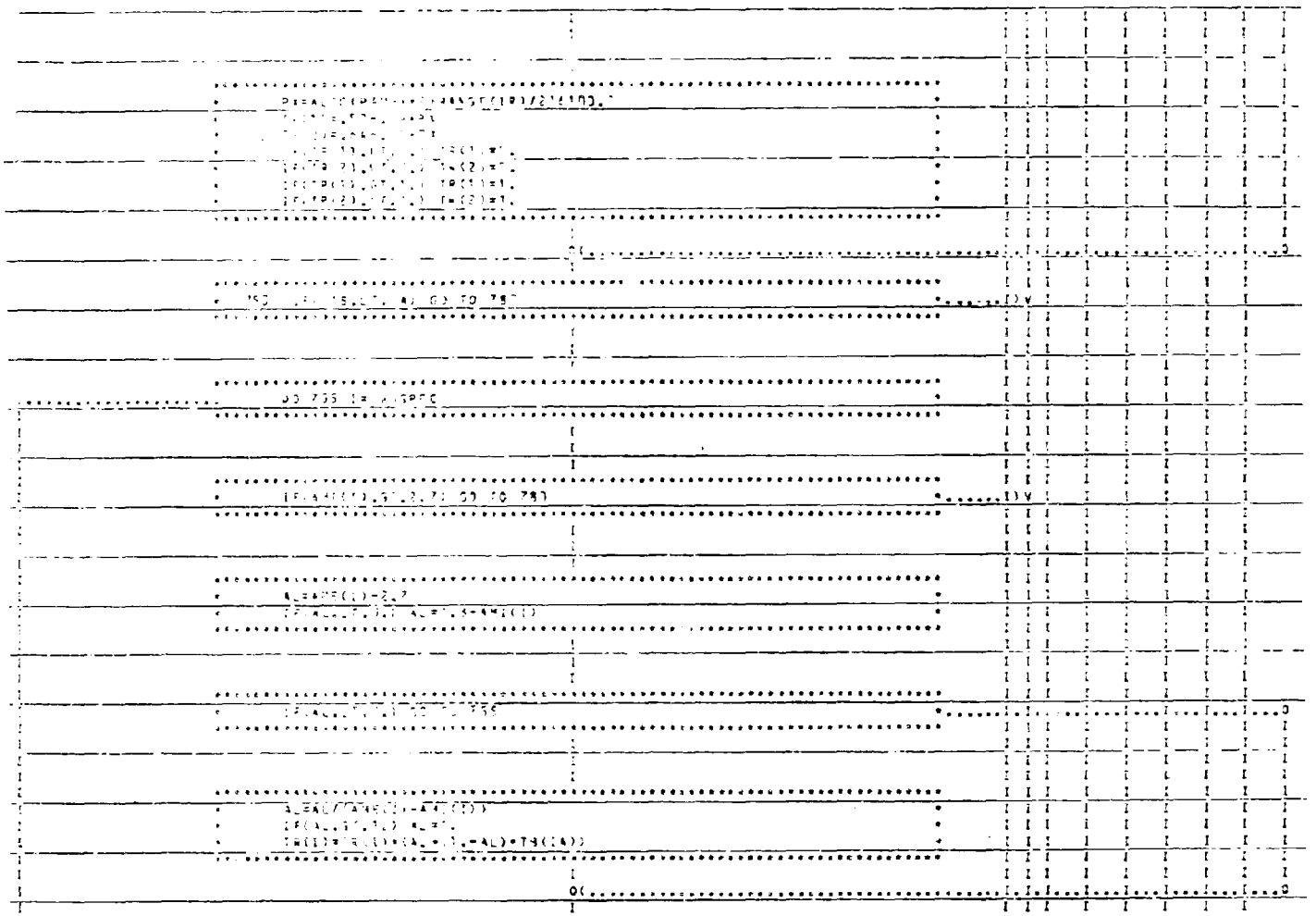
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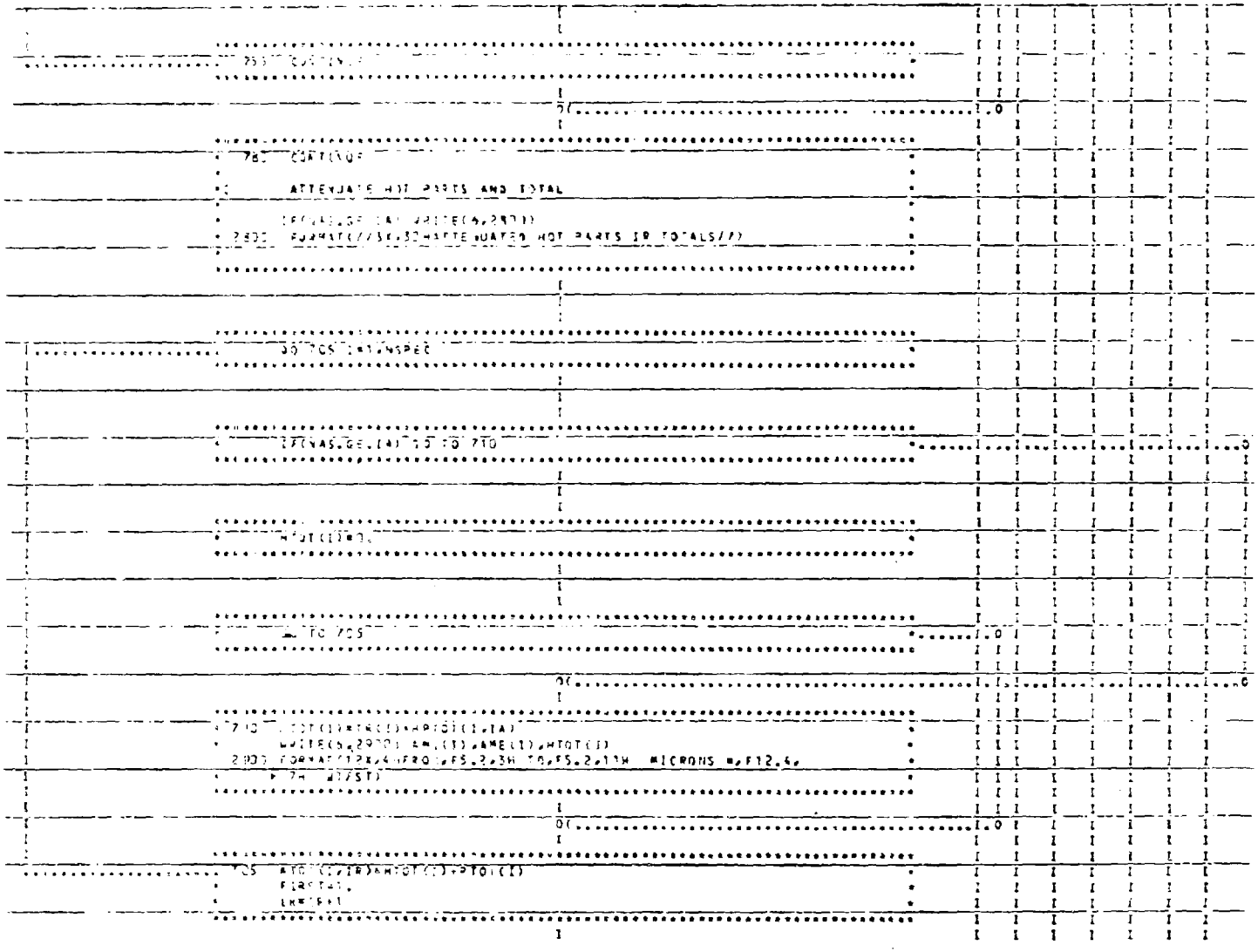
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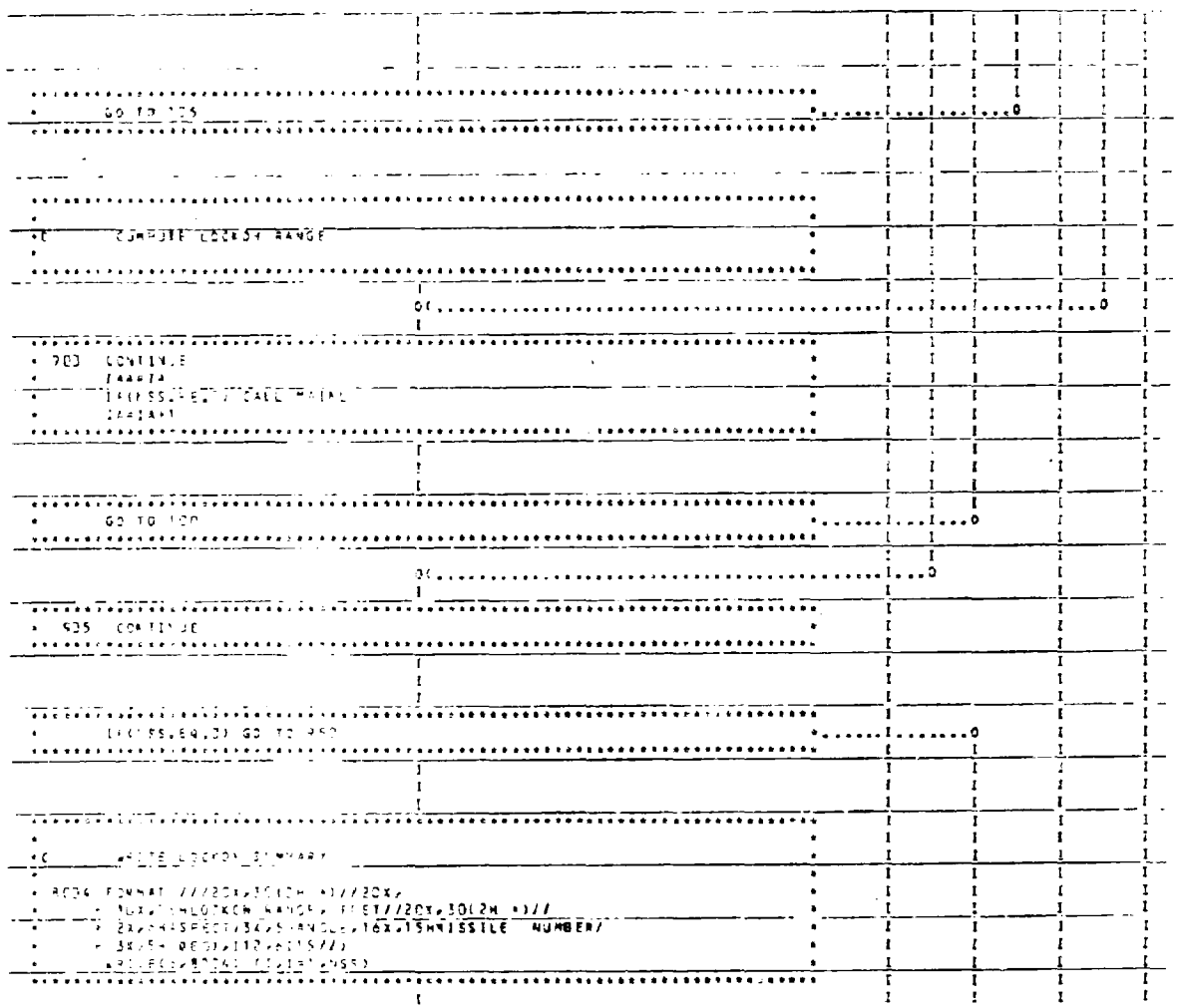
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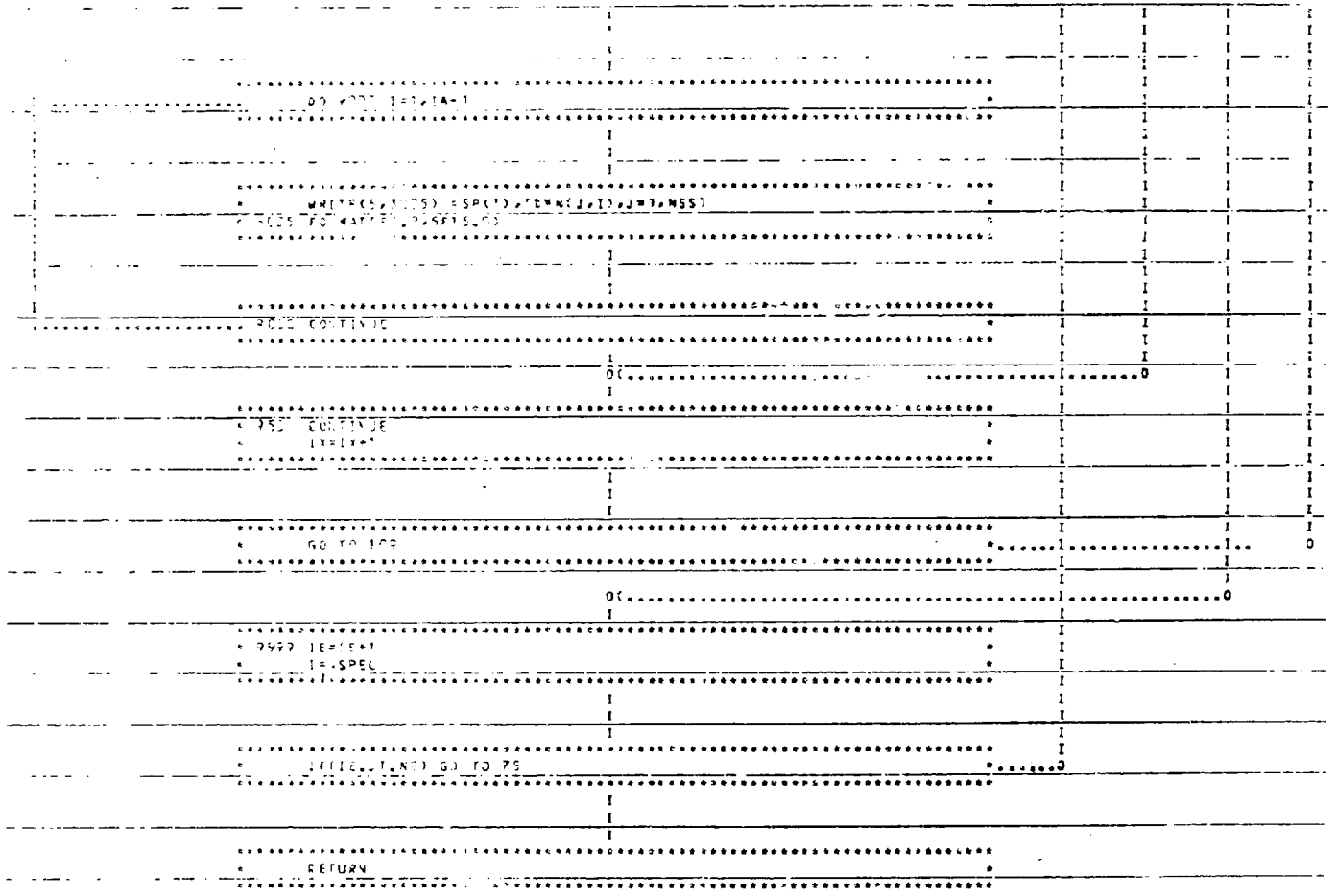
BEST AVAILABLE COPY

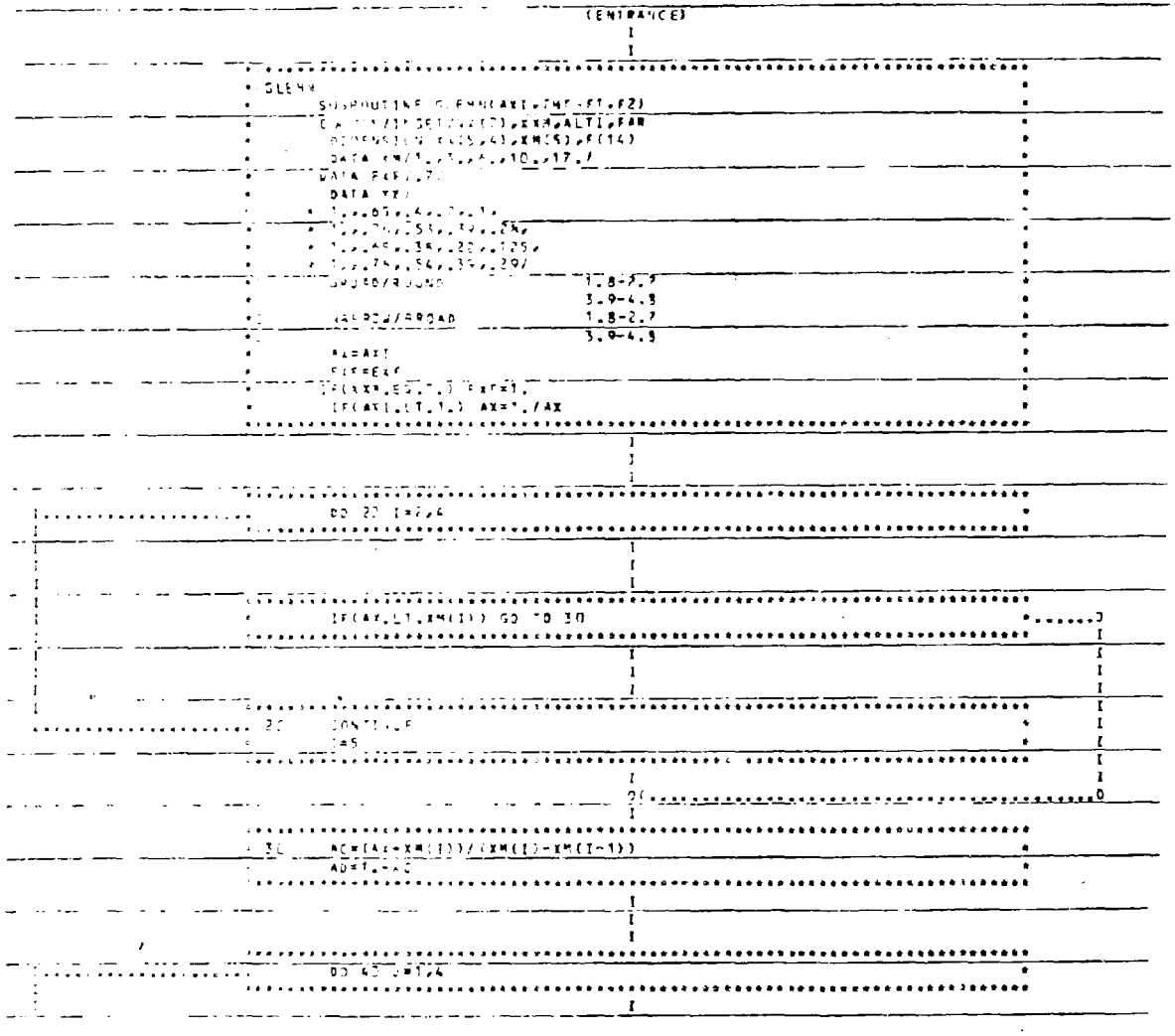


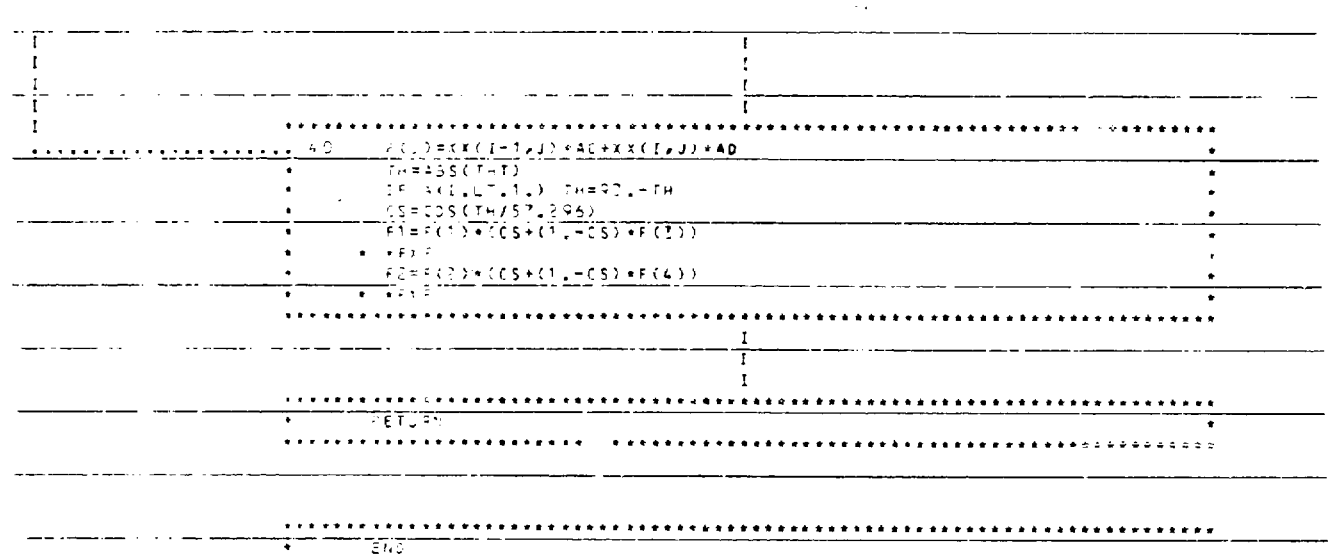


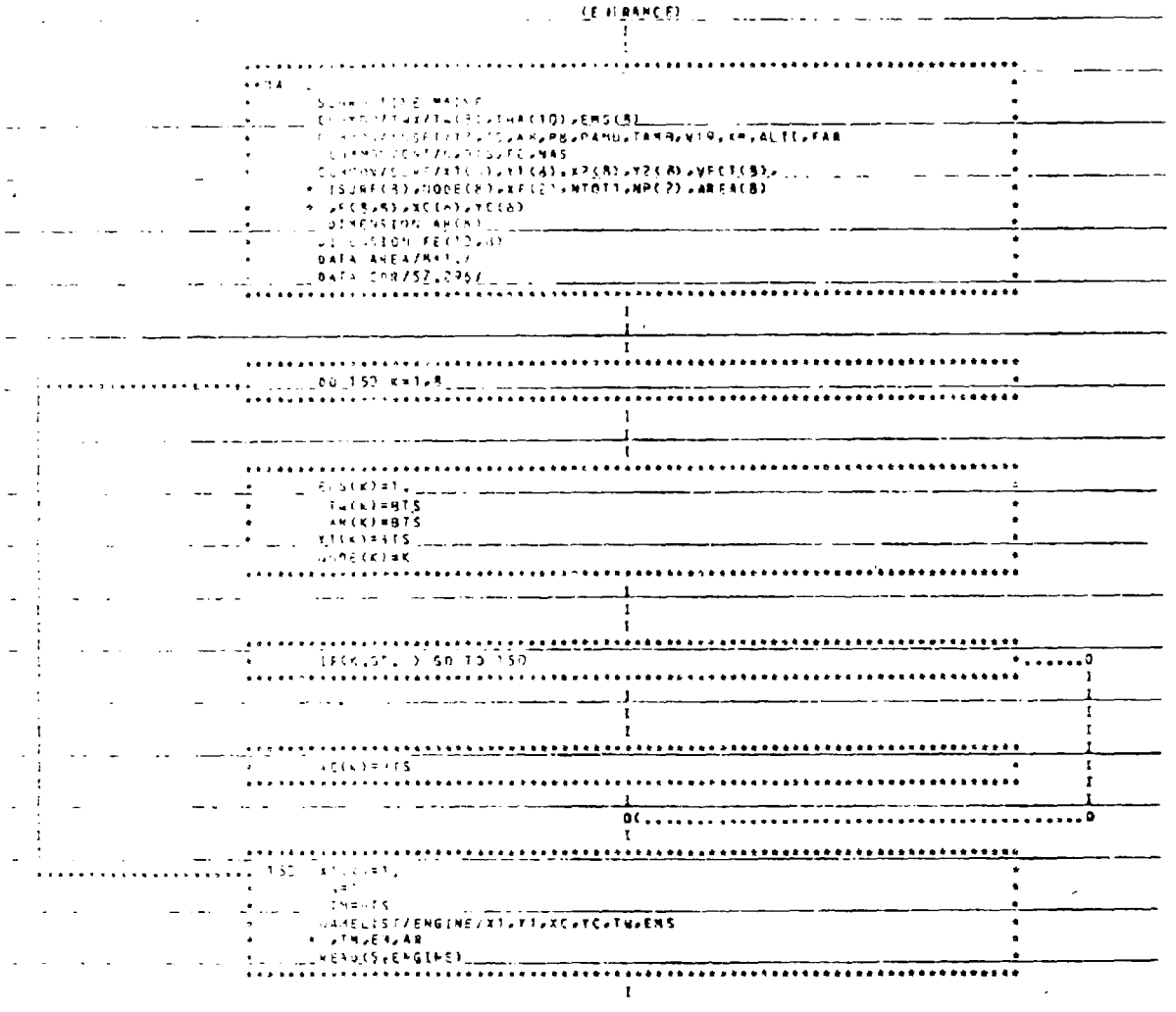


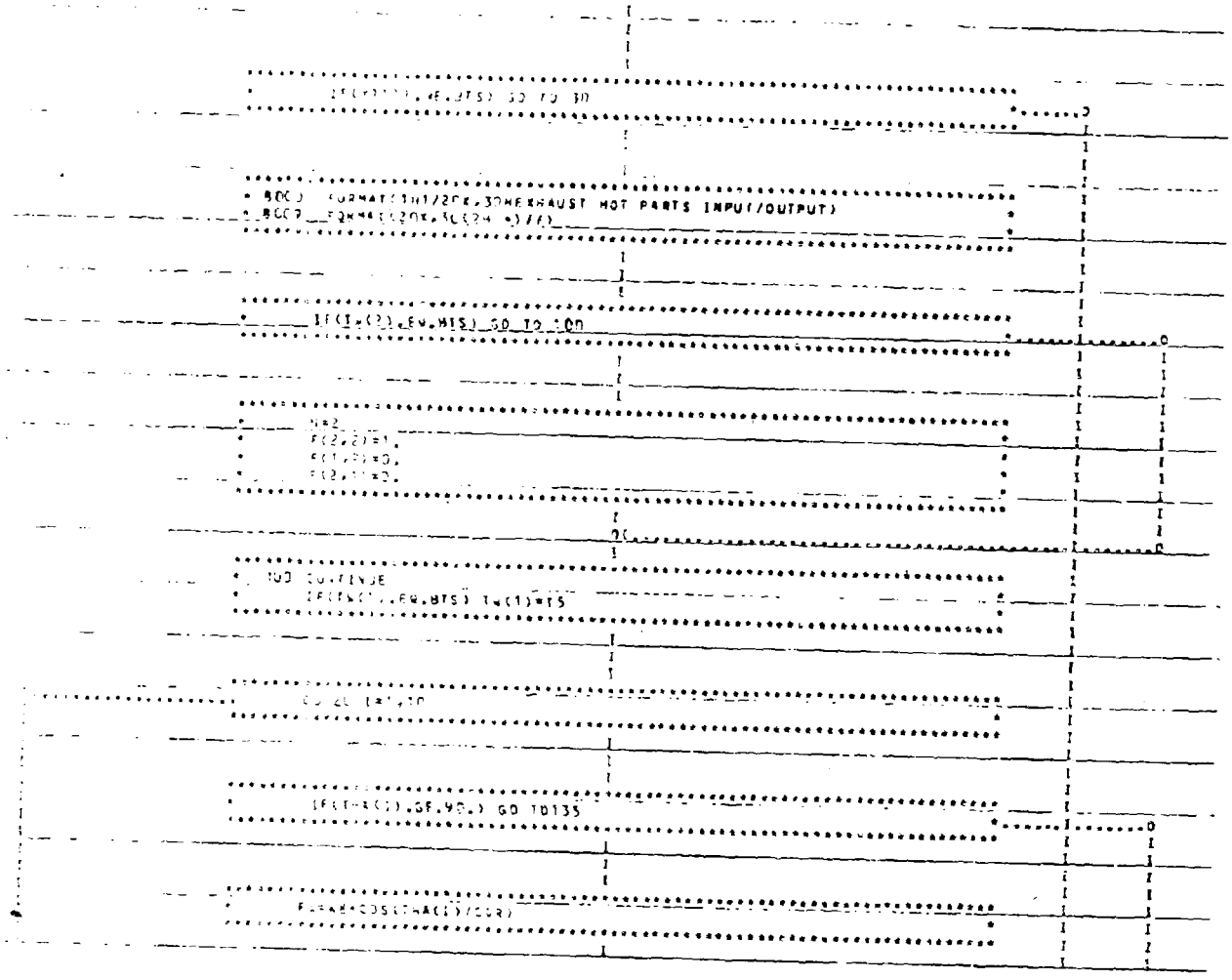

GO TO 125
C COMPUTE CLOSEST RANGE
903 CONTINUE
GO TO 100
935 CONTINUE
IF(SS.EQ.3) GO TO 950
C WRITE BLOCKON SUMMARY
FORMAT ////20X,30(1H *)///20X,
20X,'BLOCKON RANGE, FEET///20X,30(2H *)///
23X,'ASPECT',34X,'RANGE',16X,'MISSILE NUMBER'/
3X,5(8(I2,6(' '))/)
WRITE(6,904) (I,(IB(I,J),J=1,5),

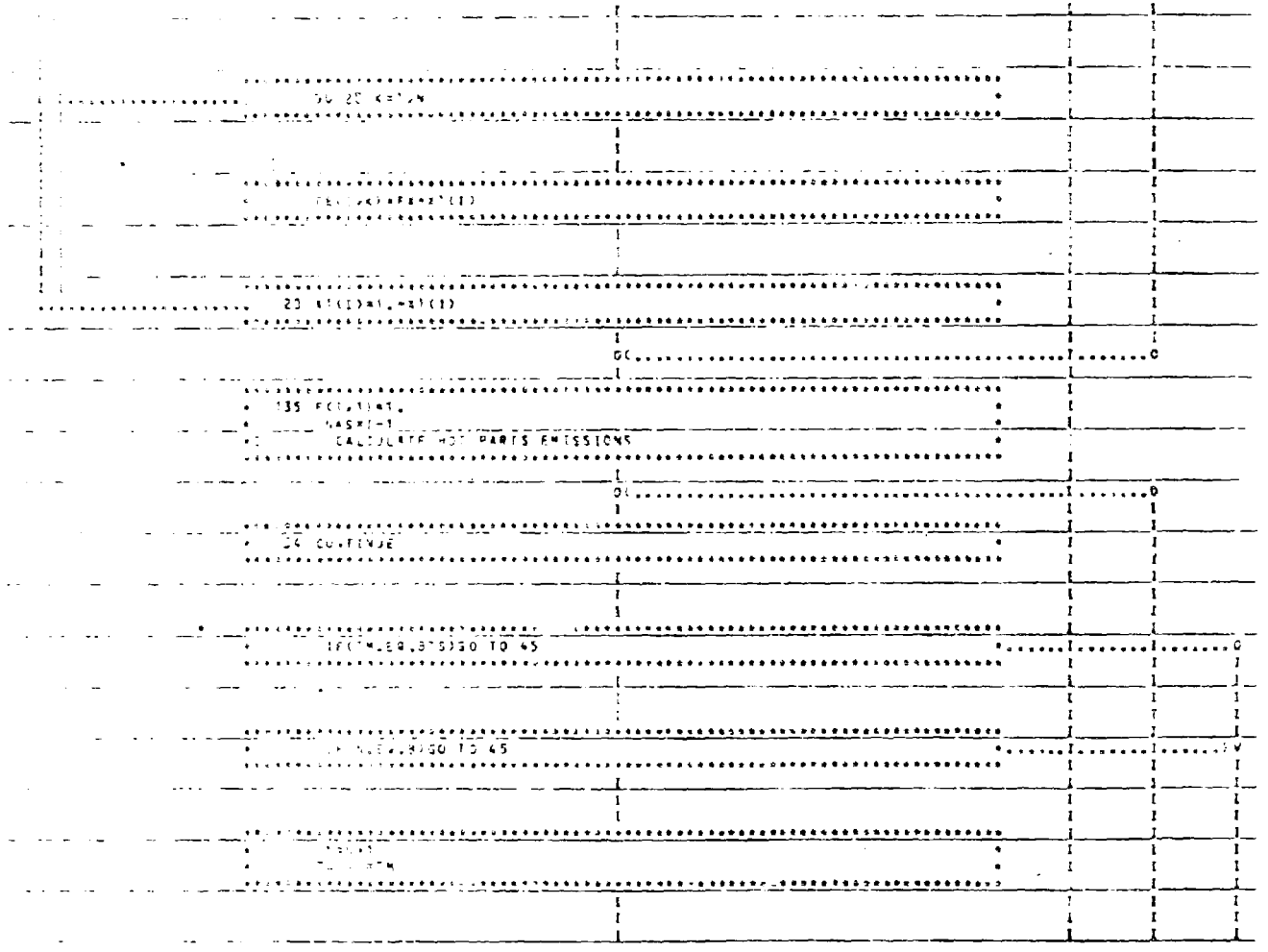


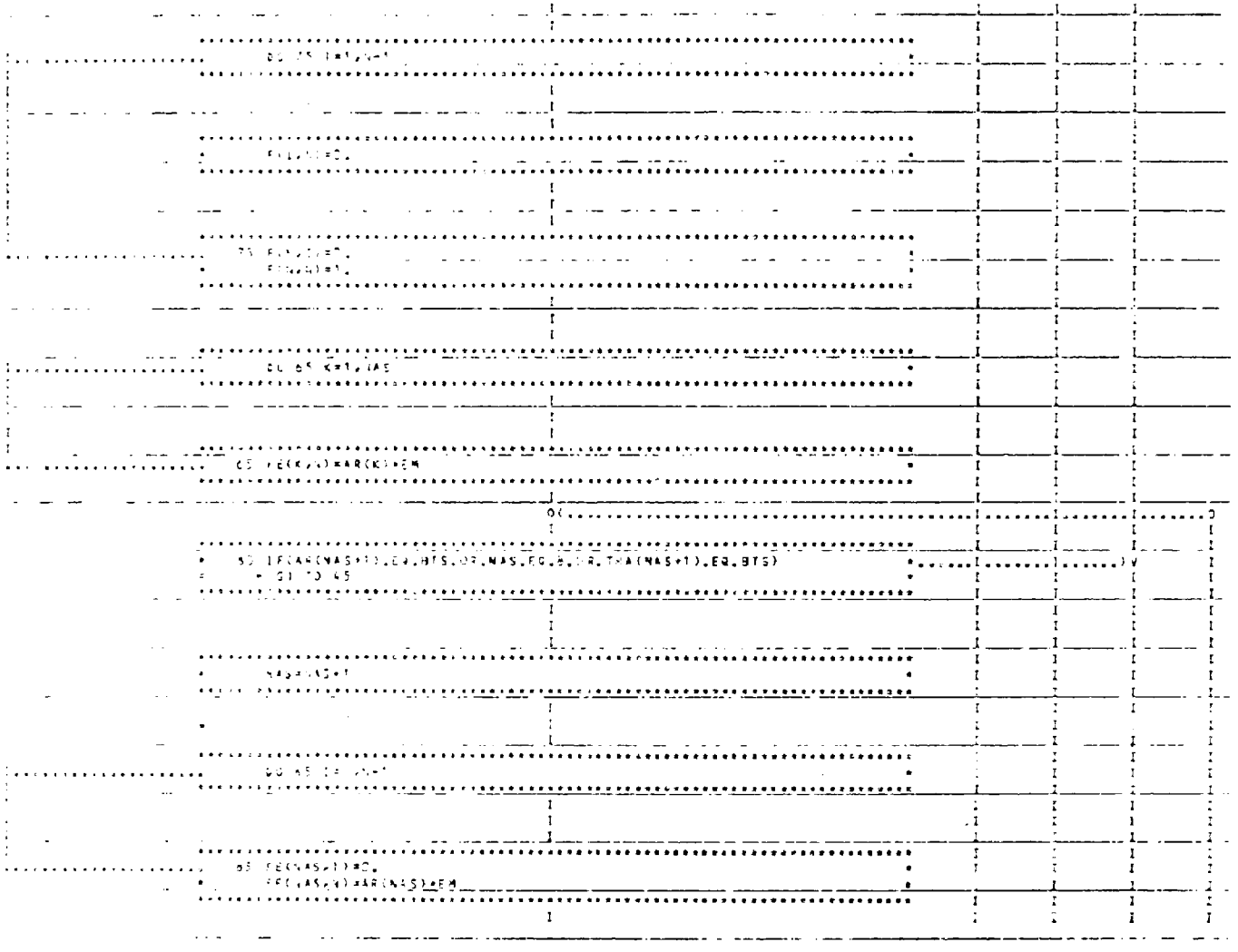

(ENTRANCE)
SUBROUTINE
DATA
DATA
DATA
DATA
1.8-2.7
3.9-4.8
1.8-2.7
3.9-4.8
AL=ALT
IF(AX.EQ.1.) AX=.
IF(AX.LT.1.) AX=./AX
DO 20 I=2,4
IF(AX.LT.XM(I)) GO TO 30
CONTINUE
I=5
AC=(AX-XM(I))/(XM(I)-XM(I-1))
AD=1.-AC
DO 40 J=1,4

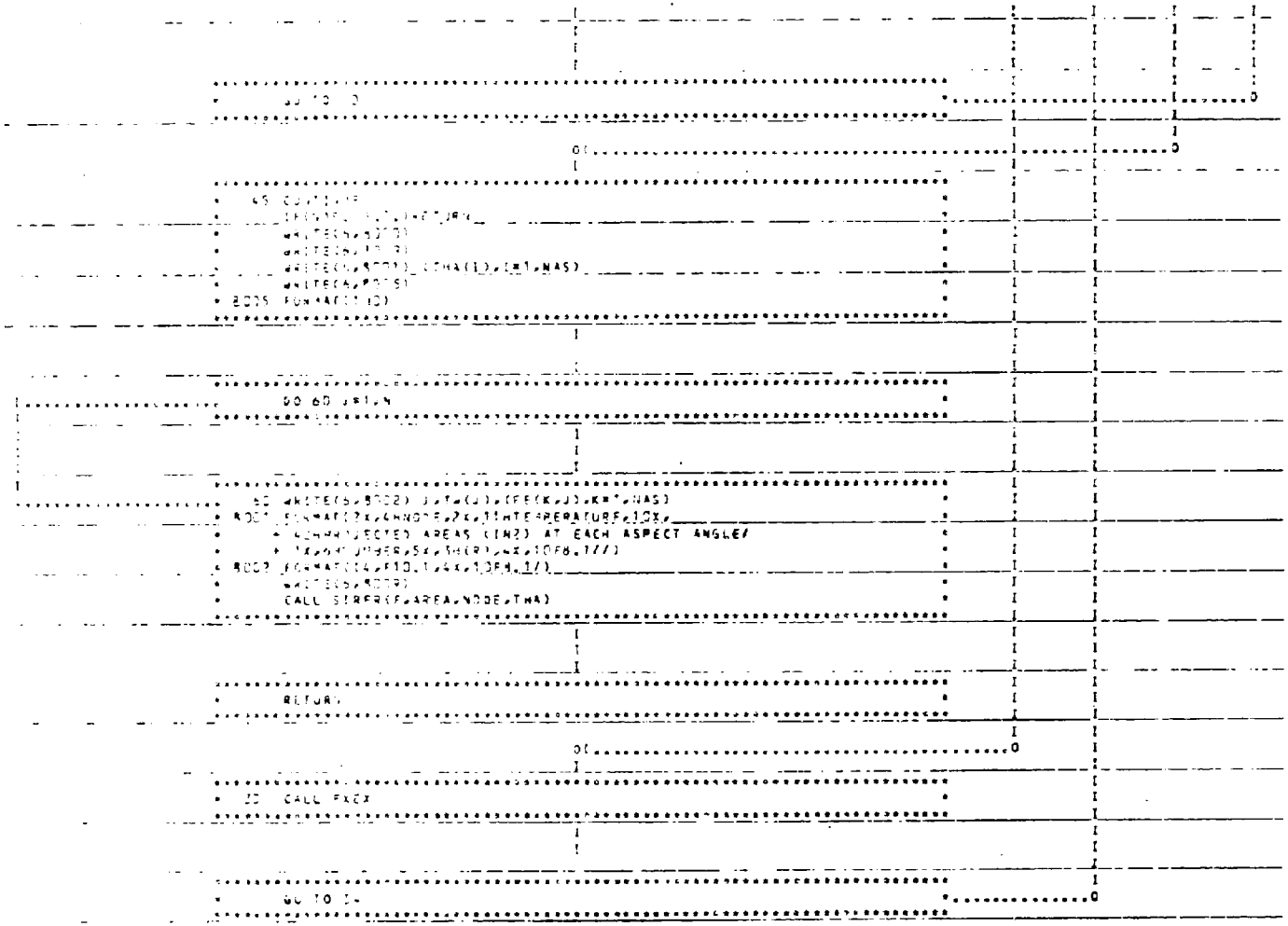

40
A(,)=XX(I-1,J)*AC+XX(I,J)*AD
TH=ABS(T-T)
IF A(I,L-.1.) TH=90.-TH
CS=COS(TH/57.296)
F1=F(1)*(CS+(1.-CS)*F(2))
F2=F(3)*(CS+(1.-CS)*F(4))
RETURN
END


(ENTRANCE)
DO 150 K=1,8
150 CONTINUE
RETURN
END

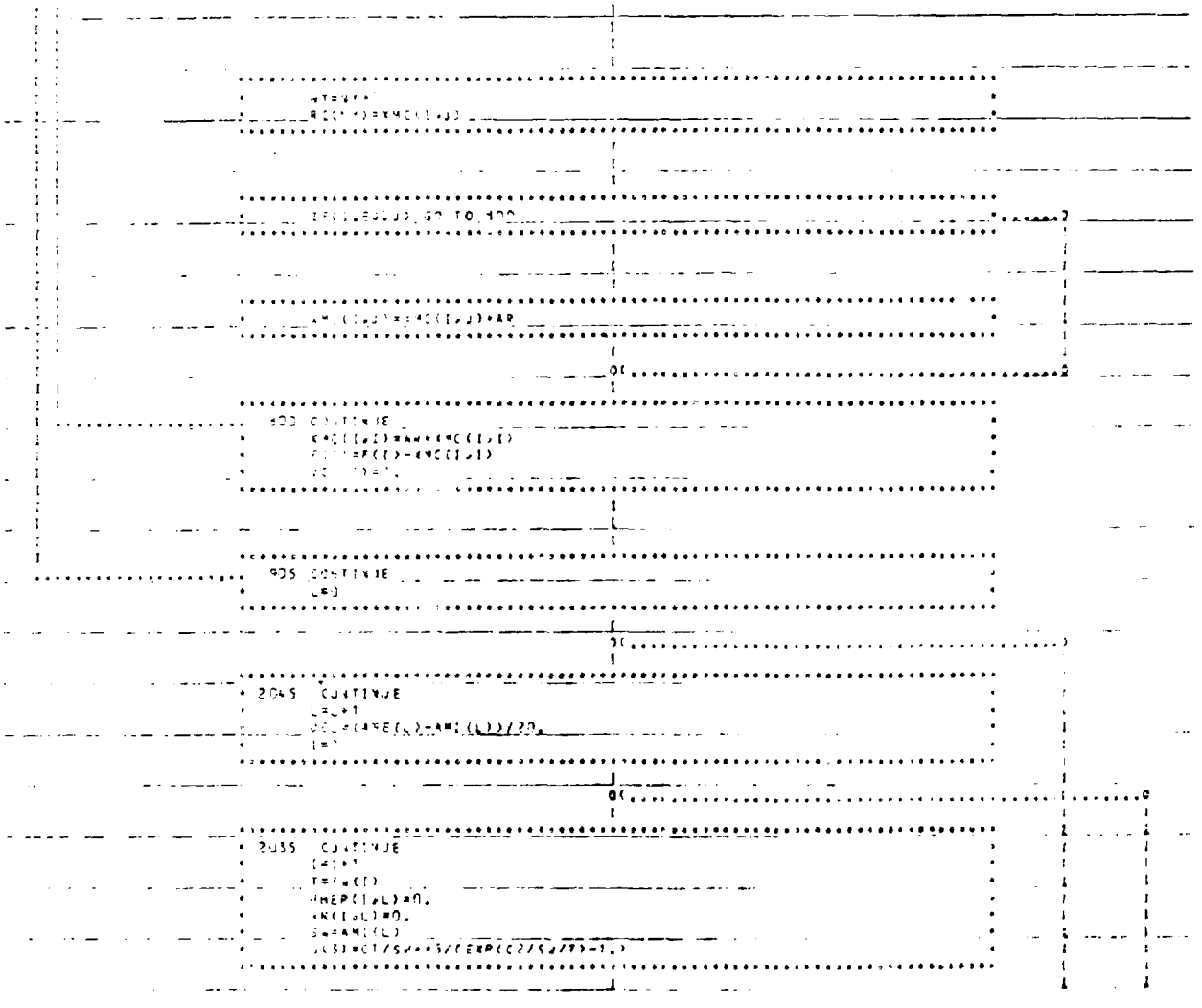


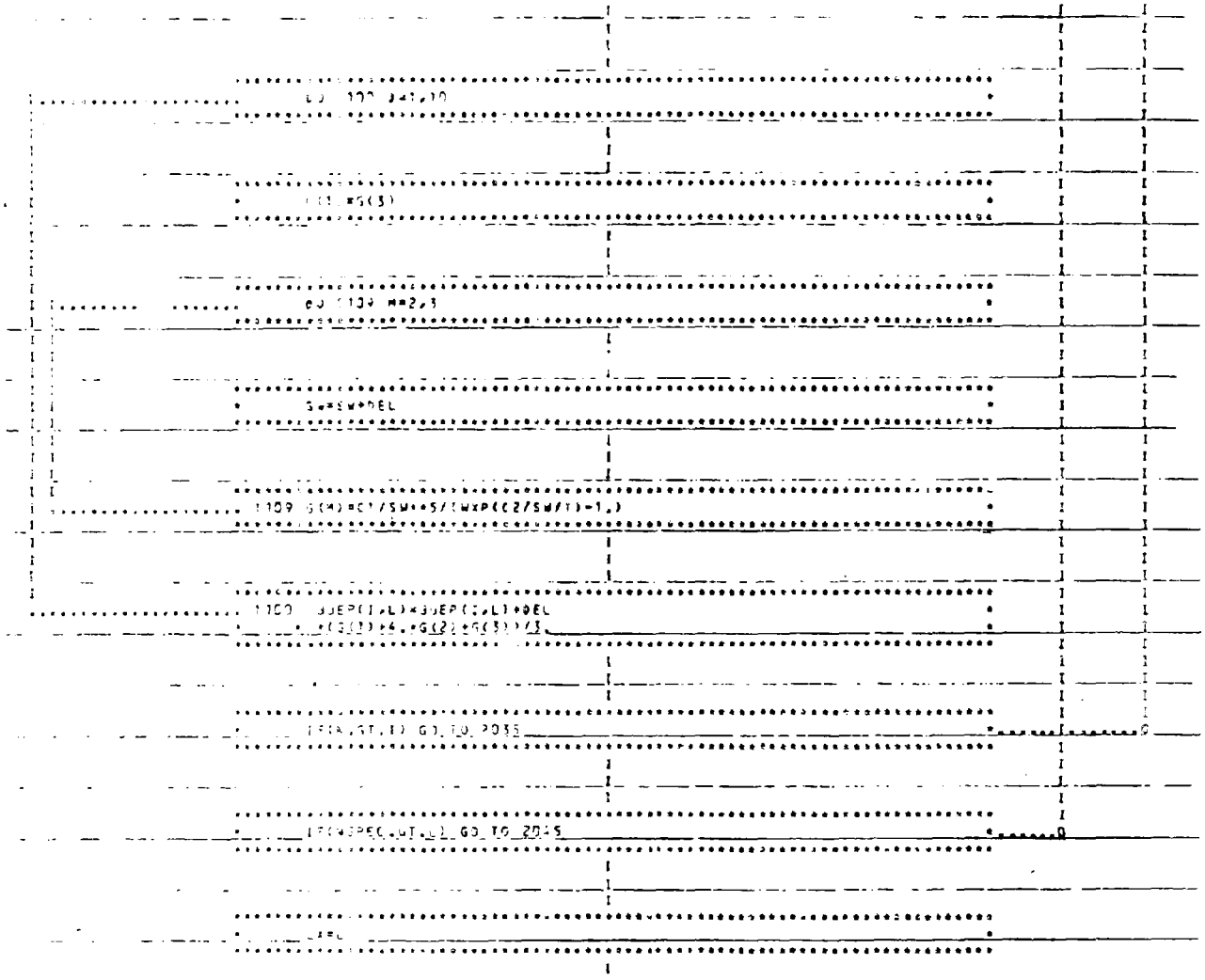


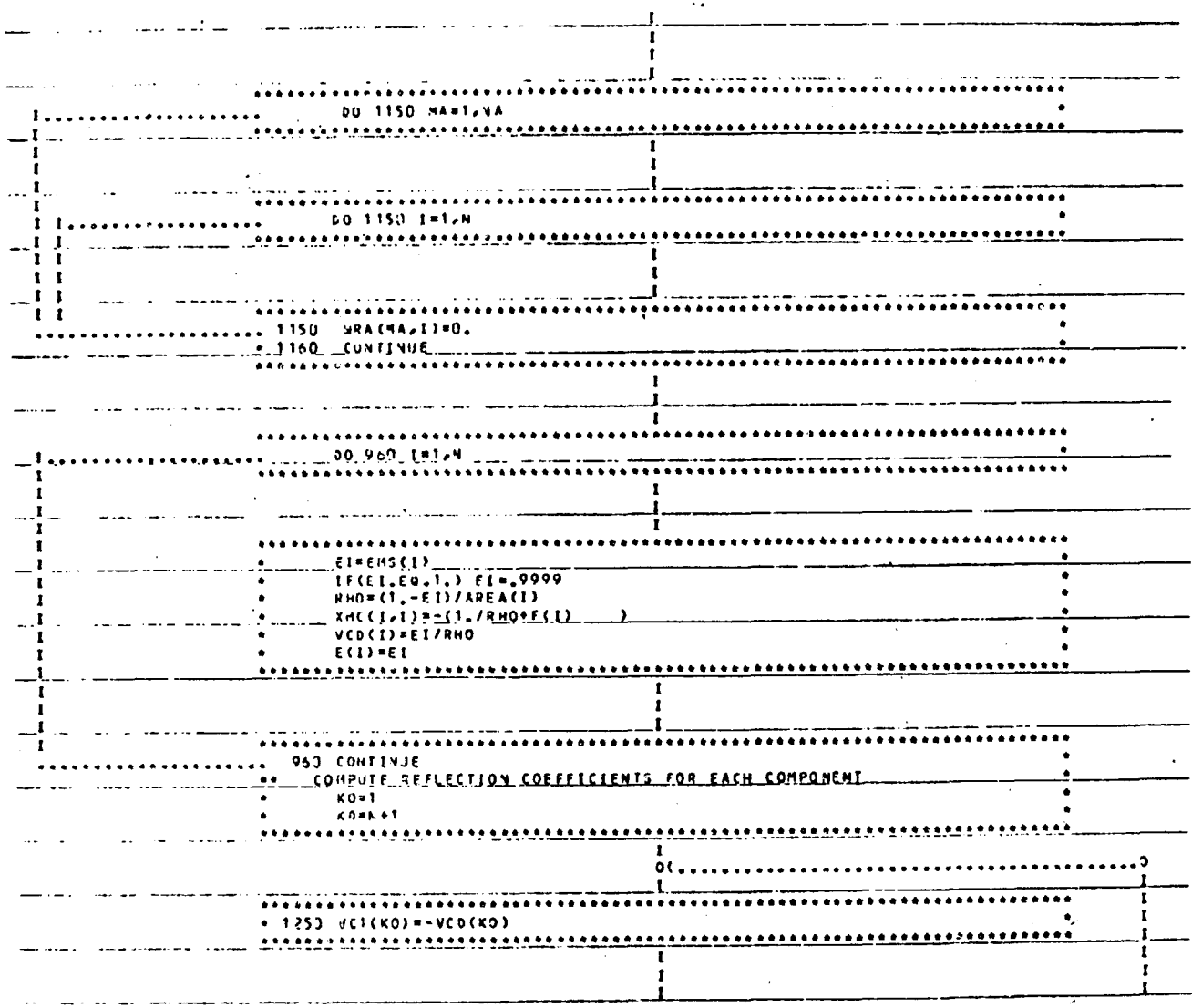


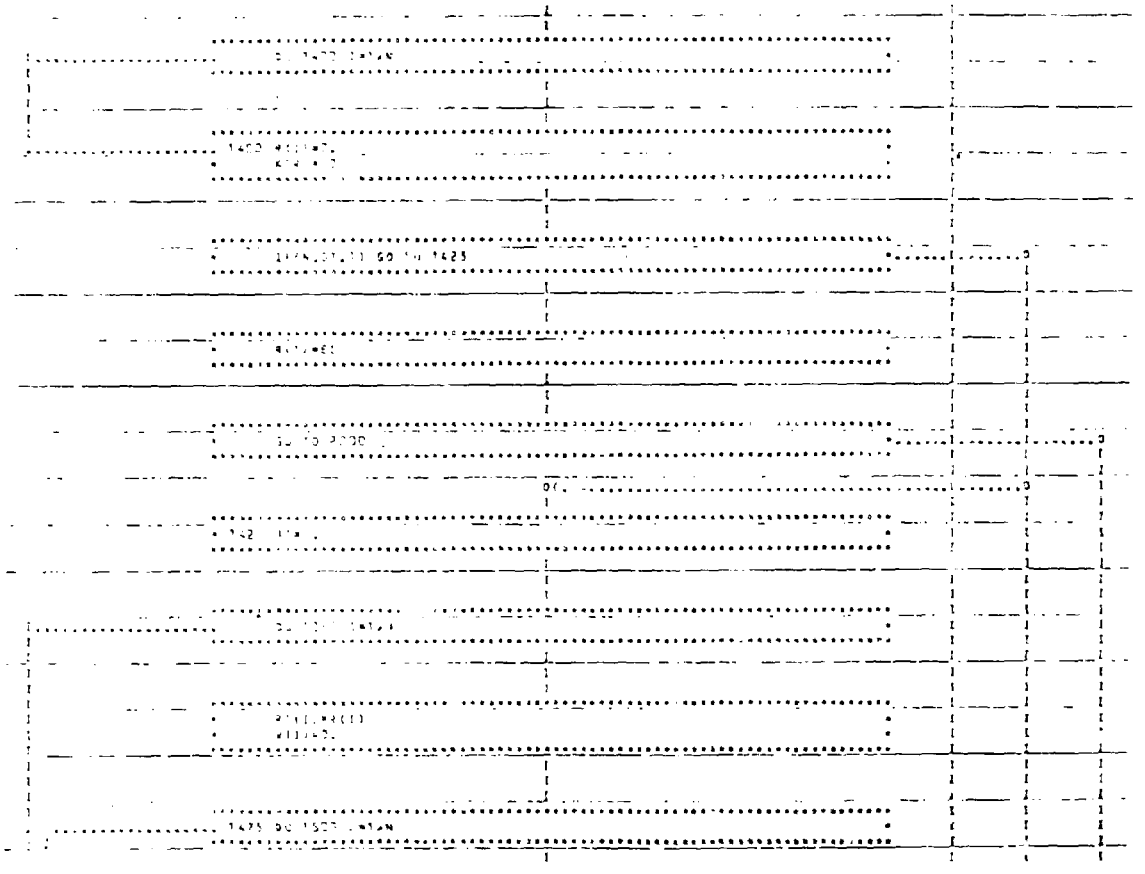

GO TO 3
65 CONTINUE
WRITE(6,9070)
WRITE(6,9071)
WRITE(6,9072) (THA(I),I=1,NAS)
WRITE(6,9073)
9070 FORMAT(1H0)
DO 60 J=1,N
60 WRITE(6,9002) J,TA(J),(FF(K,J),K=1,NAS)
9002 FORMAT(2X,4HNODE,2X,11HTEMPERATURE,10X,
+ 43HNORMALIZED AREAS (IN2) AT EACH ASPECT ANGLE/
+ 1X,4HNUMBER,5X,5HTEMP,4X,10F8.1///)
WRITE(6,9009)
CALL SIRFR(F,AREA,NODE,TWA)
RETURN
70 CALL EXCX
GO TO 2

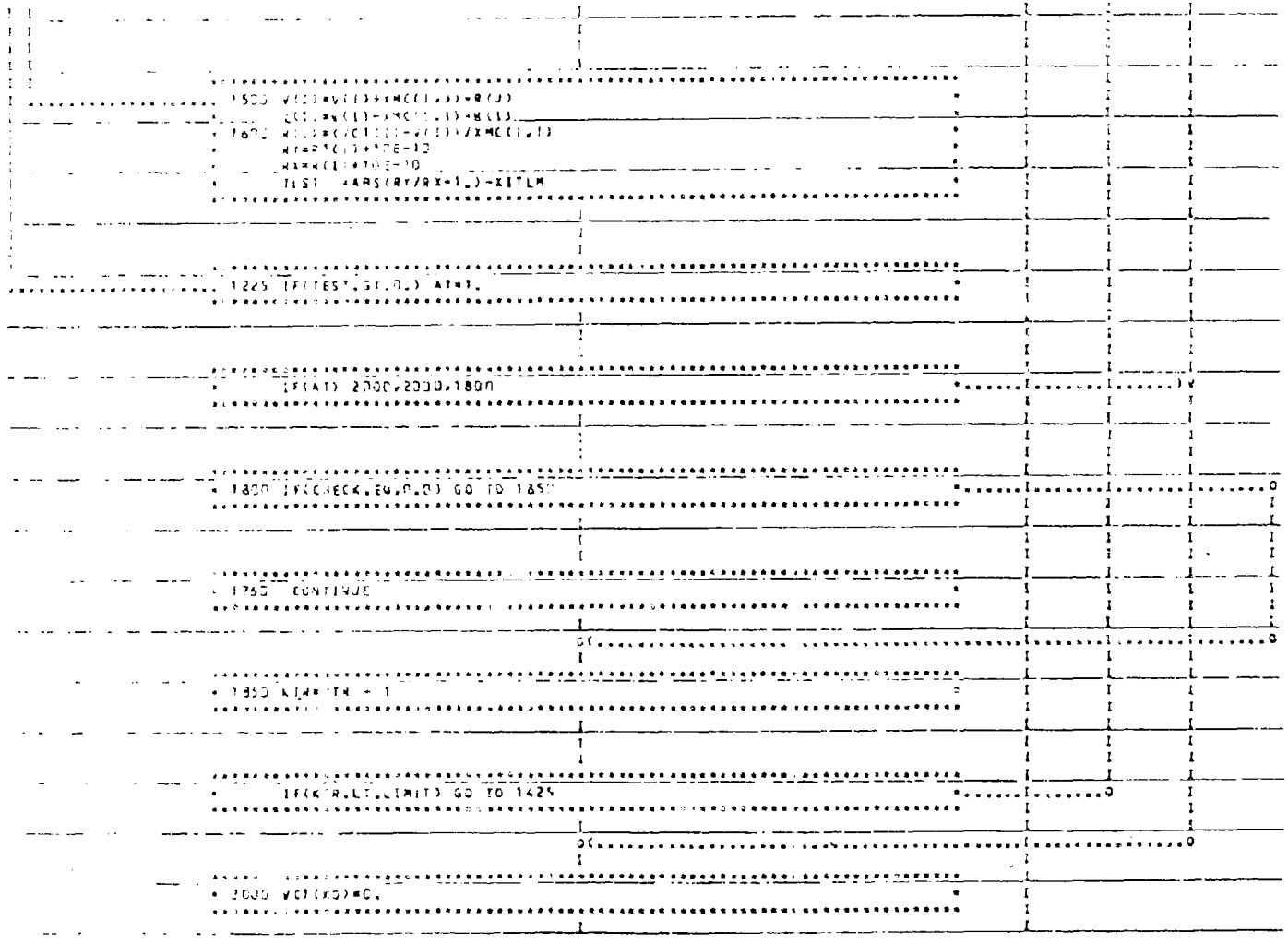


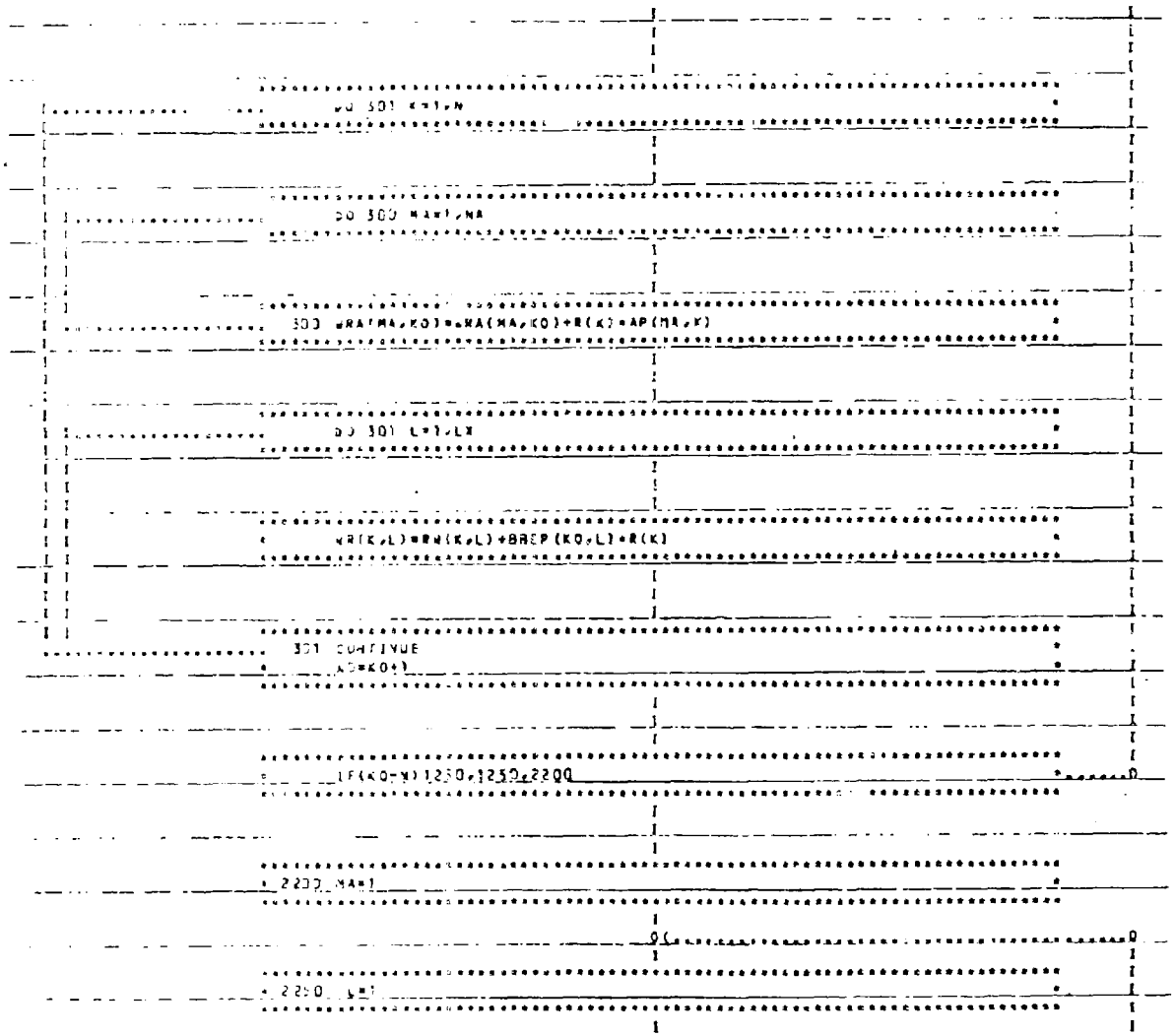


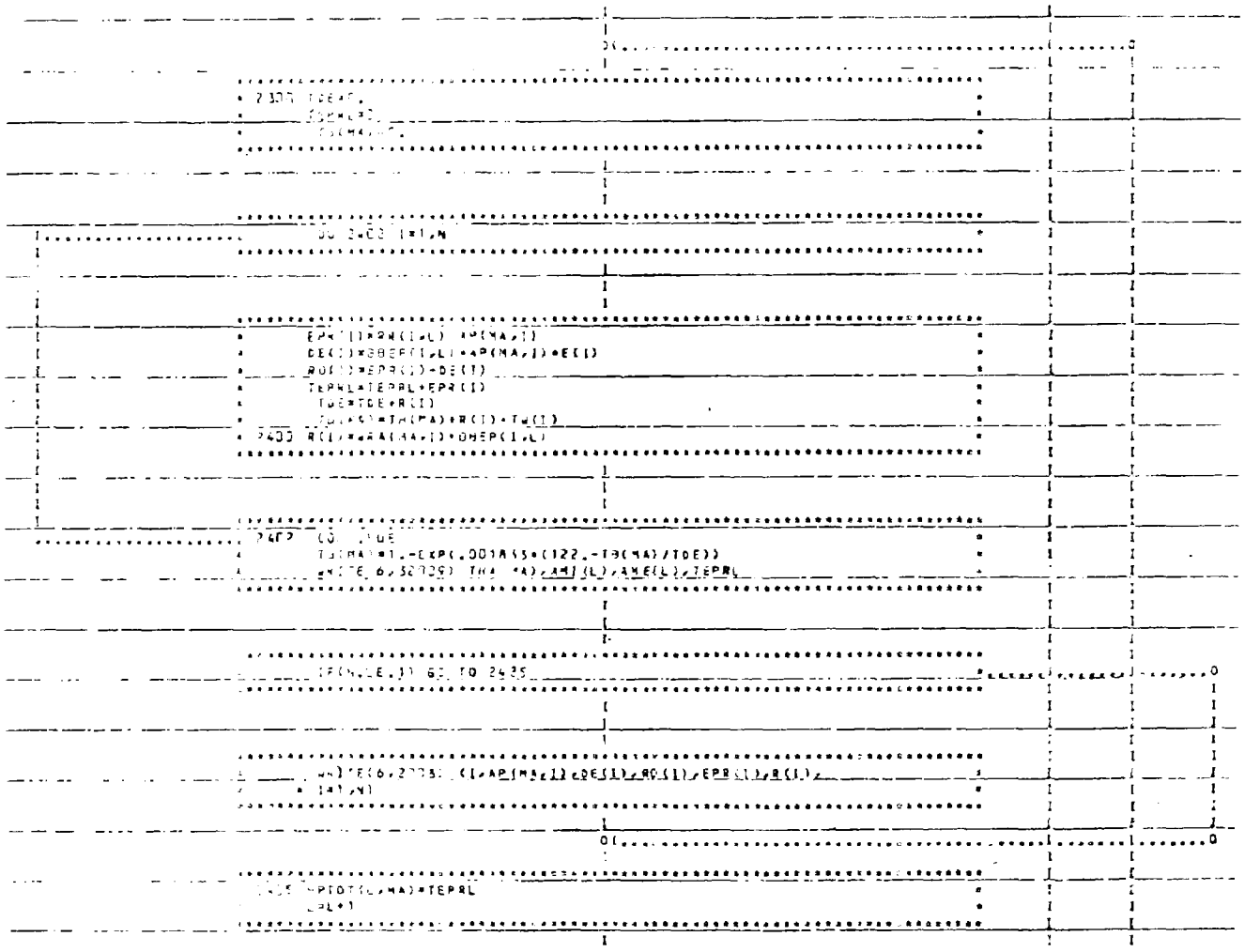


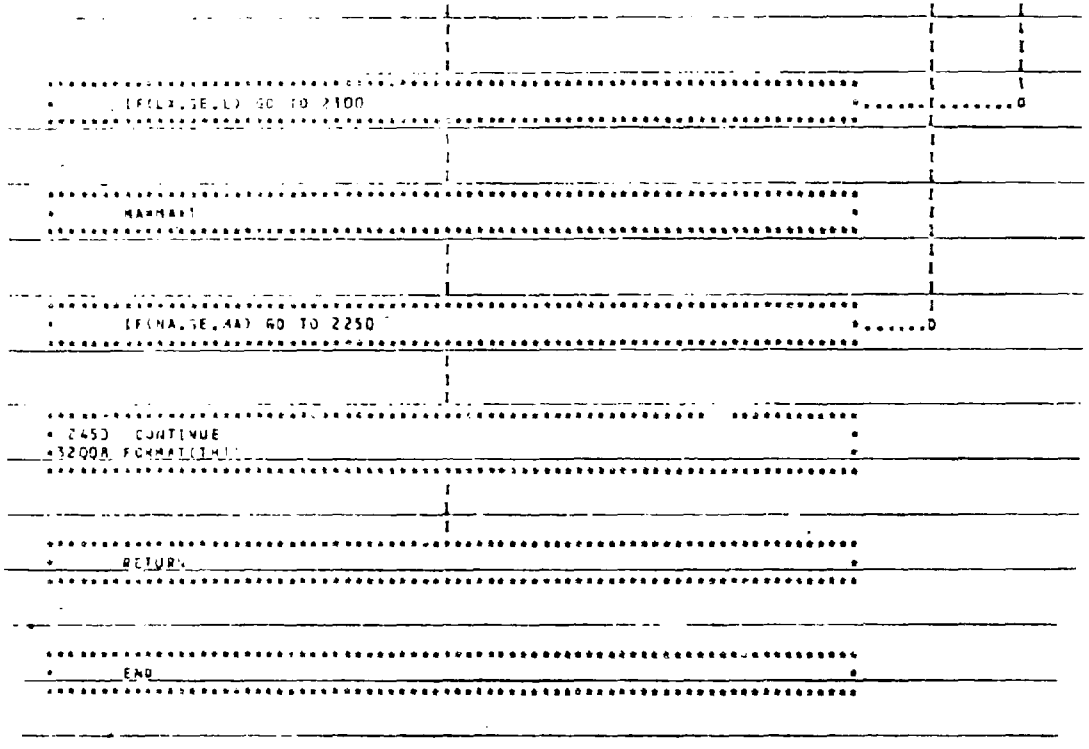

DO 1150 MA=1,MA
DO 1150 I=1,N
1150 WRA(MA,I)=0.
1160 CONTINUE
DO 960 I=1,N
EI=EMS(I)
IF(EI.EQ.1.) EI=.9999
RHO=(1.-EI)/AREA(I)
XMC(I,1)=-(1./RHO+E(I))
VCD(I)=EI/RHO
E(I)=EI
960 CONTINUE
COMPUTE REFLECTION COEFFICIENTS FOR EACH COMPONENT
KO=1
KO=K+1
1250 VCI(KO)=-VCD(KO)

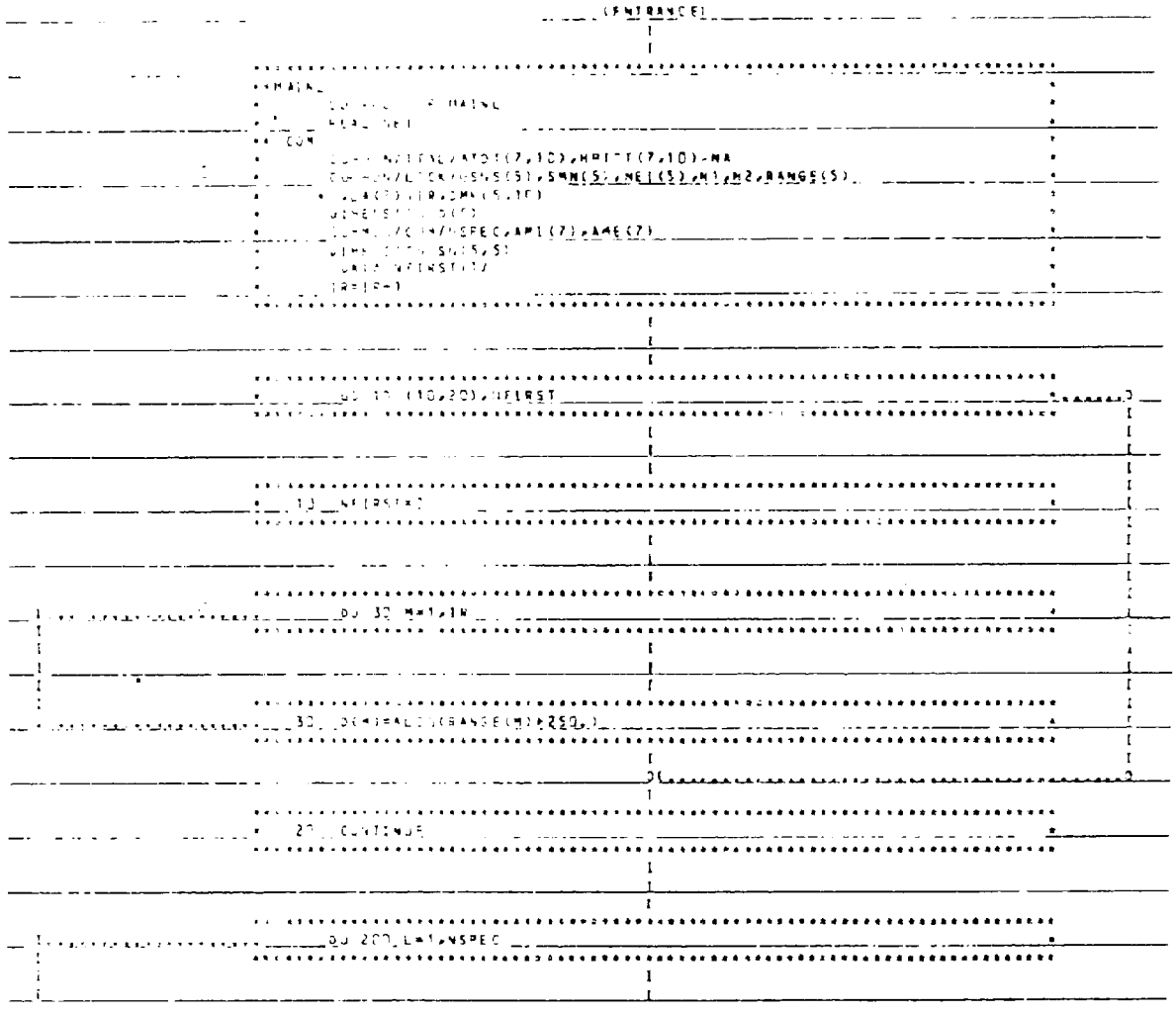


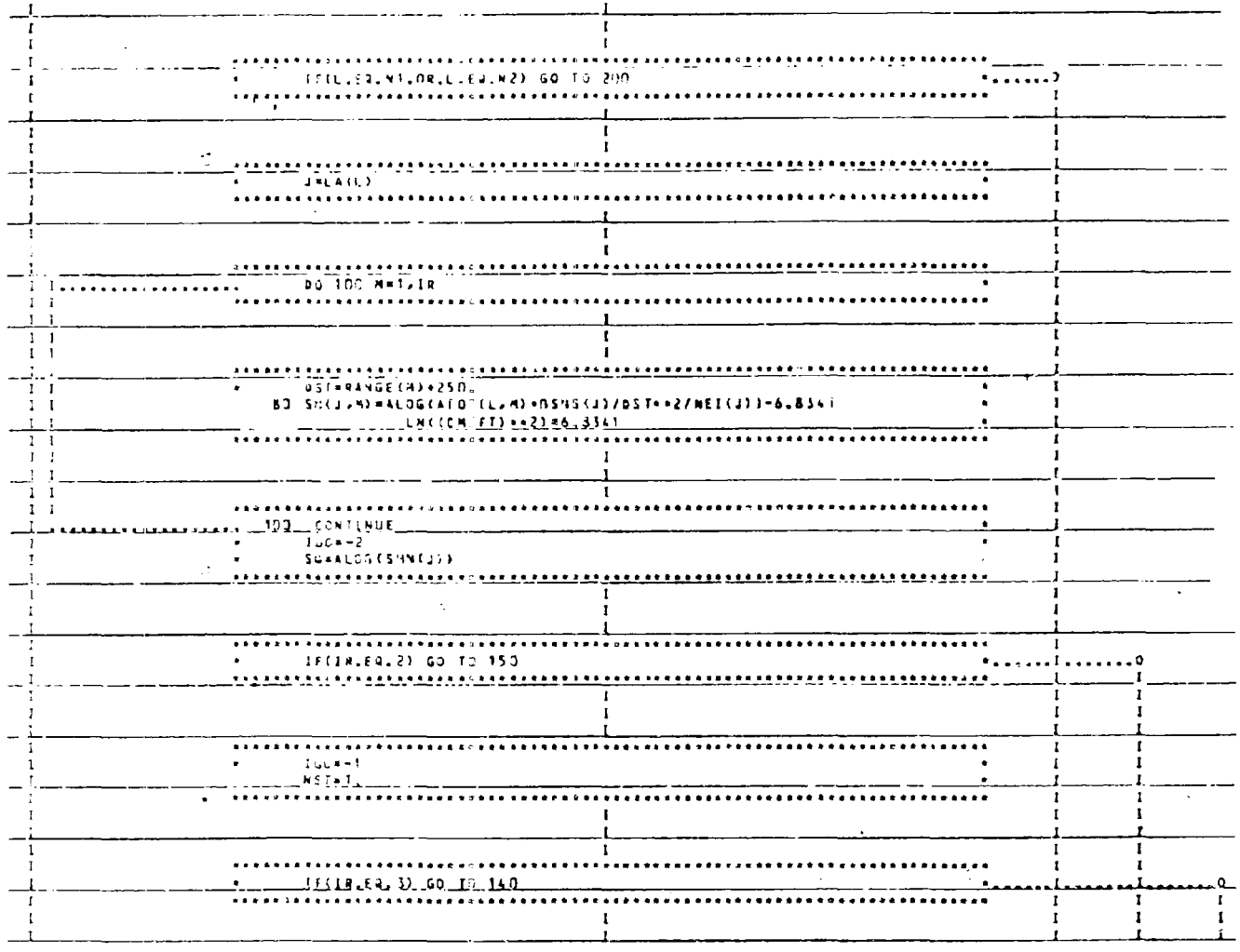

1500 V(I)=V(I)+XM(I,J)*B(J)
C(I)=V(I)-XM(I,I)*B(I)
1600 X(I)=C(I)/XM(I,I)
RY=R(I)*1.E-13
RX=C(I)*1.E-10
TEST =ABS(RY/RX-1.)-XITLM
1225 IF(TEST.GT.0.) AT=1.
IF(AT) 2000,2000,1800
1800 IF(CHECK.EQ.0.0) GO TO 1850
1750 CONTINUE
1850 KM=TH + 1
IF(R.LT.LIMIT) GO TO 1425
2000 VC(XO)=C.

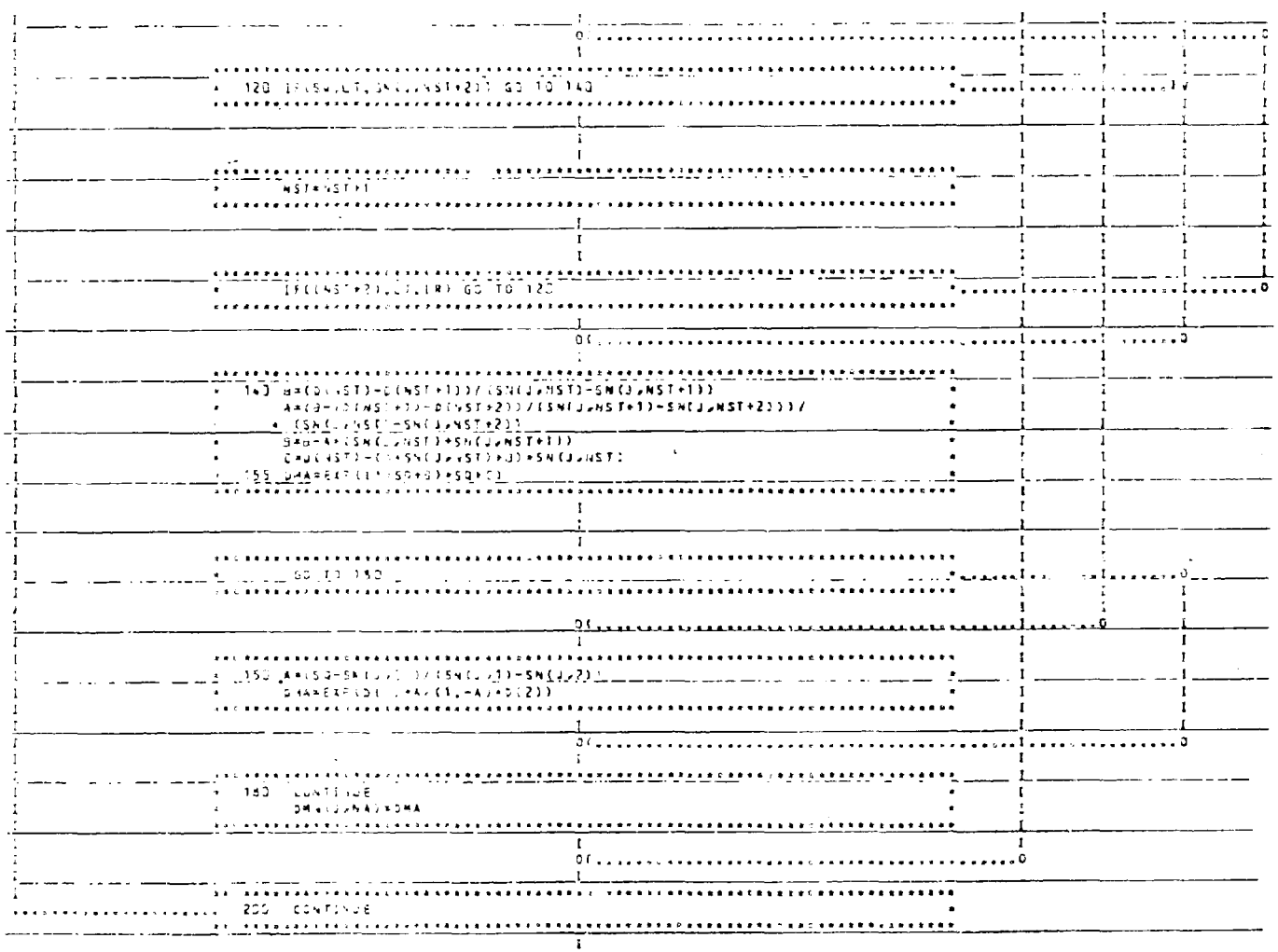

DO 301 K=1,N
DO 300 MA=1,NA
300 WRA(MA,KO)=WA(MA,KO)+R(K)*AP(MA,K)
DO 301 L=1,LX
WR(K,L)=WN(K,L)+BREP(KO,L)*R(K)
301 CONTINUE
KO=KO+1
IF(KO-M)1250,1250,2200
2200 MA=1
2250 LM=1



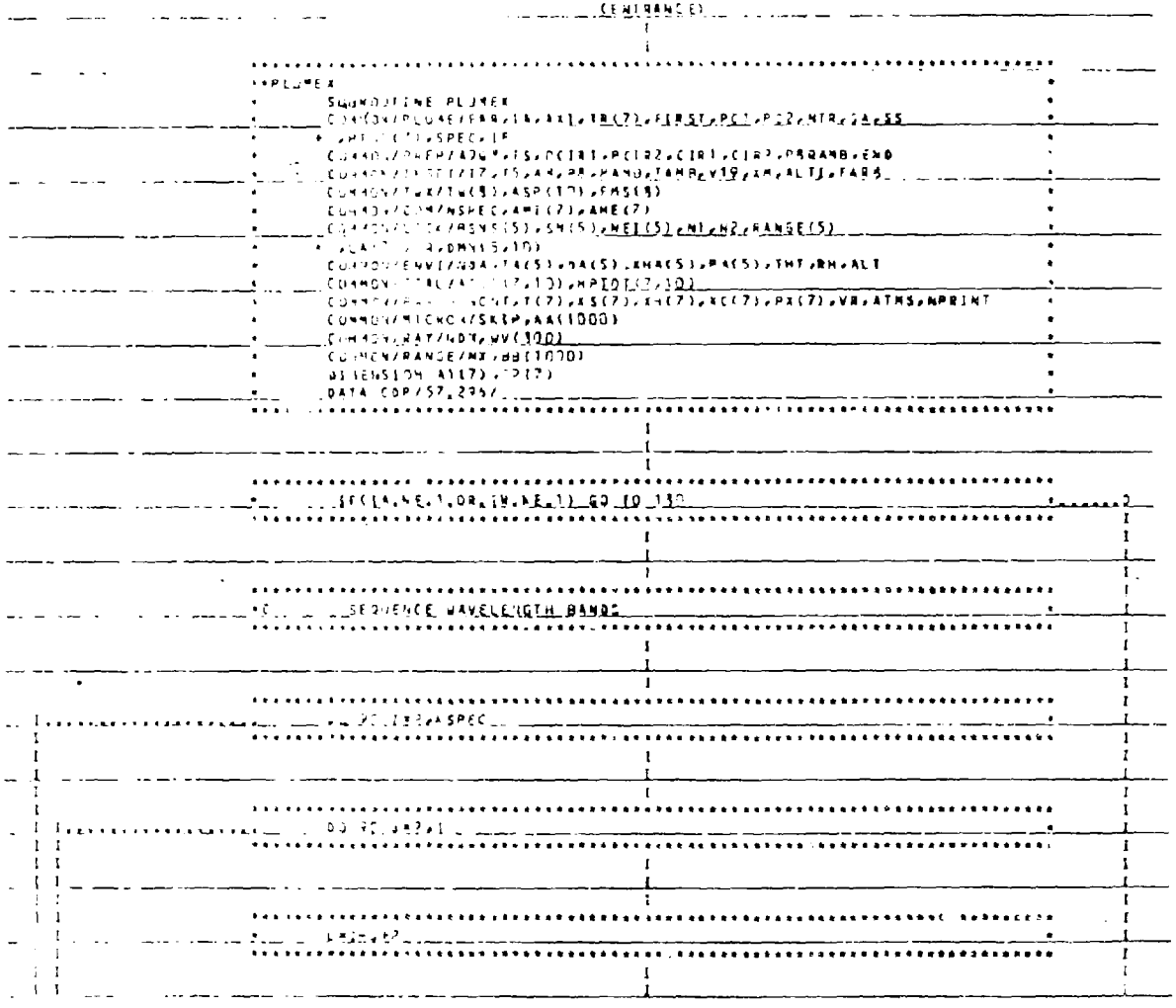

IF(LA,GE,L) GO TO 2100
MAXMAX=
IF(NA,GE,AA) GO TO 2250
2450 CONTINUE
RETURN
END

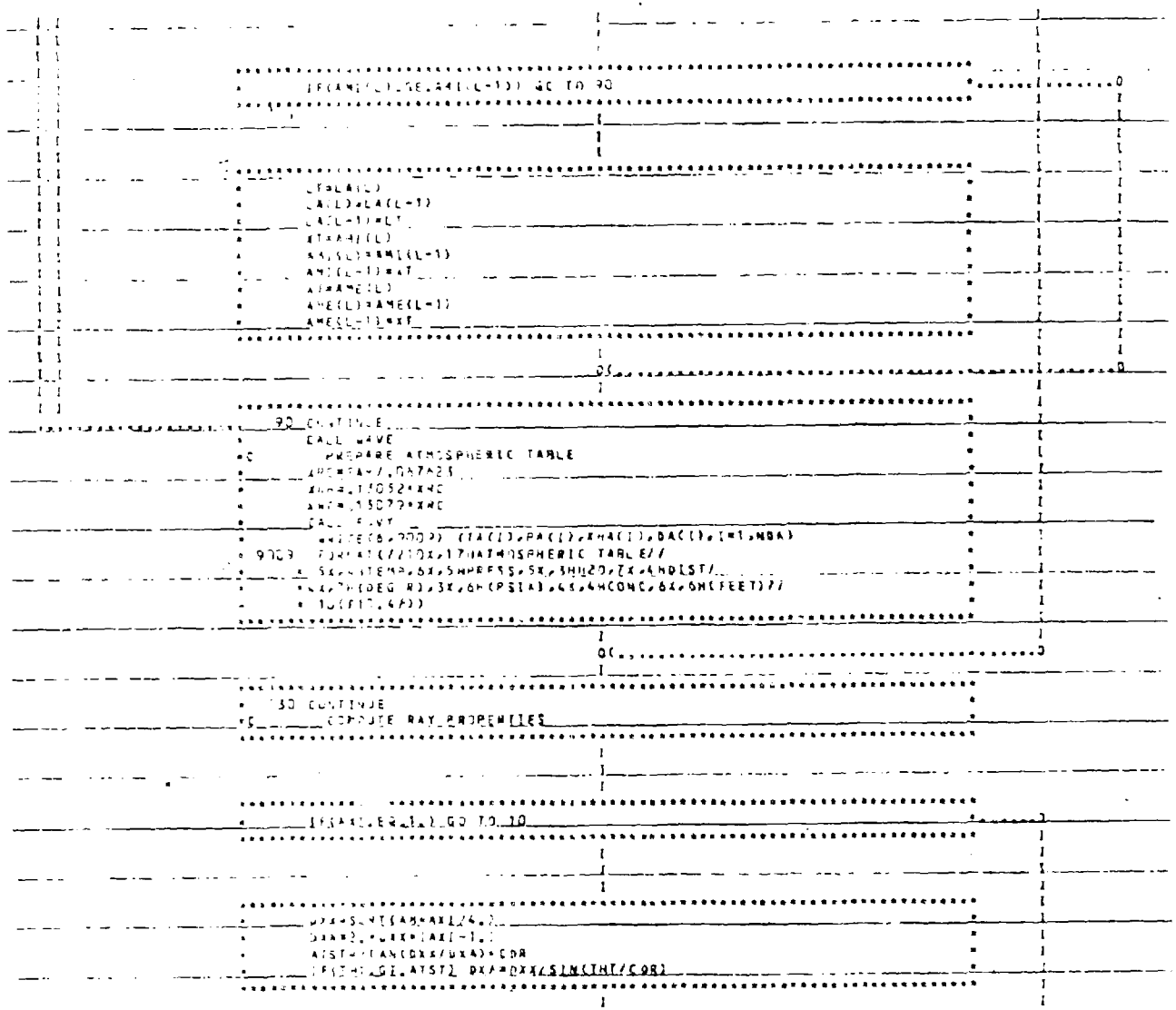

(ENTRANCE)
*MAIN_
* MAIN
* REAL*8
* COM
* COMMON/ATO/I(7,10),HBIT(7,10),NA
* COMMON/LOR/GS(5,5),SMN(5),NE(5),M1,M2,RANGE(5),
* 1A(7),IR,CMA(5,10)
* DIMENSION D(7)
* COMMON/CON/NSPEC,AM1(7),AME(7)
* DIMENSION SW(5,5)
* CALL NFIRST(7)
* IR=IR+1
DO 10 (10,20),NFIRST
10 NFIRST=7
DO 30 M=1,IR
30 DO 40 I=1,(RANGE(M)+250.)
40 CONTINUE
DO 200 L=1,NSPEC

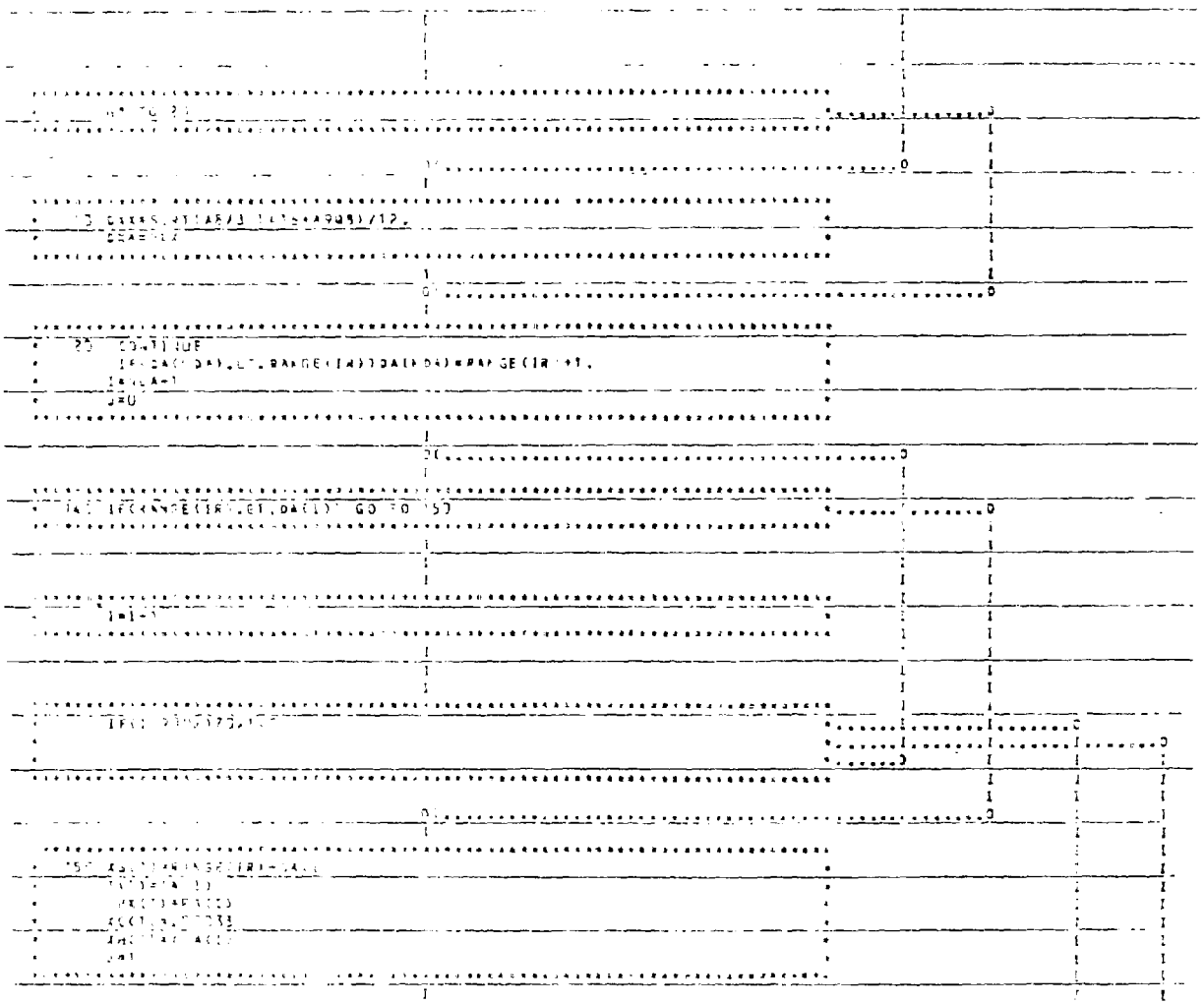

IF(L.EQ.M1.OR.L.EQ.M2) GO TO 200
J=LA(L)
DO 100 M=1,IR
DST=RANGE(M)*250.
BO SN(J,M)=ALOG(AFO*(L,M)*DSNS(J)/DST**2/WEI(J))-6.854
LN((CM FT)**2)+6.334
100 CONTINUE
IGO=2
SG=ALOG(SMN(J))
IF(IR.EQ.2) GO TO 150
IGO=1
NSI=1
IF(IR.EQ.3) GO TO 140

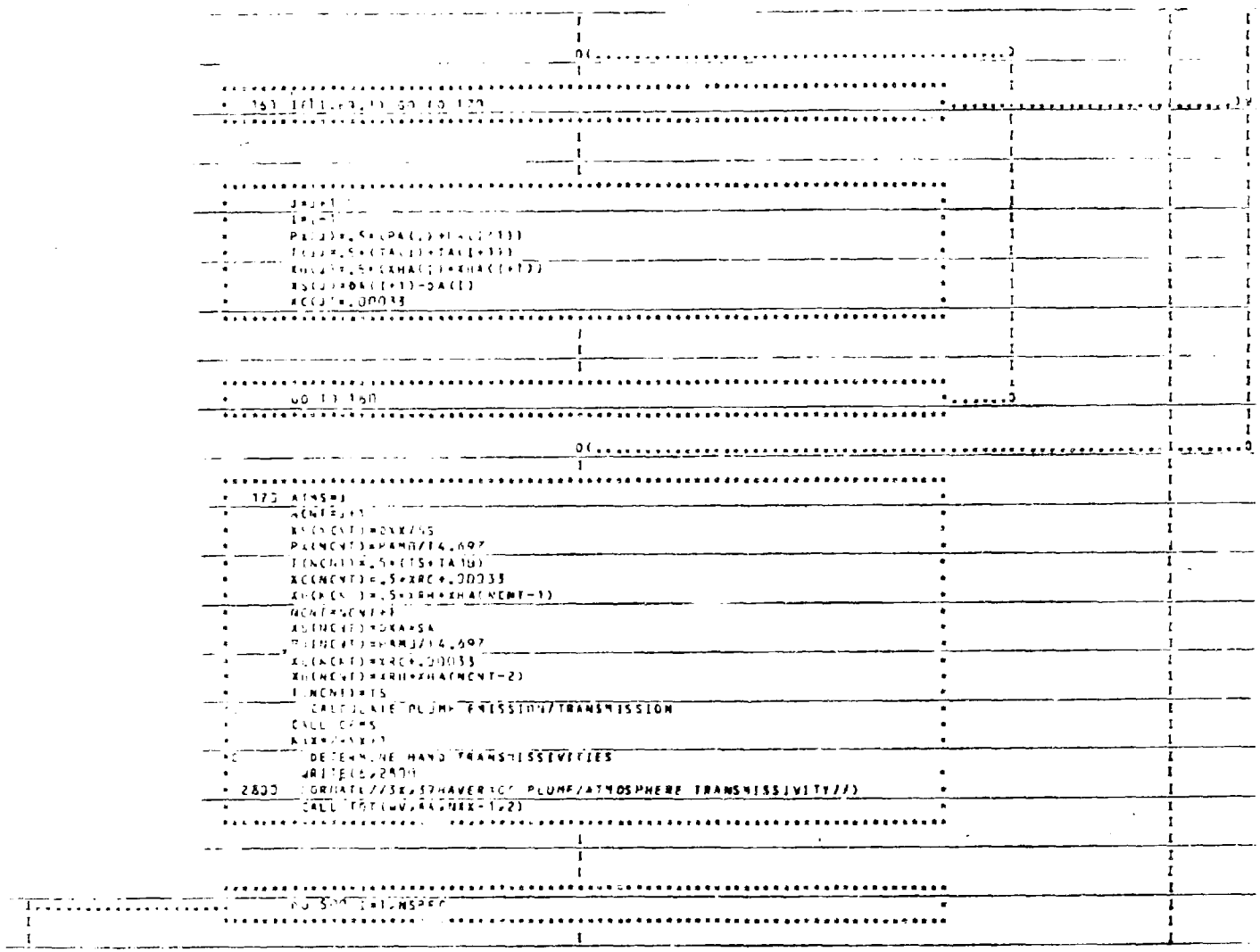

120 IF(SN(I,J,NST+2)) GO TO 140
NST=NST+1
IF((NST+2),LT,LIM) GO TO 120
140 B=(D(I,J,ST)-D(I,J,NST+1))/(SN(I,J,NST)-SN(I,J,NST+1))
A=(D(I,J,NST+1)-D(I,J,NST+2))/(SN(I,J,NST+1)-SN(I,J,NST+2))/
(SN(I,J,NST)-SN(I,J,NST+2))
B=B-A*(SN(I,J,NST)+SN(I,J,NST+1))
C=D(I,J,NST)-(A*SN(I,J,NST)+B)*SN(I,J,NST)
155 DMA=EXP(((A*SQ+B)*SQ+C)
GO TO 190
150 A=(SQ-SN(I,J,2))/(SN(I,J,1)-SN(I,J,2))
DMA=EXP(D(I,J,2)+A*(1.-A)*D(2))
190 CONTINUE
DM(I,J,NA)=DMA
200 CONTINUE

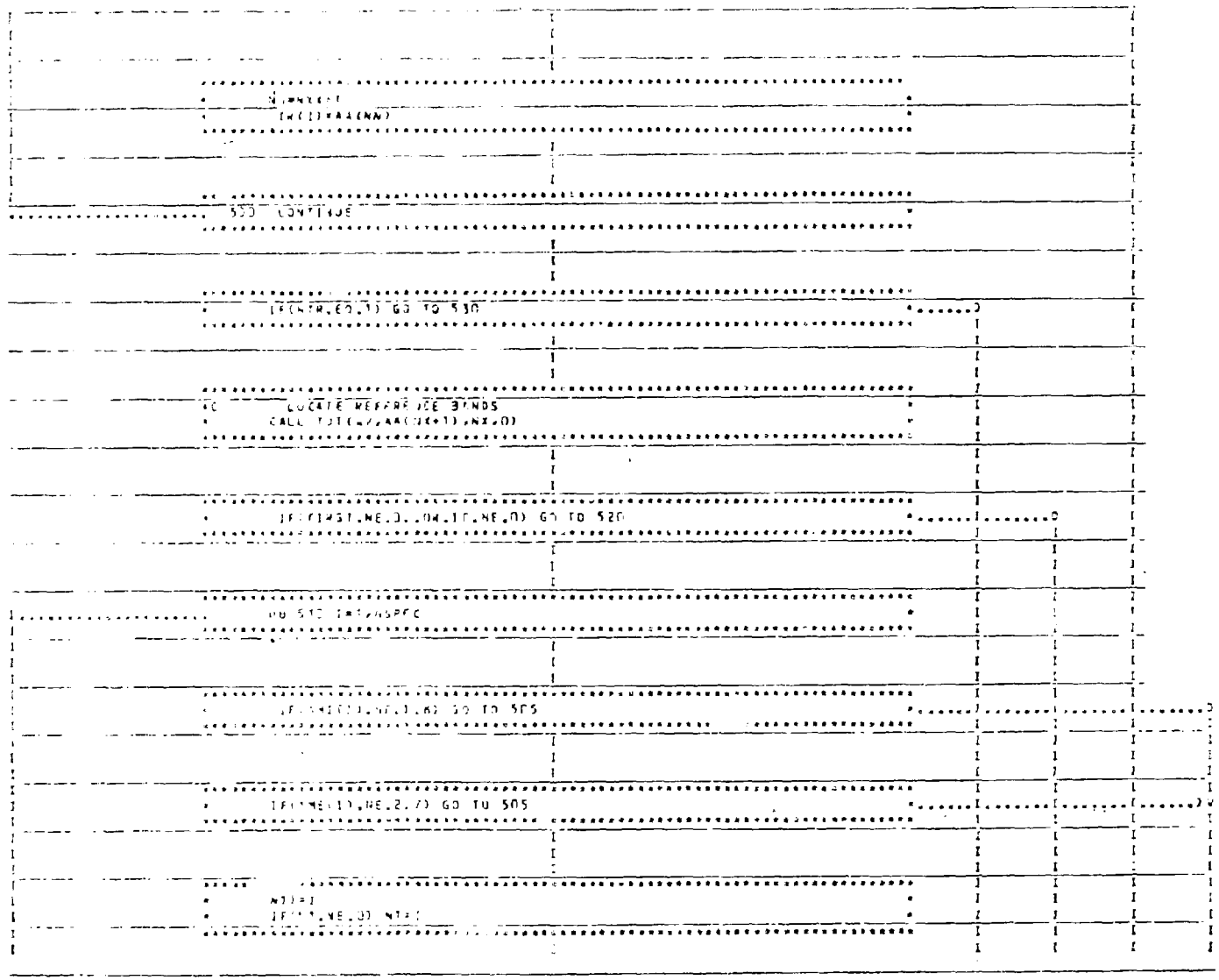
```
      RETURN
      END
```

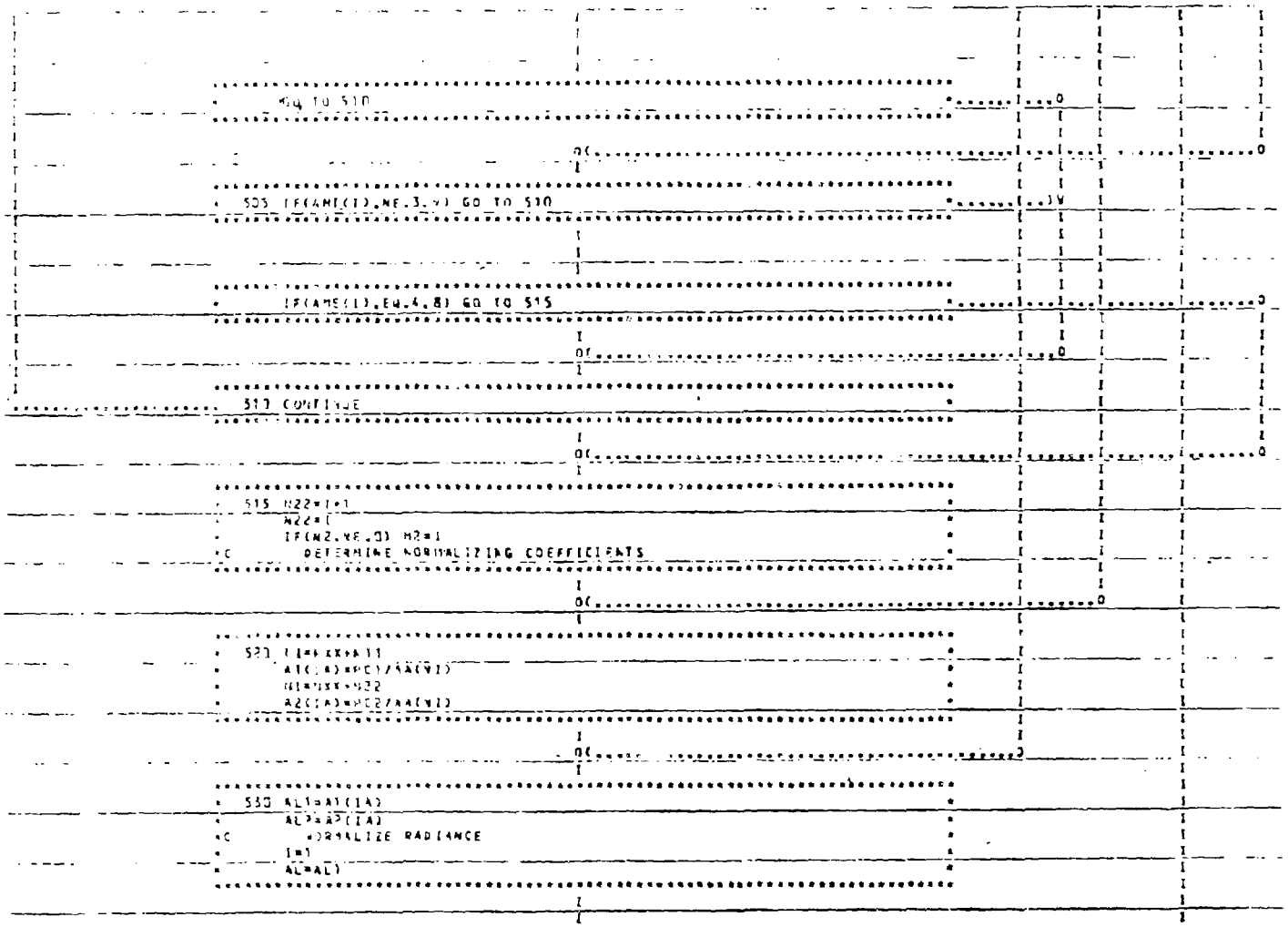

(ENTRANCE)
SUBROUTINE PLANEX
SPEC.LE.1.OR.IW.NE.1) GO TO 130
SEQUENCE WAVELENGTH BANDS
DO 99 J=2,I
END

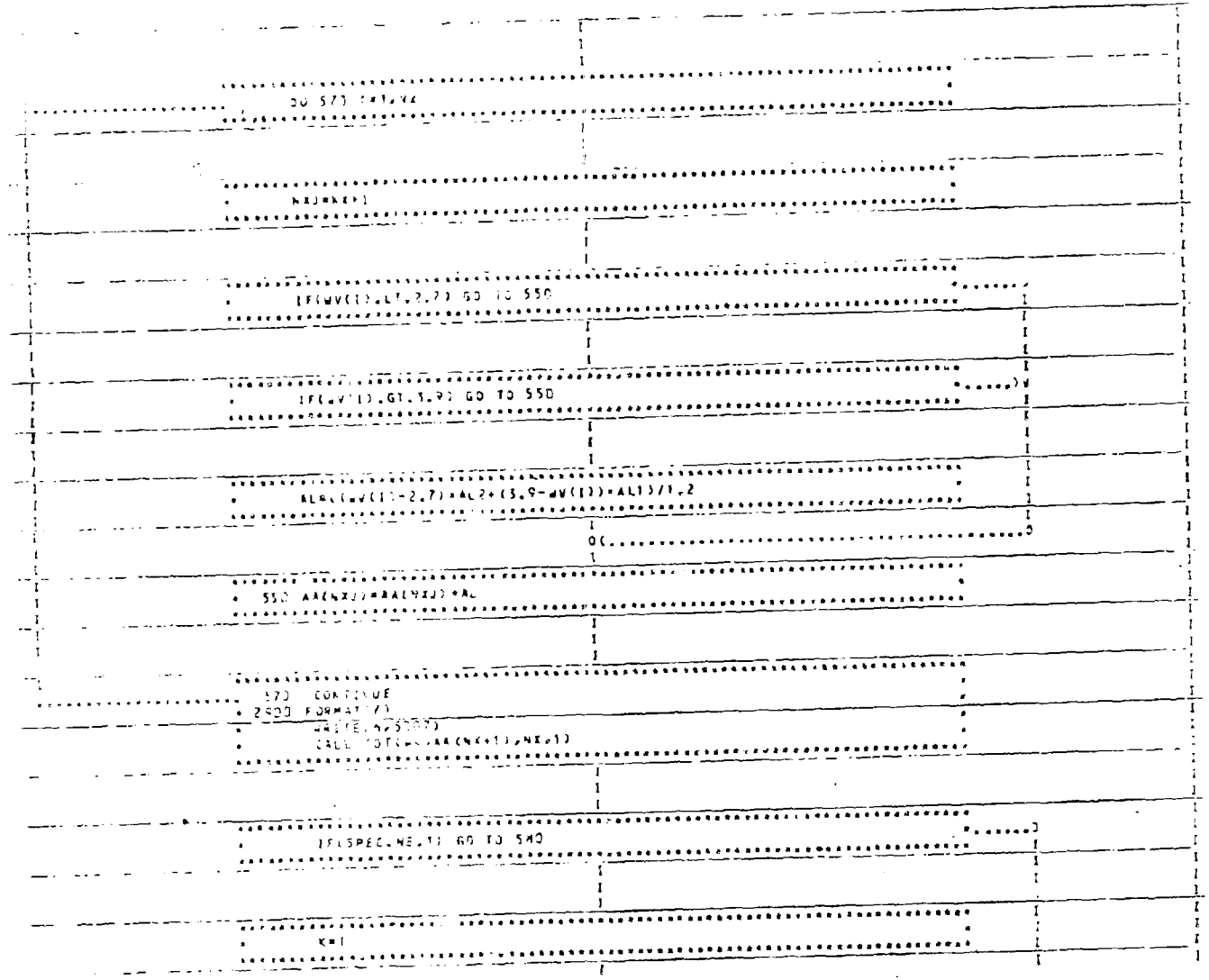

IF(AM(L).GE.AA(L-1)) GO TO 90
ZA(L)=ZA(L-1)
AA(L)=AA(L-1)
AM(L)=AM(L-1)
AME(L)=AME(L-1)
90 CONTINUE
CALL WAVE
C PREPARE ATMOSPHERIC TABLE
AMM=AM(1)*XMC
AMT=AM(2)*XMC
WRITE(6,9709) (ZA(I),PA(I),AMA(I),DA(I),I=1,NBA)
9709 FORMAT(//10X,17HATMOSPHERIC TABLE//
5X,4HZETA,8X,5HPRESS,5X,3HH2O,7X,4HDLST/
4X,7H(DEG R),3X,6H(PSIA),4S,4HCONC,8X,6H(FEET))//
1P(F17.4F))
130 CONTINUE
C COMPUTE RAY PROPERTIES
IF(A(1).EQ.1.) GO TO 10
DXA=SQRT(AM*AX1/4.)
DXA=DXA*EXP(AX(I-1))
ATST=ATAN(DXX/DXA)+COR
IF(ATST.GT.ATST2) DXA=DXX/SIN(THT/COR)

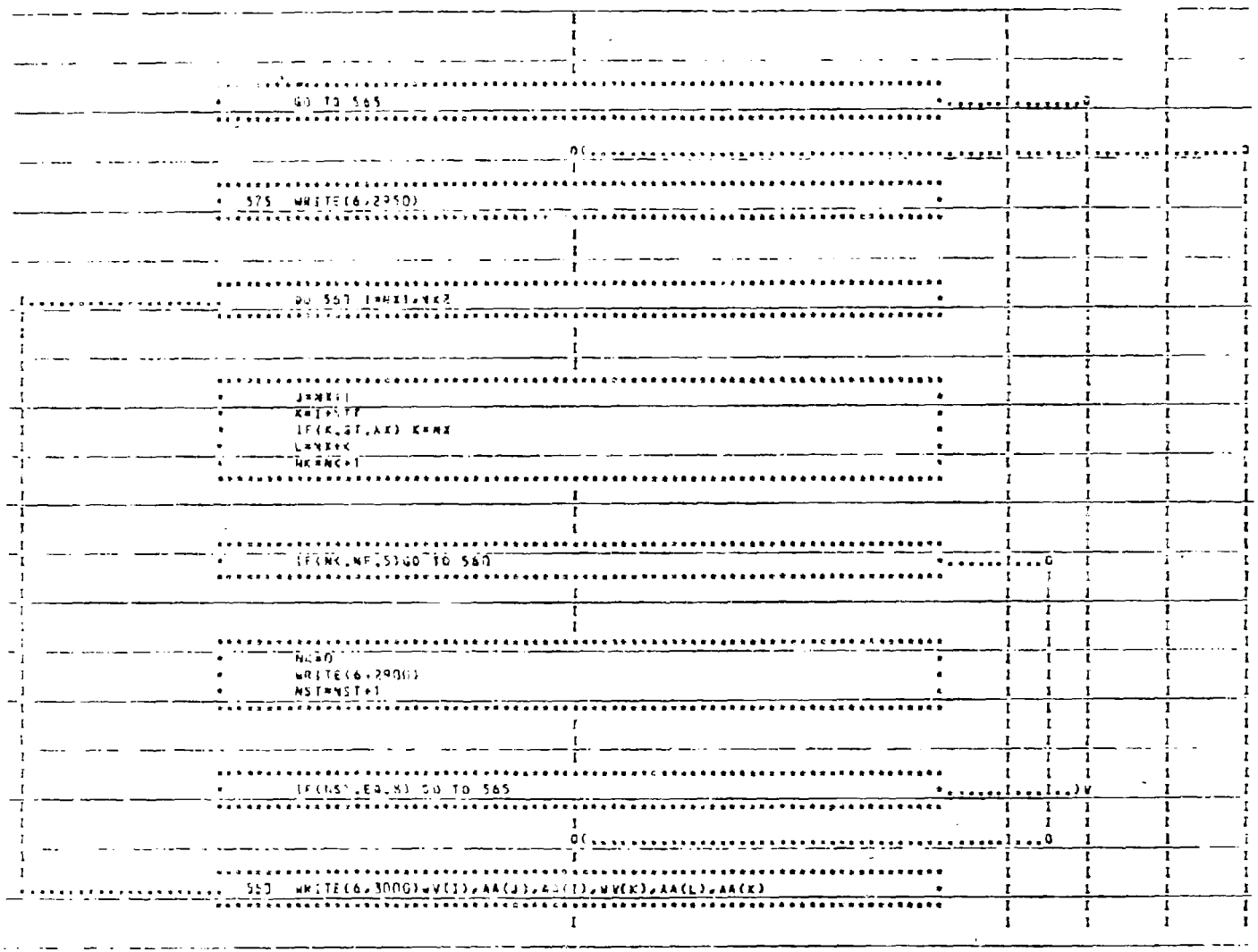


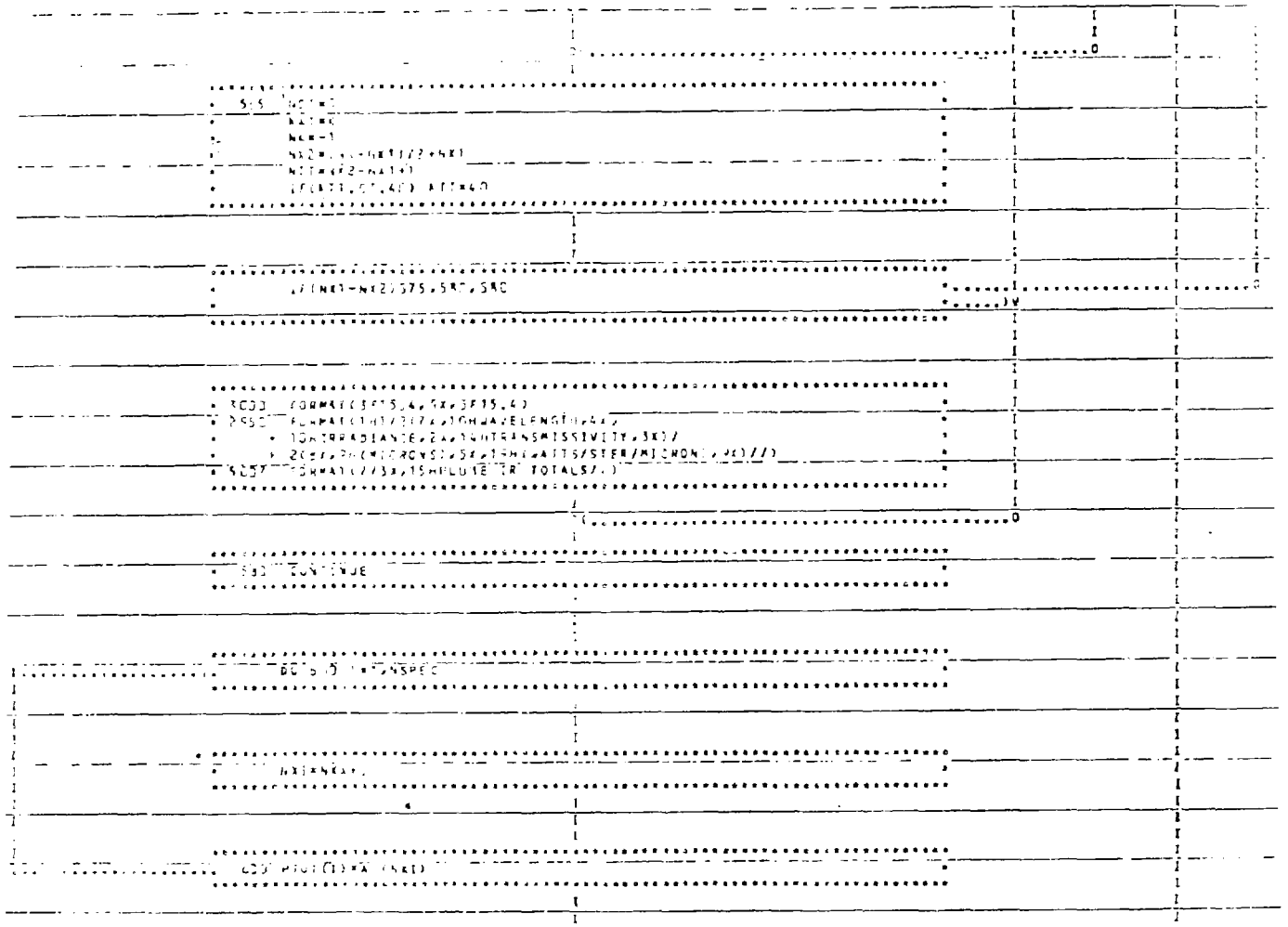


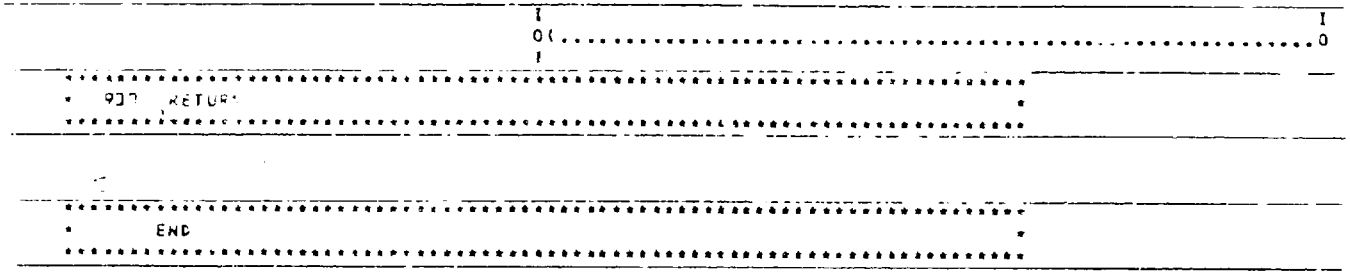


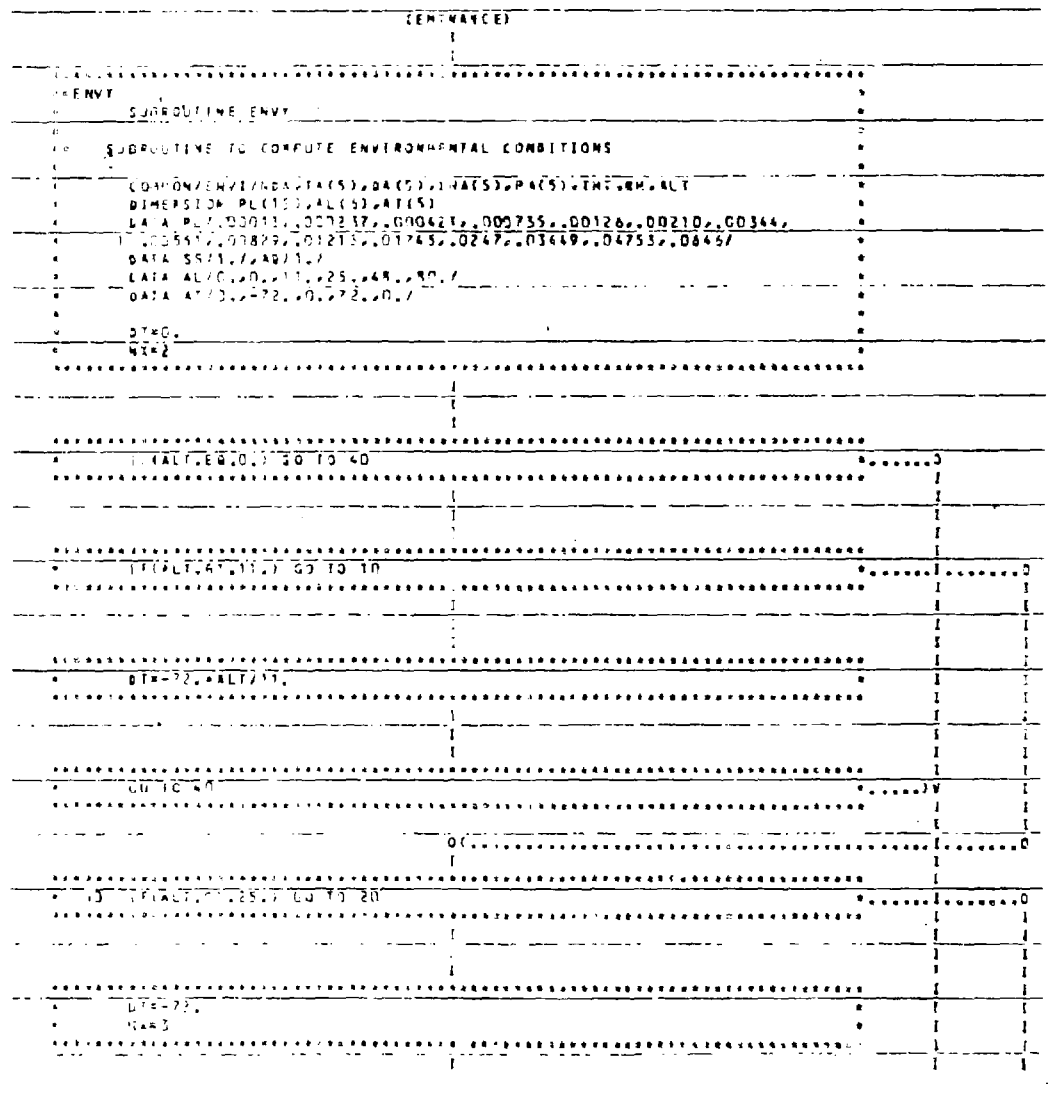

GO TO 510
505 IF(AMI(I).NE.3.Y) GO TO 510
IF(AMS(I).EQ.4.8) GO TO 515
511 CONTINUE
515 N22=I+1
N22=(
IF(N2.NE.0) N2=1
C DETERMINE NORMALIZING COEFFICIENTS
521 II=N*XX+A11
A1(IA)=PC1/AA(NI)
NI=NXX+N22
A2(IA)=PC2/AA(NI)
530 AL1=A1(IA)
AL2=A2(IA)
C NORMALIZE RADIANCE
IM1
AL=AL1

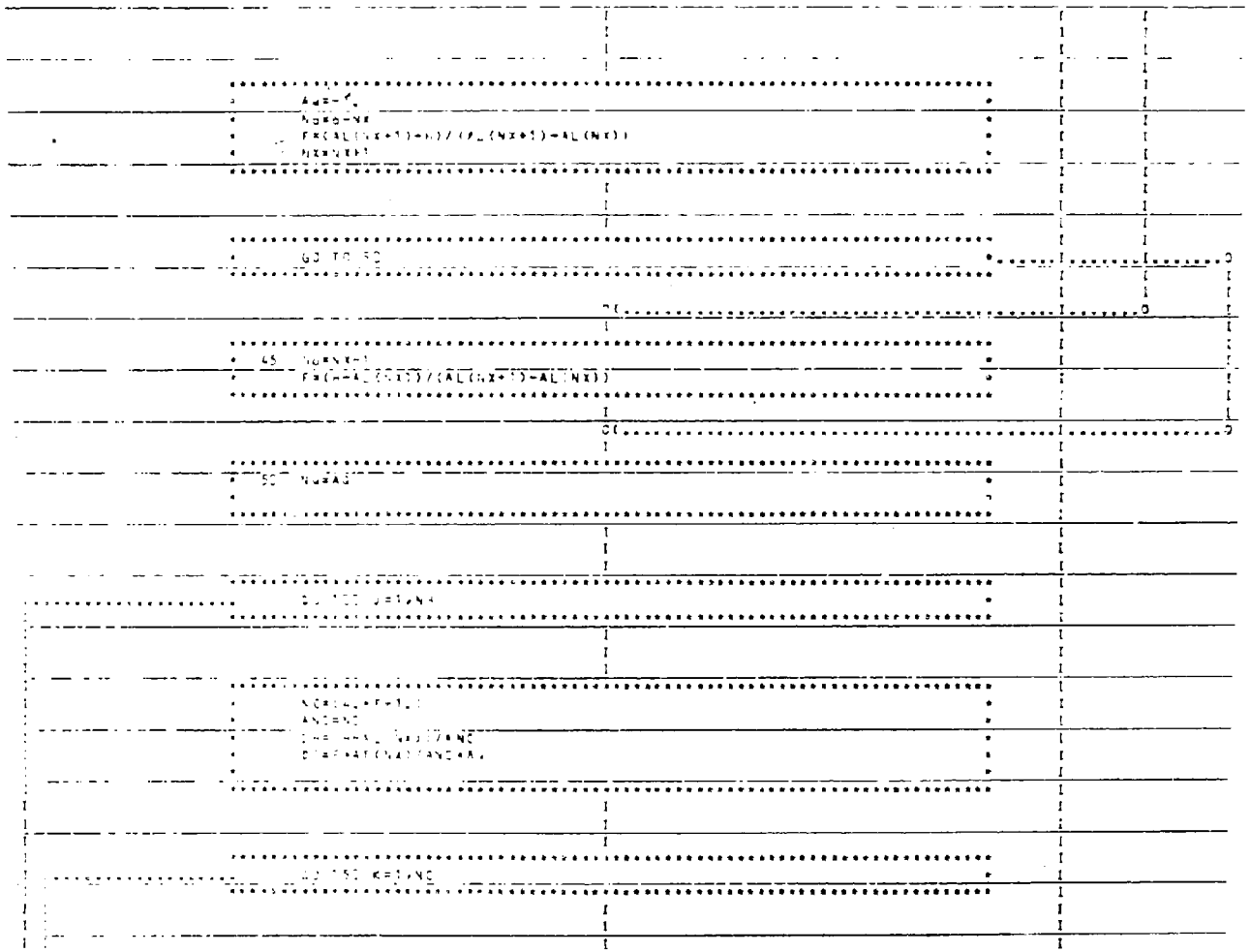

DO 573 I=1,44
NEJ=NEJ+1
IF(WV(I).LT.2.7) GO TO 550
IF(WV(I).GT.3.9) GO TO 550
AL=((WV(I)-2.7)*AL2+(3.9-WV(I))*AL1)/1.2
GO
550 AA(NEJ)=AA(NEJ)*AL
573 CONTINUE
2500 FORMAT(/)
WRITE(6,2500)
CALL TOT(AA(NEJ+1),NEJ+1)
IF(SPEC.NE.1) GO TO 540
K=1

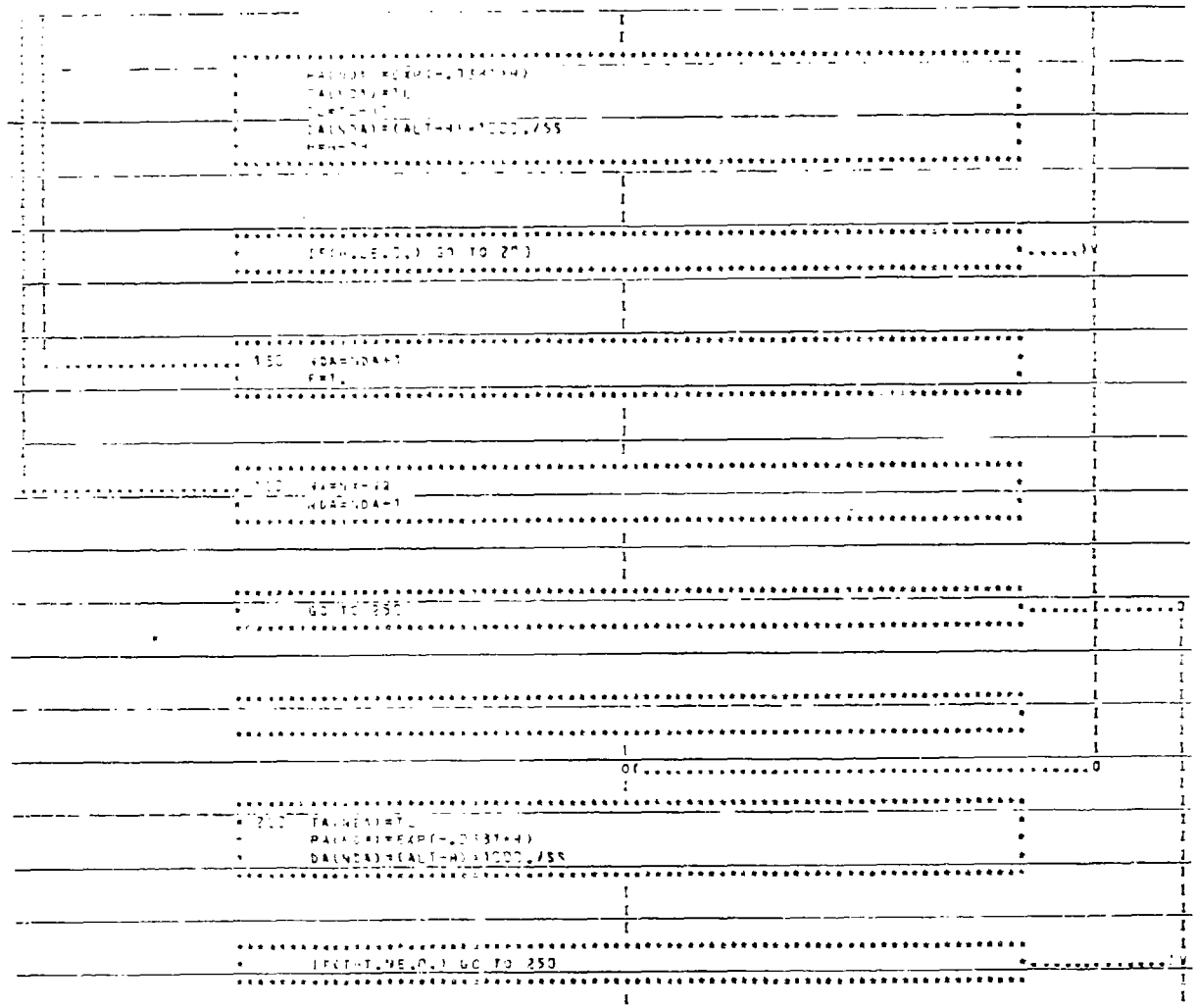

GO TO 565
575 WRITE(6,2950)
DO 557 I=MX1,MX2
J=MX(I)
K=I+1
IF(K.GT.AX) K=MX
L=MX(K)
MK=MK+1
IF(MK.NE.5)GO TO 560
MK=0
WRITE(6,2900)
MST=MST+1
IF(MST.EQ.8) GO TO 565
557 WRITE(6,3000)V(I),AA(J),A(I),VV(K),AA(L),AA(K)

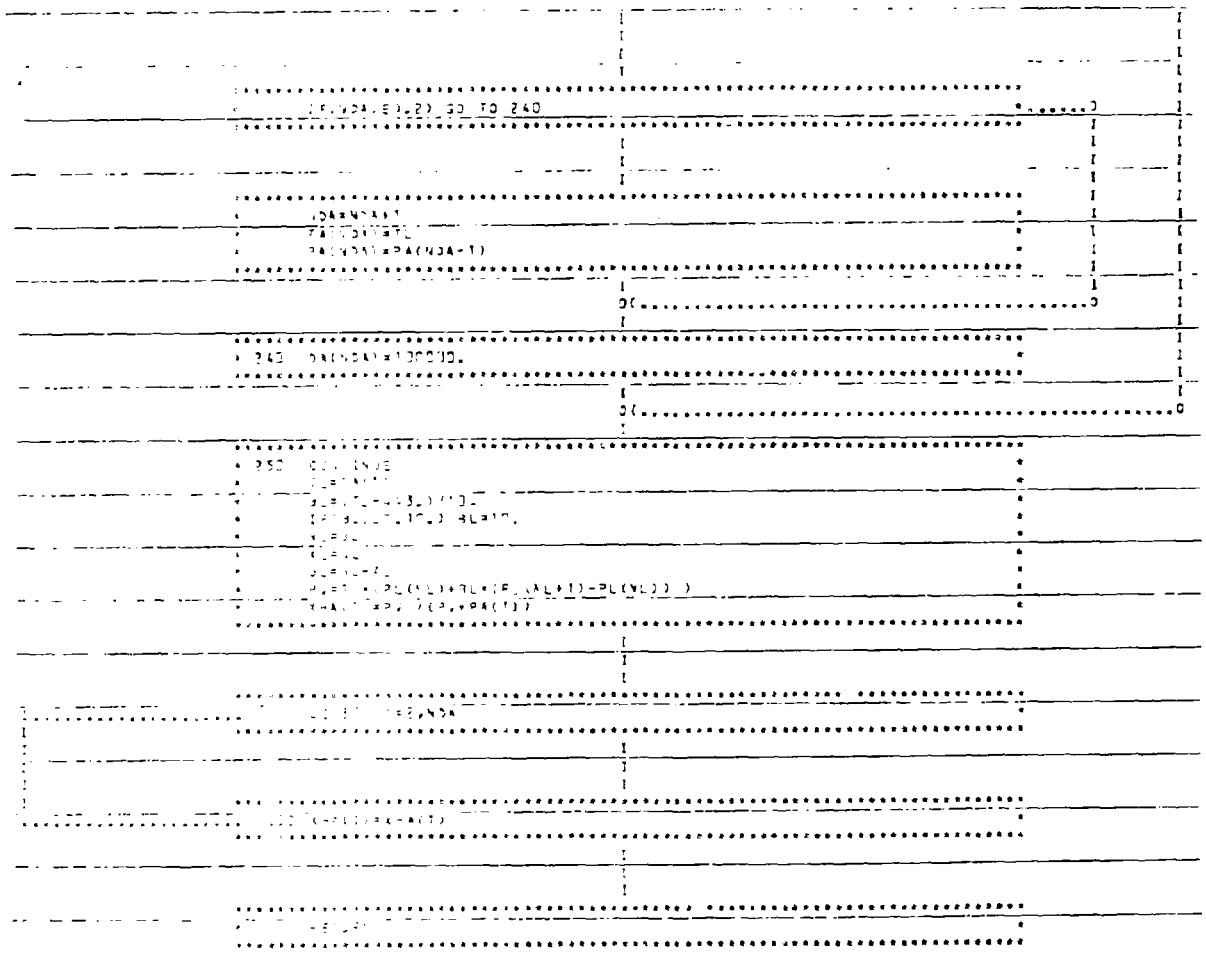


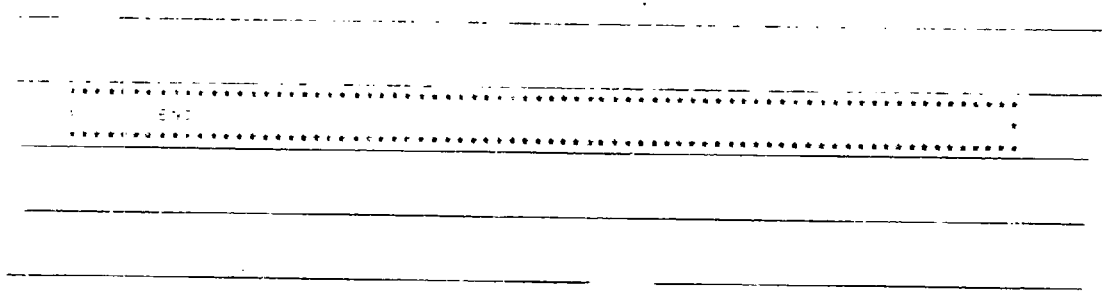

I
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END

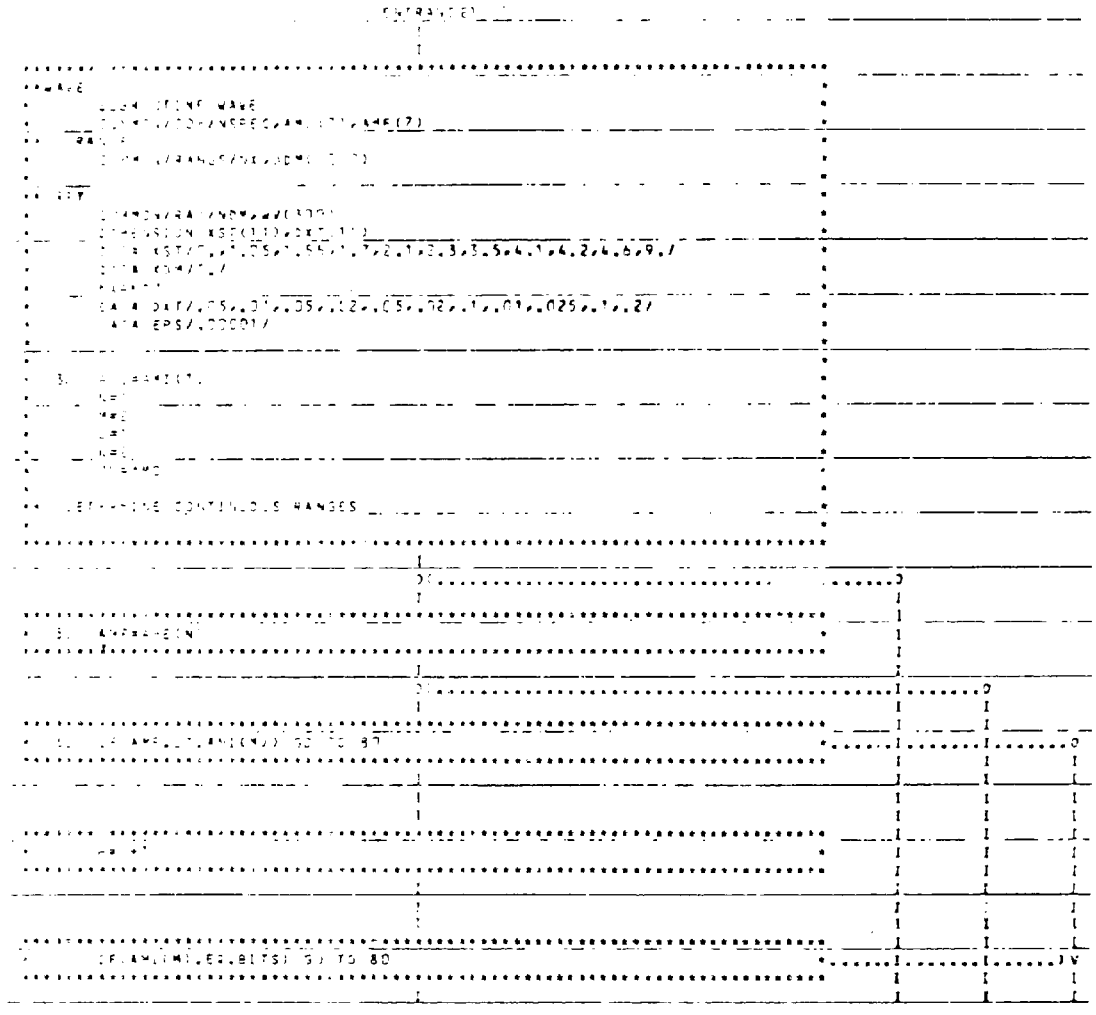

(ENTRANCE)
*ENVT
SUBROUTINE ENVT
SUBROUTINE TO COMPUTE ENVIRONMENTAL CONDITIONS
COMMON/ENVI/RHA,TA(5),DA(5),VA(5),PA(5),TMT,RM,ALT
DIMENSION PL(15),AL(9),AT(5)
DATA PL/.00011,.00737,.00062,.00735,.00126,.00210,.00344,
1 .00551,.00829,.01215,.01745,.02472,.03449,.04753,.06459/
DATA SS/1./,AD/1./
DATA AL/0.,10.,11.,25.,48.,90./
DATA AT/3.,-72.,0.,72.,0./
DT=0.
N=2
IF(ALT.EQ.0.) GO TO 40
IF(ALT.GT.11.) GO TO 10
DT=-72.*ALT/11.
GO TO 40
IF(ALT.GT.25.) GO TO 20
DT=-72.
N=3

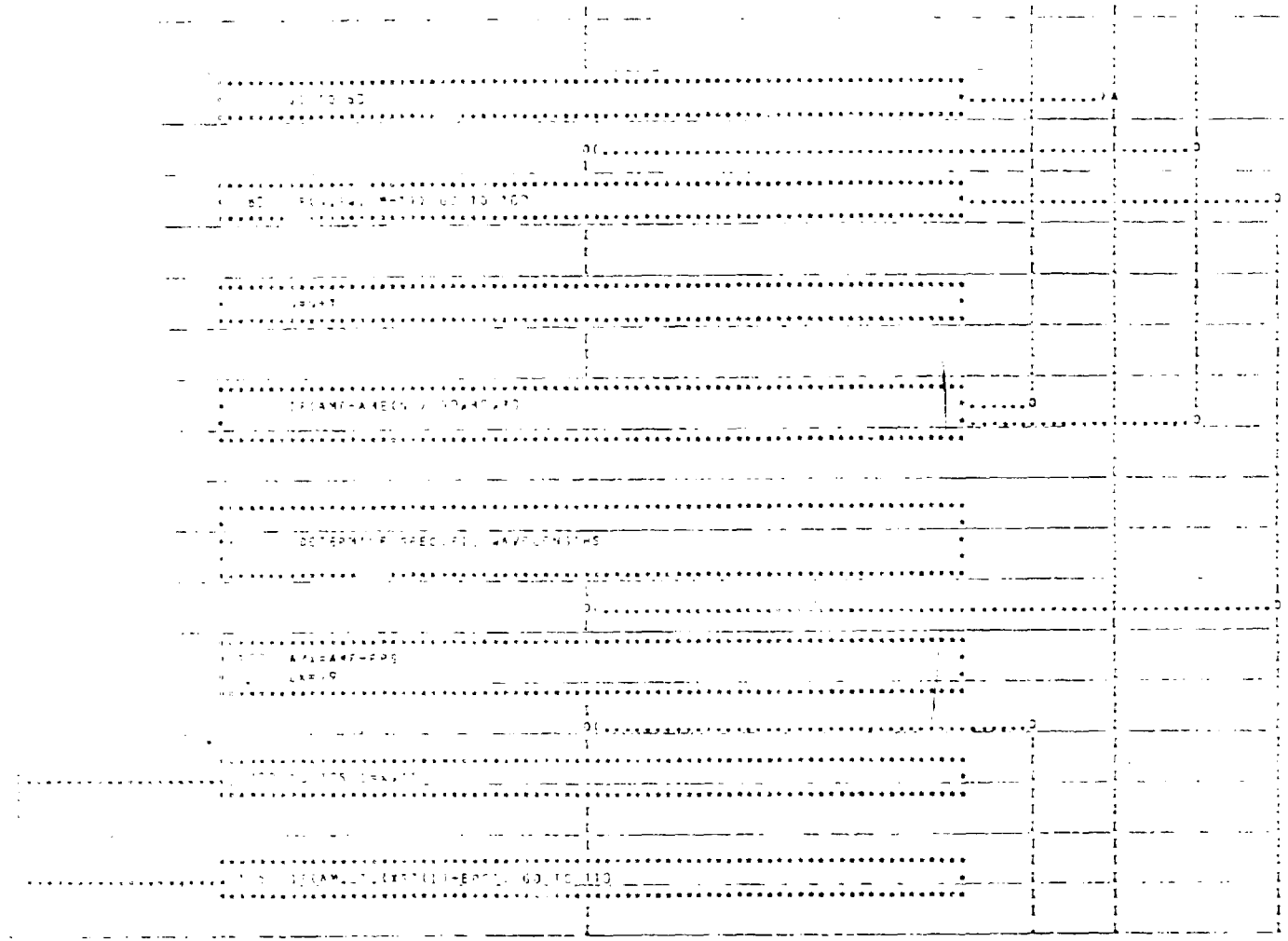


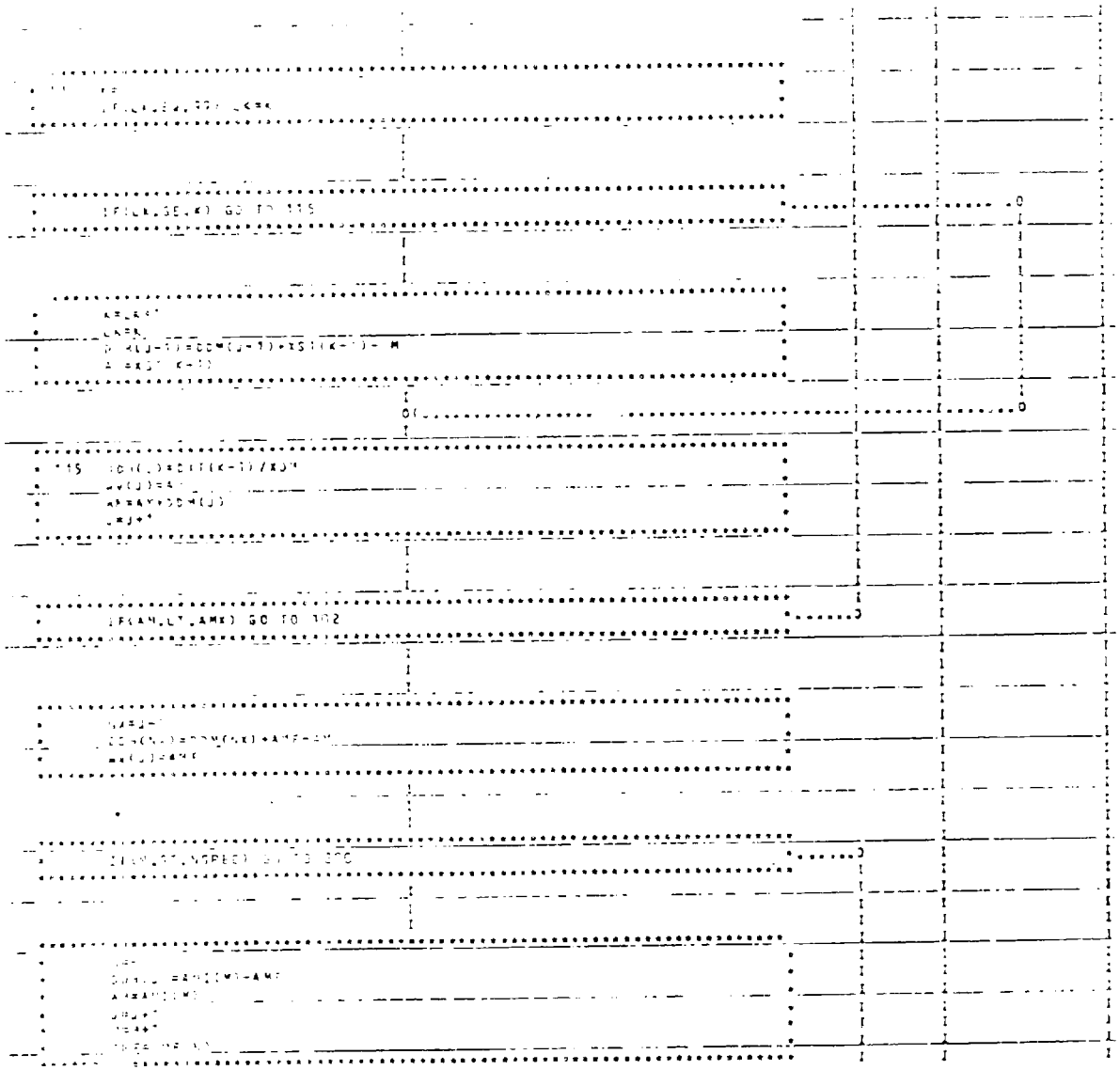


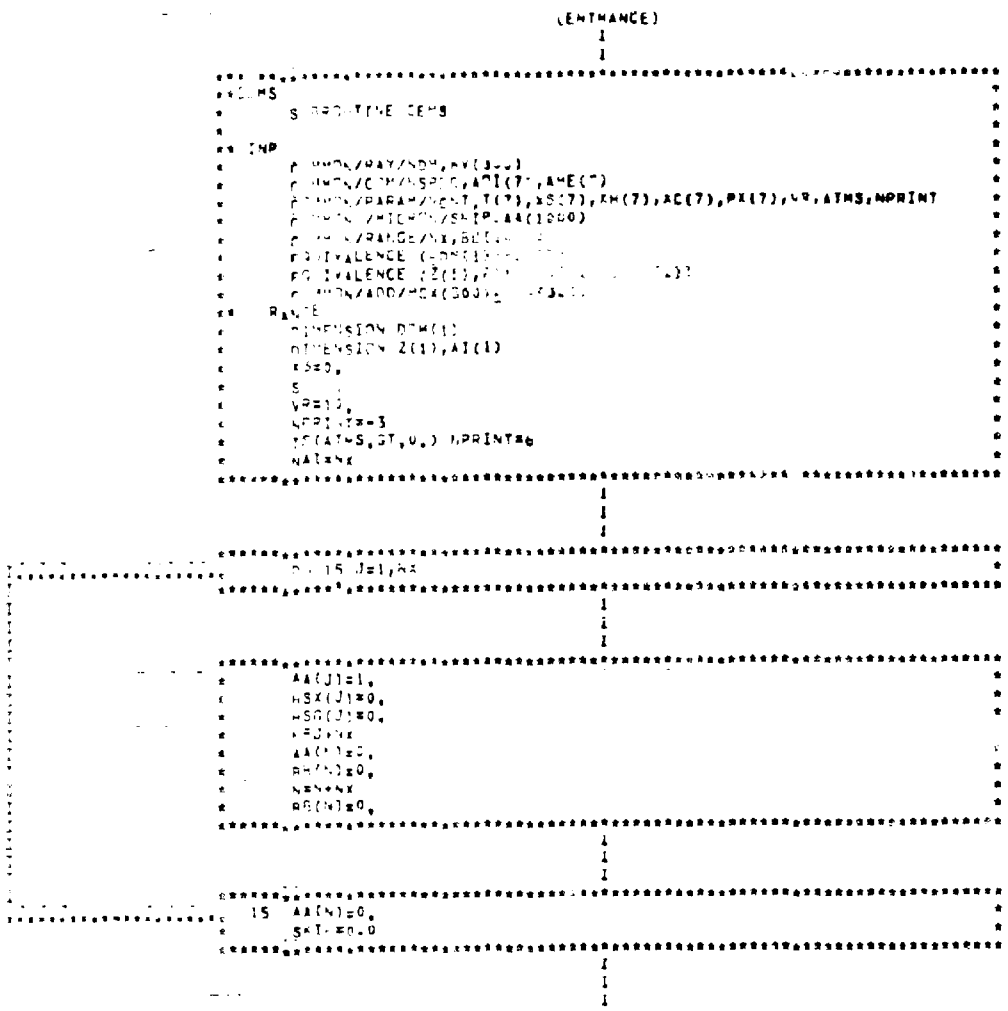


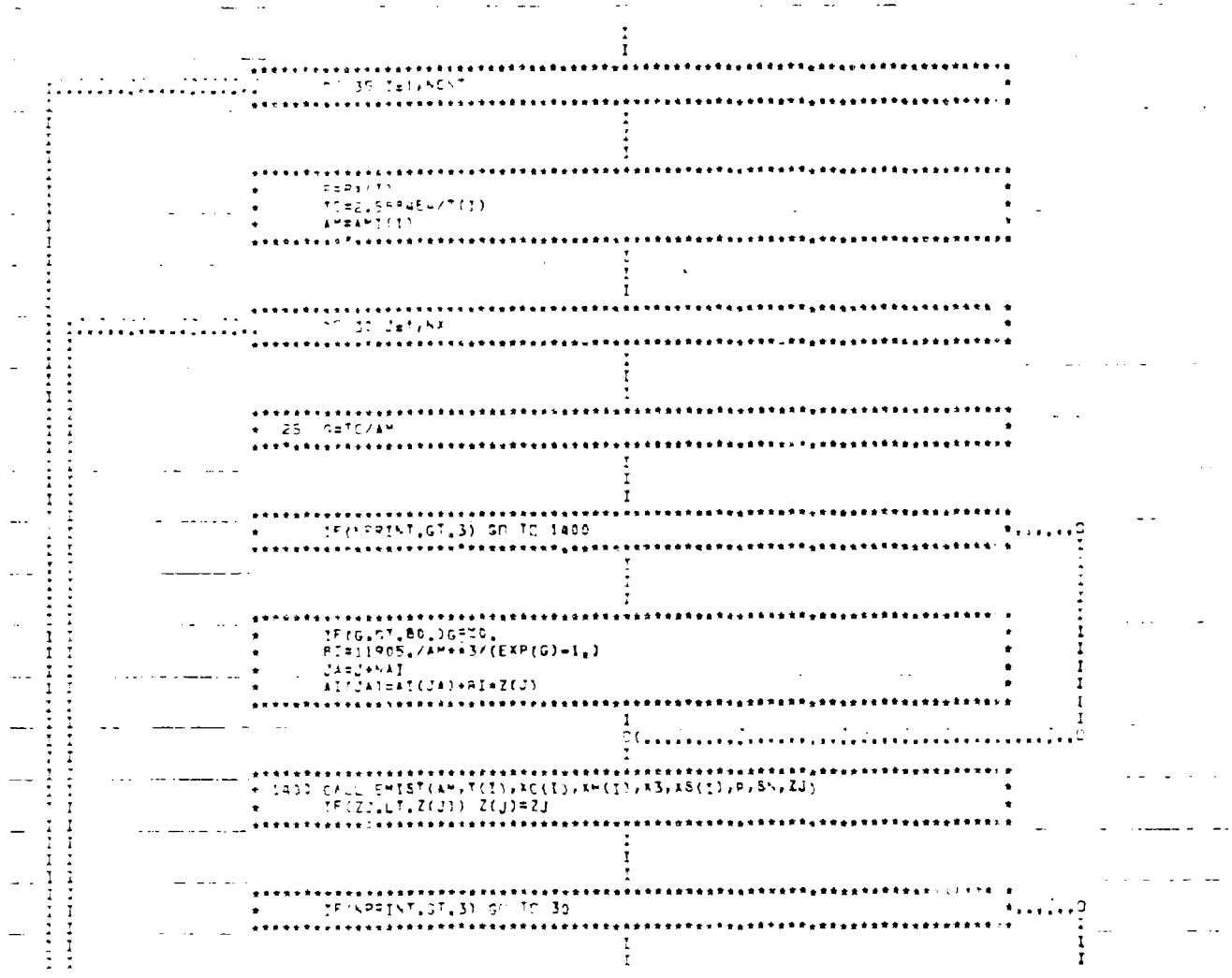


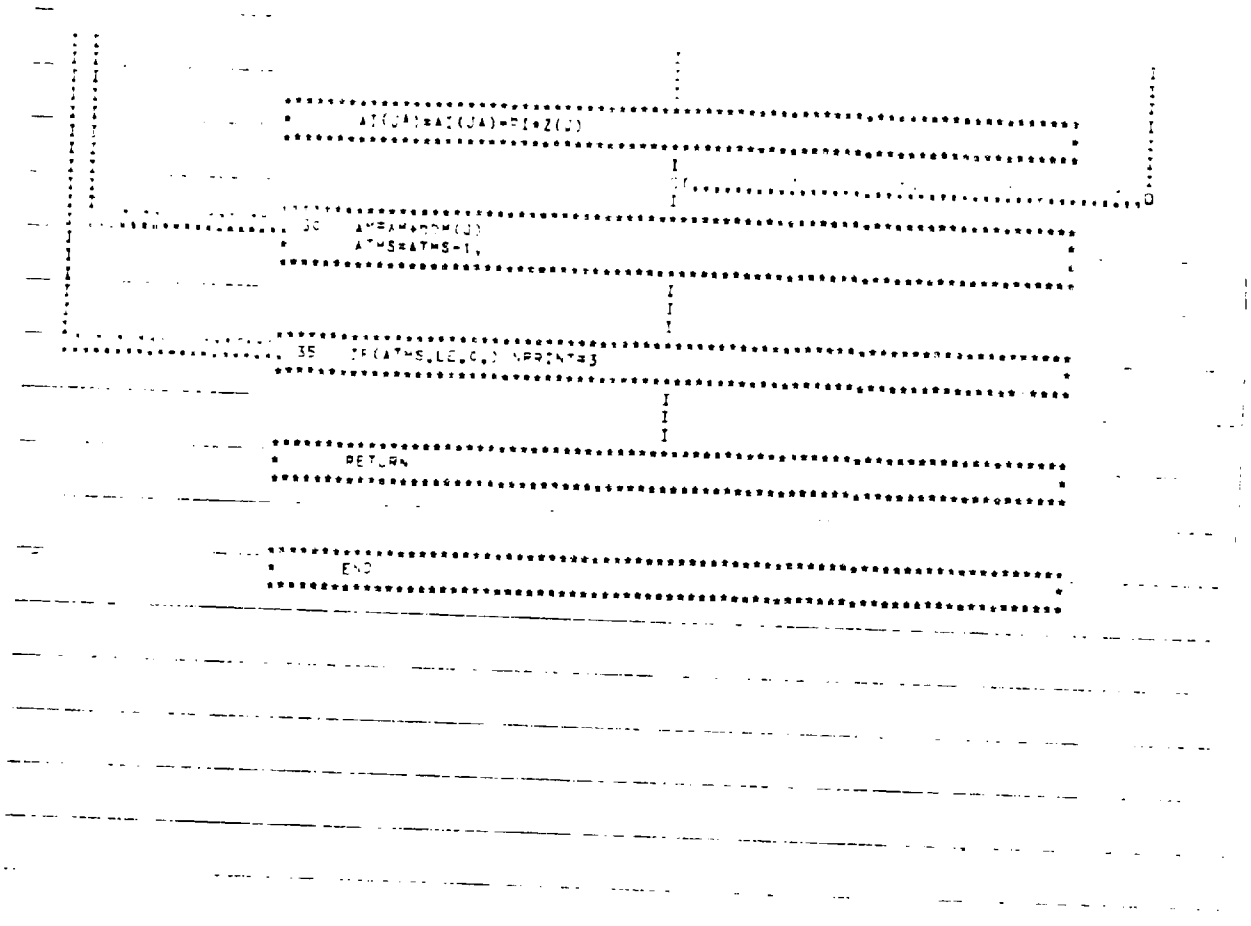







(ENTRANCE)
C**CMS
C S PROGRAM CEMS
C
C** INP
C COMMON/RAY/SDM,XX(3,
C COMMON/COMMON/SPEC,AMI(7,,AME(7)
C COMMON/PARAM/CONST,T(7),XS(7),AM(7),AC(7),PX(7),V9,AIMS,NPRINT
C COMMON /MICRO/SS(P,AA(100)
C COMMON/RANGE/MX,BE(
C EQUIVALENCE (
C EQUIVALENCE (Z(1),
C COMMON/ADD/MD4(300)
C** RANGE
C DIMENSION DUM(1)
C DIMENSION Z(1),AI(1)
C XS=0.
C S
C VPE=1.
C NPRINT=-3
C CS(AIMS,GT,0.) NPRINT=0
C NAI=NX
DO 15 J=1,NX
C AA(J)=1.
C HSX(J)=0.
C HSG(J)=0.
C XEJ=XX
C AA(1)=0.
C BB(N)=0.
C N=N+NX
C BB(N)=0.
15 AA(N)=0.
SXI=0.0

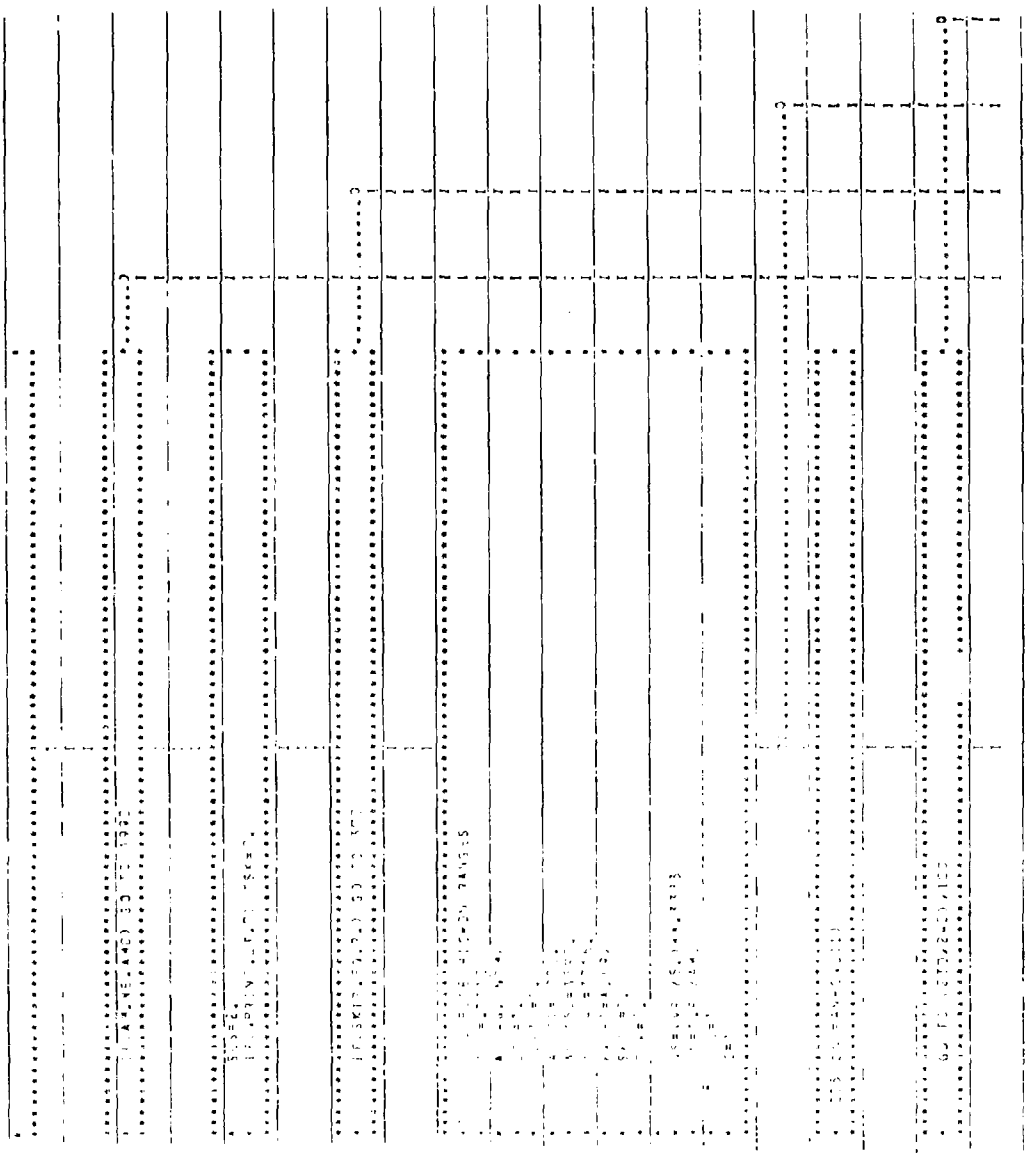



AI(JA)=AI(JA)+FI*Z(J)
30 AM=AM+RDM(J)
ATMS=ATMS-1.
35 IF(ATMS.LE.0.) NPRINT=3
RETURN
END

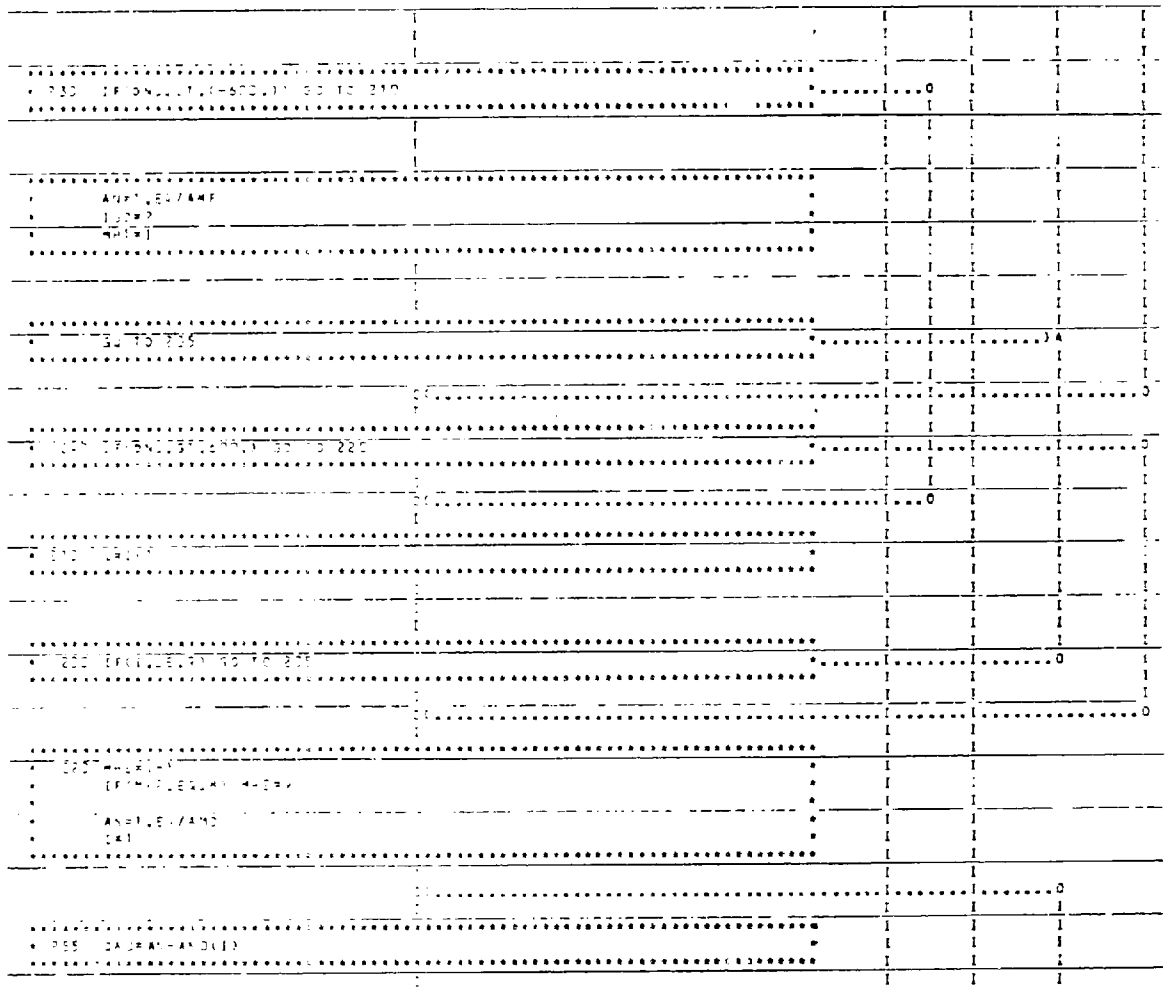
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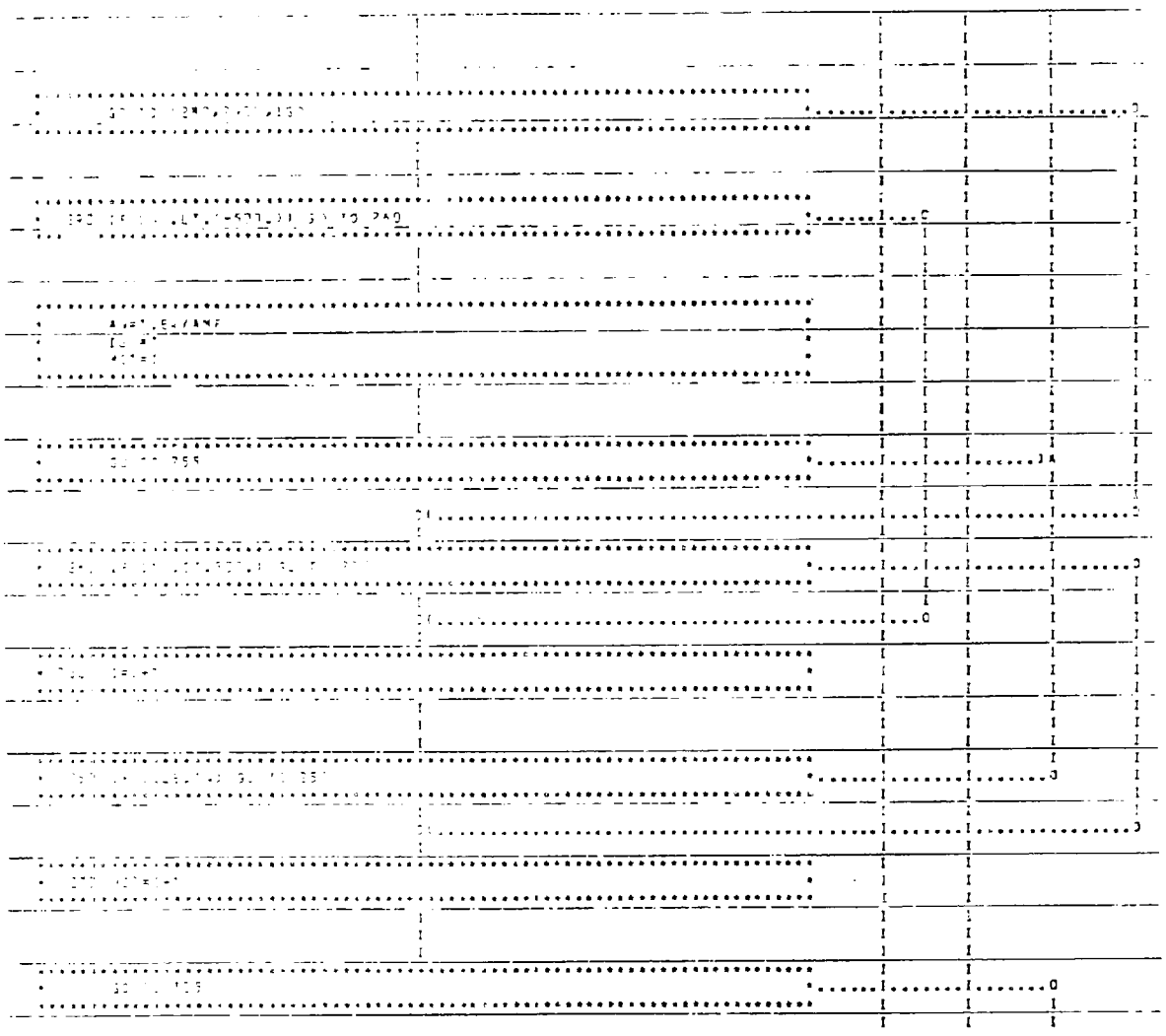
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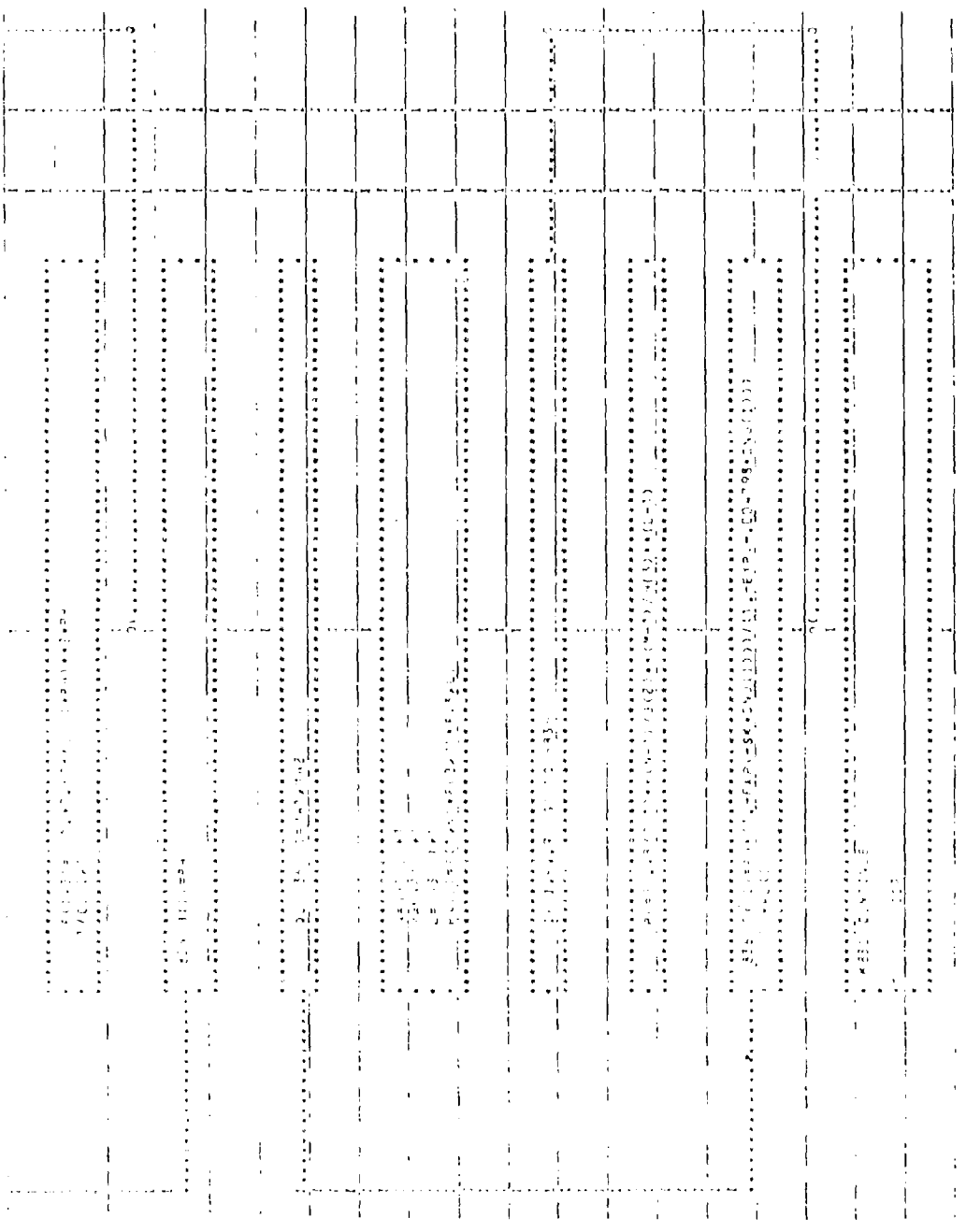


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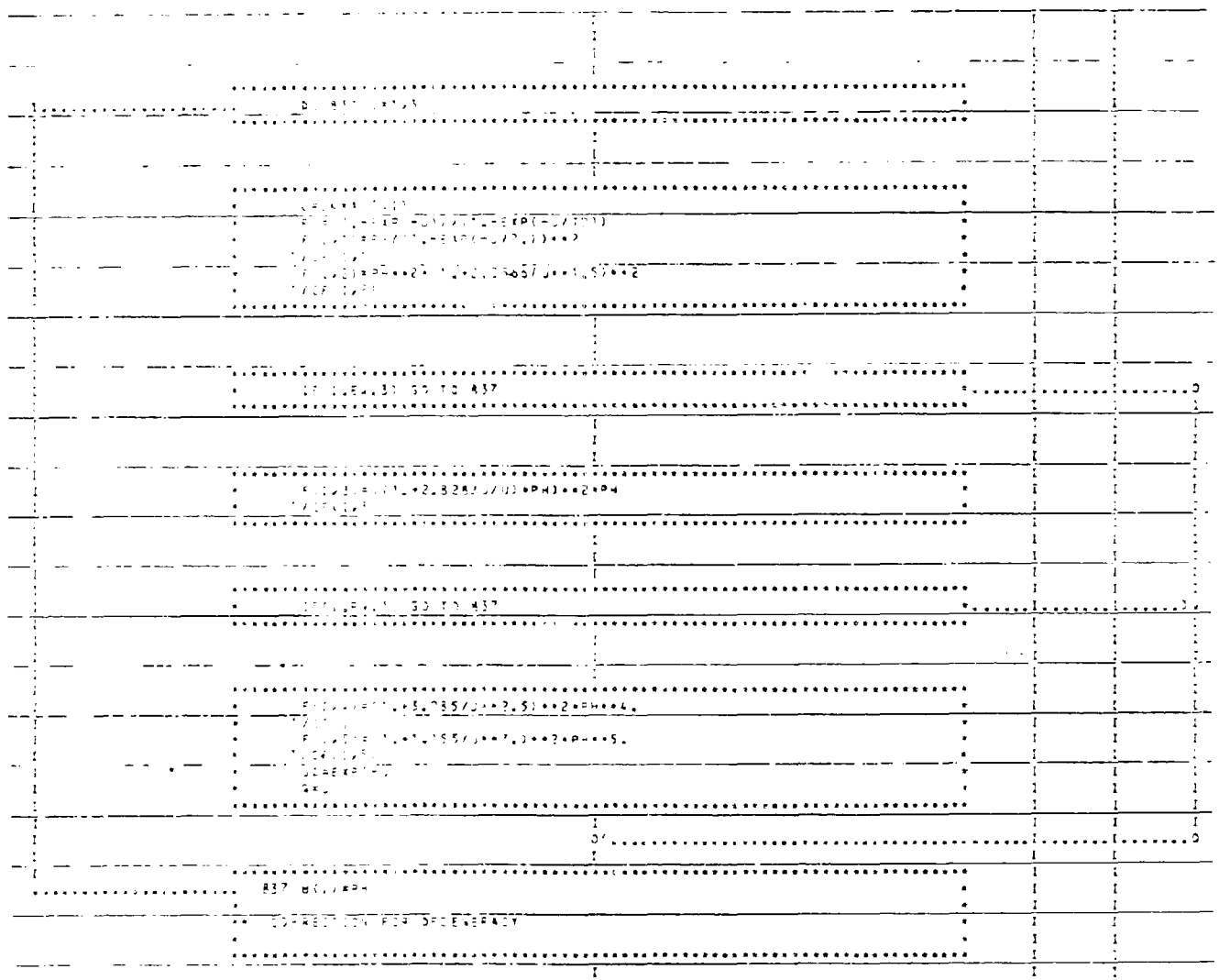


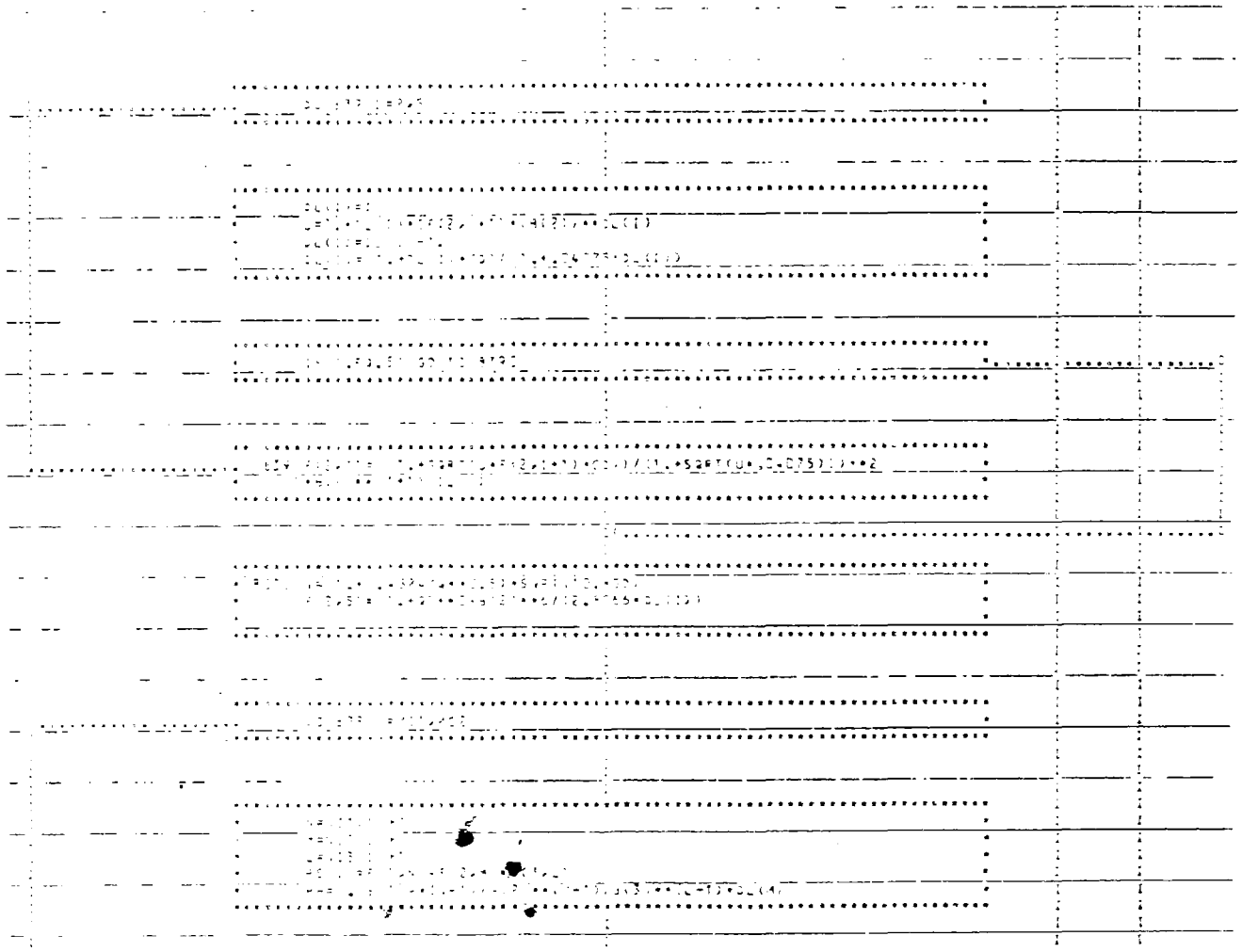


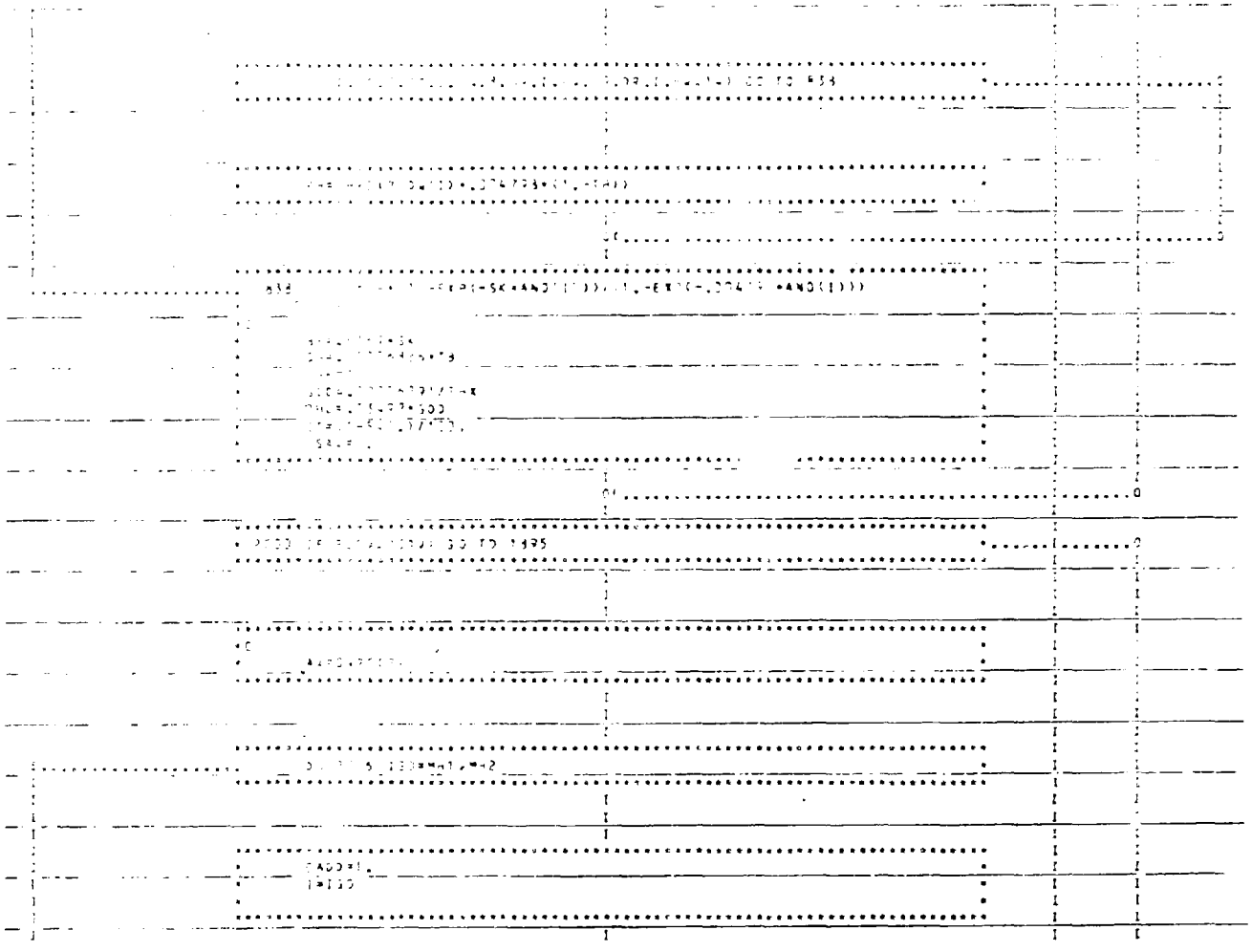
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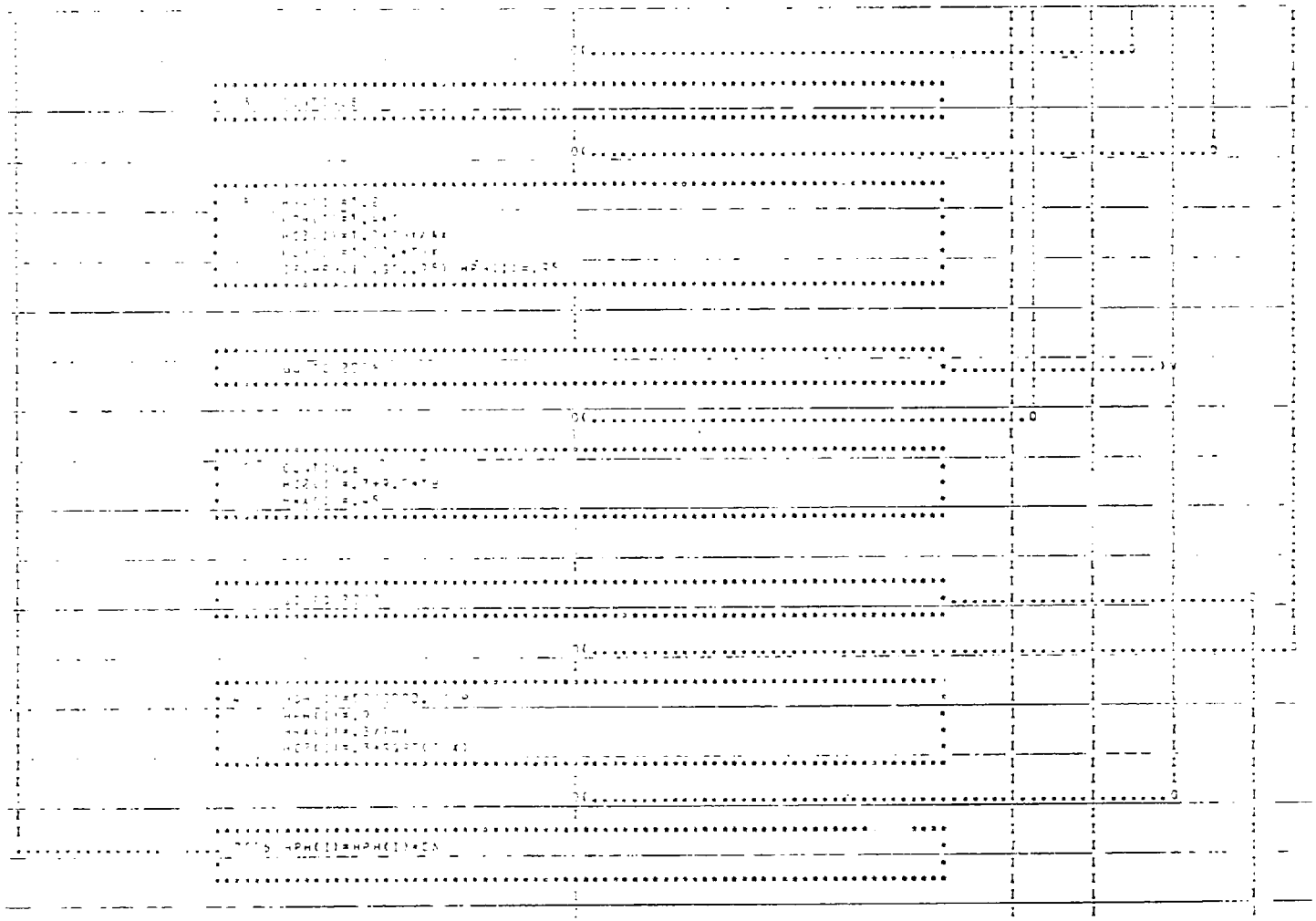


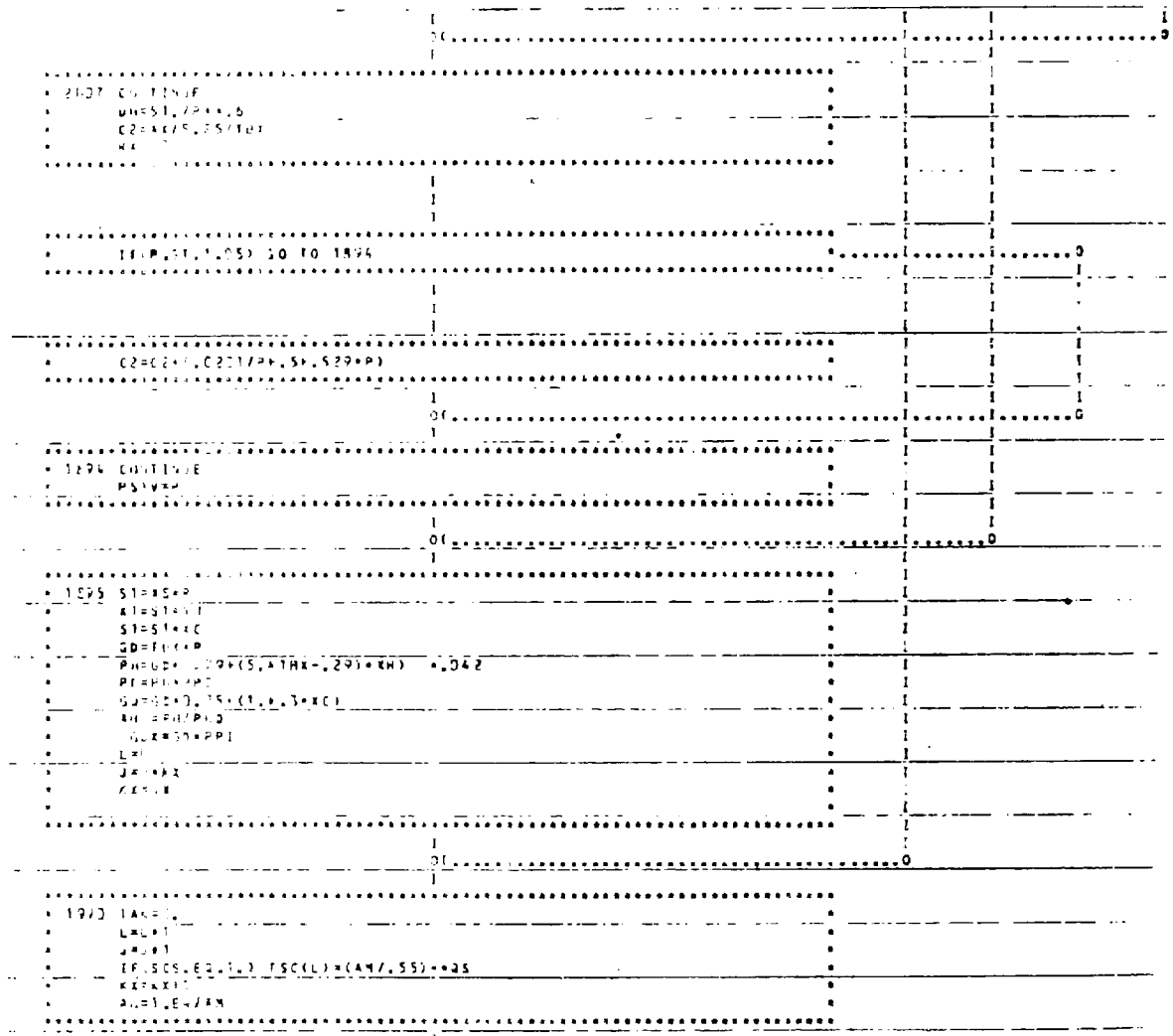
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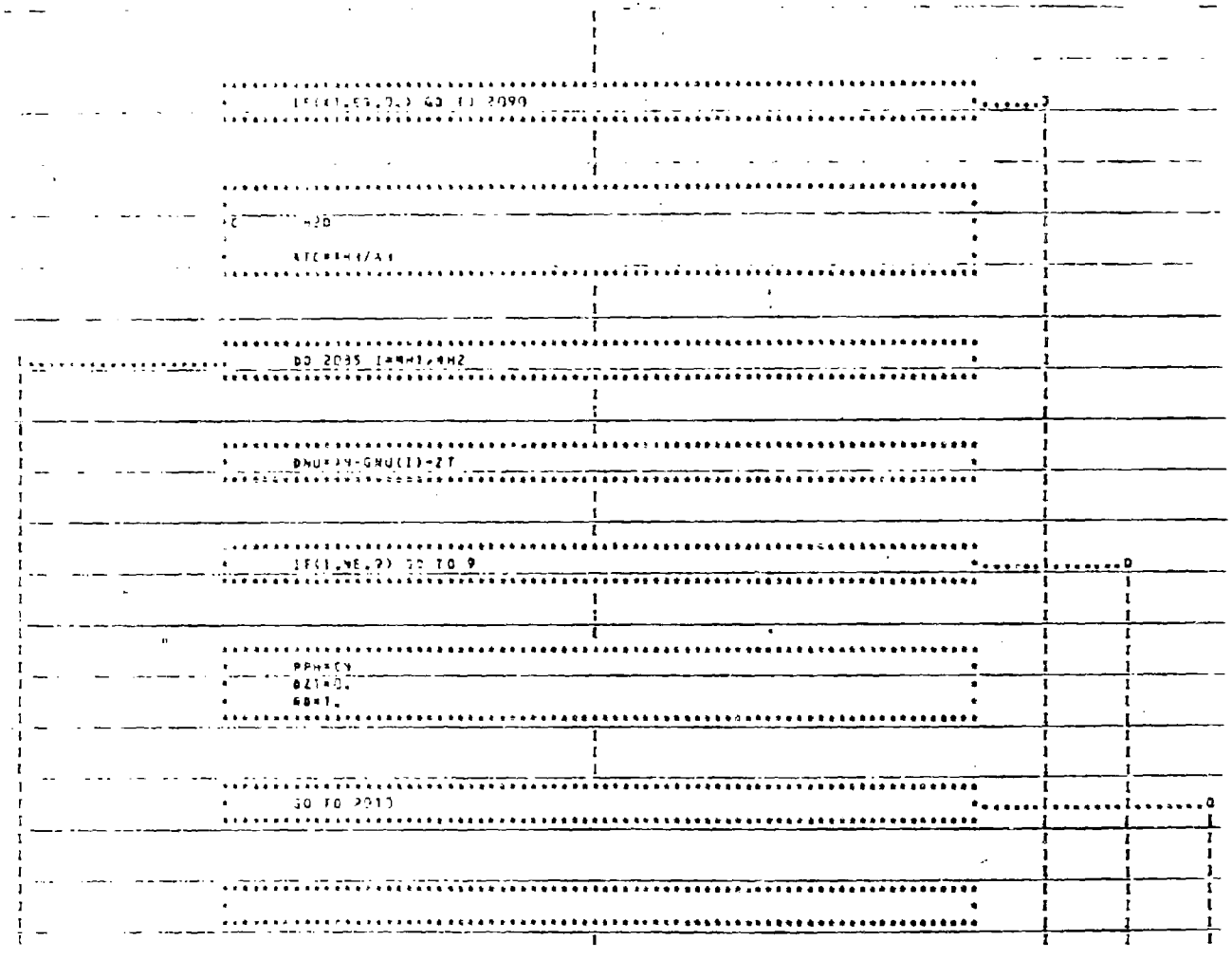


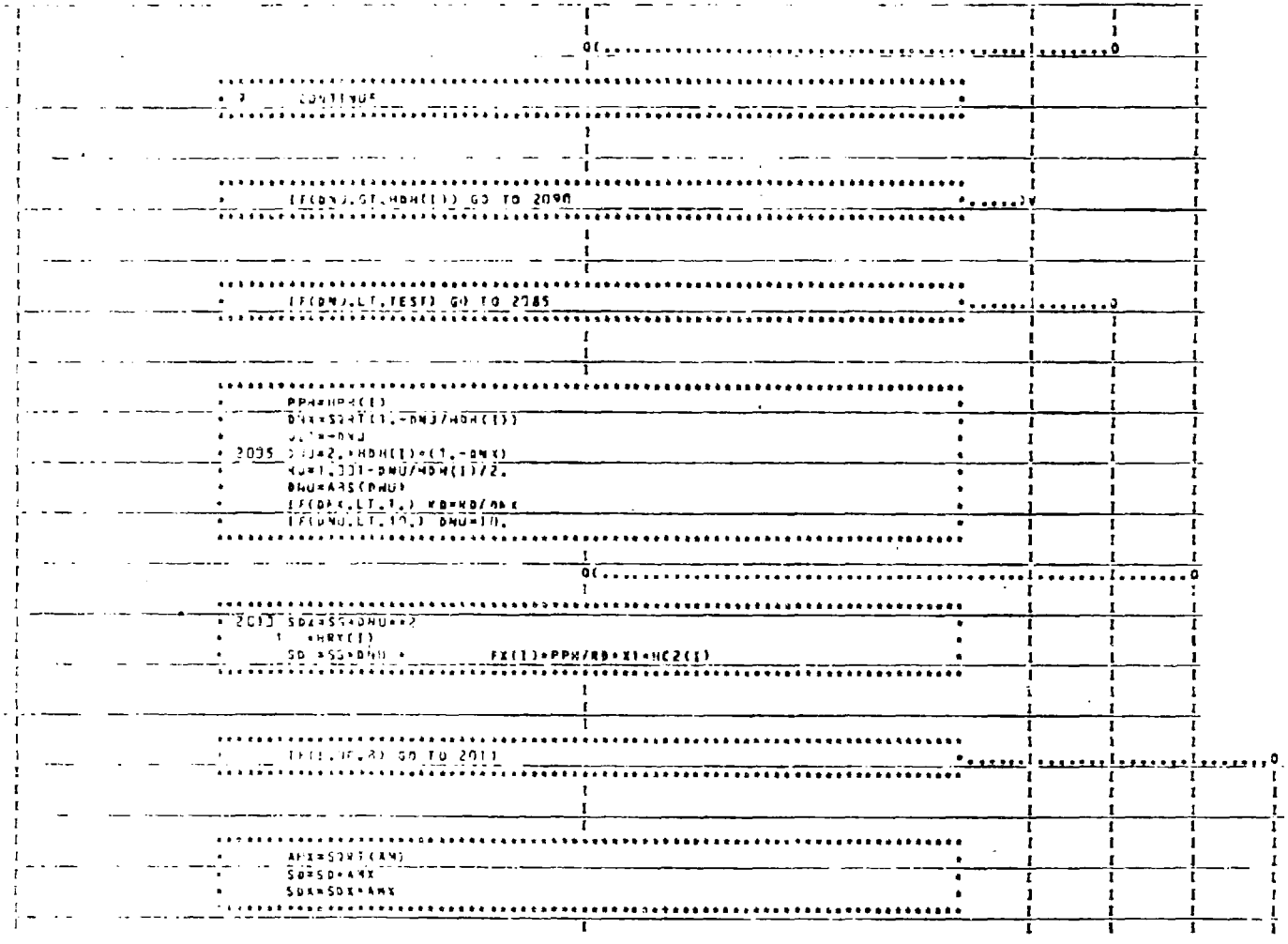


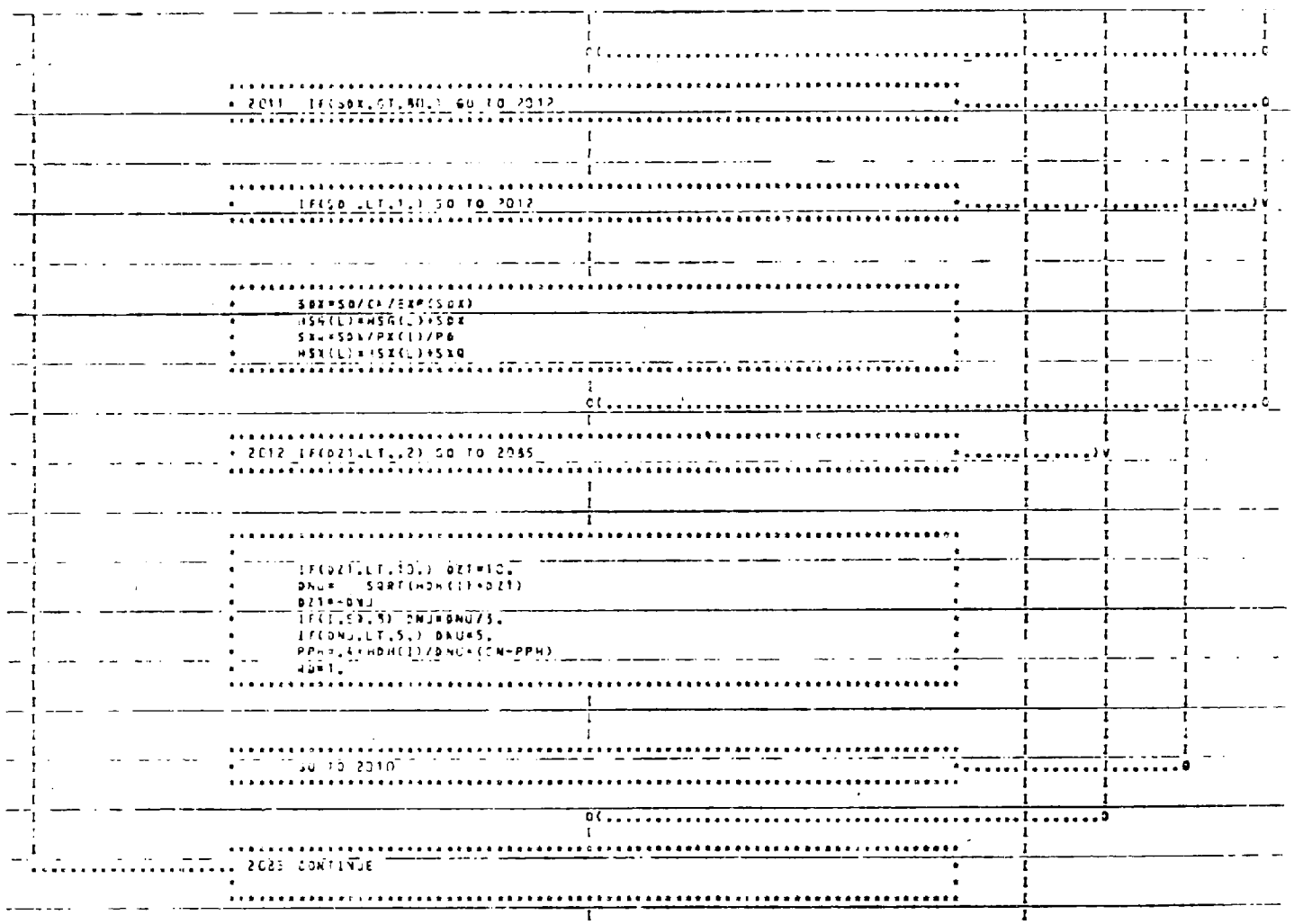


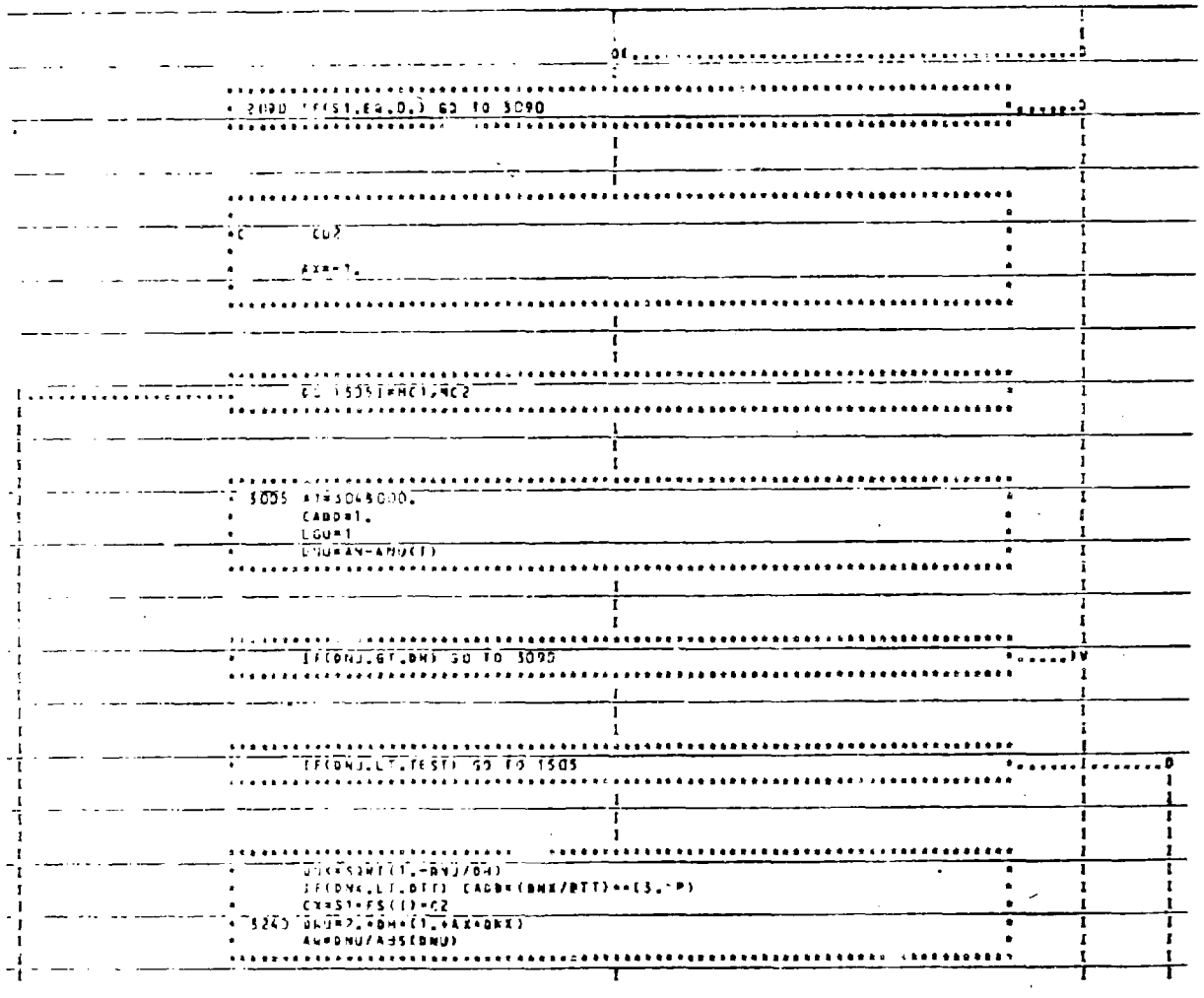


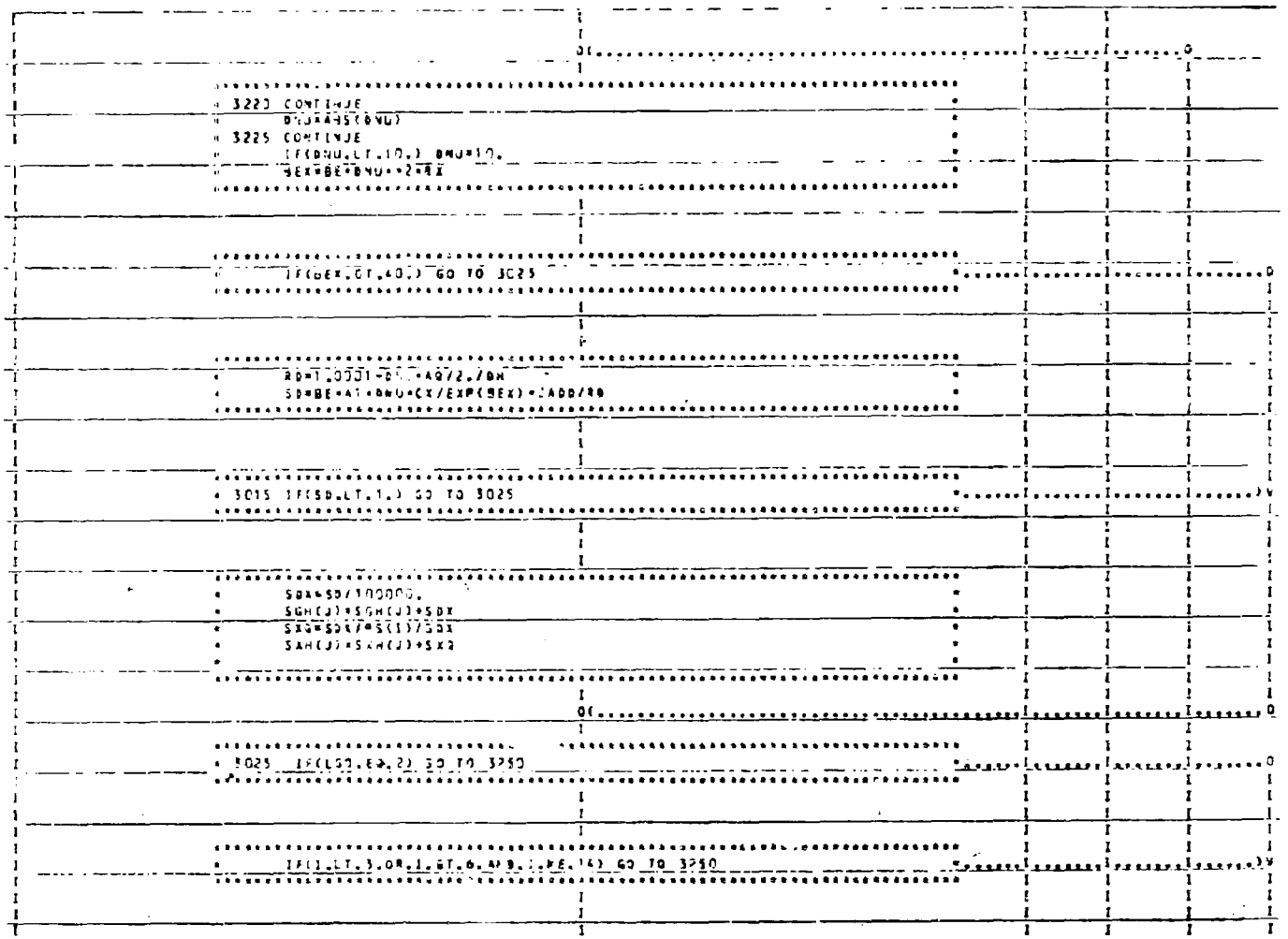

2107 CO TINUE
UH=51.72***.6
C2=**(5.55/TH
**
IF(P.GT.*.05) GO TO 1896
C2=C2*(.C2C1/P**.5*.529*P)
1896 CONTINUE
PSTVR2
1895 S1=S*P
*1=S1**1
S1=S1**C
SD=F***P
PH=UD* .29*(S.ATHR-.29)*RH) *.042
PI=PH*PI
GU=GD*3.75*(1.+.3*EC)
RH =PH/PI
GL=GU*PPI
L=1
JK=KK
ZZ=.8
197) IAK=1
L=L+1
J=J+1
IF.SCS.EQ.1.) FSC(L)=(AM/.55)**.25
KI=KKI
AL=1.E-/AM

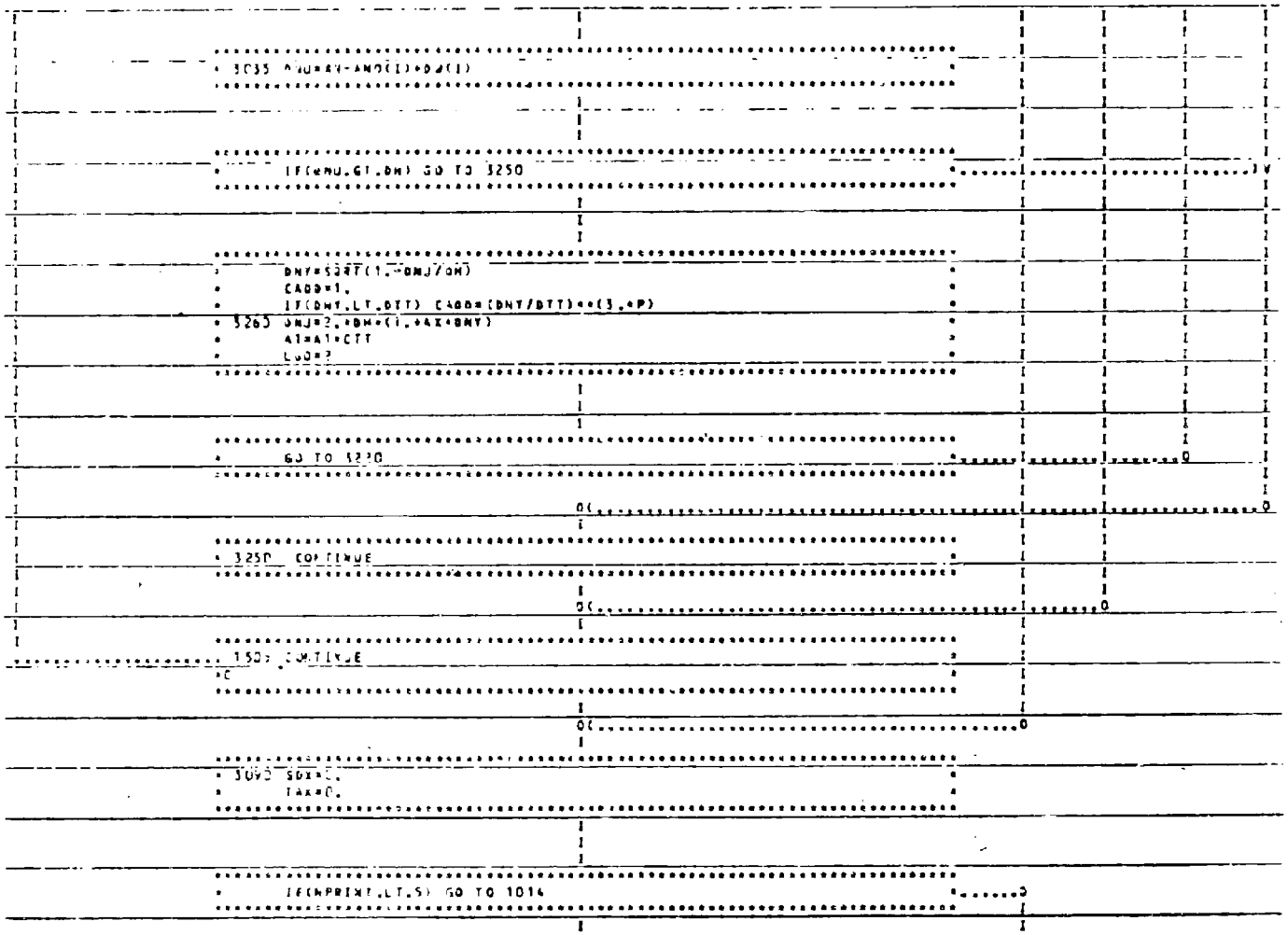

IF(I.EQ.2) GO TO 2090
H2O
ATCH1H2/A1
DO 2085 I=NH1,NH2
DNU=ZN-GNU(I)-ZT
IF(I.NE.2) GO TO 9
PPH=CN
BZT=0.
GO=1.
GO TO 2010

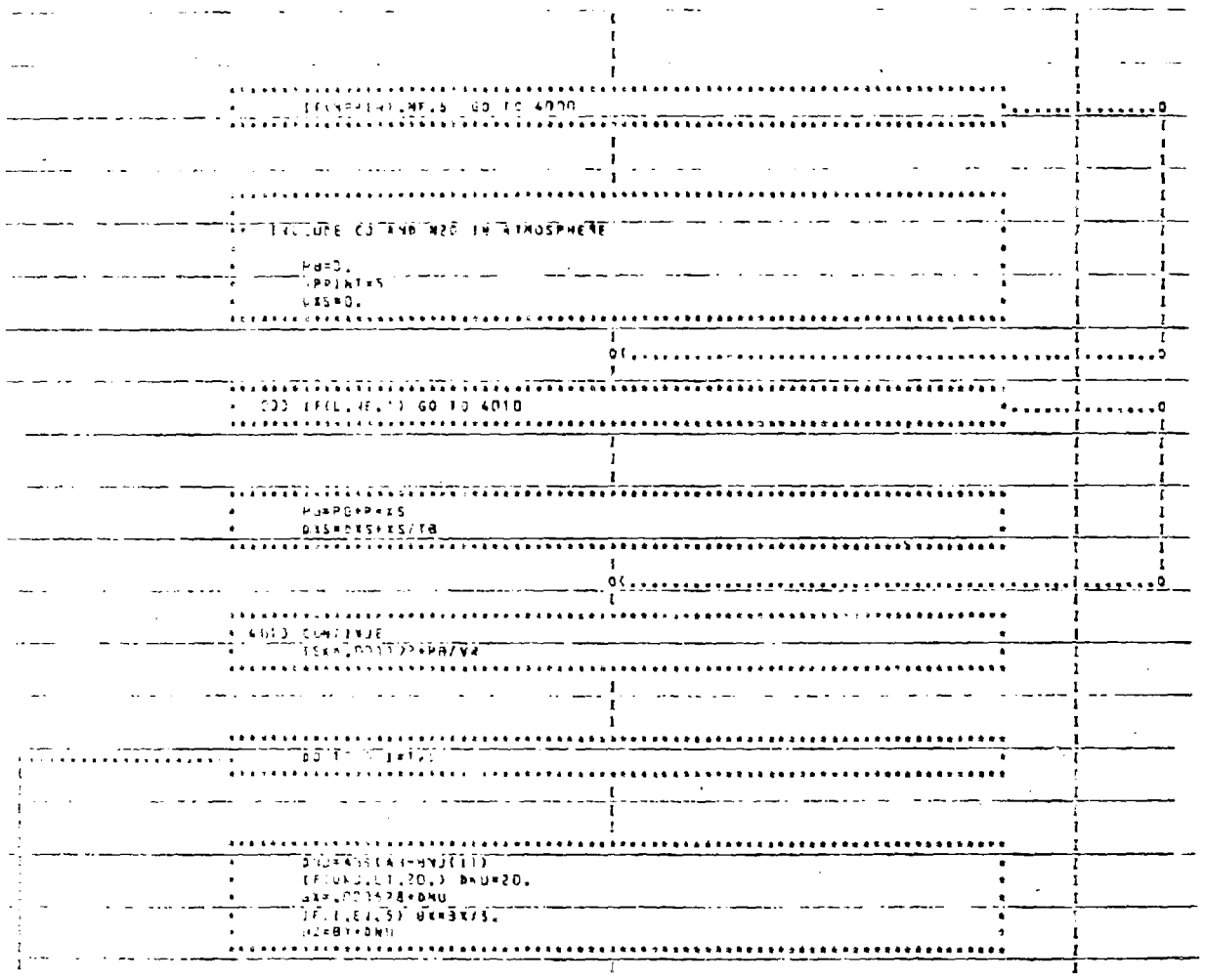


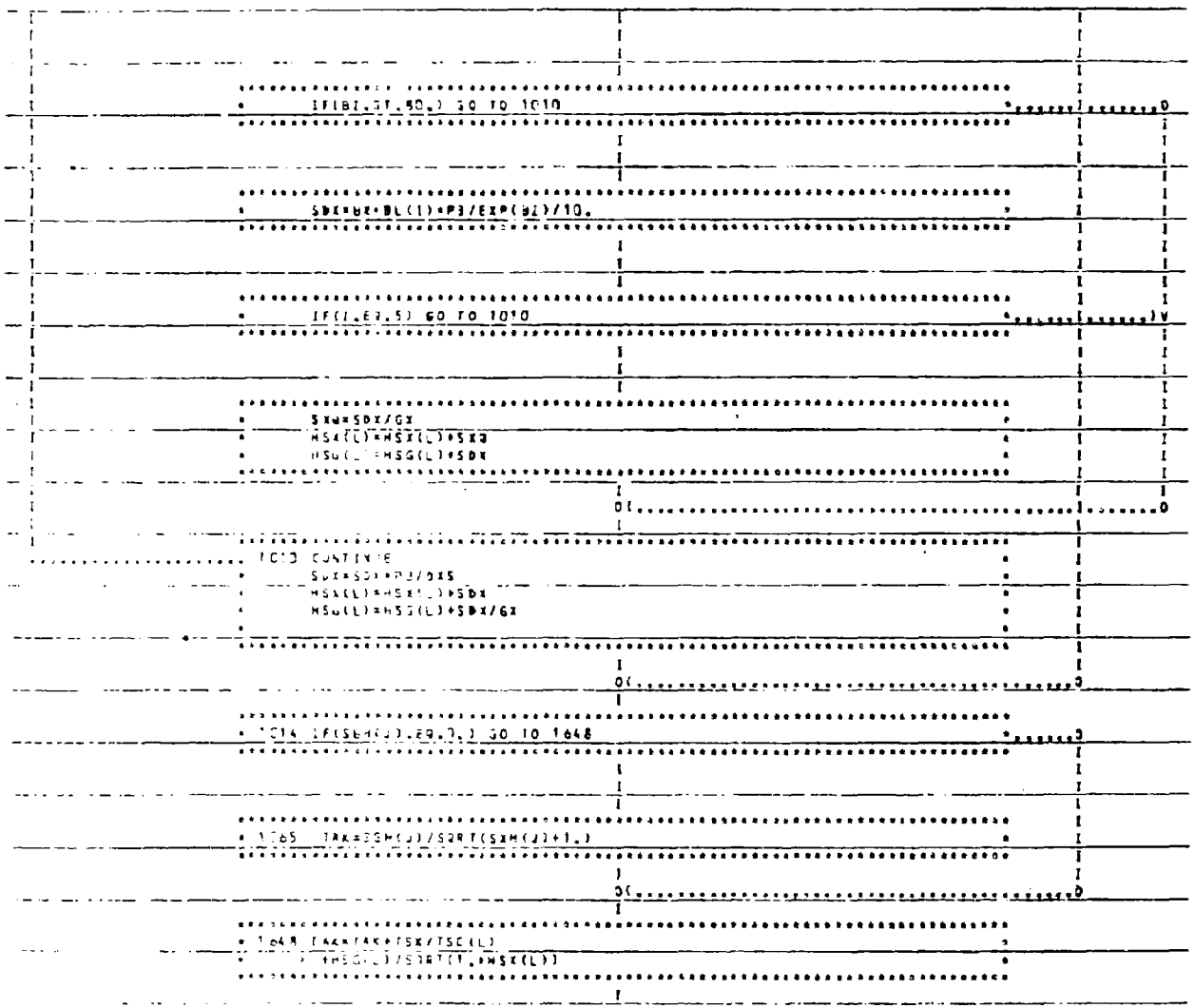

2011 IF(SDX.GT.80.) GO TO 2012
IF(SD .LT.1.) GO TO 2012
SDX=SD/CA/EXP(SDX)
HSY(L)=HSY(L)+SDX
SX=SDX/PX(I)/P6
HSX(L)=HSX(L)+SXQ
2012 IF(DZT.LT.2) GO TO 2035
IF(DZT.LT.10.) DZT=10.
DNU= SQRT(HDH(I)*DZT)
DZT=DNU
IF(I.EQ.9) DNU=DNU/3.
IF(DNU.LT.5.) DNU=5.
PP=.4*HDH(I)/DNU*(CN-PPH)
WW=1.
GO TO 2010
2035 CONTINUE

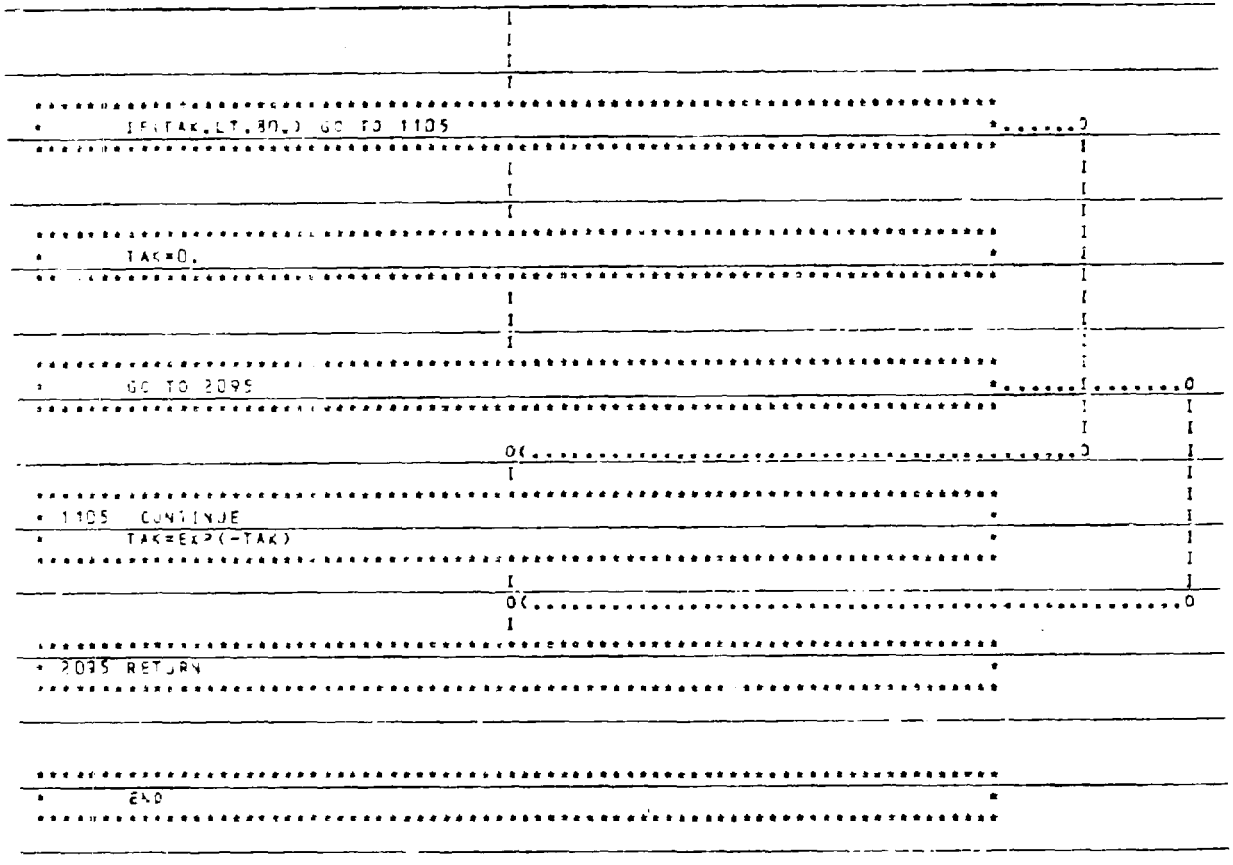

2080 IF(S1.EQ.0.) GO TO 3090
C CO2
AX=-1.
EQ 1505(1*NC1,NC2
5005 AY=5045000.
CADD=1.
LOU=1
DNU=AN-ANV(I)
IF(DNJ.GT.DH) GO TO 3090
IF(DNJ.LT.TEST) GO TO 1505
UK=SNT(1.-BNJ/DH)
IF(DNK.LT.DTT) CADD=(DNK/DTT)**(3.*P)
CX=S1*FS(I)*C2
5240 DAU=2.*DM*(1.+AX*DNX)
AW=DNU/ABS(DNU)

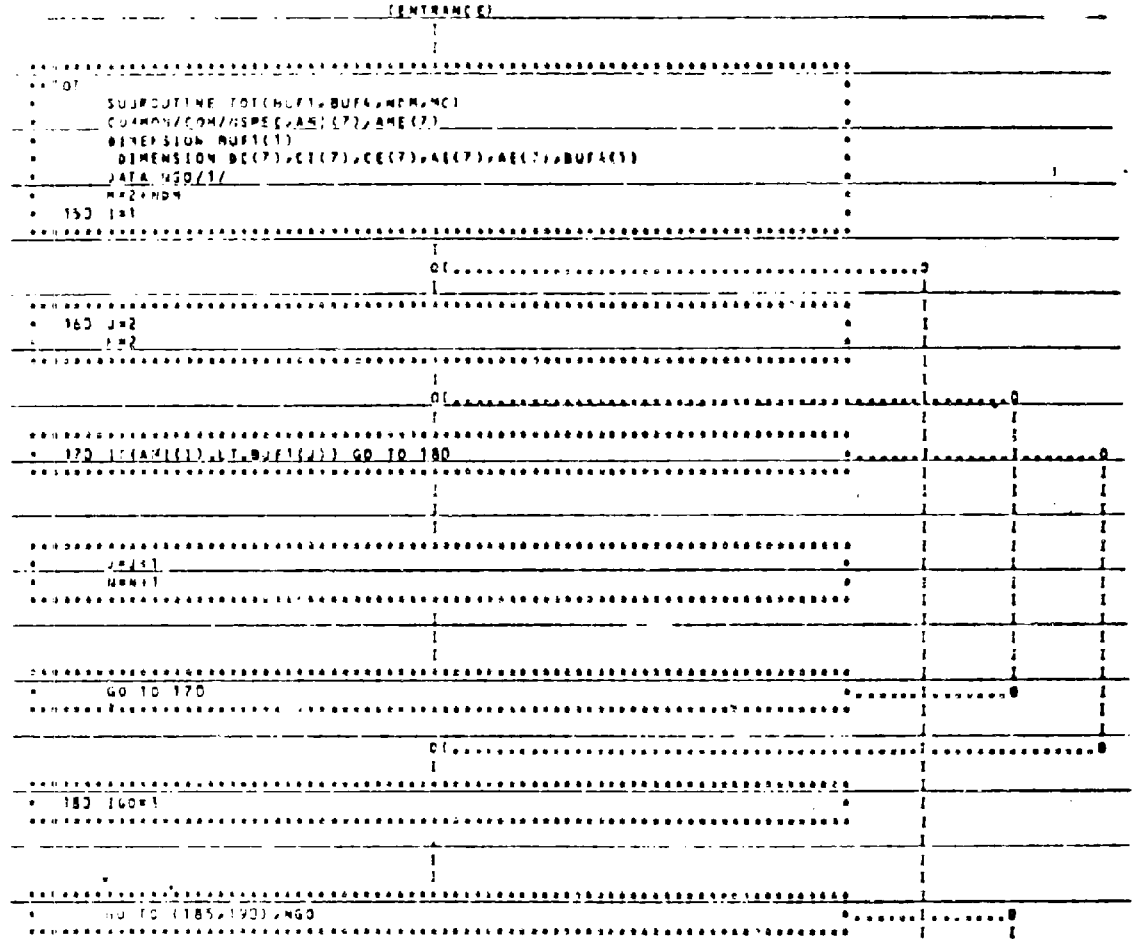

C 3223 CONTINUE
C DMU=ABS(DMU)
C 3225 CONTINUE
C IF(DMU.LT.10.) DMU=10.
C SEX=BE*DMU**2+AX
C IF(SEX.GT.40.) GO TO 3025
C RD=1.0001-D*A972./DX
C SD=BE*AT*DMU*CX/EXP(SEX)*CADD/RD
C 3015 IF(SD.LT.1.) GO TO 3025
C SDX=SD/100000.
C SGH(J)=SGH(J)+SDX
C SXD=SDX/FS(1)/SDX
C SAH(J)=SAH(J)+SXD
C 3025 IF(LSD.EQ.2) GO TO 3250
C IF(I.LT.3.OR.I.GT.6.AND.(.NE.14) GO TO 3250

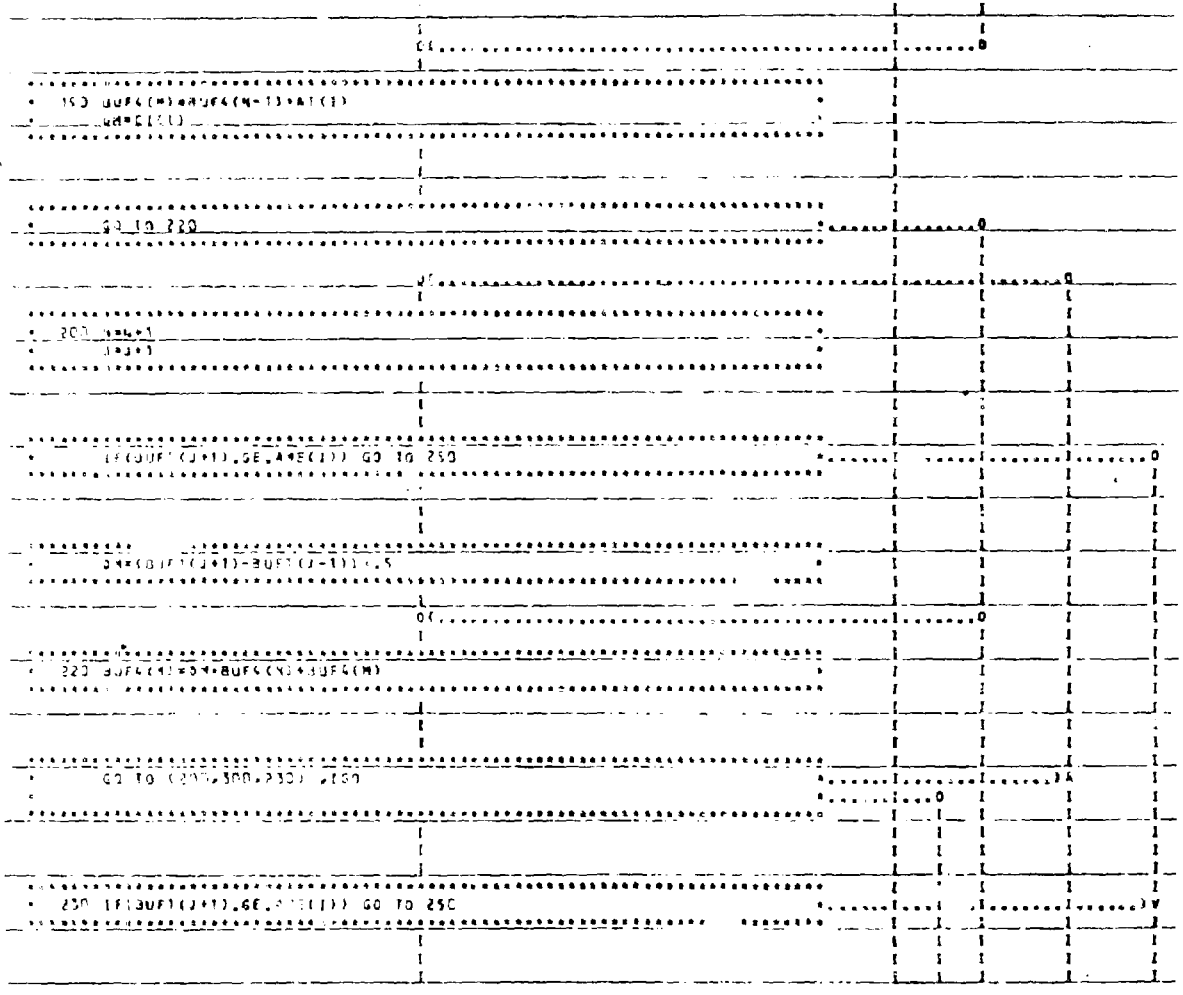

3035 ANUM=AN-AMO(I)*DJ(I)
IF(ANU.GT.DH) GO TO 3250
DNY=SQRT(1.-DMJ/DH)
CADD=1.
IF(DNY.LT.DTT) CADD=(DNY/DTT)**(3.*P)
3260 DMJ=2.*DH*(1.+AX*DNY)
A1=A1*CTT
L=0=7
GO TO 3220
3250 CONTINUE
150: CONTINUE
C
3090 SDX=0.
TAX=0.
IF(NPRINT.LT.5) GO TO 1016

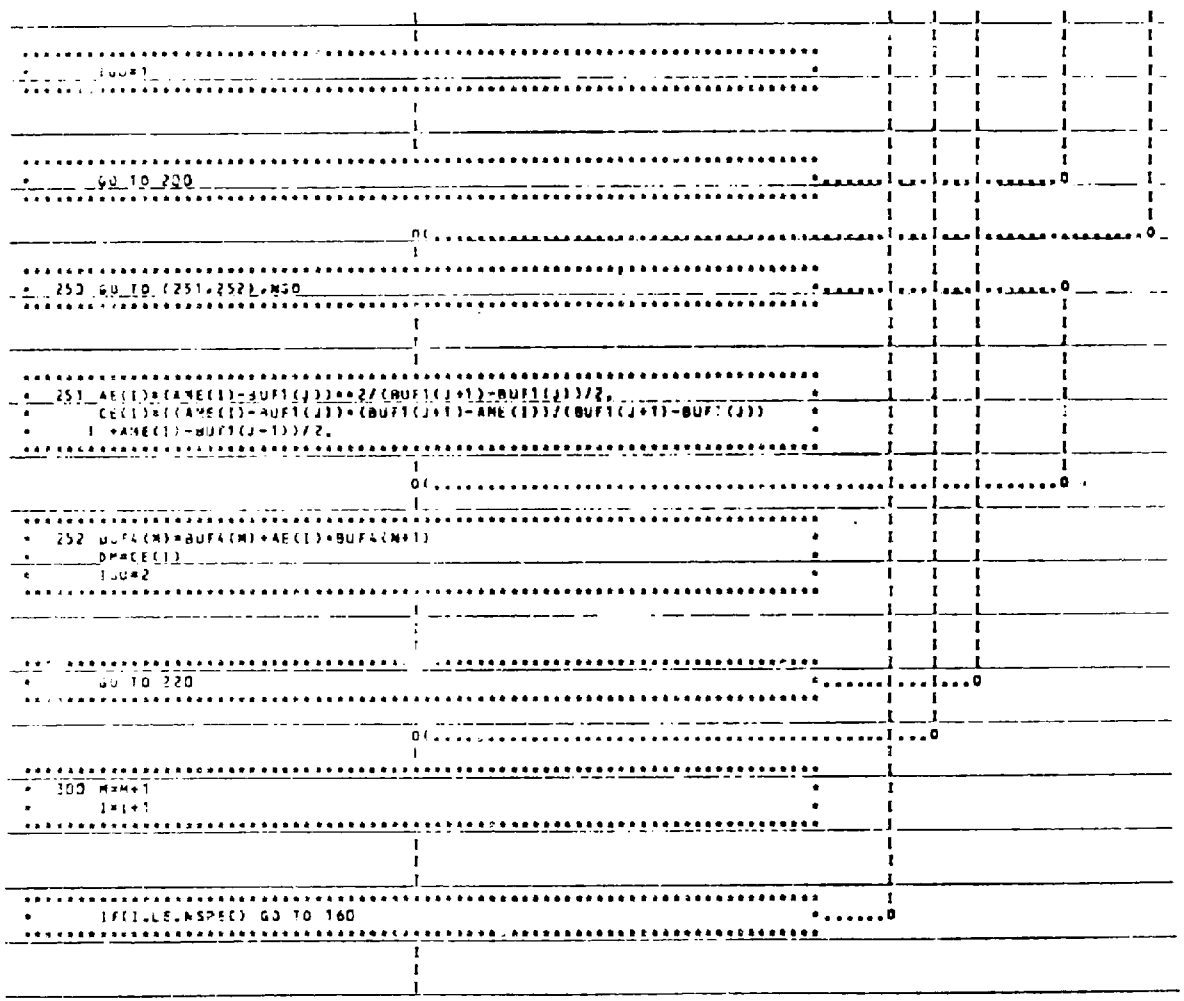



IF(BI.GT.50.) GO TO 1010
SDX=DX*BL(I)*P3/EXP(BI)/10.
IF(I.EQ.5) GO TO 1010
SXW=SDX/GX
HSX(L)=HSX(L)+SXW
HSG(L)=HSG(L)+SDX
1013 CONTINUE
SUX=SUX+PJ/DXS
HSX(L)=HSX(L)+SDX
HSG(L)=HSG(L)+SDX/GX
1014 IF(SB4(J).EQ.1.) GO TO 1648
1165 TAK=BGM(J)/SQRT(SIM(J)+1.)
1648 TAK=TAK+TSX/TSC(L)
+HSG(L))/SQRT(1.+HSX(L))


IF(TAK.LT.80.) GO TO 1105
TAK=0.
GO TO 2095
1105 CONTINUE
TAK=EXP(-TAK)
2095 RETURN
END


(ENTRANCE)
SUBROUTINE TDI(BUF1,BUF4,NEM,NC)
COMMON/COM/NSPEC,AM(7),AME(7)
DIMENSION BUF1(1)
DIMENSION BC(7),CI(7),CE(7),AE(7),AE(7),BUF4(1)
DATA NGO/1/
M=2*NEM
150 I=1
160 J=2
I=2
170 IF(AM(I).LT.BUF1(J)) GO TO 180
I=I+1
M=M+1
GO TO 170
180 I60=1
GO TO (185,190),NGO
185 A(I)=(BUF1(J)-AM(I))**2/(BUF1(J)-BUF1(J-1))/2.
C(I)=((AM(I)-BUF1(J-1))*(BUF1(J)-AM(I))/(BUF1(J)-BUF1(J-1))
1 +BUF1(J-1)-AM(I))/2.
BC(I)=AME(I)-AM(I)




J=J+1
GO TO 200
250 GO TO (251,252),NSO
251 AE(I)=(ANE(I)-BUF1(J))**2/(BUF1(J+1)-BUF1(J))/2.
CE(I)=((ANE(I)-BUF1(J))*(BUF1(J+1)-ANE(I))/(BUF1(J+1)-BUF1(J))
1 +ANE(I)-BUF1(J-1))/2.
252 BUF4(M)=BUF4(M)+AE(I)*BUF4(M+1)
DM=CE(I)
J=J+2
GO TO 220
300 M=M+1
I=I+1
IF(I.LE.NSPEC) GO TO 160

```
      NQC=2
      IF(MC.EQ.0) RETURN
      MU=ND**1
      IQ=I-J

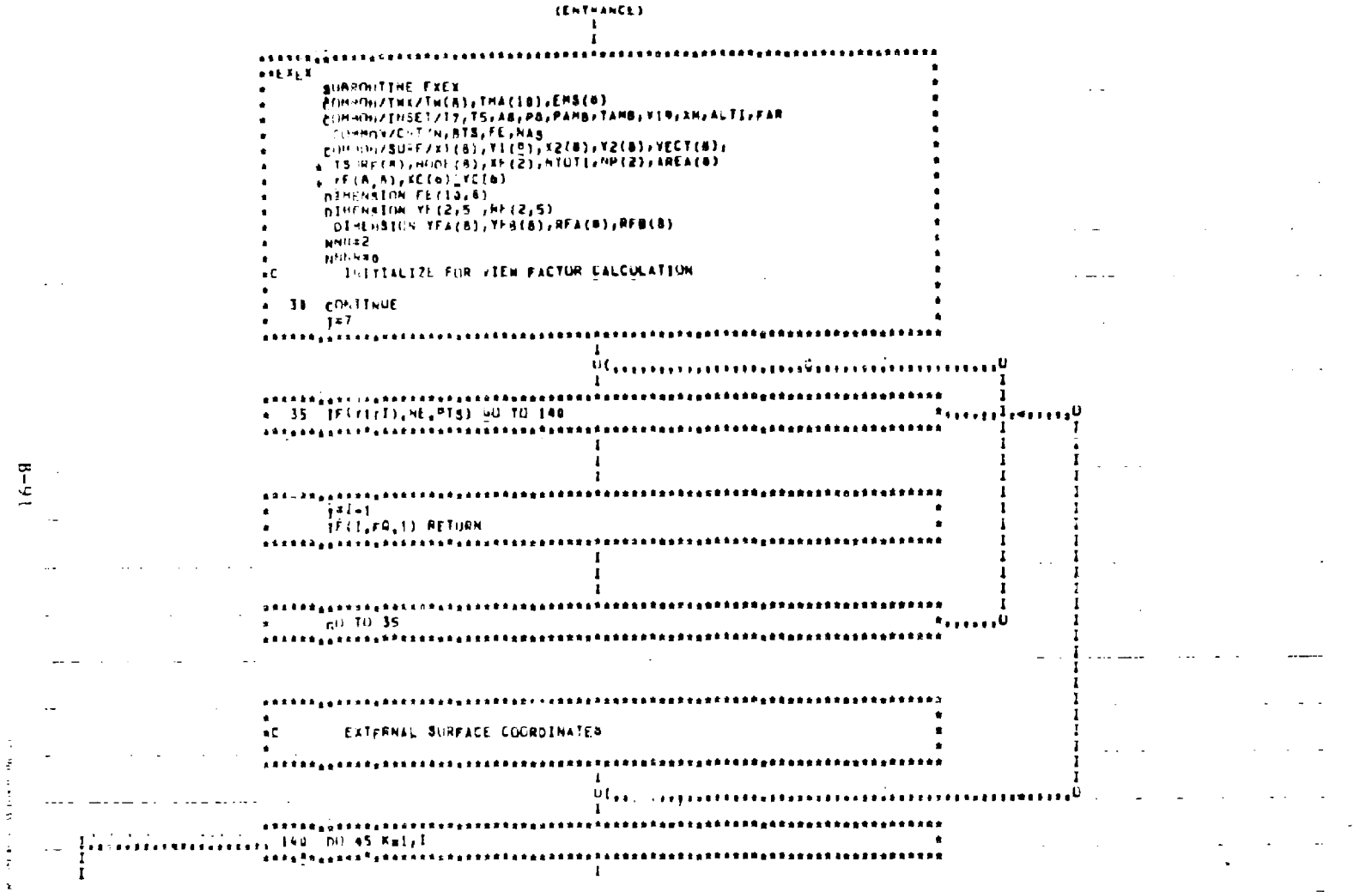
      DO 340 I=1,ID

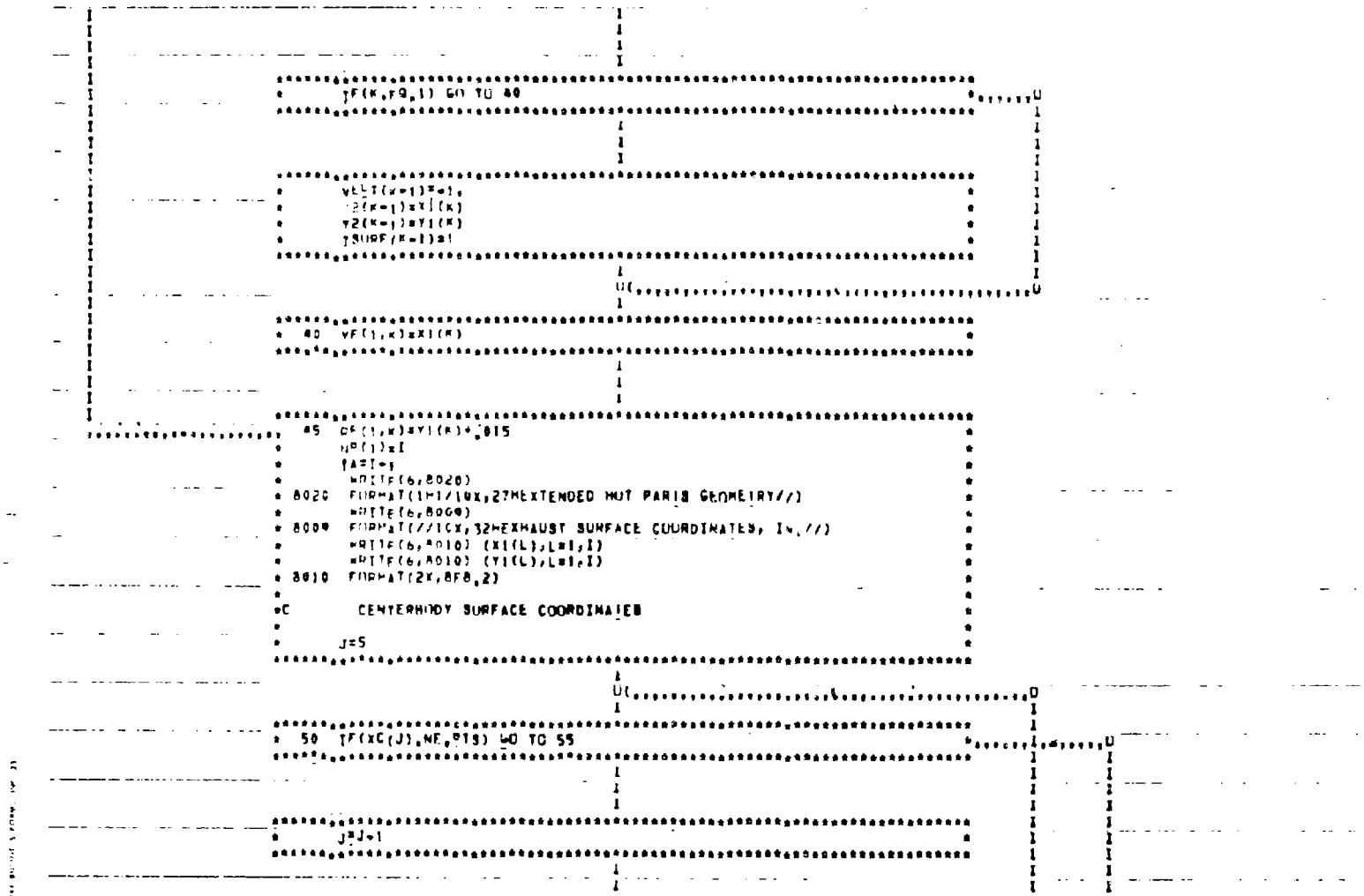
      K=I+MQ
       IF(MC.EQ.2) BUF4(K)=BUF4(K)/DC(I)

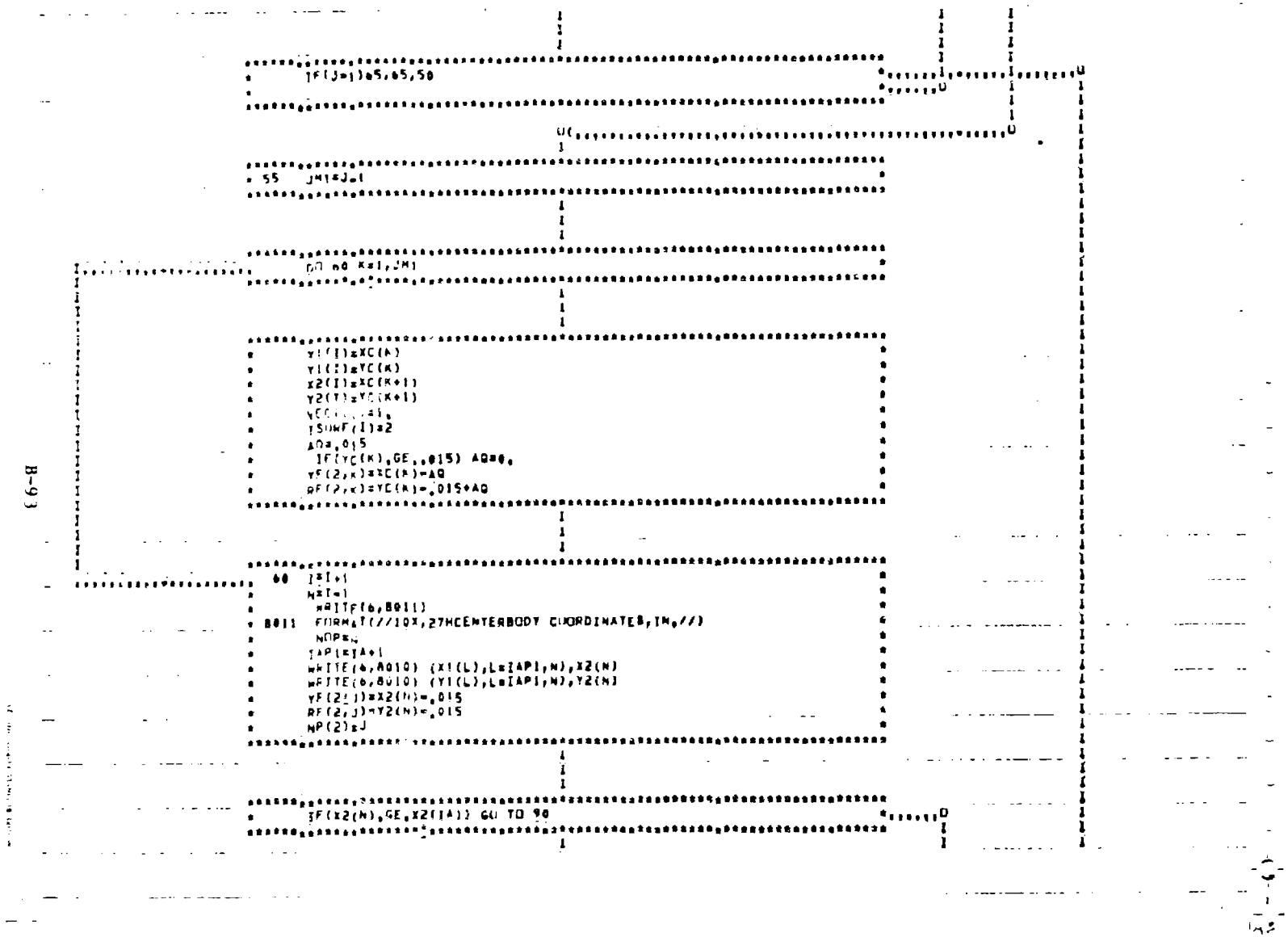
  340 WRITE(6,5008) AMI(I),AME(I),BUF4(K)
 5008 FORMAT(12X,4HFROM,F5.2,3H TO,F5.2,11H  MICRONS =,F12.4,7H  WT/SR)

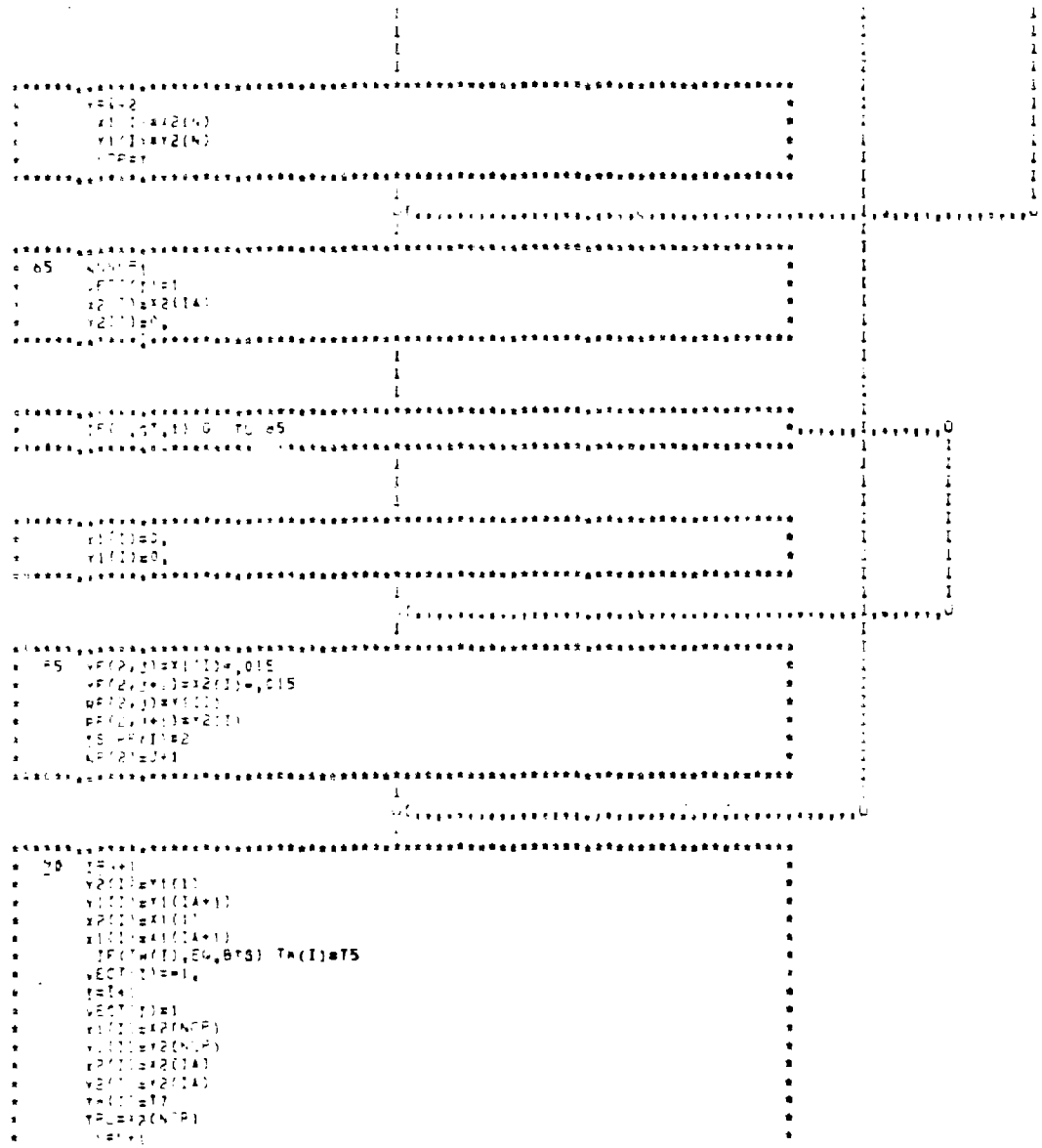
      RETURN

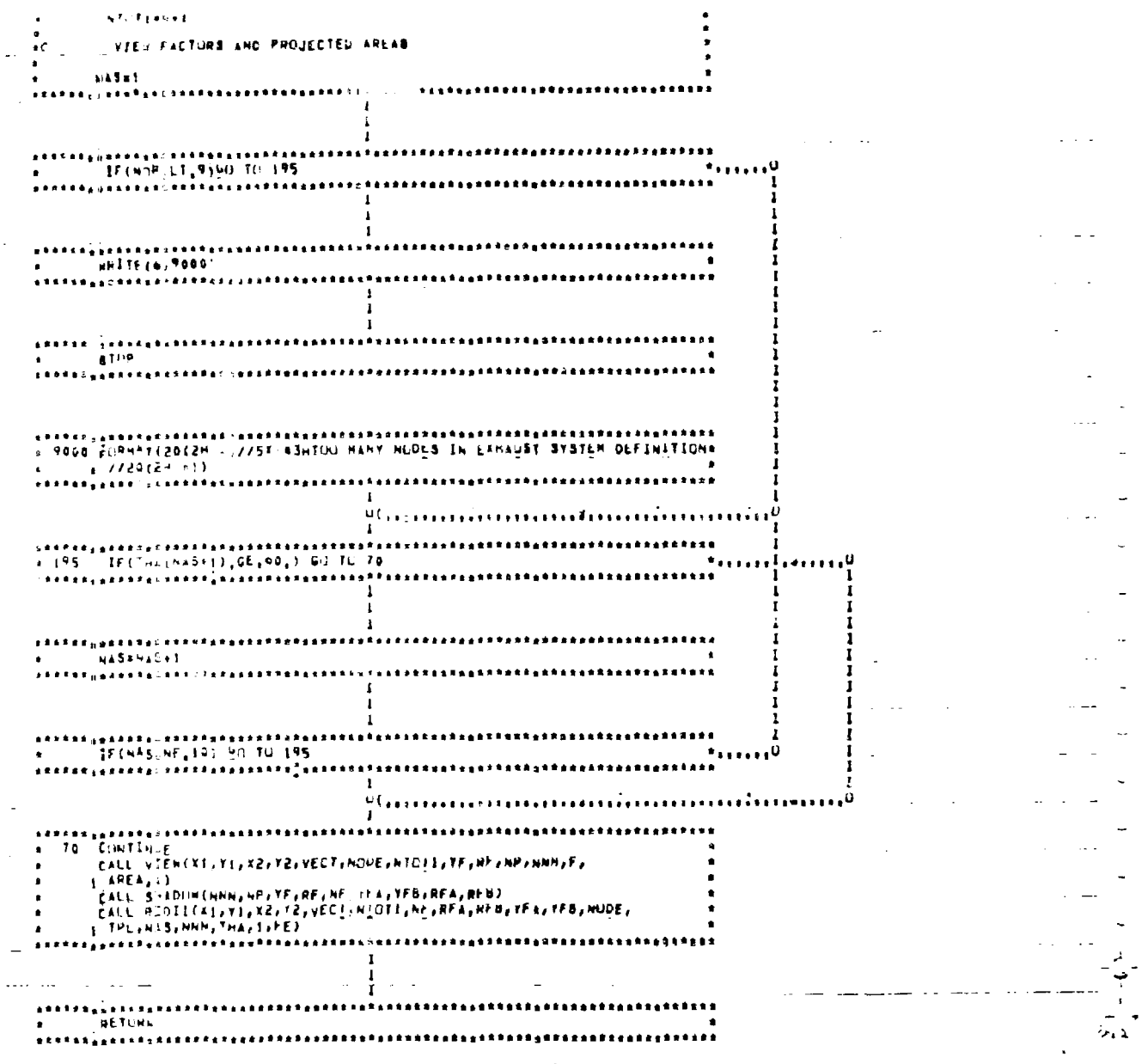
      END
```

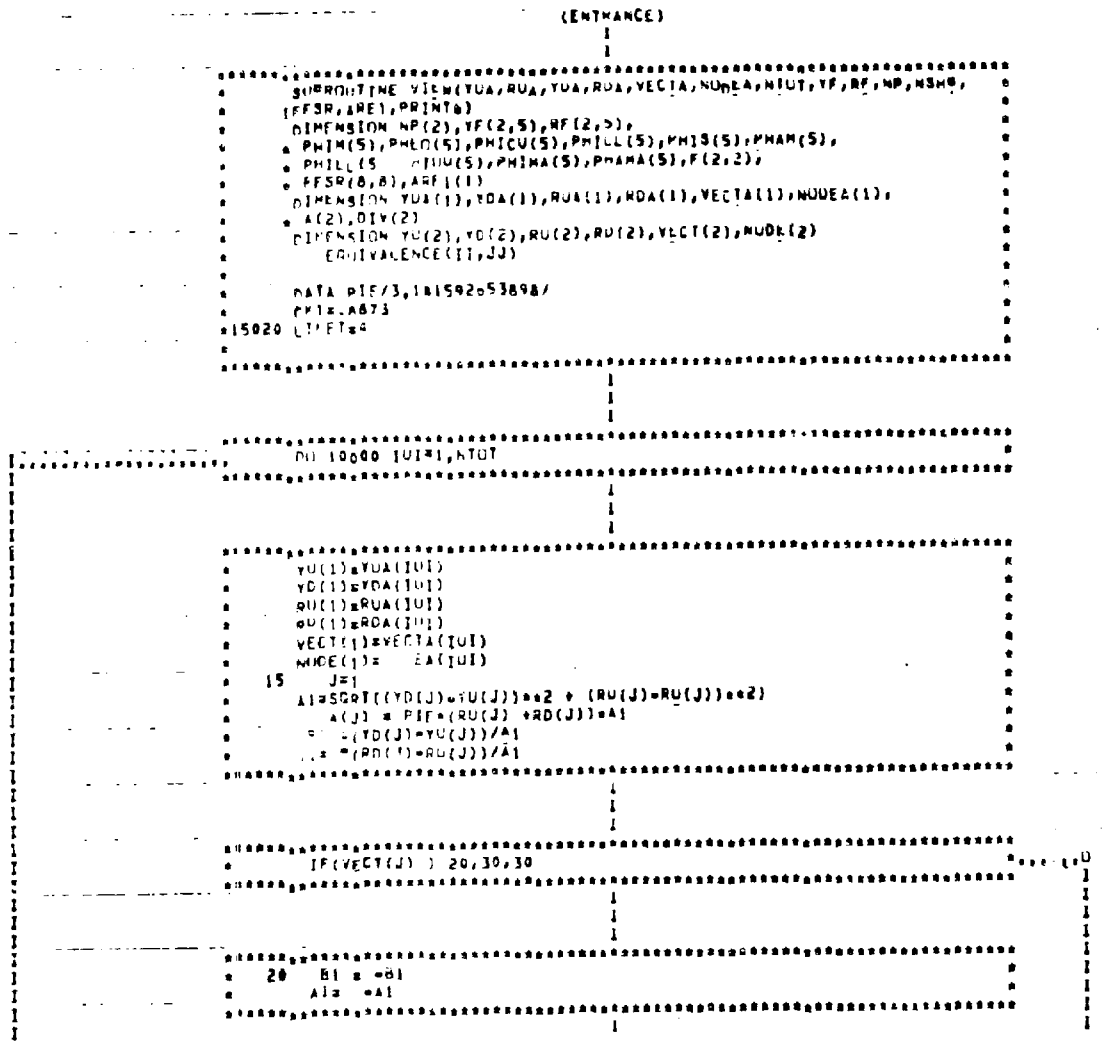

(ENTRANCE)
SUBROUTINE FXEX
COMMON/TMX/TM(8),TMA(10),EMS(8)
COMMON/INSET/I7,T5,A8,P8,PAMB,TAMB,V10,XM,ALTI,FAR
COMMON/CNTRN/BTS,FE,NAS
COMMON/SURF/X1(8),Y1(8),X2(8),Y2(8),VECT(8),
1 TSURF(8),NODE(8),XP(2),NTOTI,NP(2),AREA(8)
2 ,FF(8,8),XC(8),YC(8)
DIMENSION FE(13,8)
DIMENSION YF(2,5 ,NP(2,5)
DIMENSION YFA(8),YFB(8),RFA(8),RFB(8)
NN=2
N=0
C INITIALIZE FOR VIEW FACTOR CALCULATION
38 CONTINUE
I=7
35 IF(Y1(I).NE.PTS) GO TO 140
I=I-1
IF(I.EQ.1) RETURN
GO TO 35
C EXTERNAL SURFACE COORDINATES
140 DO 45 K=1,I

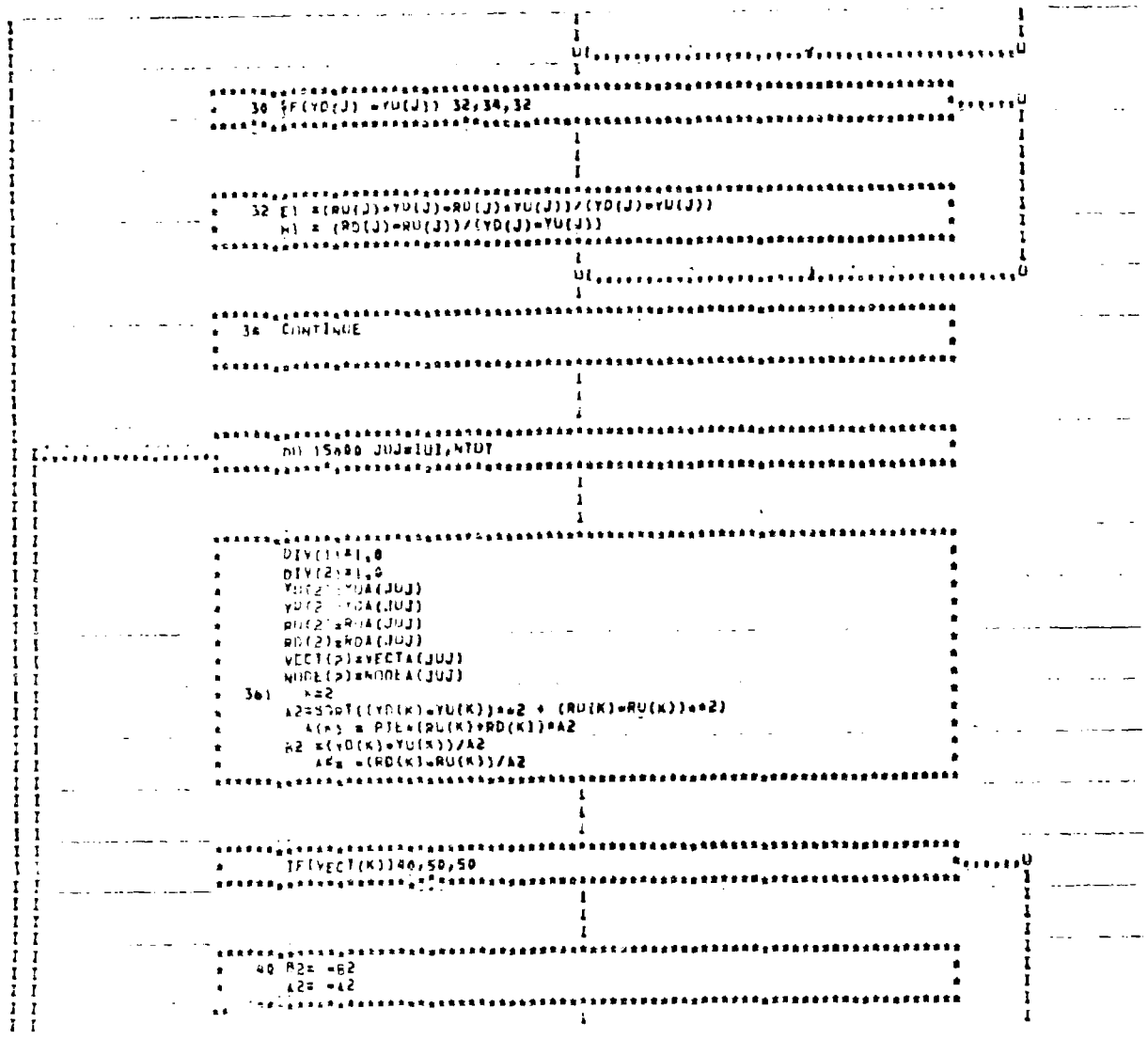

IF(K.EQ.1) GO TO 40
XF(1,K)=XI(K)
YF(1,K)=YI(K)+.015
NP(1)=I
IA=I-1
WRITE(6,8020)
8020 FORMAT(1H1//10X,27HEXTENDED NUT PARIS GEOMETRY//)
WRITE(6,8000)
8000 FORMAT(///1CX,32HEXHAUST SURFACE COORDINATES, IN.//)
WRITE(6,8010) (XI(L),L=1,I)
WRITE(6,8010) (YI(L),L=1,I)
8010 FORMAT(2X,8F8.2)
CENTERBODY SURFACE COORDINATES
J=5
IF(XC(J).NE.0.0) GO TO 55
J=J+1

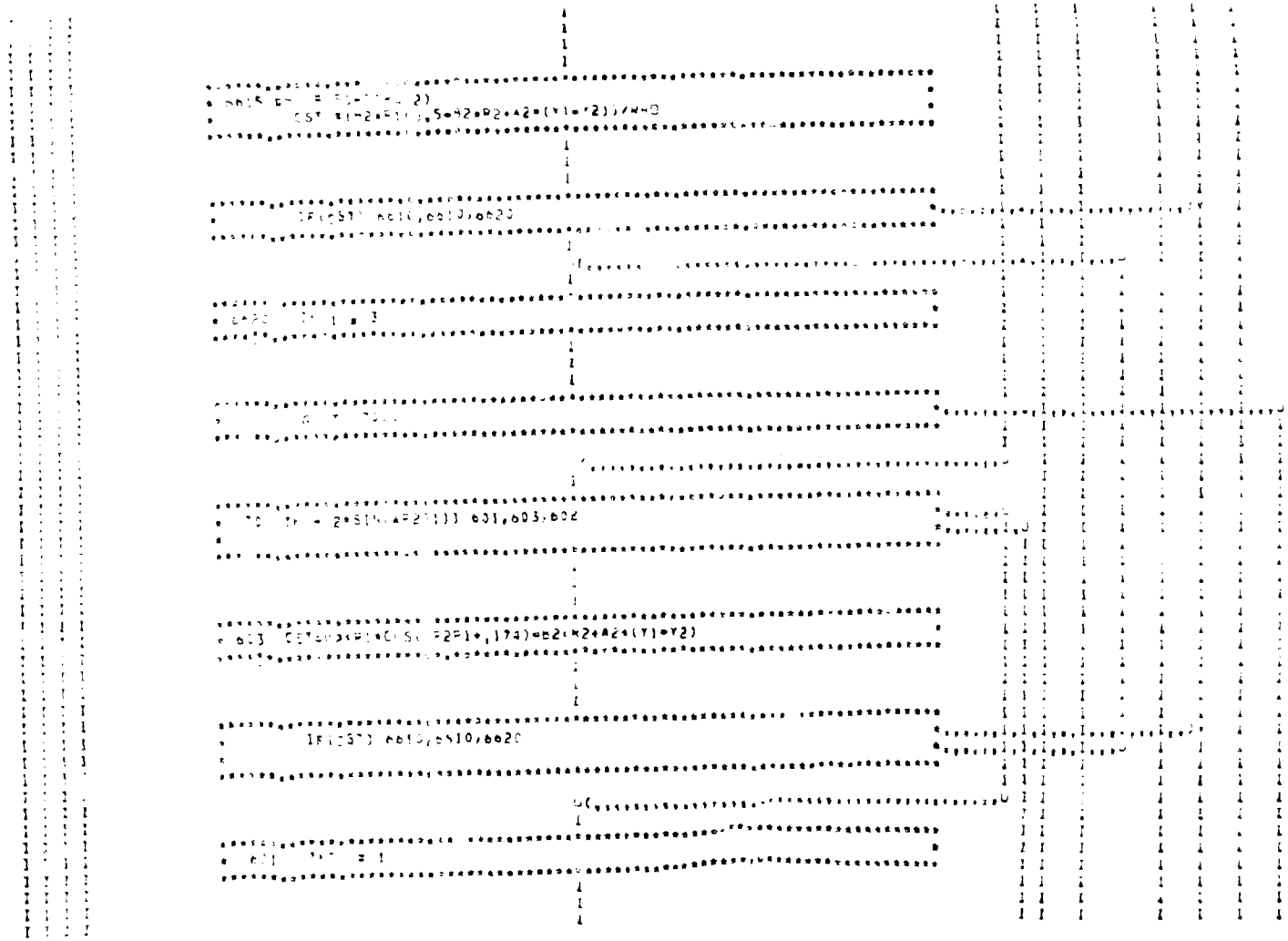

IF(J-1)65,65,50
55 JM1=J-1
DO 60 K=1,JM1
X1(I)=XC(K)
Y1(I)=YC(K)
X2(I)=XC(K+1)
Y2(I)=YC(K+1)
SUMF(I)=2
AD=.015
IF(YC(K).GE..015) AD=0.
YF(2,K)=XC(K)-AD
RF(2,K)=YC(K)-.015+AD
60 I=I+1
N=I-1
CALL IF(6,8011)
8011 FORMAT(//10X,27HCENTERBODY COORDINATES,IN,//)
NOP=1
IAP(1)=1
WRITE(6,8010) (X1(L),L=IAP1,N),X2(N)
WRITE(6,8010) (Y1(L),L=IAP1,N),Y2(N)
YF(2,J)=X2(N)-.015
RF(2,J)=Y2(N)-.015
NP(2)=J
IF(X2(N).GE.X2(1)) GO TO 90

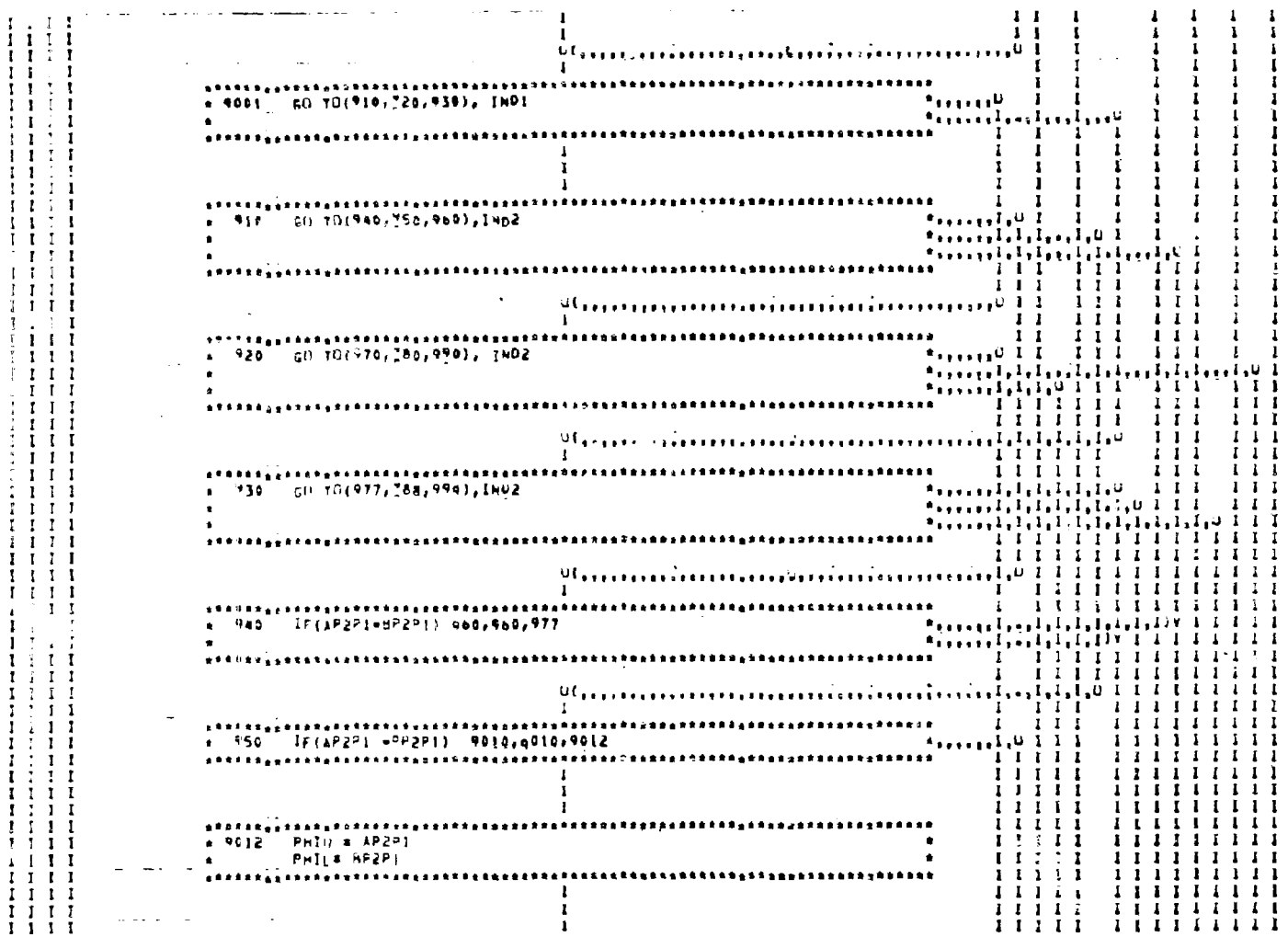

X1(1)=X2(N)
Y1(1)=Y2(N)
IF(I.GT.1) GO TO 65
X2(1)=X2(IA)
Y2(1)=Y2(IA)
65 X1(I)=X1(I-1)+.015
Y1(I)=Y1(I-1)
X2(I)=X2(IA-I)
Y2(I)=Y2(IA-I)
IF(I.GT.1) GO TO 85
X1(1)=0.
Y1(1)=0.
85 XF(2,I)=X1(I)+.015
YF(2,I)=X2(I)+.015
XF(1,I)=Y1(I)
YF(1,I)=Y2(I)
IS=IF(I)=2
NF(2)=J+1
20 I=I+1
Y2(I)=Y1(I)
Y1(I)=Y1(IA+1)
X2(I)=X1(I)
X1(I)=X1(IA+1)
IF(TH(I),EQ.BTS) TH(I)=TS
VEC(I)=1.
I=I+1
VEC(I)=1
X1(I)=X2(N-P)
Y1(I)=Y2(N-P)
X2(I)=X2(IA)
Y2(I)=Y2(IA)
TH(I)=TZ
TP=X2(N-P)
I=I+1

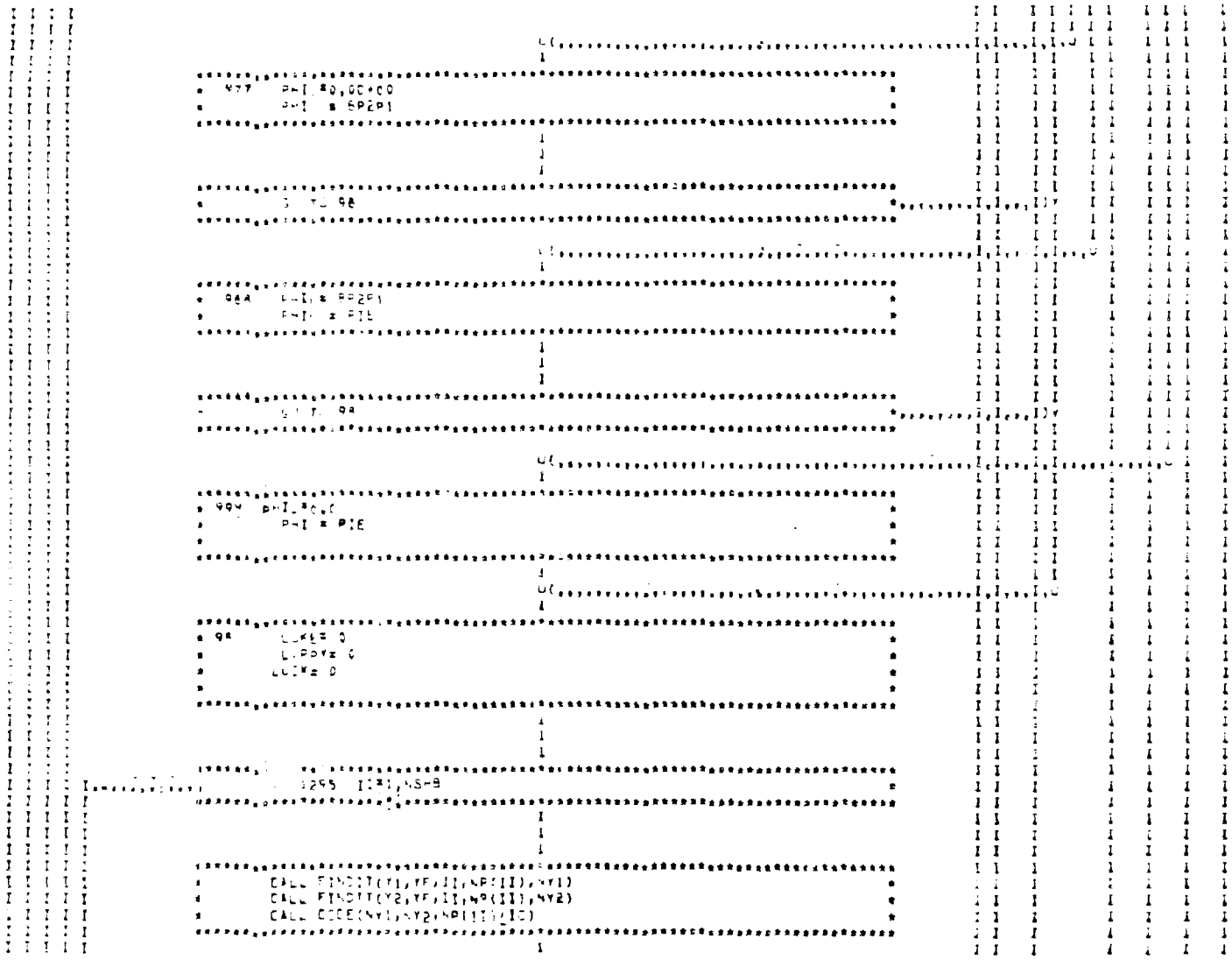

C VIEW FACTORS AND PROJECTED AREAS
NAS=1
IF(NAP.LT.9)GO TO 195
WRITE(6,9000)
STOP
9000 FORMAT(20(2H ,///5X,43HTOO MANY NODES IN EXHAUST SYSTEM DEFINITION
1 ///20(2H ,1)
195 IF(THA(NAS+1),GE.90.) GO TO 70
NAS=NAS+1
IF(NAS.NE.10) GO TO 195
70 CONTINUE
CALL VIEW(X1,Y1,X2,Y2,VECT,NODE,NTOT1,YF,RF,NP,NNN,F,
1 AREA,1)
CALL SHADOW(NNN,NP,YF,RF,NF,YFA,YFB,RFA,RFB)
CALL RADII(X1,Y1,X2,Y2,VECT,NTOT1,NP,RFA,RFB,YFA,YFB,NODE,
1 TPL,NAS,NNN,THA,1,PE)
RETURN

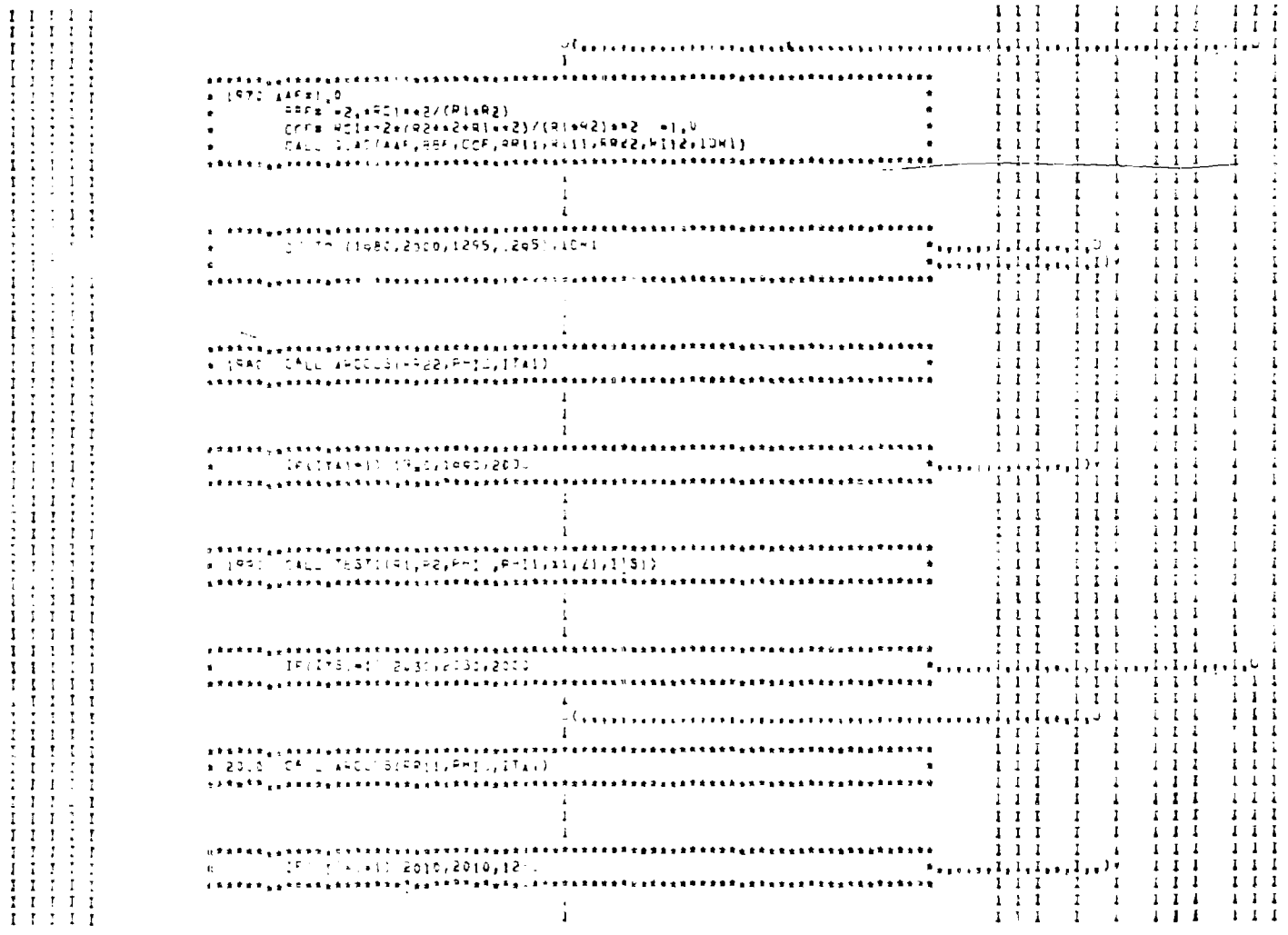

(ENTRANCE)
SUBROUTINE VIEW(YUA,RUA,YDA,RDA,VECTA,NUDEA,NTOT,YF,RF,NP,NSHP,
1FFSR,ARE),PRINT8)
DIMENSION NP(2),YF(2,5),RF(2,5),
* PHIM(5),PHED(5),PHICU(5),PHILL(5),PHIS(5),PHAM(5),
* PHIL(5 PHIUU(5),PHIMA(5),PHAMA(5),F(2,2),
* FFSR(8,8),ARE1(1)
DIMENSION YUA(1),YDA(1),RUA(1),RDA(1),VECTA(1),NUDEA(1),
* A(2),DIV(2)
DIMENSION YU(2),YD(2),RU(2),RD(2),VECT(2),NUDE(2)
EQUIVALENCE(II,JJ)
DATA PIE/3,1415926538/
PI=.4873
15020 LIMIT=4
DO 10000 IUI=1,NTOT
YU(1)=YUA(IUI)
YD(1)=YDA(IUI)
RU(1)=RUA(IUI)
RD(1)=RDA(IUI)
VECT(1)=VECTA(IUI)
NUDE(1)= EA(IUI)
15 J=1
A1=SQRT((YD(J)-YU(J))**2 + (RU(J)-RU(J))**2)
A(J) = PIE*(RU(J) +RD(J))*A1
= -(YD(J)-YU(J))/A1
= (RD(J)-RU(J))/A1
IF(VECT(J)) 20,30,30
20 B1 = -B1
A1= -A1

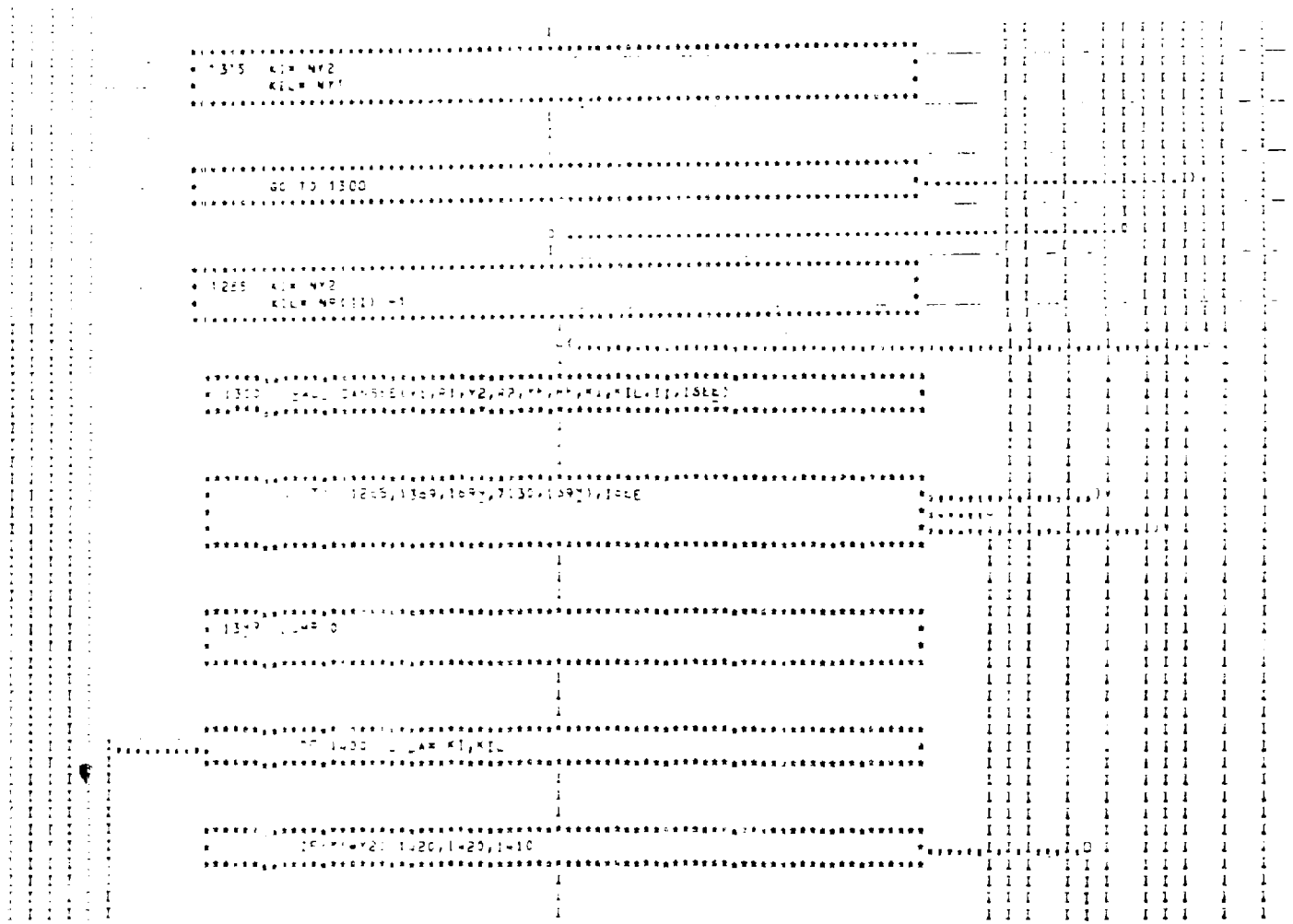

30 IF(YD(J) -YU(J)) 32,34,32
32 E1 =(RU(J)*YU(J)-RU(J)*YU(J))/(YD(J)*YU(J))
M1 = (RD(J)-RU(J))/(YD(J)-YU(J))
34 CONTINUE
DO 1500 JUJ=IUI,NTOT
DIV(1)=A1.0
DIV(2)=A1.0
YU(1)=YUA(JUJ)
YU(2)=YDA(JUJ)
RU(2)=RUA(JUJ)
RD(2)=RDA(JUJ)
VECT(P)=VECTA(JUJ)
NODE(P)=NODEA(JUJ)
361 K=2
A2=SQRT((YD(K)-YU(K))**2 + (RU(K)-RU(K))**2)
A(P) = PIE*(RU(K)+RD(K))*A2
R2 =(YD(K)+YU(K))/A2
A2= -(RD(K)-RU(K))/A2
IF(VECT(K))40,50,50
40 R2= -R2
A2= -A2

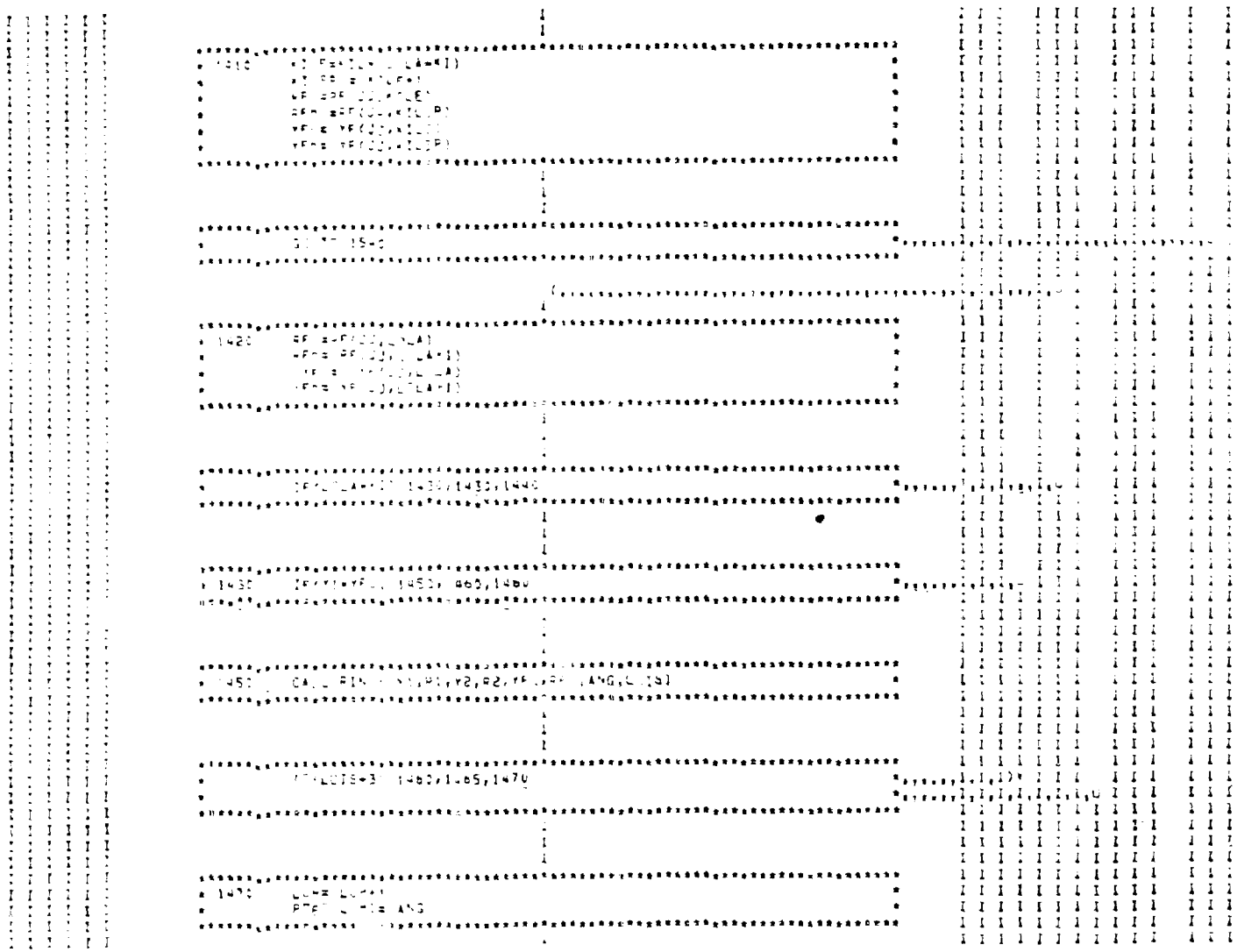


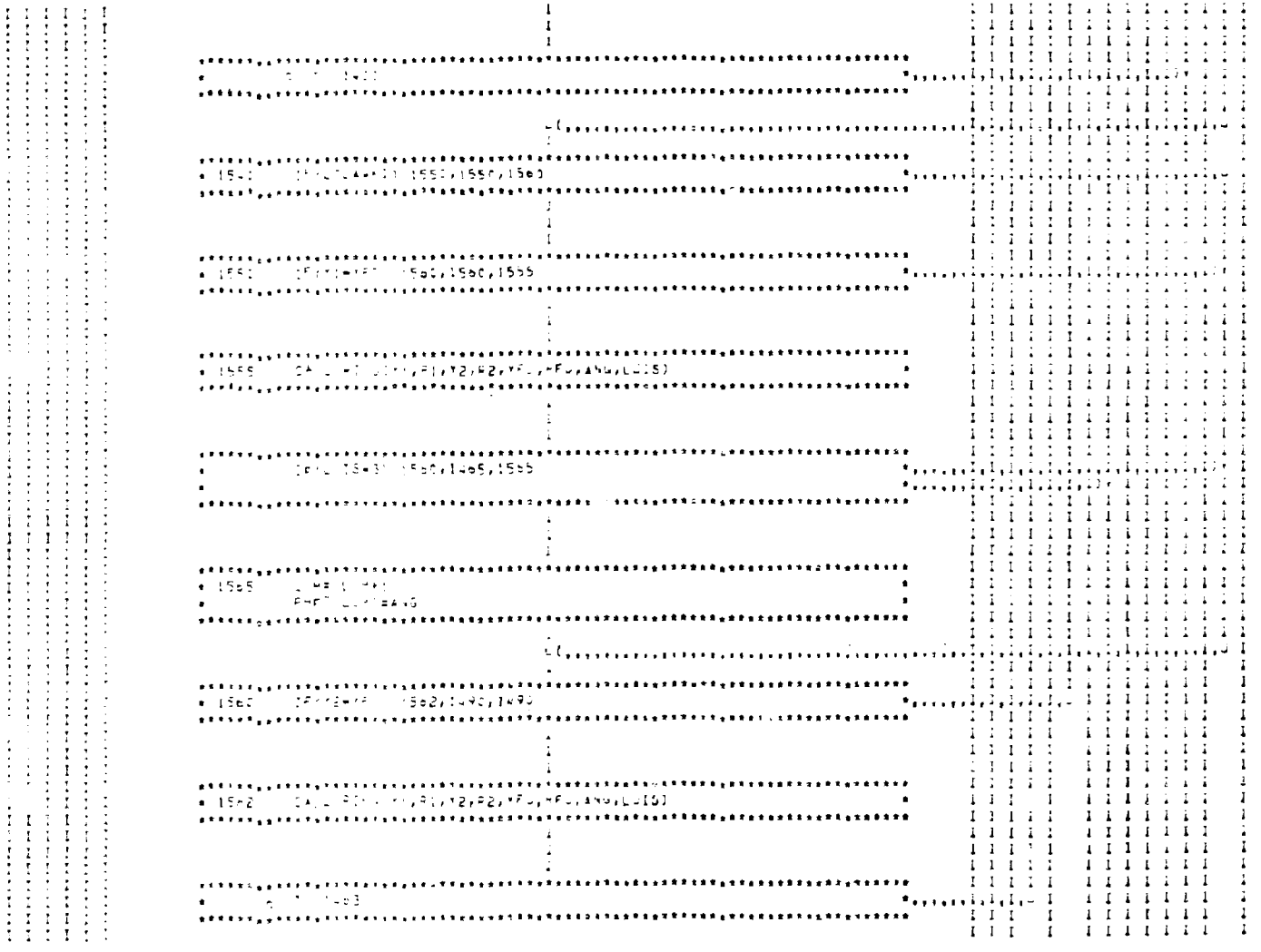

4001 GO TO(910,920,930), IND1
915 GO TO(940,950,960),IND2
920 GO TO(970,980,990), IND2
930 GO TO(977,988,999),IND2
940 IF(AP2P1-BP2P1) 960,960,977
950 IF(AP2P1 -BP2P1) 9010,9010,9012
9012 PHIU = AP2P1
PHIL= BP2P1

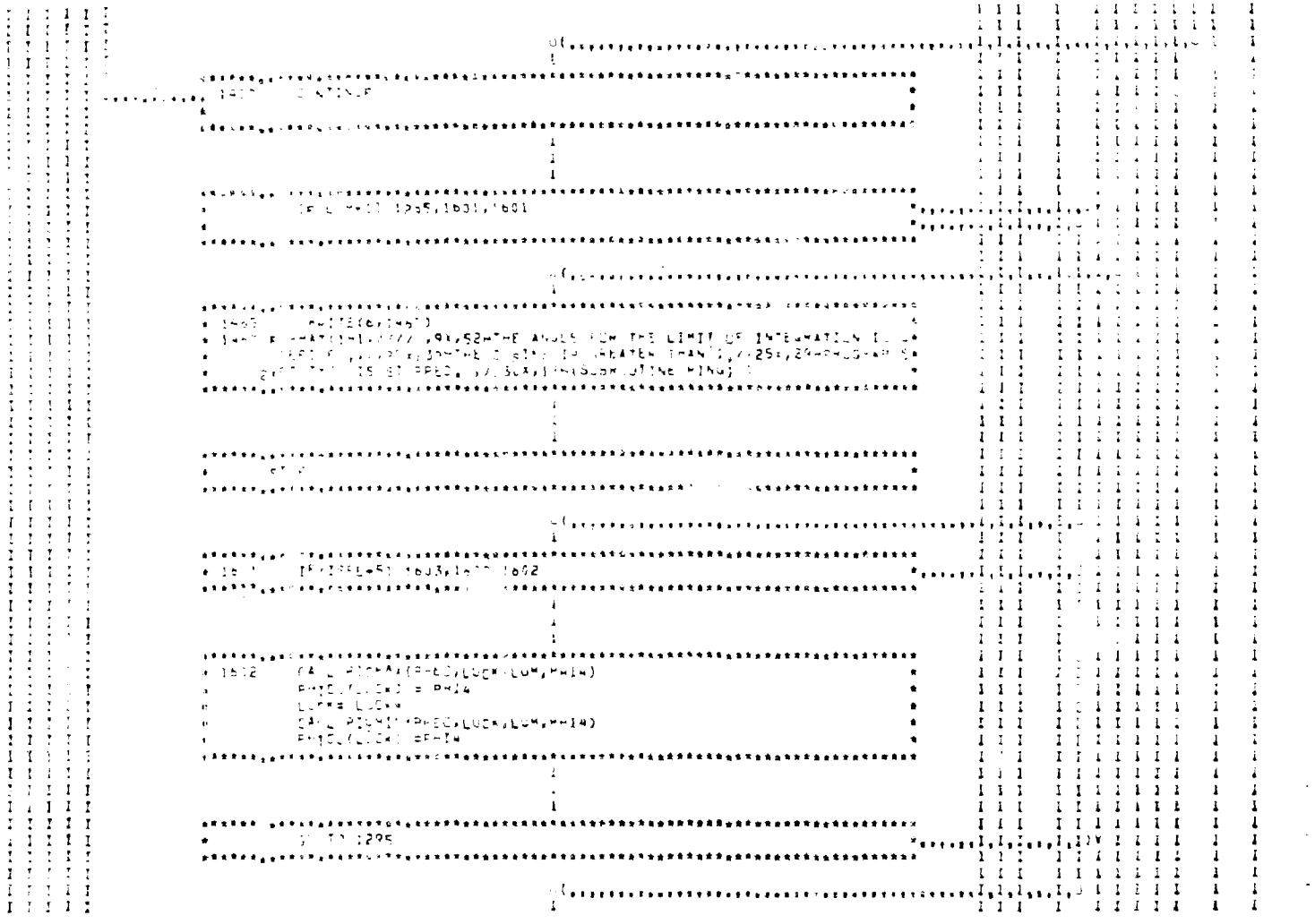


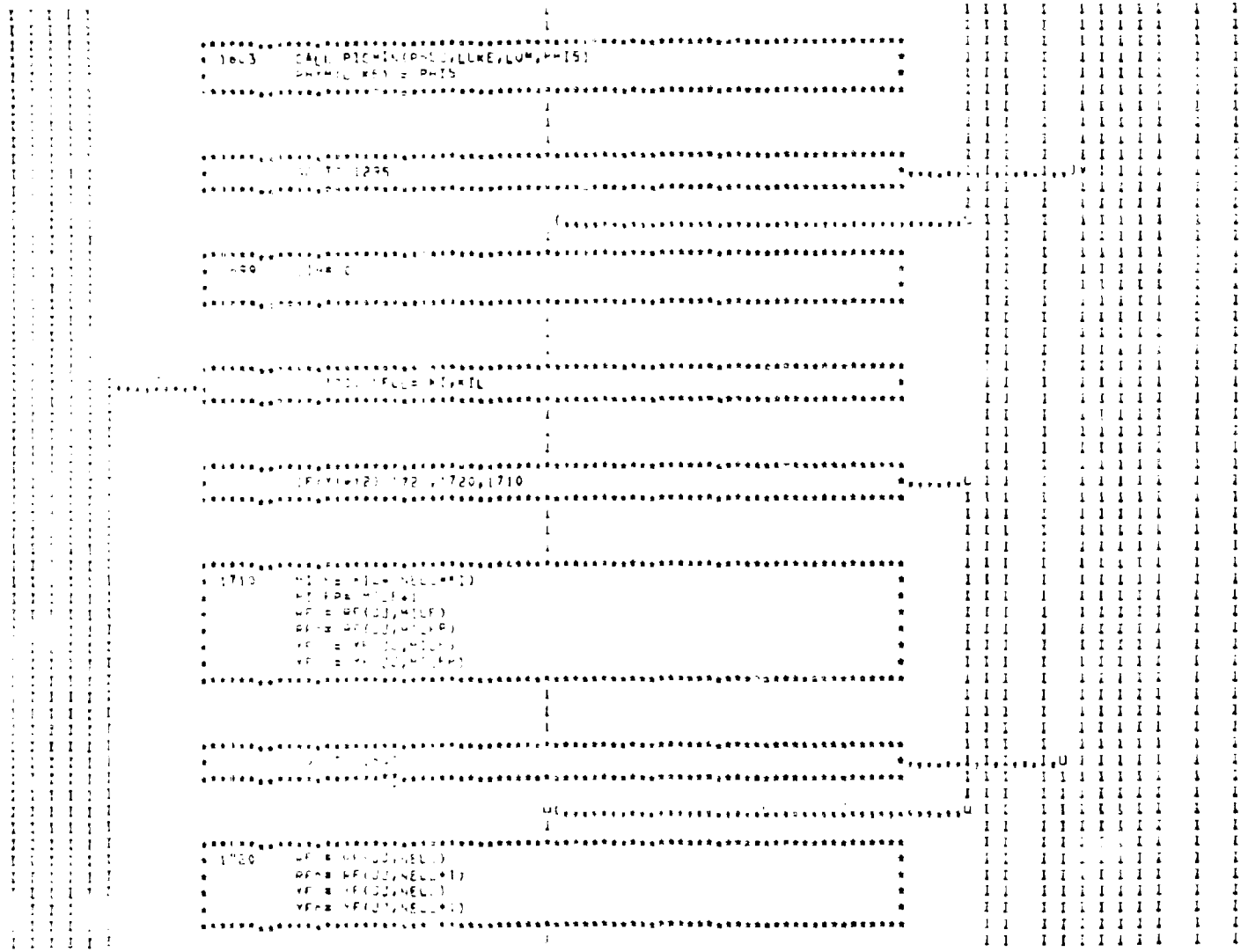


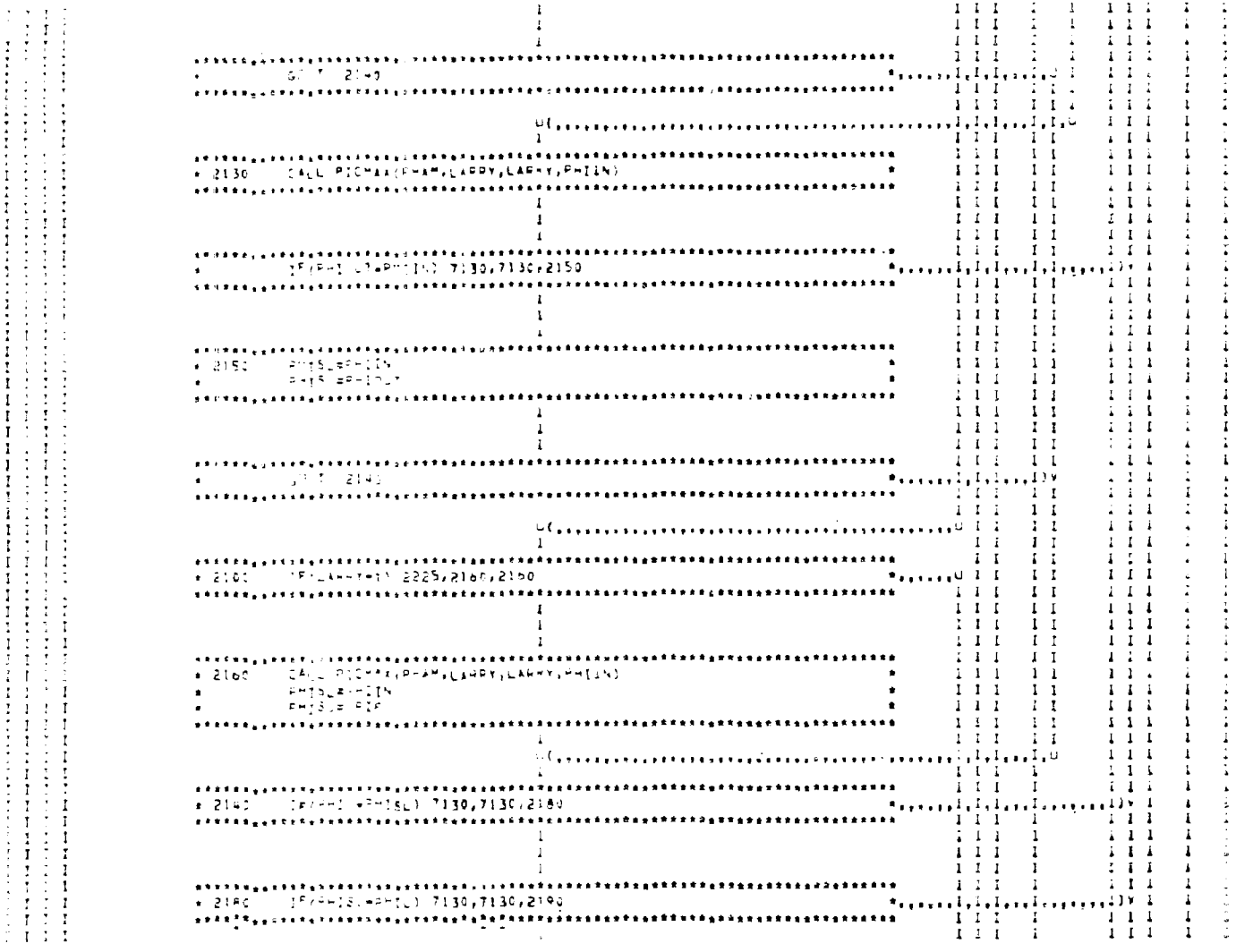


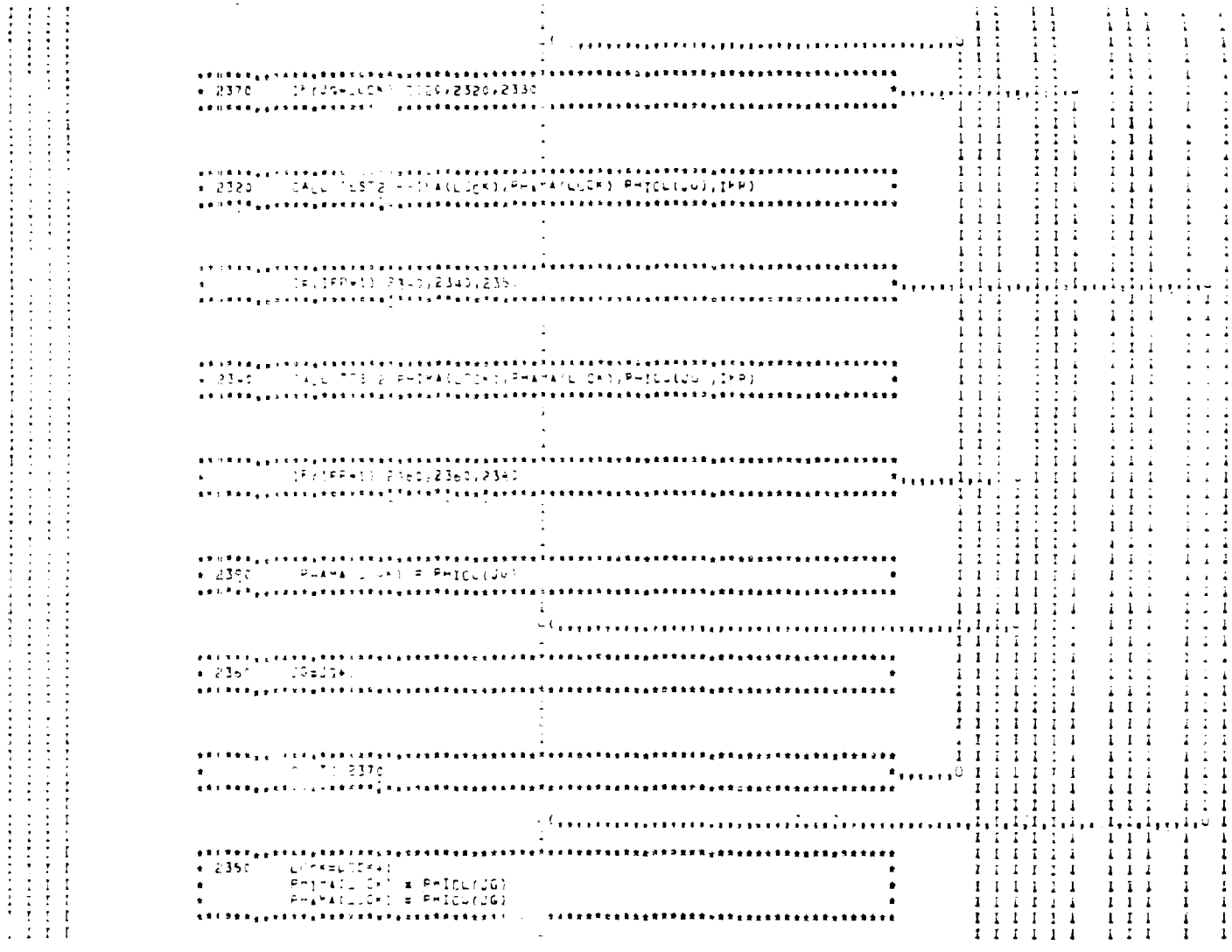


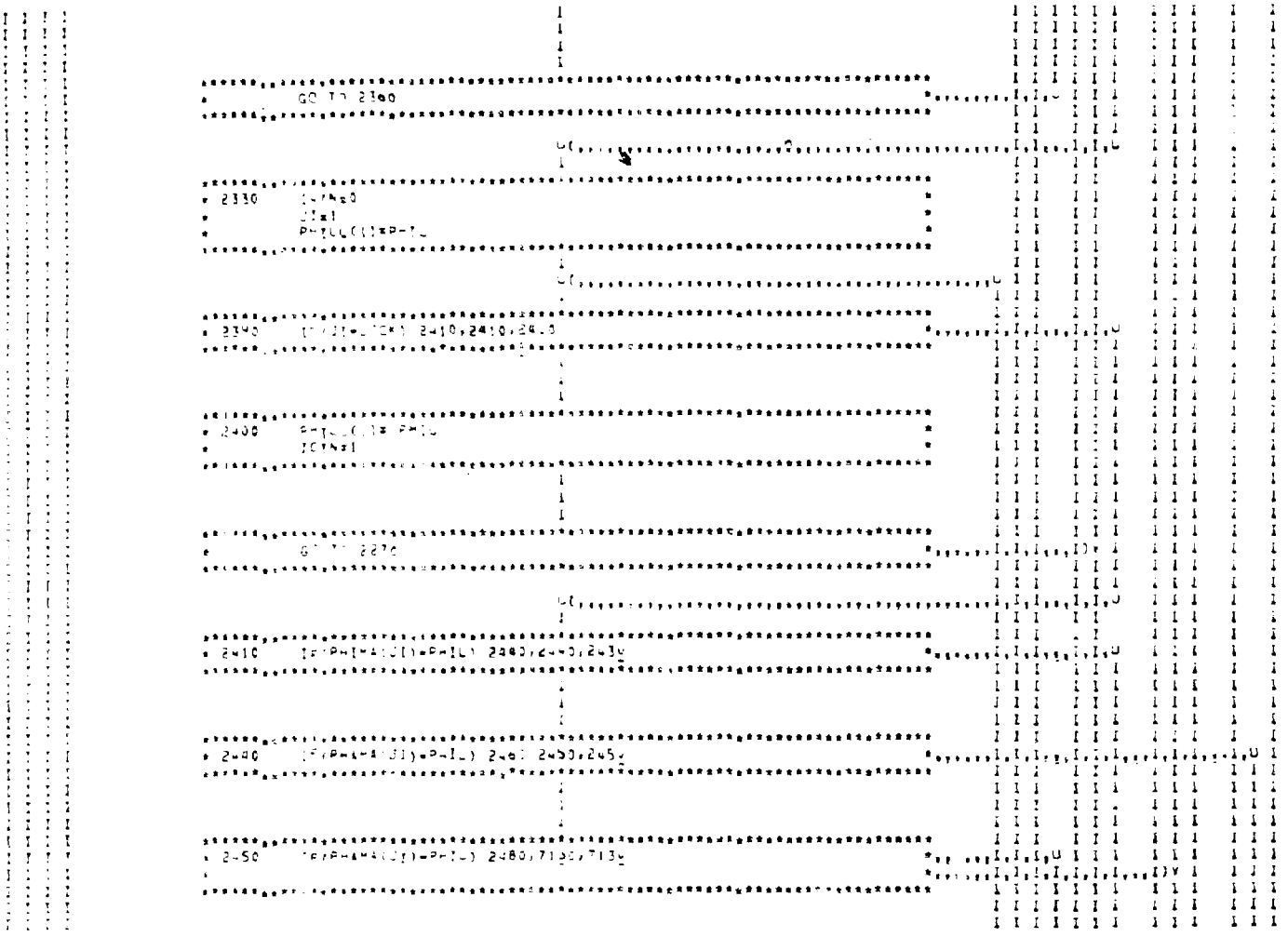


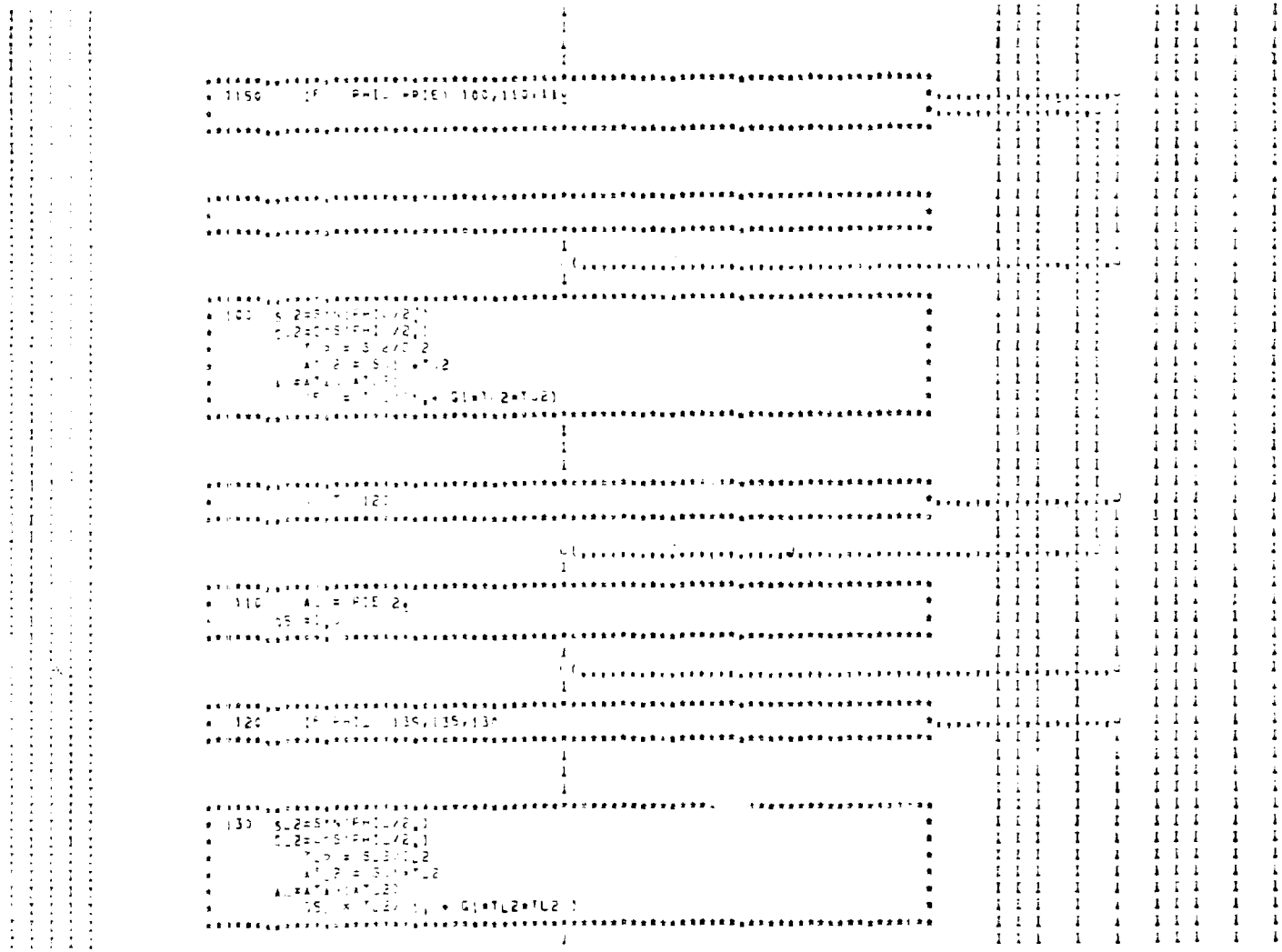




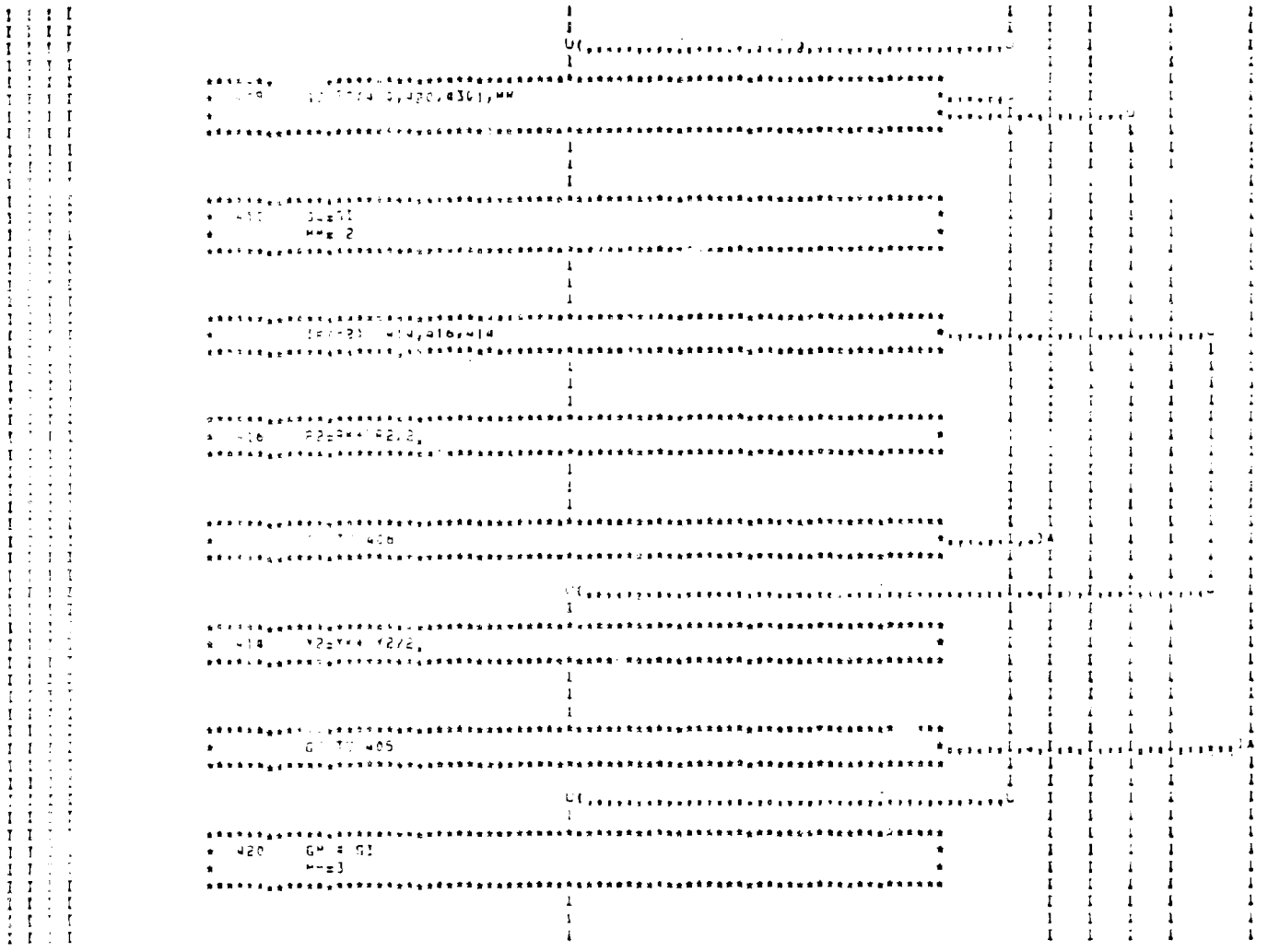


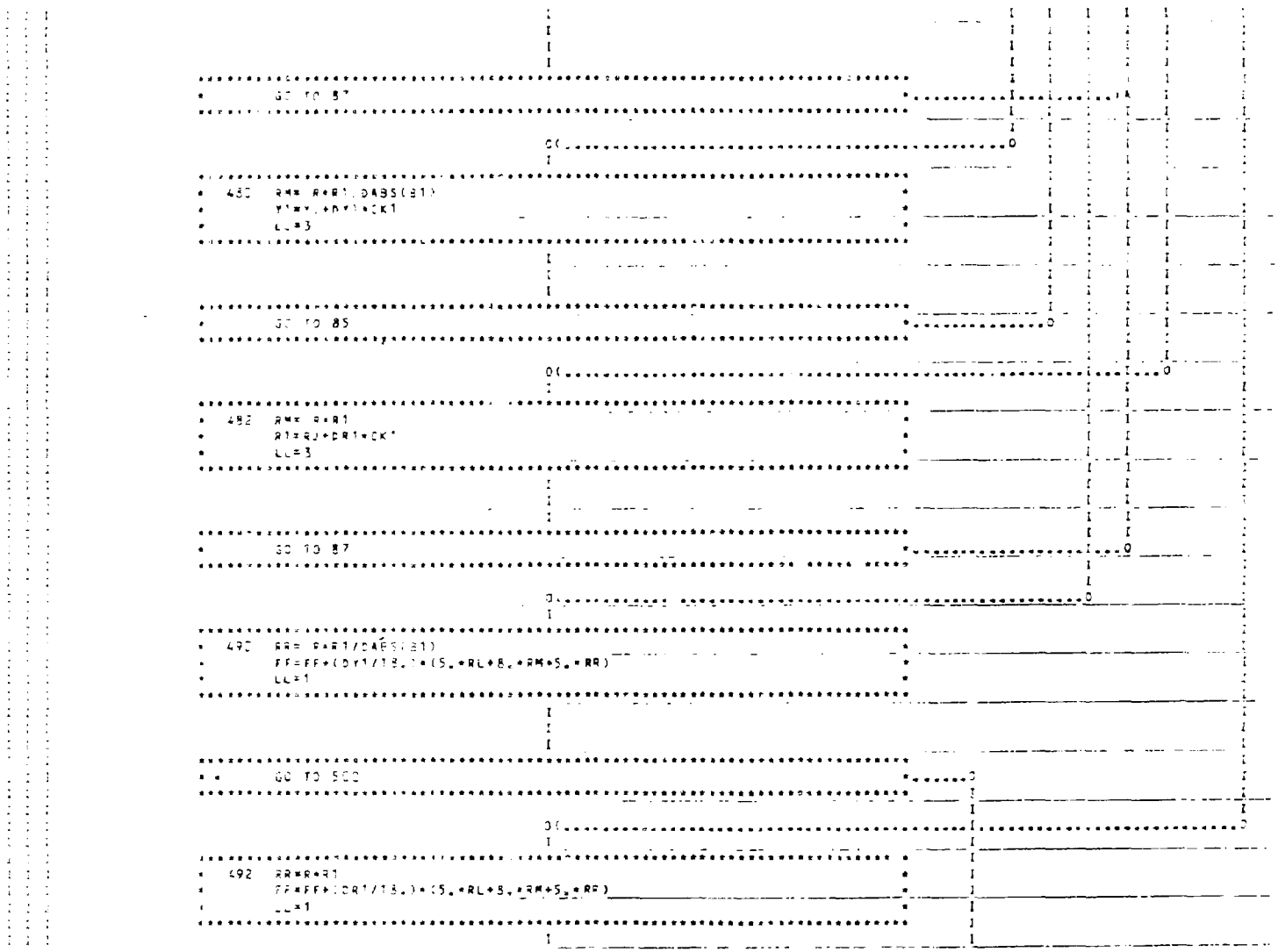




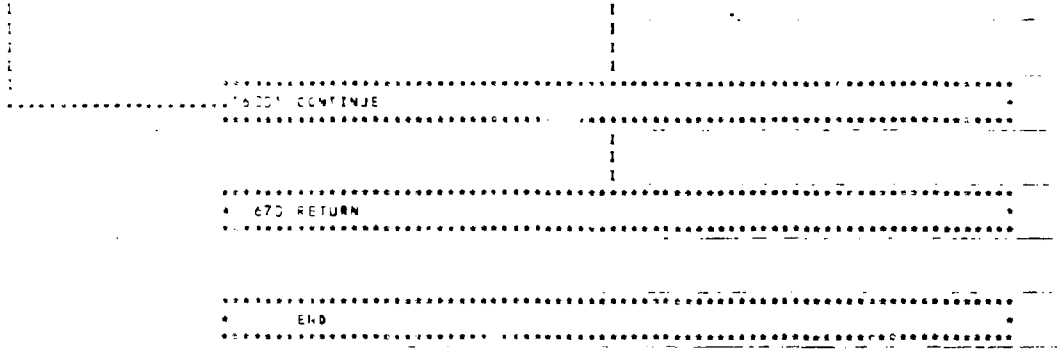


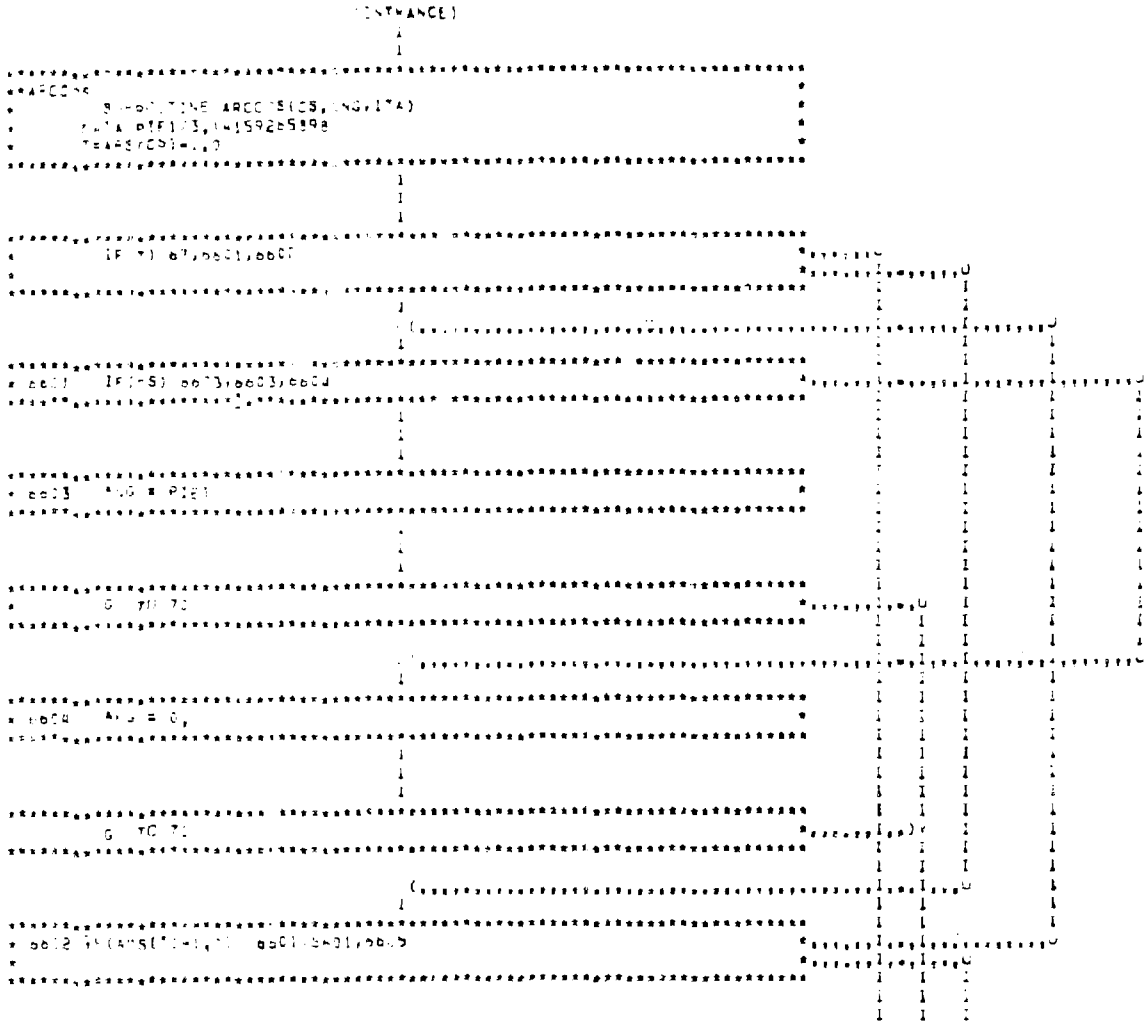
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C
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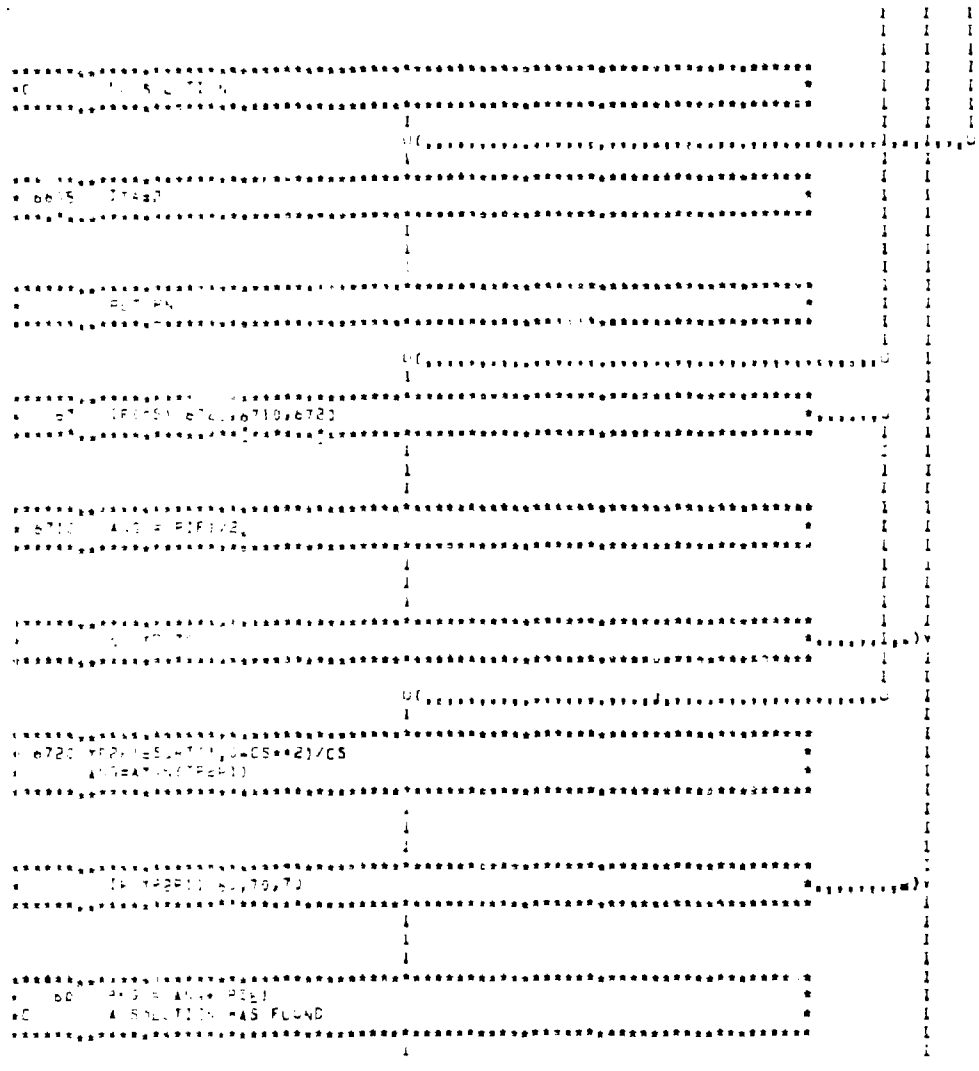


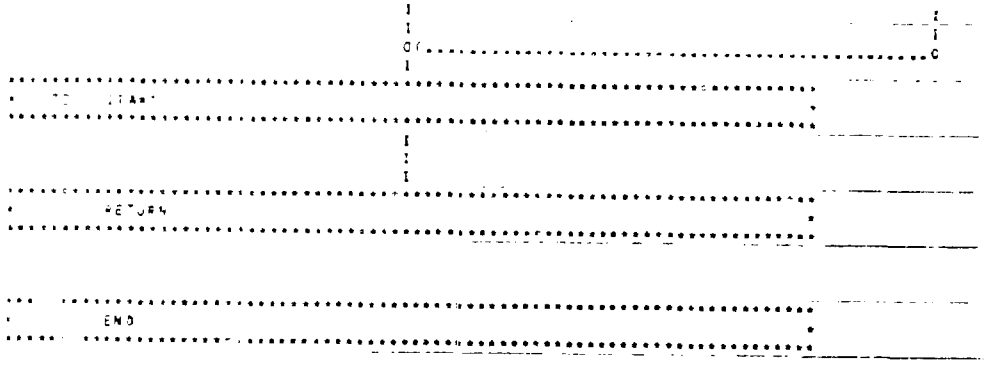

GO TO 87
480 RM=R*R1/DABS(B1)
Y1=Y1+DY1*CK1
LL=3
GO TO 85
482 RM=R*R1
R1=RJ+DR1*CK*
LL=3
GO TO 87
490 RR=R*R1/DABS(B1)
FF=FF+(DY1/18.)*(5.*RL+8.*RM+5.*RR)
LL=1
GO TO 500
492 RR=R*R1
FF=FF+(DR1/18.)*(5.*RL+8.*RM+5.*RR)
LL=1

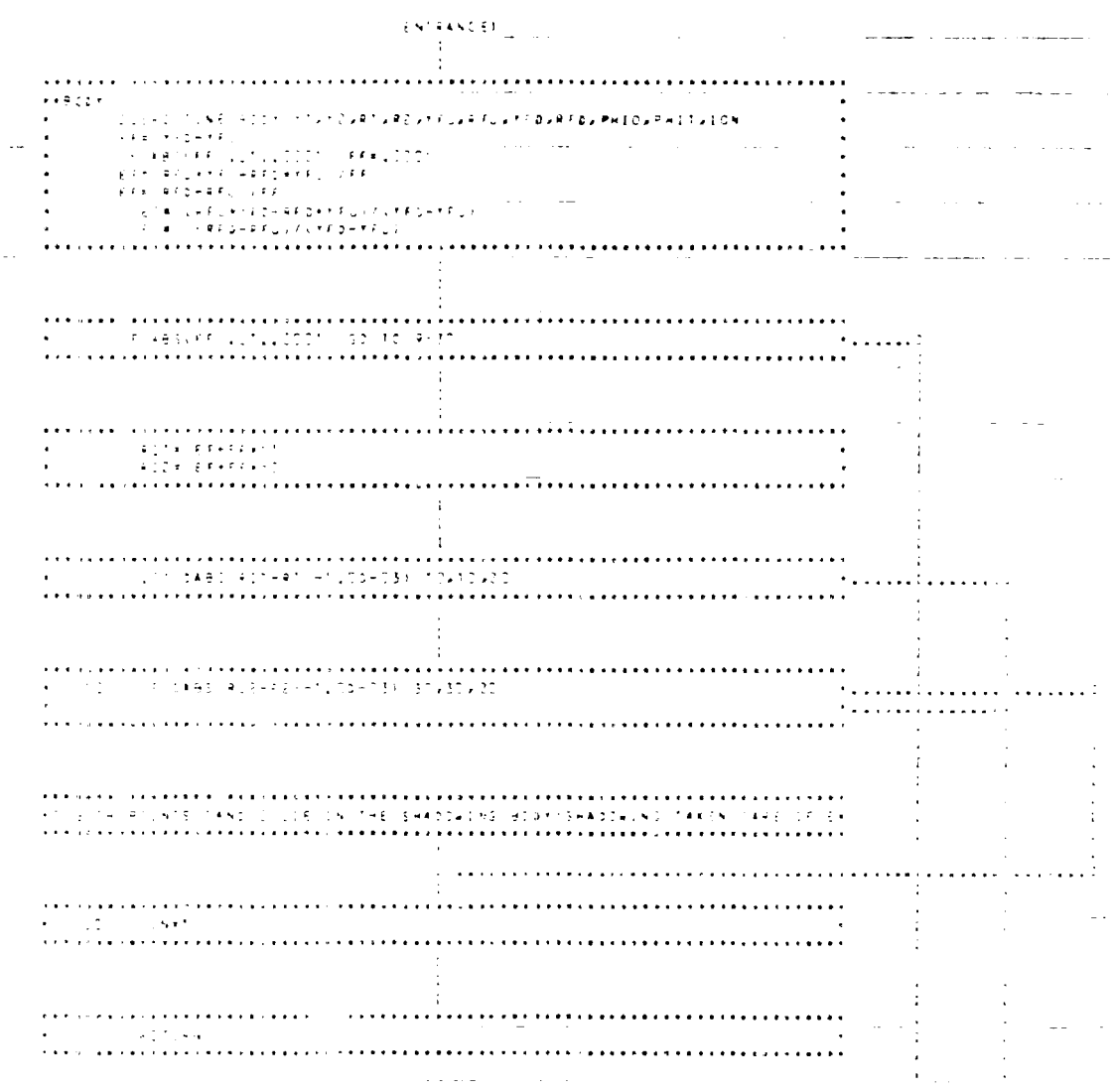

500 CONTINUE
600 F(J,K)= FF*2.*PIE/A(J)
F(K,J)= F(J,K)*A(J)/A(K)
641 IF(F(J,K) .LT. 1.00+00) F(J,K)=0.00+00
IF(F(K,J) .LT. 1.00+00) F(K,J)=0.00+00
NOD1=NODE(J)
NOD2=NODE(K)
FFSP(NOD1,NOD2)=F(J,K)
FFSP(NOD2,NOD1)=F(K,J)
15000 CONTINUE
ARE(NOD1 = A(J)/144.0
16000 CONTINUE
WRITE(6,1502)
1502 FORMAT(//26X,28HSYSTEM INTERNAL VIEW FACTORS//)
DO 16001 I=1,NTOT
DO 16000 J=1,NTOT
16004 WRITE(6,650) I,J,FFSP(I,J),J,I,FFSP(J,I)
650 FORMAT(18X,2HF(,I2,1H,,I2,3H)= ,F7.5,10X,2HF(,I2,1H,,I2,3H)= ,F7.5
16000 CONTINUE
LINE1=LINE1+1
ARE2=ARE1(I)*144.0
WRITE(6,15005) I,ARE2
15005 FORMAT(28X,5HAREA(,I2,3H)= ,F7.2,8H SQ. IN.,///)
LINE1=LINE1+2


6000 CONTINUE
* 670 RETURN
* END

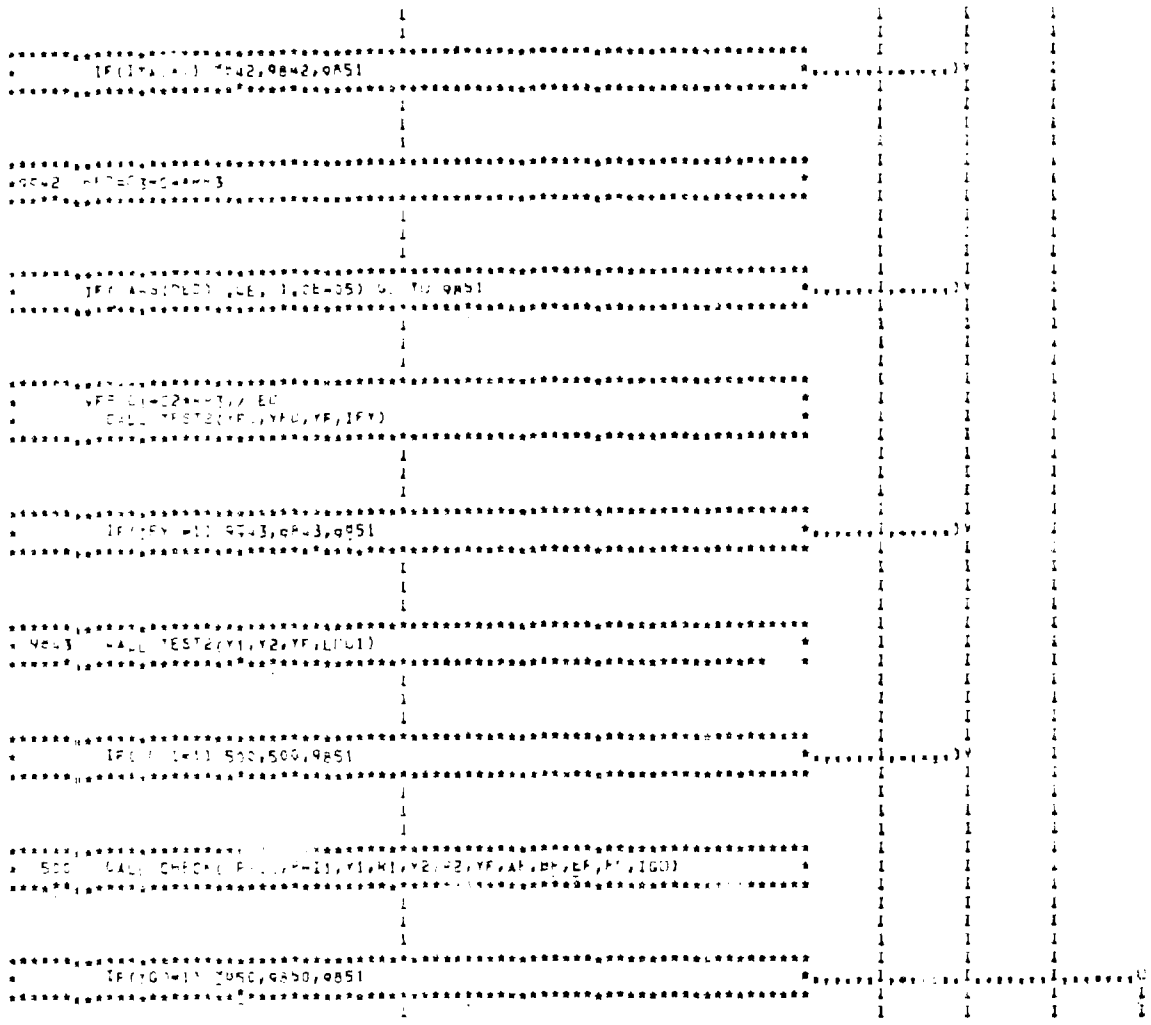

(ENTRANCE)

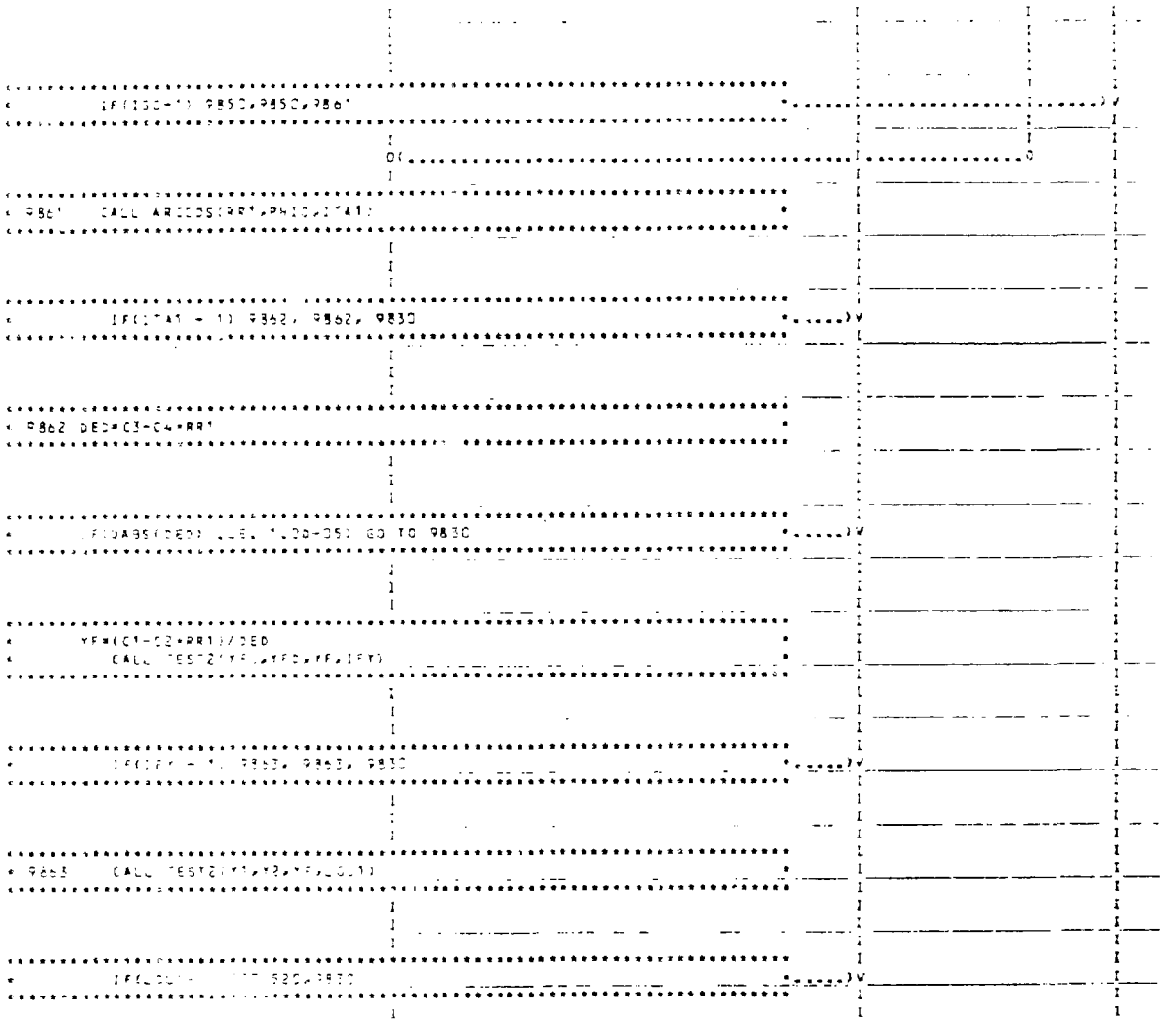


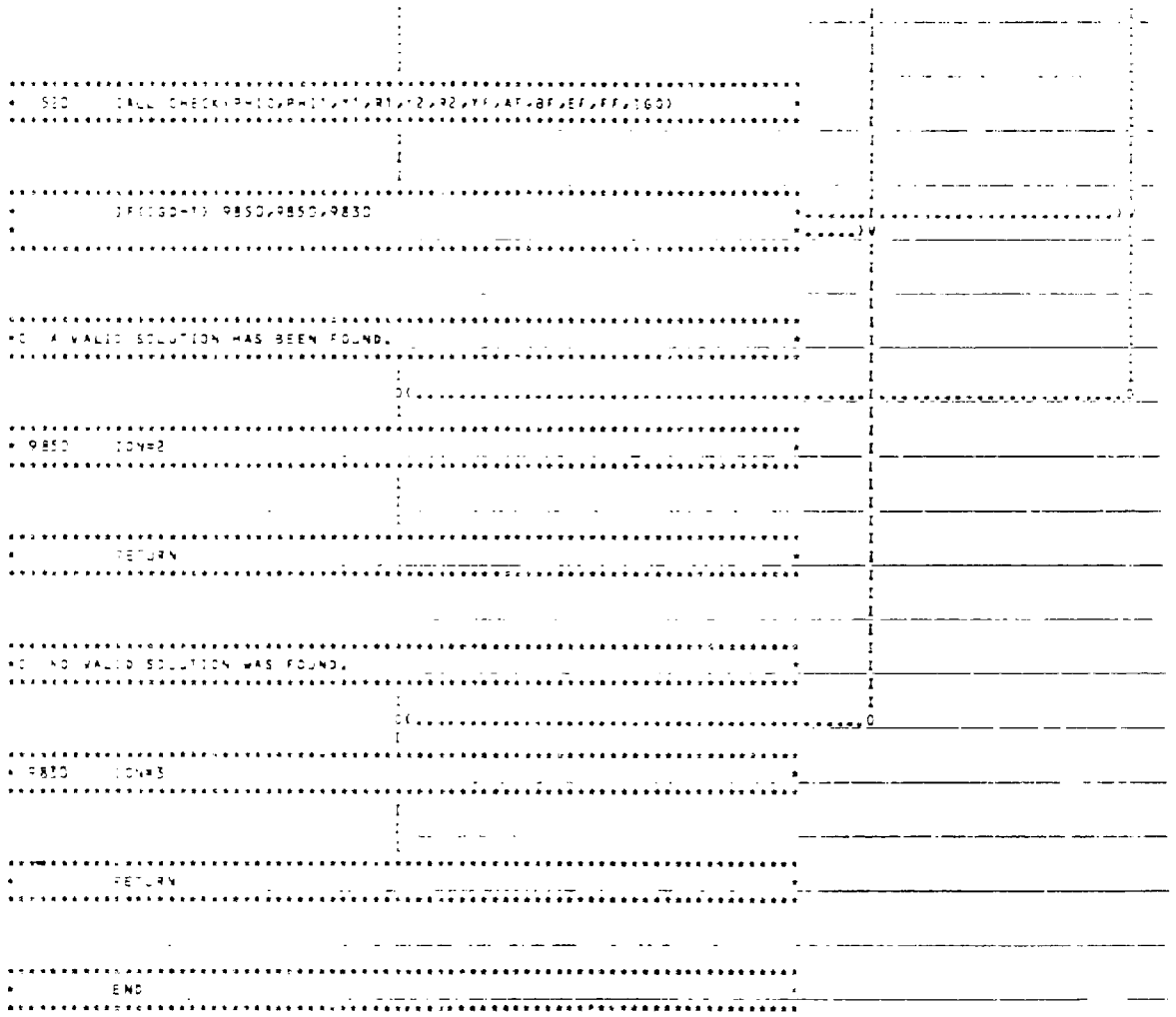

RETURN
END

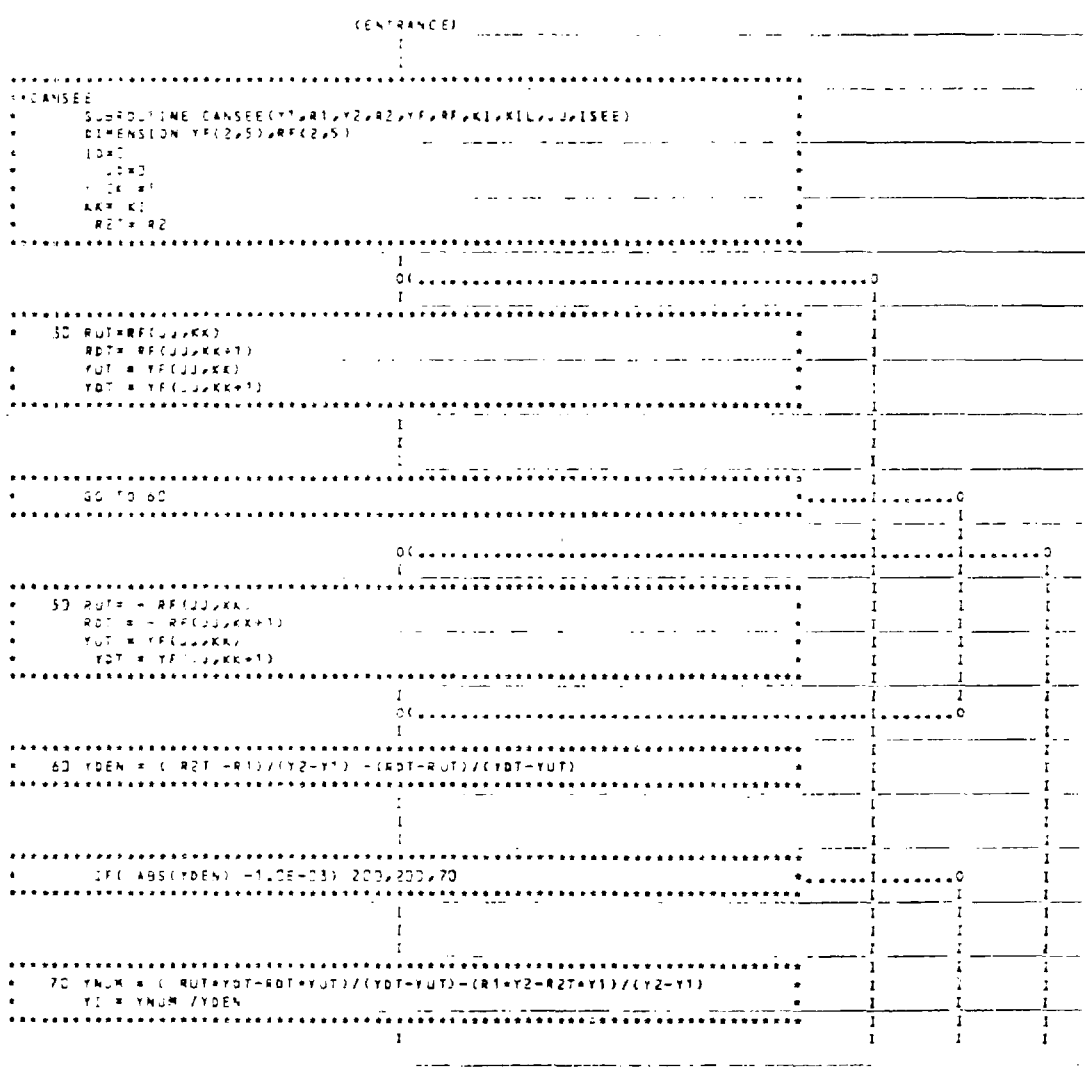

ENTRANCE

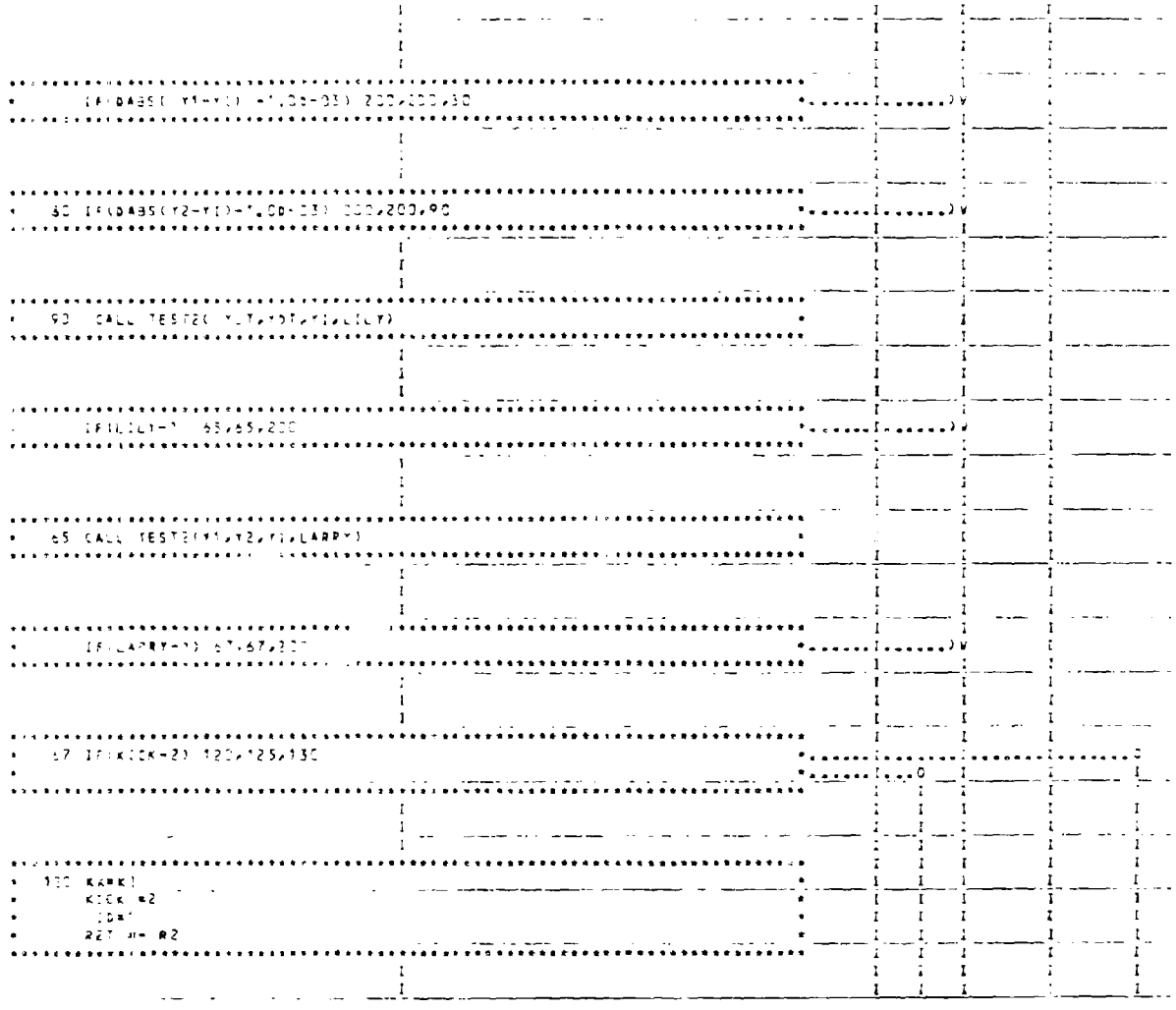


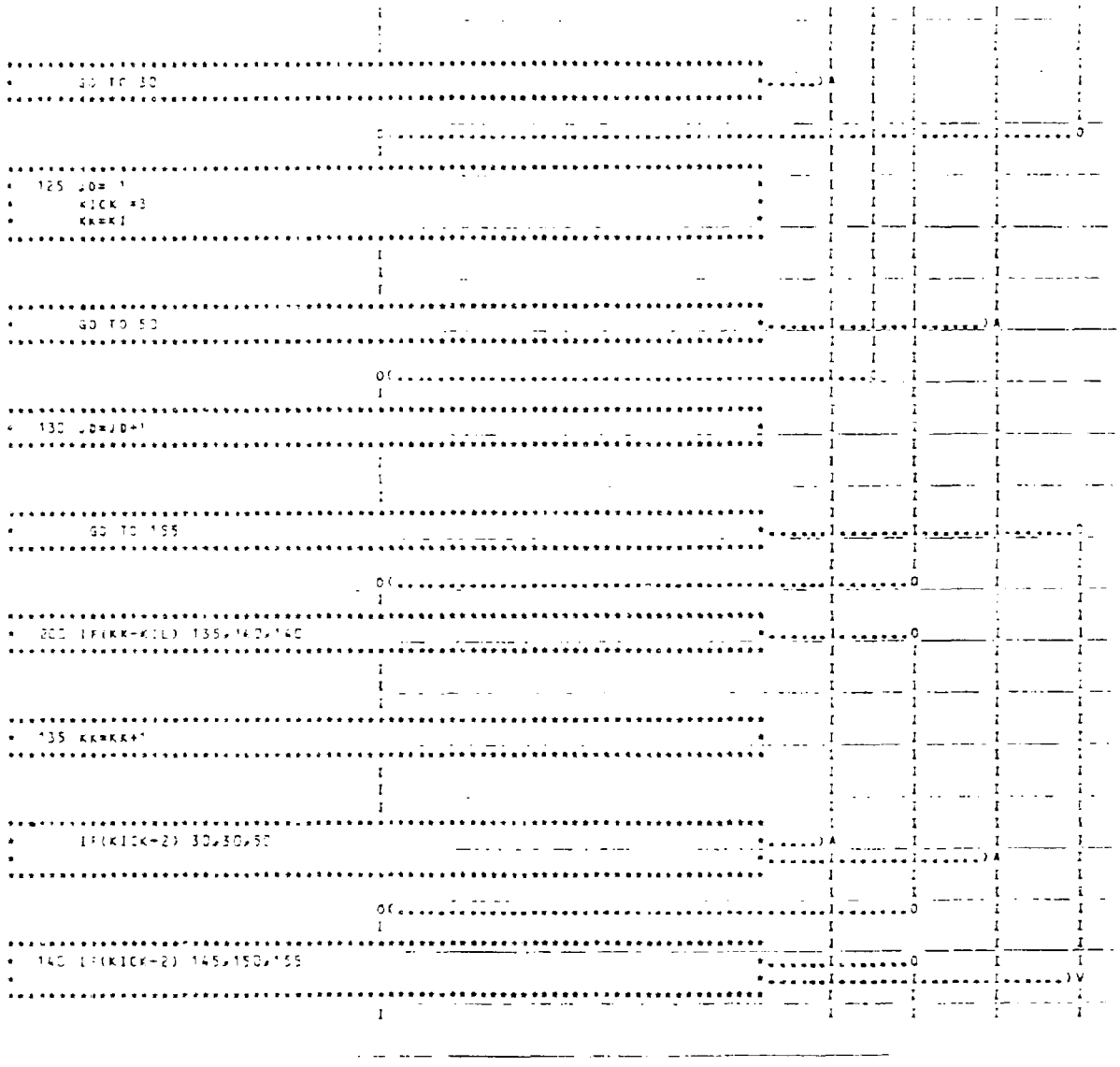


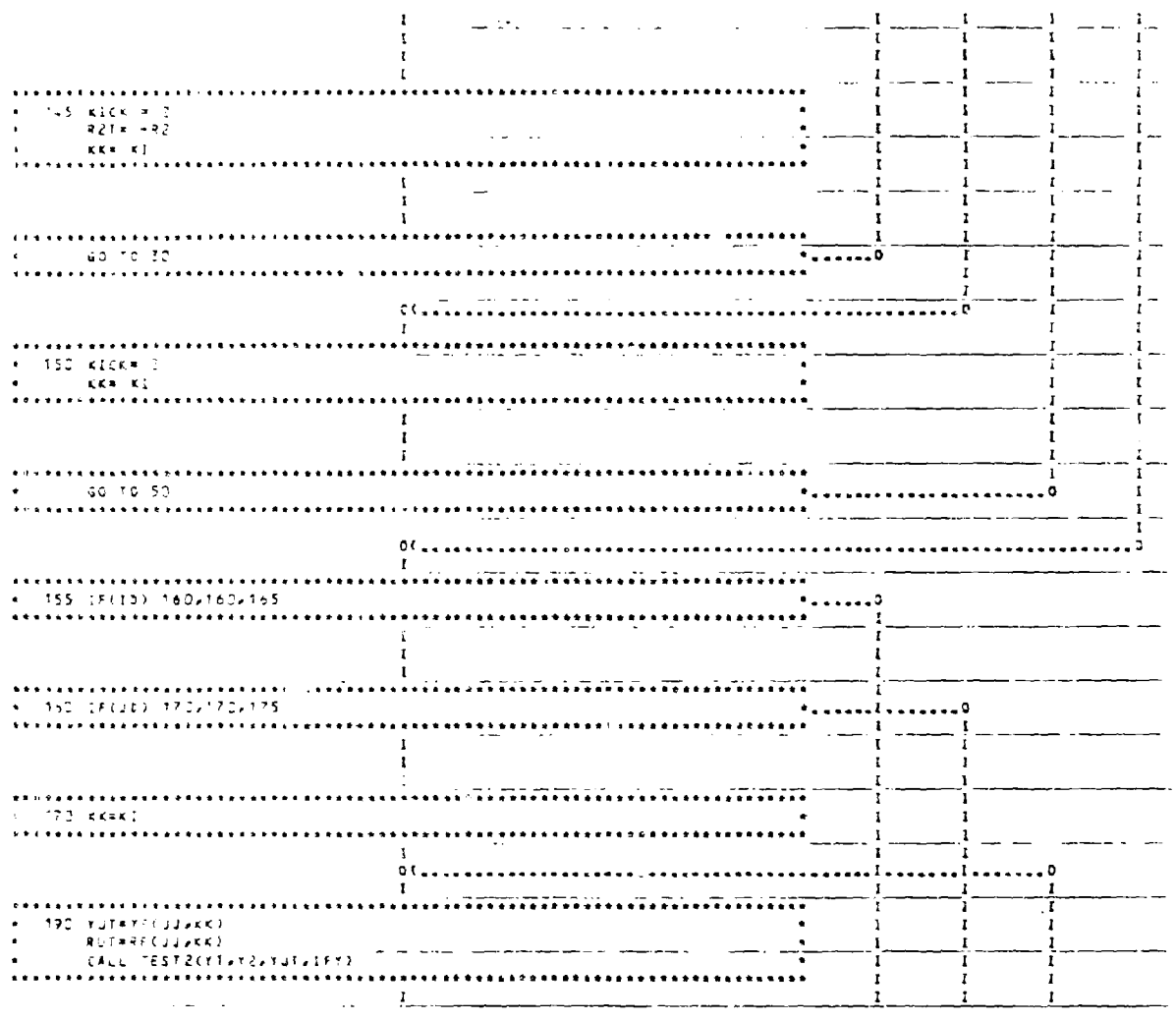

IF(ISC-1) 9850,9850,9860
9861 CALL ARCOS(RR1,PHIC,ITA1)
IF(ITA1 - 1) 9862, 9862, 9830
9862 DED=C3-C4*RR1
IF(DABS(DED) .LE. 1.0D-05) GO TO 9830
YR=(C1-C2*RR1)/DED
CALL TEST2(YR,YRO,YF,IFY)
IF(IFY - 1) 9863, 9863, 9830
9863 CALL TEST2(Y1,Y2,YF,ICL)

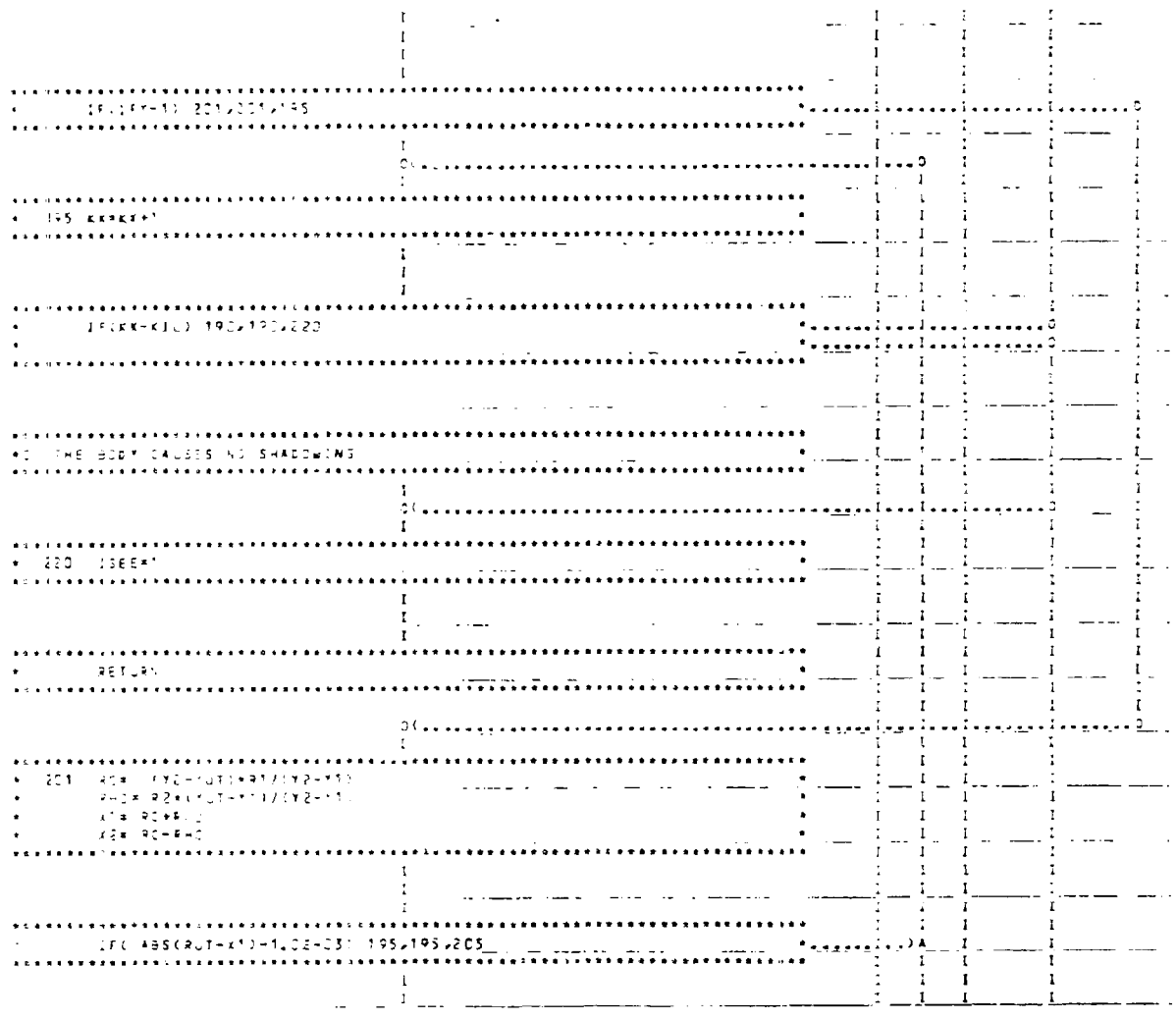

SIC CALL CHECK(PHI,PHI1,Y1,R1,I2,R2,YY,AF-8F,EF,FF,IGO)
IF(IGO-1) 9850,9850,9830
C A VALID SOLUTION HAS BEEN FOUND.
9850 IOK=2
RETURN
C NO VALID SOLUTION WAS FOUND.
9830 IOK=3
RETURN
END

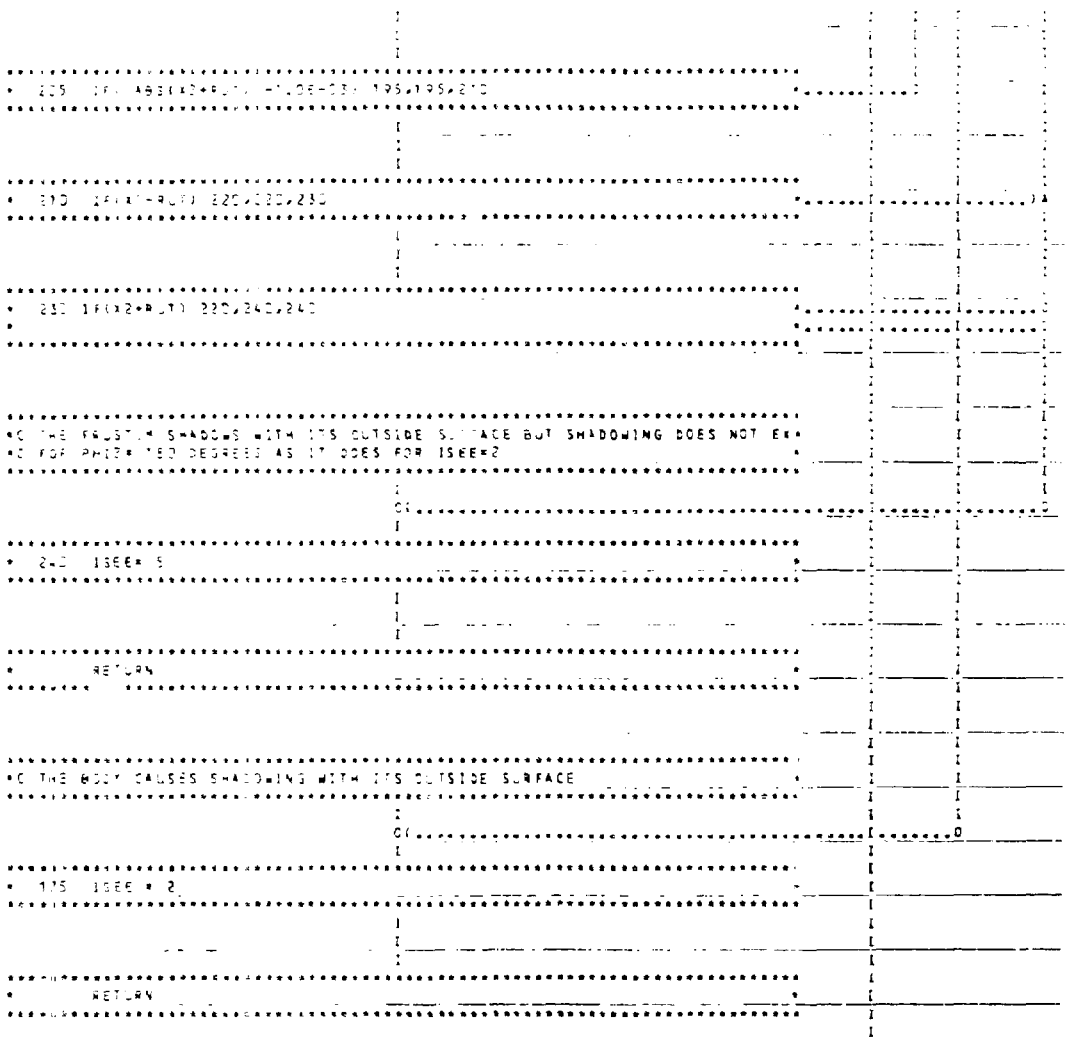

(ENTRANCE)
C*CANSEE
SUBROUTINE CANSEE(Y1,R1,Y2,R2,YF,RF,K1,K1L,JJ,ISEE)
DIMENSION YF(2,5),RF(2,5)
ISEE=0
JJ=J
K1=1
KK=K1
R2T=R2
DO RUT=RF(JJ,KK)
RDT=RF(JJ,KK+1)
YUT=YF(JJ,KK)
YDT=YF(JJ,KK+1)
GO TO 60
DO RUT=-RF(JJ,KK)
RDT=-RF(JJ,KK+1)
YUT=YF(JJ,KK)
YDT=YF(JJ,KK+1)
60 YDEN=(R2T-R1)/(Y2-Y1)-(RDT-RUT)/(YDT-YUT)
IF(ABS(YDEN)-1.0E-03) 200,200,70
70 YNUM=(RUT*YDT-RDT*YUT)/(YDT-YUT)-(R1*Y2-R2T*Y1)/(Y2-Y1)
YI=YNUM/YDEN

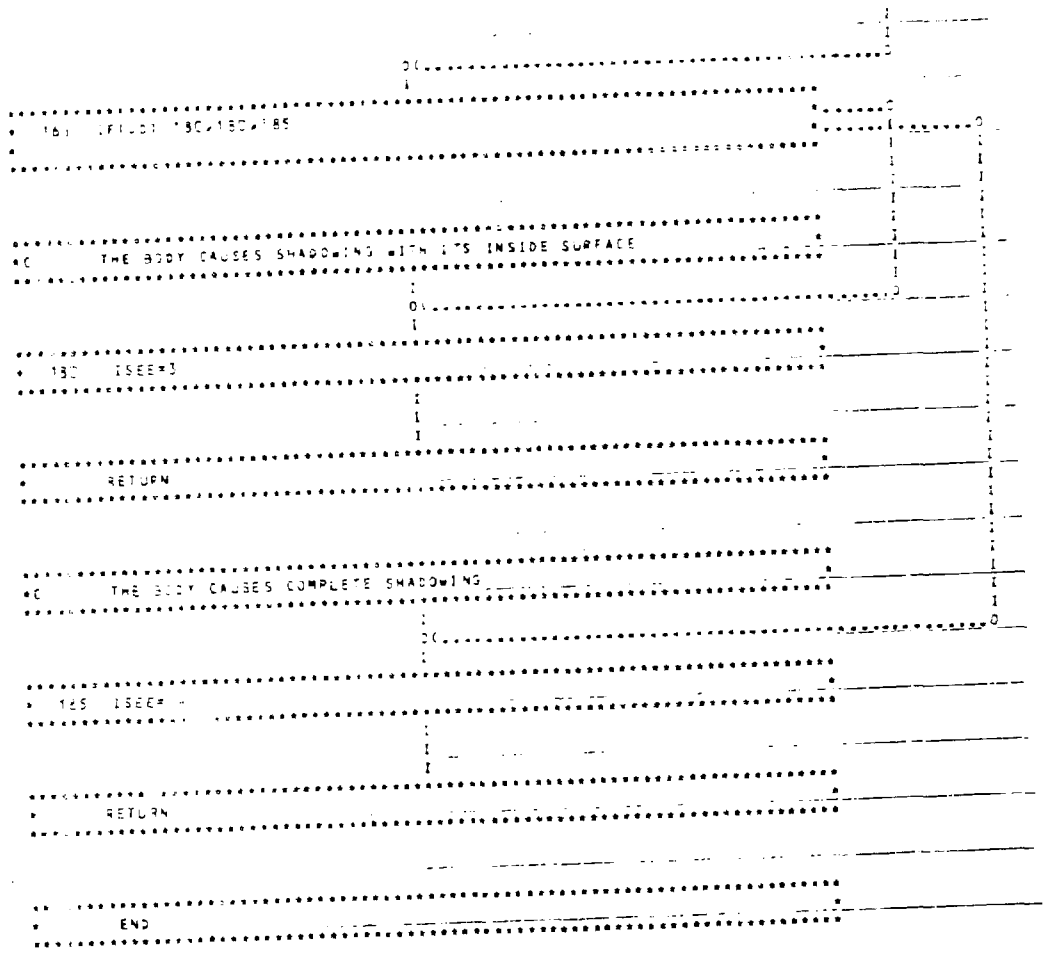

IF(DABS(Y1-Y2) .LT.1.0D-03) 200,200,80
80 IF(DABS(Y2-Y1)-1.0D-03) 200,200,90
90 CALL TEST2(Y,Y2,Y1,X1,LY)
IF(LY-1) 65,65,200
65 CALL TEST2(Y1,Y2,Y1,LARRY)
IF(LARRY-1) 67,67,200
67 IF(KICK-2) 120,125,130
100 KARK1
KICK =2
GO TO
RET =+ R2

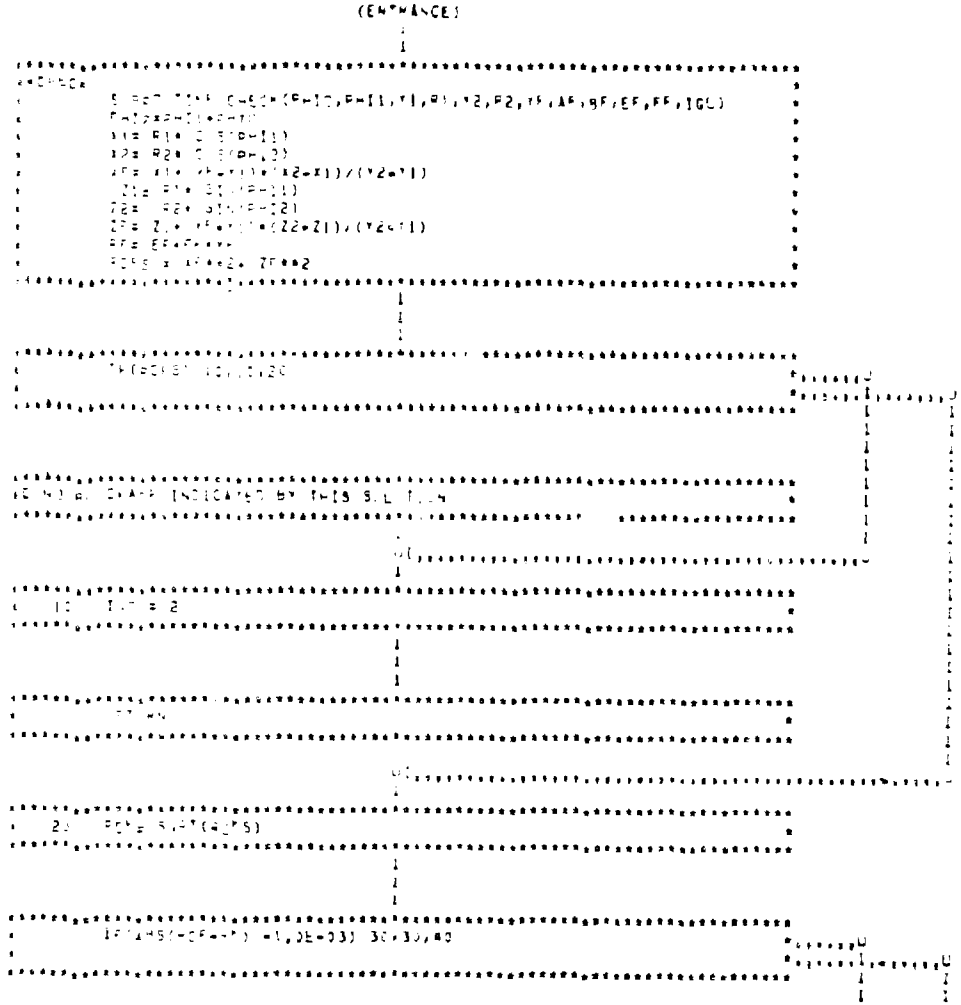

GO TO 30
125 JO= 1
KICK =3
KK=KI
GO TO 50
130 JO=JO+1
GO TO 155
200 IF(KK-KIL) 135,140,140
135 KK=KK+1
IF(KICK-2) 30,30,50
140 IF(KICK-2) 145,150,155

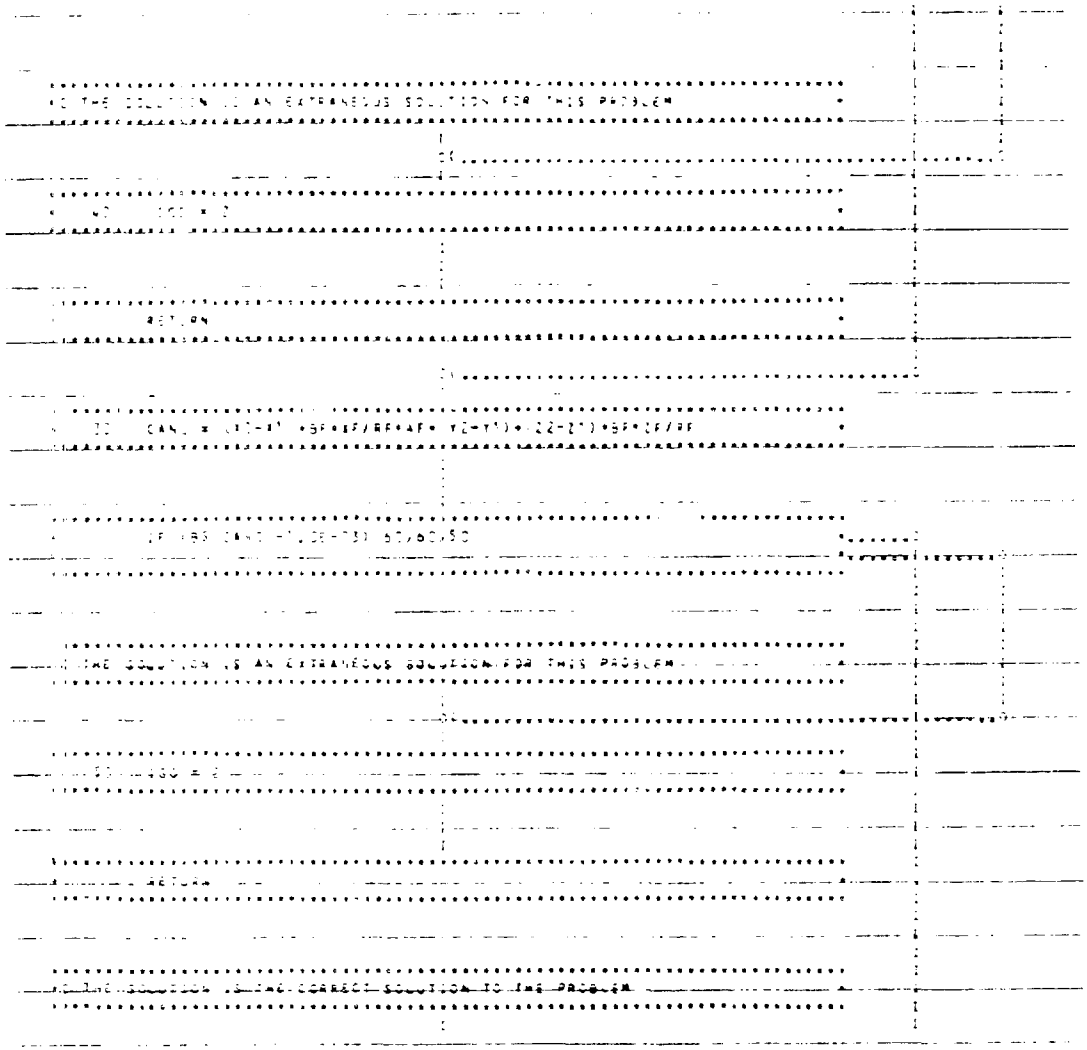

145 KICK = 2
R2I= -R2
KK= KI
GO TO 30
150 KICK= 2
KK= KI
GO TO 50
155 IF(I3) 160,160,165
160 IF(J0) 170,170,175
170 KKK=1
190 YJT=YF(JJ,KK)
RJT=RF(JJ,KK)
CALL TEST2(Y1,Y2,YJT,IFY)

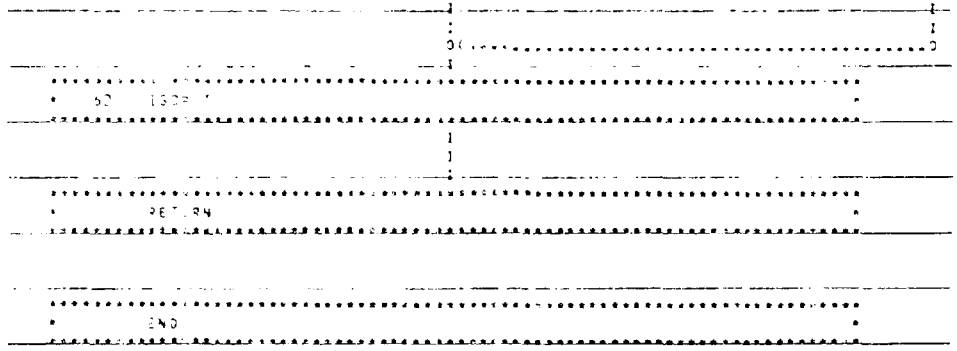

IF(IFX-1) 201,201,195
195 RETURN
IF(XK-K1C) 190,190,220
C THE BODY CAUSES NO SHADOWING
220 ISEE=1
RETURN
201 RC=-(XC-(YOUT-Y1)*R1/(Y2-Y1)
R=1.= R2*(YOUT-Y1)/(Y2-Y1)
X1= RC+R
X2= RC-R
IF(ABS(ROT-X1)-1.0E-03) 195,195,205

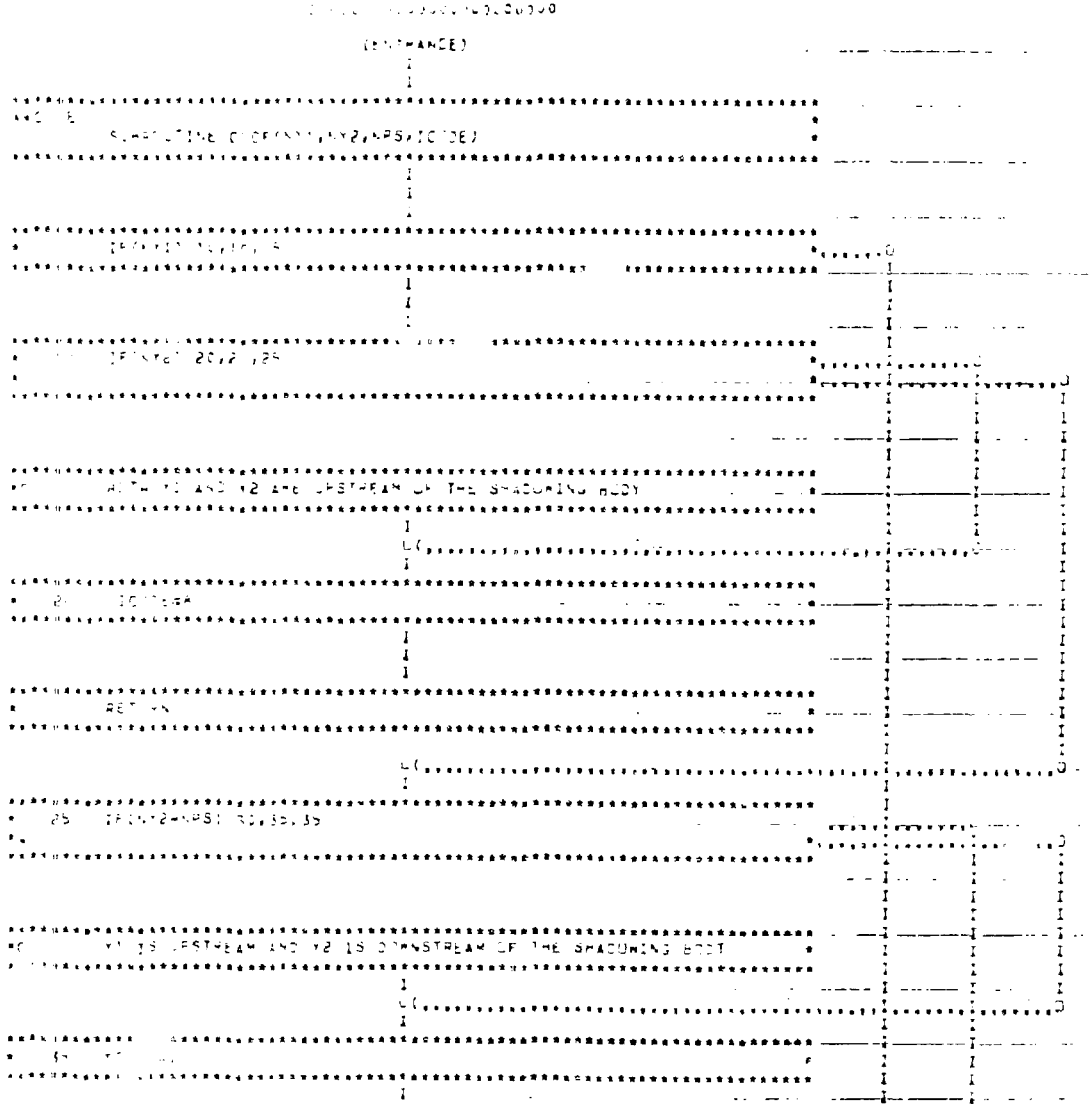

C 225 IF(ABS(X2+R_JT) .LT.195.195.210
C 230 IF(X2+R_JT) 220,230,230
C 235 IF(X2+R_JT) 220,240,240
C THE FRUSTUM SHADOWS WITH ITS OUTSIDE SURFACE BUT SHADOWING DOES NOT EX
C FOR PHI2= 180 DEGREES AS IT DOES FOR ISEE=2
C 240 ISEE= 5
RETURN
C THE BODY CAUSES SHADOWING WITH ITS OUTSIDE SURFACE
C 175 ISEE = 2
RETURN

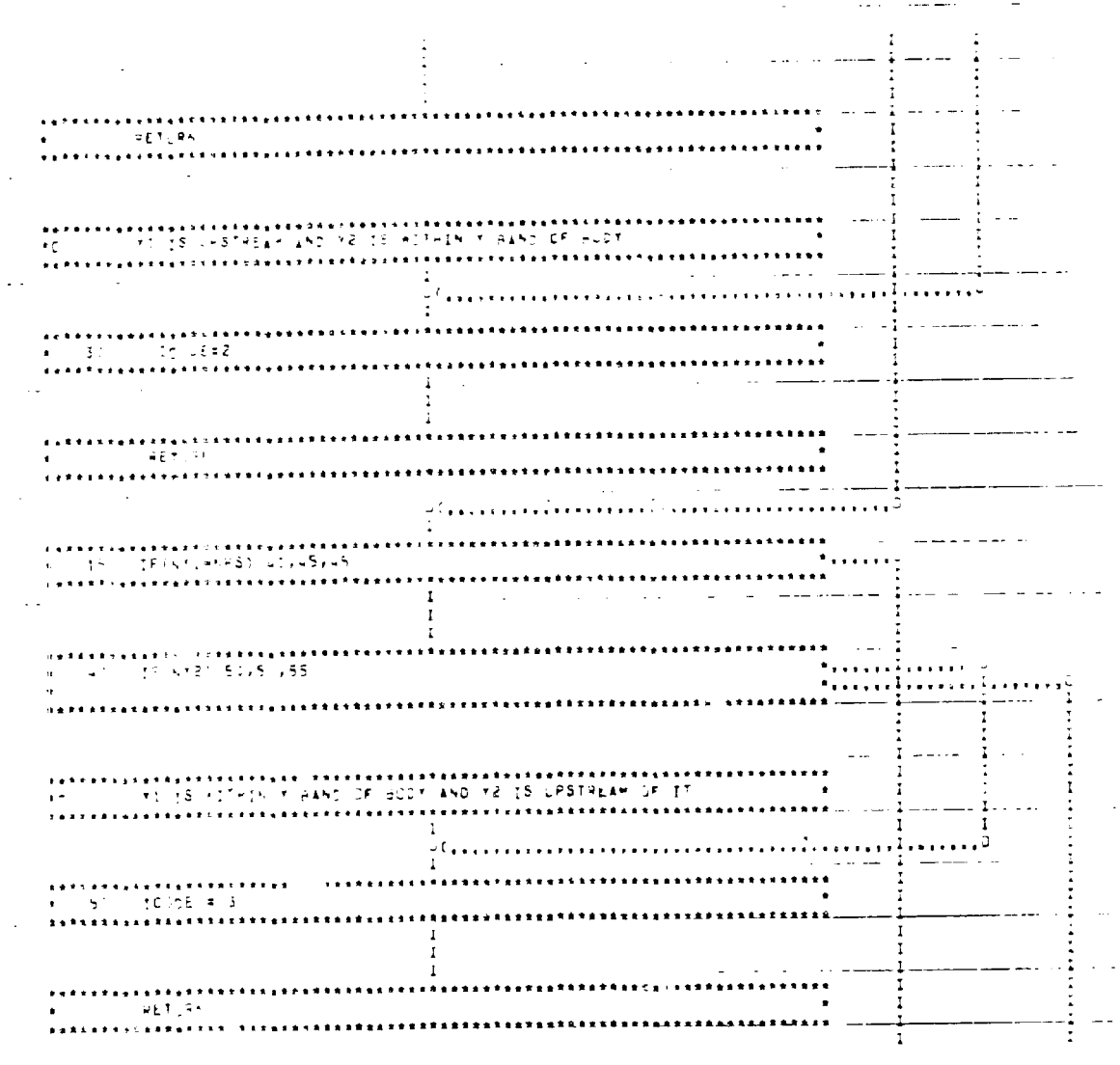

C THE BODY CAUSES SHADOWING WITH ITS INSIDE SURFACE
C THE BODY CAUSES COMPLETE SHADOWING
RETURN
END

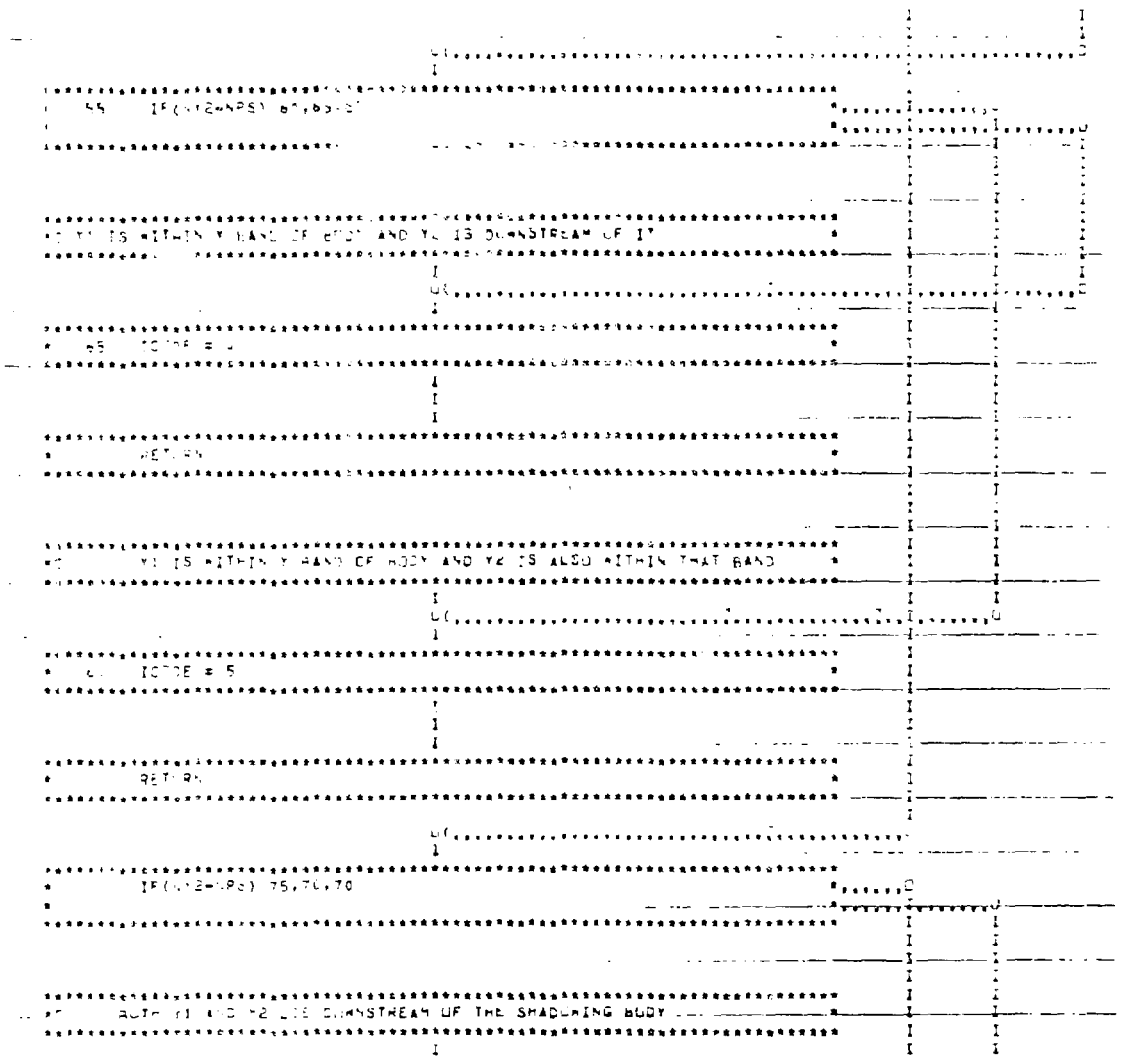

(ENTRANCE)

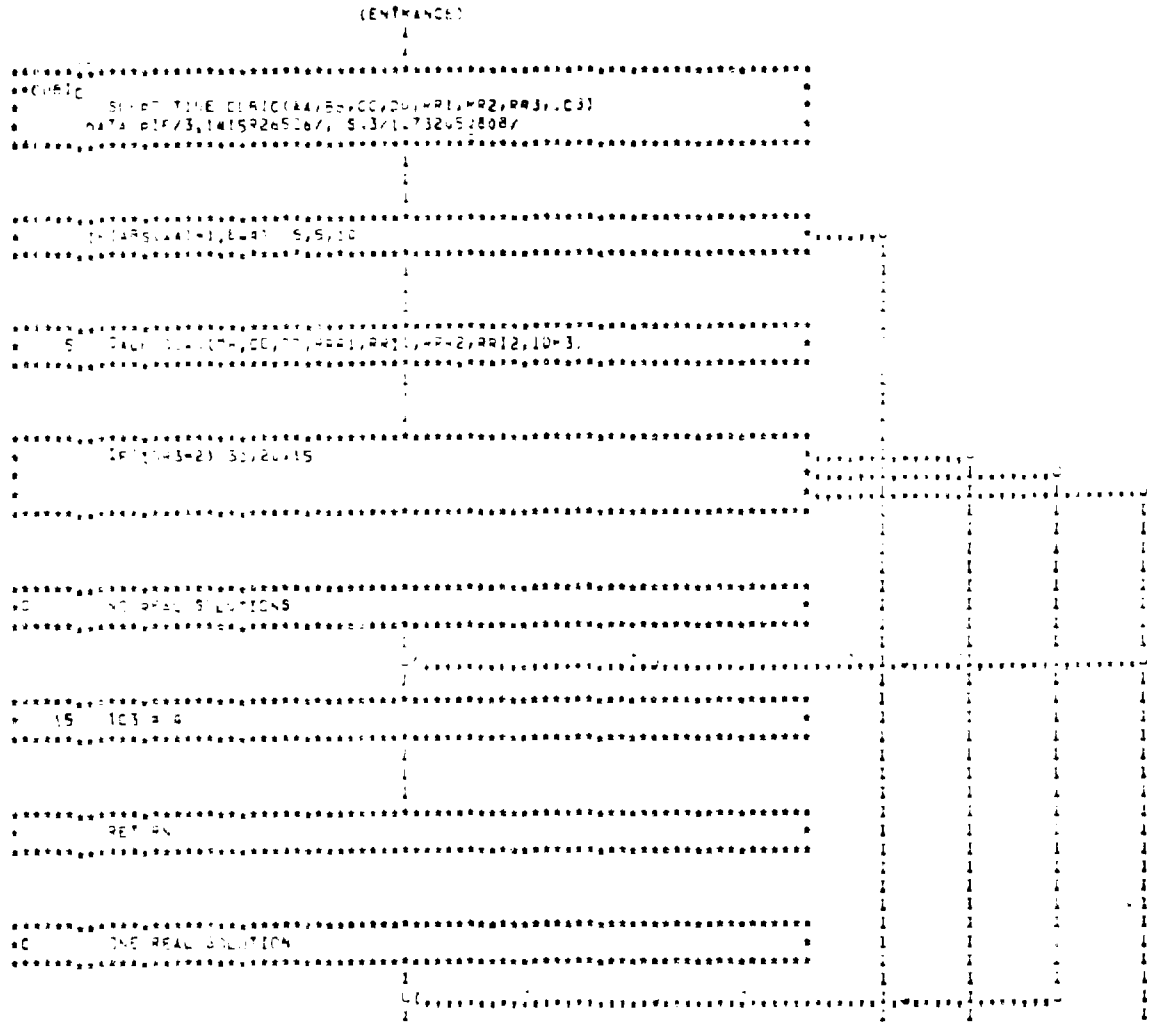


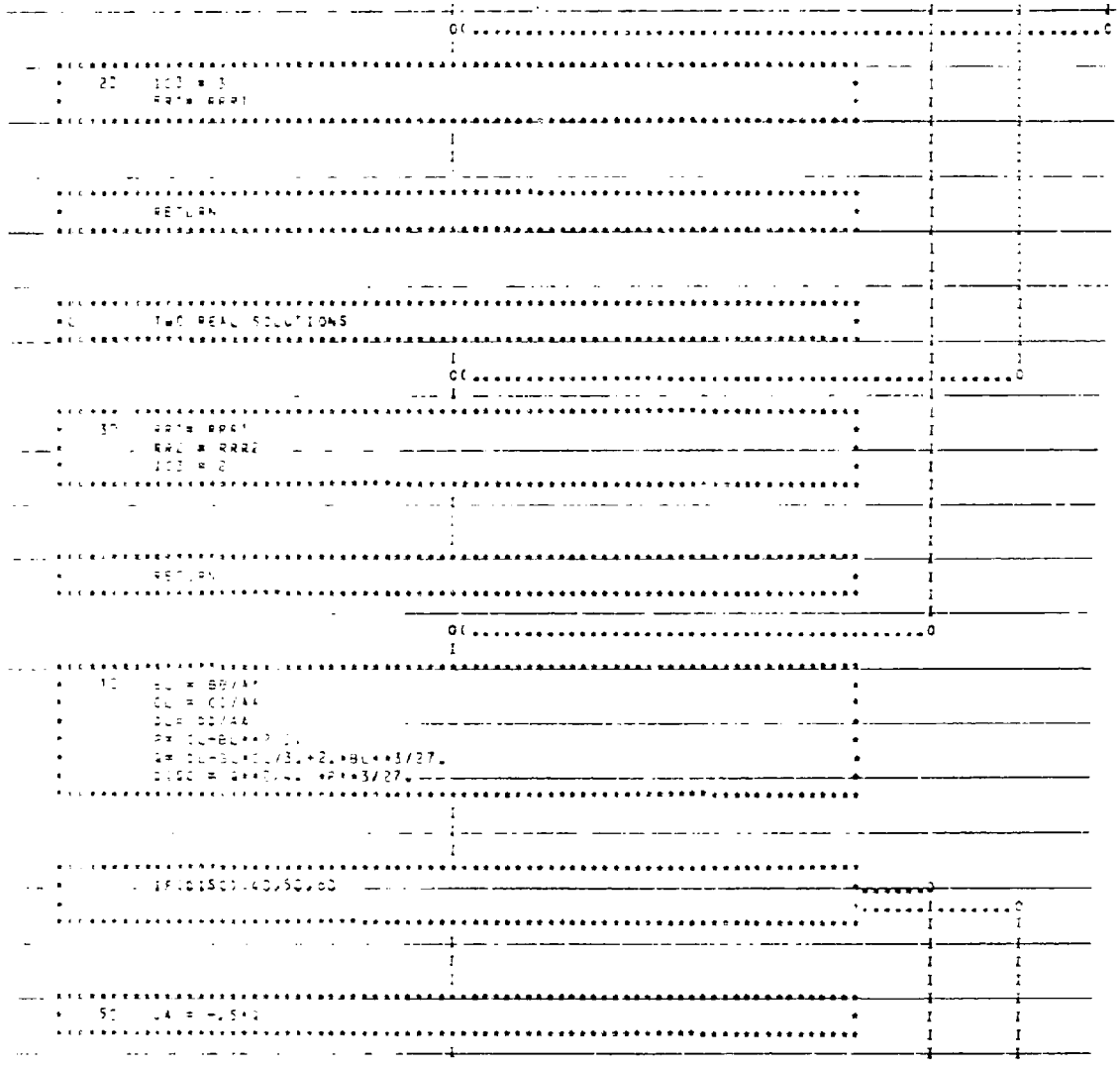

DO LOOP
RETURN
END

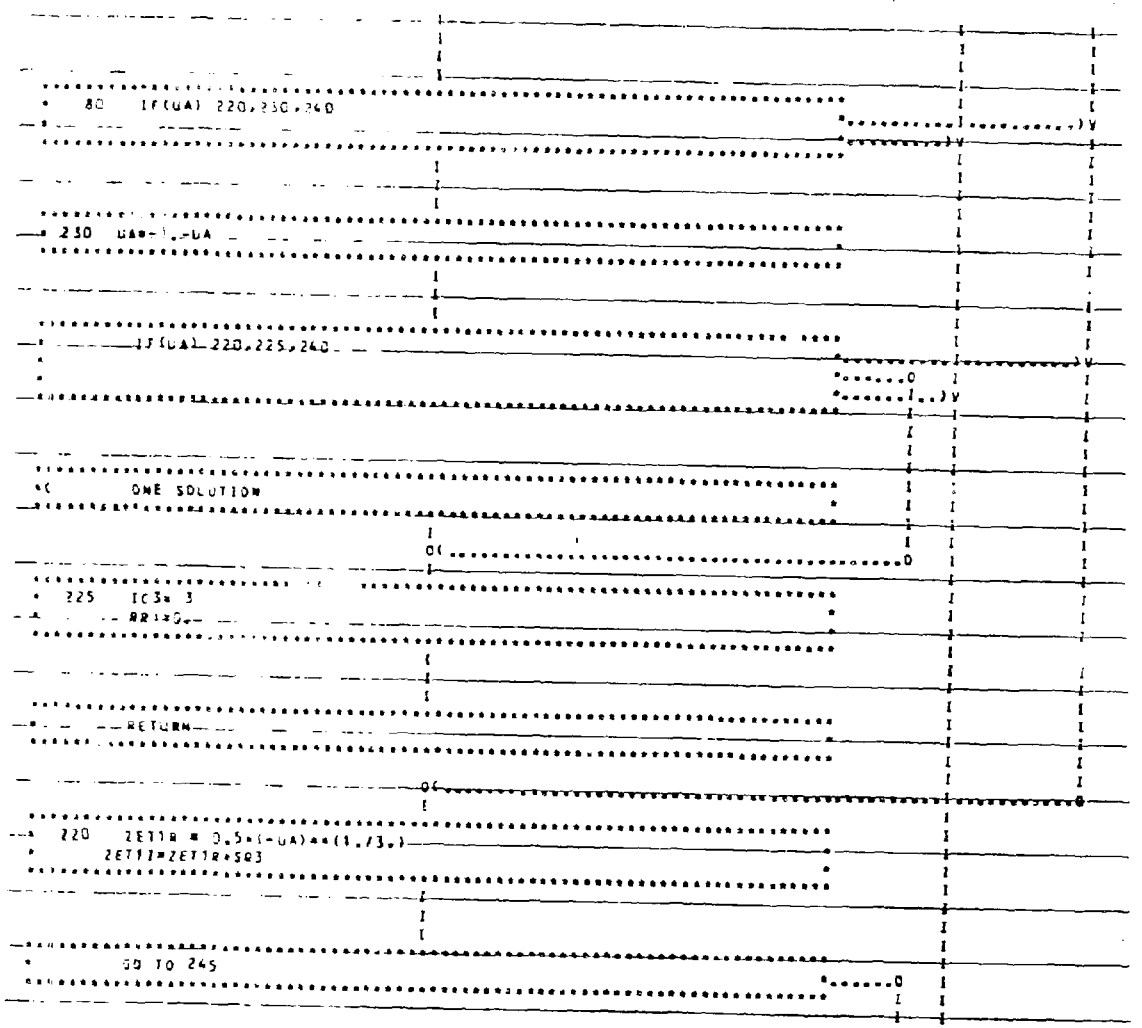

(ENTRANCE)
RETURN
RETURN
RETURN

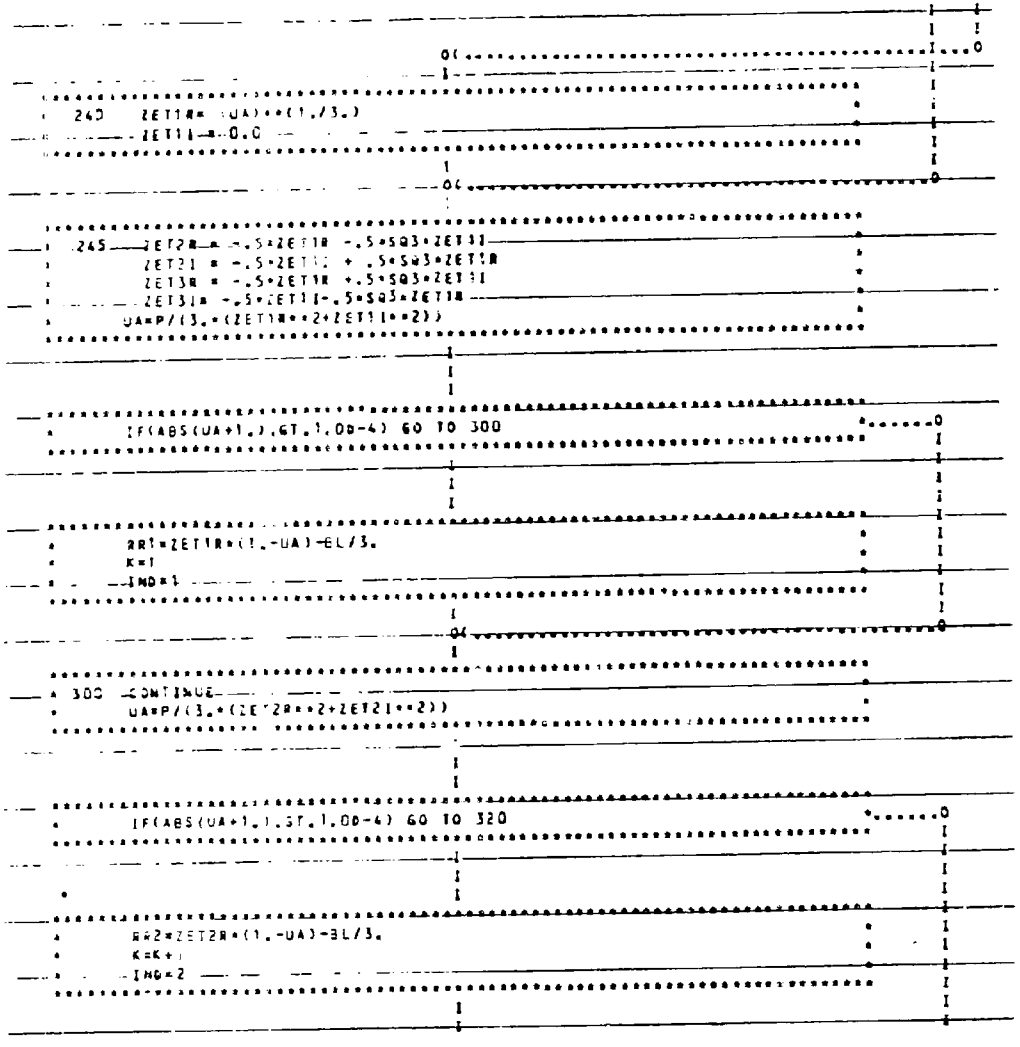

RETURN
Y1 IS UPSTREAM AND Y2 IS WITHIN Y BAND OF BODY
GO TO 852
RETURN
IF (Y1-YUPS) 851,853,853
IF (Y2-YUPS) 851,851,855
Y1 IS WITHIN Y BAND OF BODY AND Y2 IS UPSTREAM OF IT
GO TO CASE # 3
RETURN

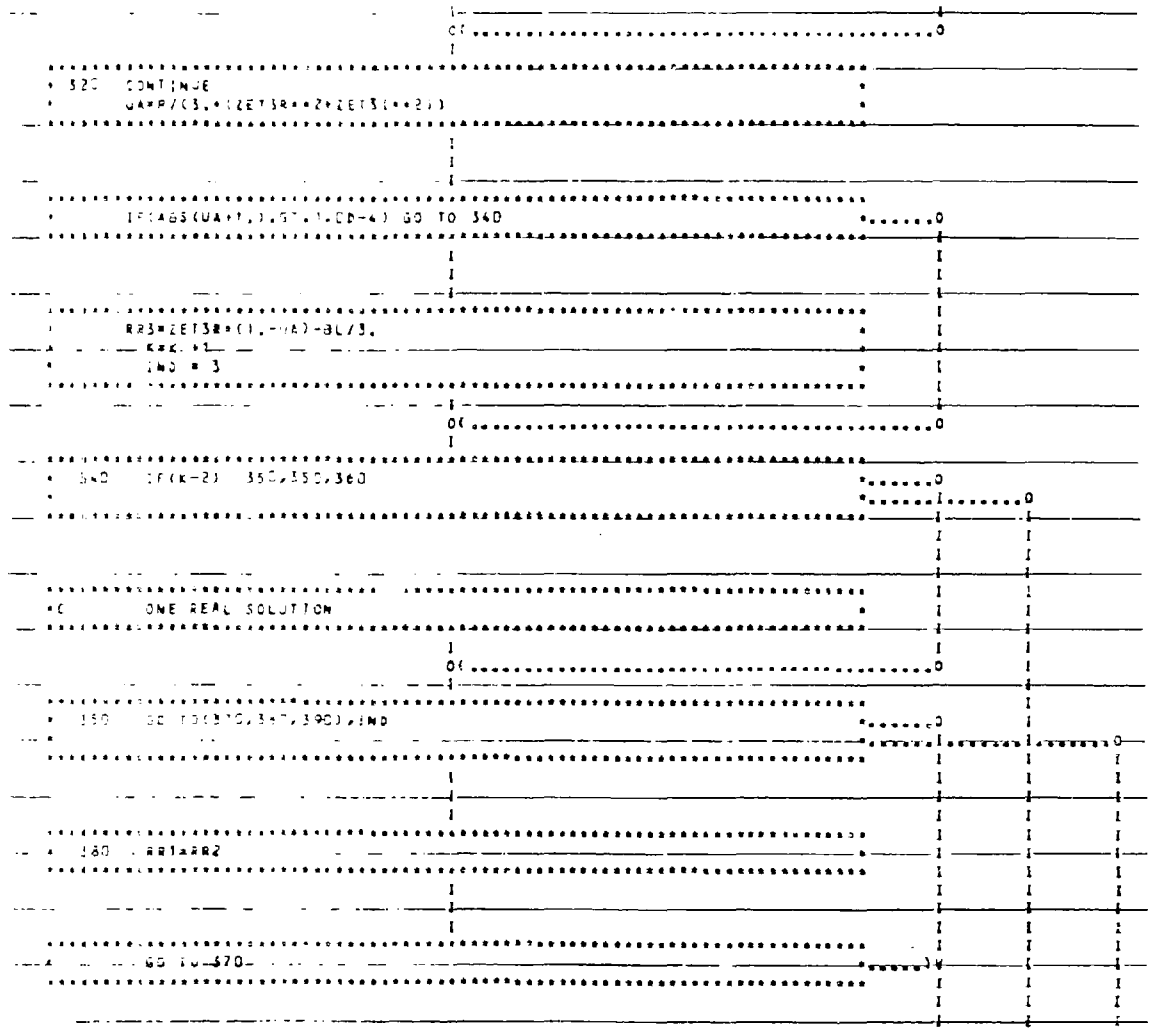


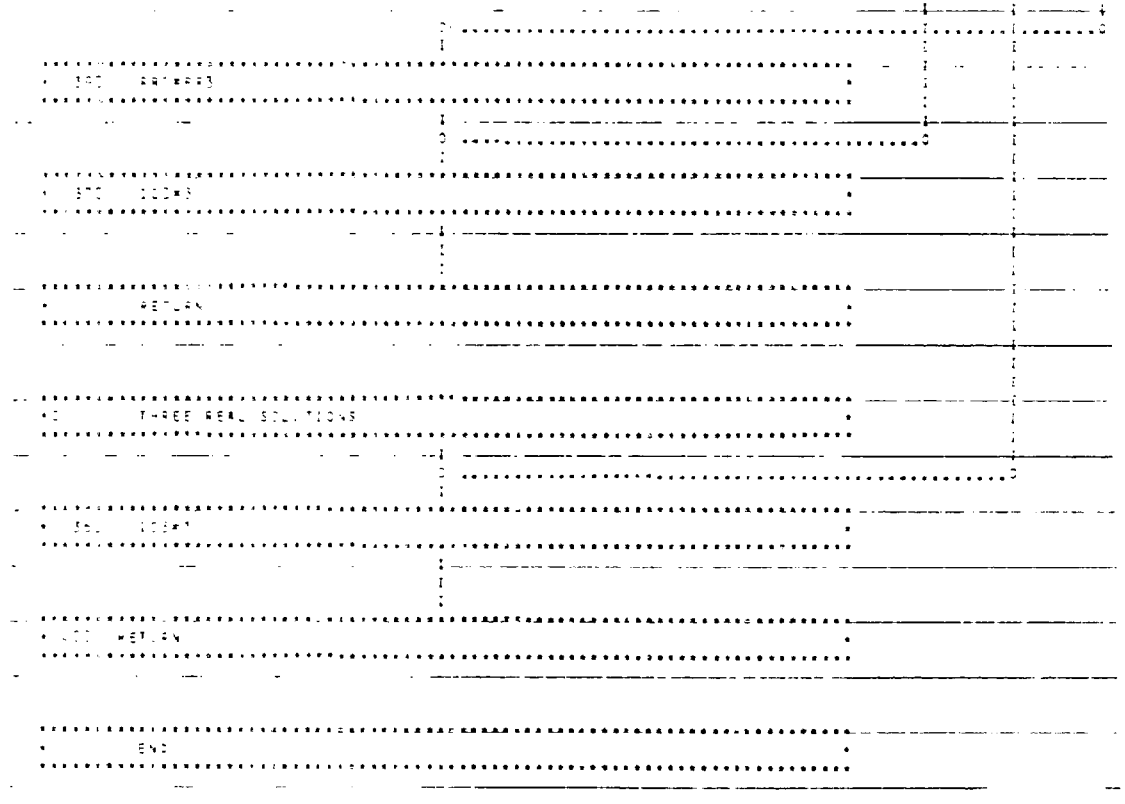

(ENTRANCE)
SUBROUTINE CUBIC(AA,BB,CC,DD,RR1,RR2,RR3,IC)
DATA EPS/3.1415926535897932385/, S3/1.7320508075688/
IC=IABS(AA)+IABS(BB)+IABS(CC)
IF(IC.EQ.0) GO TO 5
IF(IC-3)=2) 30,20,15
IC = 3
RETURN
ONE REAL SOLUTION

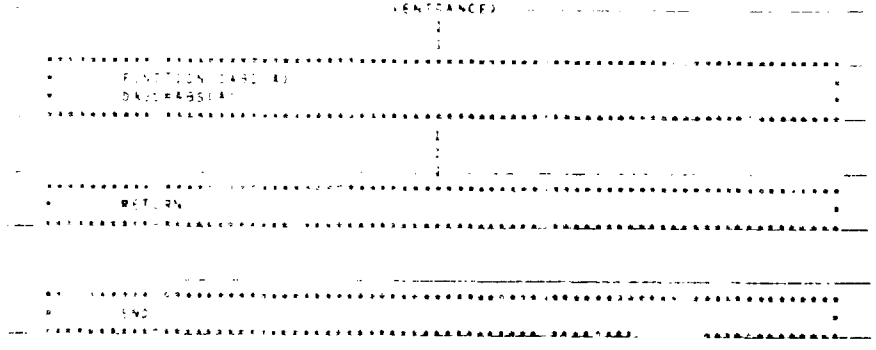

20 ICD = 3
RR*= RRR1
RETURN
TWO REAL SOLUTIONS
30 RR1= RRR
RR2 = RRR2
ICD = 2
RETURN
10 AL = BB/AA
CL = CC/AA
DL= DD/AA
P= CL-BL**2 /3.
Q= DL-BL*CL/3.+2.*BL**3/27.
D=QQ = Q**2/4. +P**3/27.
IF(DISC).40,50,60
SD DA = -.5*Q

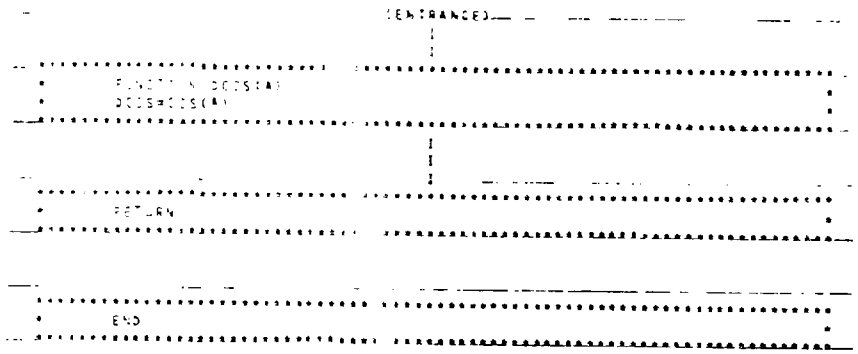

80 IF(UA) 220,230,240
230 UA=-1.-UA
IF(UA) 220,225,240
ONE SOLUTION
225 IC3= 3
RR=0.
RETURN
220 ZETTR = 0.5*(-UA)**(1./3.)
ZETTI=ZETTR*SQ3
GO TO 245

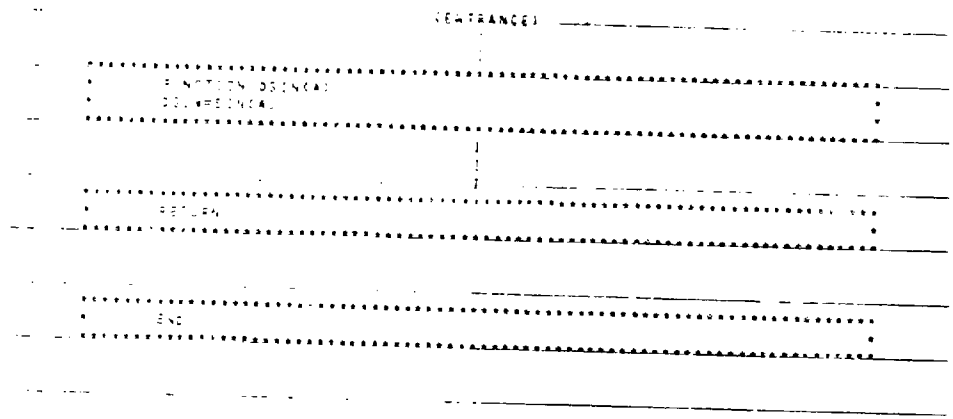

240 ZET1R= (UA)**(1./3.)
ZET1I=0.0
245 ZET2R = -.5*ZET1R -.5*SQ3*ZET3I
ZET2I = -.5*ZET1I + .5*SQ3*ZET3R
ZET3R = -.5*ZET1R +.5*SQ3*ZET3I
ZET3I= -.5*ZET1I-.5*SQ3*ZET1R
UA=P/(3.*(ZET1R**2+ZET1I**2))
IF(ABS(UA+1.).GT.1.0D-4) GO TO 300
AR1=ZET1R*(1.-UA)-BL/3.
K=1
IND=1
300 CONTINUE
UA=P/(3.*(ZET2R**2+ZET2I**2))
IF(ABS(UA+1.).GT.1.0D-4) GO TO 320
AR2=ZET2R*(1.-UA)-BL/3.
K=K+1
IND=2

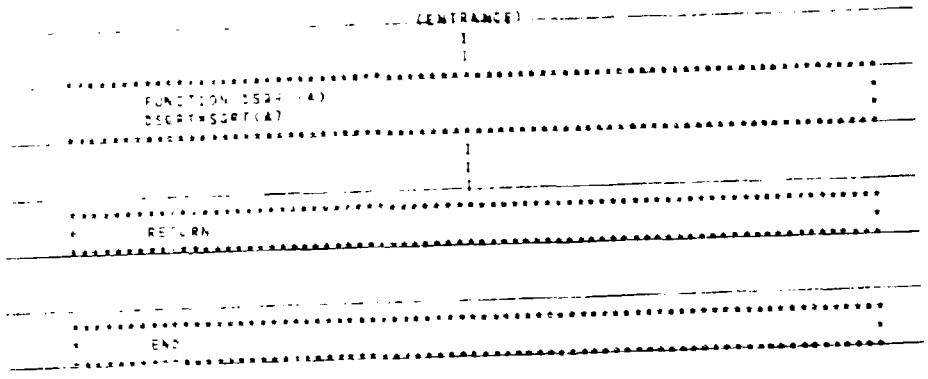

320 CONTINUE
UA=P/(3.*(ZET3R**2+ZET3I**2))
IF(ABS(UA**3).GT.1.0D-6) GO TO 340
RR3=ZET3R*(1.-UA)-BL/3.
K=K+1
IND = 3
340 IF(K-2) 350,350,360
C ONE REAL SOLUTION
350 GO TO(370,380,390),IND
380 RR1=RR2
GO TO 670



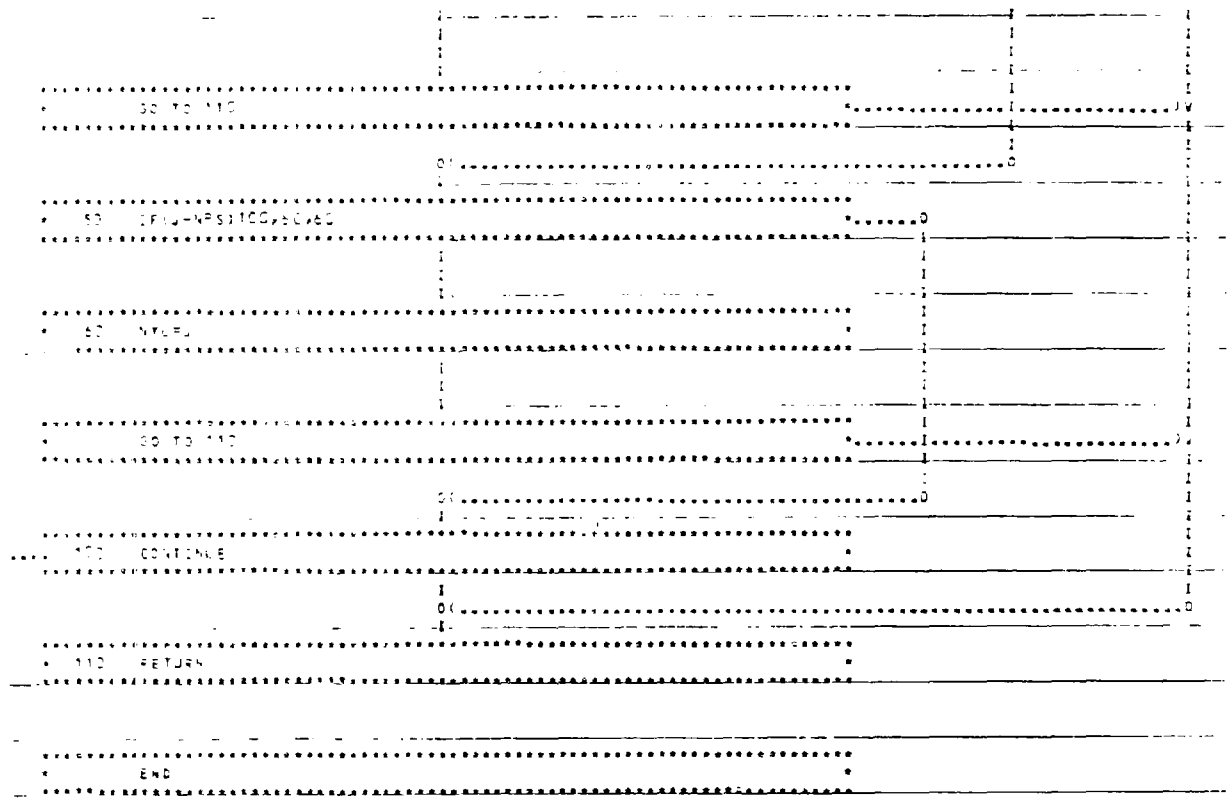

(ENTRANCE)
FUNCTION CASE 8)
RETURN
END

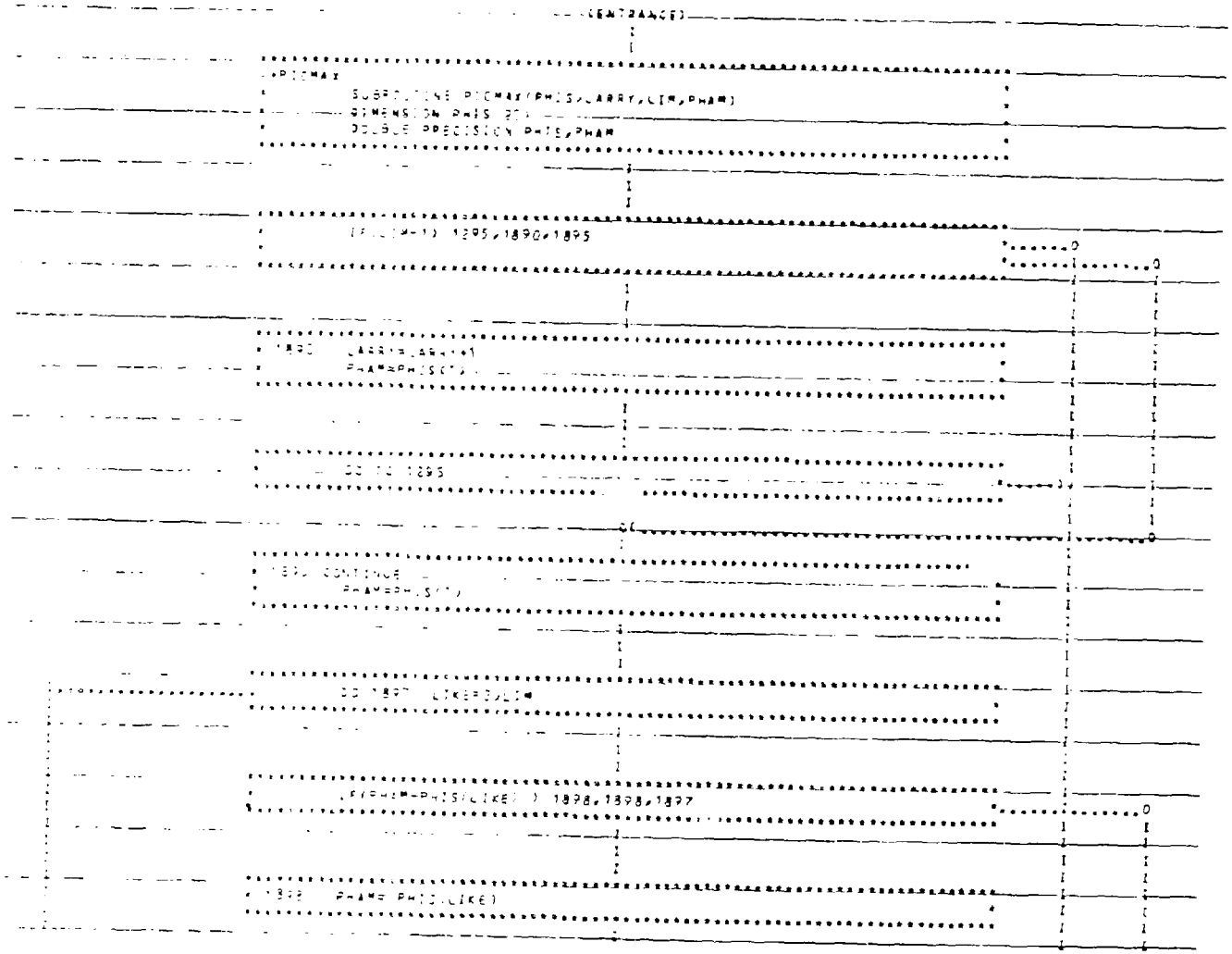

(ENTRANCE)
RETURN
END

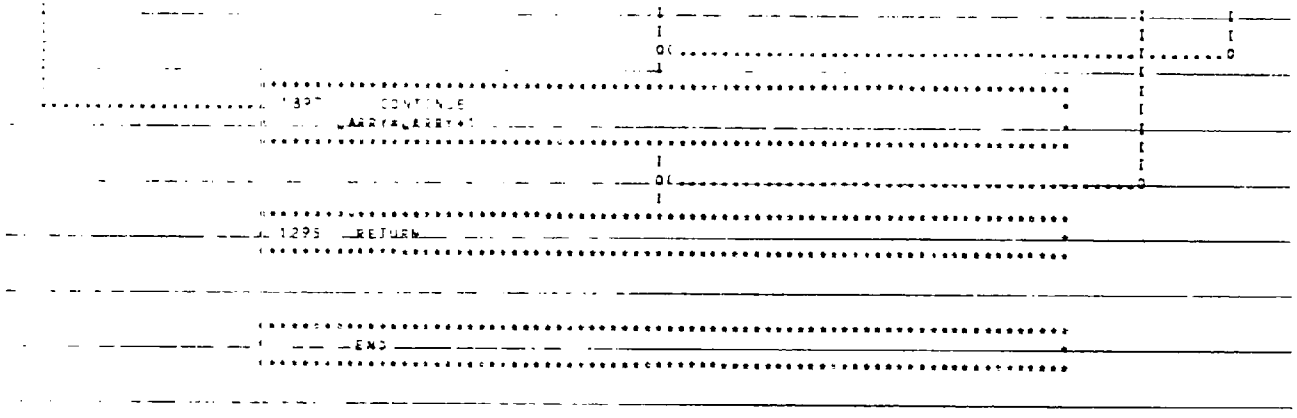

(ENTRANCE)
RETURN
END

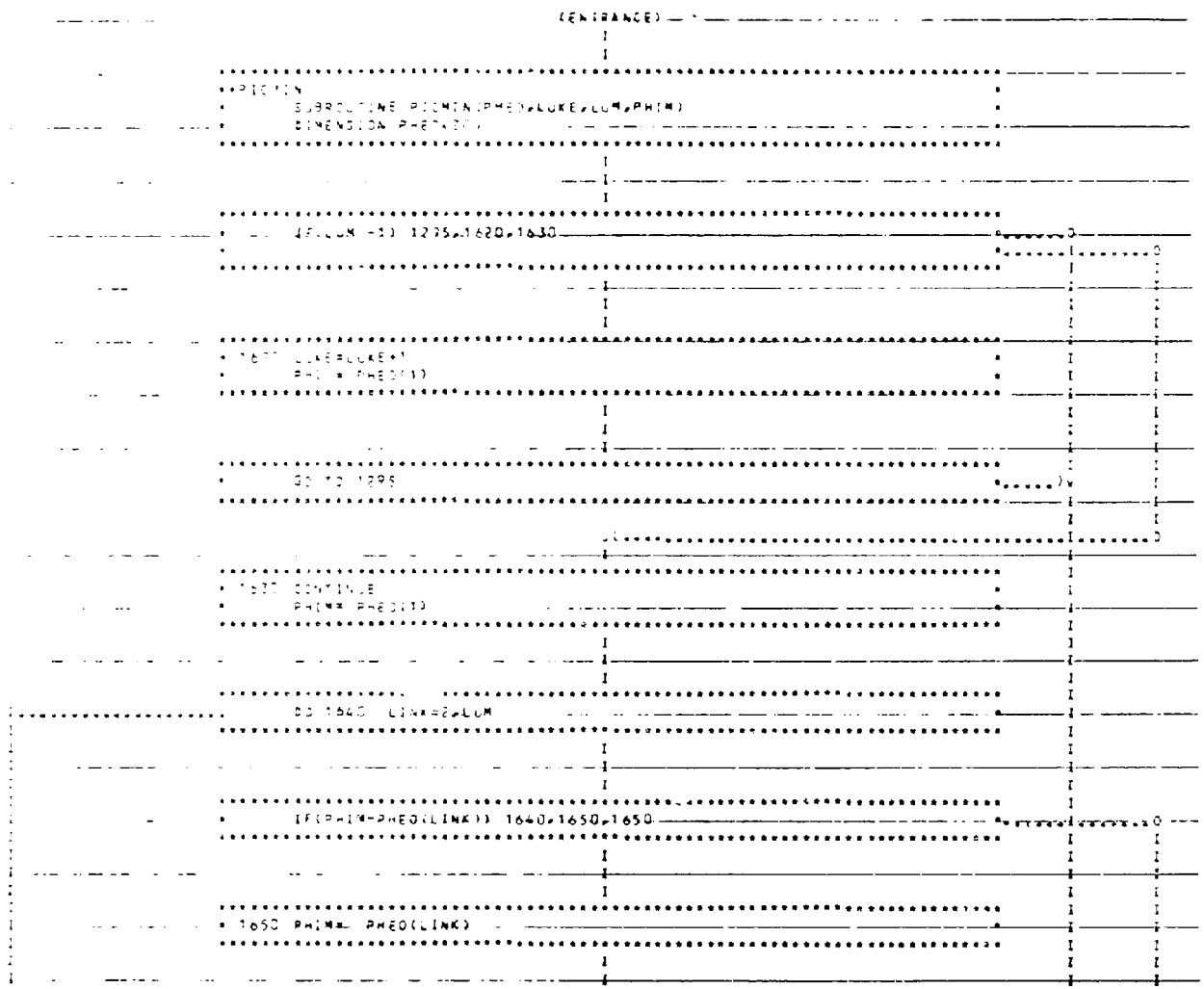

(ENTRANCE)
FUNCTION DSQRT(A)
DSQRT=SQRT(A)
RETURN
END

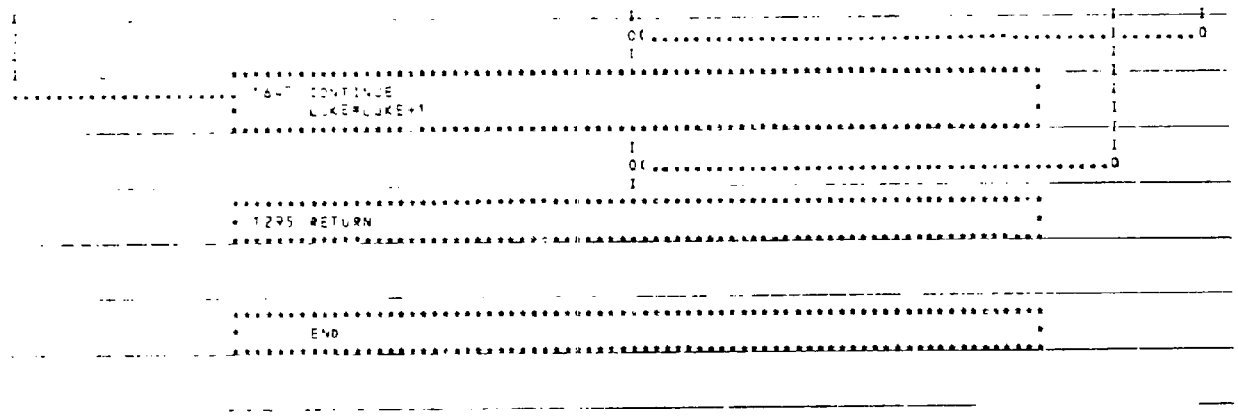


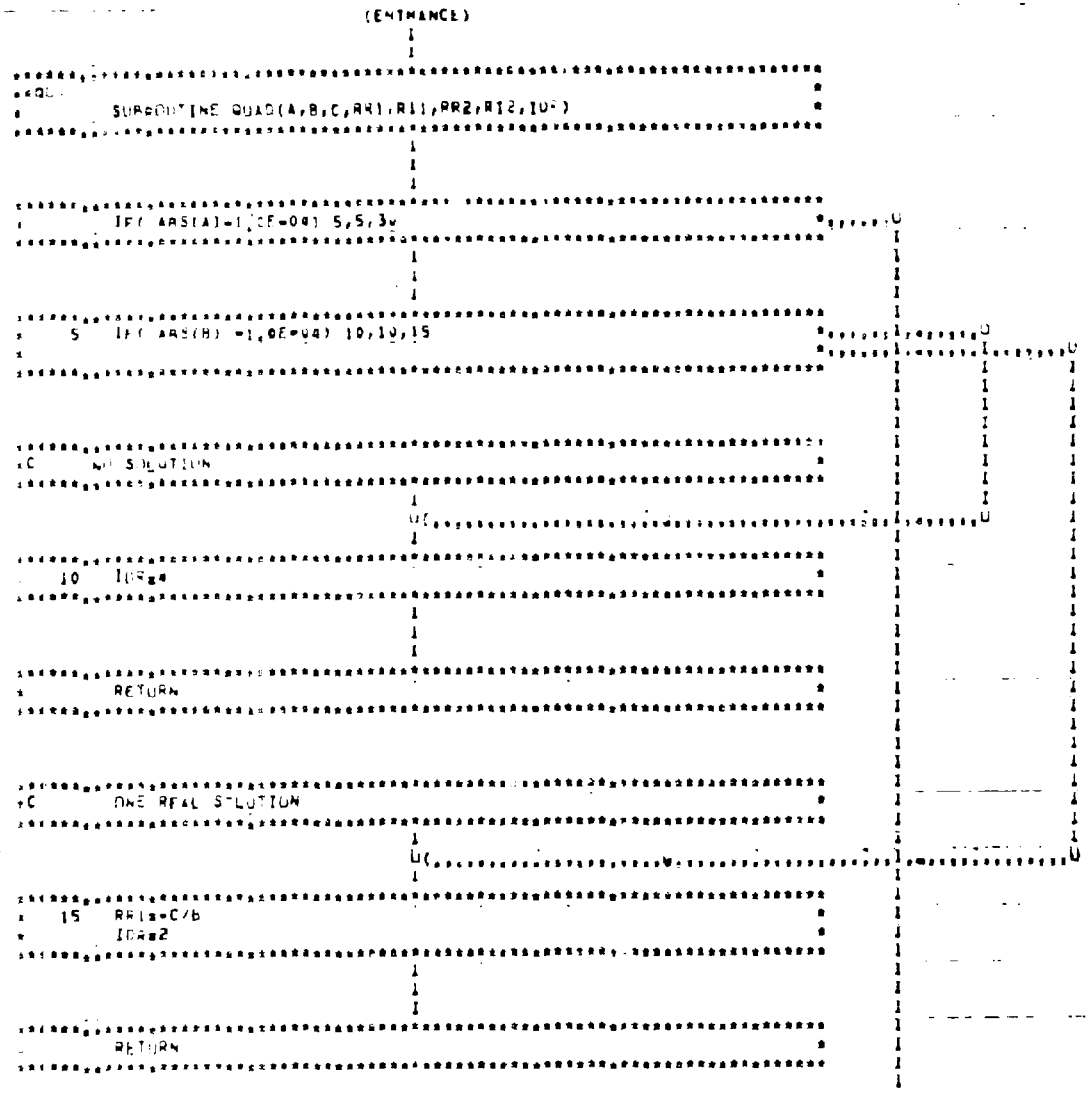

GO TO 110
IF(J-NPS)100,100,80
NPS=J
GO TO 110
100 CONTINUE
110 RETURN
END

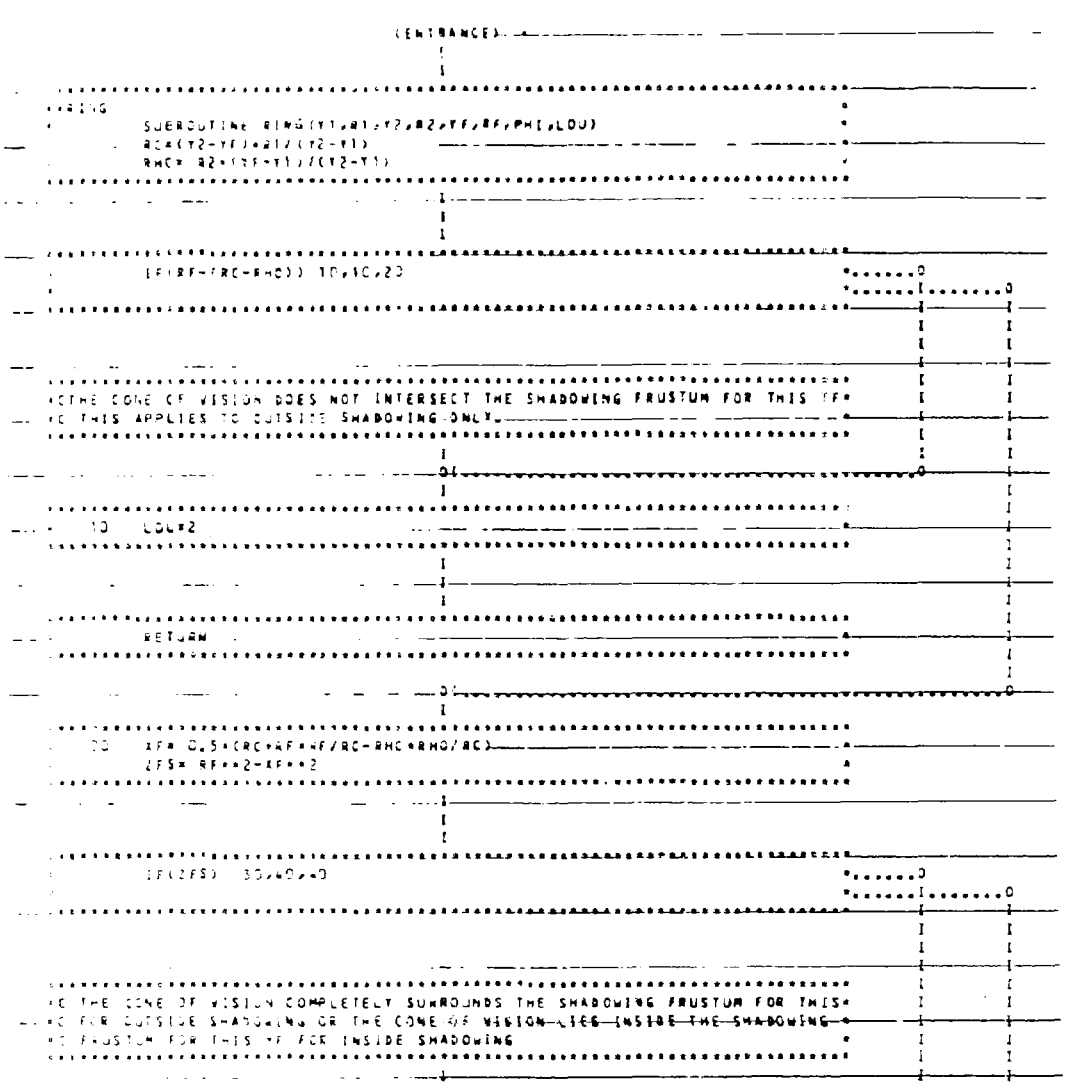

(ENTRANCE)
PICMAX
SUBROUTINE PICMAX(PHIS,LARRY,LIM,PHAM)
DIMENSION PHIS 2C
DOUBLE PRECISION PHIE,PHAM
IF(LIM-1) 1295,1890,1895
1890 LARRY=LARRY+1
PHAM=PHIS(1)
DO TO 1895
1895 CONTINUE
PHAM=PHIS(1)
DO 1897 LIKE=2,LIM
IF(PHIM-PHIS(LIKE)) 1898,1898,1897
1898 PHAM= PHIS(LIKE)

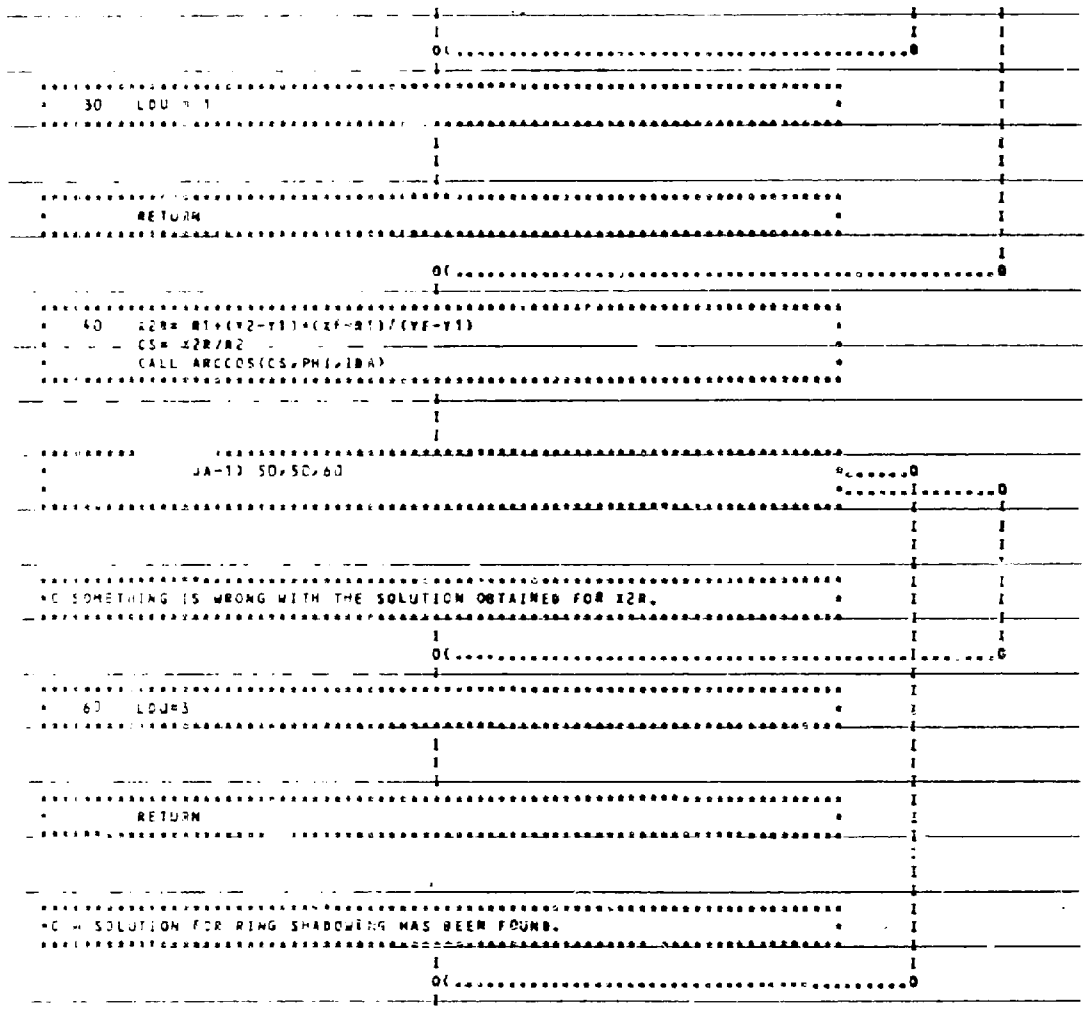


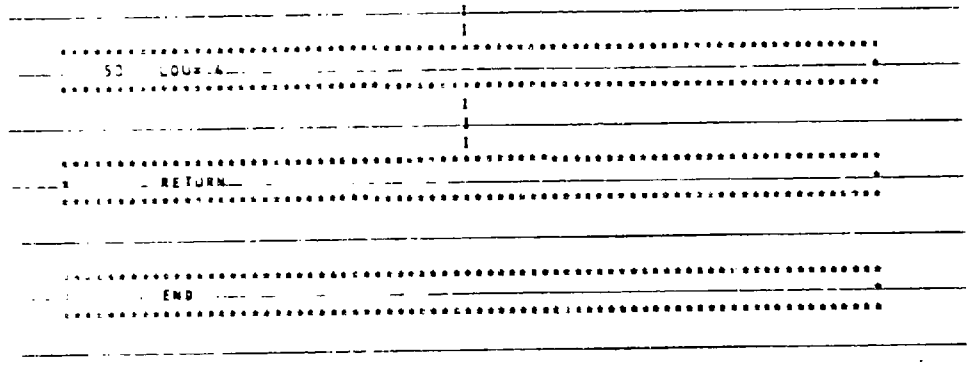

(ENTRANCE)
*PICKIN
SUBROUTINE PICKIN(PHEO,LUKE,LUM,PHIM)
DIMENSION PHEO(3)
IF(LUM -1) 1275,1620,1630
1620 LUKE=LUKE+1
PHI = PHEO(1)
GO TO 1295
1630 CONTINUE
PHIM= PHEO(1)
DO 1640 LINK=2,LUM
IF(PHIM-PHEO(LINK)) 1640,1650,1650
1650 PHIM= PHEO(LINK)

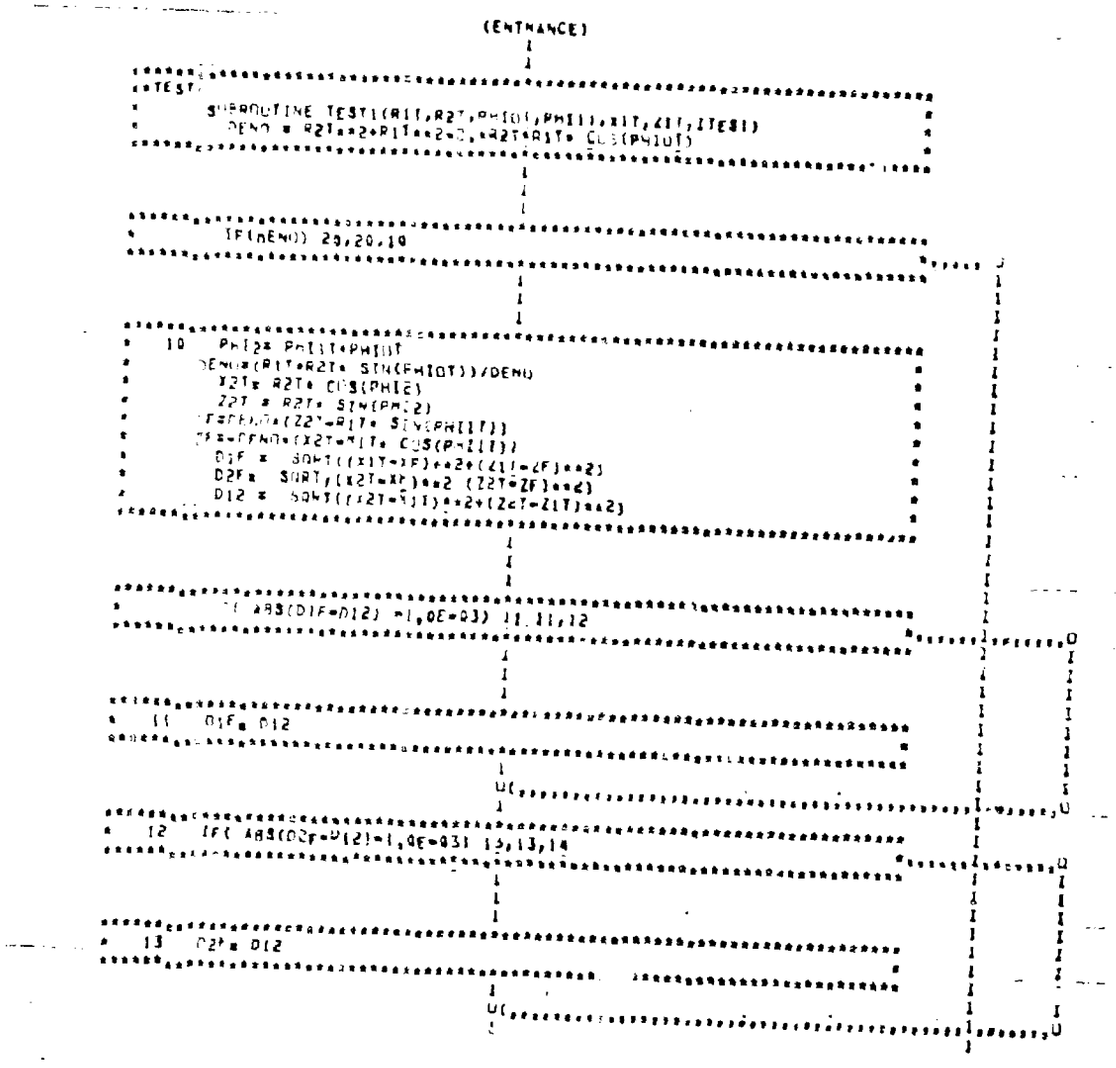

'60' CONTINUE
LAKE=LAKE+1
1295 RETURN
END

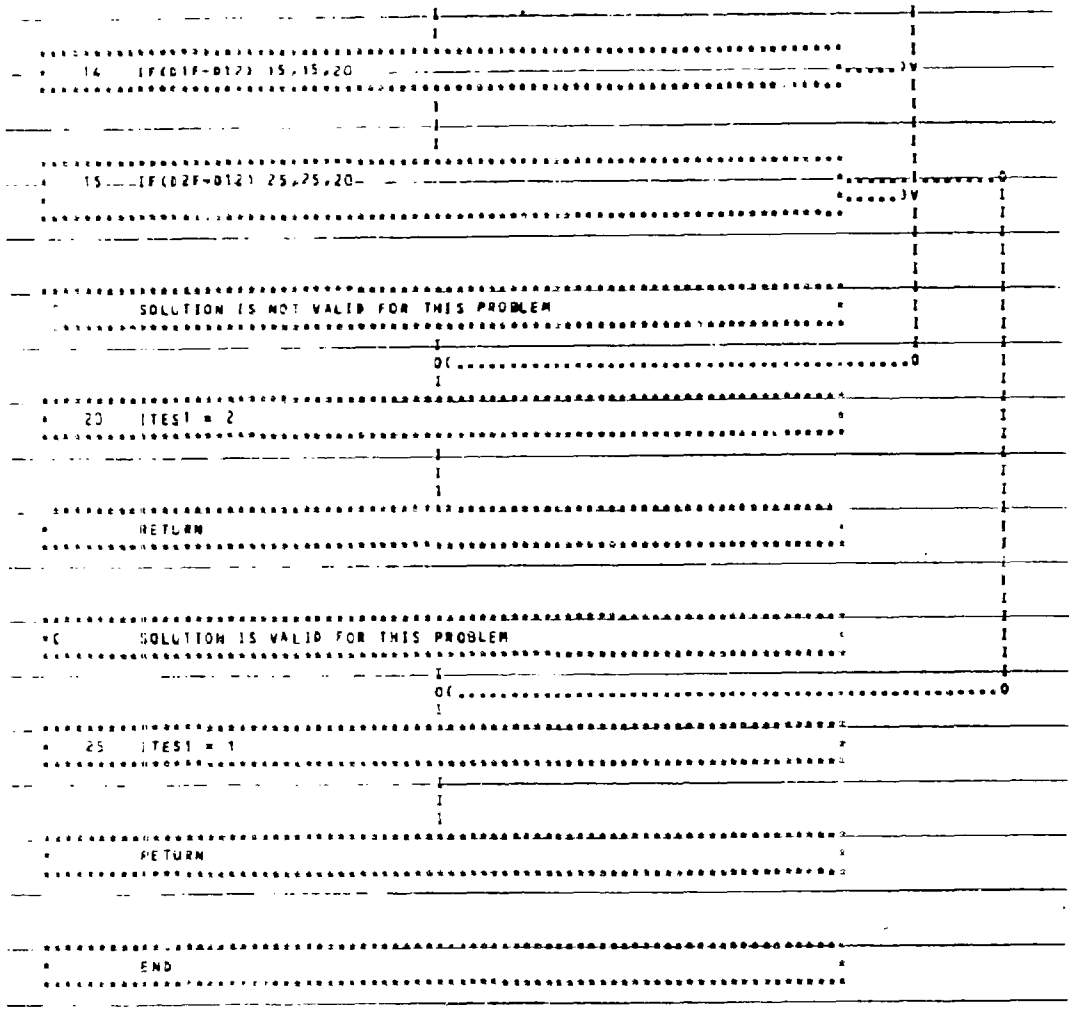

(ENTRANCE)
SUBROUTINE QUAD(A,B,C,RR1,RI1,RR2,RI2,IDE)
IF(ABS(A)-1.0E-04) 5,5,3
5 IF(ABS(B) -1.0E-04) 10,10,15
NO SOLUTION
10 IDE=0
RETURN
ONE REAL SOLUTION
15 RR1=-C/B
IDE=2
RETURN

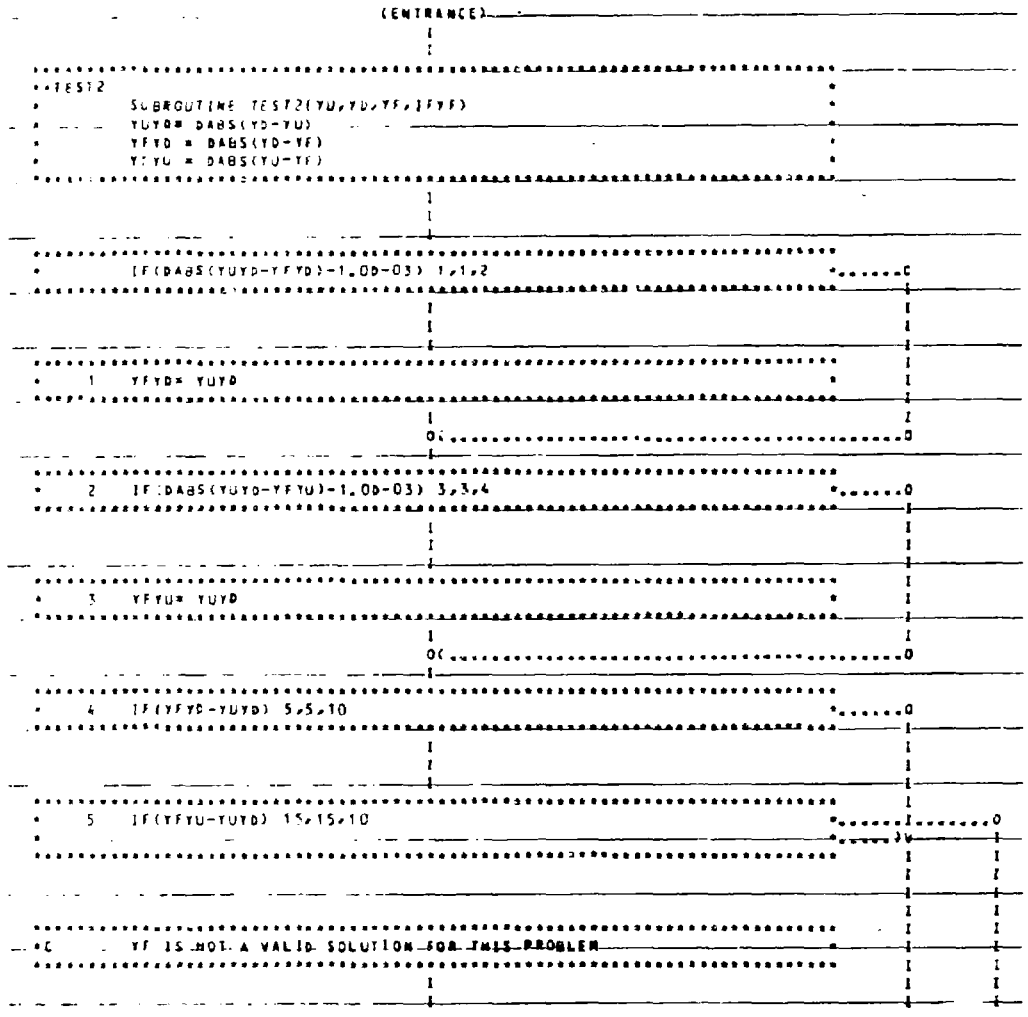

(ENTRANCE)
RING
SUBROUTINE RING(Y1,R1,Y2,R2,YF,RF,PHI,LOU)
RC=(Y2-YF)*R1/(Y2-Y1)
RHO=(R2*(YF-Y1)+R1*(Y2-YF))/(Y2-Y1)
IF(RF-FRC-RHO)) 10,10,20
C THE CONE OF VISION DOES NOT INTERSECT THE SHADOWING FRUSTUM FOR THIS YF
C THIS APPLIES TO OUTSIDE SHADOWING ONLY
10 LOU=2
RETURN
20 XF=0.5*(RC*RF+RF/RC-RHO*RHO/RC)
ZFS=RF**2-XF**2
IF(ZFS) 30,40,40
C THE CONE OF VISION COMPLETELY SURROUNDS THE SHADOWING FRUSTUM FOR THIS
C FOR OUTSIDE SHADOWING OR THE CONE OF VISION LIES INSIDE THE SHADOWING
C FRUSTUM FOR THIS YF FOR INSIDE SHADOWING

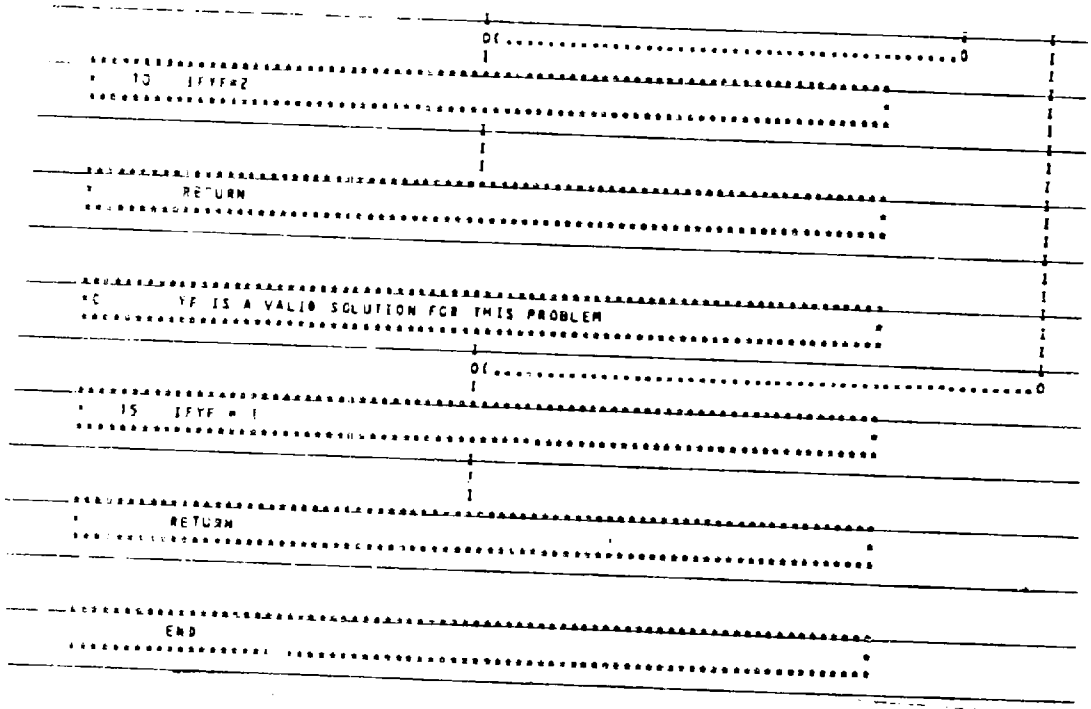

30 LOU = 1
RETURN
40 Z2R= B1+(Y2-Y1)*(XF-B1)/(YF-Y1)
CS= Z2R/R2
CALL ARCCOS(CS,PHI,IBA)
IA-1) 50,50,60
C SOMETHING IS WRONG WITH THE SOLUTION OBTAINED FOR Z2R.
60 LOU=3
RETURN
C = SOLUTION FOR RING SHADOWING HAS BEEN FOUND.

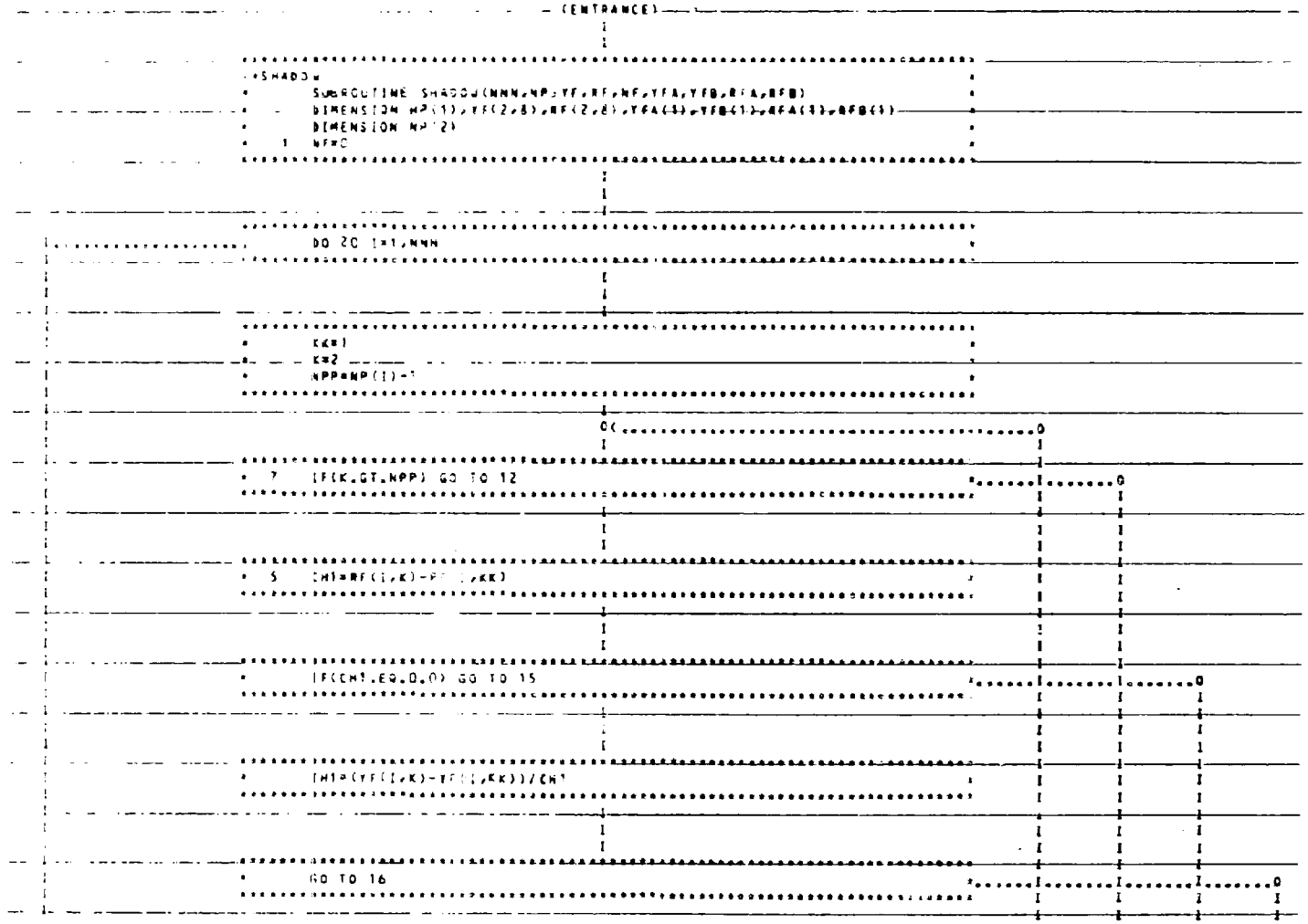

SO
RETURN
END

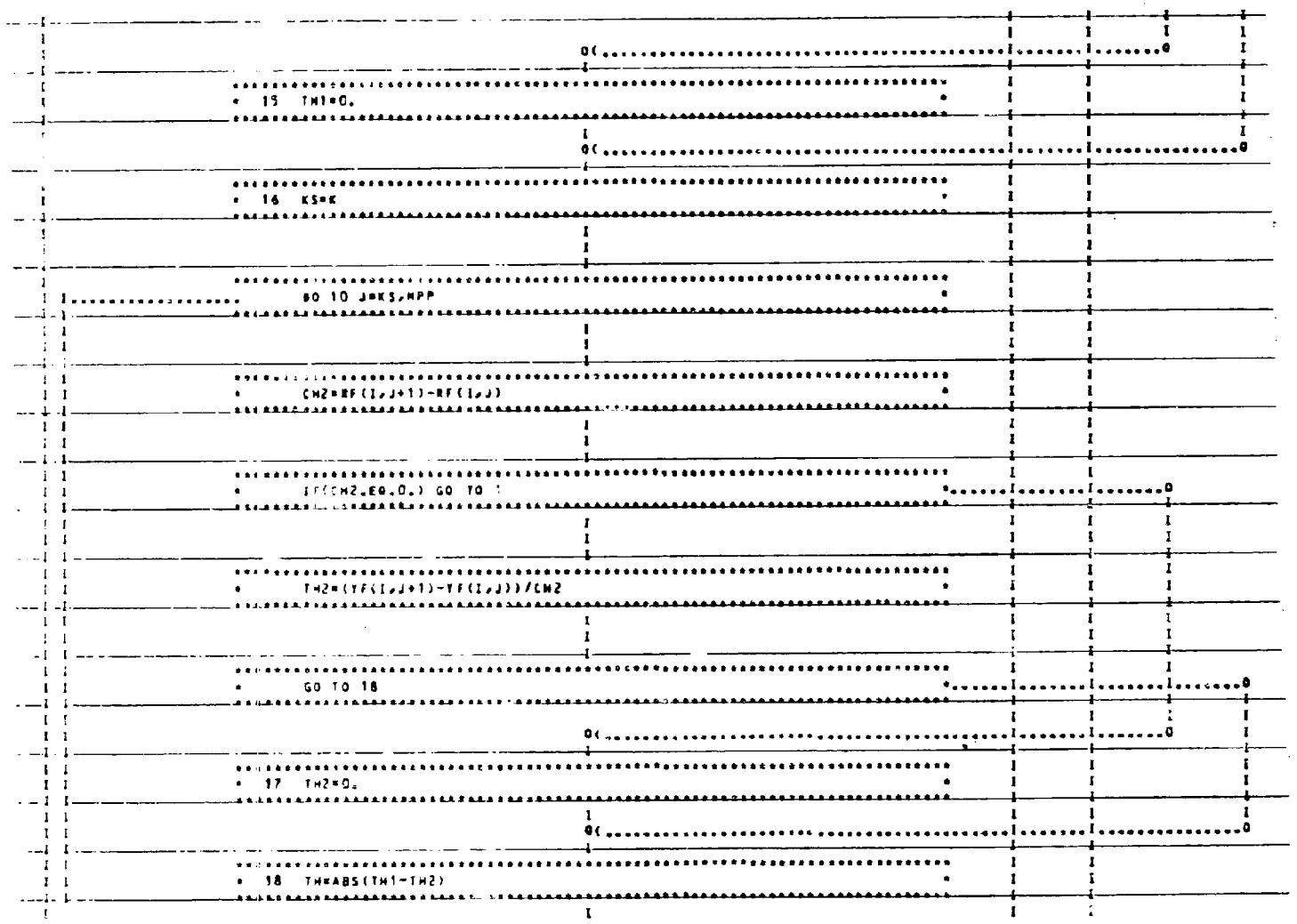

(ENTRANCE)
TEST
SUBROUTINE TEST1(R1T,R2T,PHI0T,PHI1T,X1T,Z1T,ITEST)
DENO = R2T**2+R1T**2-2.*R2T*R1T* COS(PHI0T)
IF(DENO) 20,20,10
10 PHI2= PHI1T+PHI0T
DENO=(R1T-R2T* SIN(PHI0T))/DENO
X2T= R2T* COS(PHI2)
Z2T = R2T* SIN(PHI2)
D1F=SQRT((X2T-R1T* SIN(PHI1T))
D2F=SQRT((X2T-R1T* COS(PHI1T))
D1F = SQRT((X1T-XF)**2+(Z1T-ZF)**2)
D2F= SQRT((X2T-XF)**2 (Z2T-ZF)**2)
D12 = SQRT((X2T-X1T)**2+(Z2T-Z1T)**2)
IF(ABS(D1F-D12) -1.0E-03) 11,11,12
11 D1F= D12
IF(ABS(D2F-D12)-1.0E-03) 13,13,14
13 D2F= D12

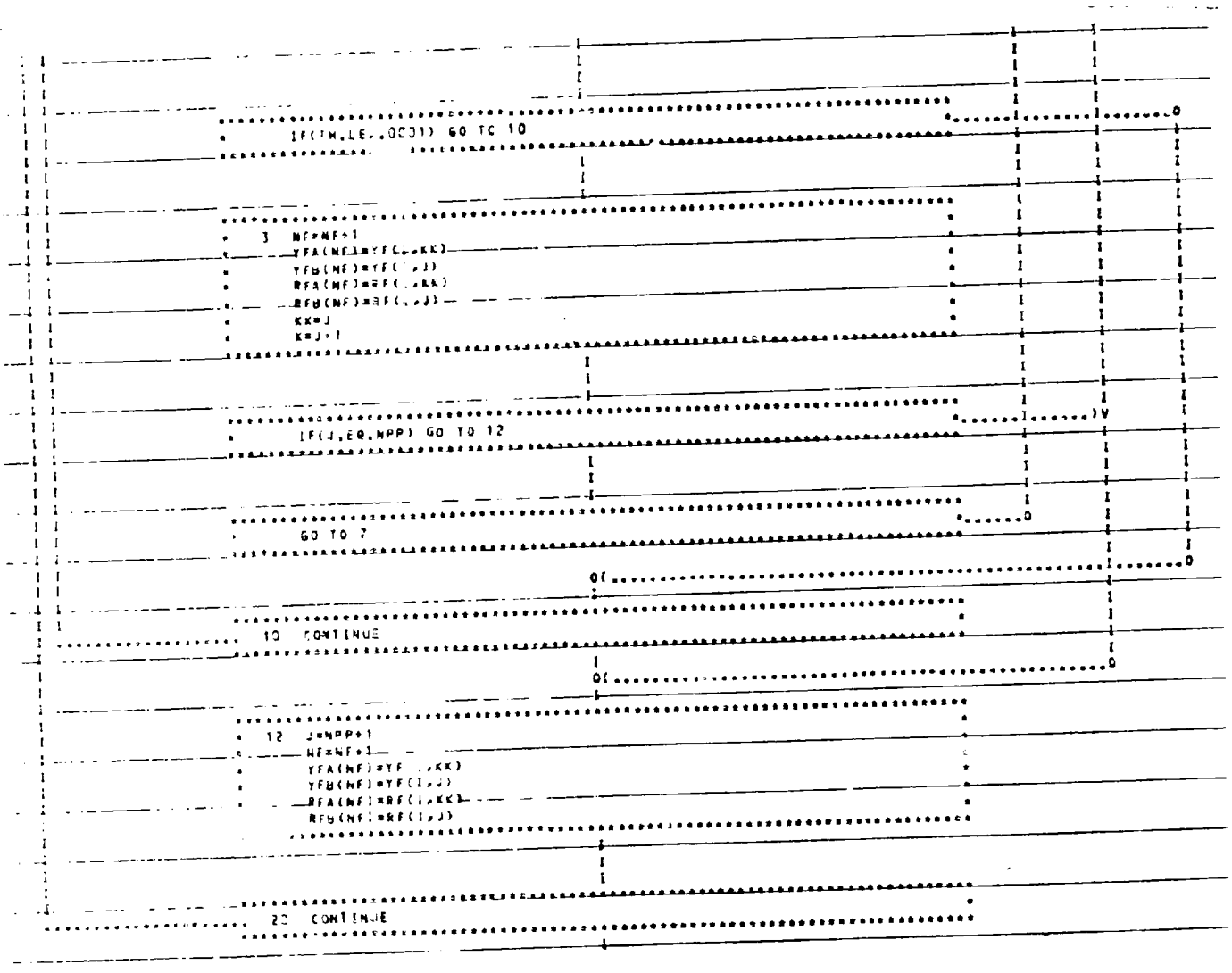

14 IF(DIF-0.12) 15,15,20
15 IF(D2F-0.12) 25,25,20
SOLUTION IS NOT VALID FOR THIS PROBLEM
20 ITEST = 2
RETURN
SOLUTION IS VALID FOR THIS PROBLEM
25 ITEST = 1
RETURN
END

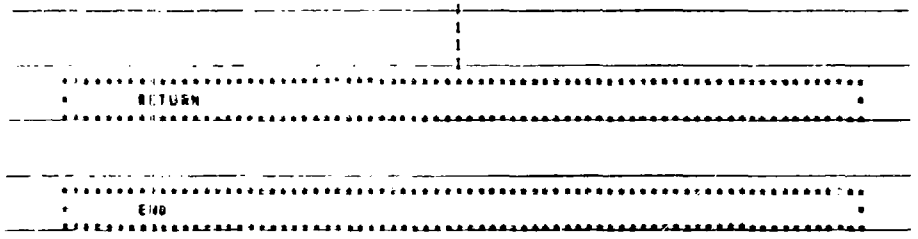

(ENTRANCE)
C TEST2
SUBROUTINE TEST2(YU,YD,YF,IFYF)
YUYD= DABS(YD-YU)
YFYD = DABS(YD-YF)
YFYU = DABS(YU-YF)
IF(DABS(YUYD-YFYD)-1.0D-03) 1,1,2
1 YFYD= YUYD
IF(DABS(YUYD-YFYU)-1.0D-03) 3,3,4
3 YFYU= YUYD
4 IF(YFYD-YUYD) 5,5,10
5 IF(YFYU-YUYD) 15,15,10
C YF IS NOT A VALID SOLUTION FOR THIS PROBLEM

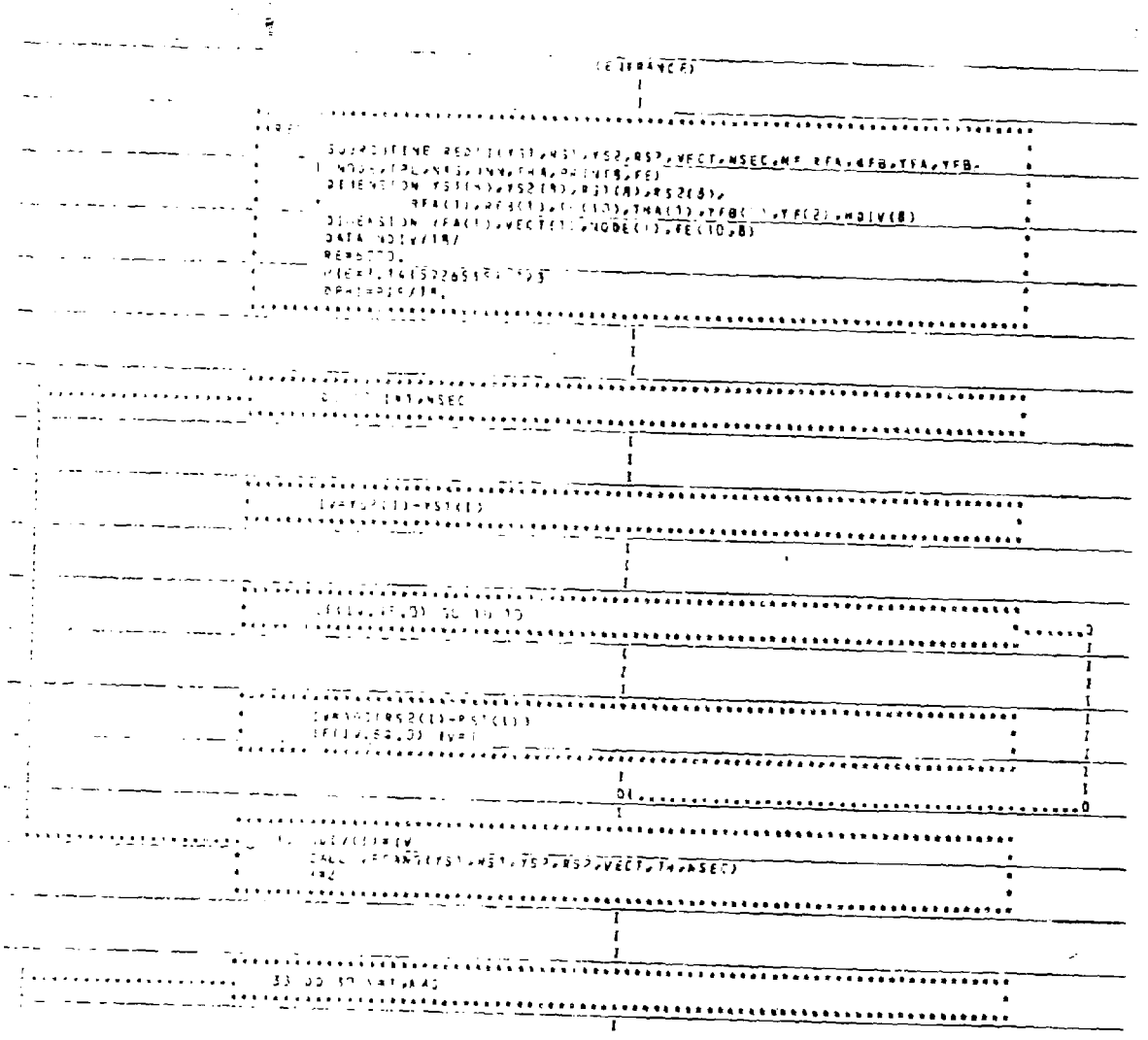

10 IFYF=2
RETURN
C YF IS A VALID SOLUTION FOR THIS PROBLEM
15 IFYF = 1
RETURN
END

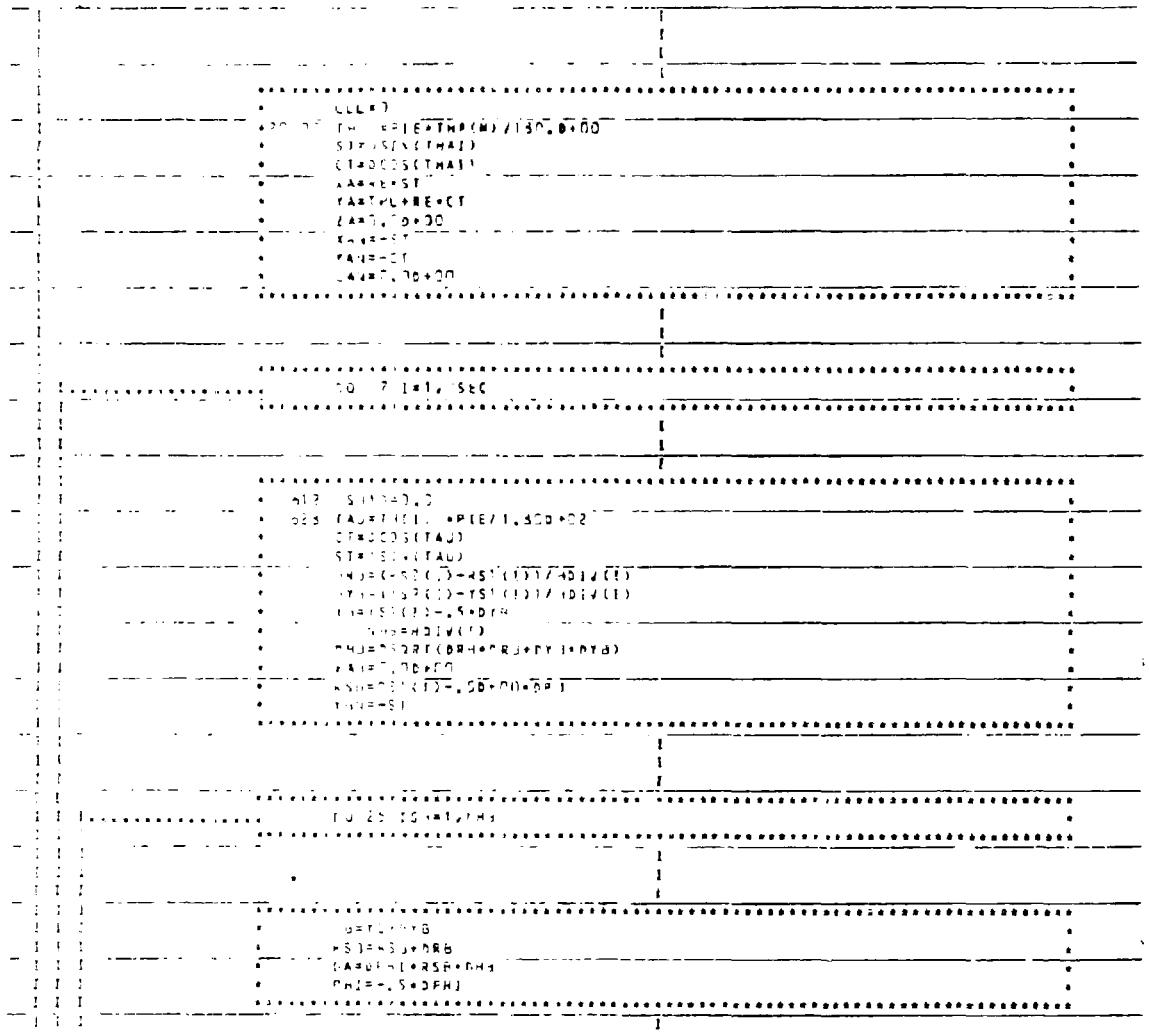

(ENTRANCE)
SHADOW
SUBROUTINE SHADOW(NNN,NP,YF,RF,NF,YFA,YFB,RFA,RFB)
DIMENSION NP(1),YF(2,8),RF(2,8),YFA(1),YFB(1),RFA(1),RFB(1)
DIMENSION NP(2)
1 NF=0
DO 20 I=1,NNN
KK=I
K=2
NPP=NP(I)-1
7 IF(K.GT.NPP) GO TO 12
5 CH1=RF(I,K)-RF(I,KK)
IF(CH1.EQ.0.0) GO TO 15
CH1=(YF(I,K)-YF(I,KK))/CH1
GO TO 16

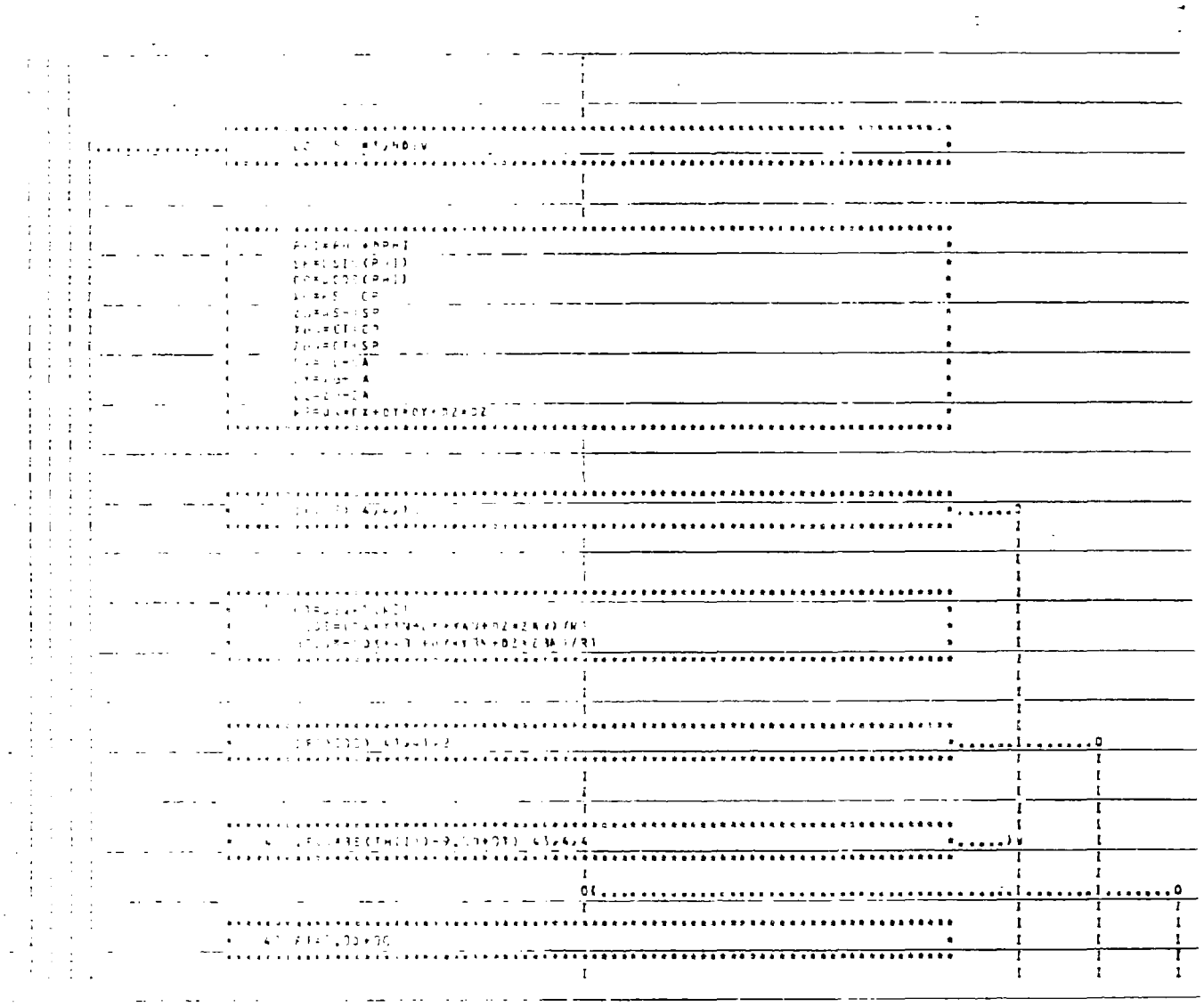

15 TH1=0.
16 KS=K
DO 10 J=KS,KPP
CH2=RF(I,J+1)-RF(I,J)
IF(CH2.EQ.0.) GO TO 1
TH2=(YF(I,J+1)-YF(I,J))/CH2
GO TO 18
17 TH2=0.
18 TH=ABS(TH1-TH2)

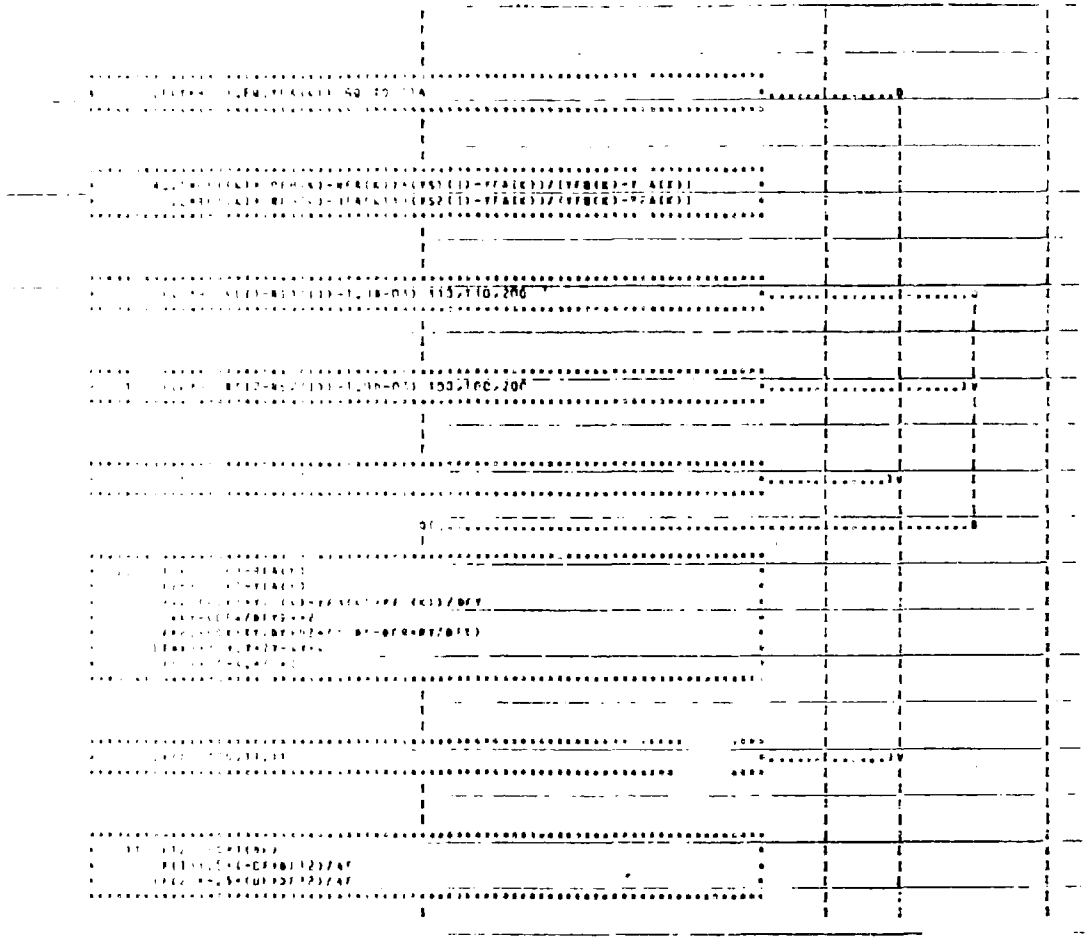

IF(TH.LE..0001) GO TO 10
3 NF=NF+1
YFA(NF)=YF(.,KK)
YFB(NF)=YF(.,J)
RFA(NF)=RF(.,KK)
RFB(NF)=RF(.,J)
KK=J
K=J+1
IF(J.EQ.NPP) GO TO 12
GO TO 7
10 CONTINUE
12 J=NPP+1
NF=NF+1
YFA(NF)=YF(.,KK)
YFB(NF)=YF(1,J)
RFA(NF)=RF(1,KK)
RFB(NF)=RF(1,J)
20 CONTINUE

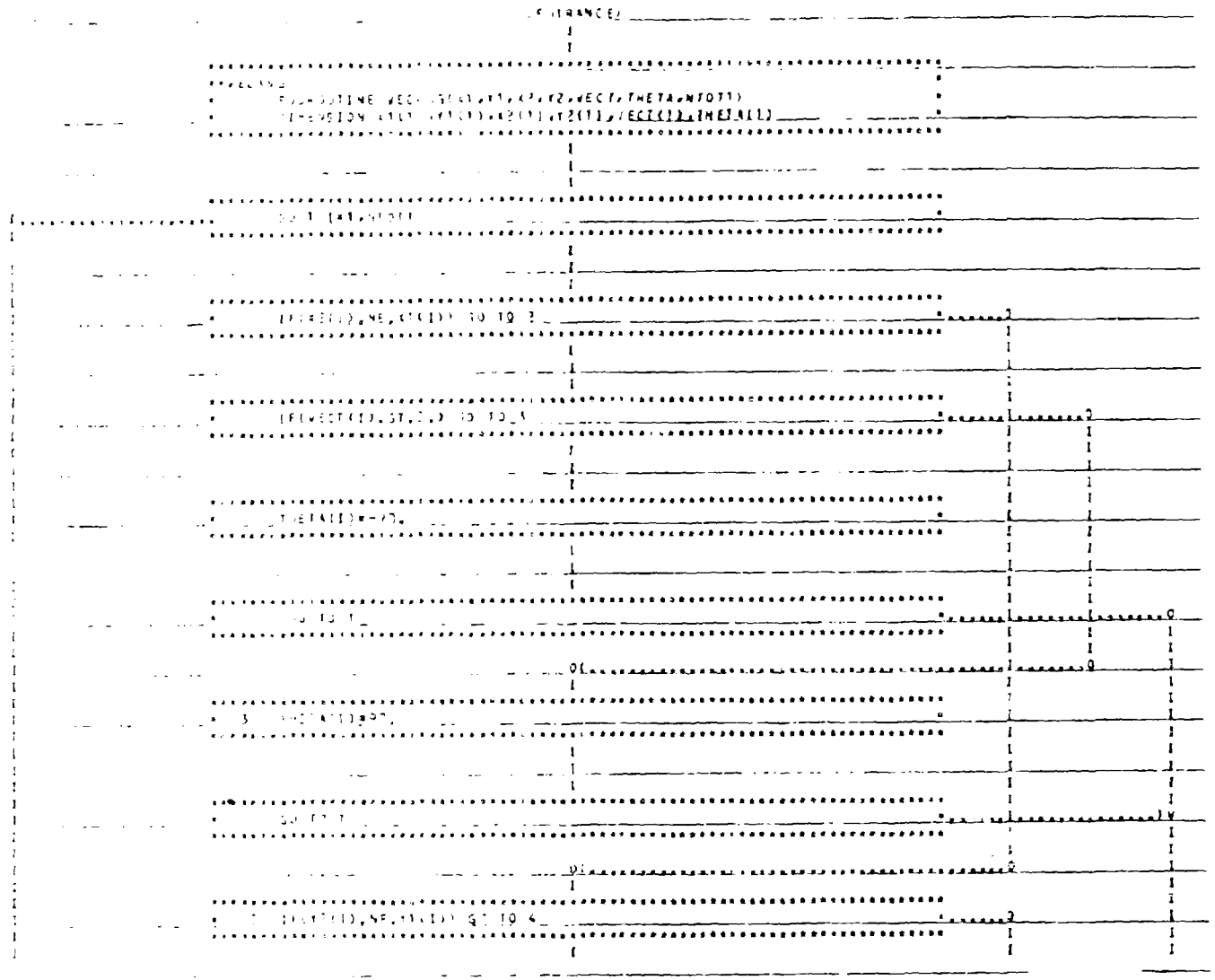

RETURN
END

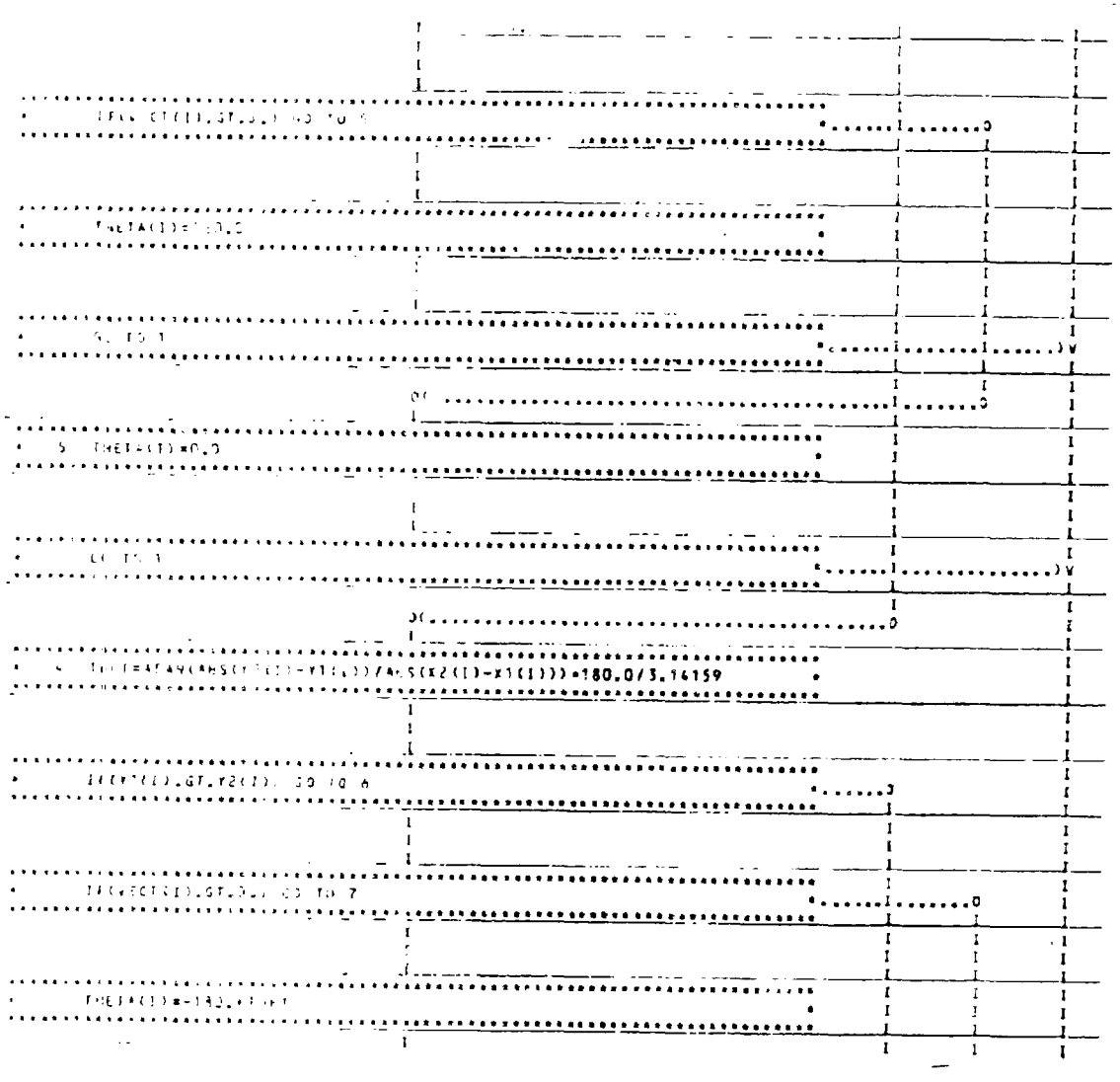


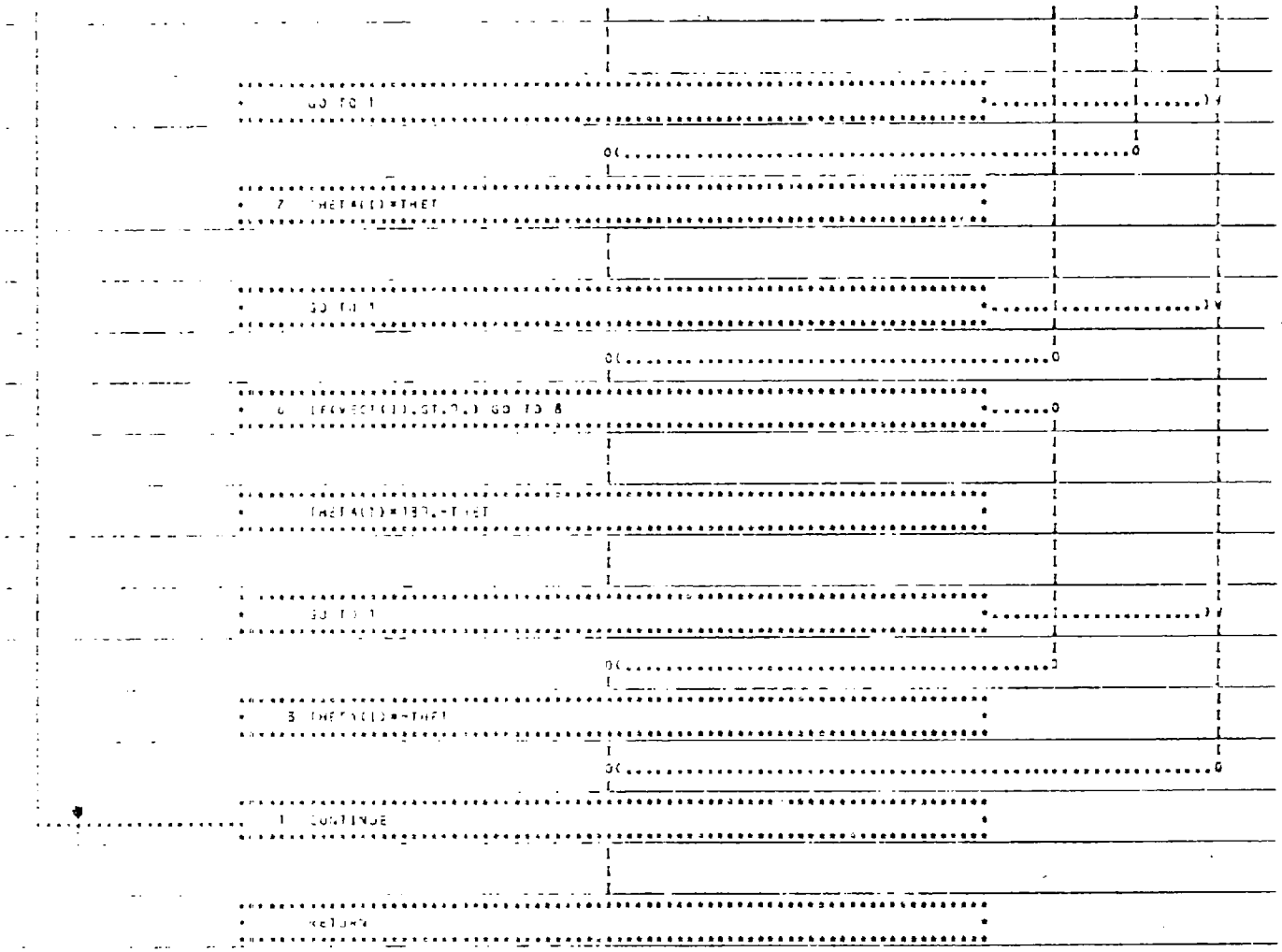












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