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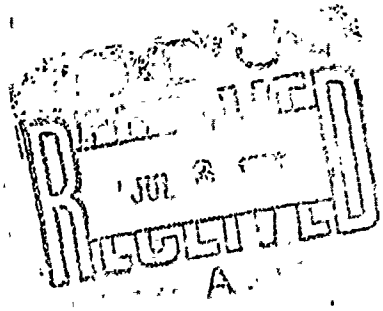
USER'S MANUAL

AEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MATERIAL ABLATION COMPUTER PROGRAM (ASTHMA3)

Volume II - Fortran Variables, Flow Charts, and Program Listings

January 1972

Air Force Rocket Propulsion Laboratory
Director of Laboratories
Edwards, California 93523
Air Force Systems Command
United States Air Force



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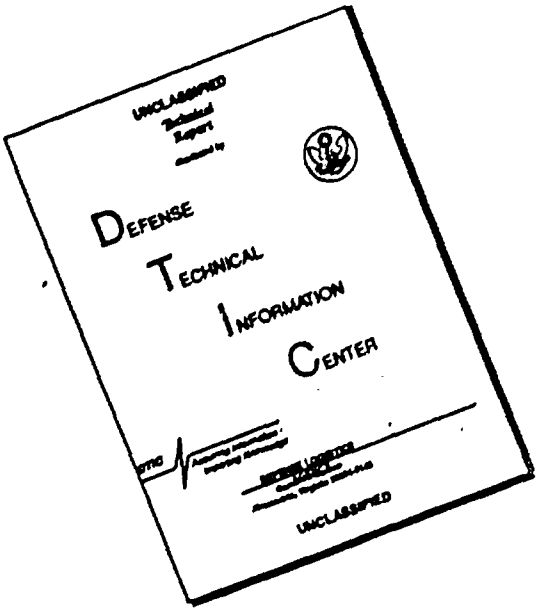

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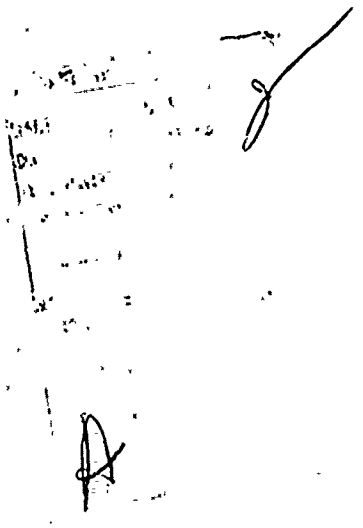

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13. ABSTRACT

This document presents definitions of Fortran variables names, flow charts, and listings for the Aerotherm Axi-Symmetric Transient Heating and Material Ablation Program, Version 3 (ASTHMA3).

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USER'S MANUAL

AEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MATERIAL ABLATION COMPUTER PROGRAM (ASTHMA3)

VOLUME II

FORTRAN VARIABLES, FLOW CHARTS, AND PROGRAM LISTINGS

Prepared Under the Sponsorship of

Air Force Rocket Propulsion Laboratory
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United States Air Force

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Approved for Public Release
Distribution Unlimited

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FOREWORD

This report is one of two computer program user's manuals prepared by Aerotherm Division of Acurex Corporation under USAF Contract F04611-69-C-0081. Included herein is Volume II of the manual for Version 3 of the Aerotherm Axi-Symmetric Transient Heating and Material Ablation (ASTHMA3) computer code. This volume presents definitions of Fortran variables, flow charts, and program listings. The code was originally developed under USAF Contract F04611-67-C-0047, and upgraded under the subject contract. The work was administered under the direction of the Air Force Rocket Propulsion Laboratory with Mr. Robert J. Schoner as Project Officer.

Mr. John W. Schaefer was Program Manager and Mr. Mitchell R. Wool was Program Engineer. The ASTHMA code upgrading was performed by Dr. Carl B. Moyer and Mr. Kurt E. Suchsland.

This technical report has been reviewed and is approved.

A. D. Brown, Jr., Lt. Col., USAF
Chief, Technology Division

ABSTRACT

This document presents definitions of Fortran variable names, flow charts, and listings for the Aerotherm Axi-Symmetric Transient Heating and Material Ablation Program, Version 3 (ASTHMA3).

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SECTION 1

INTRODUCTION

The computer program described in this user's manual is a revised edition of the Axi-Symmetric Transient Heating and Material Ablation Program (ASTHMA3). The current program solves all problems that the earlier version could solve and provides additional computational capabilities.

The purpose of Volume I of this user's manual was to enable an unfamiliar user to utilize effectively the Axi-Symmetric Transient Heating and Material Ablation Program. It contains a general description of the problems ASTHMA3 solves, an input data deck preparation guide, and a sample problem input and output. Volume II of this manual, included herein, contains the following additional program documentation:

- Definitions for important Fortran variables used
- Flow charts of program logic for each Fortran routine
- Listings of Fortran IV source decks

These are given in Sections 2, 3, and 4, respectively.

SECTION 2

FORTRAN VARIABLE NAMES

This section contains a list of Fortran variable names used in ASTHMA.

Descriptions of the relative positions of nodes employ a simple convention in order to avoid the repeated use of lengthy phraseology. The nodal net is assumed to be visualized by the reader as read in from bottom to top in each column, with the columns encountered in left to right sequence. Thus, for a given node, the node in the same row in the preceding column is described as being to the left of the given node, and so on. This convention simplifies verbal descriptions in the list below. It will be understood, however, that ASTHMA numbers nodes as encountered in the read in process, independent of the user's visualization convention of the nodal network.

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
AA( )	IN,FT2	BLANK	READ IN AS GRID RADIUS COMPONENT, LATER REPLACED BY NODAL BOX SIDE AREA FOR SIDE ADJACENT TO PRECEDING (LEFT) COLUMN
AB( )	IN,FT2	BLANK	READ IN AS GRID POINT AXIAL (Z) COMPONENT, LATER REPLACED BY NODAL BOX SIDE AREA FOR SIDE ADJACENT TO PRECEDING ROW
AC(K)	FT2	BLANK	TOP SURFACE AREA OF NODE K
AD(K)	FT2	BLANK	AREA OF SIDE OF NODAL BOX K ADJACENT TO NEXT (RIGHT) COLUMN
AG	FT2	BACK	AREA OF THAT SIDE OF NODAL BOX CALLED OUT AS THE SIDE EXPOSED TO THE BACK WALL BOUNDARY CONDITION
BLANK	---	LOCAL	DATA BLANK/6H/
BP	---	LOCAL	DIMENSIONLESS MASS TRANSFER PARAMETER B PRIME
BPG	---	LOCAL	NO PHYSICAL SIGNIFIANCE IN ASTHMA, EQUALS ZERO
BR	---	BLANK	RATIO OF BLOWN TO UNBLOWN MASS TRANSFER COEFFICIENT, BLOWING REDUCTION RATIO
BRP	---	LOCAL	CONSTANT VALUE OF BLOWING REDUCTION PARAMETER
CAP(I)	BTU/DEGR	BLANK	TOTAL THERMAL CAPACITY OF NODE I
CEC	---	LOCAL	CONSERVATION OF ENERGY CHECK, TOTAL SURFACE HEAT CONDUCTION FLUX OVER TOTAL INTERNAL STORAGE

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
CH	LB/FT2-SEC	BLANK	HEAT TRANSFER COEFFICIENT
CHI(I,J)	LB/FT2-SEC	BLANK	I-TH TABULAR VALUE OF HEAT TRANSFER COEFFICIENT IN J-TH TIME TABLE
CM	LB/FT2-SEC	BLANK	MASS TRANSFER COEFFICIENT
CMD	LB/FT2-SEC	LOCAL	NO PHYSICAL SIGNIFICANCE IN ASTHMA, EQUALS ZERO
CMDOT(J)	LB/FT2-SEC	BLANK	STORED VALUE OF ABLATION RATE M-DOT FOR J-TH COLUMN(SURFACE POINT)
CMH	---	BLANK	RATIO OF MASS TO HEAT TRANSFER COEFFICIENTS
CMHS	---	LOCAL	INPUT VALUE OF CMH
CMT(J)	LB/FT2	BLANK	TIME INTEGRATED VALUE OF EROSION FOR J-TH COLUMN
CNI(I,J)	BTU/FT-SEC-DEGR	BLANK	I-TH TABULAR VALUE OF THERMAL CONDUCTIVITY IN J-TH MATERIAL PROPERTIES TABLE(FOR MATERIAL NO. J), THIS CONDUCTIVITY APPLIES ALONG ROWS (N-DIRECTION, FIXED M)
CNI2(I,J)	BTU/FT-SEC-DEGR	BLANK	I-TH TABULAR VALUE OF THERMAL CONDUCTIVITY J-TH MATERIAL PROPERTIES TABLE (FOR MATERIAL NO. J),THIS CONDUCTIVITY APPLIES ALONG COLUMNS (M-DIRECTION,FIXED N), REPLACED BY CNI(I,J) IF ENTERED AS ZERO
CON(K)	BTU/FT-SEC-DEGR OR DEGR	BLANK	STORES RELEVANT CONDUCTIVITY OF A BACK-WALL NODE FOR OPTION 1 BACK WALL HEAT TRANSFER CALCULATION, OR OPTION 2 BACK WALL NODE TEMPERATURE

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
CPT(I,J)	BTU/LB	BLANK	I-TH TABULAR VALUE OF SPECIFIC HEAT IN J-TH MATERIALS PROPERTIES TABLE (FOR MATERIAL NO. J)
CR(K)	IN	BLANK	RADIUS COORDINATE OF K-TH GRID POINT
CRA(K)	FT2-SEC-DEGR/BTU	BLANK	INTERFACE (CONTACT) RESISTANCE BETWEEN NODE K AND NEXT NODE (UP) IN SAME COLUMN
CRB(K)	FT2-SEC-DEGR/BTU	BLANK	INTERFACE(CONTACT) RESISTANCE BETWEEN NODE IN NEXT (RIGHT) COLUMN IN SAME ROW
CT2	BTU/LB	LOCAL	UNUSED PLACE HOLDER
CZ(K)	IN	BLANK	AXIAL(Z) COORDINATE OF K-TH GRID POINT
DELHF(I)	BTU/LB	LOCAL	HEAT OF FORMATION AT 298 DEG K OF MATERIAL ASSIGNED TO I-TH SURFACE TABLE (PRESSURE SET)
DEN	VARIOUS	LK	INTERPOLATION RATIO, ALSO USED AS SUM OF CONDUCTANCES (DENOMINATOR IN FRACTION)
DENSV	VARIOUS	LK	SAVED VALUE OF DEN
DH2	BTU/LB	LOCAL	HEAT OF FORMATION OF ABLATING MATERIAL
DH2S	BTU/LB	LOCAL	SAVED VALUE OF DH2
DLTH	SEC	BLANK	INPUT FIXED TIME STEP
DMS	LB/FT2-SEC	LOCAL	PARAMETRIC VALUE OF TRANSFER COEFFICIENT ON SURFACE THERMOCHEMISTRY TABLE CARDS
DS(J)	FT	BLANK	INCREMENT IN CENTERLINE RECESSION AT J-TH COLUMN DURING CURRENT TIME STEP

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
DSDT(J)	FT/SEC	BLANK	COLUMN CENTERLINE SURFACE RECESSION RATE AT J-TH COLUMN
DSDTB(J)	FT/SEC	BLANK	NEW VALUE OF COLUMN CENTERLINE SURFACE RECESSION RATE AT J-TH COLUMN
DSDTBN(J)	FT/SEC	BLANK	NEW VALUE OF NORMAL SURFACE RECESSION RATE AT J-TH COLUMN
DSN(J)	FT	BLANK	INCREMENT IN NORMAL RECESSION AT J-TH COLUMN DURING CURRENT TIME STEP
DST(J)	FT	BLANK	TOTAL CENTERLINE RECESSION IN CURRENT SURFACE NODE AT J-TH COLUMN
DSIT(J)	FT	BLANK	INTEGRATED CENTERLINE RECESSION AT J-TH COLUMN
DTK	SEC	BLANK	TIME STEP
DTHM	SEC	LOCAL	MININUM TIME STEP EMPLOYED BETWEEN TWO OUTPUT TIMES
DTHS	SEC	BLANK	MINIMUM NODE STABILITY LIMITING TIME STEP
D2(I)	VARIOUS	LOCAL	UTILITY VARIABLE USED FOR OUTPUT DERIVATIVES FROM LOOK
EBW	---	BACK	BACK WALL EMITTANCE FOR CURRENT BACK WALL BEING CONSIDERED
EIIER(I)	BTU/FT2-SEC	BLANK	VALUE OF ERROR IN SURFACE ENERGY BALANCE AT I-TH ITERATION
EMN(J)	---	BLANK	SLOPE DR/DZ OF NORMAL TO SURFACE AT J-TH COLUMN (SURFACE POINT)

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
EM1	---	LOCAL	EMITTANCE OF MATERIAL ABOVE A NODAL GAP, AT CURRENT NODAL TEMPERATURE
EM2	---	LOCAL	EMITTANCE OF MATERIAL BELOW A NODAL GAP AT CURRENT NODAL TEMPERATURE
EPSV(I)	---	BLANK	EMITTANCE OF A NODE SAVED FOR BACK WALL ENERGY TRANSFER CALCULATIONS
EPSW	---	BACK	CONSTANT BACK WALL EMITTANCE VALUE
EPT(I,J)	---	BLANK	I-TH TABULAR ENTRY OF EMITTANCE IN PROPERTIES TABLE FOR J-TH MATERIAL
ETA	---	BLANK	MULTIPLICATIVE FACTOR ON STABILTY LIMITED TIME STEP DETERMINED FROM NODAL TIME CONSTANT
FT	FT/IN	BLANK	NUMERICAL CONVERSION CONSTANT .083333 ...FT/IN
FV	---	BLANK	NUMERICAL CONSTANT 0.5
G(J)	LB/FT2-SEC	BLANK	SAVED VALUE OF CONVECTIVE MASS TRANSFER COEFFICIENT RHE-UE-CM AT J-TH SURFACE POINT
GZ(J)	LB/FT2-SEC	BLANK	SAVED VALUE OF CONVECTIVE MASS TRANSFER COEFFICIENT BEFORE BLOWING CORRECTION, AT J-TH SURFACE POINT
HA	VARIOUS	LOCAL	UTILITY VARIABLE, MANY TEMPORARY USES
HB	VARIOUS	LOCAL	UTILITY VARIABLE, MANY TEMPORARY USES
HBW	BTU/FT2-SEC-DEGR	BACK	CONVECTIVE TRANSFER COEFFICIENT AT A BACK WALL SURFACE

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
HC	VARIOUS	LOCAL	UTILITY VARIABLE, MANY TEMPORARY USES
HCH	BTU/LB	LOCAL	ENTHALPY OF ABLATING MATERIAL AT SURFACE TEMPERATURE
HCONV	BTU/FT2-SEC-DEGR	BACK	CONSTANT VALUE OF BACK WALL HEAT TRANSFER COEFFICIENT
HD	VARIOUS	LOCAL	UTILITY VARIABLE, MANY TEMPORARY USES
HE	VARIOUS	LOCAL	UTILITY VARIABLE, MANY TEMPORARY USES
HEDG(J)	BTU/LB	BLANK	SAVED VALUE OF INPUT RECOVERY ENTHALPY (AS INTERPOLATED IN TIME TABLE FOR J-TH SURFACE POINT
HF	VARIOUS	LOCAL	UTILITY VARIABLE, MANY TEMPORARY USES
HG	FT2	LOCAL	UTILITY VARIABLE IN GEOMETRY CALCULATIONS
HGA	BTU/LB	LOCAL	NO PHYSICAL SIGNIFICANCE IN ASTHMA, EQUALS ZERO
HH	FT2	LOCAL	UTILITY VARIABLE, GEOMETRY CALCULATIONS
HM	BTU/FT-SEC-DEGR	LOCAL	UTILITY VARIABLE USED FOR STORAGE OF NODAL CONDUCTIVITIES
HMS	BTU/FT-SEC-DEGR	LOCAL	SAVED VALUE OF HM
HS	FT3	LOCAL	UTILITY VARIABLE IN NODAL VOLUME CALCULATION
HSH	BTU/LB	LOCAL	ENTHALPY TERM USED TO SCALE SENSIBLE ENTHALPY TABLE ENTRIES TO ZERO AT THE DATUM STATE

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
HWL(J)	BTU/LB	BLANK	STORED VALUE OF ENTHALPY OF FROZEN EDGE GASES AT CURRENT SURFACE TEMPERATURE OF J-TH SURFACE POINT, ZERO IF NO EDGE TABLES ARE PROVIDED
HZ	BTU/LB	LOCAL	Z-ENTHALPY TERM OBTAINED BY LOOK-UP IN FROZEN EDGE TABLES, USED IN CONSTRUCTING SURFACE THERMOCHEMISTRY TABLES
I	---	LOCAL	UTILITY INDEX OFTEN USED AS NODE COUNTER
IAB	---	BLANK	FLAG, INITIALLY ZERO, USED TO DETECT FIRST PASS THROUGH ABLATING (B PRIME INDEPENDENT) SURFACE ENERGY BALANCE PACKAGE
IABLS(J)	---	BLANK	SAVED VALUE OF IAB AT J-TH COLUMN
IEX	---	LK	INDEX RETURNED BY LOOK, VALUES GREATER THAN ZERO INDICATE EXTRAPOLATION WAS REQUIRED FOR LATEST LOOK-UP
IFIN	---	LOCAL	NOT CURRENTLY USED
IFORM(I)	---	LOCAL	VARIABLE USED TO STORE ADJUSTABLE OUTPUT FORMAT FOR IN DEPTH TEMPERATURES
IG	---	LOCAL	FLAG USED TO MARK A MAXIMUM TEMPERATURE ENTRY IN A B PRIME TABLE
IMI(K)	---	LK	INDEX OF LAST ENTRY IN TABLE NUMBER K
II(J)	---	BLANK	STORED INDEX DESCRIBING CURRENT BOUNDARY HEATING CONDITIONS OPTION AT J-TH SURFACE POINT (1,2,OR 3)

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
III	---	LOCAL	UTILITY INDEX, USUALLY NUMBER OF ROWS
IJ	---	LOCAL	TEMPORARY BOUNDARY CONDITION HEATING OPTION IDENTIFICATION(1,2,OR3)
ILO(K)	---	LK	INDEX OF FIRST ENTRY IN TABLE NUMBER K
IN	---	LOCAL	UTILITY INDEX, USUALLY INDEX FOR NEXT TRANSFER COEFFICIENT VALUE IN SURFACE THERMOCHEMISTRY TABLES
INCH	---	LOCAL	LOGICAL UNIT NUMBER, USED FOR INPUT OF SURFACE THERMOCHEMISTRY TABLES
INICK	---	LOCAL	UTILITY INDEX USED IN OUTPUT OF NODAL TEMPERATURES
INPUT	---	LOCAL	LOGICAL UNIT NUMBER, USED FOR INPUT OTHER THAN SURFACE THERMOCHEMISTRY TABLES
INT	---	LOCAL	UTILITY INDEX
IOPT(NTH)	---	LOCAL	BOUNDARY CONDITION HEATING OPTION NUMBER OF THE NTH-TH ENTRY IN THE CURRENT TIME TABLE
IP	---	LOCAL	INDEX ON PRESSURE IN SURFACE THERMO-CHEMISTRY TABLE INPUT
IPN	---	LOCAL	INDEX ON PRESSURE IN SURFACE THERMOCHEMISTRY TABLE INPUT
IR(K)	---	LK	REMEMBERED INDEX IN K-TH TABLE ADJACENT TO PREVIOUS VALUE FOR WHICH A LOOK-UP WAS PERFORMED

LIST OF VARIABLE NAMES FOR
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HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
IS	---	LOCAL	SAVED VALUE OF IJ DURING TIME TABLE INPUT
ISEN(I)	---	ENRGY	NUMBER OF ENTRIES IN FROZEN EDGE TABLE FOR I-TH TABLE
ISKIP	---	LOCAL	SAVED HOLLERITH FORMAT SPECIFICATION 6H,A6,6X
IT	---	LOCAL	UTILITY INDEX, USUALLY USED AS PROPERTIES TABLE INDEX
ITER	---	LOCAL	ACCUMULATED NUMBER OF TIME STEPS TAKEN
ITS	---	BLANK	NUMBER OF ITERATIONS TAKEN IN LATEST SURFACE ENERGY BALANCE SEARCH
ITSR(J)	---	BLANK	SAVED VALUE OF ITS FOR J-TH SURFACE POINT
IX	---	LOCAL	FLAG ON TYPE OF INPUT ERROR IN SURFACE THERMOCHEMISTRY TABLE INPUT
IZ( )	---	LOCAL	OUTPUT INDEX ARRAY FROM SUBROUTINE ORDERD
J	---	LOCAL	UTILITY INDEX OFTEN USED AS A COLUMN COUNTER
JFORM( )	---	LOCAL	ARRAY USED FOR OUTPUT FORMAT CONSTRUCTED FOR NODAL TEMPERATURES
JJ	---	LOCAL	UTILITY VARIABLE, OFTEN USED FOR SWITCH SENSE

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ASLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
JNG	---	LOCAL	FLAG TO IDENTIFY TYPE OF SURFACE THERMOCHEMISTRY TABLE ENTRY,=1 FOR FROZEN EDGE TABLE, 0 FOR ZERO B PRIME (INDEPENDENT SURFACE TEMERATURE) ENTRY, 1 FOR SURFACE EQUILIBRIUM (B PRIME INDEPENDENT) IN CMA FORMAT -- (0,1, AND 2 USED IN ACE FORMAT)
JNICK	---	LOCAL	UTILITY INDEX USED IN OUTPUT OF NODAL TEMPERATURES
JT	---	LOCAL	UTILITY INDEX
K	---	LOCAL	UTILITY INDEX, OFTEN USED FOR PRECEDING NODE
KASE	---	LOCAL	INPUT, NON-ZERO CALLS FOR READ OF AN ADDITIONAL STACKED PROBLEM, ZERO INDICATES LAST PROBLEM
KBW(KT)	---	LOCAL	INDEX FOR KT-TH TIME TABLE USED TO CHECK FOR CONSISTENCY OF TIME TABLE ASSIGNMENTS TO NODES IN BACK-WALL, FRONT WALL SENSE, 0 DENOTES FRONT-WALL, 1 DENOTES BACK-WALL, 2 DENOTES NOT YET ASSIGNED
KCAN	---	LOCAL	INDEX USED IN IDENTIFICATION OF THE HEATED SURFACE NODE IN A GIVEN COLUMN
KCENT	---	BLANK	INPUT FLAG DENOTING NODAL CENTER OPTION, 0 INDICATES BACK-SHIFTED, 1 INDICATES CENTERED
KDROP(J)	---	BLANK	FLAG,1 INDICATES A NODE WAS DROPPED IN COLUMN J AT THIS TIME STEP, 0 INDICATES NO DROP

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
KGAP(I)	---	BLANK	RADIATION GAP FLAG, 1 INDICATES RADIATION GAP HAS BEEN SPECIFIED AT THE TOP OF THE I-TH NODE, 0 INDICATES CONTACT CONDUCTANCE ONLY
KHI(I,J)	---	ENRGY	MARKS LAST ENTRY IN NO-ABLATION (TEMPERATURE INDEPENDENT) PART OF A SURFACE THERMOCHEMISTRY TABLE FOR I-TH VALUE OF MASS TRANSFER COEFFICIENT AND J-TH PRESSURE, REGARDLESS OF USERS INPUT LABELLING, THIS IS TAKEN AS LAST TEMPERATURE BEFORE TEMPERATURE ENTRIES BEGIN TO DESCEND IF EVER
KK	---	LOCAL	TOTAL NUMBER OF NODES
KLOG	---	LOCAL	INPUT FLAG, 1 CALLS FOR NEW, FASTER PROPERTIES LOOK-UP LOGIC, 0 CALLS FOR OLDER LOGIC
KMTL(J)	---	LOCAL	MATERIAL NUMBER ASSIGNED TO J-TH SURFACE THERMOCHEMISTRY TABLE TO IDENTIFY SPECIFIC HEAT FUNCTION TO BE EMPLOYED IN ABLATION CALCULATIONS, ZERO IMPLIES ONE
KN	---	LOCAL	FLAG, 1 INDICATES OPTION 1 ENTRIES EXIST IN CURRENT TIME TABLE, ZERO INDICATES NO OPTION 1 ENTRIES YET DISCOVERED
KNW	---	LOCAL	FLAG, 1 INDICATES OPTION 1 ENTRIES OCCUR SOMEWHERE IN HEATING TABLES CONSIDERED AS A WHOLE, ZERO INDICATES NO OPTION 1 ENTRIES

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
KNST	---	LOCAL	FLAG USED TO IDENTIFY FIRST SURFACE THERMOCHEMISTRY DECK ENCOUNTERED, TO CHECK ERRONEOUS ASSIGNMENT OF TABLE IF TABLE EXISTS
KORTG	---	LOCAL	INPUT FLAG, 1 CALLS FOR ORTHOGONALITY CORRECTIONS TO THERMAL CONDUCTANCES, ZERO OMITS CORRECTIONS
KOUT	---	LK	LOGICAL UNIT NUMBER FOR PRINTED OUTPUT
KOOP	---	BLANK	NOT USED
KRESC	---	BLANK	FLAG, INPUT BUT ADJUSTED BY ADDING 1, SPECIFYING TYPE OF FIRST TO SECOND NODE LINKAGE, 1 DENOTES EXPLICIT, 2 DENOTES QUARTER IMPLICIT, 3 DENOTES HALF IMPLICIT
KSH(I)	---	BLANK	DENOTES SIDE HEATED FOR NODE I, 1 IMPLIES HEATED SURFACE BOUNDARY CONDITION,2,3 AND 4 IMPLY BACK-WALL BOUNDARY CONDITION, THESE INPUT NUMBERS LATER ADJUSTED TO ACCOUNT FOR VARIOUS BACK-WALL HEATING OPTIONS
KSLOP	---	BLANK	INPUT SLOPE ROUTINE FLAG, ADJUSTED UP BY ONE, 1 DENOTES LINEAR AVERAGING, 2 DENOTES QUADRATIC SLOPE FINDER
KSSW	---	LOCAL	UTILITY VARIABLE USED FOR SENSE SWITCH SENSE
KSTRP	---	LOCAL	SPECIAL PUNCHED OUTPUT FLAG, CALLS FOR PUNCHED OUTPUT AT ALL PRINT TIMES, 2 CALLS FOR PUNCHED OUPUT ONLY AT SPECIAL TIMES, SEE TPN( )

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ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
KSUR(J)	---	BLANK	DENOTES NODE NUMBER OF CURRENT SURFACE NODE IN J-TH COLUMN
KT	---	LOCAL	UTILITY INDEX, USUALLY TIME TABLE COUNTER
KTCTB	---	LOCAL	INPUT FLAG, ADJUSTED UPWARD BY ONE, DENOTING SURFACE THERMOCHEMISTRY TABLE FORMAT, 1 DENOTES STANDARD ACE FORMAT, 4 DENOTES CMA FORMAT
KTH(I)	---	BLANK	INPUT FLAG FOR NODE I, 1 DENOTES NODE I TO BE CONSIDERED IN STABILITY LIMITED TIME STEP CALCULATIONS, 0 DENOTES THAT NODE I IS NOT TO BE CONSIDERED
KTS	---	LOCAL	SAVED VALUE OF MATERIAL IDENTIFICATION NUMBER
KTU(I)	---	BLANK	TIME TABLE NUMBER ASSIGNED TO NODE I
KWE(I)	---	BLANK	NOT PRESENTLY USED IN ASTHMA
L	---	LOCAL	UTILITY INDEX
LCI	---	LOCAL	NUMBER OF LINES REMAINING IN CURRENT OUTPUT PAGE
LCTX	---	LOCAL	NUMBER OF LINES TO BE WRITTEN IN CURRENT OUTPUT OPERATION
LL	---	LOCAL	UTILITY VARIABLE, USUALLY LOWER LIMIT OF IMPLIED LOOP
LLL	---	LOCAL	UTILITY VARIABLE
LLLM	---	LOCAL	UTILITY VARIABLE FOR NUMBER OF LINES TO BE WRITTEN

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
LR	---	LOCAL	UTILITY INDEX USUALLY ON CORNER COORDINATE TO LOWER RIGHT
LU	---	LOCAL	UTILITY VARIABLE
M	---	LOCAL	UTILITY INDEX, OFTEN USED AS NODE COUNTER
MATL(I)	---	BLANK	INPUT MATERIAL IDENTIFICATION NUMBER ASSIGNED TO NODE I
MCRIT	---	LOCAL	ROW INDEX OF NODE WITH SMALLEST STABILTY LIMITED TIME STEP
MP	---	BLANK	NUMBER OF ROWS IN NODAL GRID
MOUT	---	LOCAL	ABSOLUTE VALUE OF MATERIAL IDENTIFI-CATION NUMBER FOR OUTPUT PURPOSES
MPR(I)	---	BLANK	STORED ROW INDEX OF I-TH OUTPUT NODE TEMPERATURE IN AN OUTPUT LINE
M2	---	LOCAL	UTILITY INTEGER
N	---	LOCAL	UTILITY INDEX, OFTEN USED AS NODE COUNTER
NC	---	LOCAL	UTILITY INTEGER
NCORN	---	PARAM	MAXIMUM NUMBER OF NODAL GRID (INTERSECTION) POINTS
NCRIT	---	LOCAL	COLUMN INDEX OF NODE WITH SMALLEST STABILITY LIMITED TIME STEP

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
NMI(I,J)	---	ENRGY	MARKS THE TOP ENTRY IN THE ABLATING PART OF THE J-TH SURFACE THERMOCHEMISTRY TABLE, FOR THE I-TH VALUE OF MASS TRANSFER COEFFICIENT
NMT	---	BLANK	NUMBER OF TIME TABLES READ IN
NLO(I,J)		ENRGY	MARKS BOTTOM ENTRY IN ABLATING PART OF J-TH SURFACE THERMOCHEMISTRY TABLE, FOR THE I-TH VALUE OF MASS TRANSFER COEFFICIENT
NMC	---	LOCAL	NUMBER OF ENTRIES IN SET OF B-PRIME VALUES FOR CURRENT SURFACE TABLES
NMG(I)	---	ENRGY	NUMBER OF TABULAR MASS TRANSFER COEFFIENT ENTRIES TMG( ) IN I-TH SURFACE THERMOCHEMISTRY TABLE
NMT	---	BLANK	NUMBER OF MATERIAL PROPERTY TABLES
NN		BLANK	NUMBER OF COLUMNS IN NODAL GRID
NNODE	---	PARAM	MAXIMUM NUMBER OF NODES ALLOWED
NNPR(I)	---	BLANK	STORED COLUMN INDEX OF I-TH OUTPUT NODE TEMPERATURE IN AN OUTPUT LINE
NOPT	---	LOCAL	NUMBER OF OPTION SWITCHES IN CURRENT TIME TABLE
NPG	---	LOCAL	CURRENT PAGE NUMBER FOR OUTPUT LISTING, USED IN COMMUNICATION WITH LCOUNT
NPGI	---	LOCAL	SAVED VALUE OF NPG
NPR	---	ENRGY	NUMBER OF SURFACE THERMOCHEMISTRY TABLES

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
NR	---	LOCAL	NOT CURRENTLY USED
NS	---	LOCAL	TOTAL CURRENT NUMBER OF NON-NULL NODES
NSEN	---	LOCAL	NUMBER OF ENTRIES IN CURRENT FROZEN EDGE TABLES
NST	---	LOCAL	INPUT FLAG, NON-ZERO CALLS FOR RE-USE OF CURRENTLY STORED SURFACE THERMOCHEMISTRY TABLES
NTH	---	LOCAL	INDEX FOR TIME TABLE ENTRY
PIB	FT2/IN2	BLANK	CONSTANT PI/144
PLA(I)	FT	BLANK	PATH LENGTH IN NODE I FROM NODAL CENTER TO CENTER OF FACE BORDERING PRECEDING COLUMN (BETWEEN NODE I AND NODE I-MM)
PLB(I)	FT	BLANK	PATH LENGTH IN NODE I FROM NODAL CENTER TO CENTER OF FACE BORDERING NEXT NODE (I+1) OR HEATED SURFACE IF I IS A SURFACE NODE
PLBS(J)	FT	BLANK	SAVED SUM OF ORIGINAL VALUES OF PLB+PLD FOR THE CURRENT SURFACE NODE IN COLUMN J
PLC(I)	FT	BLANK	PATH LENGTH IN NODE I FROM NODAL CENTER TO CENTER OF FACE BORDERING NEXT COLUMN (BETWEEN NODE I AND NODE I+MM) OR OF RIGHT FACE IF I IS IN LAST COLUMN
PLD(I)	FT	BLANK	PATH LENGTH IN NODE I FROM NODAL CENTER TO CENTER OF FACE BORDERING PRECEDING NODE(I-1) OR OF BOTTOM FACE IF I IS IN FIRST ROW

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
PR(J)	ATM	BLANK	VALUE OF CURRENT PRESSURE AT COLUMN J AS DETERMINED BY INTERPOLATION IN INPUT TIME TABLES
PRT	SEC	BLANK	NEXT OUTPUT TIME
PRTI(I)	SEC	LOCAL	I-TH OUTPUT INTERVAL(OPTIONAL)
PSV	ATM	LOCAL	SAVED VALUE OF PRESSURE IN SURFACE THERMOCHEMISTRY TABLES
QCHM(J)	BTU/FT2-SEC	BLANK	SAVED VALUE OF SURFACE ENERGY FLUX TERM Q-CHEM AT COLUMN J
QCHMT(J)	BTU	BLANK	SAVED VALUE OF TIME AND SURFACE AREA INTEGRATED VALUES OF QCHM(J)
QCNV(J)	BTU/FT2-SEC	BLANK	SAVED VALUE OF SURFACE CONVECTIVE ENERGY FLUX TERM FOR COLUMN J
QCNVT(J)	BTU	BLANK	SAVED VALUE OF TIME AND SURFACE AREA INTEGRATED VALUES OF QCNV(J)
QCONDT(J)	BTU	BLANK	SAVED VALUE OF TIME-AND SURFACE-AREA INTEGRATED VALUES OF QNP(K) FOR ALL NODES K IN COLUMN J
QNP(K)	BTU/FT2-SEC	BLANK	SAVED VALUE OF SURFACE HEAT CONDUCTION ENERGY FLUX INTO SOLID AT NODE K
QNTI	BTU	LOCAL	TIME INTGRATED VALUE OF TOTAL SUBSURFACE ENERGY STORAGE FROM INITIAL TIME
QNTS	BTU	BLANK	TIME AND SURFACE AREA INTEGRATED VALUE OF TOTAL HEAT FLUX CONDUCTED FROM HEATED SURFACE INTO INTERIOR FROM INITIAL TIME

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
QRAB(J)	BTU/FT2	BLANK	SAVED VALUE OF RADIATION FLUX ABSORBED AT J-TH SURFACE POINT
QRABT(J)	BTU	BLANK	SAVED VALUE OF TIME AND SURFACE AREA INTEGRATED VALUE OF QRAD(J)
QRAD(J)	BTU/FT2-SEC	BLANK	SAVED VALUE OF RADIATED FLUX AWAY FROM HEATED SURFACE AT J-TH COLUMN
QRADT(J)	BTU	BLANK	SAVED VALUE OF TIME AND SURFACE AREA INTEGRATED VALUES OF QRAD(J)
QSUM	BTU/SEC	BLANK	ACCUMULATED(OVER SURFACE POINTS) SUM OF AREA INTEGRATED VALUES OF SURFACE HEAT CONDUCTION ENERGY FLUX INTO SOLID
QWL	BTU/SEC	BACK	CURRENT ENERGY FLUX INTO CONSIDERED NODE FROM BACK-WALL BOUNDARY CONDITION
QWLS	BTU/SEC	LOCAL	SUMMED VALUE(OVER ALL BACK-WALL NODES) OF QWL AT CURRENT TIME
R	IN	LOCAL	RADIUS OF CURRENT SURFACE POINT
RA(I)	BTU/SEC-DEGR	BLANK	CONDUCTANCE BETWEEN NODE I AND NEXT NODE TO THE RIGHT (NODE I+MM)
RANK	DEG R	LOCAL	ADDITIVE CONVERSION CONSTANT TO CONVERT DEG F TO DEG R
RAT	---	LOCAL	RATIO OF CURRENT NODAL COLUMN CENTERLINE LENGTH TO INITAL NODAL COLUMN-CENTERLINE LENGTH
RB(I)	BTU/SEC-DEGR	BLANK	CONDUCTANCE BETWEEN NODE I AND NEXT NODE UP (I+1)

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
RECORD( )	---	LOCAL	ALPHAMERIC TITLING INFORMATION FROM FIRST THREE CARDS READ
RET(I,J)	BTU/LB	BLANK	I-TH ENTRY IN J-TH TIME TABLE OF RECOVERY ENTHALPY(OPTION 1) OR ASSIGNED SURFACE TEMPERATURE (OPTION 2)
RO	LB/FT3	BLANK	ABLATING MATERIAL DENSITY
RSV	FT	LOCAL	NOT CURRENTY USED IN ASTHMA
RT(I,J)	LB/FT3	BLANK	I-TH ENTRY IN J-TH MATERIAL PROPERTY TABLE FOR DENSITY, ONLY RT(1,1) IS USED
SGEP	BTU/FT2 SEC-DEGR**4	BACK	PRODUCT OF SIG AND EMITTANCE OF A BACK WALL NODE
SG4EP	BTU/FT2- SEC-DEGR**4	BACK	EQUALS 4 TIMES SGEP
SIG	BTU/FT2- SEC-DEGR**4	BLANK	STEFAN-BOLTZMANN CONSTANT
SINAC(I)	---	BLANK	SINE OF ANGLE BETWEEN TOP FACE OF A NODE (BETWEEN I AND I+1) AND LINE BETWEEN NODAL CENTERS I AND I+1
SINAD(I)	---	BLANK	SINE OF ANGLE BETWEEN RIGHT FACE OF NODE (BETWEEN I AND I+MM) AND LINE BETWEEN NODAL CENTERS I AND I+MM
SR(J)	IN	BLANK	RADIUS OF SURFACE POINT IN COLUMN J
STAB	BTU/FT2-SEC	BACK	EXTRA TERM IN DENOMINATOR OF STABILITY LIMIT FOR TIME STEPS DERIVING FROM BACK-WALL TERMS

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
SZ(J)	IN	BLANK	AXIAL COORDINATE OF J-TH SURFACE POINT
TA(I)	DEG R	BLANK	OLD(PREVIOUS) TEMPERATURE OF NODE I
TB(I)	BTU/SEC,DEGR	BLANK	NET HEAT FLUX INTO NODE I, LATER BECOMES NEW TEMPERATURE OF NODE I
TBKP(I,J)	---	BLANK	I-TH ENTRY IN J-TH TIME TABLE FOR BLOWING REDUCTION PARAMETER LAMBDA
TCHEM(I,J,K)	BTU/LB	ENRGY	INITIALLY READ AS Z-ENTHALPY TERM FOR BOTH EDGE AND SURFACE TABLES, FOR EDGE TABLES IS STORED IN TZSEN, FOR SURFACE TABLES IS FIRST MODIFIED TO 'CHEMICAL PRODUCTION' TERM AND THEN TO CM/CH*CHEM PROD-HW, FOR I-TH ENTRY, J-TH TRANSFER COEFFICIENT, AND K-TH PRESSURE
TCPSEN(I,K)	BTU/LB DEGR	ENRGY	SLOPE OF THSEN VS, TW AT I-TH TEMPERATURE IN K-TH EDGE TABLE
TCZSEN(I,K)	BTU/LB DEGR	LOCAL	DERIVATIVE OF FROZEN EDGE GAS Z-ENTHALPY (TZSEN) WITH RESPECT TO TEMPERATURE AT I-TH ENTRY IN K-TH EDGE TABLE
TH	SEC	BLANK	CURRENT TIME
THF	SEC	BLANK	FINAL PROBLEM TIME
THP	SEC	LOCAL	OUTPUT INTERVAL
THSEN(I,K)	BTU/LB	ENRGY	VALUE OF FROZEN EDGE ENTHALPY NEW AT I-TH TEMPERATURE IN K-TH TABLE
THT(I,J)	SEC	BLANK	VALUE OF TIME AT I-TH ENTRY IN J-TH TIME TABLE

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
THZ(I,J)	BTU/LB	BLANK	VALUE OF SENSIBLE ENTHALPY OF MATERIAL J AT I-TH TEMPERATURE IN MATERIAL PROPERTY TABLE
TLMC(I,J,K)	---	ENRGY	TABULAR VALUE OF LN B-PRIME AT AT I-TH ENTRY, J-TH TRANSFER COEFFICIENT, IN K-TH SURFACE THERMOCHEMISTRY TABLE
TMPR(K)	DEG R	BLANK	SMALL ARRAY FILLED WITH NODAL TEMPERATURES FOR ONE LINE OF OUTPUT
TMG(J,K)	LB/FT2-SEC	ENRGY	J-TH ENTRY IN TRANSFER COEFFICIENT TABLE FOR K-TH THERMOCHEMISTRY TABLE
TPI(I,J)	ATM,LN ATM	BLANK	I-TH TABULAR VALUE OF PRESSURE IN J-TH TIME TABLE (CONVERTED TO LN FORM AFTER INPUT)
TPN(I)	SEC	LOCAL	SPECIAL TIME FOR PUNCHED OUTPUT OPTIONAL)
TPR(K)	ATM,LN ATM	ENRGY	TABULAR VALUE OF PRESSURE FOR K-TH SURFACE THERMOCHEMISTRY TABLE, LATER CONVERTED TO LN FORM
TPTCG(I)	SEC	LOCAL	I-TH TIME OF CHANGE IN OUTPUT INTERVAL (OPTIONAL FEATURE)
TQR(I,J)	BTU/FT2-SEC	BLANK	I-TH ENTRY FOR RADIATION FLUX TO HEATED SURFACE IN J-TH TIME TABLE
TRES	DEG R	BACK	RESERVOIR TEMPERATURE COMMUNICATING WITH BACK-WALL NODES
TR2	DEG R**2	BACK	SQUARE OF TRES
TR4	DEG R**4	BACK	FOURTH POWER OF TRES

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
TS(J)	DEG R	BLANK	TEMPERATURE OF J-TH SURFACE POINT
TSEN(I)	BTU/LB	LOCAL	READ IN AS ENTHALPY IN FROZEN EDGE TABLES AND WALL ENTHALPY IN SURFACE THERMOCHEMISTRY TABLES BUT LATER CONVERTED TO FROZEN EDGE ENTHALPY AT WALL TEMPERATURE
TSURF(I)	---	LOCAL	ALPHAMERIC NAME OF SURFACE SPECIES FOR I-TH ENTRY IN CURRENT SURFACE TABLES
TT(I,J)	DEG R	BLANK	I-TH ENTRY FOR TEMPERATURE IN J-TH MATERIAL PROPERTY TABLE
TTMX(J)	DEG R	BLANK	MAXIMUM TEMPERATURE IN J-TH MATERIAL PROPERTIES TABLE
TTS(I,J,K)	DEG R	ENRGY	TABULAR VALUE OF TEMPERATURE AT I-TH ENTRY, J-TH TRANSFER COEFFICIENT, K-TH SURFACE THERMOCHEMISTRY TABLE
TTSEN(I,K)	DEG R	ENRGY	I-TH TABULAR VALUE OF TEMPERATURE IN K-TH FROZEN EDGE TABLE
TWL	DEG R	BACK	TEMPERATURE OF BACK-WALL, NEEDED FOR CALCULATION OF RADIATION FLUX AT A BACK-WALL NODE
TZ	DEG R	LOCAL	DATUM TEMPERATURE (536 DEGR)
TZSEN(I,K)	BTU/LB	LOCAL	I-TH ENTRY FOR Z-ENTHALPY TERM IN K-TH FROZEN EDGE TABLE
U(J)	BTU/SEC-DEGR	BLANK	THERMAL CONDUCTANCE BETWEEN NODAL POINT OF SURFACE NODE IN J-TH COLUMN AND J-TH SURFACE POINT
VFZ	---	LOCAL	NOT CURRENTLY USED IN ASTHMA

LIST OF VARIABLE NAMES FOR
AEROTHERM AXI-SYMMETRIC TRANSIENT
HEATING AND MATERIAL ABLATION PROGRAM (ASTHMA)

ROUTINE: ASTHMA

VARIABLE	UNITS	STORAGE	DESCRIPTION
VF1(I)	---	BLANK	OPTION 1 VIEW FACTOR FOR NODE I
VF3(I)	---	BLANK	OPTION 3 VIEW FACTOR FOR NODE I
VITER(I)	---OR DEG R	BLANK	VALUE OF INDEPENDENT VARIABLE IN SURFACE ENERGY BALANCE SEARCH AT I-TH ITERATION FOR CURRENT SURFACE POINT CONSIDERED
VK	---	LOCAL	FLOATING VALUE OF UTILITY INDEX
VKIN	---	BLANK	NOT CURRENTLY USED IN ASTHMA
VOL(I)	FT3	BLANK	VOLUME OF NODE I
VR	---	LK	TABULAR INTERPOLATION RATIO RETURNED BY LOOK SUBROUTINE
WLQ	---	LOCAL	UNEQUAL DIFFUSION EXPONENT
WLS	---	LOCAL	SAVED VALUE OF WLQ
Y2(I)	VARIES	LOCAL	UTILITY VARIABLE USED FOR OUTPUT INTERPOLATED FROM LOOK
Z	IN	LOCAL	AXIAL LOCATION OF CURRENT SURFACE POINT
ZRO	VARIES	BLANK	FLOATING ZERO

SECTION 3

FLOW CHARTS

Computer generated flow charts were produced and are given in this section. The flow charts show transfers as lines on the right edge of the figures and Do-loop blocks on lines on the left edge of the figures. Routines are presented in alphabetical order.

```
C
C*****************************************************************
C
C          A R C A S T   P R O G R A M
C
C*****************************************************************
C
C          SEE THE FULL LISTING OF THIS ROUTINE FOR--
C                    +  DIMENSION STATEMENTS
C                         +  COMMON STATEMENTS
C                              +  INCLUDE STATEMENTS
C                                   +  EQUIVALENCE STATEMENTS
C                                        +  DATA STATEMENTS
C*****************************************************************
C
  300 FORMAT(2I3,10E6.4,7I1)
  301 FORMAT(4E7.5)
  302 FORMAT(4I1,I2,6E6.4)
  303 FORMAT(I2,F8.2,5F10.5)
 9090 FORMAT(I2,8E6.4)
  304 FORMAT(1H1,25X,71HAEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MA
     1TERIAL ABLATION PROGRAM/113X,4HPAGE,I3//)
  305 FORMAT(12A6)
  306 FORMAT(//11H INPUT DATA//27H   DIMENSIONS OF INPUT DATA//114H   TI
     1ME              SEC                    TEMPERATURE   DEG R
     2          DENSITY                LB PER CUBIC FT/112H   SPECIFIC HEAT
     3   BTU PER LB DEG R   CONDUCTIVITY  BTU PER FT SEC DEG R      EMIS
     4SIVITY          DIMENSIONLESS/105H   HEAT COEFFICIENT  LB PER SQ FT
     5 SEC   ENTHALPY      BTU PER LB                NODAL COORDINATES
     6INCHES/44H   RESISTANCES      SQ FT SEC DEG R PER BTU///20H   PRO
     7BLEM CONSTANTS//85H   MMAX NMAX      INIT TIME   FINL TIME   PRNT
     8TIME   TIME INCR   TIME CNST          /)
  307 FORMAT(//20H   NODAL COORDINATES//5X,1HI,5X,1HJ,5X,6HRC(IN),7X,6HZ
     1C(IN),7X,6HRN(IN),7X,6HZN(IN)/)
  308 FORMAT(13H   NODAL DATA//97H   MATL THTA SIDE ENTB HTTB   HEAT CNS
     1T   INIT TEMP   CONT RES A  CONT RES B      VF1          VF3/)
  309 FORMAT(29H   MATERIAL PROPERTIES TABLES/)
  310 FORMAT(/15H   MATERIAL NO.I3//73H      TEMP       DENSITY    SPEC
     1HEAT    CONDUCT     EMISSIV     CONDUCT2/)
  311 FORMAT(//25H   HEATING TABLES, OPTION I2/)
  312 FORMAT(1PH   HEAT TABLE NO.I3//50H      TIME     HEAT COEFF  RECOV
     1 ENTH   RAD FACTOR/)
  313 FORMAT(//22H   WALL ENTHALPY TABLE//34H      TEMP       ENTH 1
     1 ENTH 2/)
  314 FORMAT(1X,2I5,6X,6(E11.4,1X)//)
  315 FORMAT(1X,6E12.4)
  316 FORMAT(1X,5I5,2X,6(1P1E11.3,1X))
  317 FORMAT(1PH   HEAT TABLE NO.I3//97H      TIME        TEMP     RECOV
     1 ENTH/)
  318 FORMAT(3X,I3,3X,I3,1X,4E13.5)
  319 FORMAT(///12H OUTPUT DATA//20H   DIMENSIONS OF OUTPUT DATA//118H
     1 TIME          SEC                    QTOT,SUR,INT    BTU
     2          CONVECTIVE HEAT COEFF  LB PER SQ FT SEC/115H   TEMPERAT
     3URE  DEG R                  QNET AND QCONV  BTU PER SQ FT SEC
     4  QTOT                  BTU PER SQ FT//)
  320 FORMAT(2I6)
  321 FORMAT(I2,10E7.5)
  322 FORMAT(//30H H VS  TEMPERATURE, TABLE NO. I2/3X4HTEMP9X1HH8X4HTEMP
     19X1HH8X4HTEMP9X1HH8X4HTEMP9X1HH8X4HTEMP9X1HH)
  323 FORMAT(//23H H VS  TIME, TABLE NO. I2/3X4HTIME9X1HH8X4HTIME9X1HH8X
     14HTIME9X1HH8X4HTIME9X1HH8X4HTIME9X1HH)
  324 FORMAT(10E11.3)
  332 FORMAT(/ 111H                NODE      TEMP       NODE      TEMP
     1  NODE      TEMP       NODE      TEMP       NODE      TEMP/)
  333 FORMAT(10X,5(I5,I4,E12.4))
  334 FORMAT(16X,
     1       72H   TIME       QTOT,SUR    QTOT,INT   CNSV ENER  CRNODE
     2 ITER  NODE D-TIME,2X,11H ACT D-TIME/)
  335 FORMAT(16X,4(E11.4,1X),2I3,I5,2E13.5/)
  337 FORMAT(//11X,2I4,5E12.4)
  594 FORMAT (1H //23X10H---TIME DEPENDENT BOUNDARY CONDITIONS---/1H )
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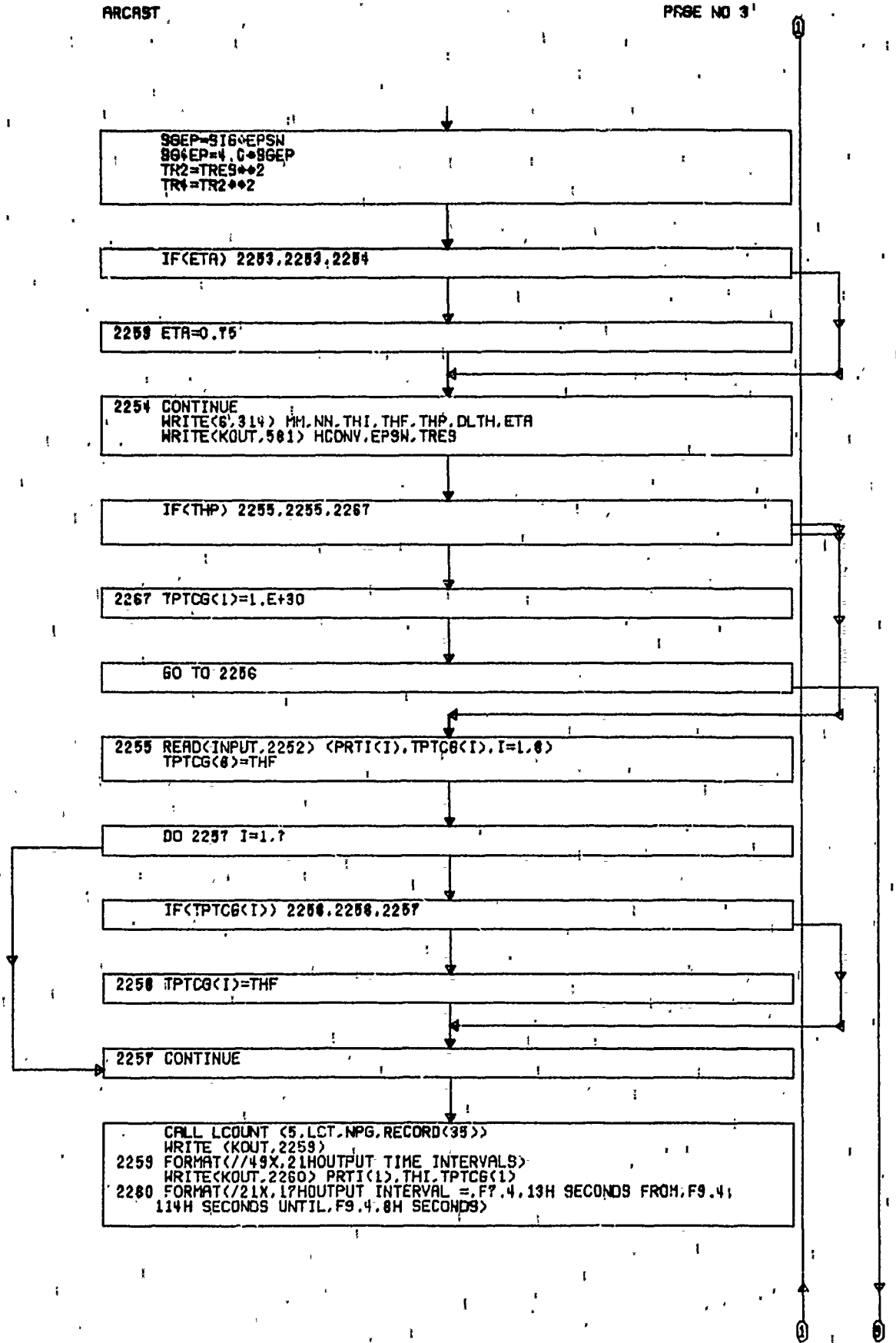
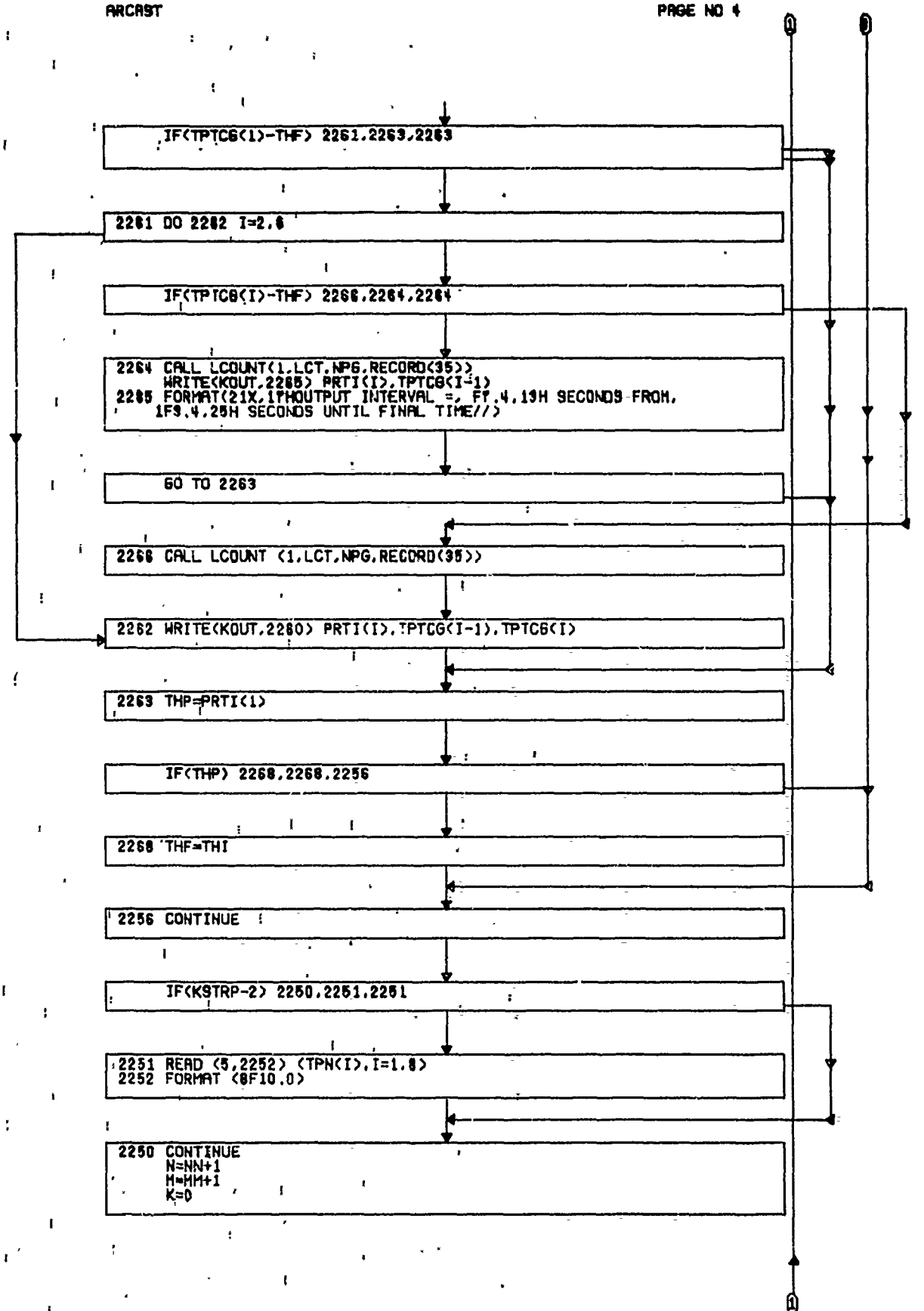
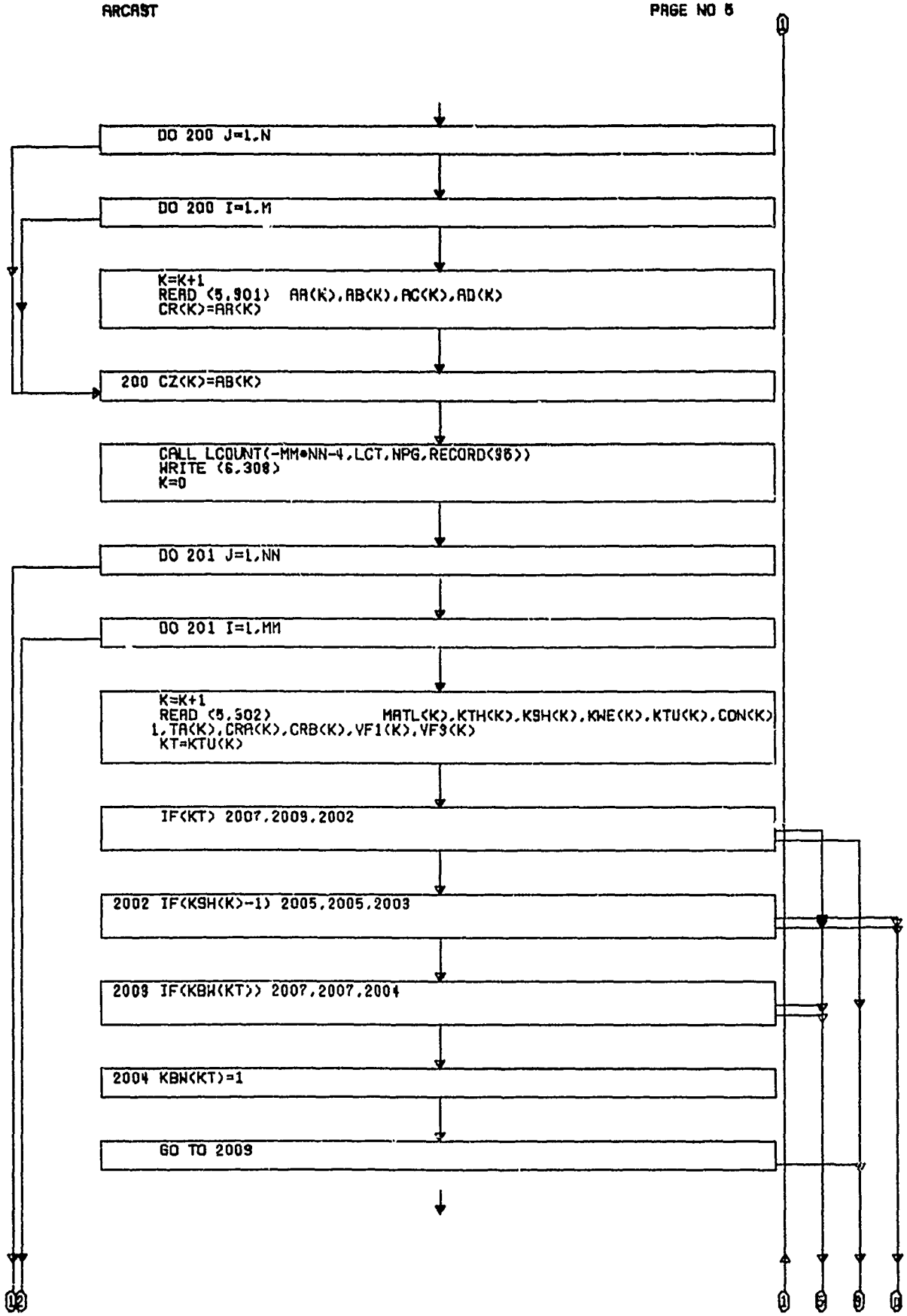
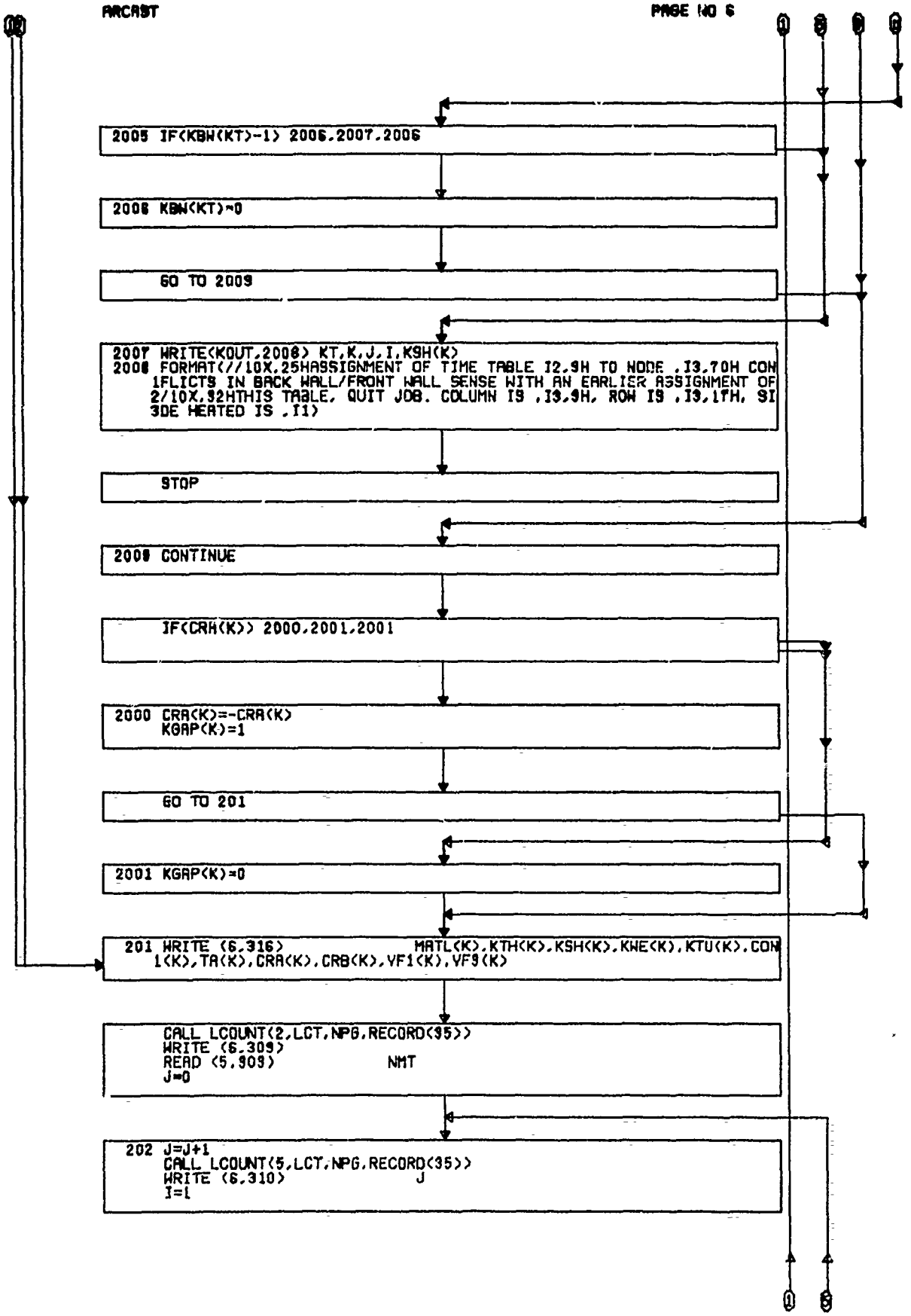
```
  535 FORMAT (9X,4HTIME,8X,4HPROB,3X,8HRECOVERY,3X,9HRADIATION,4X,4HHEAT
     15X,8HPRESSURE,3X,7HBLOWING/9X,5H(SEC),7X,4HOPTN,3X,8HENTHALPY,3X,
     29HHEAT RATE,4X,5HCOEFF,14X,9HREDUCTION/28X,8H(BTU/LB),2X,11H(BTU/S
     3Q FT-,1X,10H(LB/SQ FT-,3X,5H(ATM),3X,9HPARAMETER /40X,7HSECOND),
     44X,7H9ECOND))
 5350 FORMAT (9X,4HTIME,8X,4HPROB,3X,8HRECOVERY,3X,9HRADIATION,4X,4HHEAT
     15X,8HPRESSURE,3X,7HBLOWING/9X,5H(SEC),7X,4HOPTN,3X,8HENTHALPY,3X,
     29HHEAT RATE,4X,5HCOEFF,14X,9HREDUCTION/28X,8H(BTU/LB),2X,11H(BTU/S
     3Q FT-,1X,10H(BTU/SQ FT,3X,8H(ATM),3X,9HPARAMETER /40X,7HSECOND),
     44X,9H-SEC-DGR))
  536 FORMAT (6X,F8.2,6X,I2,4X,2(F8.2,3X),F8.4,3X,F8.5,3X,F8.3)
  537 FORMAT (1H /3X,89HCH/CHO = PHI/(EXP(PHI)-1.) WHERE PHI = 2.*BRP*M
     1DOT/CHO. BRP IN TABLE)
  538 FORMAT(//27X30H---SURFACE EQUILIBRIUM DATA---)
  552 FORMAT (9X,4HTIME,8X,4HPROB,3X,7HSURFACE,4X,7HSURFACE/9X,5H(SEC),
     17X,4HOPTN,5X,4HTEMP,5X,9HRECESSION/28X,7H(DEG R),5X,6H(MILS))
  556 FORMAT (9X,4HTIME,8X,4HPROB,5X,4HVIEW,5X,9HRADIATION/9X,5H(SEC),
     17X,4HOPTN,4X,6HFACTOR,4X,9HHEAT RATE/38X,11H(BTU/SQ FT-/40X,
     27HSECOND))
 5780 FORMAT(E6.4,6X,E8.5,E6.4,F4.2,E7.5,6X,2E8.5,A6,I1,12X,I2)
 5781 FORMAT(E8.4,E8.5,3X,E6.4,F4.2,E7.5,6X,2E8.5,A6,I1,12X,I2)
 5782 FORMAT(E6.4,6X,E6.4,E6.4,F4.2,E7.5,6X,2E8.5,A6,I1,12X,I2)
 5789 FORMAT(//6X,14HKINETICS PRM =E10.3,8X,10HPRESSURE =,F9.4,4H ATM//
     17X,2(4HTEMP,5X,26HM-DOT-  CHEM.PROD  SURFACE,3X)/6X,2(36H(DEG R)
     2CHAR/CM   (BTU/LB)  SPECIES,2X))
 5790 FORMAT (6X,26HNO RADIUS CORRECTION ON CH)
 5791 FORMAT(3F8.5,F9.4,F5.3,2F9.3,I2,2X,A6)
 5792 FORMAT(//6X,3HP =,F9.4,4H ATM//6X,3(25HTEMPERATURE  EDGE ENTH   )/
     16X,3(25H  (DEG R)    AT T-WALL   ))
 5793 FORMAT (//6X,37HBAD SURFACE EQUILIBRIUM TABLE OF TYPE,I2)
 5794 FORMAT (//6X,74HEQUAL MASS AND HEAT TRANSFER COEFFICIENTS AND EQUA
     1L DIFFUSION COEFFICIENTS)
 5795 FORMAT(5X,F8.2,2X,F7.4,2X,F8.2,4X,A6,1X,F8.2,2X,F7.4,2X,F8.2,4X,A6
     1)
 5796 FORMAT(2F10.0,3(9X,I1),5(I1,F5.0))
 5797 FORMAT(//6X,45HRATIO OF MASS TO HEAT TRANSFER COEFFICIENTS =,F6.3/
     1 6X,28HUNEQUAL DIFFUSION EXPONENT =,F6.3)
 5798 FORMAT                              (6X,F9.2,4X,F9.2,3X,F9.2,4X,F9.
     22,3X,F9.2,4X,F9.2)
 5799 FORMAT (6X,66HHEAT TRANSFER COEFFICIENT MULTIPLIED BY (R INITIAL/R
     1 CURRENT)**1.8)
  581 FORMAT(/94X20HBACK WALL CONVECTION10X9HBACK WALL10X9HRESERVOIR/
     132X23HCOEF BTU/FTSQ-SEC-DEG R8X10HEMISSIVITY8X11HTEMPERATURE/
     237XF10.4,18XF6.3,10XF10.2)
  819 FORMAT(25H0UT OF RANGE OF H TABLES/5X7H TEMP= E9.4,10X6HTIME= E9.
     14)
  820 FORMAT(54H IS LARGER THAN THE LAST ENTRY IN THE WALL ENTH. TABLE)
  821 FORMAT(55H IS SMALLER THAN THE FIRST ENTRY IN THE WALL ENTH.TABLE)
  822 FORMAT(24H0THE TEMPERATURE OF  NODE2I4)
  823 FORMAT(49H1S LARGER THAN THE LAST ENTRY IN MATL. PROP. TAB.I3)
  824 FORMAT(51H1S SMALLER THAN THE FIRST ENTRY IN MATL. PROP. TAB.I3)
C-----GENERAL CONSTANTS
      FV=.5
      FT=.083333333
      RANK = 459.688
      ZRO=0.0
      PIB=.021816616
      INCH=5
      INPUT=5
      KOUT=6
      SIG=.481E-12
      NPG=1
C-----MAIN INPUT BLOCK INCLUDING OUTPUT LISTING OF INPUT
```

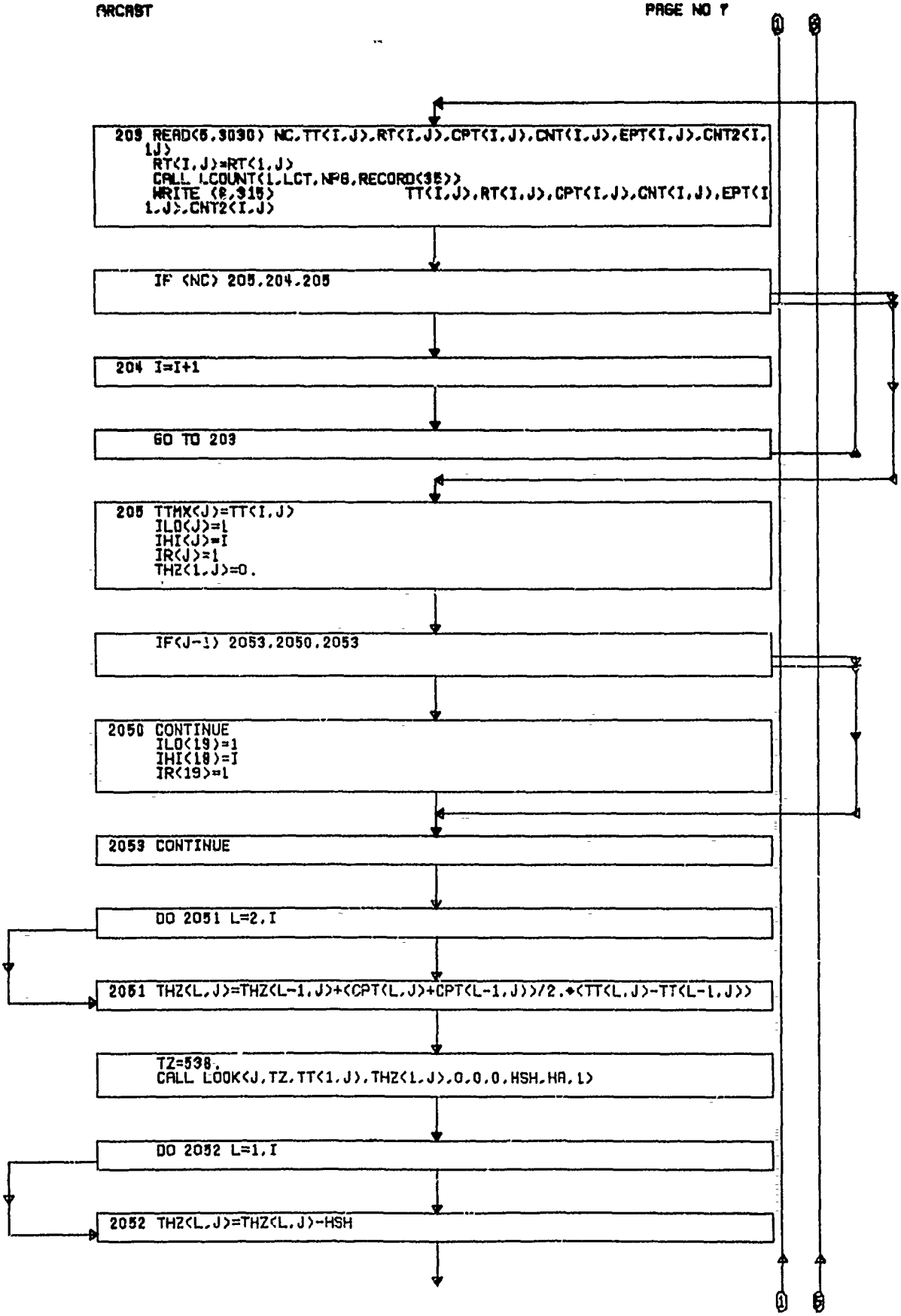
```
  225 WRITE (6,304)        NPG
      READ (5,305)              (RECORD(I),I=1,36)
      WRITE (6,305)             (RECORD(I),I=1,36)
      WRITE (6,306)
      READ (5,900) MM,NN,THI,THF,TKP,DLTH,ETA,DH2,BRP,HCONV,EPSW,TRES,
     1KASE,KSTRP,KRESC,KSLOP,KCENT,KLOG,KORTG
      KSLOP=KSLOP+1
      KRESC=KRESC+1
```

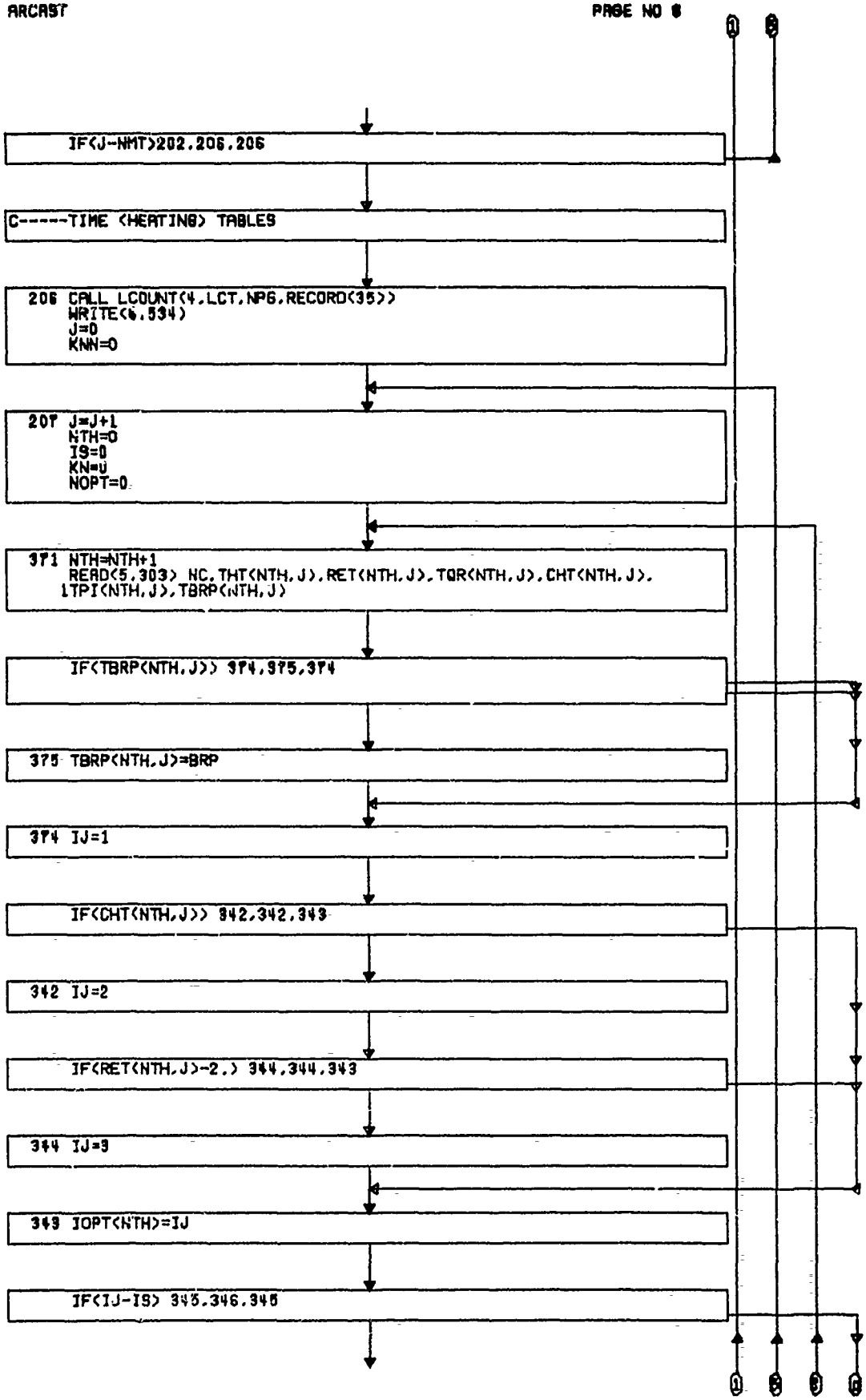

SGEP=SIG*EPSN
SG4EP=4.0*SGEP
TR2=TRES**2
TR4=TR2**2
IF(ETA) 2253,2253,2254
2253 ETA=0.75
2254 CONTINUE
WRITE(6,314) MM,NN,THI,THF,THP,DLTH,ETA
WRITE(KOUT,581) HCONV,EPSN,TRES
IF(THP) 2255,2255,2267
2267 TPTCG(1)=1.E+30
GO TO 2256
2255 READ(INPUT,2252) (PRTI(I),TPTCG(I),I=1,6)
TPTCG(6)=THF
DO 2257 I=1,7
IF(TPTCG(I)) 2256,2256,2257
2256 TPTCG(I)=THF
2257 CONTINUE
CALL LCOUNT (5,LCT,NPG,RECORD(35))
WRITE (KOUT,2259)
2259 FORMAT(//49X,21HOUTPUT TIME INTERVALS)
WRITE(KOUT,2260) PRTI(1),THI,TPTCG(1)
2260 FORMAT(/21X,17HOUTPUT INTERVAL =,F7.4,13H SECONDS FROM,F9.4,
114H SECONDS UNTIL,F9.4,8H SECONDS)

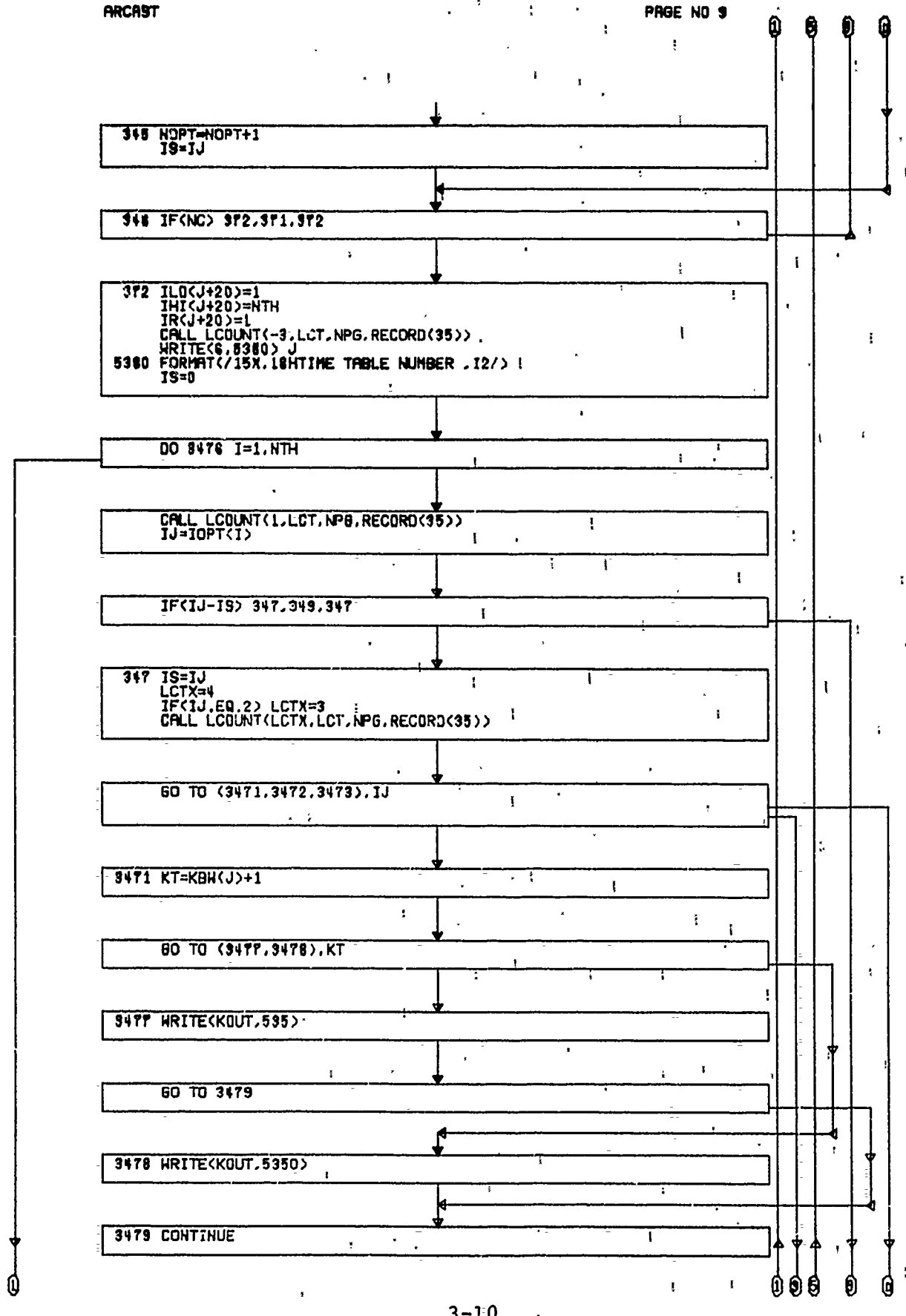

IF(TPTCG(1)-THF) 2261,2263,2263
2261 DO 2262 I=2,6
IF(TPTCG(I)-THF) 2266,2264,2264
2264 CALL LCOUNT(1,LCT,NPG,RECORD(35))
WRITE(KOUT,2265) PRTI(I),TPTCG(I-1)
2265 FORMAT(21X,1PHOUTPUT INTERVAL =, F7.4,19H SECONDS FROM,
1F9.4,25H SECONDS UNTIL FINAL TIME//)
GO TO 2263
2266 CALL LCOUNT (1,LCT,NPG,RECORD(35))
2262 WRITE(KOUT,2260) PRTI(I),TPTCG(I-1),TPTCG(I)
2263 THP=PRTI(1)
IF(THP) 2268,2268,2256
2268 THF=THI
2256 CONTINUE
IF(KSTRP-2) 2250,2251,2251
2251 READ (5,2252) (TPN(I),I=1,8)
2252 FORMAT (8F10.0)
2250 CONTINUE
N=NN+1
M=MM+1
K=0

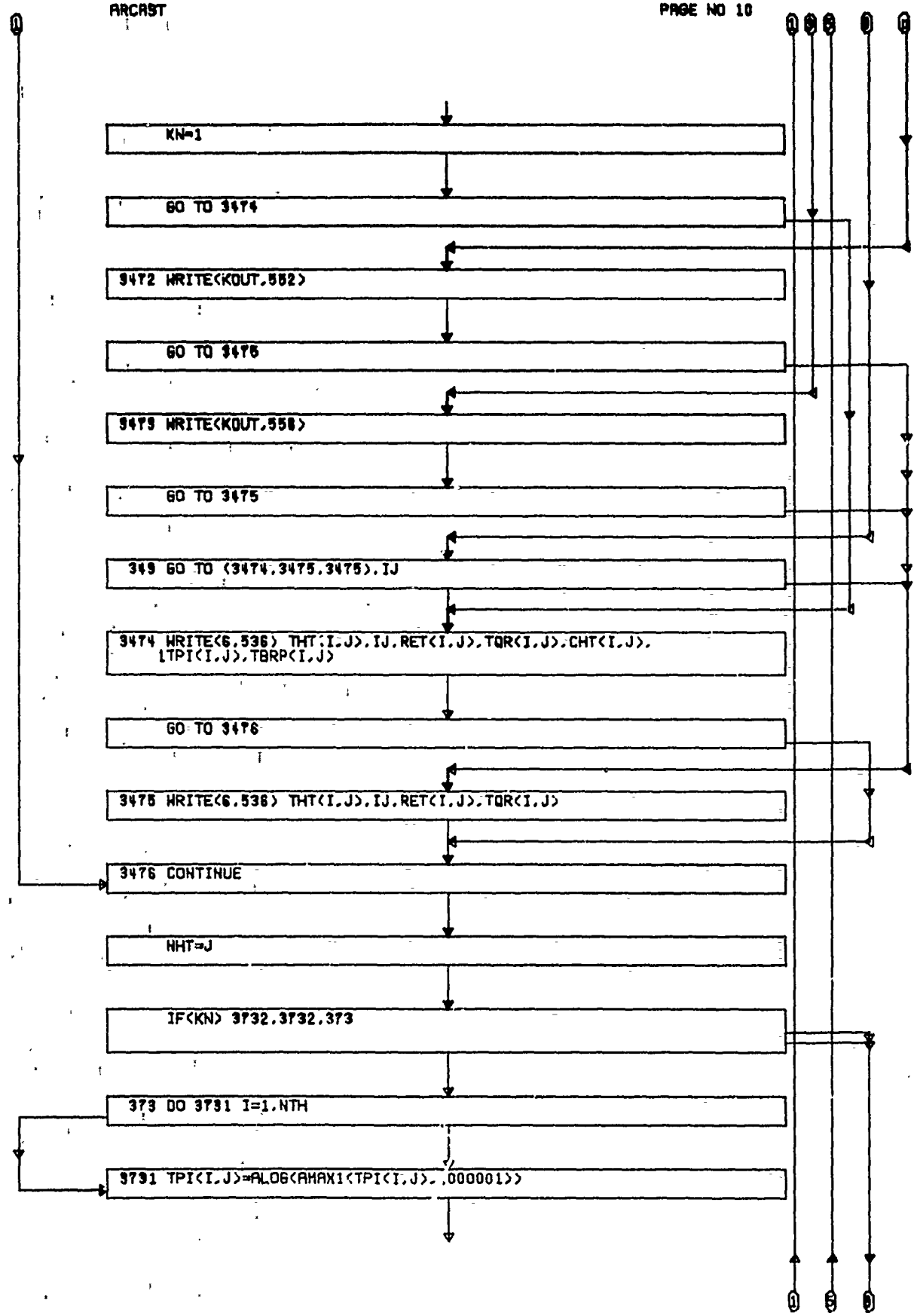

DO 200 J=1,N
DO 200 I=1,M
K=K+1
READ (5,901) AA(K),AB(K),AC(K),AD(K)
CR(K)=AA(K)
200 CZ(K)=AB(K)
CALL LCOUNT(-MM*NN-4,LCT,NPG,RECORD(96))
WRITE (6,308)
K=0
DO 201 J=1,NN
DO 201 I=1,MM
K=K+1
READ (5,902) MATL(K),KTH(K),KSH(K),KWE(K),KTU(K),CON(K)
1,TA(K),CRA(K),CRB(K),VF1(K),VF9(K)
KT=KTU(K)
IF(KT) 2007,2009,2002
2002 IF(KSH(K)-1) 2005,2005,2003
2009 IF(KBW(KT)) 2007,2007,2004
2004 KBW(KT)=1
GO TO 2009

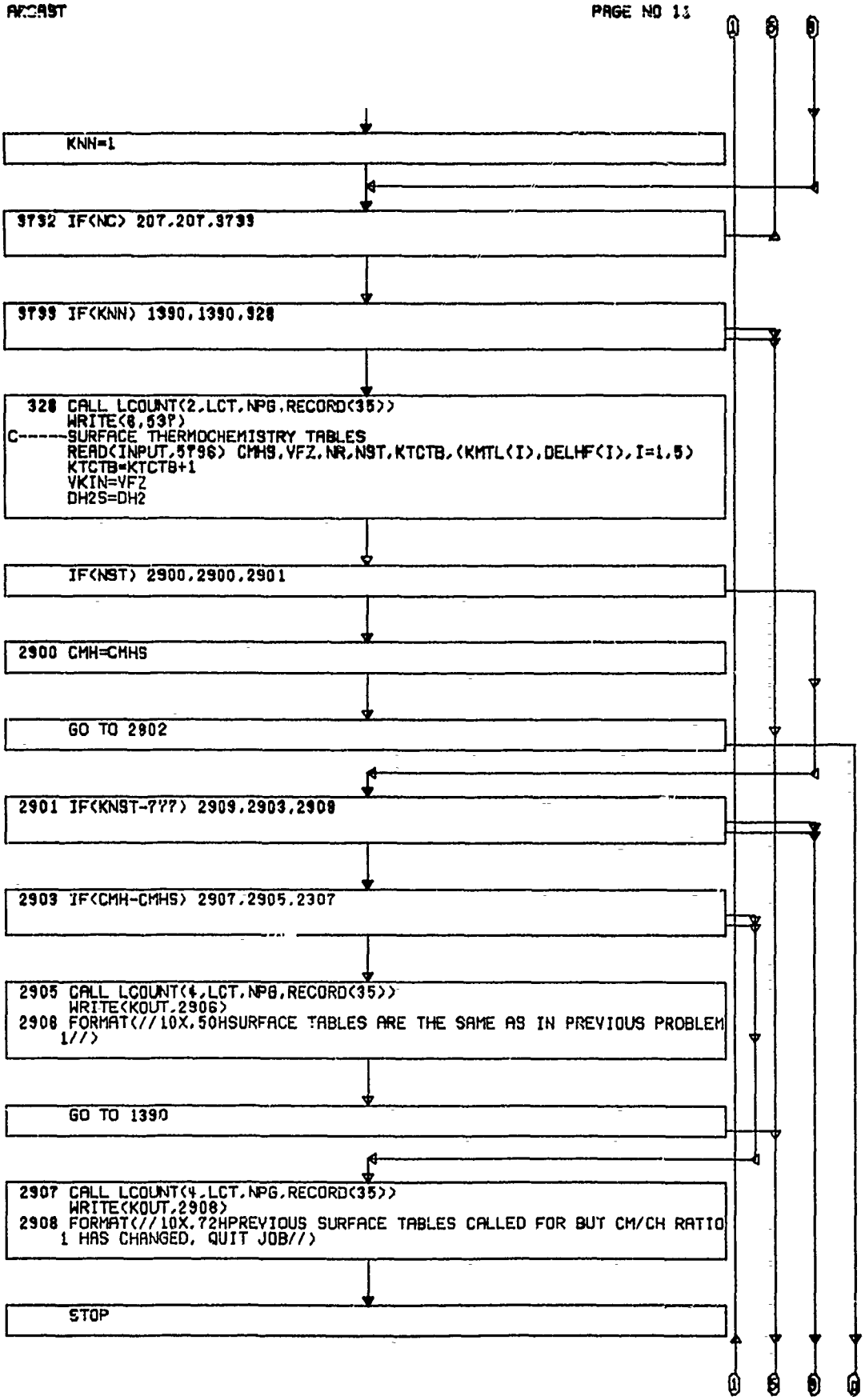

2005 IF(KBW(KT)-1) 2006,2007,2006
2006 KBW(KT)=0
GO TO 2009
2007 WRITE(KOUT,2008) KT,K,J,I,K9H(K)
2008 FORMAT(//10X,25HASSIGNMENT OF TIME TABLE I2,9H TO NODE ,I3,70H CON
1FLICTS IN BACK WALL/FRONT WALL SENSE WITH AN EARLIER ASSIGNMENT OF
2/10X,32HTHIS TABLE, QUIT JOB. COLUMN IS ,I3,9H, ROW IS ,I3,1FH, SI
3DE HEATED IS ,I1)
STOP
2009 CONTINUE
IF(CRA(K)) 2000,2001,2001
2000 CRA(K)=-CRA(K)
KGAP(K)=1
GO TO 201
2001 KGAP(K)=0
201 WRITE (6,316) MATL(K),KTH(K),KSH(K),KWE(K),KTU(K),CON
1(K),TA(K),CRA(K),CRB(K),VF1(K),VF9(K)
CALL LCOUNT(2,LCT,NPG,RECORD(35))
WRITE (6,309)
READ (5,909) NMT
J=0
202 J=J+1
CALL LCOUNT(5,LCT,NPG,RECORD(35))
WRITE (6,310) J
I=1

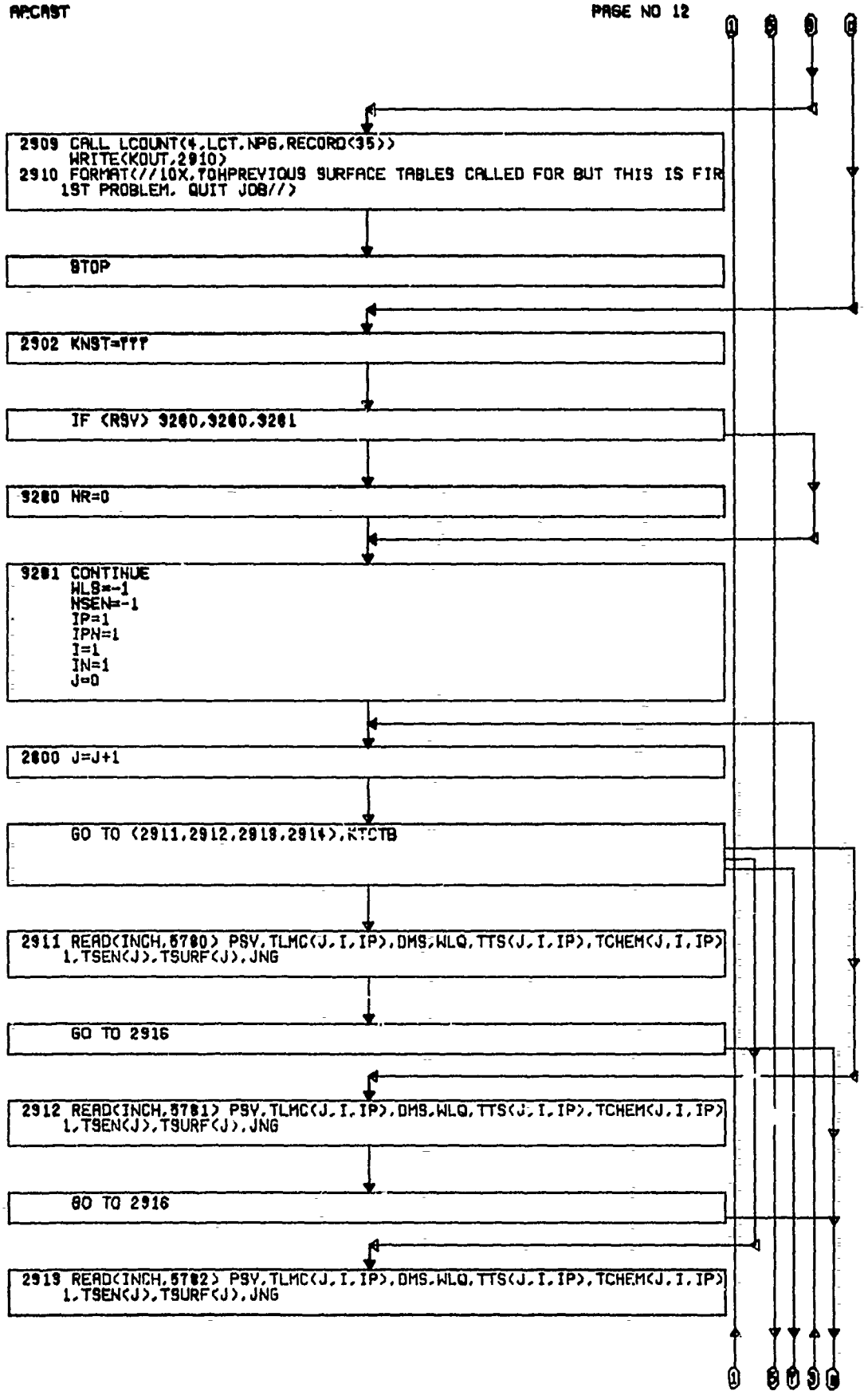

203 READ(5,3030) NC,TT(I,J),RT(I,J),CPT(I,J),CNT(I,J),EPT(I,J),CNT2(I,J)
RT(I,J)=RT(1,J)
CALL LCOUNT(1,LCT,NPG,RECORD(35))
WRITE (6,315) TT(I,J),RT(I,J),CPT(I,J),CNT(I,J),EPT(I,J),CNT2(I,J)
IF (NC) 205,204,205
204 I=I+1
GO TO 203
205 TTMX(J)=TT(I,J)
ILO(J)=1
IHI(J)=I
IR(J)=1
THZ(1,J)=0.
IF(J-1) 2053,2050,2053
2050 CONTINUE
ILO(19)=1
IHI(19)=I
IR(19)=1
2053 CONTINUE
DO 2051 L=2,I
2051 THZ(L,J)=THZ(L-1,J)+(CPT(L,J)+CPT(L-1,J))/2.*(TT(L,J)-TT(L-1,J))
TZ=538.
CALL LOOK(J,TZ,TT(1,J),THZ(1,J),0,0,0,HSH,HA,L)
DO 2052 L=1,I
2052 THZ(L,J)=THZ(L,J)-HSH

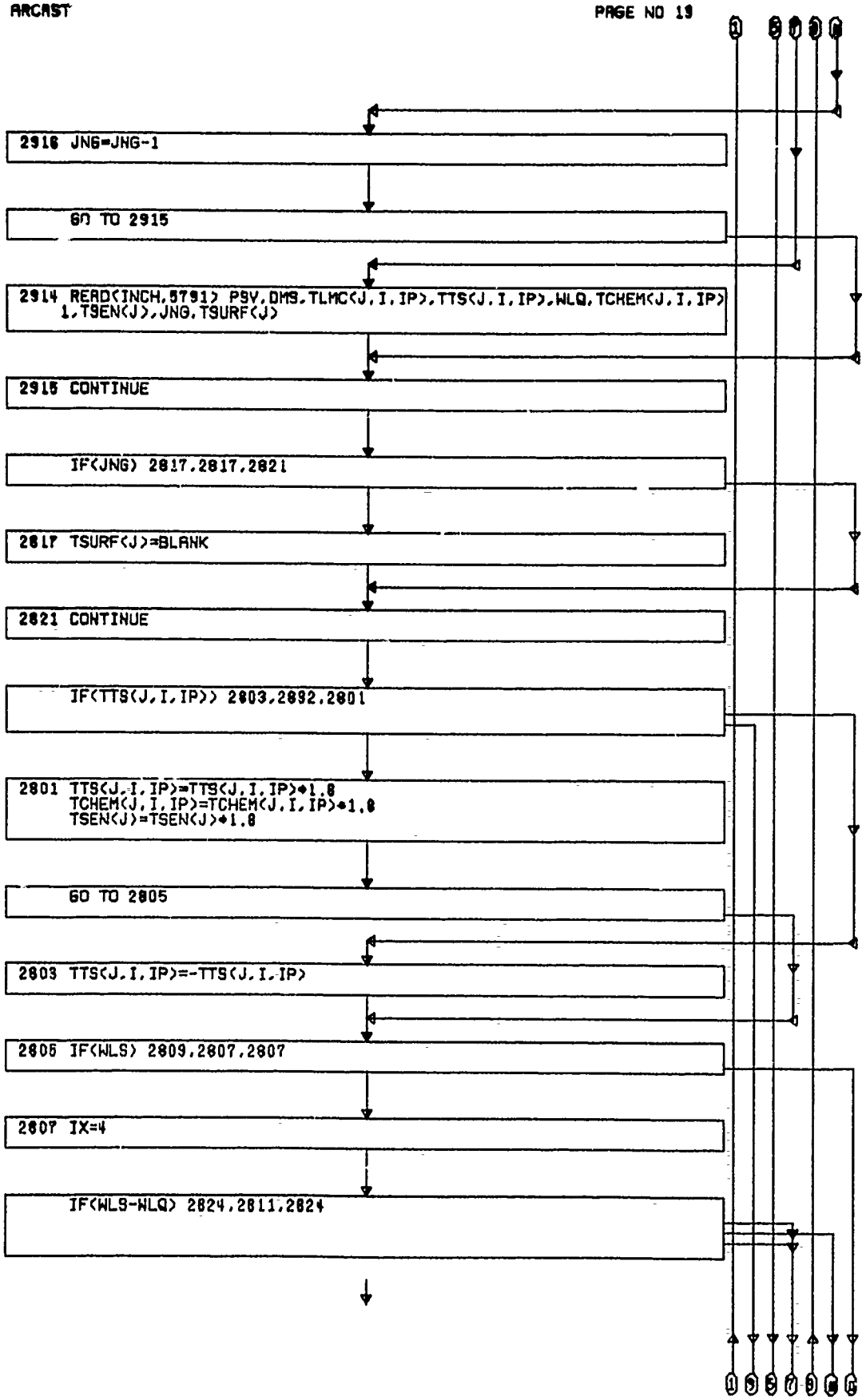

IF(J-NMT)202,206,206
C-----TIME (HEATING) TABLES
206 CALL LCOUNT(4,LCT,NPG,RECORD(35))
WRITE(6,534)
J=0
KNN=0
207 J=J+1
NTH=0
IS=0
KN=0
NOPT=0
371 NTH=NTH+1
READ(5,303) NC,THT(NTH,J),RET(NTH,J),TQR(NTH,J),CHT(NTH,J),
1TPI(NTH,J),TBRP(NTH,J)
IF(TBRP(NTH,J)) 374,375,374
375 TBRP(NTH,J)=BRP
374 IJ=1
IF(CHT(NTH,J)) 342,342,343
342 IJ=2
IF(RET(NTH,J)-2.) 344,344,343
344 IJ=3
343 IOPT(NTH)=IJ
IF(IJ-IS) 345,346,346

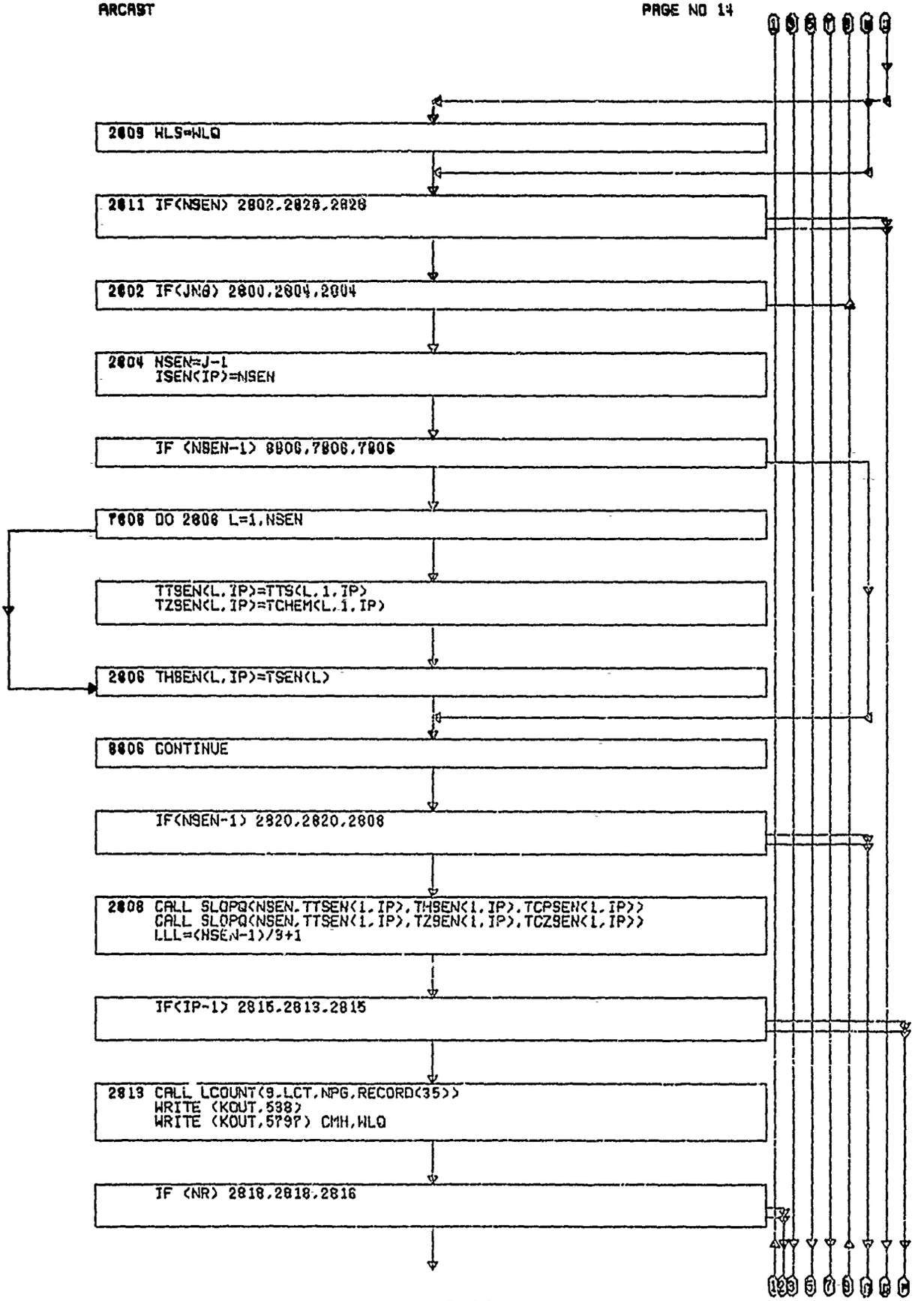

348 NOPT=NOPT+1
IS=IJ
346 IF(NC) 372,371,372
372 ILO(J+20)=1
IHI(J+20)=NTH
IR(J+20)=1
CALL LCOUNT(-3,LCT,NPG,RECORD(35))
WRITE(6,5360) J
5360 FORMAT(/15X,18HTIME TABLE NUMBER ,I2/)
IS=0
DO 3476 I=1,NTH
CALL LCOUNT(1,LCT,NPG,RECORD(35))
IJ=IOPT(I)
IF(IJ-IS) 347,349,347
347 IS=IJ
LCTX=4
IF(IJ.EQ.2) LCTX=3
CALL LCOUNT(LCTX,LCT,NPG,RECORD(35))
GO TO (3471,3472,3473),IJ
3471 KT=KBW(J)+1
GO TO (3477,3478),KT
3477 WRITE(KOUT,595)
GO TO 3479
3478 WRITE(KOUT,5350)
3479 CONTINUE

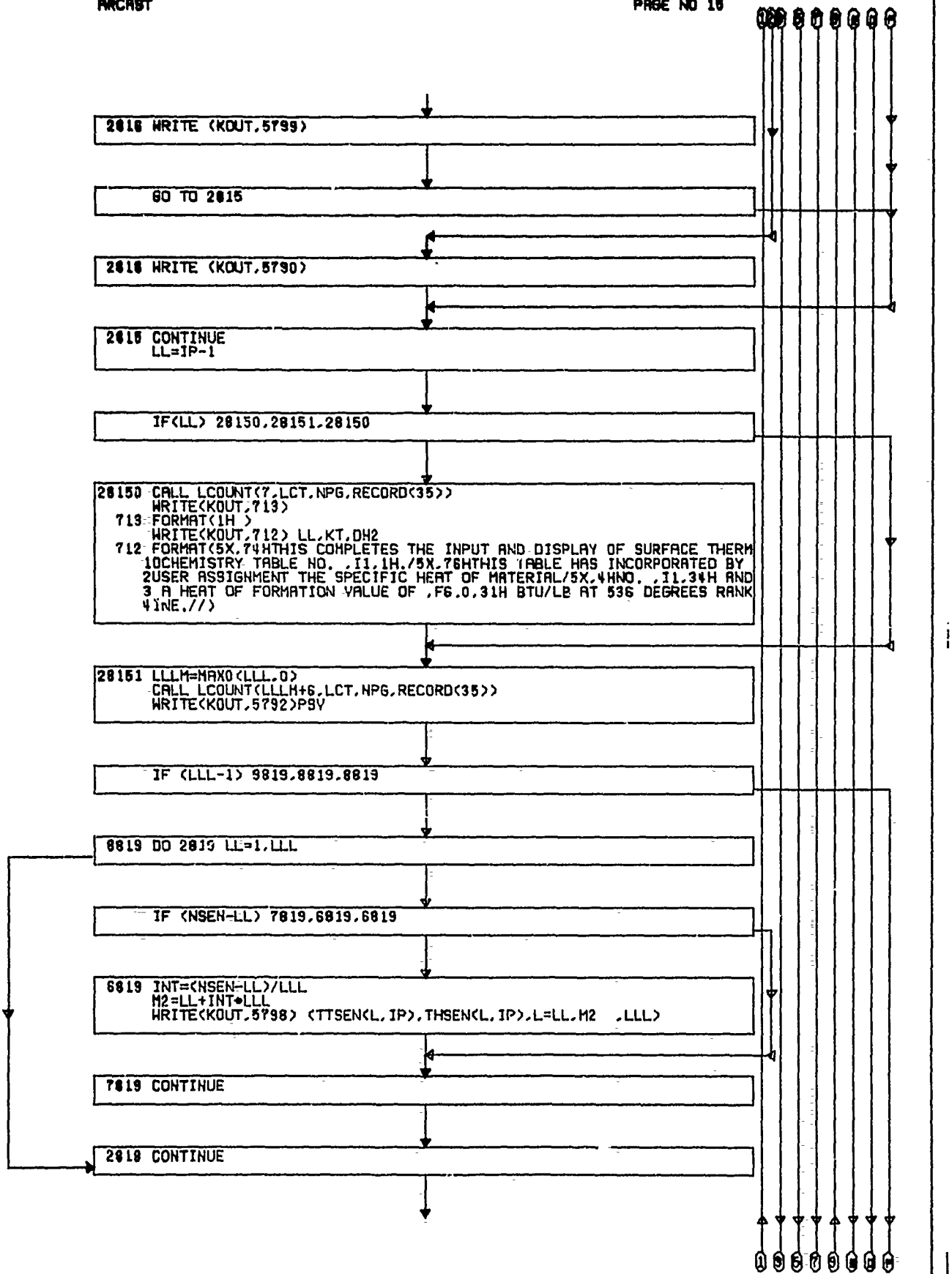

KN=1
GO TO 3474
3472 WRITE(KOUT,552)
GO TO 3476
3473 WRITE(KOUT,558)
GO TO 3475
349 GO TO (3474,3475,3475),IJ
3474 WRITE(6,536) THT(I,J),IJ,RET(I,J),TQR(I,J),CHT(I,J),
1TPI(I,J),TBRP(I,J)
GO TO 3476
3475 WRITE(6,536) THT(I,J),IJ,RET(I,J),TQR(I,J)
3476 CONTINUE
NHT=J
IF(KN) 3732,3732,373
373 DO 3731 I=1,NTH
3731 TPI(I,J)=ALOG(AMAX1(TPI(I,J),.000001))

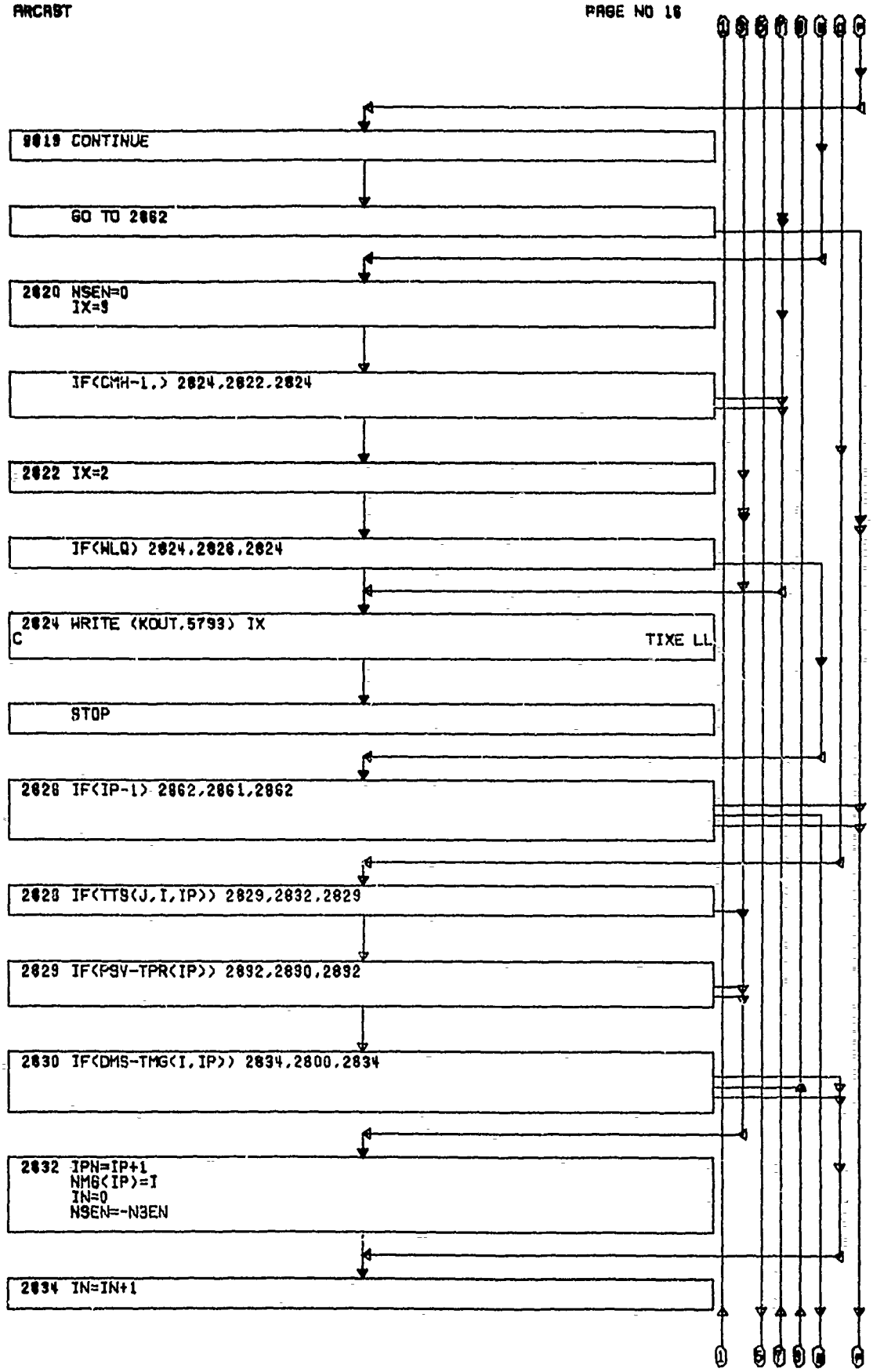

KNN=1
9792 IF(NC) 207,207,9799
9799 IF(KNN) 1390,1390,928
328 CALL LCOUNT(2,LCT,NPG,RECORD(35))
WRITE(6,53P)
C-----SURFACE THERMOCHEMISTRY TABLES
READ(INPUT,5796) CMHS,VFZ,NR,NST,KTCTB,(KMTL(I),DELHF(I),I=1,5)
KTCTB=KTCTB+1
VKIN=VFZ
DH2S=DH2
IF(NST) 2900,2900,2901
2900 CMH=CMHS
GO TO 2902
2901 IF(KNST-777) 2909,2903,2909
2903 IF(CMH-CMHS) 2907,2905,2307
2905 CALL LCOUNT(4,LCT,NPG,RECORD(35))
WRITE(KOUT,2906)
2906 FORMAT(//10X,50HSURFACE TABLES ARE THE SAME AS IN PREVIOUS PROBLEM
1//)
GO TO 1390
2907 CALL LCOUNT(4,LCT,NPG,RECORD(35))
WRITE(KOUT,2908)
2908 FORMAT(//10X,72HPREVIOUS SURFACE TABLES CALLED FOR BUT CM/CH RATIO
1 HAS CHANGED, QUIT JOB//)
STOP

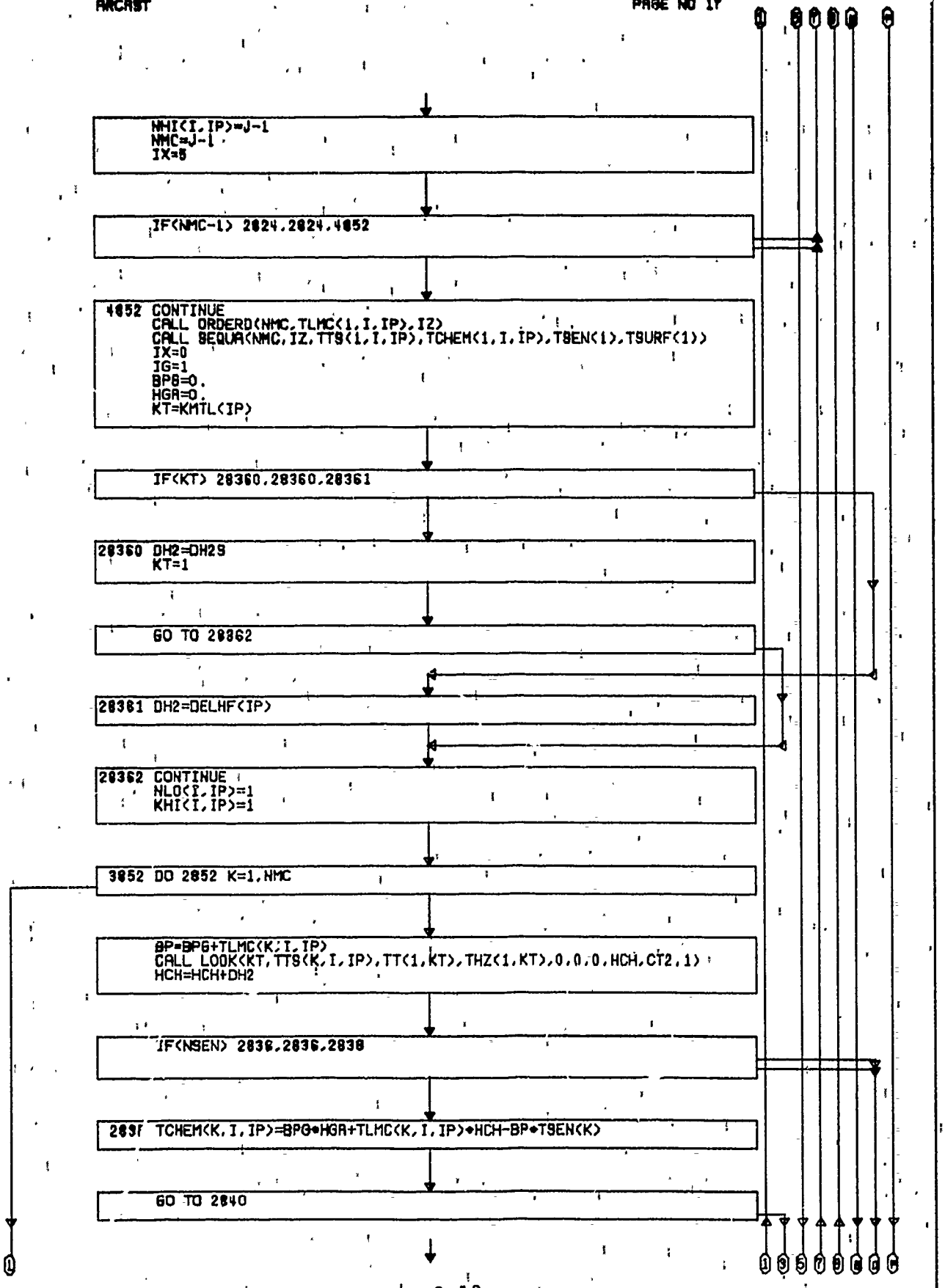

2909 CALL LCOUNT(4,LCT,NPG,RECORD(35))
WRITE(KOUT,2910)
2910 FORMAT(///10X,70HPREVIOUS SURFACE TABLES CALLED FOR BUT THIS IS FIR
1ST PROBLEM. QUIT JOB//)
STOP
2902 KNST=777
IF (RSV) 9280,9280,9281
9280 NR=0
9281 CONTINUE
WLS=-1
NSEN=-1
IP=1
IPN=1
I=1
IN=1
J=0
2800 J=J+1
GO TO (2911,2912,2913,2914),KTCTB
2911 READ(INCH,5780) PSV,TLMC(J,I,IP),DMS,WLQ,TTS(J,I,IP),TCHEM(J,I,IP)
1,TSEN(J),TSURF(J),JNG
GO TO 2916
2912 READ(INCH,5781) PSV,TLMC(J,I,IP),DMS,WLQ,TTS(J,I,IP),TCHEM(J,I,IP)
1,TSEN(J),TSURF(J),JNG
GO TO 2916
2913 READ(INCH,5782) PSV,TLMC(J,I,IP),DMS,WLQ,TTS(J,I,IP),TCHEM(J,I,IP)
1,TSEN(J),TSURF(J),JNG

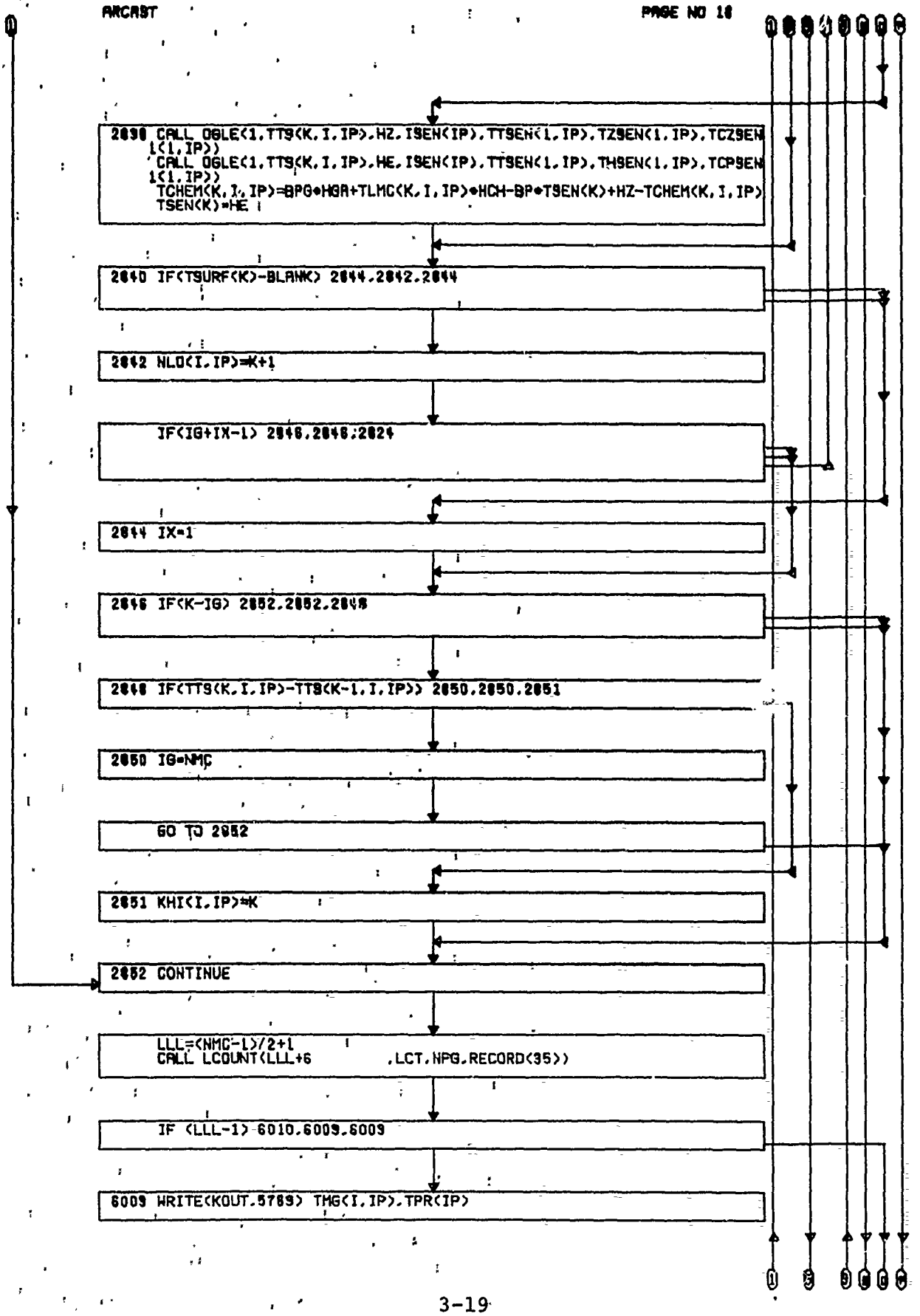

2916 JNG=JNG-1
GO TO 2915
2914 READ(INCH,5791) PSV,DMS,TLMC(J,I,IP),TTS(J,I,IP),WLQ,TCHEM(J,I,IP)
1,TSEN(J),JNG,TSURF(J)
2915 CONTINUE
IF(JNG) 2817,2817,2821
2817 TSURF(J)=BLANK
2821 CONTINUE
IF(TTS(J,I,IP)) 2803,2892,2801
2801 TTS(J,I,IP)=TTS(J,I,IP)+1.8
TCHEM(J,I,IP)=TCHEM(J,I,IP)+1.8
TSEN(J)=TSEN(J)+1.8
GO TO 2805
2803 TTS(J,I,IP)=-TTS(J,I,IP)
2805 IF(WLS) 2809,2807,2807
2807 IX=4
IF(WLS-WLQ) 2824,2811,2824

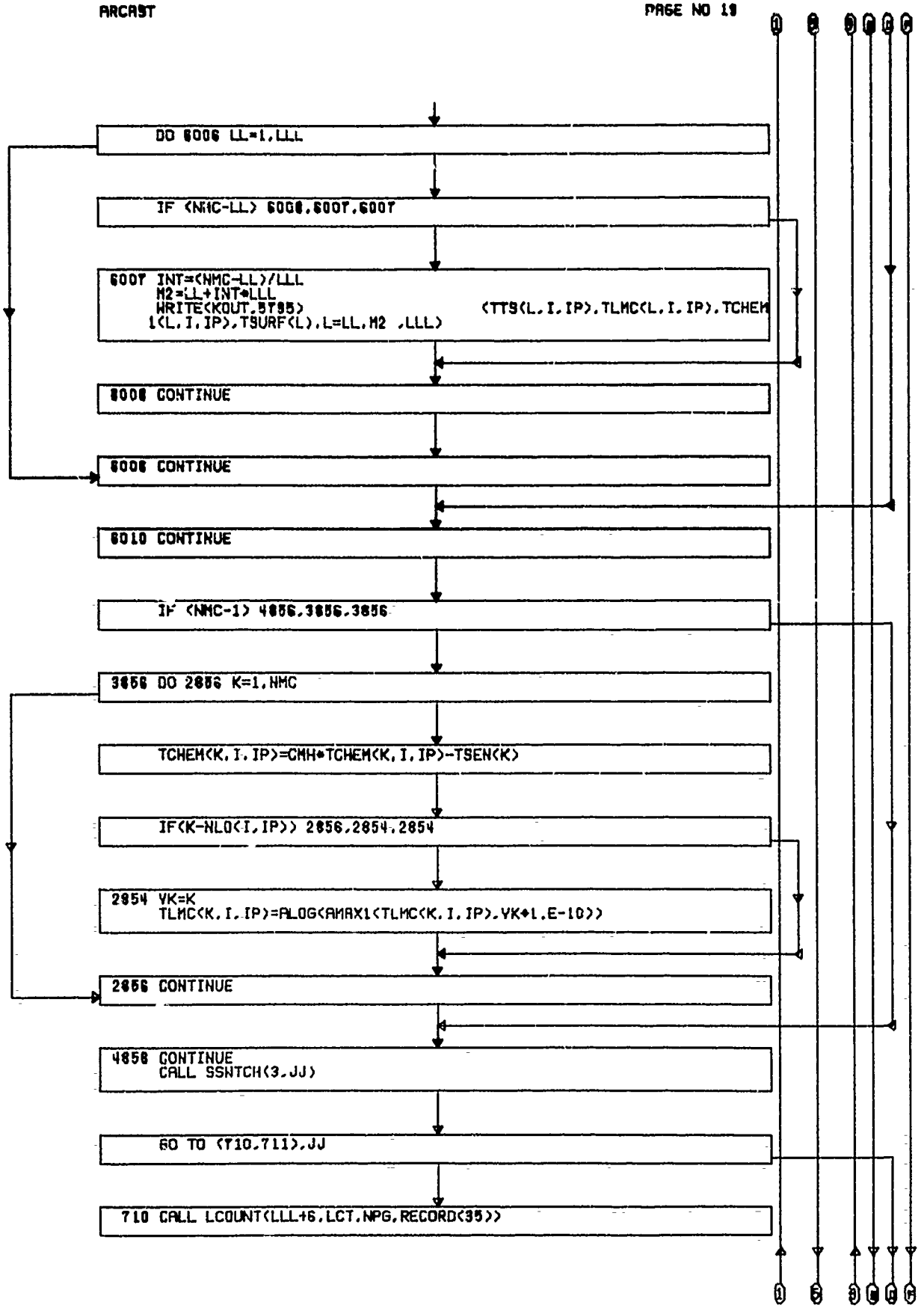

2809 WLS=WLQ
2811 IF(NSEN) 2802,2820,2820
2802 IF(JNG) 2800,2804,2804
2804 NSEN=J-1
ISEN(IP)=NSEN
IF (NSEN-1) 8806,7806,7806
7806 DO 2806 L=1,NSEN
TTSEN(L,IP)=TTS(L,1,IP)
TZSEN(L,IP)=TCHEM(L,1,IP)
2806 THSEN(L,IP)=TSEN(L)
8806 CONTINUE
IF(NSEN-1) 2820,2820,2808
2808 CALL SLOPQ(NSEN,TTSEN(1,IP),THSEN(1,IP),TCPSEN(1,IP))
CALL SLOPQ(NSEN,TTSEN(1,IP),TZSEN(1,IP),TCZSEN(1,IP))
LLL=(NSEN-1)/9+1
IF(IP-1) 2815,2813,2815
2813 CALL LCOUNT(9,LCT,NPG,RECORD(35))
WRITE (KOUT,538)
WRITE (KOUT,5797) CMH,WLQ
IF (NR) 2818,2818,2816

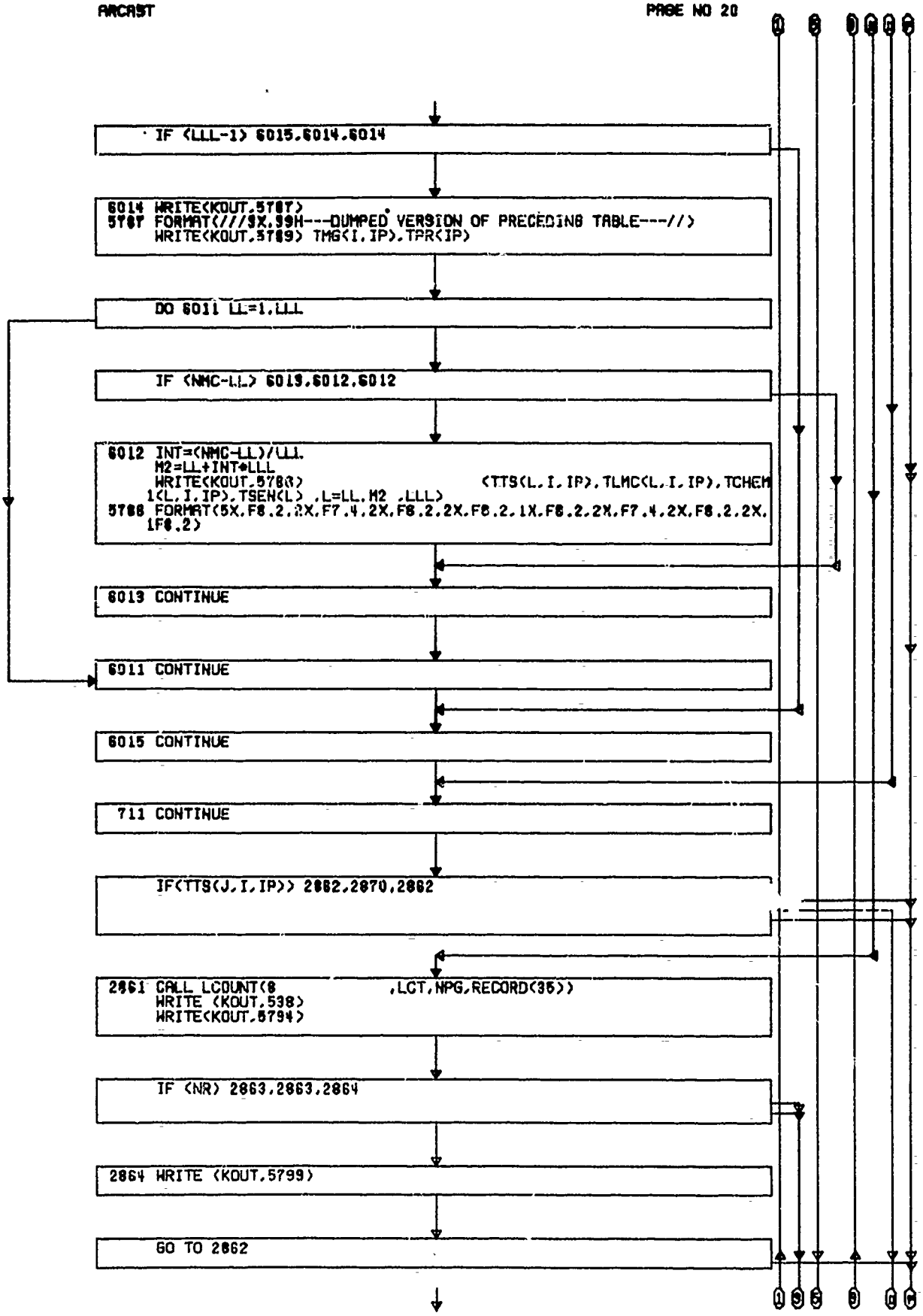

2816 WRITE (KOUT,5799)
GO TO 2815
2816 WRITE (KOUT,5790)
2815 CONTINUE
LL=IP-1
IF(LL) 28150,28151,28150
28150 CALL LCOUNT(7,LCT,NPG,RECORD(35))
WRITE(KOUT,713)
713 FORMAT(1H)
WRITE(KOUT,712) LL,KT,DH2
712 FORMAT(5X,74HTHIS COMPLETES THE INPUT AND DISPLAY OF SURFACE THERM
1OCHEMISTRY TABLE NO. ,I1,1H./5X,76HTHIS TABLE HAS INCORPORATED BY
2USER ASSIGNMENT THE SPECIFIC HEAT OF MATERIAL/5X,4HNO. ,I1,34H AND
3 A HEAT OF FORMATION VALUE OF ,F6.0,31H BTU/LB AT 536 DEGREES RANK
4INE.//)
28151 LLLM=MAX0(LLL,0)
CALL LCOUNT(LLLM+6,LCT,NPG,RECORD(35))
WRITE(KOUT,5792)PSV
IF (LLL-1) 9819,8819,8819
8819 DO 2819 LL=1,LLL
IF (NSEN-LL) 7819,6819,6819
6819 INT=(NSEN-LL)/LLL
M2=LL+INT*LLL
WRITE(KOUT,5798) (TTSEN(L,IP),THSEN(L,IP),L=LL,M2 ,LLL)
7819 CONTINUE
2819 CONTINUE

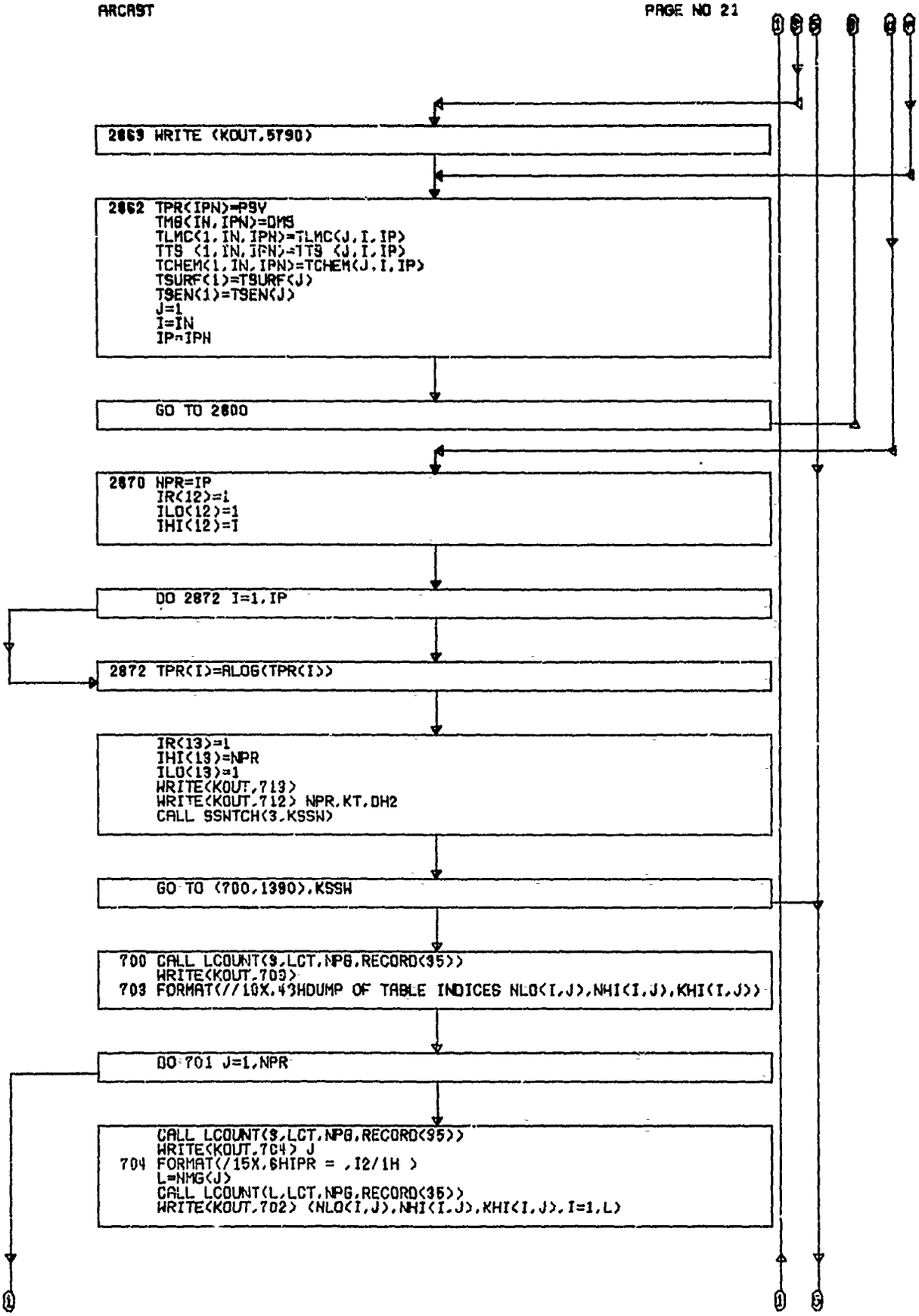

9019 CONTINUE
GO TO 2062
2020 NSEN=0
IX=9
IF(CMH-1.) 2024,2022,2024
2022 IX=2
IF(WLQ) 2024,2026,2024
2024 WRITE (KOUT,5793) IX
C TIXE LL
STOP
2026 IF(IP-1) 2062,2061,2062
2028 IF(TTS(J,I,IP)) 2029,2032,2029
2029 IF(PSV-TPR(IP)) 2032,2030,2032
2030 IF(DMS-TMG(I,IP)) 2034,2000,2034
2032 IPN=IP+1
NMG(IP)=I
IN=0
NSEN=-N3EN
2034 IN=IN+1

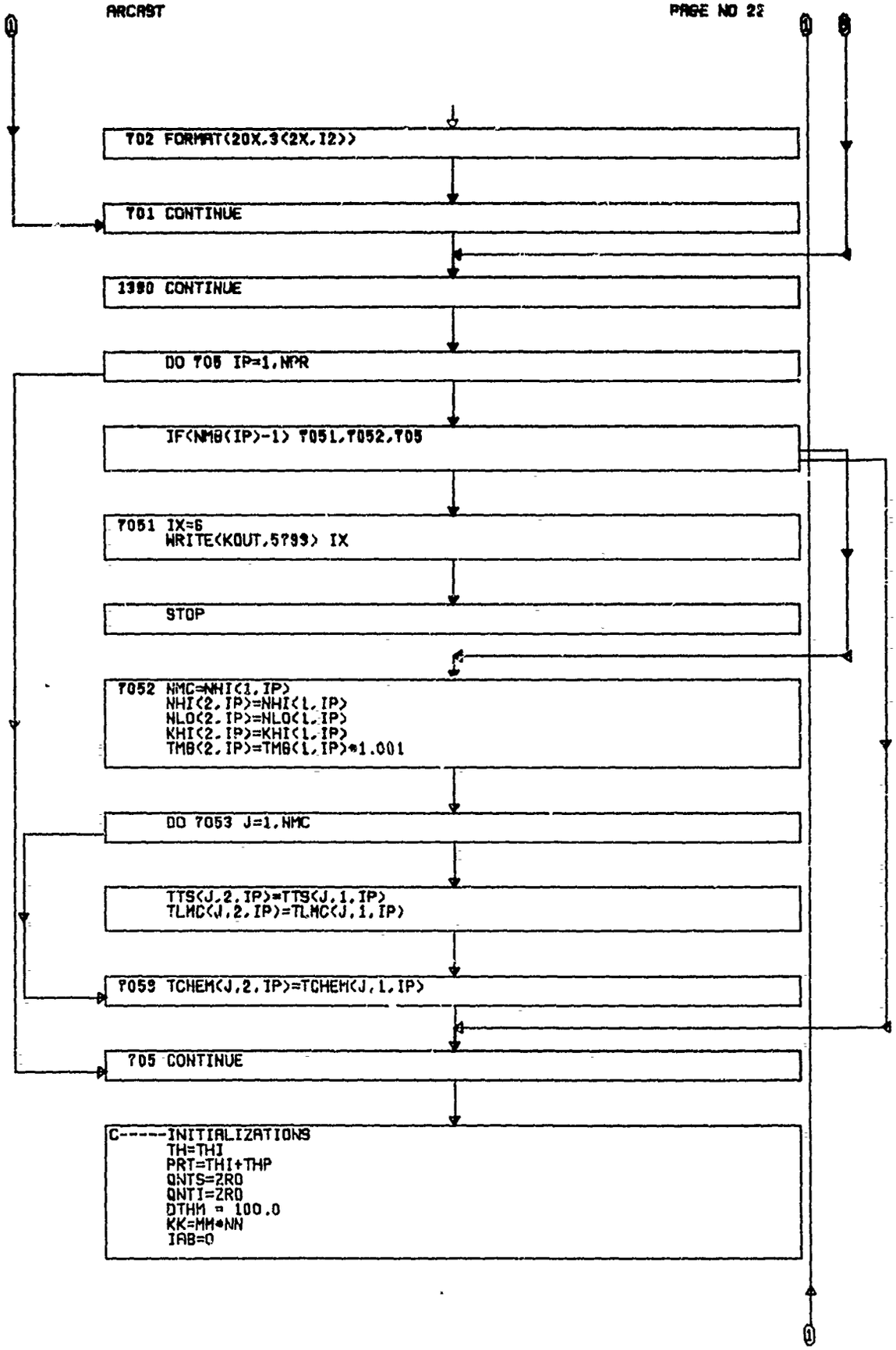

NHI(I,IP)=J-1
NMC=J-1
IX=5
IF(NMC-1) 2824,2824,4852
4852 CONTINUE
CALL ORDERD(NMC,TLMC(1,I,IP),IZ)
CALL SEQUA(NMC,IZ,TTS(1,I,IP),TCHEM(1,I,IP),TSEN(1),TSURF(1))
IX=0
IG=1
BPS=0.
HGA=0.
KT=KMTL(IP)
IF(KT) 28360,28360,28361
28360 DH2=DH2S
KT=1
GO TO 28362
28361 DH2=DELHF(IP)
28362 CONTINUE
NLO(I,IP)=1
KHI(I,IP)=1
3852 DO 2852 K=1,NMC
BP=BPG+TLMC(K,I,IP)
CALL LOOK(KT,TTS(K,I,IP),TT(1,KT),THZ(1,KT),0,0,0,HCH,CT2,1)
HCH=HCH+DH2
IF(NSEN) 2836,2836,2838
2891 TCHEM(K,I,IP)=BPG*HGA+TLMC(K,I,IP)*HCH-BP*TSEN(K)
GO TO 2840

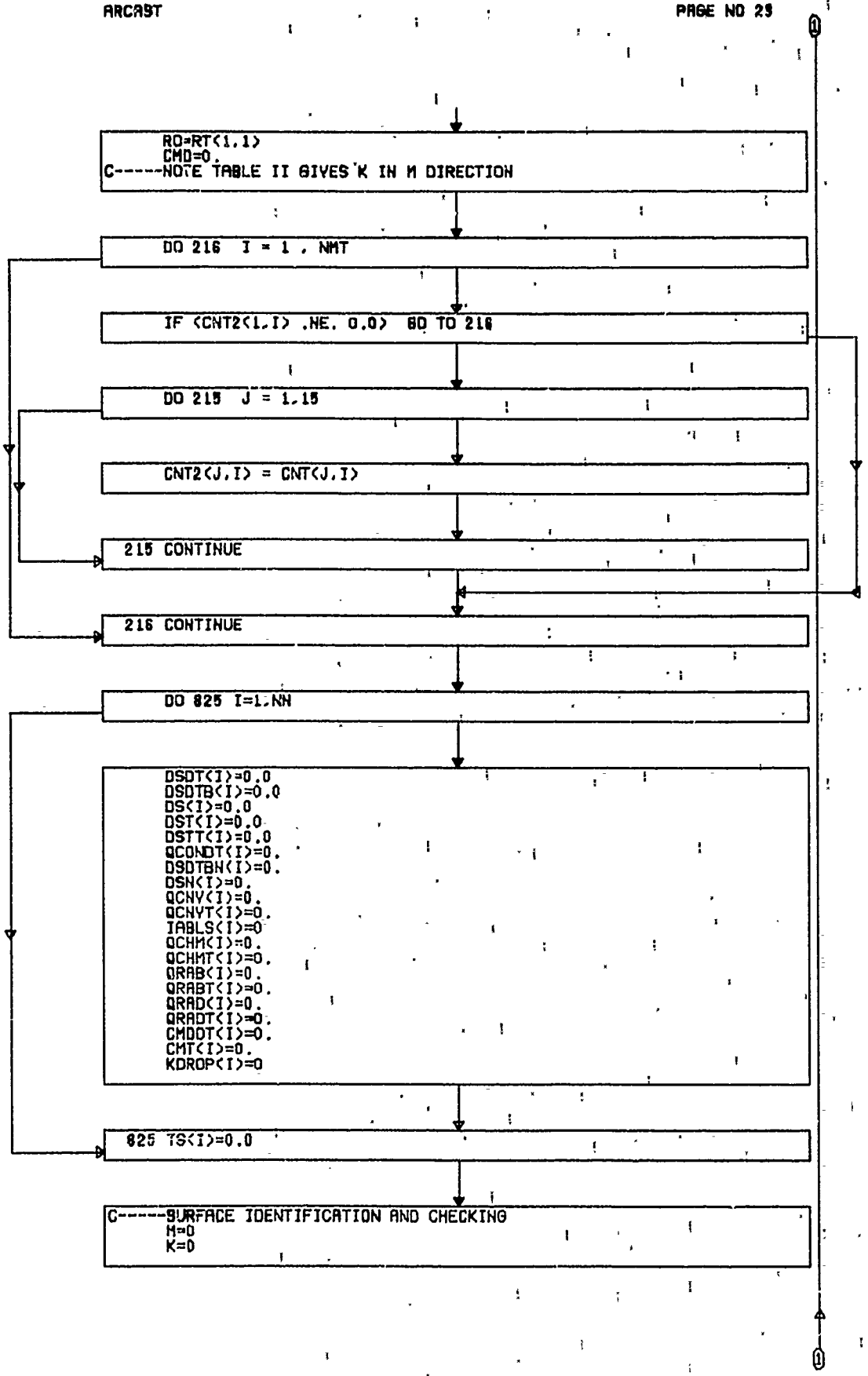

2838 CALL OGLE(1,TTS(K,I,IP),HZ,ISEN(IP),TTSEN(1,IP),TZSEN(1,IP),TCZSEN
1(1,IP))
CALL OGLE(1,TTS(K,I,IP),HE,ISEN(IP),TTSEN(1,IP),THSEN(1,IP),TCPSEN
1(1,IP))
TCHEM(K,I,IP)=BPG*HGR+TLMC(K,I,IP)*HCH-BP*TSEN(K)+HZ-TCHEM(K,I,IP)
TSEN(K)=HE
2840 IF(TSURF(K)-BLANK) 2844,2842,2844
2842 NLO(I,IP)=K+1
IF(IG+IX-1) 2846,2846,2824
2844 IX=1
2846 IF(K-IG) 2852,2852,2848
2848 IF(TTS(K,I,IP)-TTS(K-1,I,IP)) 2850,2850,2851
2850 IG=NMC
GO TO 2852
2851 KHI(I,IP)=K
2852 CONTINUE
LLL=(NMC-1)/2+1
CALL LCOUNT(LLL+6 ,LCT,NPG,RECORD(35))
IF (LLL-1) 6010,6009,6009
6009 WRITE(KOUT,5789) TMG(I,IP),TPR(IP)

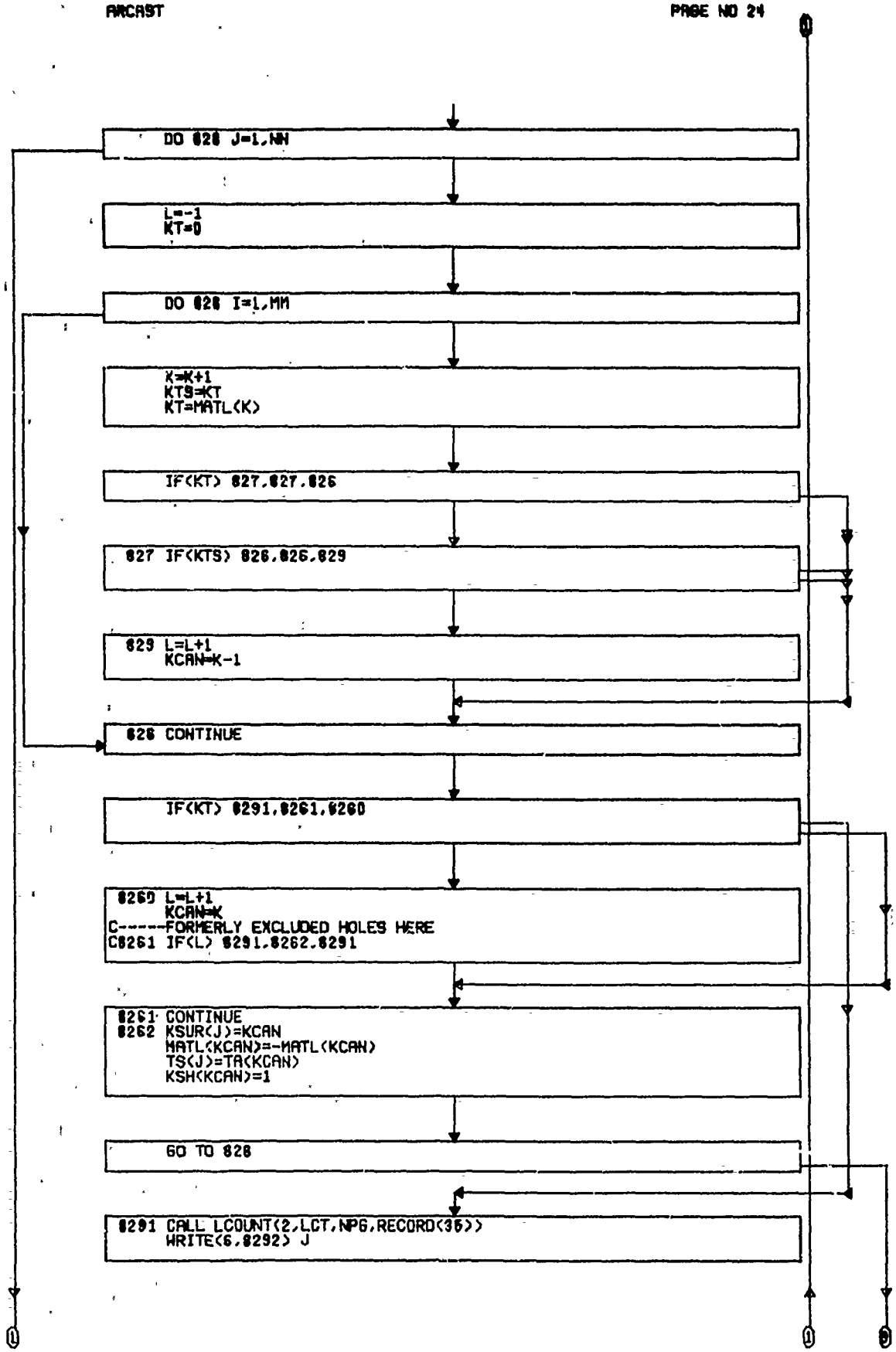

DO 6006 LL=1,LLL
IF (NMC-LL) 6006,6007,6007
6007 INT=(NMC-LL)/LLL
M2=LL+INT*LLL
WRITE(KOUT,5795)
1(L,I,IP),TSURF(L),L=LL,M2 ,LLL)
(TTS(L,I,IP),TLMC(L,I,IP),TCHEM
6006 CONTINUE
6008 CONTINUE
6010 CONTINUE
IF (NMC-1) 4856,3856,3856
3856 DO 2856 K=1,NMC
TCHEM(K,I,IP)=CMH*TCHEM(K,I,IP)-TSEN(K)
IF(K-NLO(I,IP)) 2856,2854,2854
2854 VK=K
TLMC(K,I,IP)=ALOG(AMAX1(TLMC(K,I,IP),VK+1,E-10))
2856 CONTINUE
4856 CONTINUE
CALL SSNTCH(3,JJ)
GO TO (710,711),JJ
710 CALL LCOUNT(LLL+6,LCT,NPG,RECORD(35))

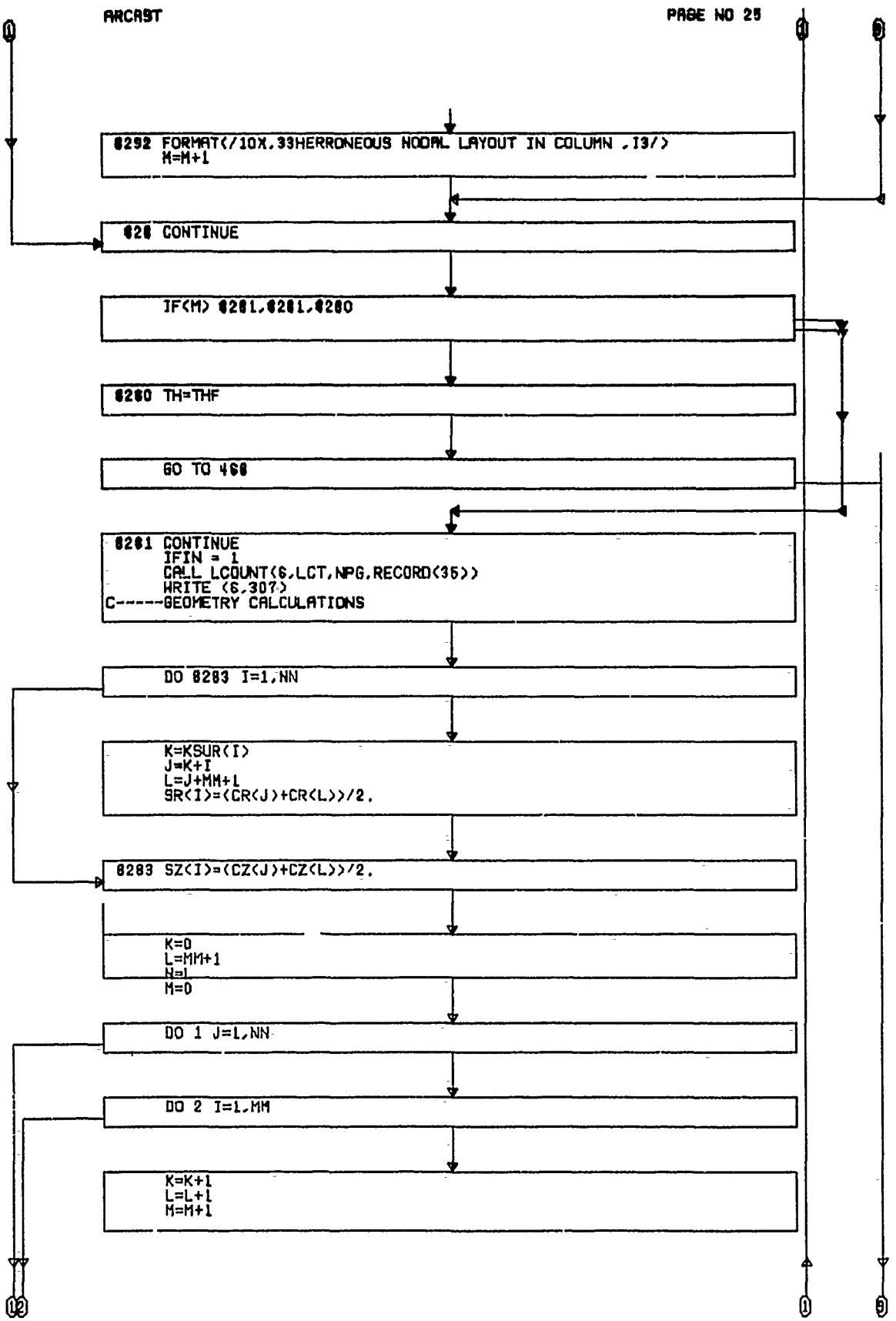

IF (LLL-1) 6015,6014,6014
6014 WRITE(KOUT,5787)
5787 FORMAT(///9X,99H---DUMPED VERSION OF PRECEDING TABLE---//)
WRITE(KOUT,5789) TMG(I,IP),TPR(IP)
DO 6011 LL=1,LLL
IF (NMC-LL) 6013,6012,6012
6012 INT=(NMC-LL)/LLL
M2=LL+INT*LLL
WRITE(KOUT,5788) (TTS(L,I,IP),TLMC(L,I,IP),TCHEM
1(L,I,IP),TSEN(L) ,L=LL,M2 ,LLL)
5788 FORMAT(5X,F8.2,2X,F7.4,2X,F8.2,2X,F8.2,1X,F8.2,2X,F7.4,2X,F8.2,2X,
1F8.2)
6013 CONTINUE
6011 CONTINUE
6015 CONTINUE
711 CONTINUE
IF(TTS(J,I,IP)) 2862,2870,2862
2861 CALL LCOUNT(8 ,LCT,NPG,RECORD(35))
WRITE (KOUT,538)
WRITE(KOUT,5794)
IF (NR) 2863,2863,2864
2864 WRITE (KOUT,5799)
GO TO 2862

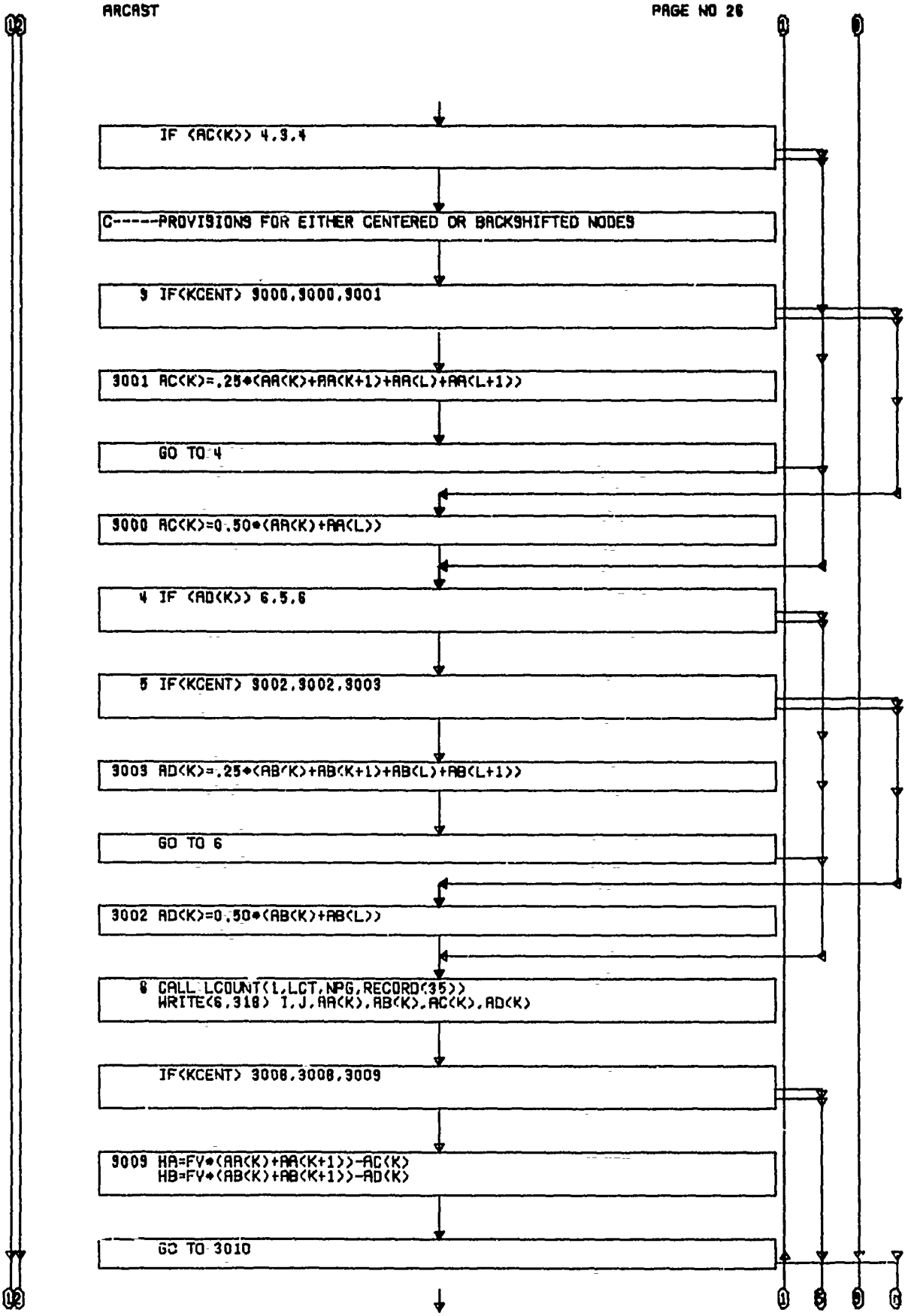

2869 WRITE (KOUT,5790)
2862 TPR(IPN)=PSV
TMB(IN,IPN)=DMS
TLMC(1,IN,IPN)=TLMC(J,I,IP)
TTS (1,IN,IPN)=TTS (J,I,IP)
TCHEM(1,IN,IPN)=TCHEM(J,I,IP)
TSURF(1)=TSURF(J)
TSEN(1)=TSEN(J)
J=1
I=IN
IP=IPN
GO TO 2800
2870 NPR=IP
IR(12)=1
ILO(12)=1
IHI(12)=I
DO 2872 I=1,IP
2872 TPR(I)=ALOG(TPR(I))
IR(13)=1
IHI(13)=NPR
ILO(13)=1
WRITE(KOUT,713)
WRITE(KOUT,712) NPR,KT,DH2
CALL SSWTCH(3,KSSW)
GO TO (700,1380),KSSW
700 CALL LCOUNT(9,LCT,NPG,RECORD(95))
WRITE(KOUT,709)
709 FORMAT(//10X,43HDUMP OF TABLE INDICES NLO(I,J),NHI(I,J),KHI(I,J))
DO 701 J=1,NPR
CALL LCOUNT(9,LCT,NPG,RECORD(95))
WRITE(KOUT,704) J
704 FORMAT(/15X,6HIPR = ,I2/1H)
L=NMG(J)
CALL LCOUNT(L,LCT,NPG,RECORD(35))
WRITE(KOUT,702) (NLO(I,J),NHI(I,J),KHI(I,J),I=1,L)

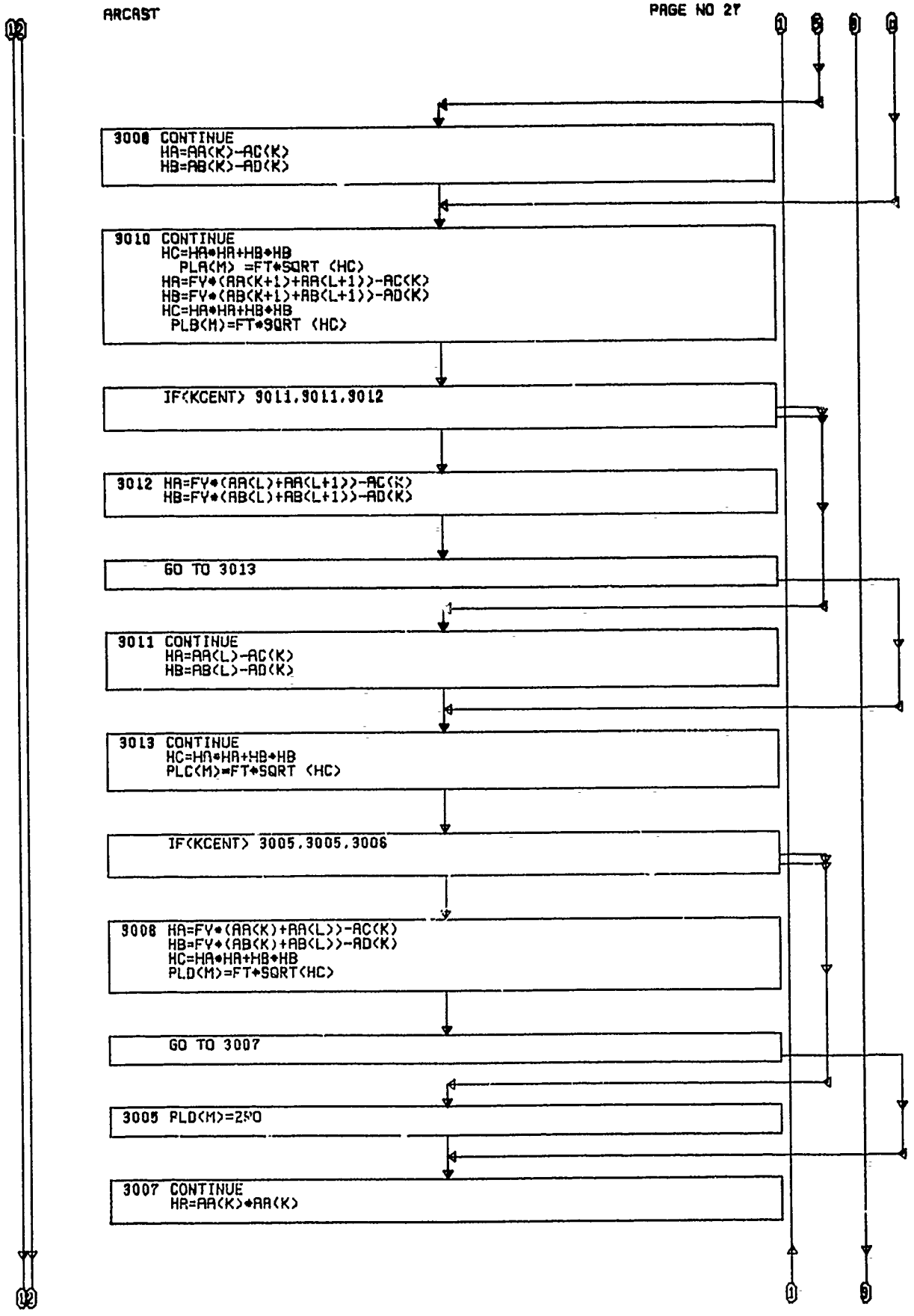

7702 FORMAT(20X,3(2X,I2))
7701 CONTINUE
1380 CONTINUE
DO 705 IP=1,NPR
IF(NMB(IP)-1) 7051,7052,705
7051 IX=6
WRITE(KOUT,5799) IX
STOP
7052 NMC=NHI(1,IP)
NHI(2,IP)=NHI(1,IP)
NLO(2,IP)=NLO(1,IP)
KHI(2,IP)=KHI(1,IP)
TMB(2,IP)=TMB(1,IP)*1.001
DO 7053 J=1,NMC
TTS(J,2,IP)=TTS(J,1,IP)
TLMC(J,2,IP)=TLMC(J,1,IP)
7059 TCHEM(J,2,IP)=TCHEM(J,1,IP)
705 CONTINUE
C-----INITIALIZATIONS
TH=THI
PRT=THI+THP
QNTS=ZRO
QNTI=ZRO
DTHM = 100.0
KK=MM*NN
IAB=0

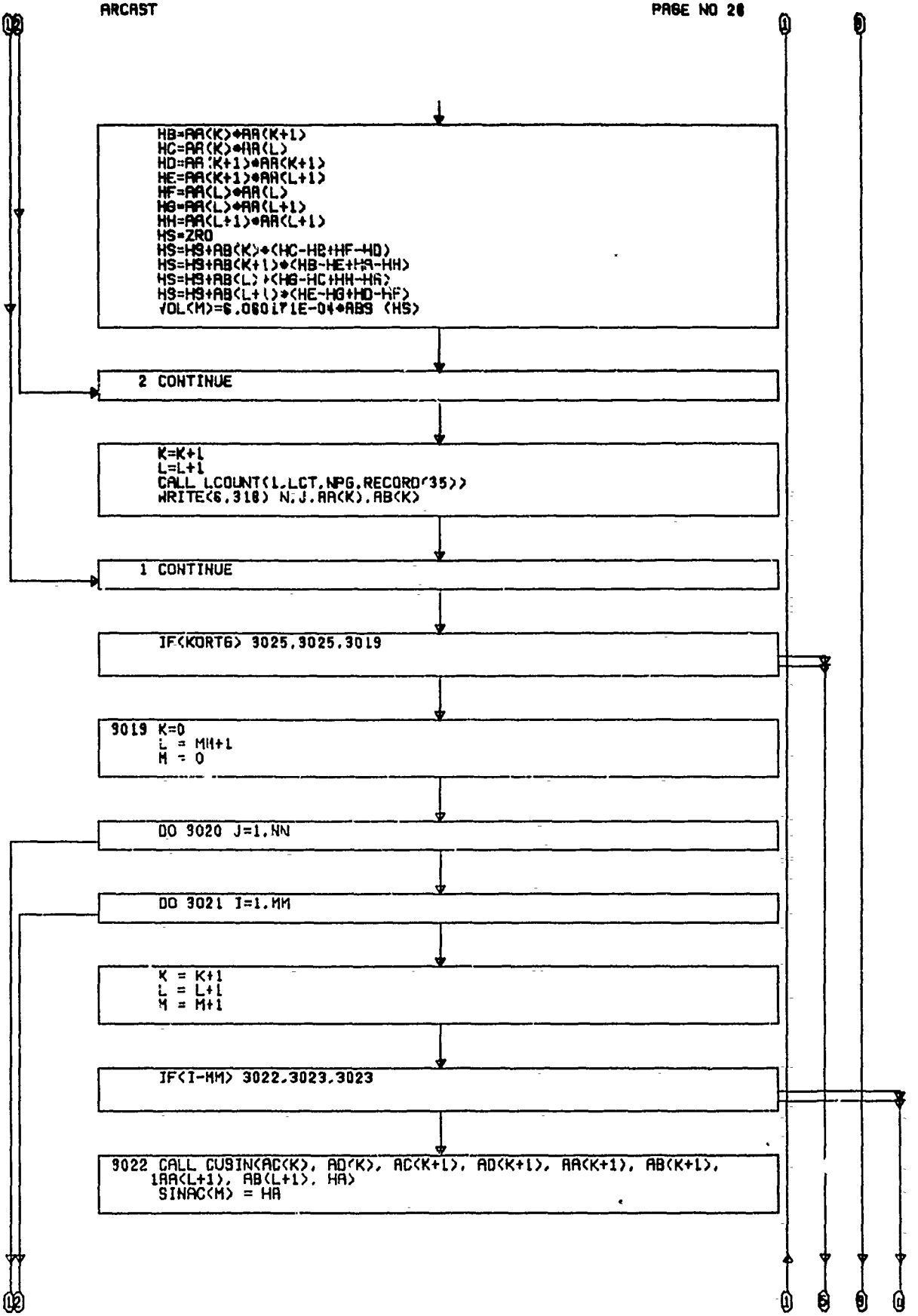

RO=RT(1,1)
CMD=0.
C-----NOTE TABLE II GIVES K IN M DIRECTION
DO 216 I = 1 , NMT
IF (CNT2(1,I) .NE. 0.0) GO TO 216
DO 215 J = 1,15
CNT2(J,I) = CNT(J,I)
215 CONTINUE
216 CONTINUE
DO 825 I=1,NN
DSDT(I)=0.0
DSDTB(I)=0.0
DS(I)=0.0
DST(I)=0.0
DSTT(I)=0.0
QCONDT(I)=0.
DSDTBN(I)=0.
DSN(I)=0.
QCNV(I)=0.
QCNVT(I)=0.
IABLS(I)=0
QCHM(I)=0.
QCHMT(I)=0.
QRAB(I)=0.
QRABT(I)=0.
QRAD(I)=0.
QRADT(I)=0.
CMDDT(I)=0.
CMT(I)=0.
KDROP(I)=0
825 TS(I)=0.0
C-----SURFACE IDENTIFICATION AND CHECKING
M=0
K=0

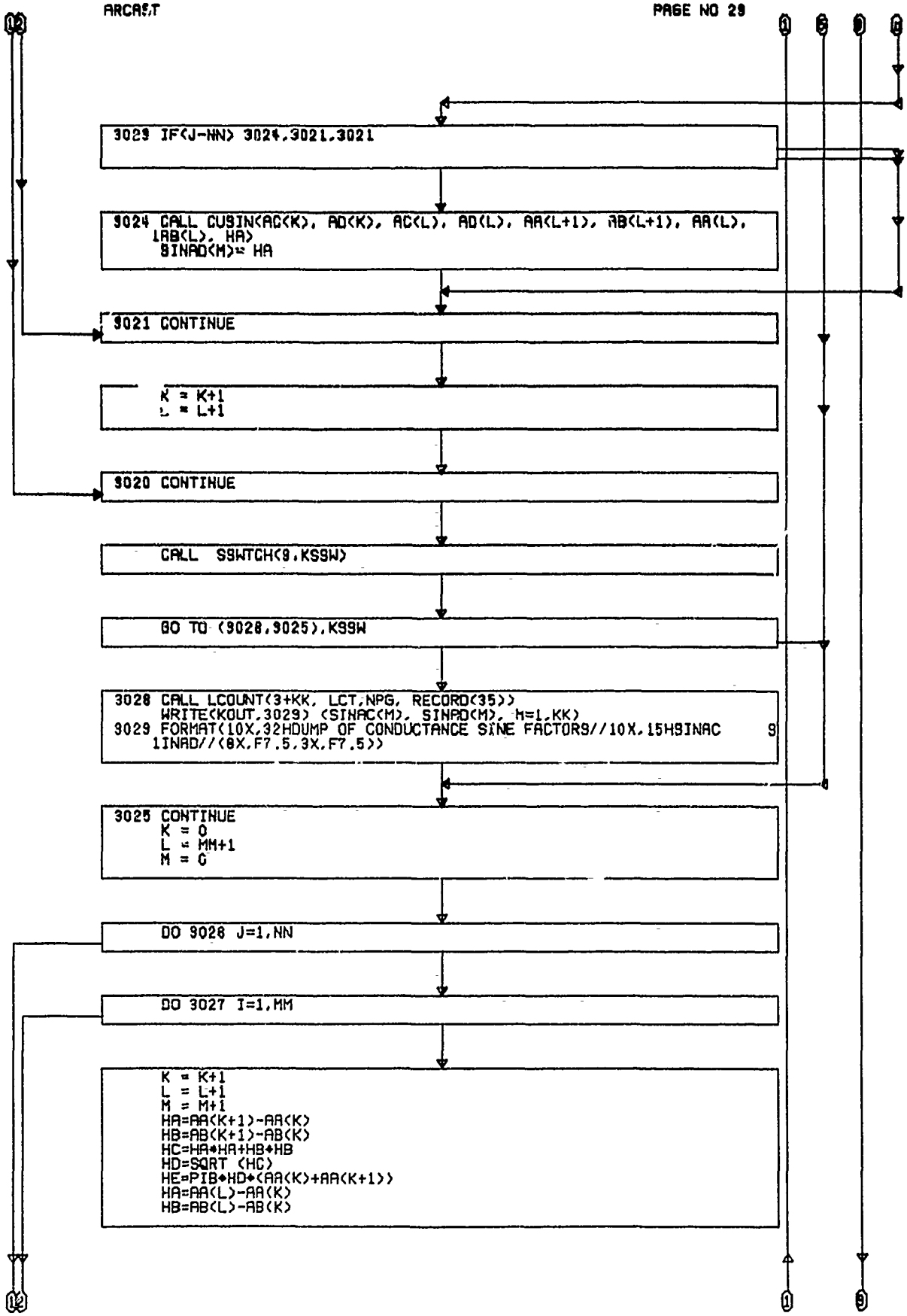

DO 826 J=1,NN
L=-1
KT=0
DO 826 I=1,MM
K=K+1
KTS=KT
KT=MATL(K)
IF(KT) 827,827,826
827 IF(KTS) 826,826,829
829 L=L+1
KCAN=K-1
826 CONTINUE
IF(KT) 8291,8261,8260
8260 L=L+1
KCAN=K
C-----FORMERLY EXCLUDED HOLES HERE
C8261 IF(L) 8291,8262,8291
8261 CONTINUE
8262 KSUR(J)=KCAN
MATL(KCAN)=-MATL(KCAN)
TS(J)=TA(KCAN)
KSH(KCAN)=1
GO TO 826
8291 CALL LCOUNT(2,LCT,NPG,RECORD(36))
WRITE(6,8292) J

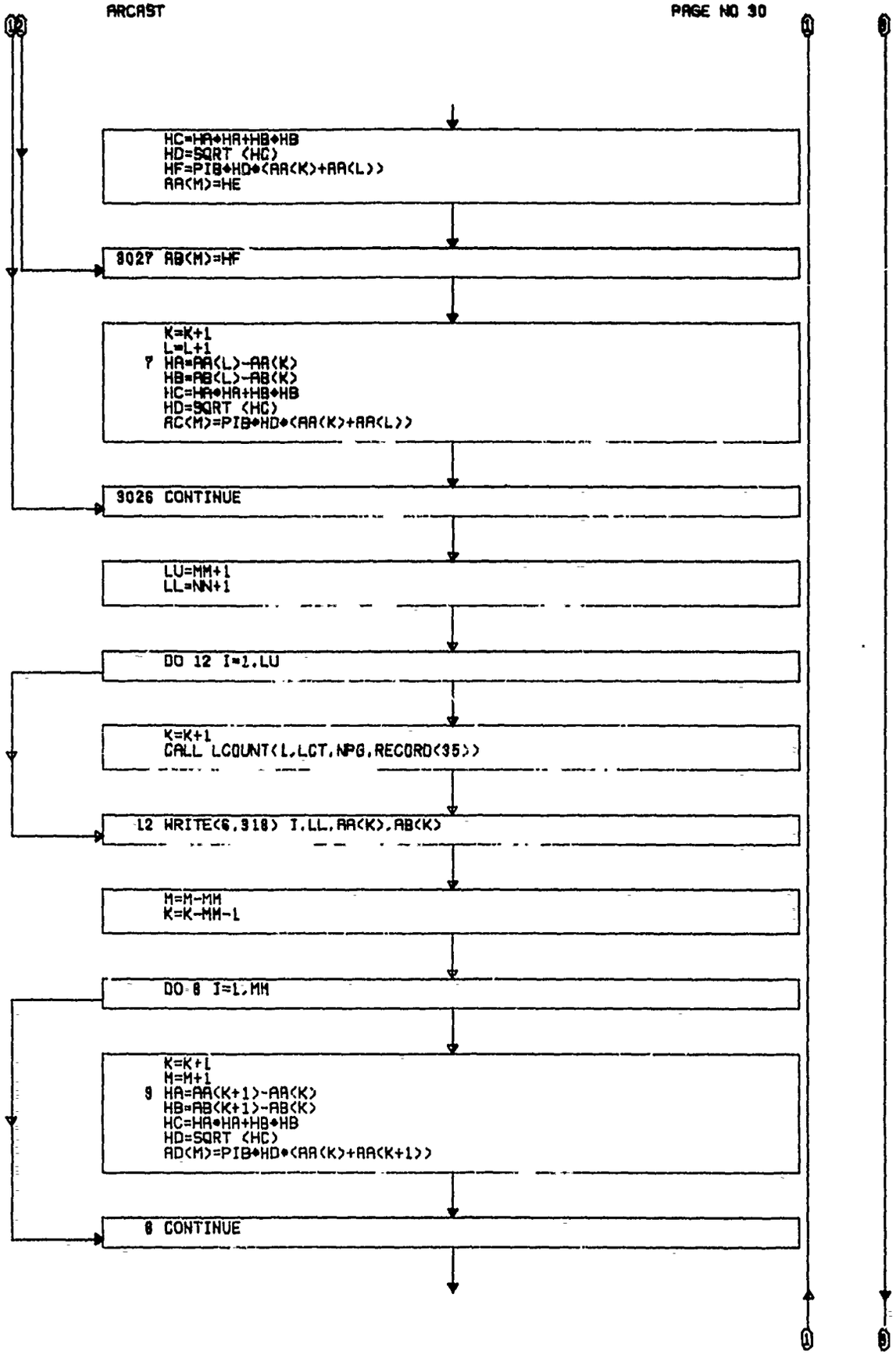

8292 FORMAT(/10X,33HERRONEOUS NODAL LAYOUT IN COLUMN ,I3/)
M=M+1
828 CONTINUE
IF(M) 8281,8281,8280
8280 TH=THF
GO TO 466
8281 CONTINUE
IFIN = 1
CALL LCOUNT(6,LCT,NPG,RECORD(35))
WRITE (6,307)
C-----GEOMETRY CALCULATIONS
DO 8283 I=1,NN
K=KSUR(I)
J=K+I
L=J+MM+1
SR(I)=(CR(J)+CR(L))/2.
8283 SZ(I)=(CZ(J)+CZ(L))/2.
K=0
L=MM+1
N=1
M=0
DO 1 J=1,NN
DO 2 I=1,MM
K=K+1
L=L+1
M=M+1

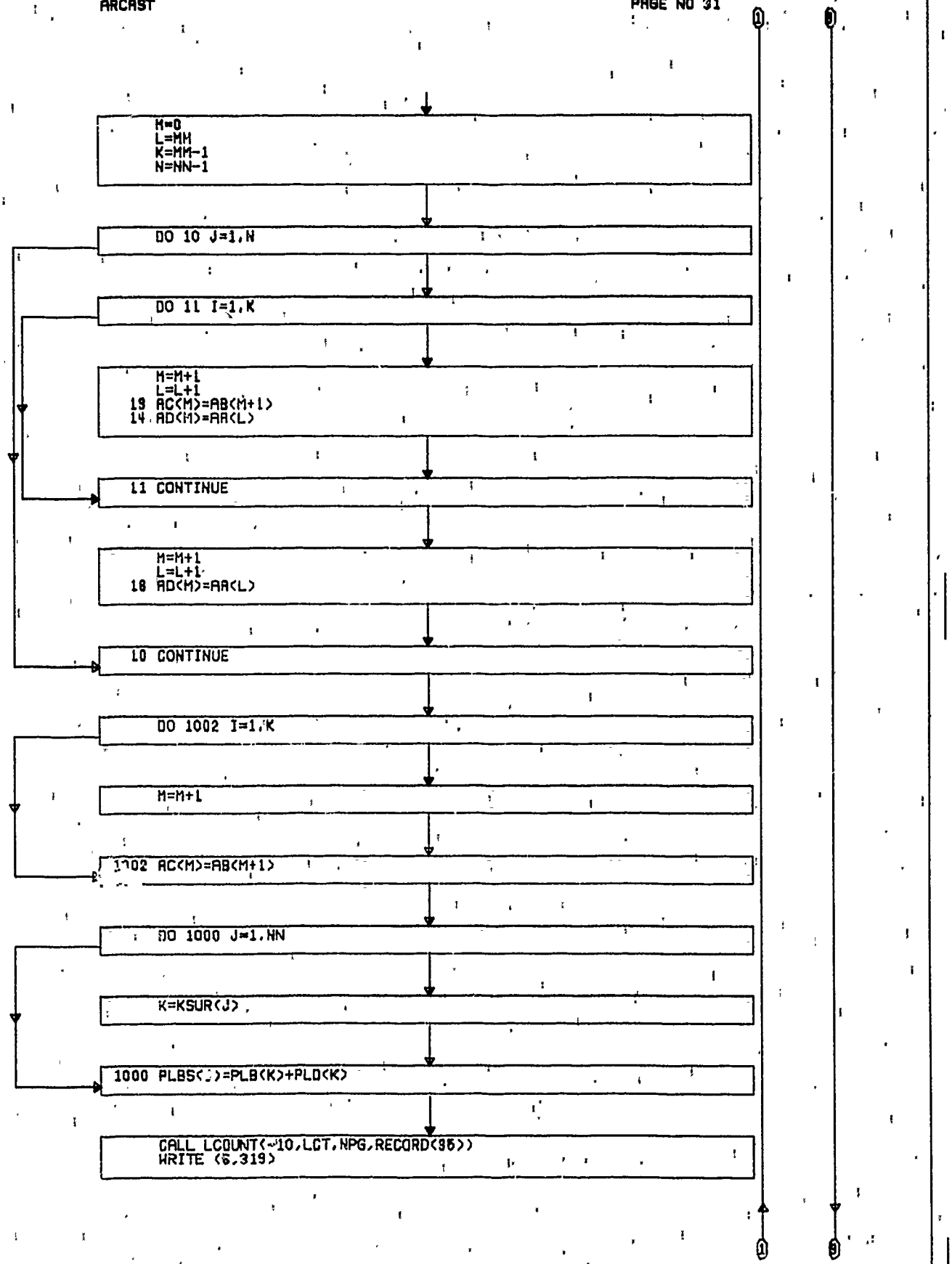

IF (AC(K)) 4,3,4
C-----PROVISIONS FOR EITHER CENTERED OR BACKSHIFTED NODES
9 IF(KCENT) 9000,9000,9001
9001 AC(K)=.25*(AA(K)+AA(K+1)+AA(L)+AA(L+1))
GO TO 4
9000 AC(K)=0.50*(AA(K)+AA(L))
4 IF (AD(K)) 6,5,6
5 IF(KCENT) 9002,9002,9003
9003 AD(K)=.25*(AB(K)+AB(K+1)+AB(L)+AB(L+1))
GO TO 6
9002 AD(K)=0.50*(AB(K)+AB(L))
6 CALL LCOUNT(1,LCT,NPG,RECORD(35))
WRITE(6,318) I,J,AA(K),AB(K),AC(K),AD(K)
IF(KCENT) 3008,3008,3009
9009 HA=FV*(AA(K)+AA(K+1))-AC(K)
HB=FV*(AB(K)+AB(K+1))-AD(K)
GO TO 3010

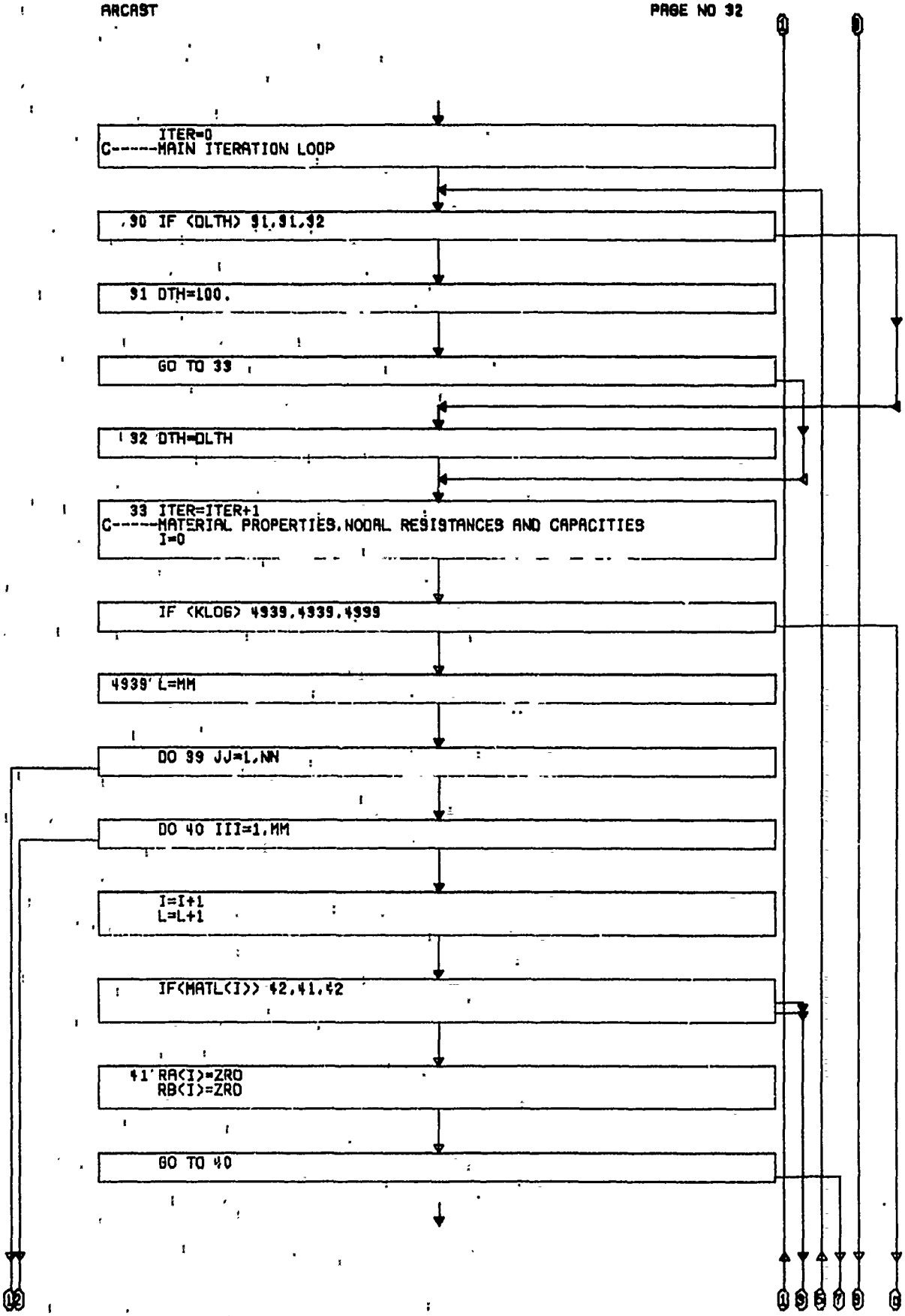

12
1
5
9
6
3008 CONTINUE
HA=AA(K)-AC(K)
HB=AB(K)-AD(K)
3010 CONTINUE
HC=HA*HA+HB*HB
PLA(M) =FT*SQRT (HC)
HA=FV*(AA(K+1)+AA(L+1))-AC(K)
HB=FV*(AB(K+1)+AB(L+1))-AD(K)
HC=HA*HA+HB*HB
PLB(M)=FT*SQRT (HC)
IF(KCENT) 3011,3011,3012
3012 HA=FV*(AA(L)+AA(L+1))-AC(K)
HB=FV*(AB(L)+AB(L+1))-AD(K)
GO TO 3013
1
3011 CONTINUE
HA=AA(L)-AC(K)
HB=AB(L)-AD(K)
3013 CONTINUE
HC=HA*HA+HB*HB
PLC(M)=FT*SQRT (HC)
IF(KCENT) 3005,3005,3006
3006 HA=FV*(AA(K)+AA(L))-AC(K)
HB=FV*(AB(K)+AB(L))-AD(K)
HC=HA*HA+HB*HB
PLD(M)=FT*SQRT(HC)
GO TO 3007
3005 PLD(M)=2*0
3007 CONTINUE
HR=AA(K)*AA(K)
12
1
9

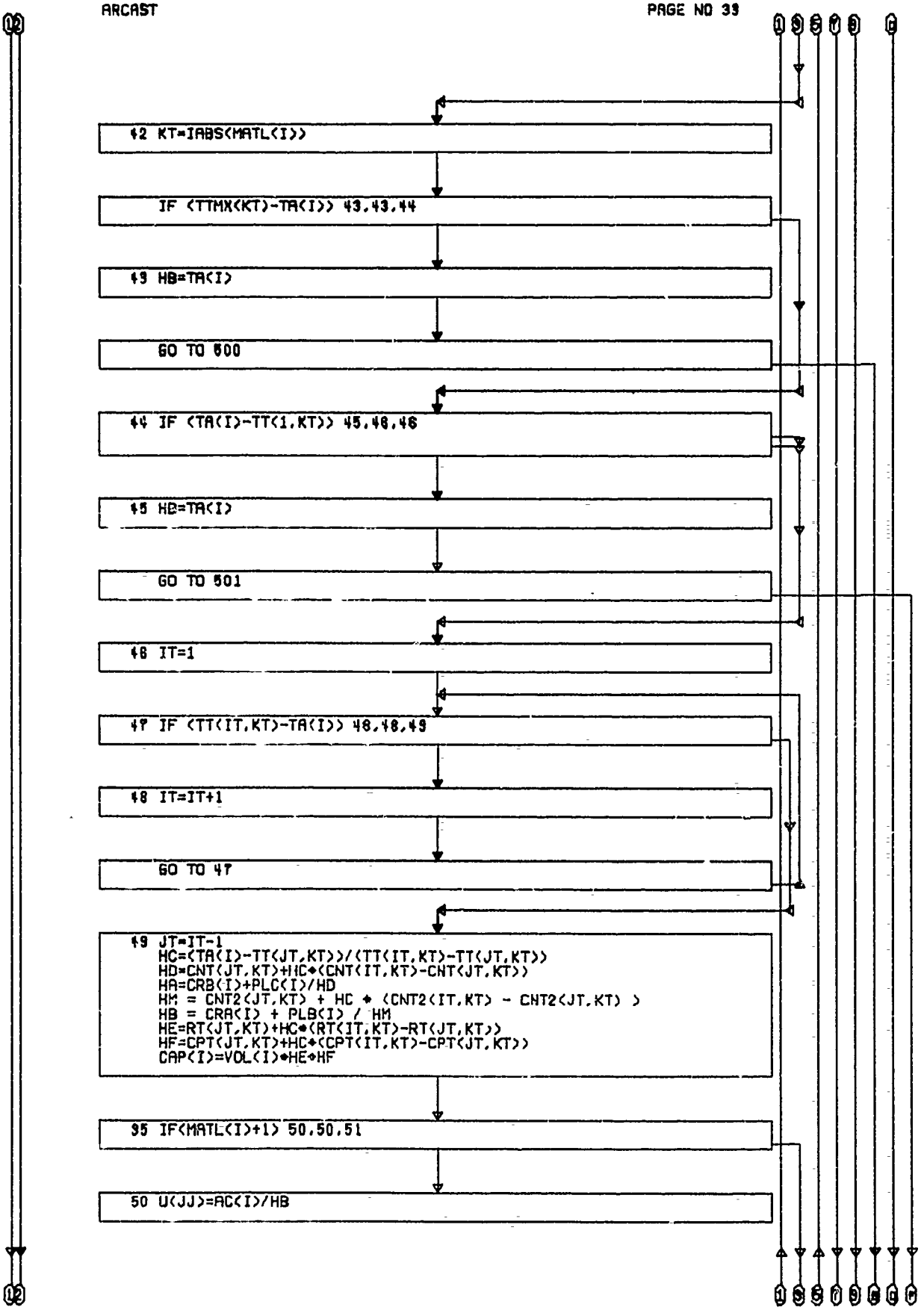

HB=AA(K)*AA(K+1)
HC=AA(K)*AA(L)
HD=AA(K+1)*AA(K+1)
HE=AA(K+1)*AA(L+1)
HF=AA(L)*AA(L)
HG=AA(L)*AA(L+1)
HH=AA(L+1)*AA(L+1)
HS=ZRO
HS=HS+AB(K)*(HC-HB+HF-HD)
HS=HS+AB(K+1)*(HB-HE+HA-HH)
HS=HS+AB(L)*(HG-HC+HH-HA)
HS=HS+AB(L+1)*(HE-HG+HD-HF)
VOL(M)=6.06017E-04*ABS (HS)
2 CONTINUE
K=K+1
L=L+1
CALL LCOUNT(1,LCT,NPG,RECORD(35))
WRITE(6,318) N,J,AA(K),AB(K)
1 CONTINUE
IF(KORTG) 3025,3025,3019
9019 K=0
L = MM+1
M = 0
DO 9020 J=1,NN
DO 3021 I=1,MM
K = K+1
L = L+1
M = M+1
IF(I-MM) 3022,3023,3023
9022 CALL CUSIN(AC(K), AD(K), AC(K+1), AD(K+1), AA(K+1), AB(K+1),
1AA(L+1), AB(L+1), HA)
SINAC(M) = HA

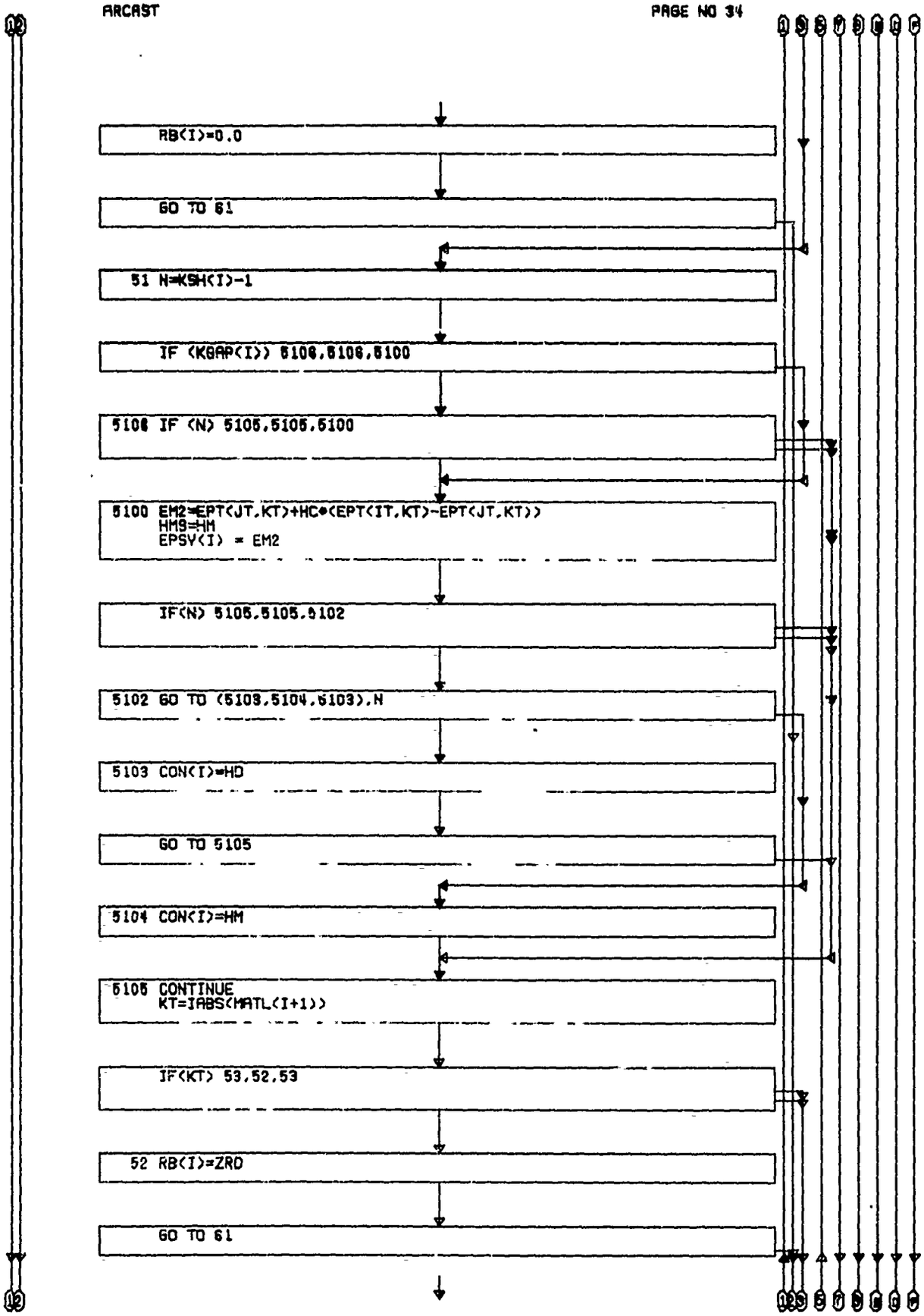

3029 IF(J-NN) 3024,3021,3021
3024 CALL CUBIN(AC(K), AD(K), AC(L), AD(L), AA(L+1), AB(L+1), AA(L), 1AB(L), HA)
SINAD(M)= HA
3021 CONTINUE
K = K+1
L = L+1
3020 CONTINUE
CALL SSWTCH(9,KS9W)
GO TO (9028,9025),K99W
3028 CALL LCOUNT(3+KK, LCT,NPG, RECORD(35))
WRITE(KOUT,3029) (SINAC(M), SINAD(M), M=1,KK)
3029 FORMAT(10X,32HDUMP OF CONDUCTANCE SINE FACTORS//10X,15HSINAC 9
1INAD//(8X,F7.5,3X,F7.5))
3025 CONTINUE
K = 0
L = MM+1
M = 0
DO 9028 J=1,NN
DO 3027 I=1,MM
K = K+1
L = L+1
M = M+1
HA=AA(K+1)-AA(K)
HB=AB(K+1)-AB(K)
HC=HA*HA+HB*HB
HD=SQRT (HC)
HE=PIB*HD*(AA(K)+AA(K+1))
HA=AA(L)-AA(K)
HB=AB(L)-AB(K)

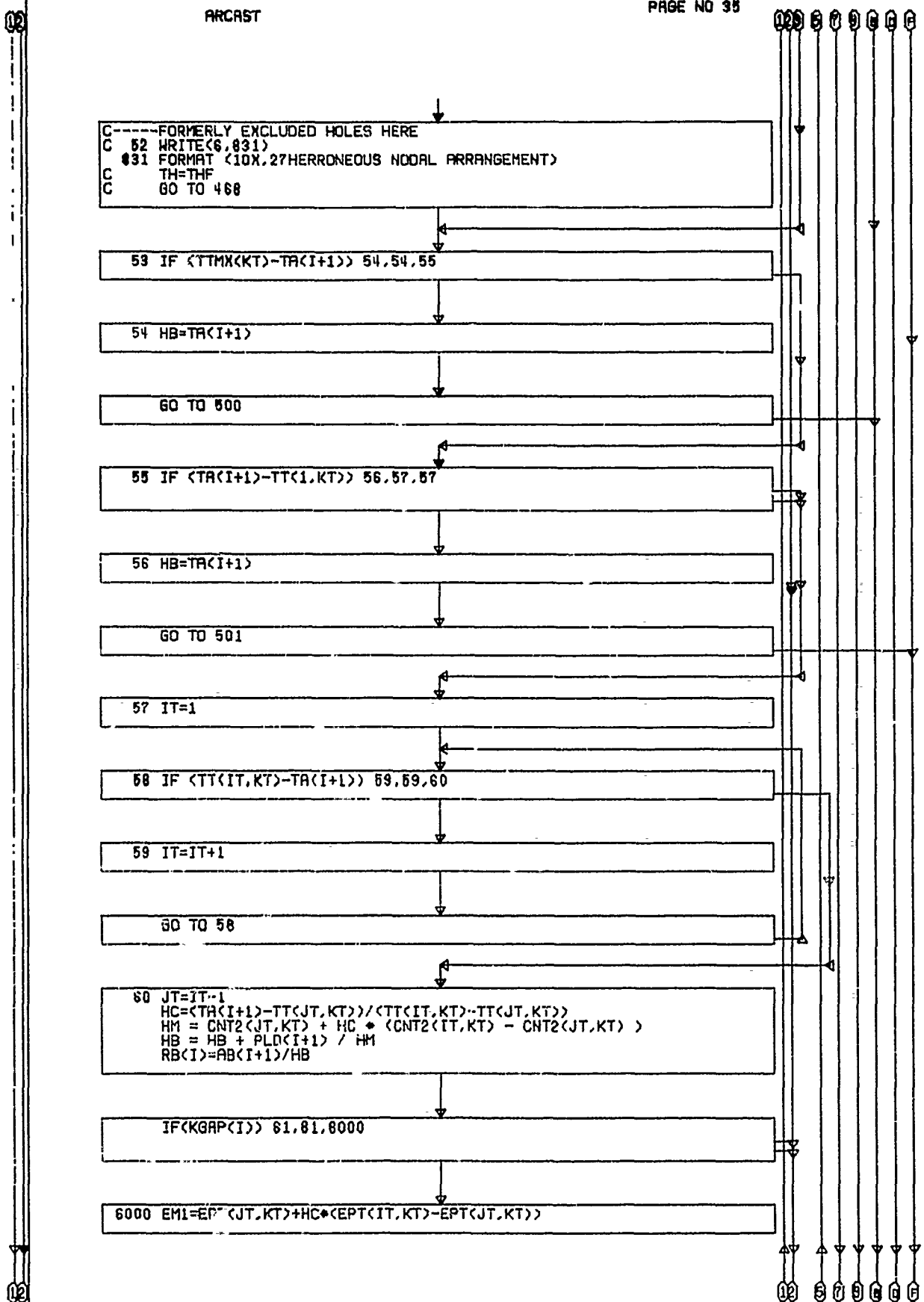

HC=HA*HA+HB*HB
HD=SQRT (HC)
HF=PIB*HD*(AA(K)+AA(L))
AA(M)=HE
9027 AB(M)=HF
K=K+1
L=L+1
7 HA=AA(L)-AA(K)
HB=AB(L)-AB(K)
HC=HA*HA+HB*HB
HD=SQRT (HC)
AC(M)=PIB*HD*(AA(K)+AA(L))
9026 CONTINUE
LU=MM+1
LL=NN+1
DO 12 I=1,LU
K=K+1
CALL LCOUNT(L,LCT,NPG,RECORD(35))
12 WRITE(6,918) I,LL,AA(K),AB(K)
M=M-MM
K=K-MM-1
DO 8 I=1,MM
K=K+1
M=M+1
9 HA=AA(K+1)-AA(K)
HB=AB(K+1)-AB(K)
HC=HA*HA+HB*HB
HD=SQRT (HC)
AD(M)=PIB*HD*(AA(K)+AA(K+1))
8 CONTINUE

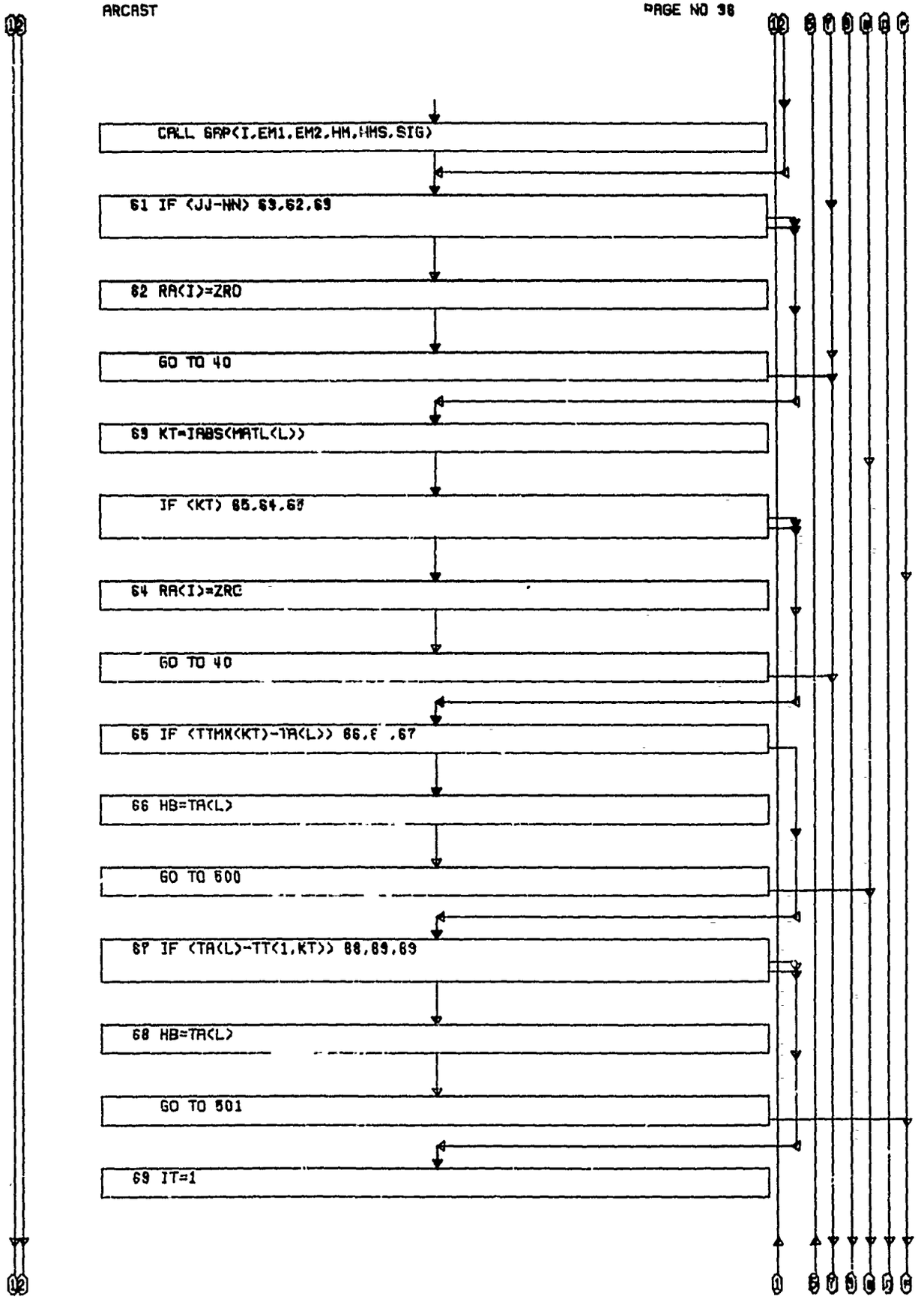

M=0
L=MM
K=MM-1
N=NN-1
DO 10 J=1,N
DO 11 I=1,K
M=M+1
L=L+1
19 AC(M)=AB(M+1)
14 AD(M)=AA(L)
11 CONTINUE
M=M+1
L=L+1
18 AD(M)=AA(L)
10 CONTINUE
DO 1002 I=1,K
M=M+1
1002 AC(M)=AB(M+1)
DO 1000 J=1,NN
K=KSUR(J)
1000 PLBS(J)=PLB(K)+PLD(K)
CALL LCOUNT(-10,LCT,NPG,RECORD(96))
WRITE (6,319)

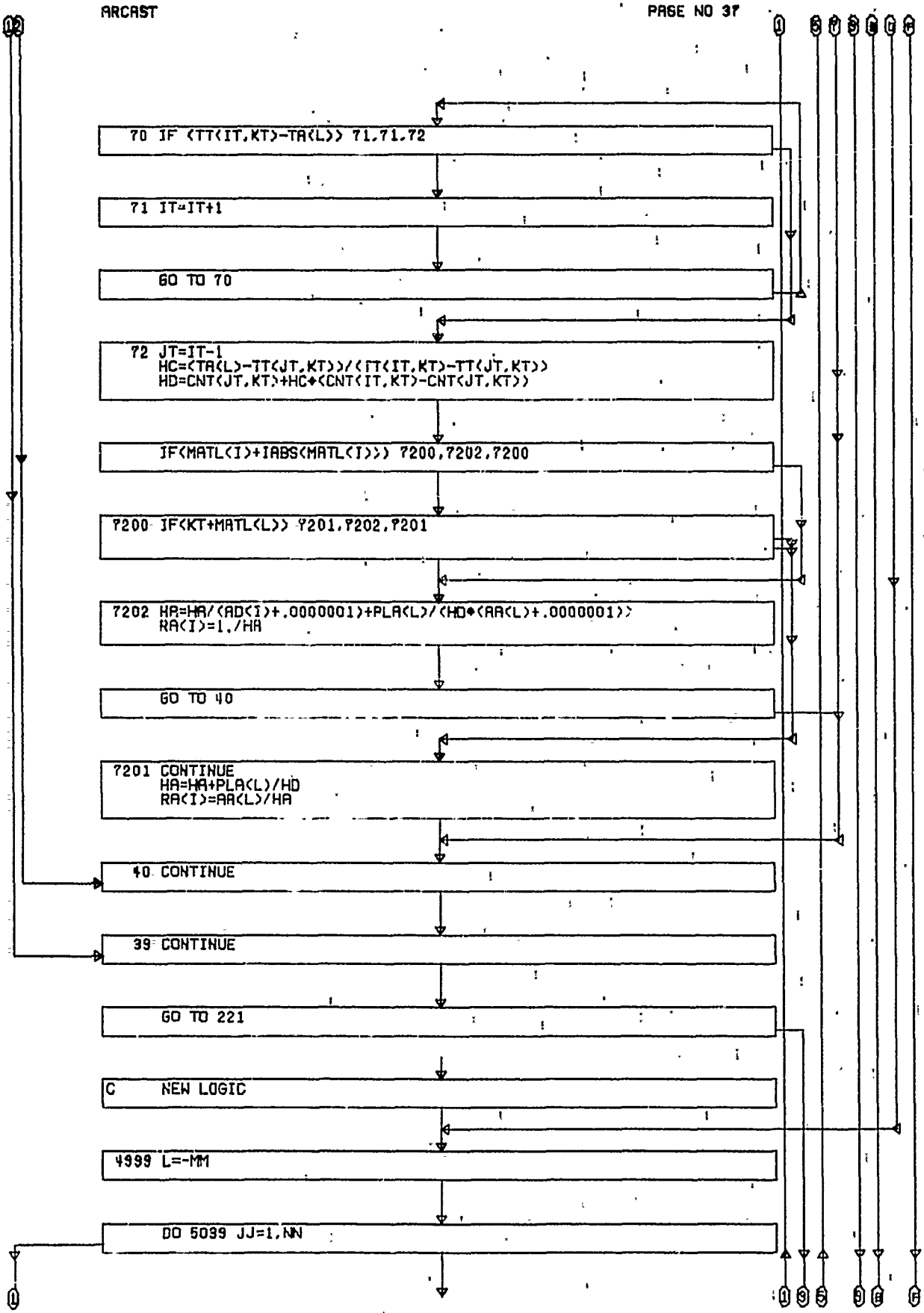

ITER=0
C-----MAIN ITERATION LOOP
90 IF (DLTH) 91,91,92
91 DTH=100.
GO TO 33
92 DTH=DLTH
33 ITER=ITER+1
C-----MATERIAL PROPERTIES, NODAL RESISTANCES AND CAPACITIES
I=0
IF (KLOG) 4939,4939,4999
4939 L=MM
DO 99 JJ=1,NN
DO 40 III=1,MM
I=I+1
L=L+1
IF(MATL(I)) 42,41,42
41 RA(I)=ZRO
RB(I)=ZRO
GO TO 40

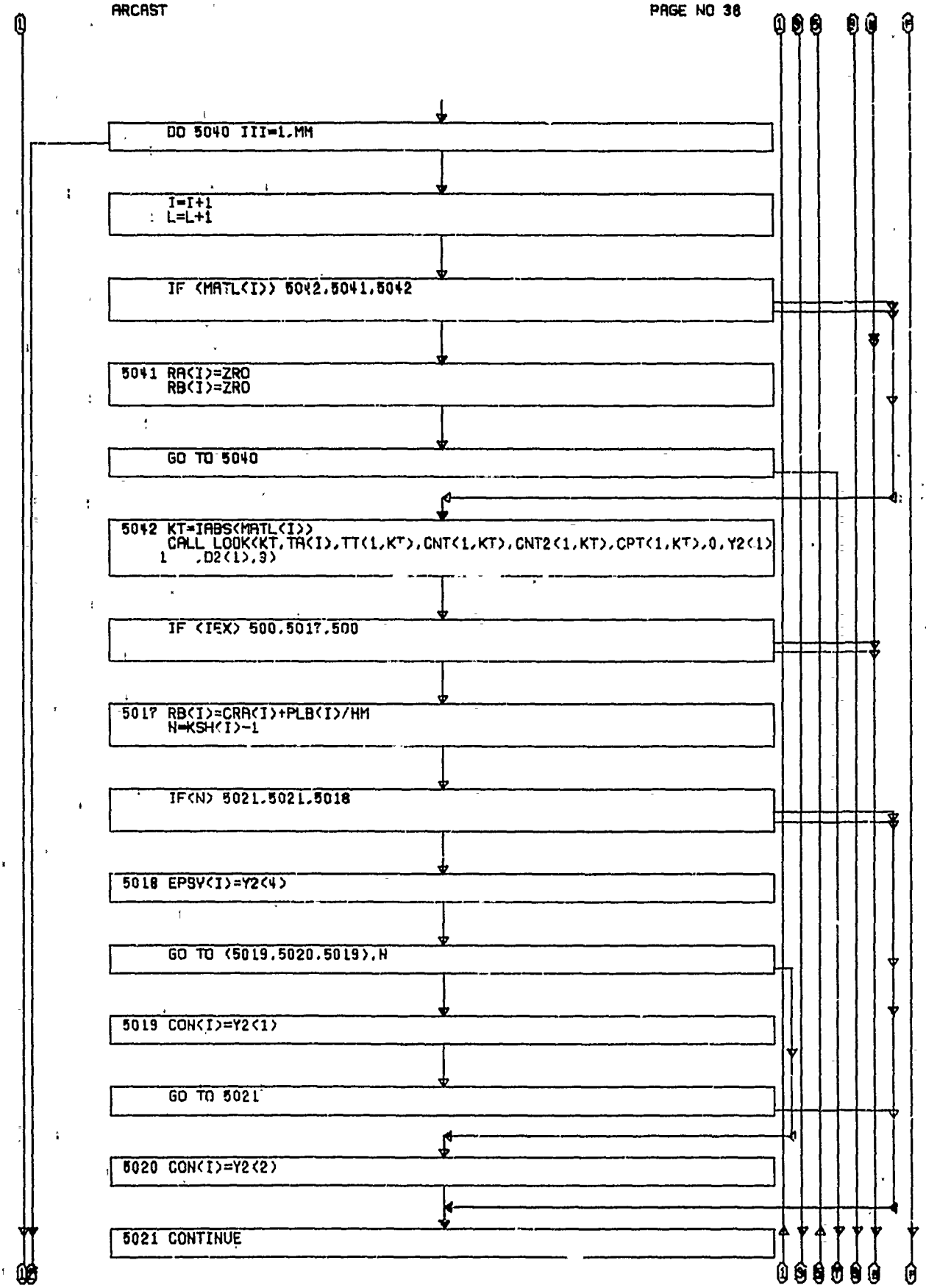

42 KT=IABS(MATL(I))
IF (TTMX(KT)-TA(I)) 43,43,44
43 HB=TA(I)
GO TO 600
44 IF (TA(I)-TT(1,KT)) 45,46,46
45 HB=TA(I)
GO TO 501
46 IT=1
47 IF (TT(IT,KT)-TA(I)) 48,48,49
48 IT=IT+1
GO TO 47
49 JT=IT-1
HC=(TA(I)-TT(JT,KT))/(TT(IT,KT)-TT(JT,KT))
HD=CNT(JT,KT)+HC*(CNT(IT,KT)-CNT(JT,KT))
HA=CRB(I)+PLC(I)/HD
HM = CNT2(JT,KT) + HC * (CNT2(IT,KT) - CNT2(JT,KT))
HB = CRA(I) + PLB(I) / HM
HE=RT(JT,KT)+HC*(RT(IT,KT)-RT(JT,KT))
HF=CPT(JT,KT)+HC*(CPT(IT,KT)-CPT(JT,KT))
CAP(I)=VOL(I)*HE*HF
95 IF(MATL(I)+1) 50,50,51
50 U(JJ)=AC(I)/HB

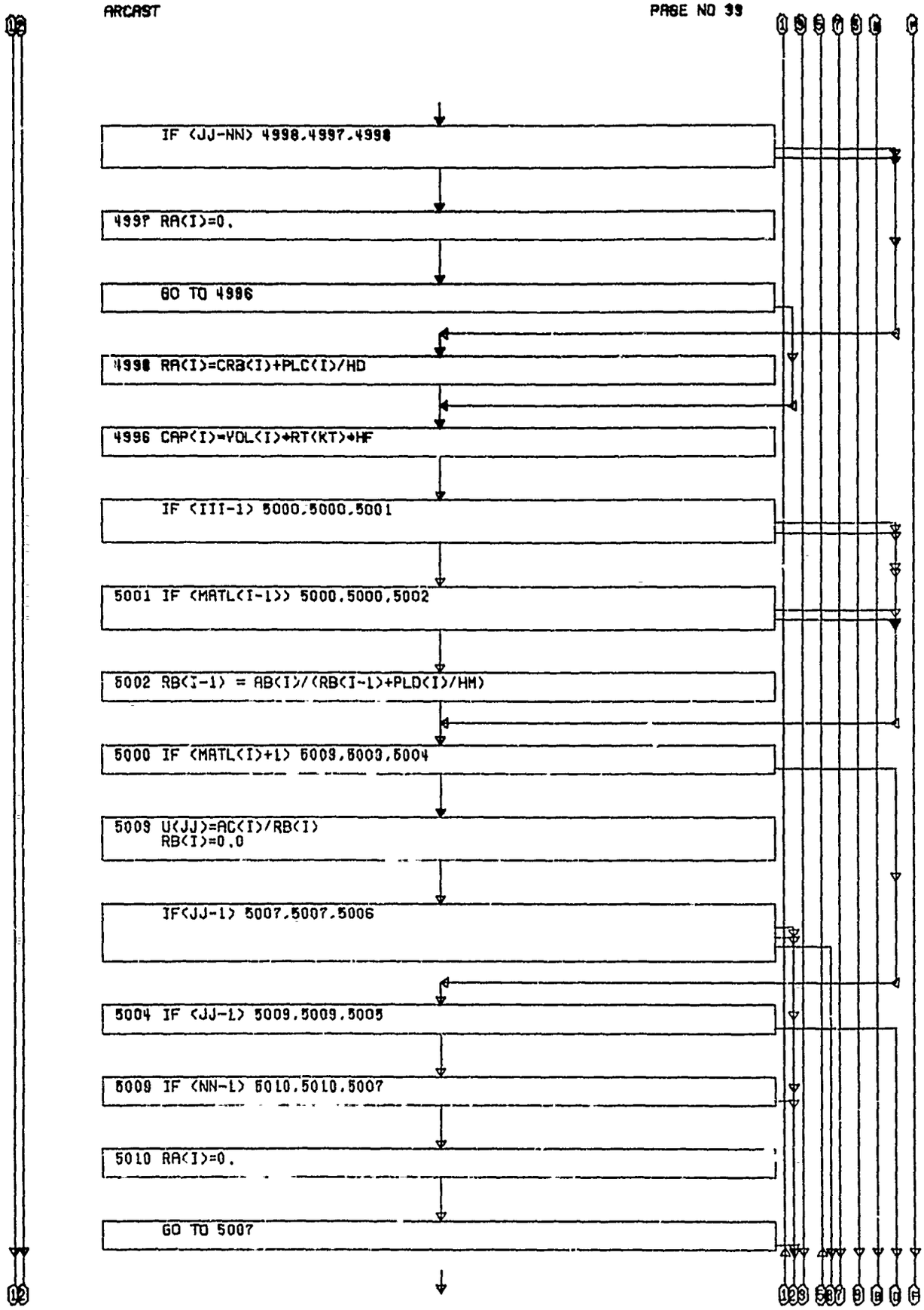

RB(I)=0.0
GO TO 61
51 N=KSH(I)-1
IF (KGAP(I)) 5106,5106,5100
5106 IF (N) 5105,5105,5100
5100 EM2=EPT(JT,KT)+HC*(EPT(IT,KT)-EPT(JT,KT))
HM9=HM
EPSV(I) = EM2
IF(N) 5105,5105,5102
5102 GO TO (5103,5104,5103),N
5103 CON(I)=HD
GO TO 5105
5104 CON(I)=HM
5105 CONTINUE
KT=IABS(MATL(I+1))
IF(KT) 53,52,53
52 RB(I)=ZRO
GO TO 61

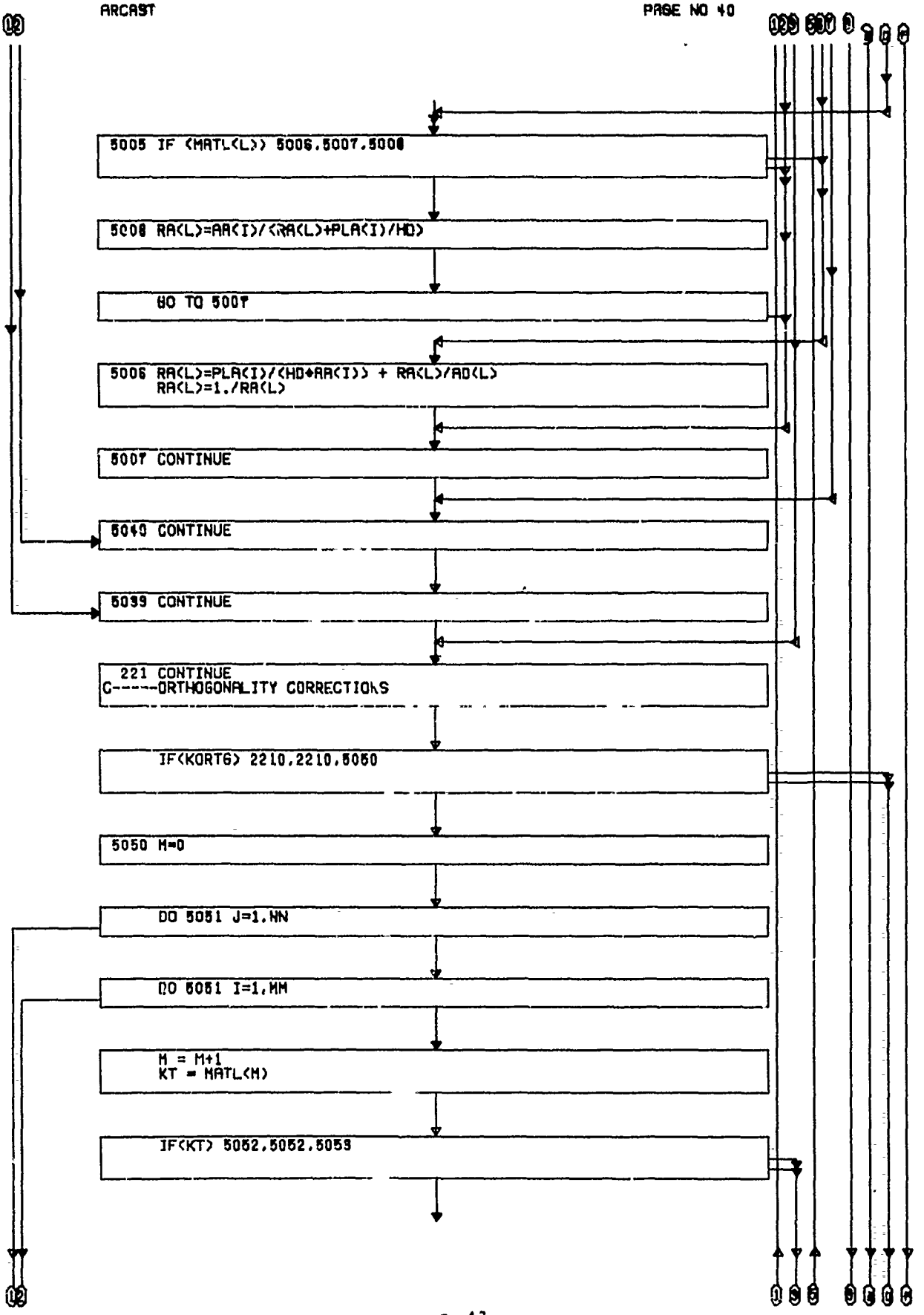

C-----FORMERLY EXCLUDED HOLES HERE
C 52 WRITE(6,631)
631 FORMAT (10X,27HERRONEOUS NODAL ARRANGEMENT)
C TH=THF
C GO TO 468
53 IF (TTMX(KT)-TA(I+1)) 54,54,55
54 HB=TA(I+1)
GO TO 500
55 IF (TA(I+1)-TT(1,KT)) 56,57,57
56 HB=TA(I+1)
GO TO 501
57 IT=1
58 IF (TT(IT,KT)-TA(I+1)) 59,59,60
59 IT=IT+1
GO TO 58
60 JT=IT-1
HC=(TA(I+1)-TT(JT,KT))/(TT(IT,KT)-TT(JT,KT))
HM = CNT2(JT,KT) + HC * (CNT2(IT,KT) - CNT2(JT,KT))
HB = HB + PLD(I+1) / HM
RB(I)=AB(I+1)/HB
IF(KGAP(I)) 61,81,8000
8000 EM1=EP (JT,KT)+HC*(EPT(IT,KT)-EPT(JT,KT))

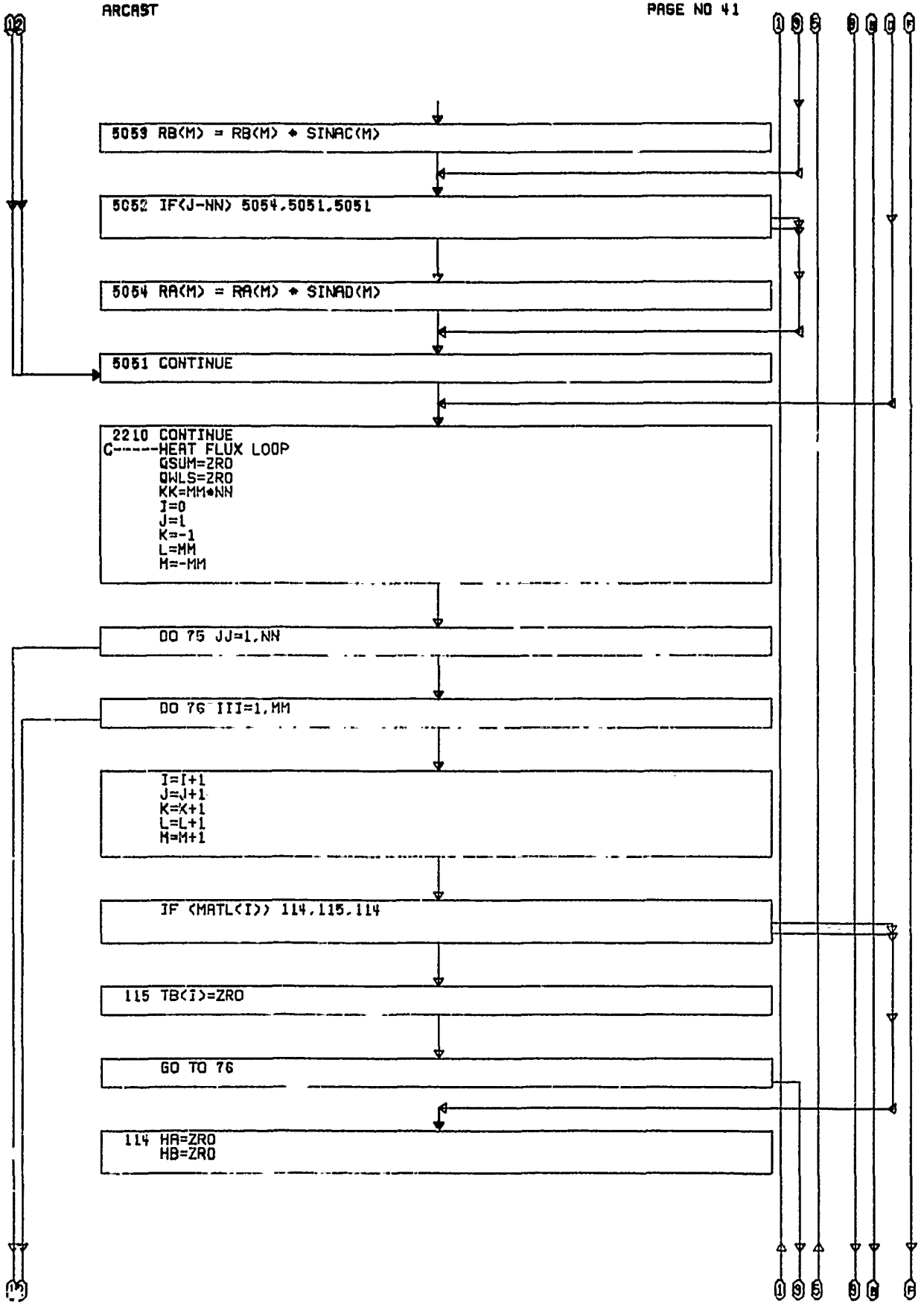

CALL GRP(I,EM1,EM2,HM,HMS,SIG)
61 IF (JJ-NN) 69,62,69
62 RA(I)=ZRO
GO TO 40
69 KT=IABS(MATL(L))
IF (KT) 65,64,69
64 RA(I)=ZRO
GO TO 40
65 IF (TTMX(KT)-TA(L)) 66,6 ,67
66 HB=TA(L)
GO TO 600
67 IF (TA(L)-TT(1,KT)) 68,69,69
68 HB=TA(L)
GO TO 601
69 IT=1

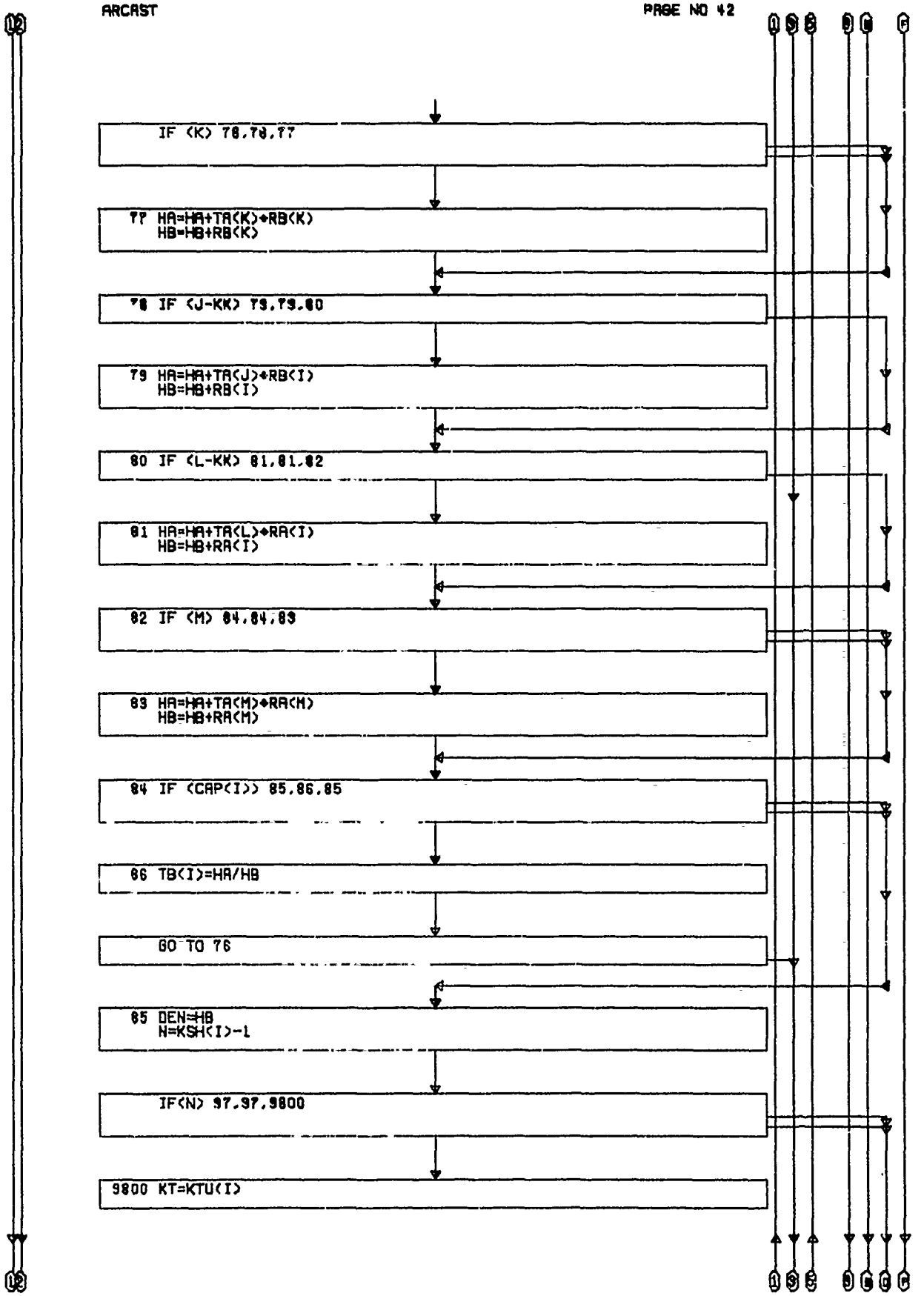

70 IF (TT(IT,KT)-TA(L)) 71,71,72
71 IT=IT+1
GO TO 70
72 JT=IT-1
HC=(TA(L)-TT(JT,KT))/(TT(IT,KT)-TT(JT,KT))
HD=CNT(JT,KT)+HC*(CNT(IT,KT)-CNT(JT,KT))
IF(MATL(I)+IABS(MATL(I))) 7200,7202,7200
7200 IF(KT+MATL(L)) 7201,7202,7201
7202 HA=HA/(AD(I)+.0000001)+PLA(L)/(HD*(AA(L)+.0000001))
RA(I)=1./HA
GO TO 40
7201 CONTINUE
HA=HA+PLA(L)/HD
RA(I)=AA(L)/HA
40 CONTINUE
39 CONTINUE
GO TO 221
C NEW LOGIC
4999 L=-MM
DO 5039 JJ=1,NN

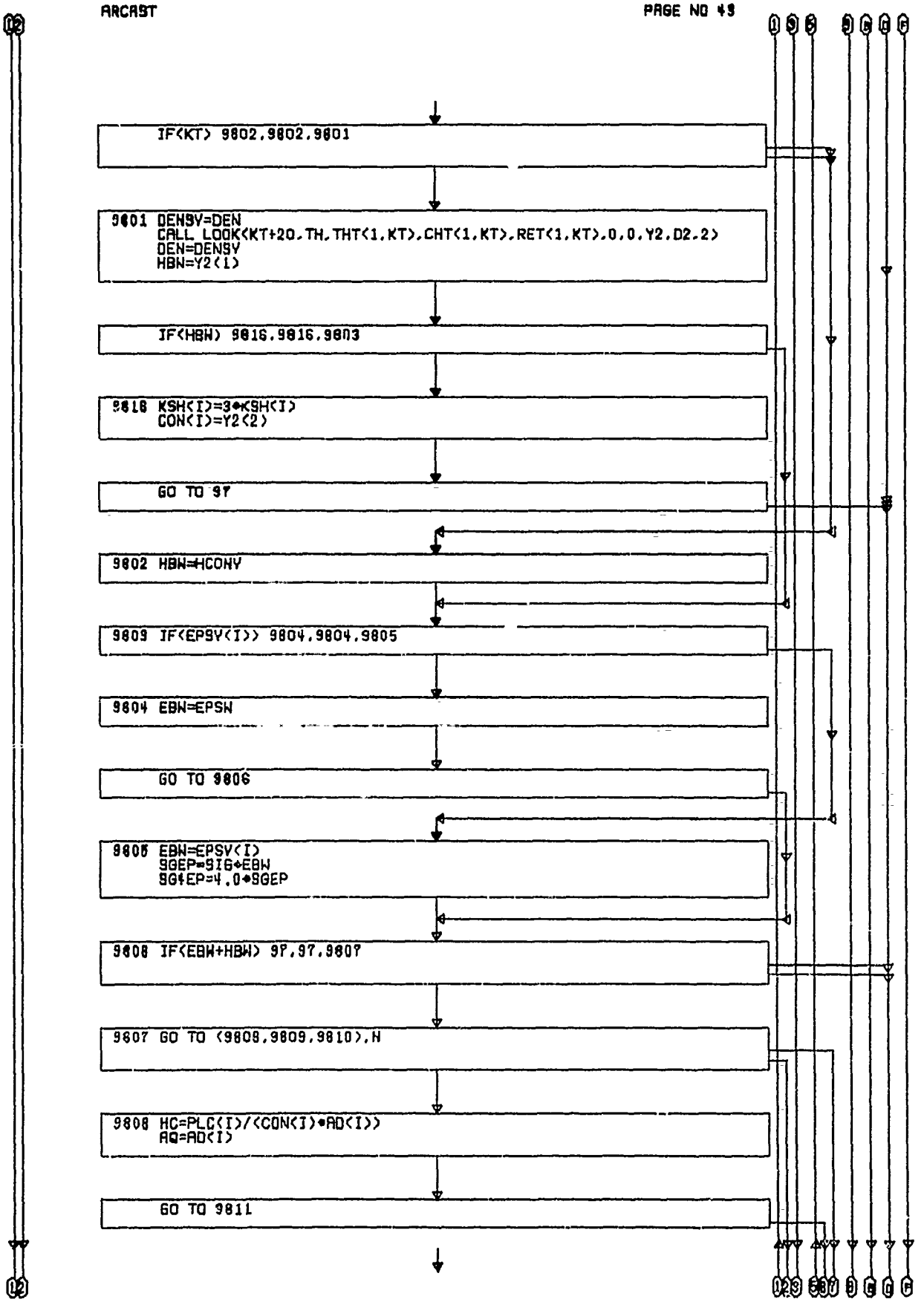

DO 5040 III=1,MM
I=I+1
L=L+1
IF (MATL(I)) 5042,5041,5042
5041 RA(I)=ZRO
RB(I)=ZRO
GO TO 5040
5042 KT=IABS(MATL(I))
CALL LOOK(KT,TA(I),TT(1,KT),CNT(1,KT),CNT2(1,KT),CPT(1,KT),0,Y2(1)
1 ,D2(1),9)
IF (IEX) 500,5017,500
5017 RB(I)=CRA(I)+PLB(I)/HM
N=KSH(I)-1
IF(N) 5021,5021,5018
5018 EPSV(I)=Y2(4)
GO TO (5019,5020,5019),N
5019 CON(I)=Y2(1)
GO TO 5021
5020 CON(I)=Y2(2)
5021 CONTINUE

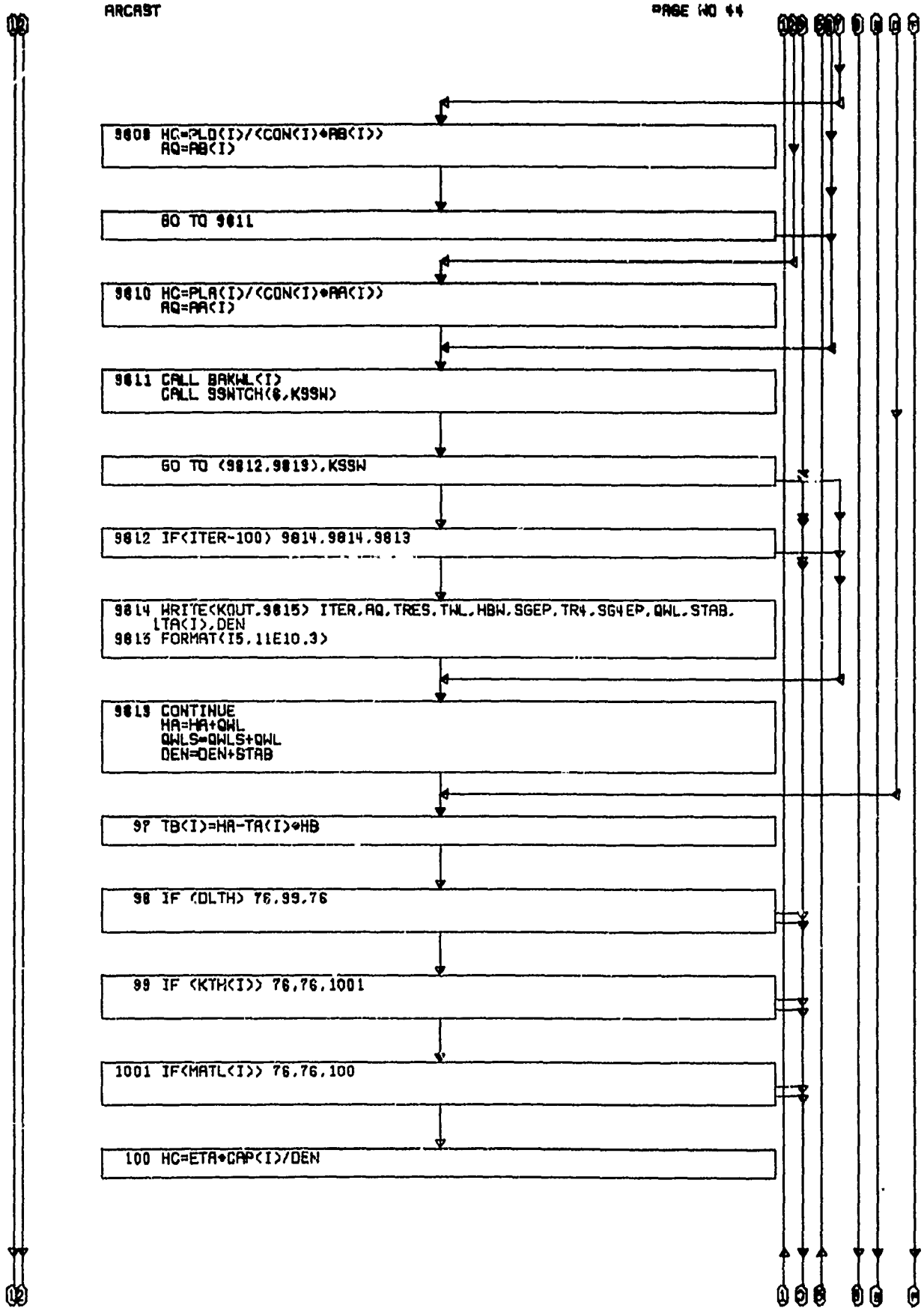

IF (JJ-NN) 4998,4997,4998
4997 RA(I)=0.
GO TO 4996
4998 RA(I)=CRB(I)+PLC(I)/HD
4996 CAP(I)=VOL(I)*RT(KT)*HF
IF (III-1) 5000,5000,5001
5001 IF (MATL(I-1)) 5000,5000,5002
5002 RB(I-1) = AB(I)/(RB(I-1)+PLD(I)/HM)
5000 IF (MATL(I)+1) 5009,5003,5004
5009 U(JJ)=AC(I)/RB(I)
RB(I)=0.0
IF(JJ-1) 5007,5007,5006
5004 IF (JJ-1) 5009,5009,5005
5003 IF (NN-1) 5010,5010,5007
5010 RA(I)=0.
GO TO 5007

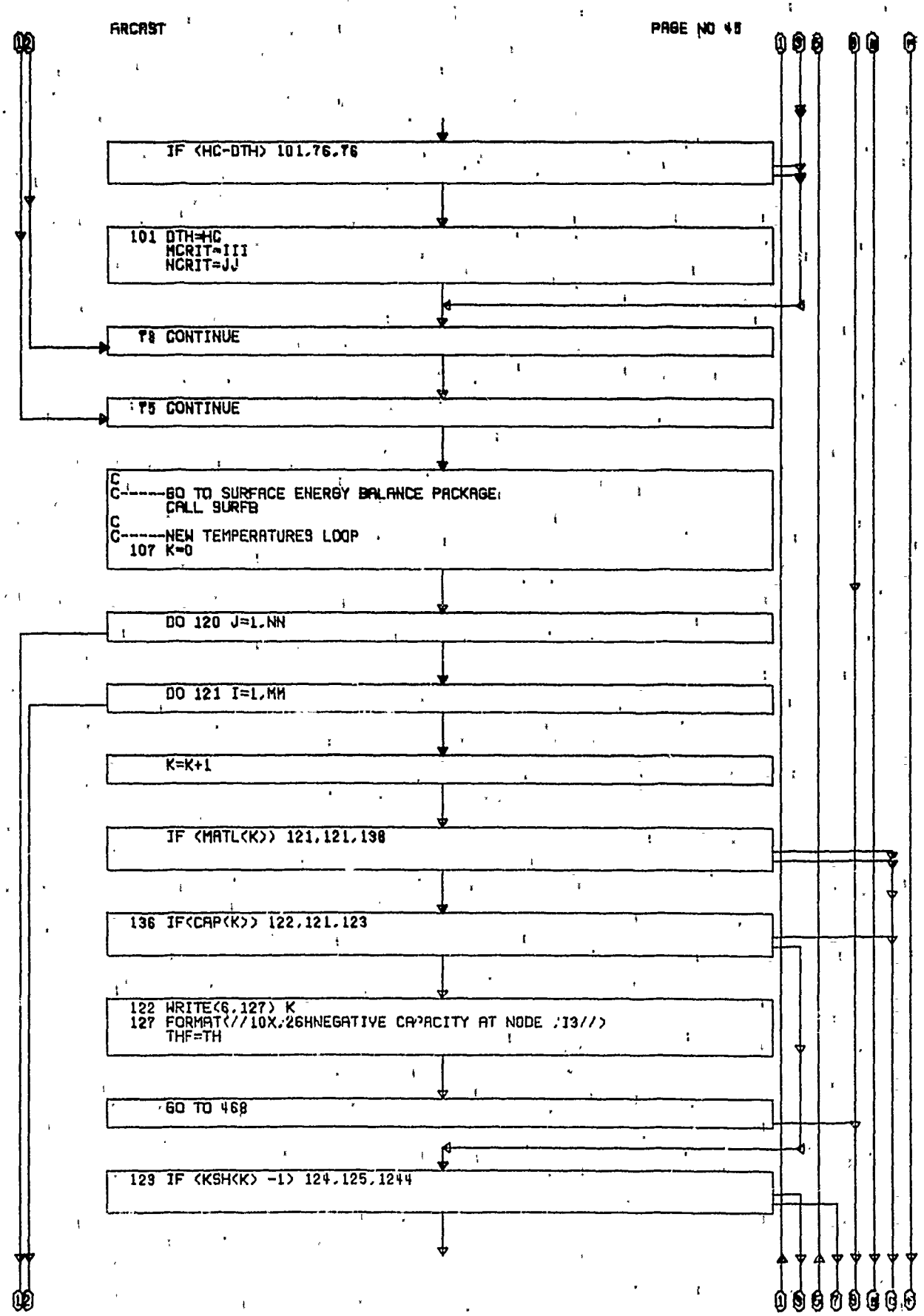

5005 IF (MATL(L)) 5006,5007,5008
5008 RA(L)=AA(I)/(RA(L)+PLA(I)/HD)
GO TO 5007
5006 RA(L)=PLA(I)/(HD*AA(I)) + RA(L)/AD(L)
RA(L)=1./RA(L)
5007 CONTINUE
5040 CONTINUE
5039 CONTINUE
221 CONTINUE
C-----ORTHOGONALITY CORRECTIONS
IF(KORTG) 2210,2210,5050
5050 M=0
DO 5051 J=1,NN
DO 5051 I=1,MM
M = M+1
KT = MATL(M)
IF(KT) 5052,5052,5059

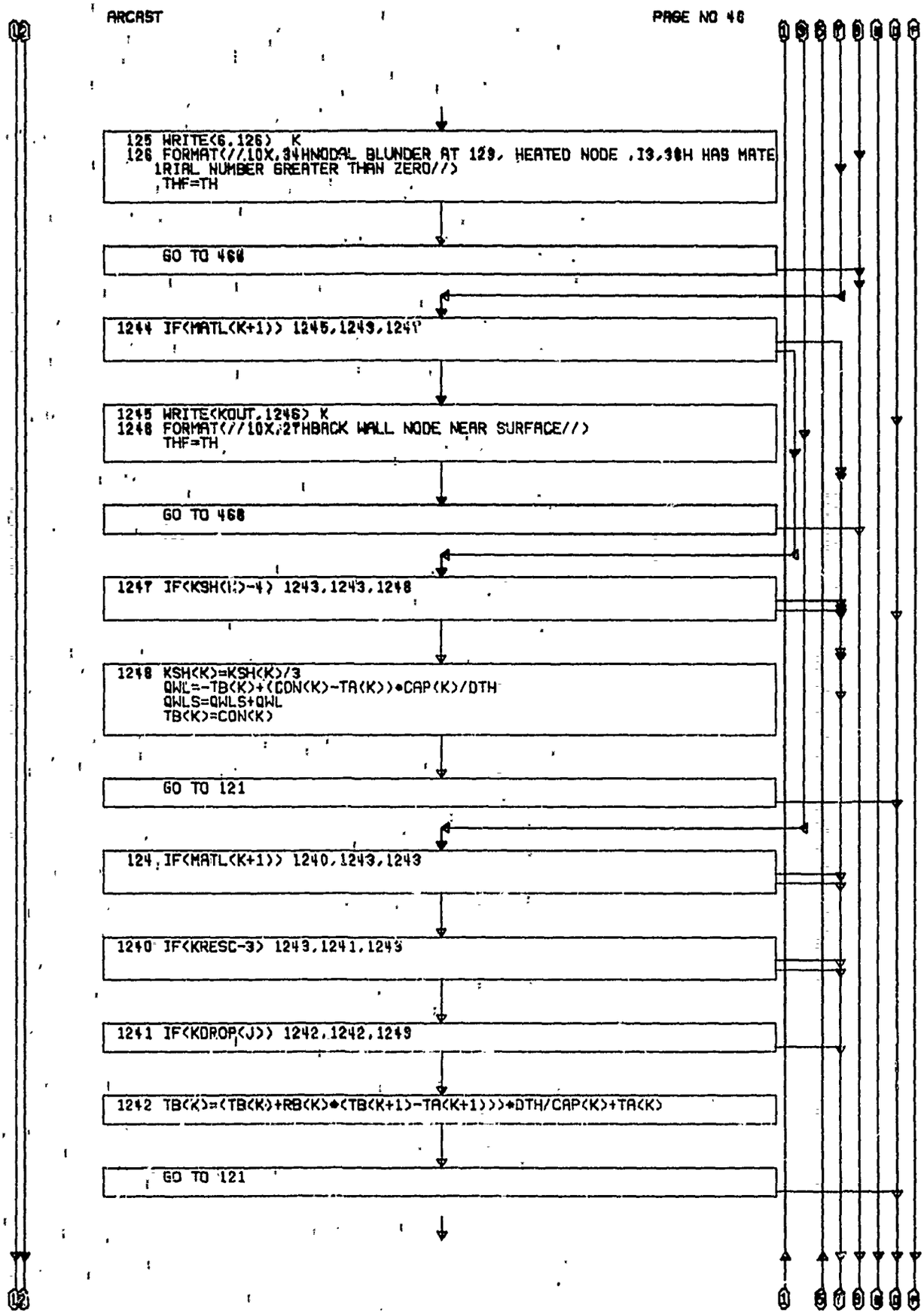

5059 RB(M) = RB(M) * SINAC(M)
5052 IF(J-NN) 5054,5051,5051
5054 RA(M) = RA(M) * SINAD(M)
5051 CONTINUE
2210 CONTINUE
C------HEAT FLUX LOOP
QSUM=ZRO
QWLS=ZRO
KK=MM*NN
I=0
J=1
K=-1
L=MM
M=-MM
DO 75 JJ=1,NN
DO 76 III=1,MM
I=I+1
J=J+1
K=K+1
L=L+1
M=M+1
IF (MATL(I)) 114,115,114
115 TB(I)=ZRO
GO TO 76
114 HA=ZRO
HB=ZRO

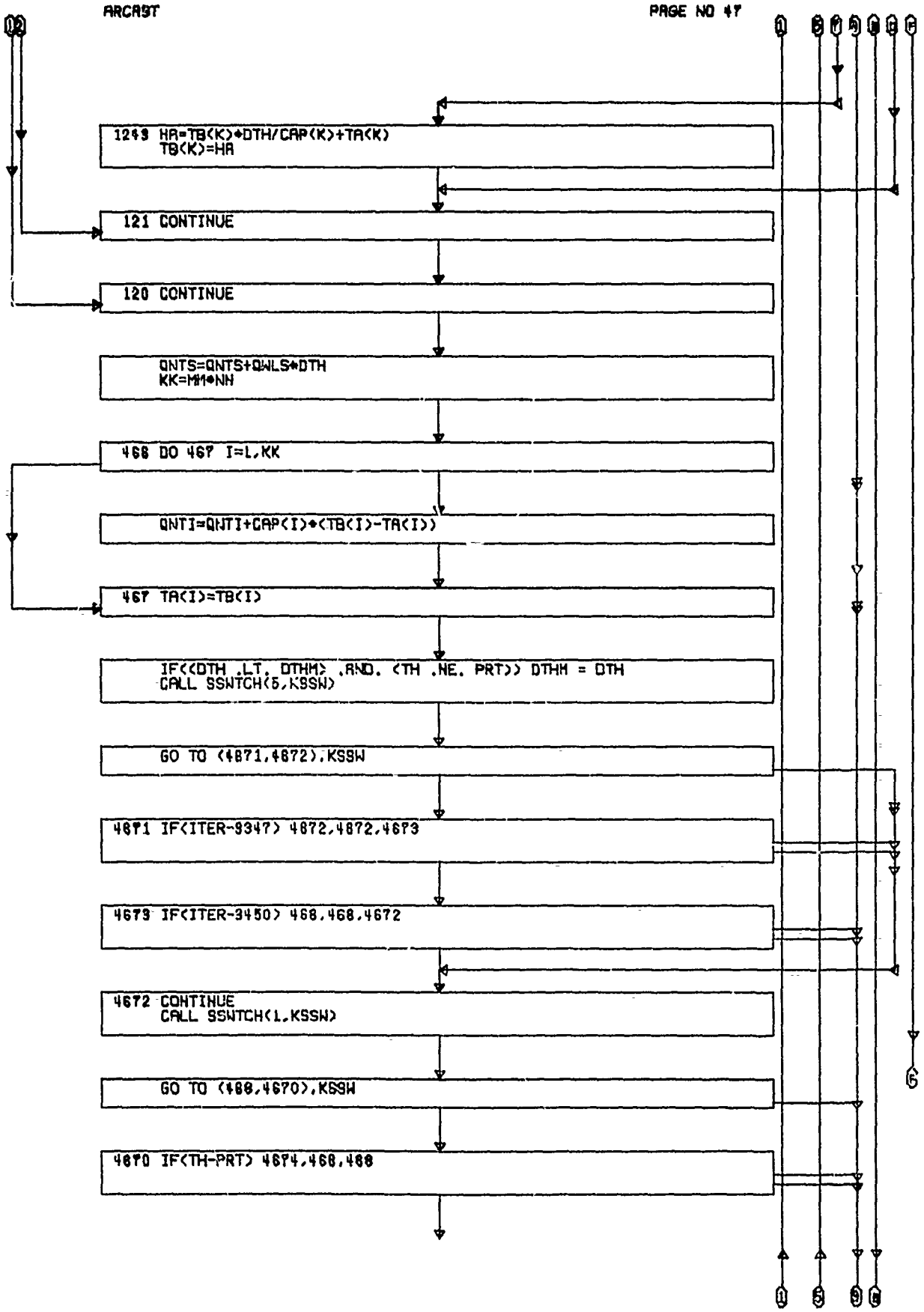

IF (K) 78,78,77
77 HA=HA+TA(K)*RB(K)
HB=HB+RB(K)
78 IF (J-KK) 79,79,80
79 HA=HA+TA(J)*RB(I)
HB=HB+RB(I)
80 IF (L-KK) 81,81,82
81 HA=HA+TA(L)*RA(I)
HB=HB+RA(I)
82 IF (M) 84,84,83
83 HA=HA+TA(M)*RA(M)
HB=HB+RA(M)
84 IF (CAP(I)) 85,86,85
86 TB(I)=HA/HB
GO TO 76
85 DEN=HB
N=KSH(I)-1
IF(N) 97,97,9800
9800 KT=KTU(I)

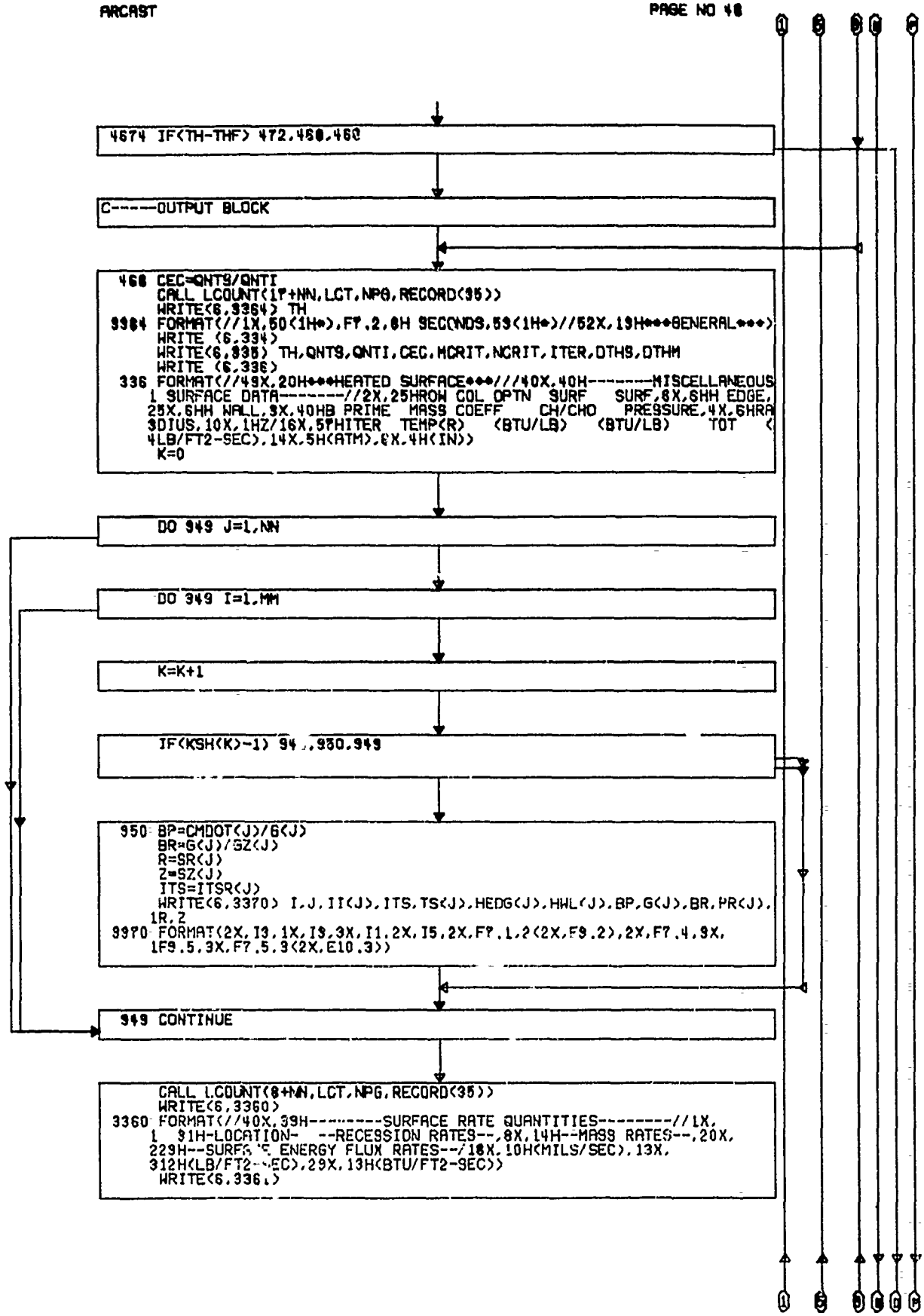

IF(KT) 9802,9802,9801
9801 DENSV=DEN
CALL LOOK(KT+20,TH,THT(1,KT),CHT(1,KT),RET(1,KT),0,0,Y2,D2,2)
DEN=DENSV
HBW=Y2(1)
IF(HBW) 9816,9816,9803
9816 KSH(I)=3*KSH(I)
CON(I)=Y2(2)
GO TO 97
9802 HBW=HCONV
9803 IF(EPSV(I)) 9804,9804,9805
9804 EBW=EPSW
GO TO 9806
9805 EBW=EPSV(I)
9806 SGEP=SIG*EBW
SGEP=4.0*SGEP
9808 IF(EBW+HBW) 97,97,9807
9807 GO TO (9808,9809,9810),N
9808 HC=PLC(I)/(CON(I)*AD(I))
AQ=AD(I)
GO TO 9811

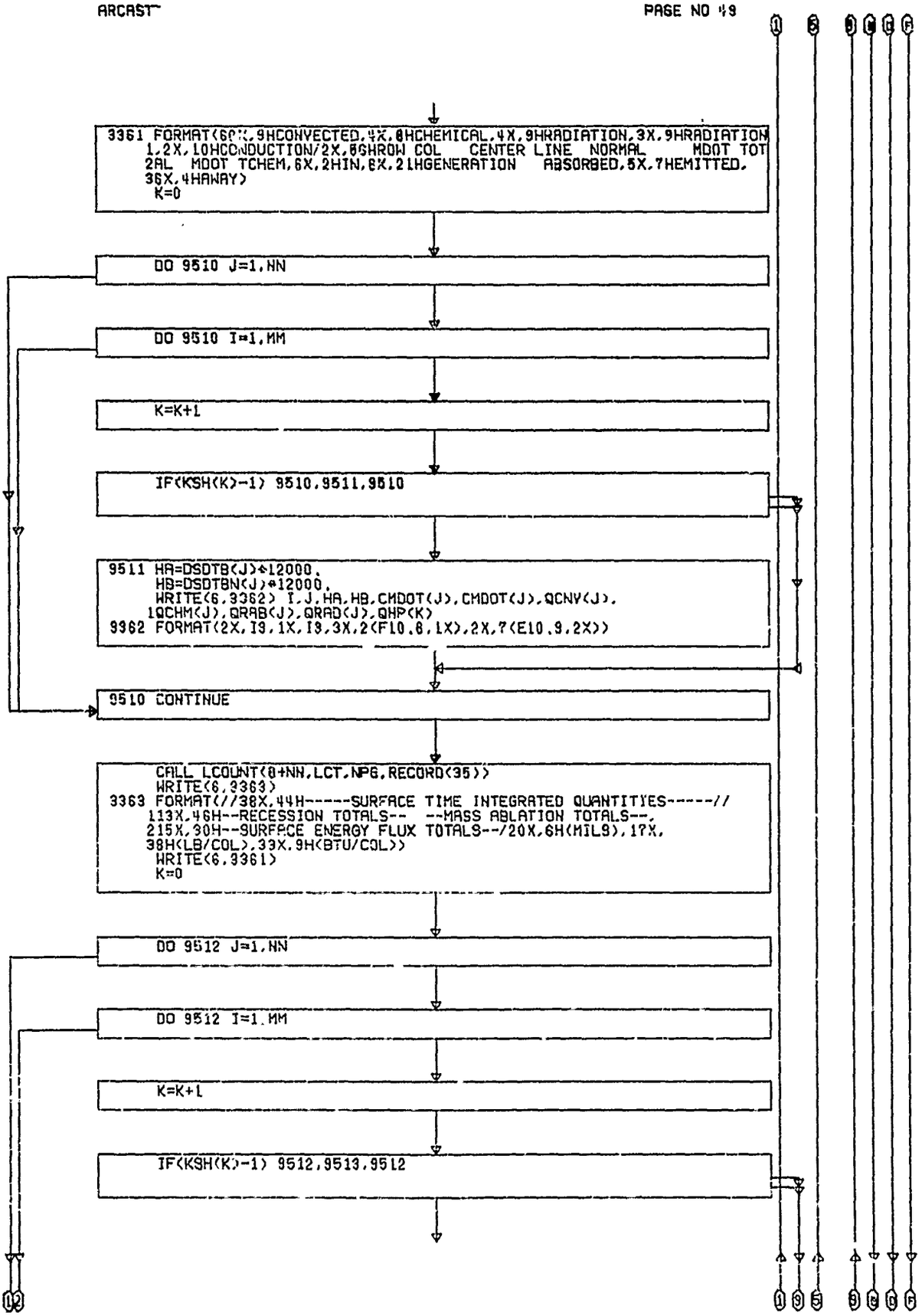

9808 HC=PLO(I)/(CON(I)*AB(I))
AQ=AB(I)
GO TO 9811
9810 HC=PLA(I)/(CON(I)*AA(I))
AQ=AA(I)
9811 CALL BAKWL(I)
CALL SSWTCH(6,KSSW)
GO TO (9812,9819),KSSW
9812 IF(ITER-100) 9814,9814,9813
9814 WRITE(KOUT,9815) ITER,AQ,TRES,TWL,HBW,SGEP,TR4,SG4EP,QWL,STAB,
1TA(I),DEN
9815 FORMAT(I5,11E10.3)
9819 CONTINUE
HA=HA+QWL
QWLS=QWLS+QWL
DEN=DEN+STAB
97 TB(I)=HA-TA(I)*HB
98 IF (DLTH) 76,99,76
99 IF (KTH(I)) 76,76,1001
1001 IF(MATL(I)) 76,76,100
100 HC=ETA*CAP(I)/DEN

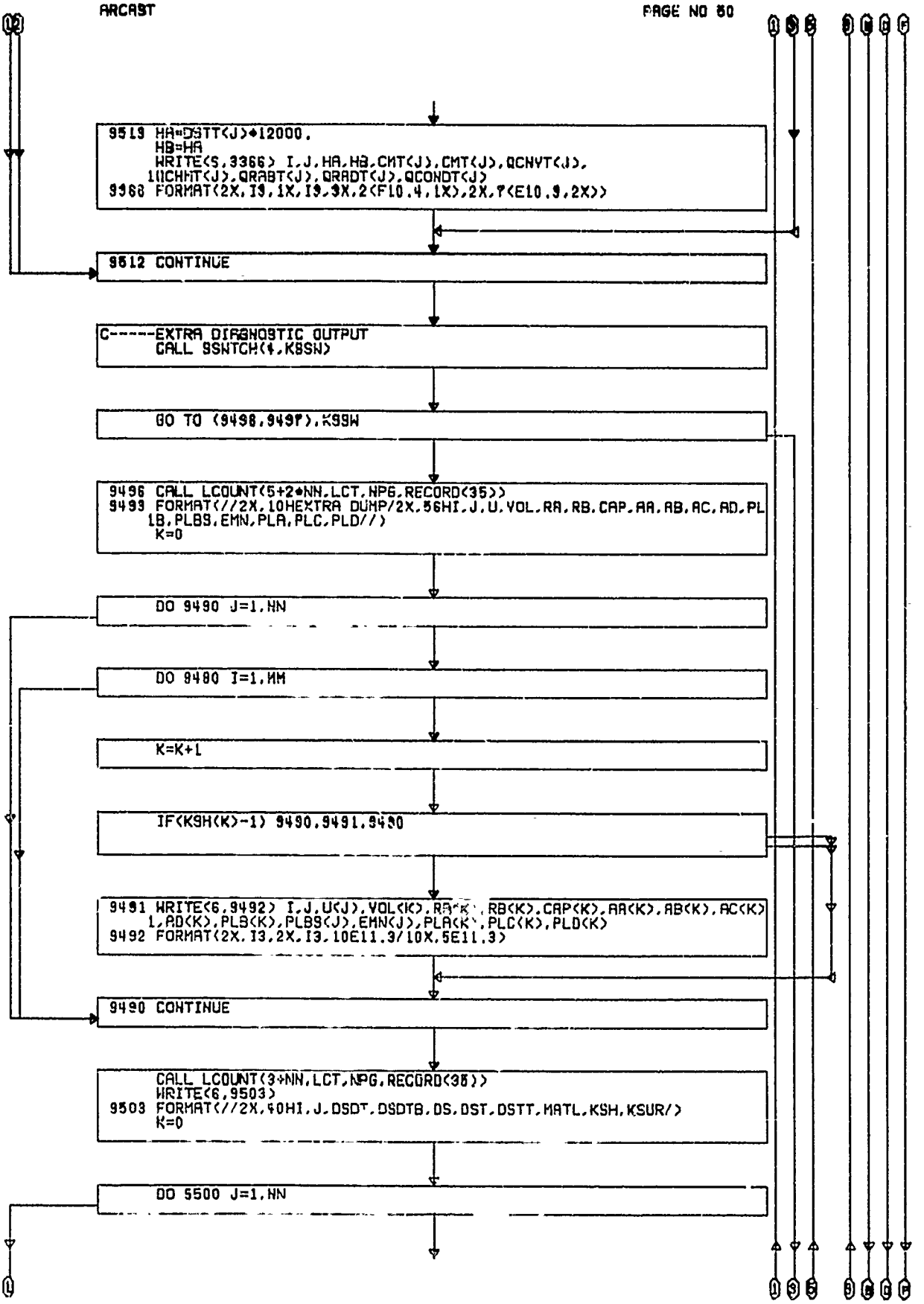

IF (HC-DTH) 101,76,76
101 DTH=HC
MCRIT=III
NCRIT=JJ
76 CONTINUE
75 CONTINUE
C
C-----GO TO SURFACE ENERGY BALANCE PACKAGE:
CALL SURFB
C
C-----NEW TEMPERATURES LOOP
107 K=0
DO 120 J=1,NN
DO 121 I=1,MM
K=K+1
IF (MATL(K)) 121,121,136
136 IF(CAP(K)) 122,121,123
122 WRITE(6,127) K
127 FORMAT(//10X,26HNEGATIVE CAPACITY AT NODE ,I3//)
THF=TH
GO TO 468
129 IF (KSH(K) -1) 124,125,1244

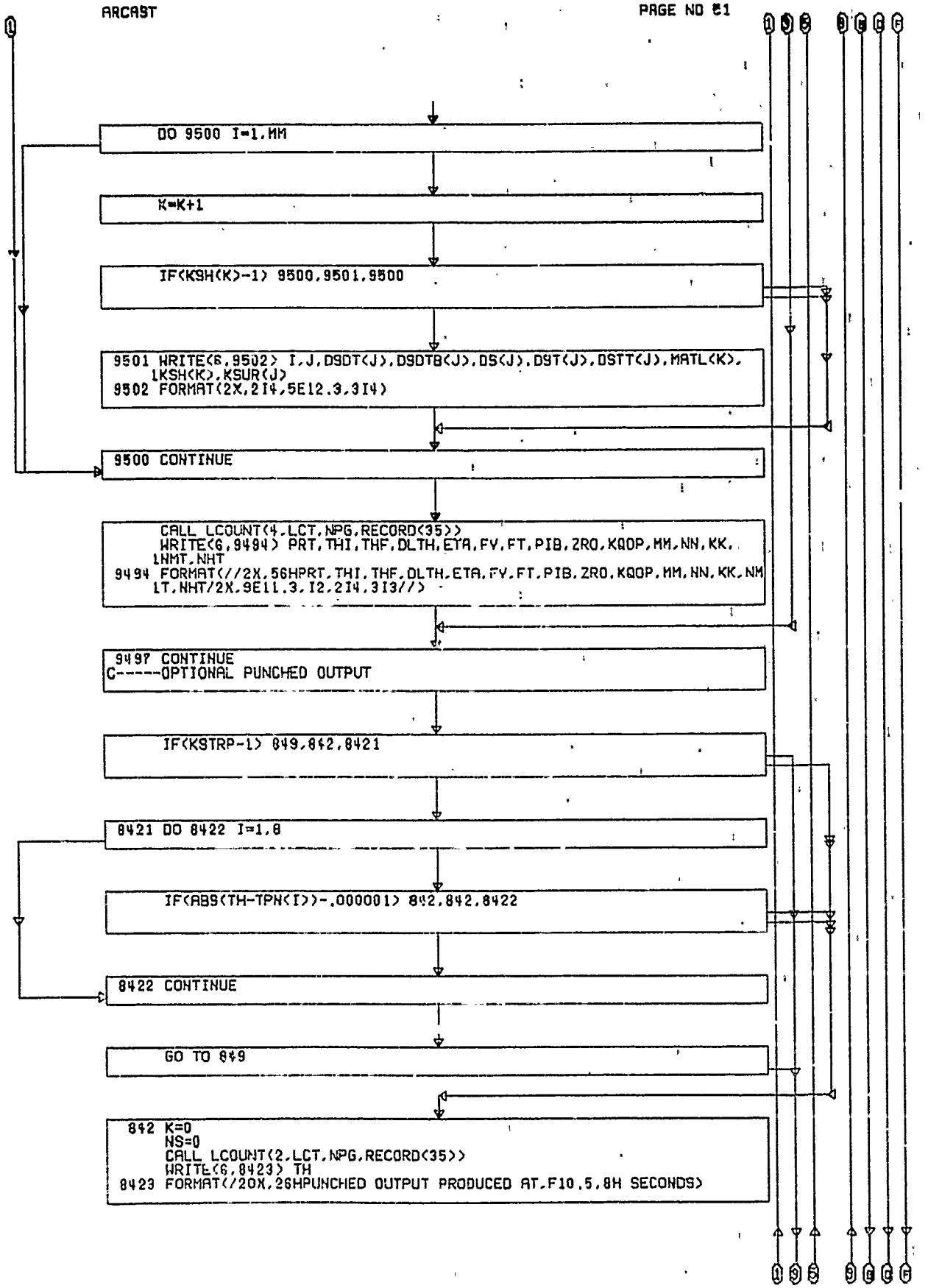

125 WRITE(6,126) K
126 FORMAT(//10X,34HNODAL BLUNDER AT 129, HEATED NODE ,I3,36H HAS MATE
1RIAL NUMBER GREATER THAN ZERO//)
THF=TH
GO TO 468
1244 IF(MATL(K+1)) 1245,1243,1241
1245 WRITE(KOUT,1246) K
1246 FORMAT(//10X,27HBACK WALL NODE NEAR SURFACE//)
THF=TH
GO TO 468
1247 IF(KSH(K)-4) 1243,1243,1248
1248 KSH(K)=KSH(K)/3
QWL=-TB(K)+(CON(K)-TA(K))*CAP(K)/DTH
QWLS=QWLS+QWL
TB(K)=CON(K)
GO TO 121
124 IF(MATL(K+1)) 1240,1243,1243
1240 IF(KRESC-3) 1243,1241,1243
1241 IF(KDROP(J)) 1242,1242,1249
1242 TB(K)=(TB(K)+RB(K)*(TB(K+1)-TA(K+1)))*DTH/CAP(K)+TA(K)
GO TO 121

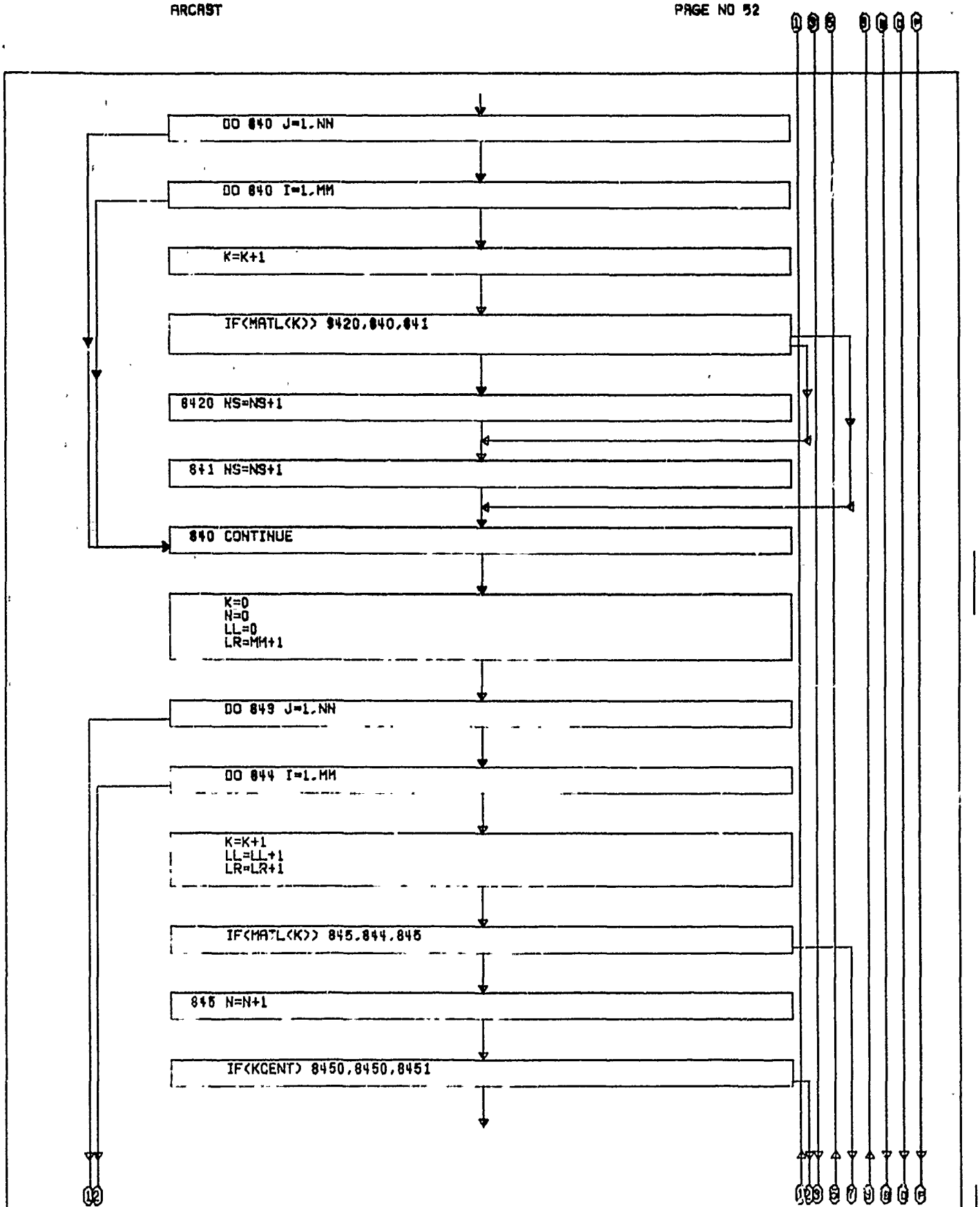

1249 HR=TB(K)*DTH/CAP(K)+TA(K)
TB(K)=HR
121 CONTINUE
120 CONTINUE
QNTS=QNTS+QWLS*DTH
KK=MM*NN
468 DO 467 I=1,KK
QNTI=QNTI+CAP(I)*(TB(I)-TA(I))
467 TA(I)=TB(I)
IF((DTH .LT. DTHM) .AND. (TH .NE. PRT)) DTHM = DTH
CALL SSWTCH(5,KSSW)
GO TO (4671,4672),KSSW
4671 IF(ITER-9347) 4672,4672,4673
4673 IF(ITER-3450) 468,468,4672
4672 CONTINUE
CALL SSWTCH(1,KSSW)
GO TO (468,4670),KSSW
4670 IF(TH-PRT) 4674,468,468

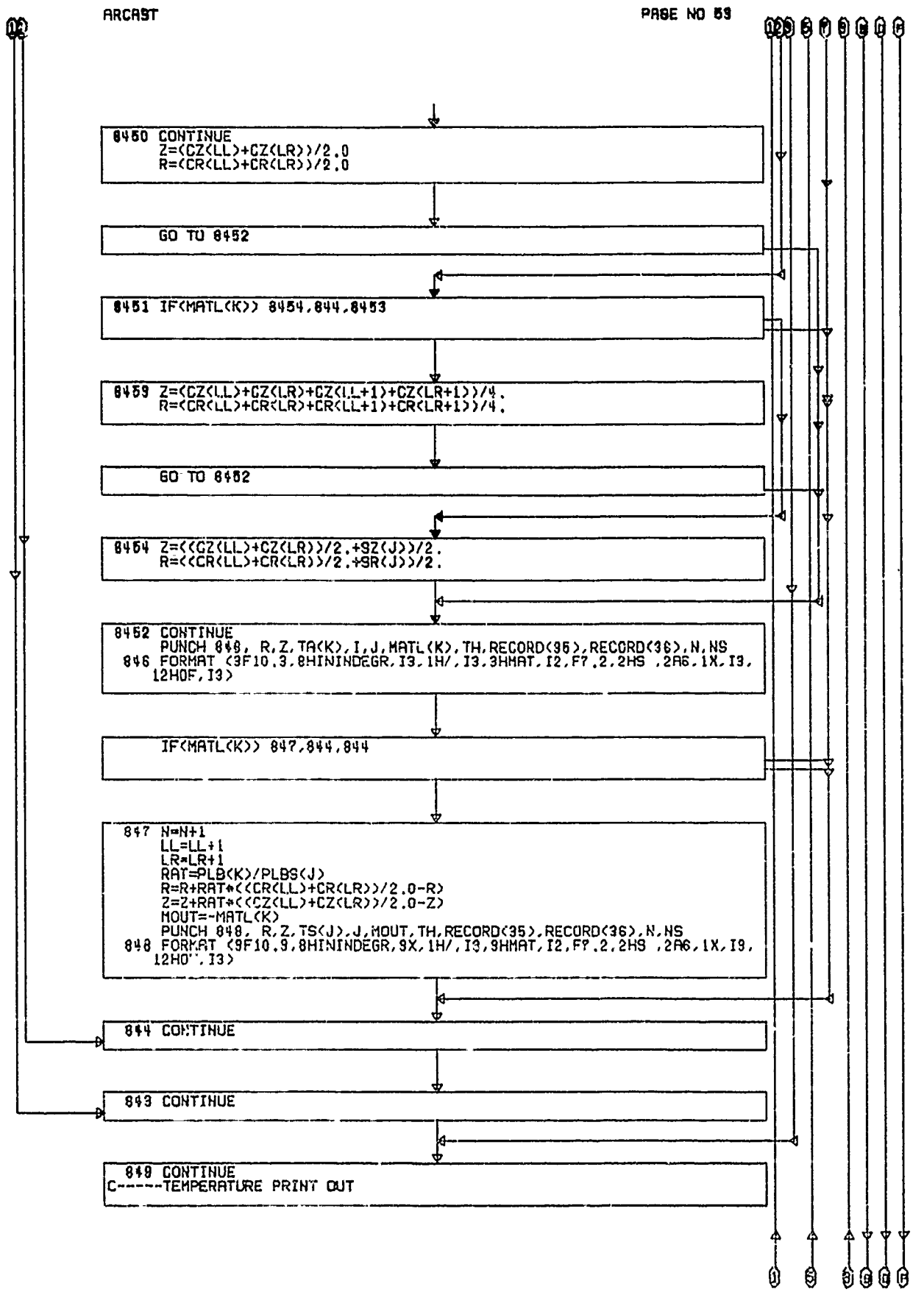

4674 IF(TH-THF) 472,460,460
C-----OUTPUT BLOCK
468 CEC=QNTS/QNTI
CALL LCOUNT(17+NN,LCT,NPG,RECORD(35))
WRITE(6,9364) TH
9364 FORMAT(//1X,50(1H*),F7.2,8H SECONDS,59(1H*)//52X,19H***GENERAL***)
WRITE (6,334)
WRITE(6,335) TH,QNTS,QNTI,CEC,MCRIT,NCRIT,ITER,DTHS,DTHM
WRITE (6,336)
336 FORMAT(//49X,20H***HEATED SURFACE***///40X,40H-------MISCELLANEOUS
1 SURFACE DATA-------//2X,25HROW COL OPTN SURF SURF,6X,6HH EDGE,
25X,6HH WALL,9X,40HB PRIME MASS COEFF CH/CHO PRESSURE,4X,6HRA
3DIUS,10X,1HZ/16X,5PHITER TEMP(R) (BTU/LB) (BTU/LB) TOT (
4LB/FT2-SEC),14X,5H(ATM),8X,4H(IN))
K=0
DO 949 J=1,NN
DO 949 I=1,MM
K=K+1
IF(KSH(K)-1) 94 ,950,949
950 BP=CMDOT(J)/G(J)
BR=G(J)/GZ(J)
R=SR(J)
Z=SZ(J)
ITS=ITSR(J)
WRITE(6,3370) I,J,II(J),ITS,TS(J),HEDG(J),HWL(J),BP,G(J),BR,PR(J),
1R,Z
9370 FORMAT(2X,I3,1X,I3,3X,I1,2X,I5,2X,F7.1,2(2X,F9.2),2X,F7.4,8X,
1F9.5,3X,F7.5,3(2X,E10.3))
949 CONTINUE
CALL LCOUNT(8+NN,LCT,NPG,RECORD(35))
WRITE(6,3360)
3360 FORMAT(//40X,39H---------SURFACE RATE QUANTITIES---------//1X,
1 91H-LOCATION- --RECESSION RATES--,8X,14H--MASS RATES--,20X,
229H--SURFACE ENERGY FLUX RATES--/18X,10H(MILS/SEC),13X,
312H(LB/FT2-SEC),29X,13H(BTU/FT2-SEC))
WRITE(6,336)

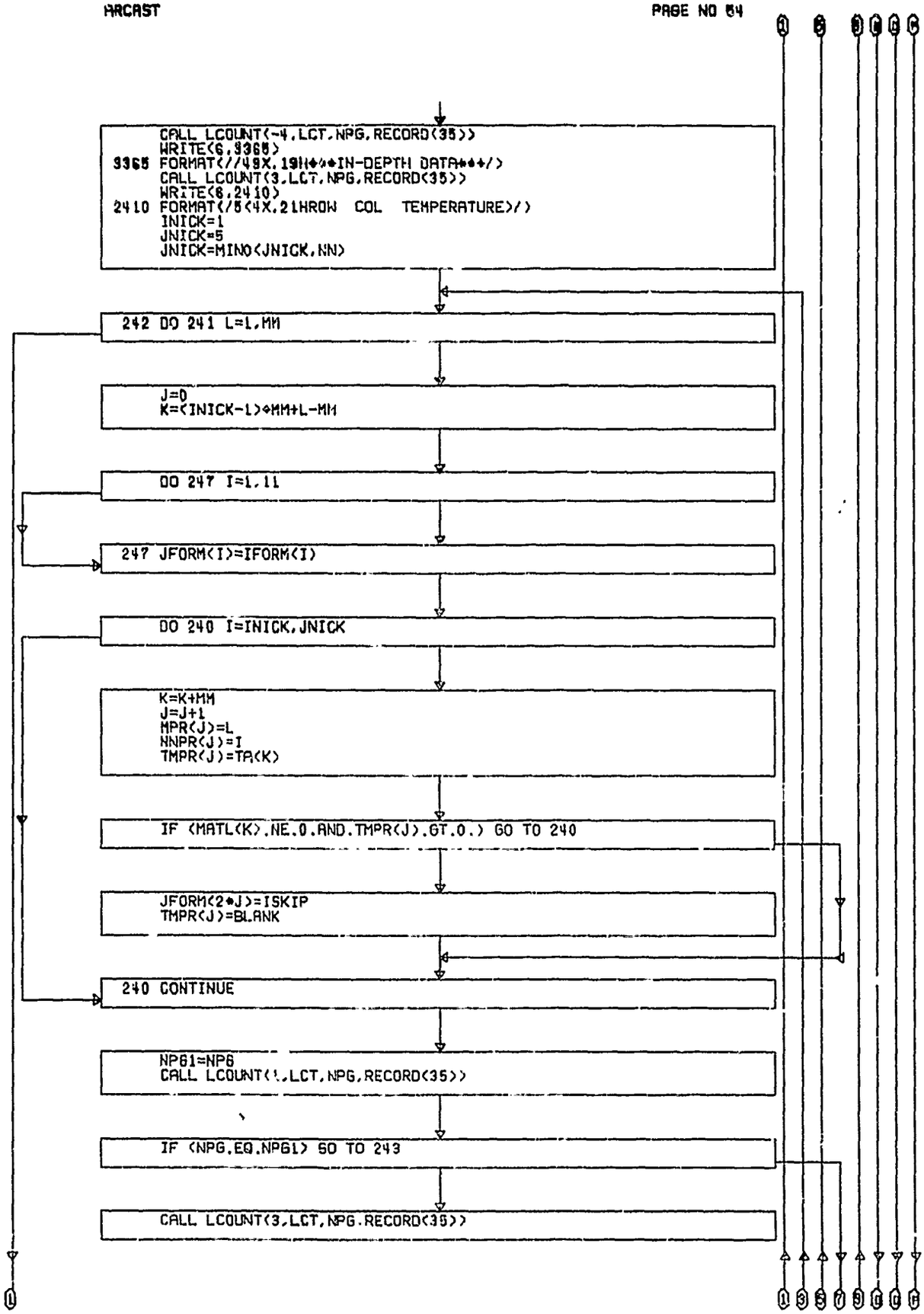

3361 FORMAT(60X,9HCONVECTED,4X,8HCHEMICAL,4X,9HRADIATION,3X,9HRADIATION
1,2X,10HCONDUCTION/2X,6$HROW COL CENTER LINE NORMAL MDOT TOT
2AL MDOT TCHEM,6X,2HIN,8X,21HGENERATION ABSORBED,5X,7HEMITTED,
36X,4HAWAY)
K=0
DO 9510 J=1,NN
DO 9510 I=1,MM
K=K+1
IF(KSH(K)-1) 9510,9511,9510
9511 HA=DSDTB(J)*12000.
HB=DSDTBN(J)*12000.
WRITE(6,9362) I,J,HA,HB,CMDOT(J),CMDOT(J),QCNV(J),
1QCHM(J),QRAB(J),QRAD(J),QHP(K)
9362 FORMAT(2X,I3,1X,I3,3X,2(F10.6,1X),2X,7(E10.3,2X))
9510 CONTINUE
CALL LCOUNT(8+NN,LCT,NPG,RECORD(35))
WRITE(6,9363)
9363 FORMAT(//38X,44H-----SURFACE TIME INTEGRATED QUANTITIES-----//
113X,46H--RECESSION TOTALS-- --MASS ABLATION TOTALS--,
215X,30H--SURFACE ENERGY FLUX TOTALS--/20X,6H(MILS),17X,
38H(LB/COL),33X,9H(BTU/COL))
WRITE(6,9361)
K=0
DO 9512 J=1,NN
DO 9512 I=1,MM
K=K+1
IF(KSH(K)-1) 9512,9513,9512
1
5
9
B
C
D
F
12

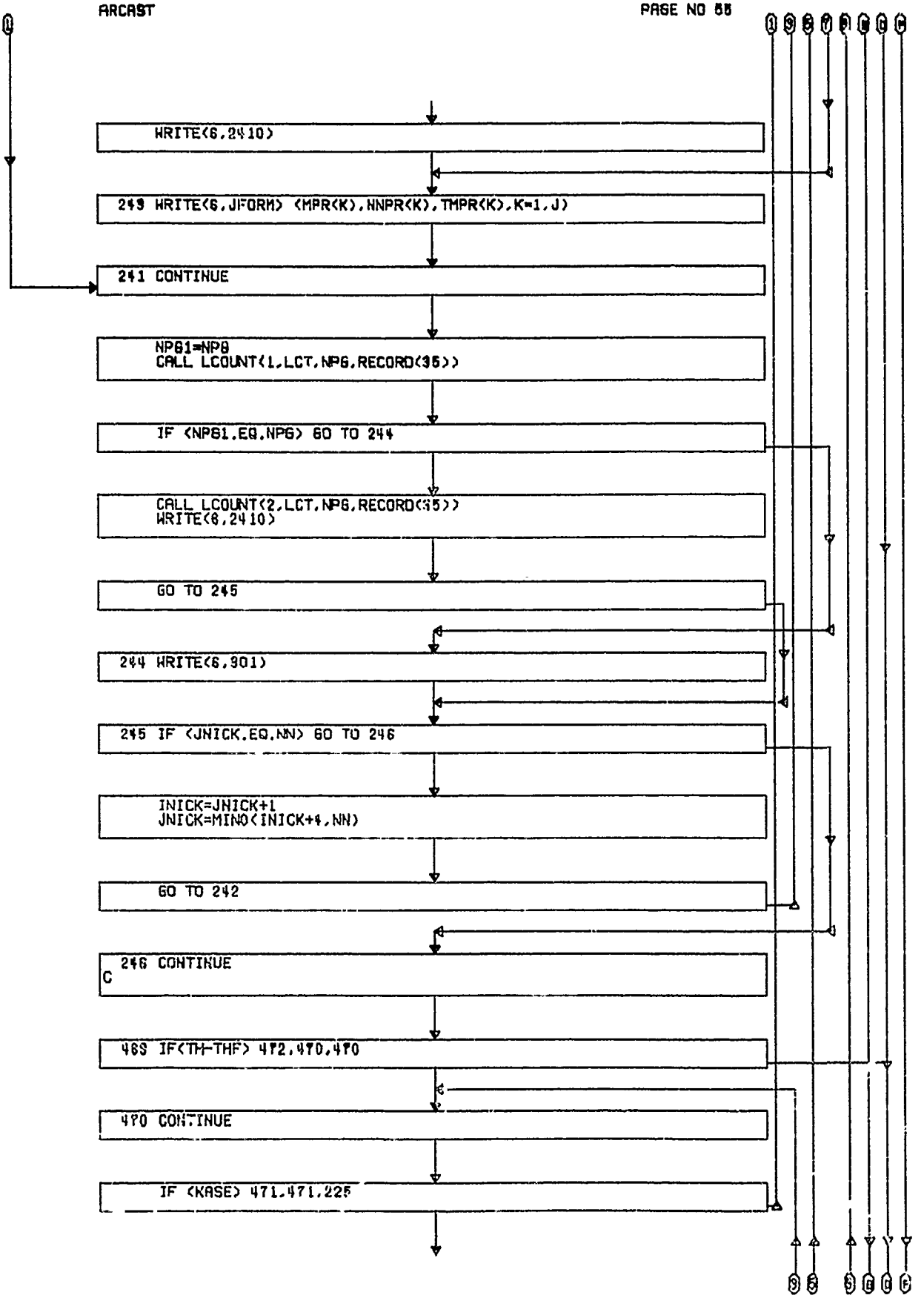

9519 HA=DSTT(J)*12000.
HB=HA
WRITE(6,3366) I,J,HA,HB,CMT(J),CMT(J),QCNVT(J),
1UCHMT(J),QRABT(J),QRADT(J),QCONDT(J)
9366 FORMAT(2X,I3,1X,I3,3X,2(F10.4,1X),2X,7(E10.3,2X))
9512 CONTINUE
C-----EXTRA DIAGNOSTIC OUTPUT
CALL SSWTCH(4,KSSW)
GO TO (9496,9497),KSSW
9496 CALL LCOUNT(5+2*NN,LCT,NPG,RECORD(35))
9499 FORMAT(//2X,10HEXTRA DUMP/2X,56HI,J,U,VOL,RA,RB,CAP,AA,AB,AC,AD,PL
1B,PLBS,EMN,PLA,PLC,PLD//)
K=0
DO 9490 J=1,NN
DO 9480 I=1,MM
K=K+1
IF(KSH(K)-1) 9490,9491,9480
9491 WRITE(6,9492) I,J,U(J),VOL(K),RA(K),RB(K),CAP(K),AA(K),AB(K),AC(K)
1,AD(K),PLB(K),PLBS(J),EMN(J),PLA(K),PLC(K),PLD(K)
9492 FORMAT(2X,I3,2X,I3,10E11.3/10X,5E11.3)
9490 CONTINUE
CALL LCOUNT(3+NN,LCT,NPG,RECORD(35))
WRITE(6,9503)
9503 FORMAT(//2X,40HI,J,DSDT,DSDTB,DS,DST,DSTT,MATL,KSH,KSUR/)
K=0
DO 5500 J=1,NN

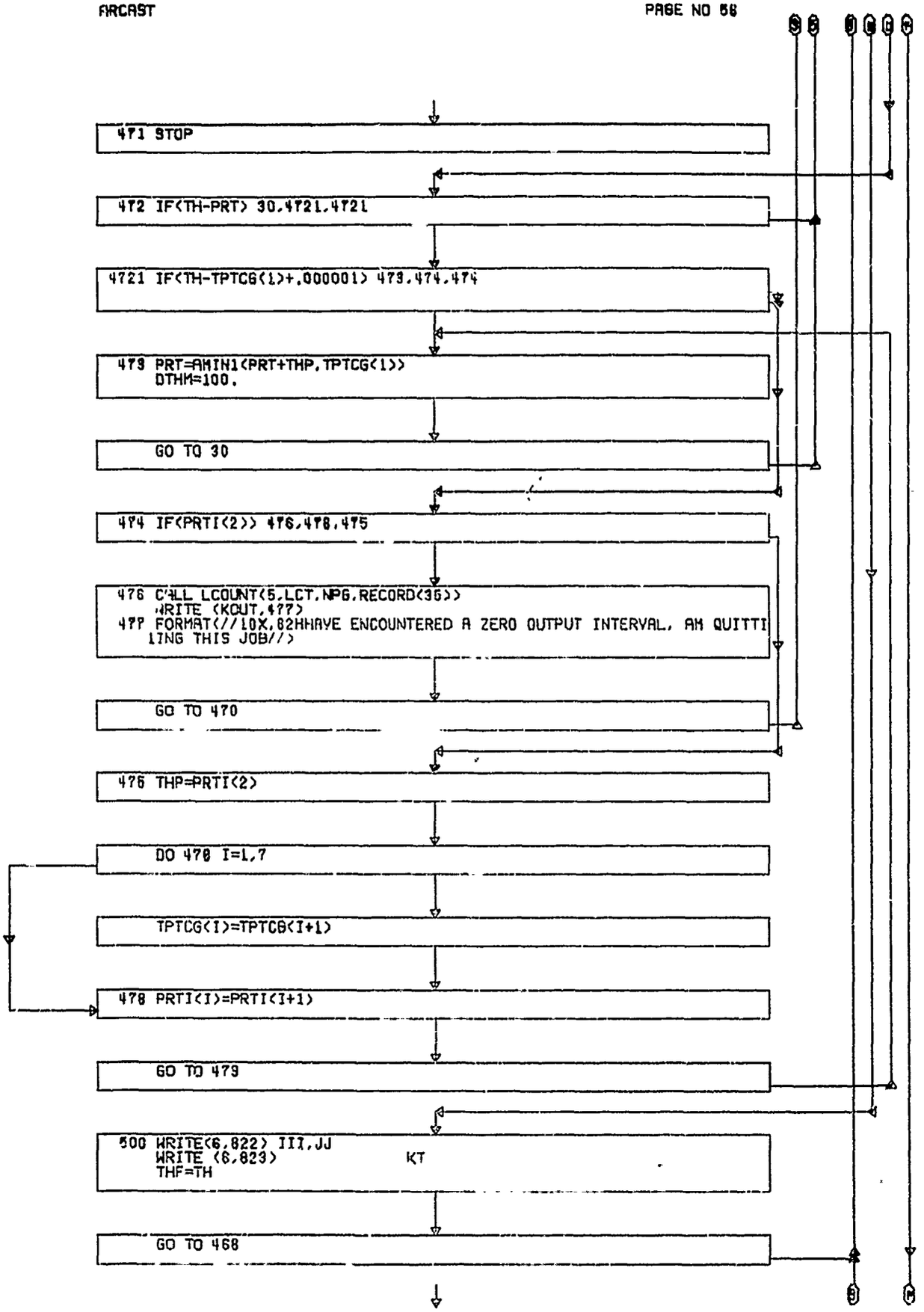

DO 9500 I=1,MM
K=K+1
IF(KSH(K)-1) 9500,9501,9500
9501 WRITE(6,9502) I,J,DSDT(J),DSDTB(J),DS(J),DST(J),DSTT(J),MATL(K),
1KSH(K),KSUR(J)
9502 FORMAT(2X,2I4,5E12.3,3I4)
9500 CONTINUE
CALL LCOUNT(4,LCT,NPG,RECORD(35))
WRITE(6,9494) PRT,THI,THF,DLTH,ETA,FV,FT,PIB,ZRO,KQOP,MM,NN,KK,
1NMT,NHT
9494 FORMAT(//2X,56HPRT,THI,THF,DLTH,ETA,FV,FT,PIB,ZRO,KQOP,MM,NN,KK,NM
1T,NHT/2X,9E11.3,I2,2I4,3I3//)
9497 CONTINUE
C-----OPTIONAL PUNCHED OUTPUT
IF(KSTRP-1) 849,842,8421
8421 DO 8422 I=1,8
IF(ABS(TH-TPN(I))-.000001) 842,842,8422
8422 CONTINUE
GO TO 849
842 K=0
NS=0
CALL LCOUNT(2,LCT,NPG,RECORD(35))
WRITE(6,8423) TH
8423 FORMAT(/20X,26HPUNCHED OUTPUT PRODUCED AT,F10.5,8H SECONDS)

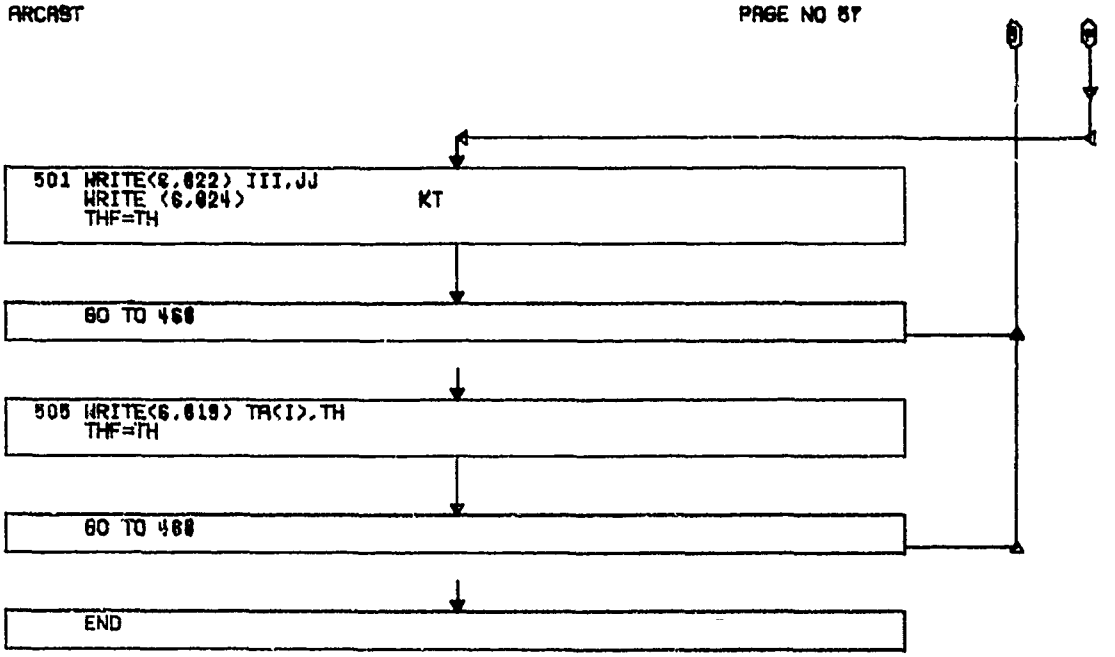

DO 840 J=1,NN
DO 840 I=1,MM
K=K+1
IF(MATL(K)) 8420,840,841
8420 NS=NS+1
841 NS=NS+1
840 CONTINUE
K=0
N=0
LL=0
LR=MM+1
DO 849 J=1,NN
DO 844 I=1,MM
K=K+1
LL=LL+1
LR=LR+1
IF(MATL(K)) 845,844,845
845 N=N+1
IF(KCENT) 8450,8450,8451

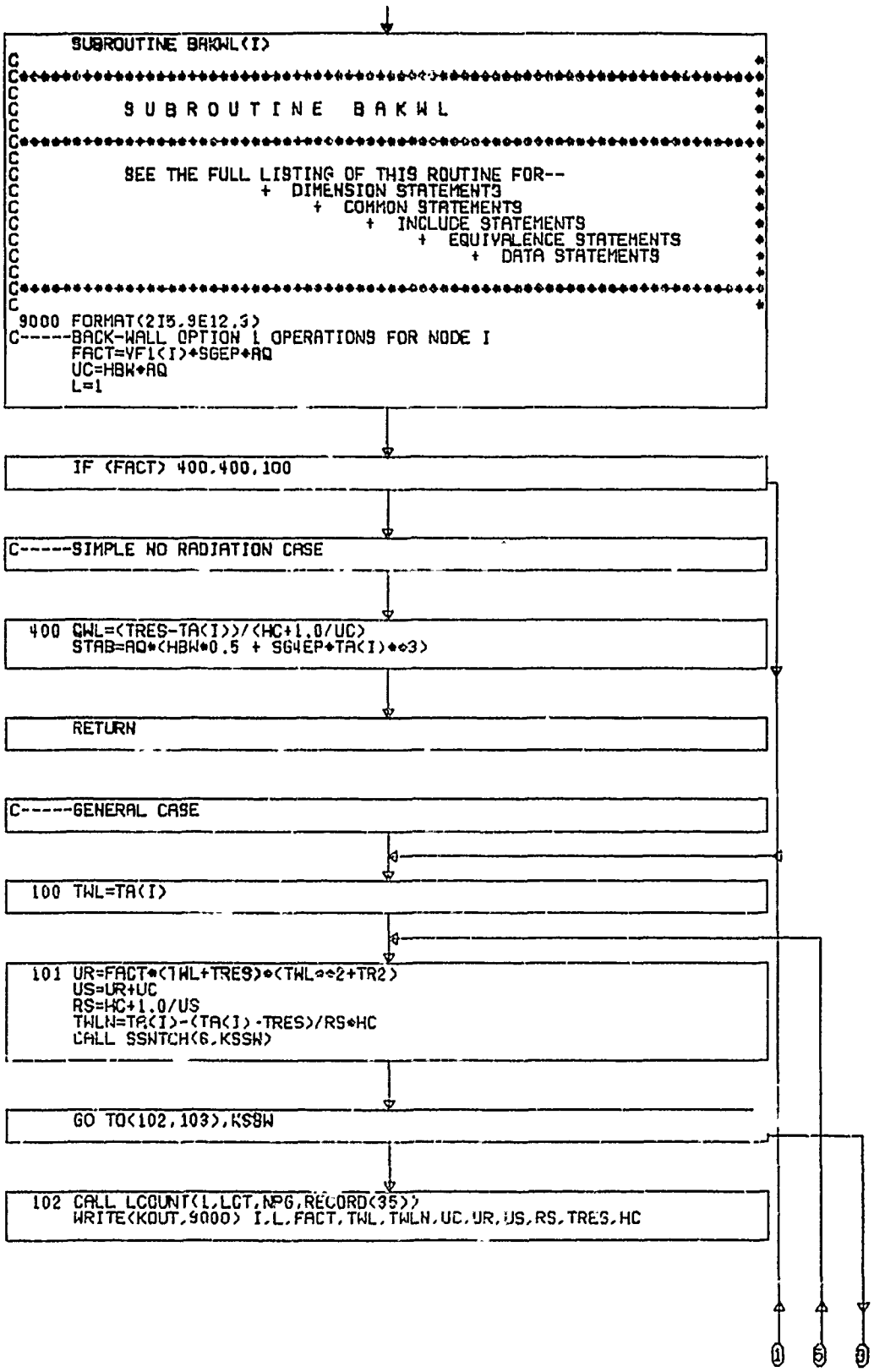

8450 CONTINUE
Z=(CZ(LL)+CZ(LR))/2.0
R=(CR(LL)+CR(LR))/2.0
GO TO 8452
8451 IF(MATL(K)) 8454,844,8453
8453 Z=(CZ(LL)+CZ(LR)+CZ(LL+1)+CZ(LR+1))/4.
R=(CR(LL)+CR(LR)+CR(LL+1)+CR(LR+1))/4.
GO TO 8452
8454 Z=((CZ(LL)+CZ(LR))/2.+SZ(J))/2.
R=((CR(LL)+CR(LR))/2.+SR(J))/2.
8452 CONTINUE
PUNCH 848, R,Z,TA(K),I,J,MATL(K),TH,RECORD(35),RECORD(36),N,NS
846 FORMAT (3F10.3,8HININDEGR,I3,1H/,I3,3HMAT,I2,F7.2,2HS ,2A6,1X,I3,
12HOF,I3)
IF(MATL(K)) 847,844,844
847 N=N+1
LL=LL+1
LR=LR+1
RAT=PLB(K)/PLBS(J)
R=R+RAT*((CR(LL)+CR(LR))/2.0-R)
Z=Z+RAT*((CZ(LL)+CZ(LR))/2.0-Z)
MOUT=-MATL(K)
PUNCH 848, R,Z,TS(J),J,MOUT,TH,RECORD(35),RECORD(36),N,NS
848 FORMAT (3F10.3,8HININDEGR,3X,1H/,I3,3HMAT,I2,F7.2,2HS ,2A6,1X,I3,
12HO'',I3)
844 CONTINUE
843 CONTINUE
849 CONTINUE
C-----TEMPERATURE PRINT OUT

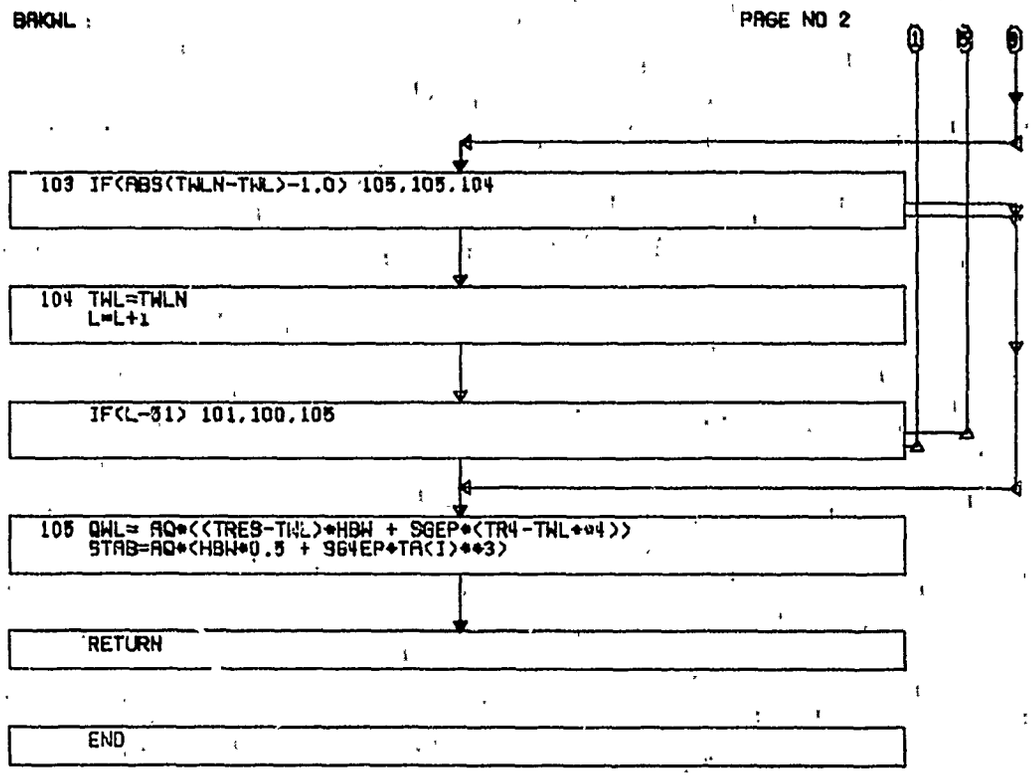

CALL LCOUNT(-4,LCT,NPG,RECORD(35))
WRITE(6,9365)
9365 FORMAT(//49X,19H***IN-DEPTH DATA***/)
CALL LCOUNT(3,LCT,NPG,RECORD(35))
WRITE(6,2410)
2410 FORMAT(/5(4X,21HROW COL TEMPERATURE)/)
INICK=1
JNICK=5
JNICK=MINO(JNICK,NN)
242 DO 241 L=1,MM
J=0
K=(INICK-1)*MM+L-MM
DO 247 I=1,11
247 JFORM(I)=IFORM(I)
DO 240 I=INICK,JNICK
K=K+MM
J=J+1
MPR(J)=L
NNPR(J)=I
TMPR(J)=TA(K)
IF (MATL(K).NE.0.AND.TMPR(J).GT.0.) GO TO 240
JFORM(2*J)=ISKIP
TMPR(J)=BLANK
240 CONTINUE
NPG1=NPG
CALL LCOUNT(1,LCT,NPG,RECORD(35))
IF (NPG.EQ.NPG1) GO TO 243
CALL LCOUNT(3,LCT,NPG,RECORD(35))

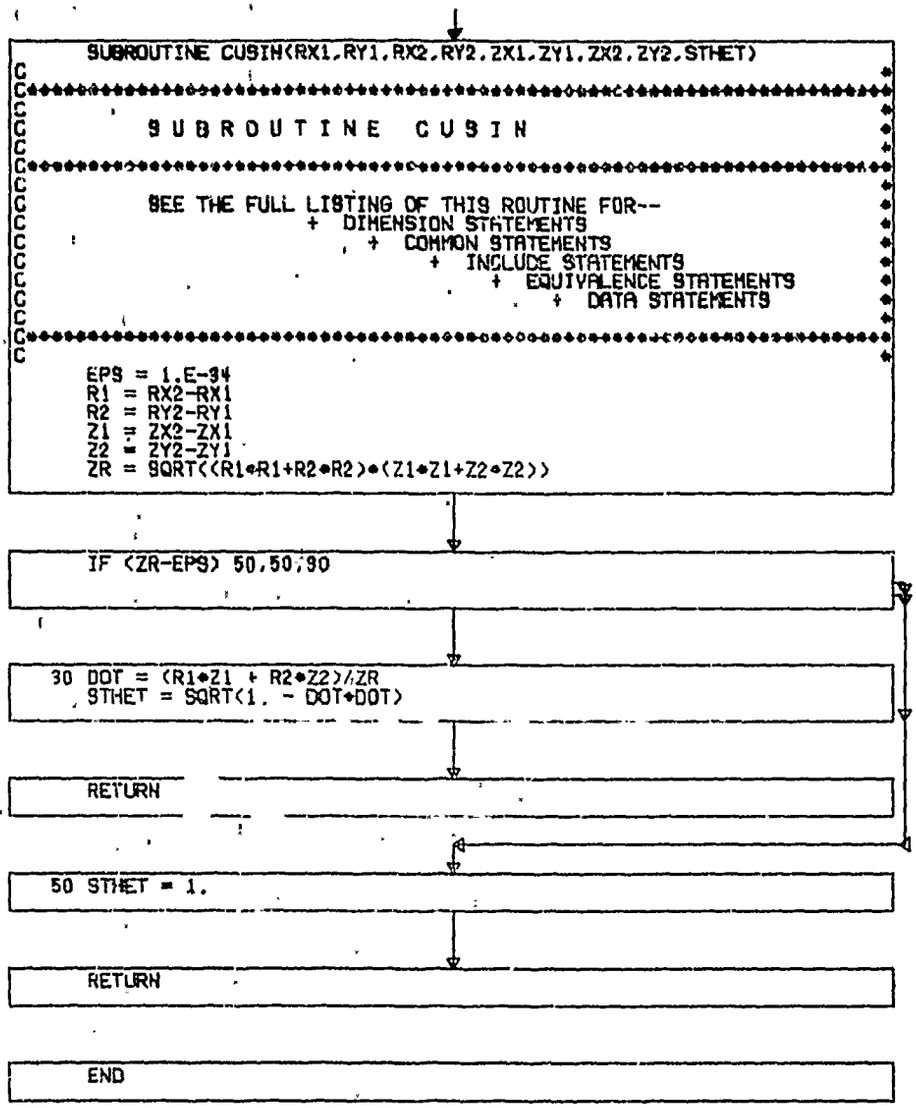

WRITE(6,2410)
249 WRITE(6,JFORM) (MPR(K),NNPR(K),TMPR(K),K=1,J)
241 CONTINUE
NPG1=NPG
CALL LCOUNT(1,LCT,NPG,RECORD(35))
IF (NPG1.EQ.NPG) GO TO 244
CALL LCOUNT(2,LCT,NPG,RECORD(35))
WRITE(6,2410)
GO TO 245
244 WRITE(6,901)
245 IF (JNICK.EQ.NN) GO TO 246
INICK=JNICK+1
JNICK=MIN0(INICK+4,NN)
GO TO 242
C 246 CONTINUE
469 IF(TH-THF) 472,470,470
470 CONTINUE
IF (KASE) 471,471,225


471 STOP
472 IF(TH-PRT) 30,4721,4721
4721 IF(TH-TPTCG(1)+.000001) 479,474,474
479 PRT=AMIN1(PRT+THP,TPTCG(1))
DTHM=100.
GO TO 30
474 IF(PRTI(2)) 476,478,475
476 CALL LCOUNT(5,LCT,NPG,RECORD(36))
WRITE (KOUT,477)
477 FORMAT(//10X,82HHAVE ENCOUNTERED A ZERO OUTPUT INTERVAL, AM QUITTI
1NG THIS JOB//)
GO TO 470
476 THP=PRTI(2)
DO 478 I=1,7
TPTCG(I)=TPTCG(I+1)
478 PRTI(I)=PRTI(I+1)
GO TO 479
500 WRITE(6,822) III,JJ
WRITE (6,823) KT
THF=TH
GO TO 468


501 WRITE(6,622) III,JJ
WRITE (6,624) KT
THF=TH
GO TO 468
505 WRITE(6,619) TR(I),TH
THF=TH
GO TO 468
END


SUBROUTINE BAKWL(I)
C
C
C
C S U B R O U T I N E B A K W L
C
C
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
C
C
9000 FORMAT(2I5,9E12.3)
C-----BACK-WALL OPTION 1 OPERATIONS FOR NODE I
FACT=VF1(I)*SGEP*AQ
UC=HBW*AQ
L=1
IF (FACT) 400,400,100
C-----SIMPLE NO RADIATION CASE
400 QWL=(TRES-TA(I))/(HC+1.0/UC)
STAB=AQ*(HBW*0.5 + SGEP*TA(I)**3)
RETURN
C-----GENERAL CASE
100 TWL=TA(I)
101 UR=FACT*(TWL+TRES)*(TWL**2+TR2)
US=UR+UC
RS=HC+1.0/US
TWLN=TA(I)-(TA(I)-TRES)/RS*HC
CALL SSWTCH(6,KSSW)
GO TO(102,103),KSSW
102 CALL LCOUNT(L,LCT,NPG,RECORD(35))
WRITE(KOUT,9000) I,L,FACT,TWL,TWLN,UC,UR,US,RS,TRES,HC
1
2
3


BAKWL :
PAGE NO 2
103 IF(ABS(TWLN-TWL)-1.0) 105,105,104
104 TWL=TWLN
L=L+1
IF(L-31) 101,100,105
105 QWL= AQ*((TRES-TWL)*HBW + SGEP*(TR4-TWL**4))
STAB=AQ*(HBW*0.5 + SIGEP*TA(I)**3)
RETURN
END


SUBROUTINE CUSIN(RX1,RY1,RX2,RY2,ZX1,ZY1,ZX2,ZY2,STHET)
C
C
C S U B R O U T I N E C U S I N
C
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
C
C
EPS = 1.E-34
R1 = RX2-RX1
R2 = RY2-RY1
Z1 = ZX2-ZX1
Z2 = ZY2-ZY1
ZR = SQRT((R1*R1+R2*R2)*(Z1*Z1+Z2*Z2))
IF (ZR-EPS) 50,50,90
30 DOT = (R1*Z1 + R2*Z2)/ZR
STHET = SQRT(1. - DOT*DOT)
RETURN
50 STHET = 1.
RETURN
END

```
      SUBROUTINE GAP(I,EM1,EM2,HM,HMS,SIG)
C                                                                      *
C***********************************************************************
C                                                                      *
C         S U B R O U T I N E   G A P                                  *
C                                                                      *
C***********************************************************************
C                                                                      *
C         SEE THE FULL LISTING OF THIS ROUTINE FOR--                   *
C                  +  DIMENSION STATEMENTS                             *
C                      +  COMMON STATEMENTS                            *
C                          +  INCLUDE STATEMENTS                       *
C                              +  EQUIVALENCE STATEMENTS               *
C                                  +  DATA STATEMENTS                  *
C                                                                      *
C***********************************************************************
C                                                                      *
```

```
      RETURN
```

```
      END
```

```
      SUBROUTINE LCOUNT (I,LCT,NPG,R)
C                                                                       *
C************************************************************************
C                                                                       *
C          S U B R O U T I N E   L C O U N T                            *
C                                                                       *
C************************************************************************
C                                                                       *
C          SEE THE FULL LISTING OF THIS ROUTINE FOR--                   *
C                        +  DIMENSION STATEMENTS                        *
C                             +  COMMON STATEMENTS                      *
C                                  +  INCLUDE STATEMENTS                *
C                                       +  EQUIVALENCE STATEMENTS       *
C                                            +  DATA STATEMENTS         *
C                                                                       *
C************************************************************************
C                                                                       *
  551 FORMAT(1H1,25X,71HAEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MA
     1TERIAL ABLATION PROGRAM/119X,4HPAGE,I3/108X,2A8)
  552 FORMAT(1H1,25X,71HAEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MA
     1TERIAL ABLATION PROGRAM/111X8HPAGES ,I3/109X,8HTHROUGH ,I3/108X,
     22A8)
      IJK=I

      IF (IJK) 2,2,3

    2 IJK=-IJK

      GO TO 4

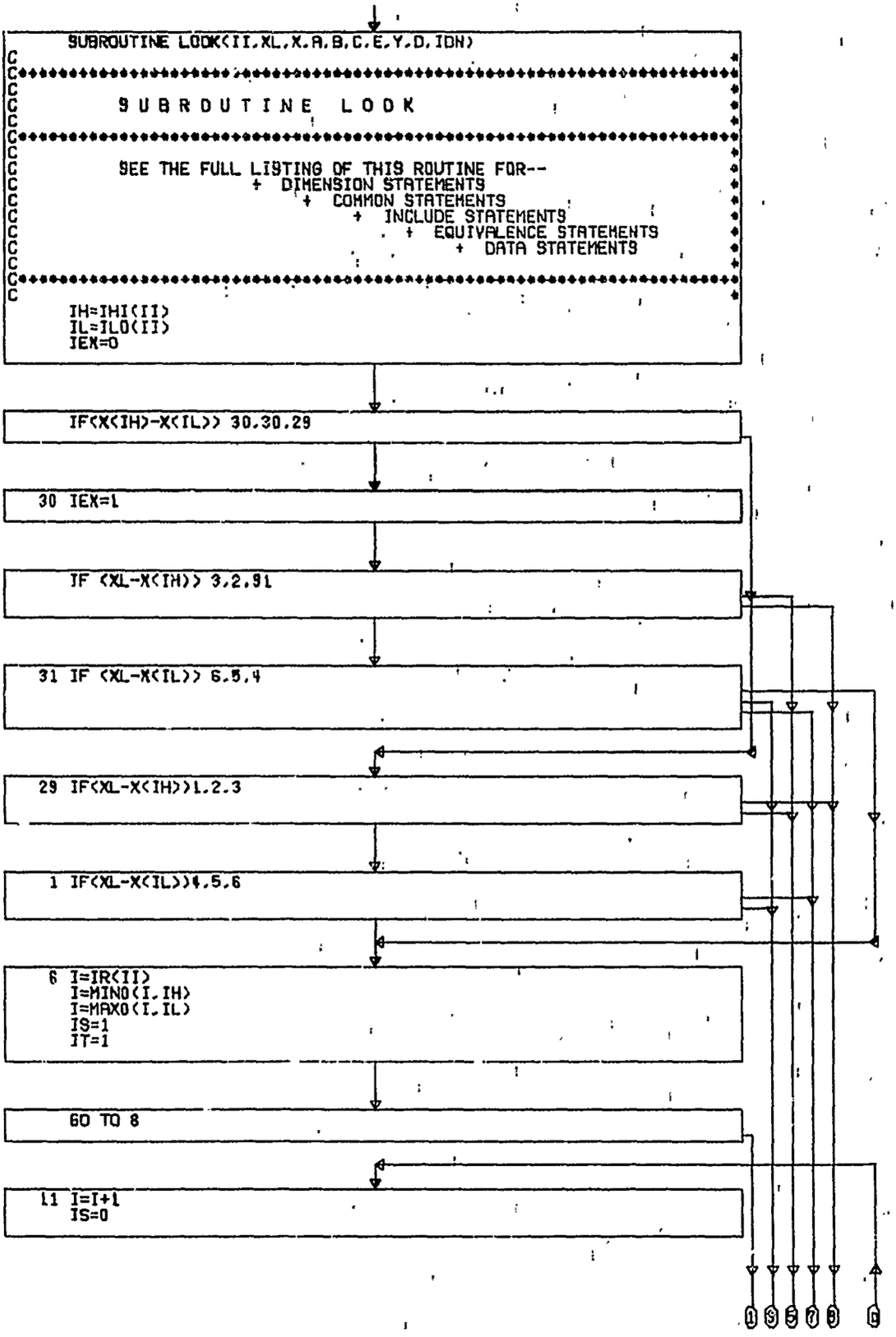
    3 LCT=LCT-IJK

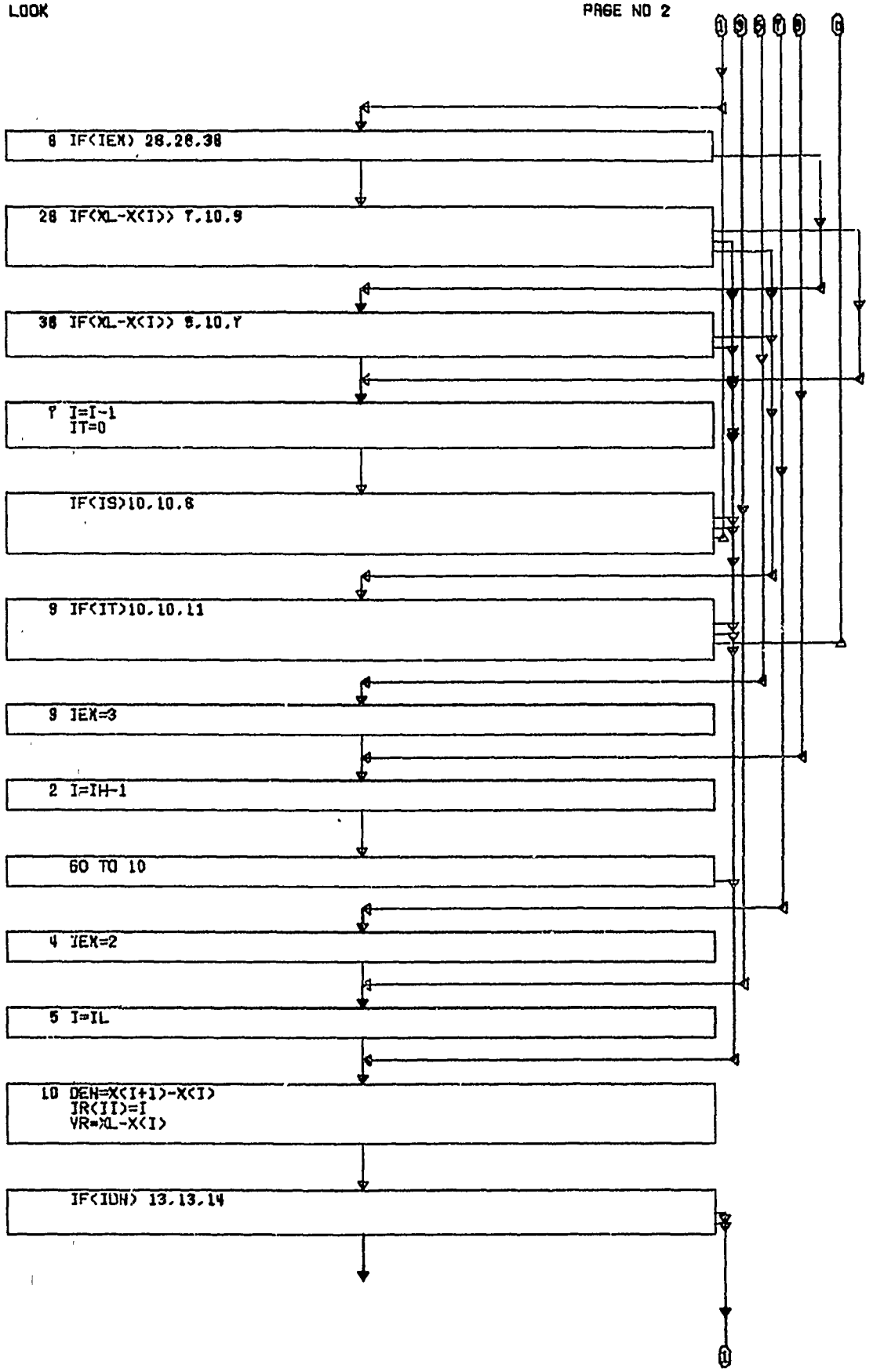
      IF (LCT) 4,5,5

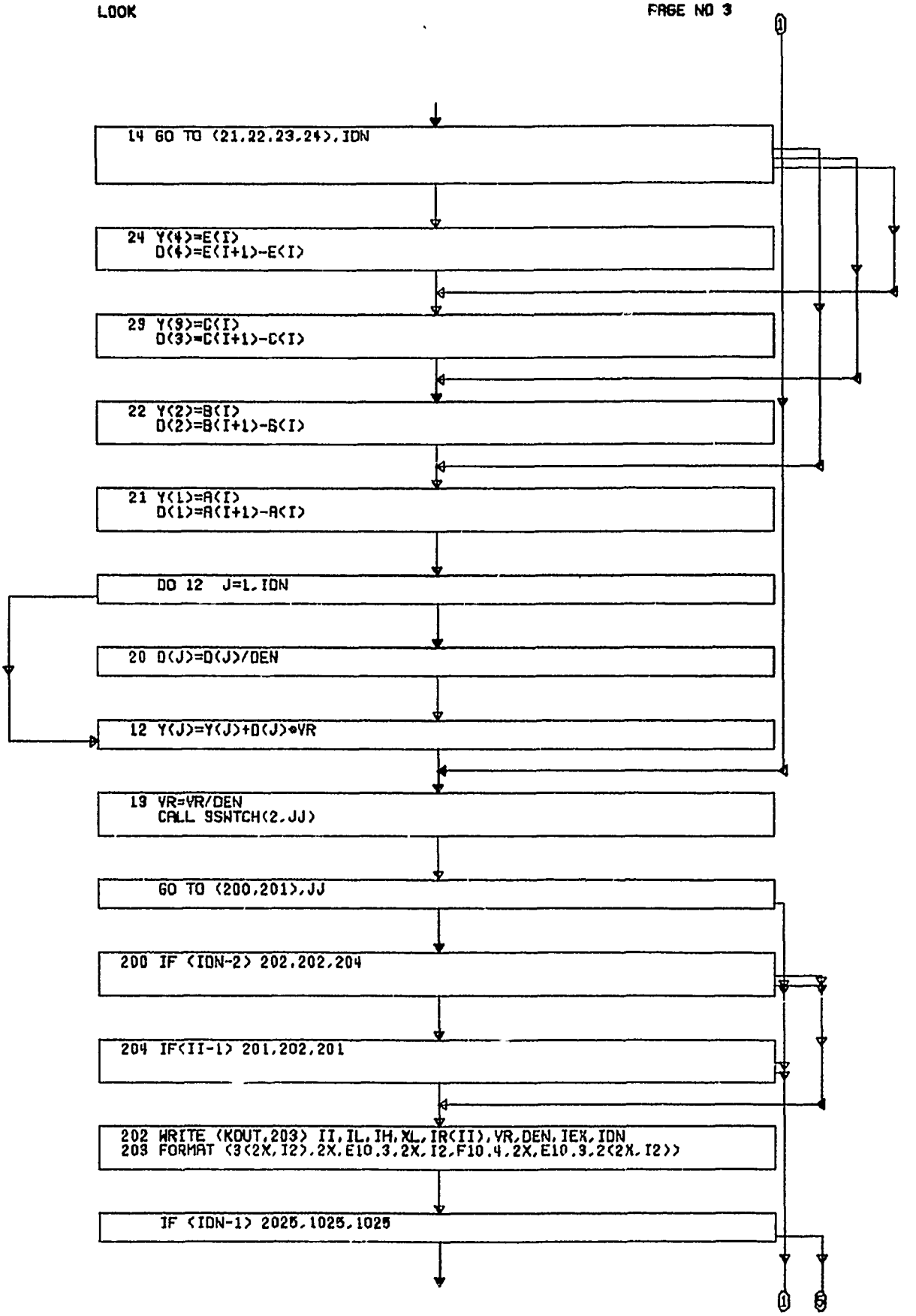
    4 NPG=NPG+1
      LCT=57-IJK
      WRITE (KOUT,551) NPG,R

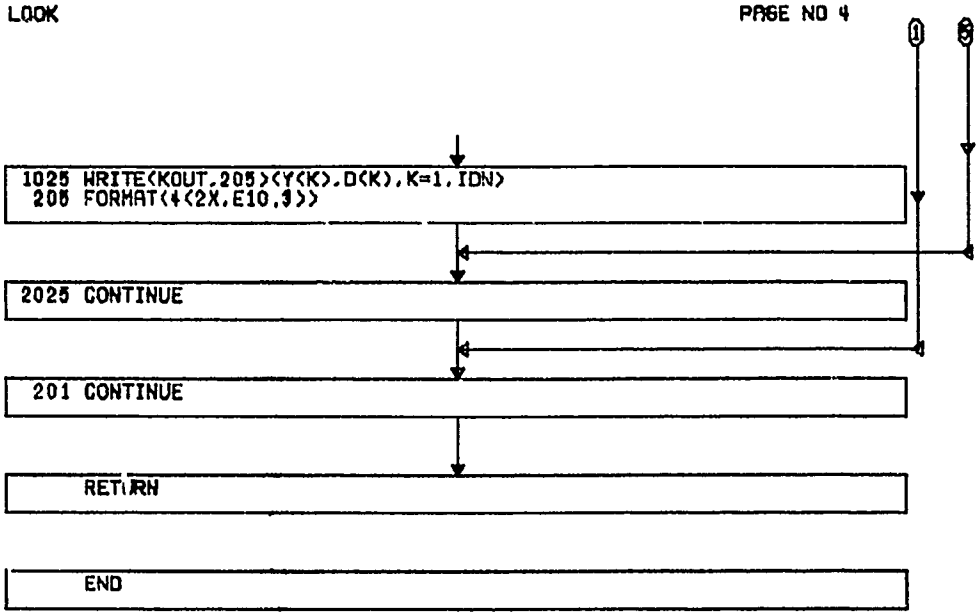
    5 RETURN

      END
```


SUBROUTINE LOOK(II,XL,X,A,B,C,E,Y,D,IDN)
C
C
C SUBROUTINE LOOK
C
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
IH=IHI(II)
IL=ILO(II)
IEX=0
IF(X(IH)-X(IL)) 30,30,29
30 IEX=1
IF (XL-X(IH)) 3,2,91
31 IF (XL-X(IL)) 6,5,4
29 IF(XL-X(IH))1,2,3
1 IF(XL-X(IL))4,5,6
6 I=IR(II)
I=MIN0(I,IH)
I=MAX0(I,IL)
IS=1
IT=1
GO TO 8
11 I=I+1
IS=0
1
5
2
7
3
4


8 IF(IEX) 28,28,38
28 IF(XL-X(I)) 7,10,9
38 IF(XL-X(I)) 8,10,7
7 I=I-1
IT=0
IF(IS)10,10,6
9 IF(IT)10,10,11
9 IEX=3
2 I=IH-1
GO TO 10
4 IEX=2
5 I=IL
10 DEN=X(I+1)-X(I)
IR(II)=I
YR=XL-X(I)
IF(IDN) 13,13,14


14 GO TO (21,22,23,24),IDN
24 Y(4)=E(I)
D(4)=E(I+1)-E(I)
29 Y(3)=C(I)
D(3)=C(I+1)-C(I)
22 Y(2)=B(I)
D(2)=B(I+1)-B(I)
21 Y(1)=A(I)
D(1)=A(I+1)-A(I)
DO 12 J=1,IDN
20 D(J)=D(J)/DEN
12 Y(J)=Y(J)+D(J)*VR
19 VR=VR/DEN
CALL SSWTCH(2,JJ)
GO TO (200,201),JJ
200 IF (IDN-2) 202,202,204
204 IF(II-1) 201,202,201
202 WRITE (KOUT,203) II,IL,IH,XL,IR(II),VR,DEN,IEX,IDN
203 FORMAT (3(2X,I2),2X,E10.3,2X,I2,F10.4,2X,E10.3,2(2X,I2))
IF (IDN-1) 2025,1025,1025
1
1
5


1
5
1025 WRITE(KOUT,205)(Y(K),D(K),K=1,IDN)
205 FORMAT(4(2X,E10.3))
2025 CONTINUE
201 CONTINUE
RETURN
END

```
      SUBROUTINE OBLE(N,XAM,PRM,NUMX,X,P,EM)
C                                                                        *
C*************************************************************************
C                                                                        *
C          S U B R O U T I N E   O B L E                                 *
C                                                                        *
C*************************************************************************
C                                                                        *
C          SEE THE FULL LISTING OF THIS ROUTINE FOR--                    *
C                    +  DIMENSION STATEMENTS                             *
C                         +  COMMON STATEMENTS                           *
C                              +  INCLUDE STATEMENTS                     *
C                                   +  EQUIVALENCE STATEMENTS            *
C                                        +  DATA STATEMENTS              *
C                                                                        *
C*************************************************************************
C                                                                        *
      XDIF=X(NUMX)-X(1)
      IS=1

    2 DO 600 J=1,N

      XA=XAM(J)
   58 IO=1
      IT=1

   61 IF(XDIF) 72,60,71

   71 IF(XA-X(IS)) 62,69,64

   72 IF(X(IS)-XA) 62,69,64

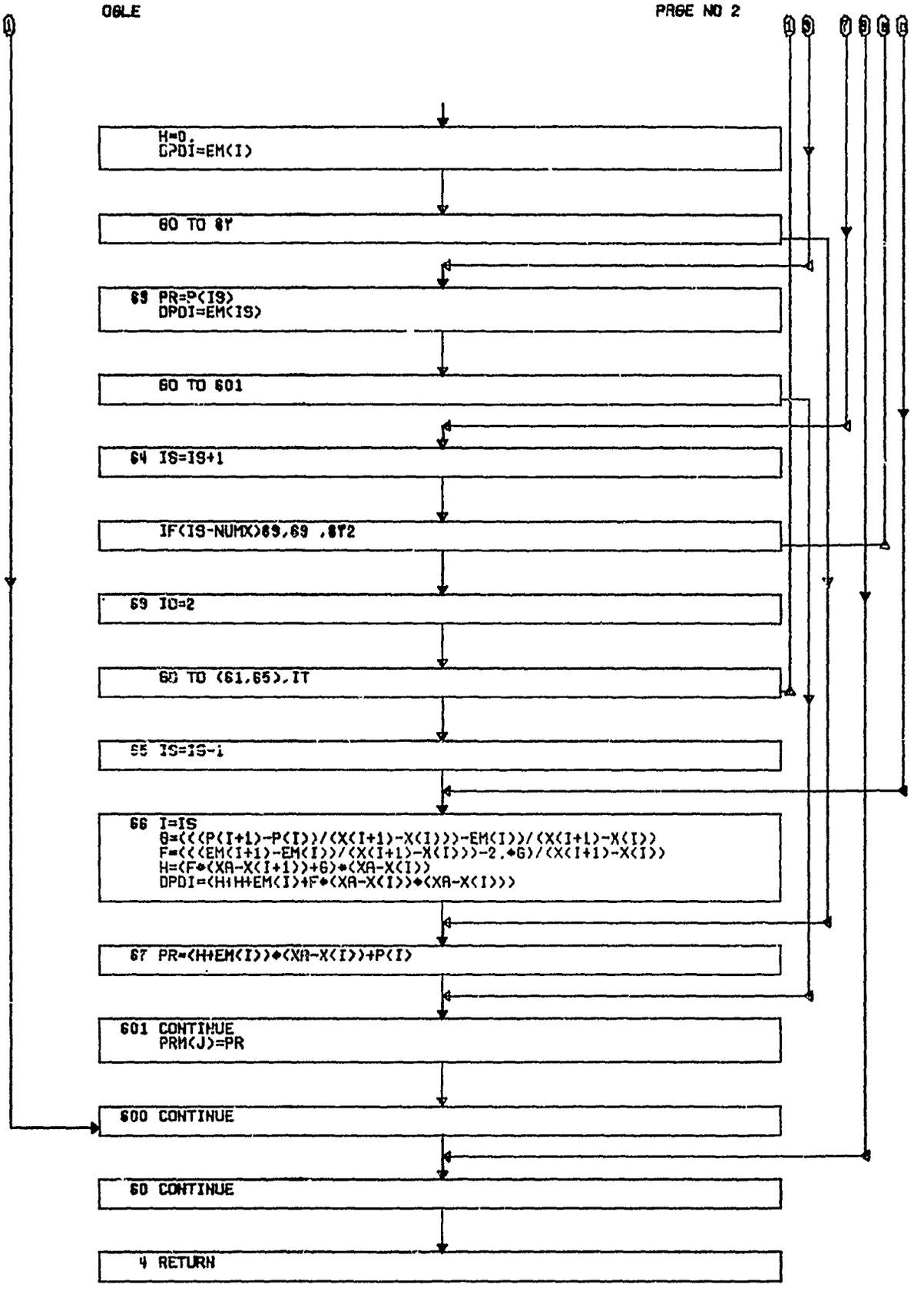
   62 IF(IS-1)671,671,68

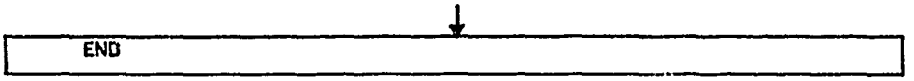
   68 IS=IS-1
      IT=2

      GO TO (61,66),IO

  672 IS=NUMX

  671 I=IS
```


H=0.
DPDI=EM(I)
GO TO 67
69 PR=P(IS)
DPDI=EM(IS)
GO TO 601
64 IS=IS+1
IF(IS-NUMX)69,69 ,672
69 ID=2
GO TO (61,65),IT
65 IS=IS-1
66 I=IS
G=(((P(I+1)-P(I))/(X(I+1)-X(I)))-EM(I))/(X(I+1)-X(I))
F=(((EM(I+1)-EM(I))/(X(I+1)-X(I)))-2.*G)/(X(I+1)-X(I))
H=(F*(XA-X(I+1))+G)*(XA-X(I))
DPDI=(H+H+EM(I)+F*(XA-X(I))*(XA-X(I)))
67 PR=(H+EM(I))*(XA-X(I))+P(I)
601 CONTINUE
PRM(J)=PR
600 CONTINUE
60 CONTINUE
4 RETURN


END

```
      SUBROUTINE ORDERD (NX,X1,I1)
C                                                                         *
C**************************************************************************
C                                                                         *
C              S U B R O U T I N E   O R D E R D                          *
C                                                                         *
C**************************************************************************
C                                                                         *
C              SEE THE FULL LISTING OF THIS ROUTINE FOR--                 *
C                          +  DIMENSION STATEMENTS                        *
C                              +  COMMON STATEMENTS                       *
C                                  +  INCLUDE STATEMENTS                  *
C                                      +  EQUIVALENCE STATEMENTS          *
C                                          +  DATA STATEMENTS             *
C                                                                         *
C**************************************************************************
C                                                                         *
      NM=IABS(NX)
      LS(1)=0
      LS(2)=1
      LS(3)=2
      LI=3
      I1(1)=1

      DO 1 N=2,NM

      I1(N)=N
      L=LS(LI)
      LA=LI
      J=N
      X1C=X1(J)
      I1C=I1(J)
      J=J-L

      IF(J) 31,31,34

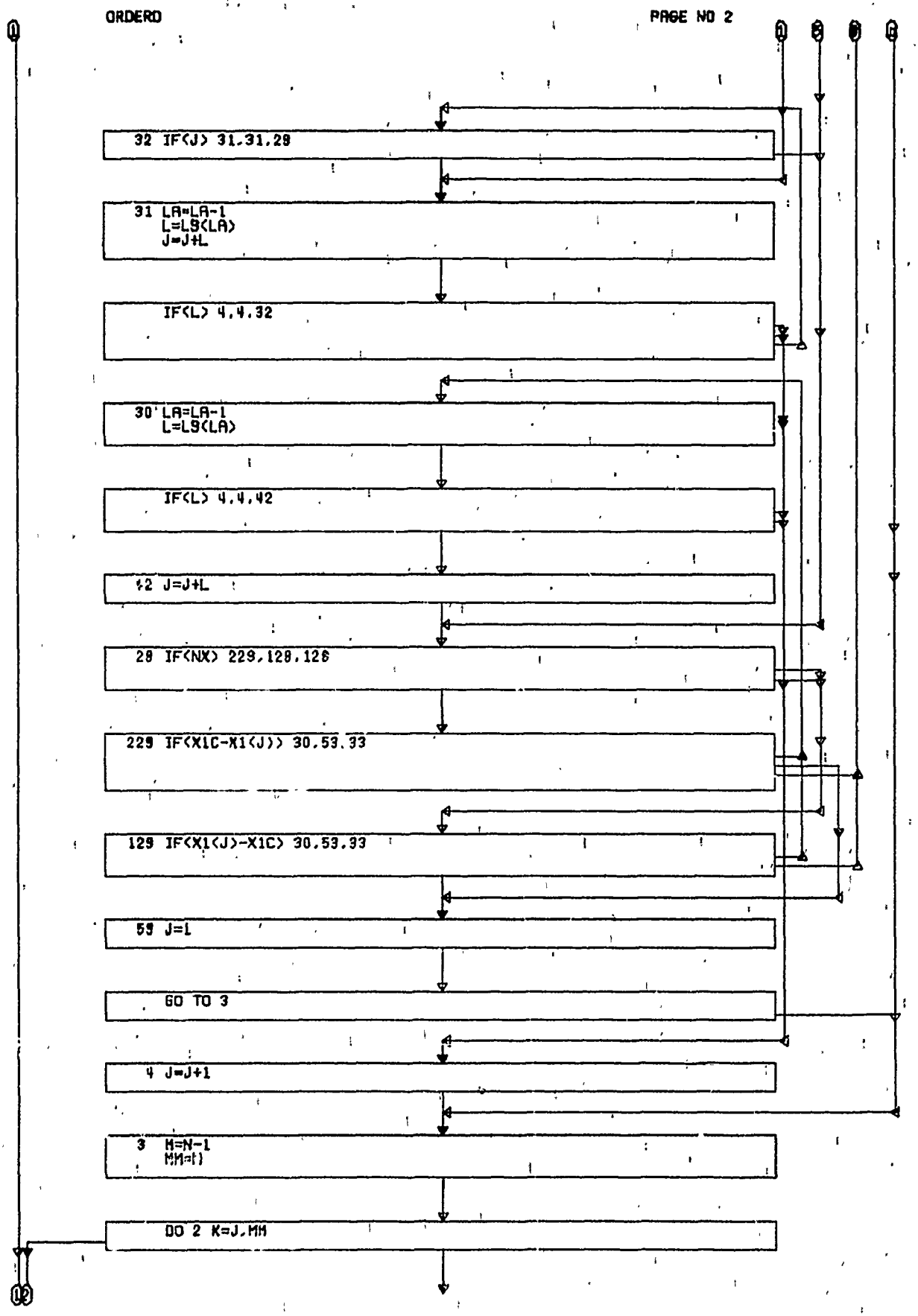
   34 LI=LI+1
      LS(LI)=L+L

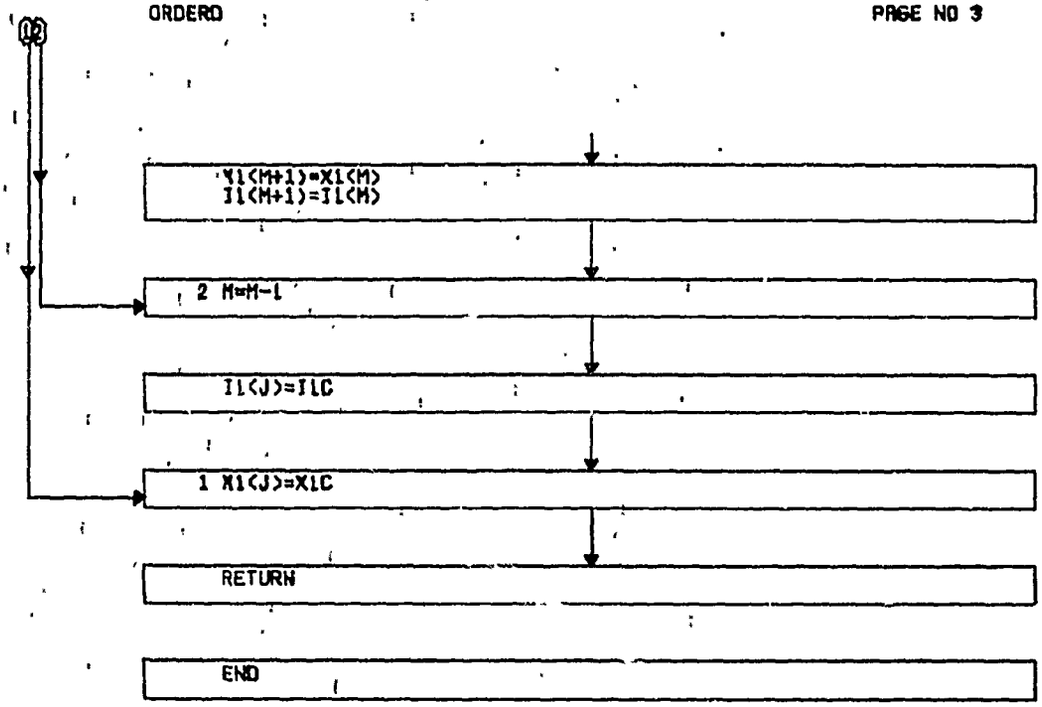
      GO TO 29

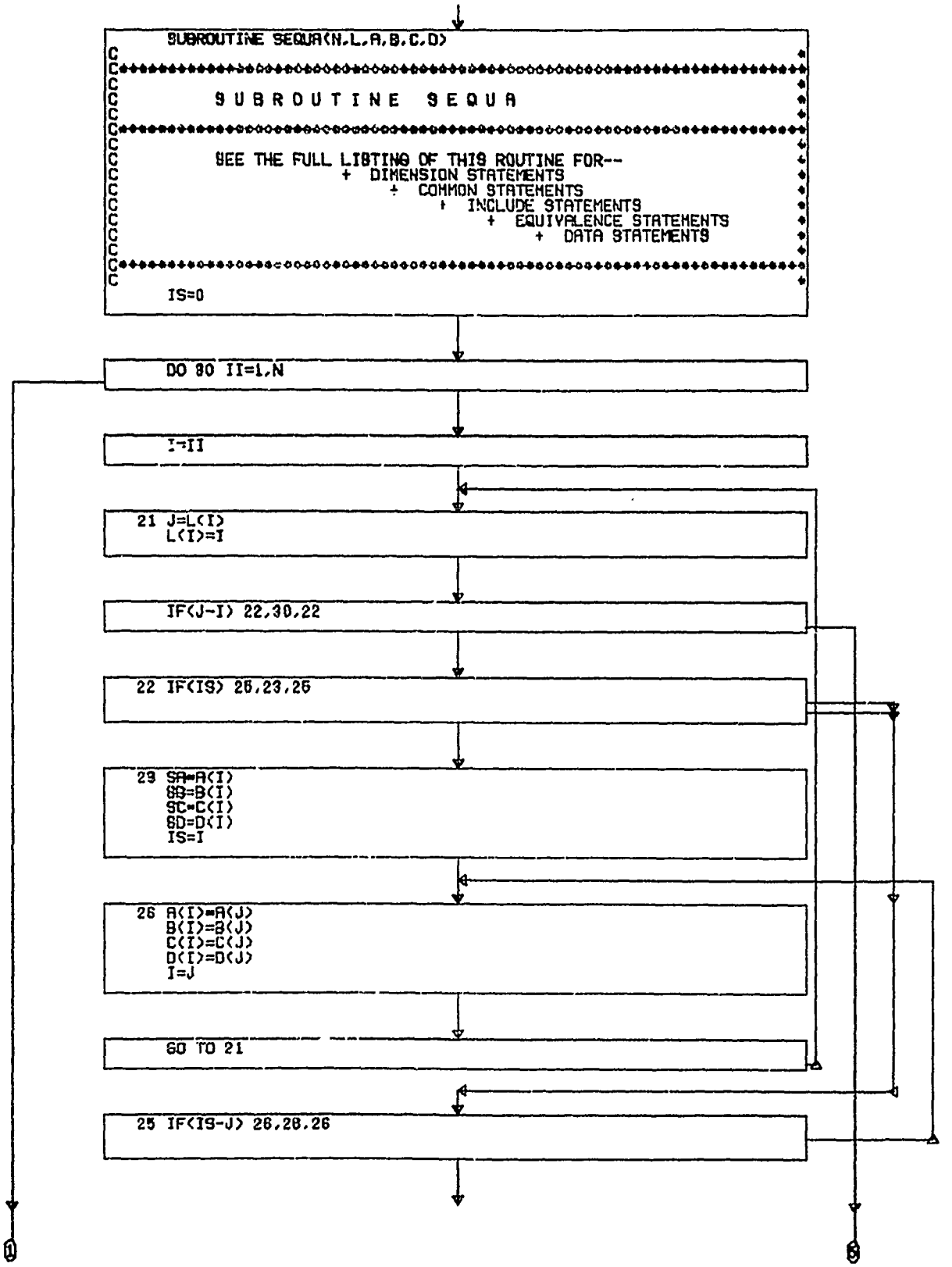
   33 LA=LA-1
      L=LS(LA)

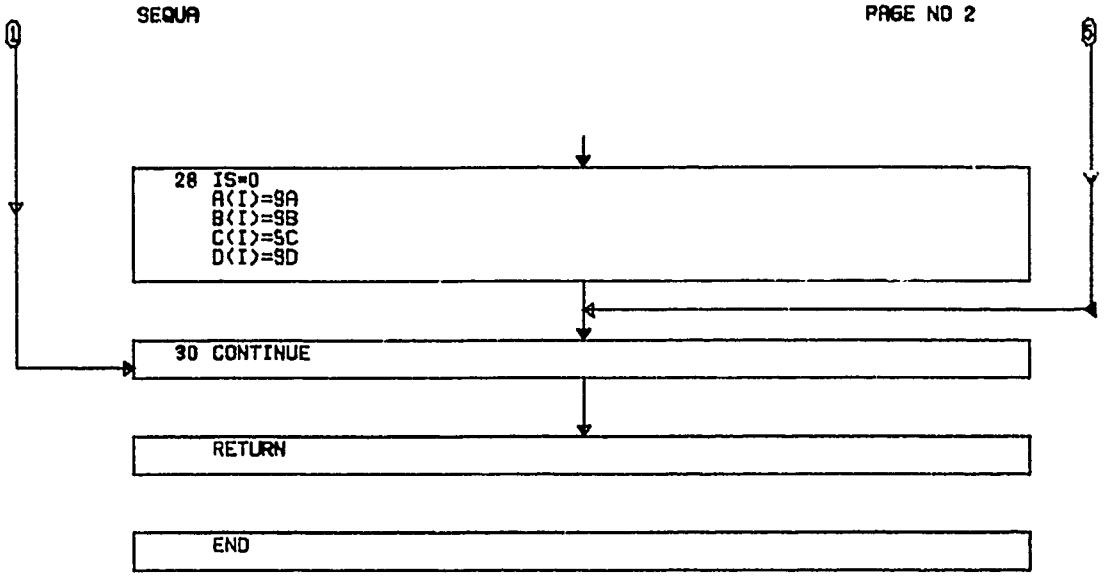
      IF(L) 3,3,41

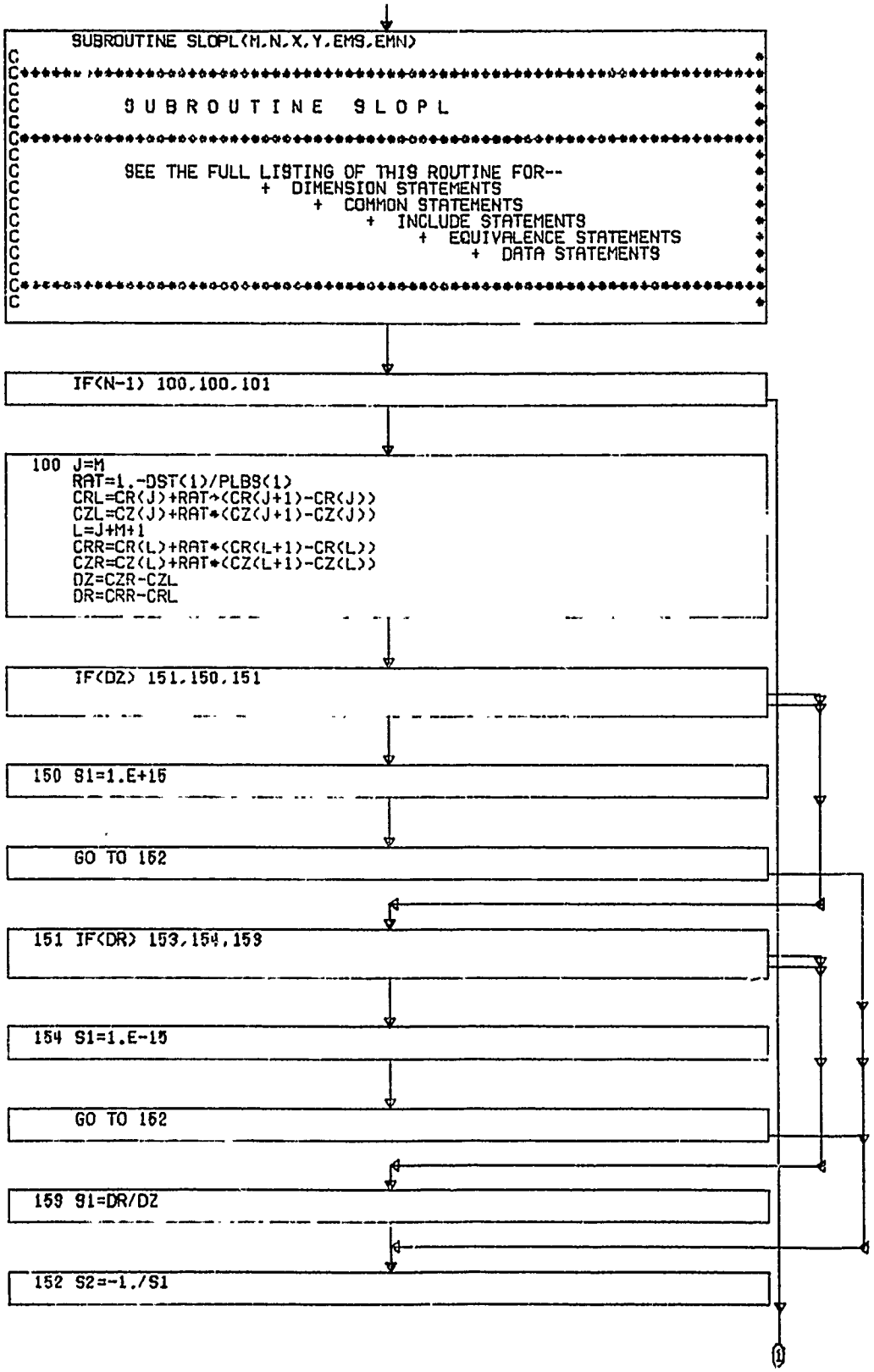
   41 J=J-L
```

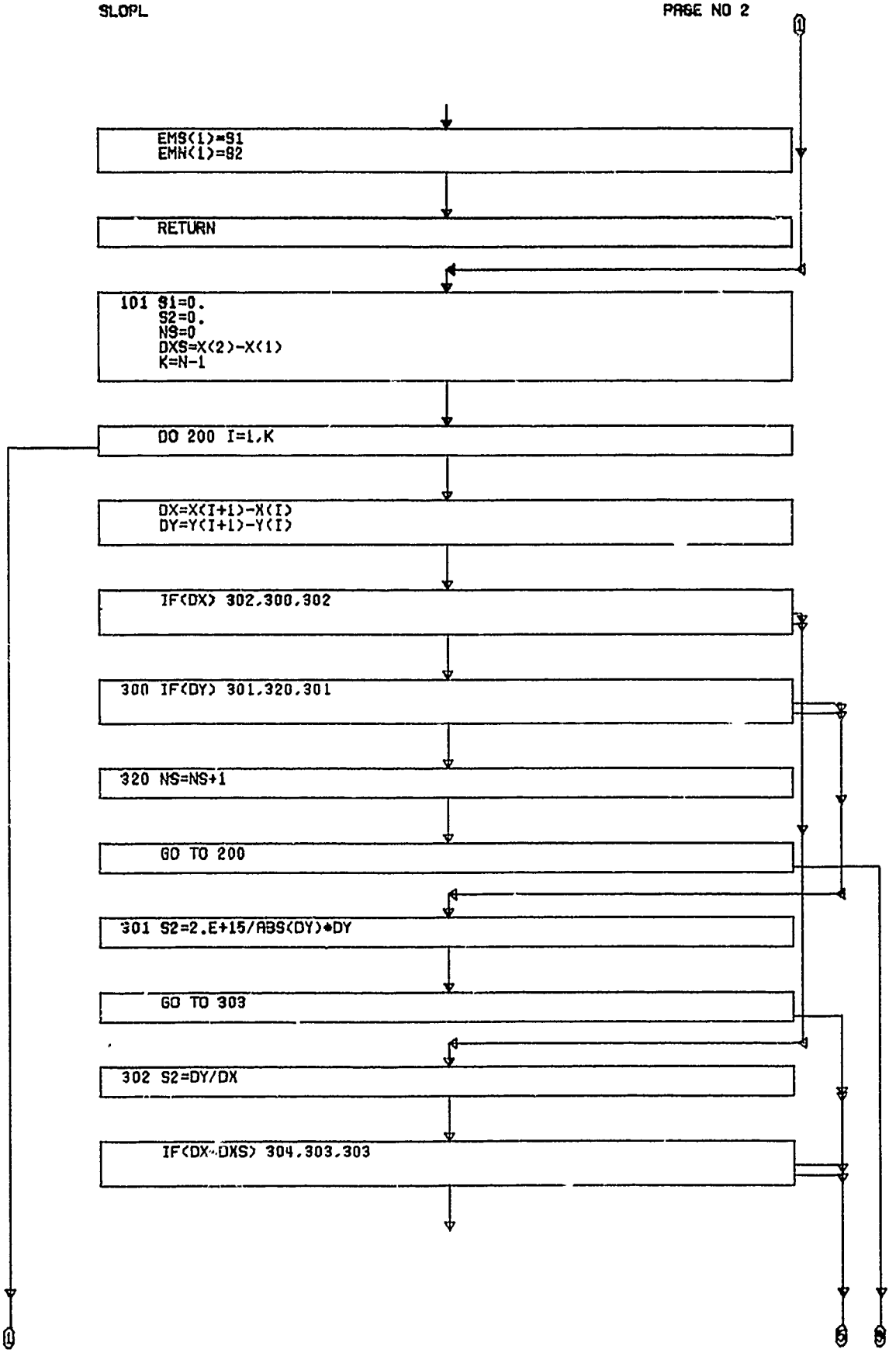

32 IF(J) 31,31,29
31 LA=LA-1
L=LS(LA)
J=J+L
IF(L) 4,4,32
30 LA=LA-1
L=LS(LA)
IF(L) 4,4,42
42 J=J+L
28 IF(NX) 229,128,126
229 IF(X1C-X1(J)) 30,59,33
129 IF(X1(J)-X1C) 30,59,33
59 J=L
GO TO 3
4 J=J+1
3 M=N-1
MM=M
DO 2 K=J,MM

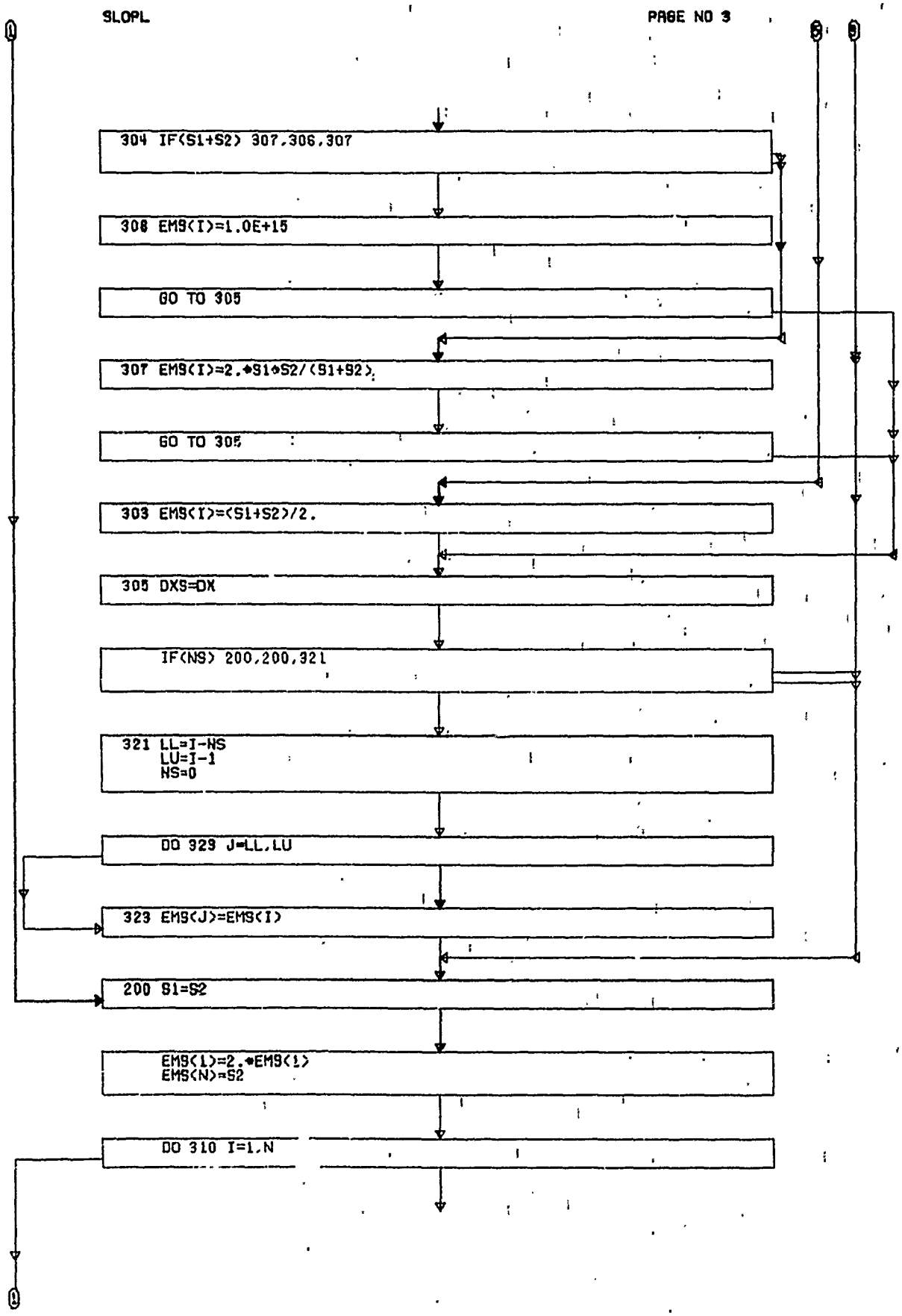

12
X1(M+1)=X1(M)
I1(M+1)=I1(M)
2 M=M-1
I1(J)=I1C
1 X1(J)=X1C
RETURN
END

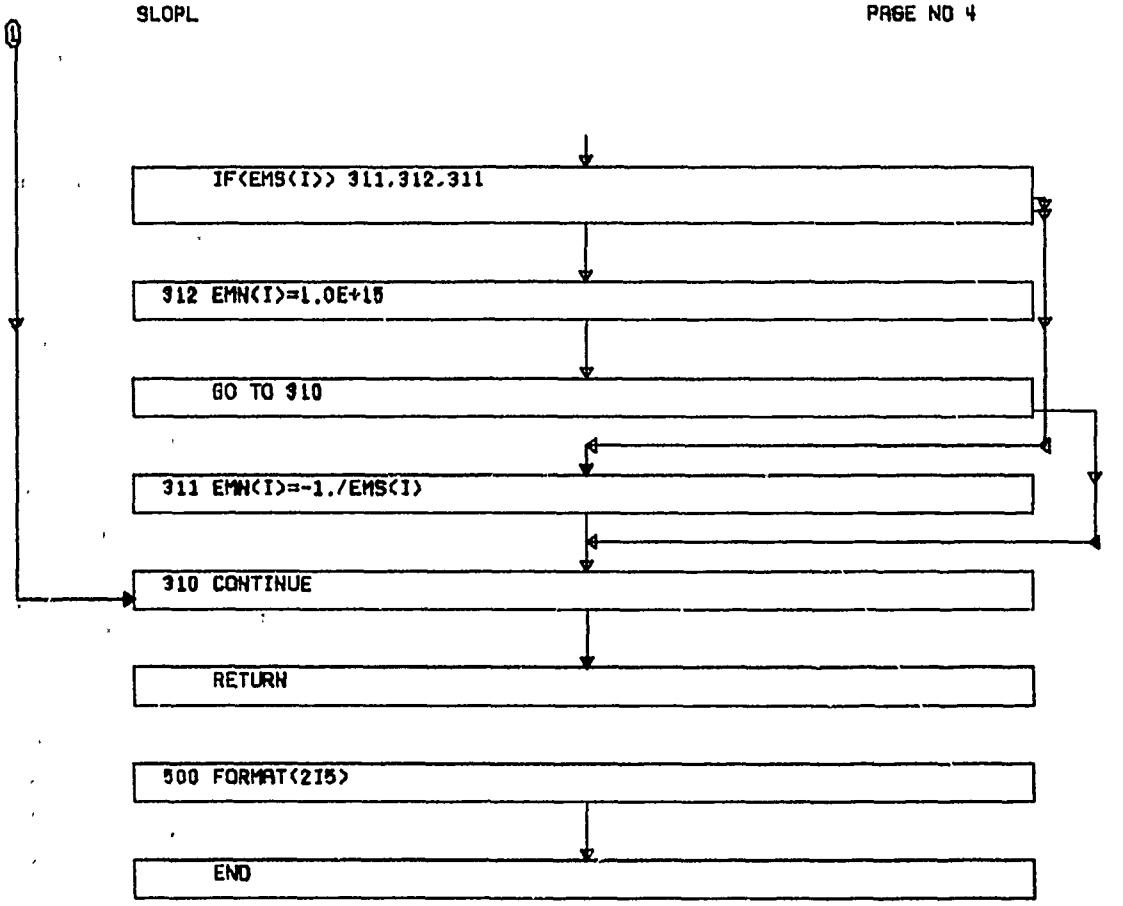

SUBROUTINE SEQUA(N,L,A,B,C,D)
C
C
C S U B R O U T I N E S E Q U A
C
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
IS=0
DO 80 II=1,N
I=II
21 J=L(I)
L(I)=I
IF(J-I) 22,30,22
22 IF(IS) 25,23,25
23 SA=A(I)
SB=B(I)
SC=C(I)
SD=D(I)
IS=I
26 A(I)=A(J)
B(I)=B(J)
C(I)=C(J)
D(I)=D(J)
I=J
GO TO 21
25 IF(IS-J) 26,26,26

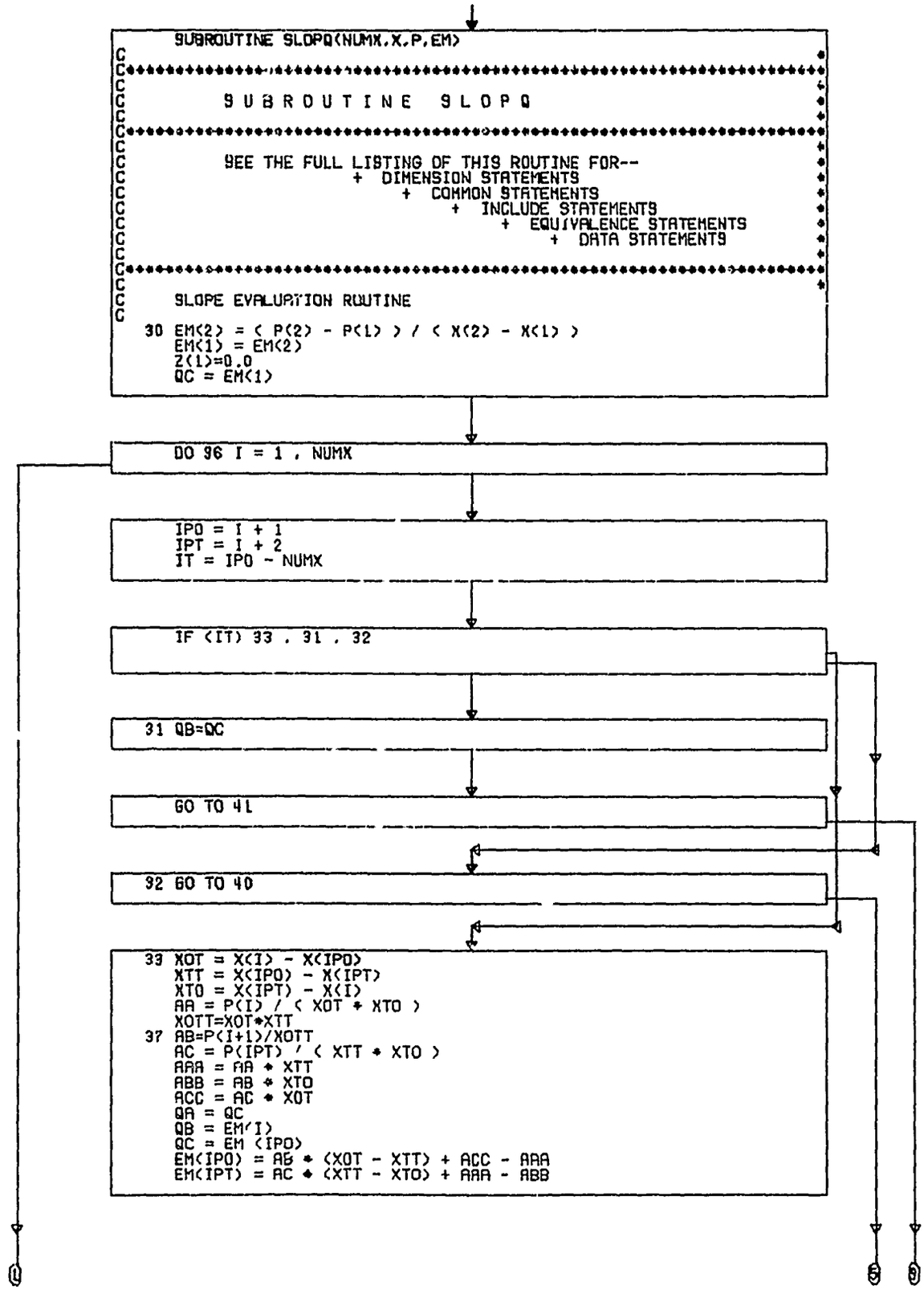

Q
S
28 IS=0
A(I)=$A
B(I)=$B
C(I)=$C
D(I)=$D
30 CONTINUE
RETURN
END

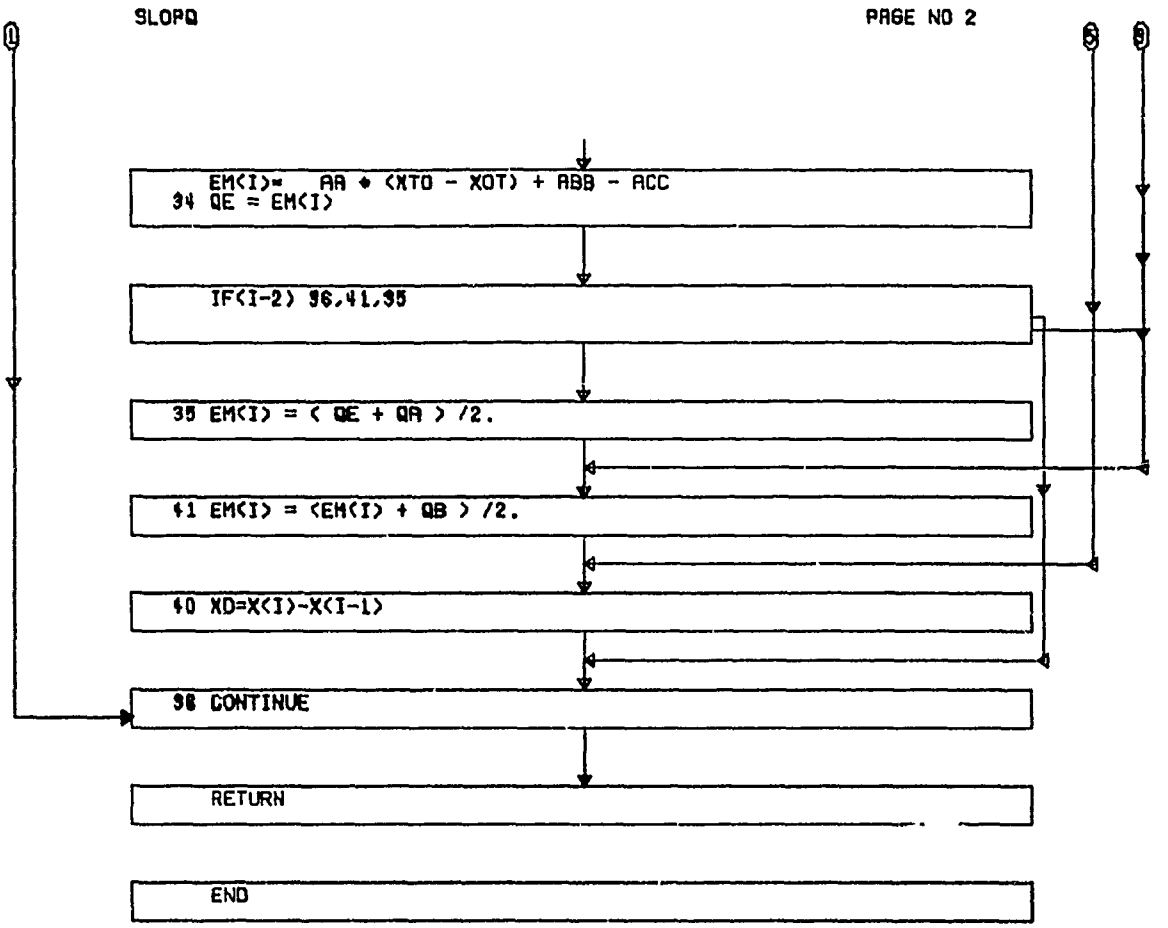

SUBROUTINE SLOPL(M,N,X,Y,EMS,EMN)
C
C
C S U B R O U T I N E S L O P L
C
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
C
IF(N-1) 100,100,101
100 J=M
RAT=1.-DST(1)/PLBS(1)
CRL=CR(J)+RAT*(CR(J+1)-CR(J))
CZL=CZ(J)+RAT*(CZ(J+1)-CZ(J))
L=J+M+1
CRR=CR(L)+RAT*(CR(L+1)-CR(L))
CZR=CZ(L)+RAT*(CZ(L+1)-CZ(L))
DZ=CZR-CZL
DR=CRR-CRL
IF(DZ) 151,150,151
150 S1=1.E+15
GO TO 152
151 IF(DR) 153,154,153
154 S1=1.E-15
GO TO 152
153 S1=DR/DZ
152 S2=-1./S1
1

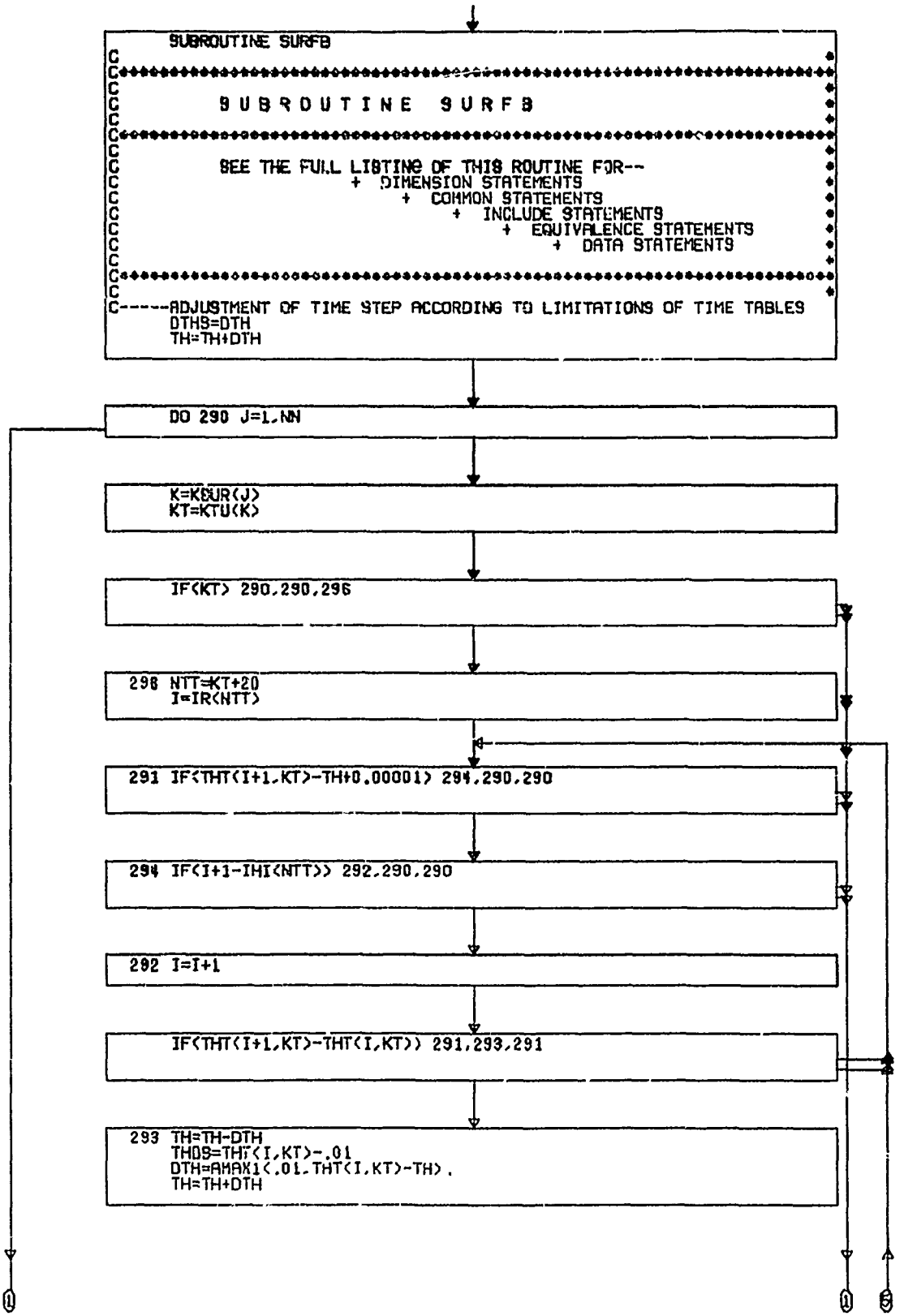

EMS(1)=S1
EMN(1)=S2
RETURN
101 S1=0.
S2=0.
NS=0
DXS=X(2)-X(1)
K=N-1
DO 200 I=1,K
DX=X(I+1)-X(I)
DY=Y(I+1)-Y(I)
IF(DX) 302,300,302
300 IF(DY) 301,320,301
320 NS=NS+1
GO TO 200
301 S2=2.E+15/ABS(DY)*DY
GO TO 303
302 S2=DY/DX
IF(DX*DXS) 304,303,303

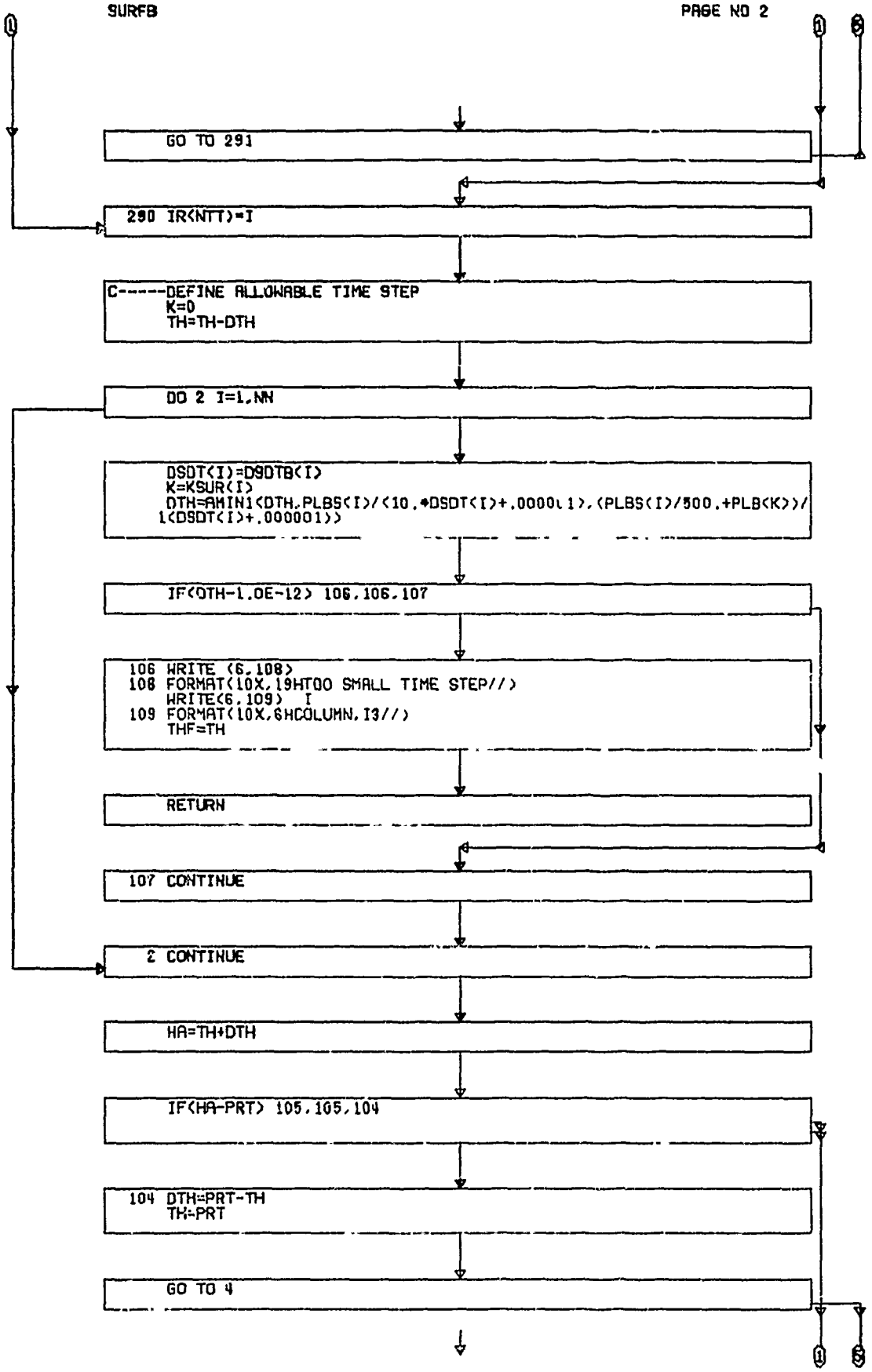

304 IF(S1+S2) 307,306,307
306 EMS(I)=1.0E+15
GO TO 305
307 EMS(I)=2.*S1*S2/(S1+S2)
GO TO 305
303 EMS(I)=(S1+S2)/2.
305 DXS=DX
IF(NS) 200,200,321
321 LL=I-NS
LU=I-1
NS=0
DO 323 J=LL,LU
323 EMS(J)=EMS(I)
200 S1=S2
EMS(1)=2.*EMS(1)
EMS(N)=S2
DO 310 I=1,N

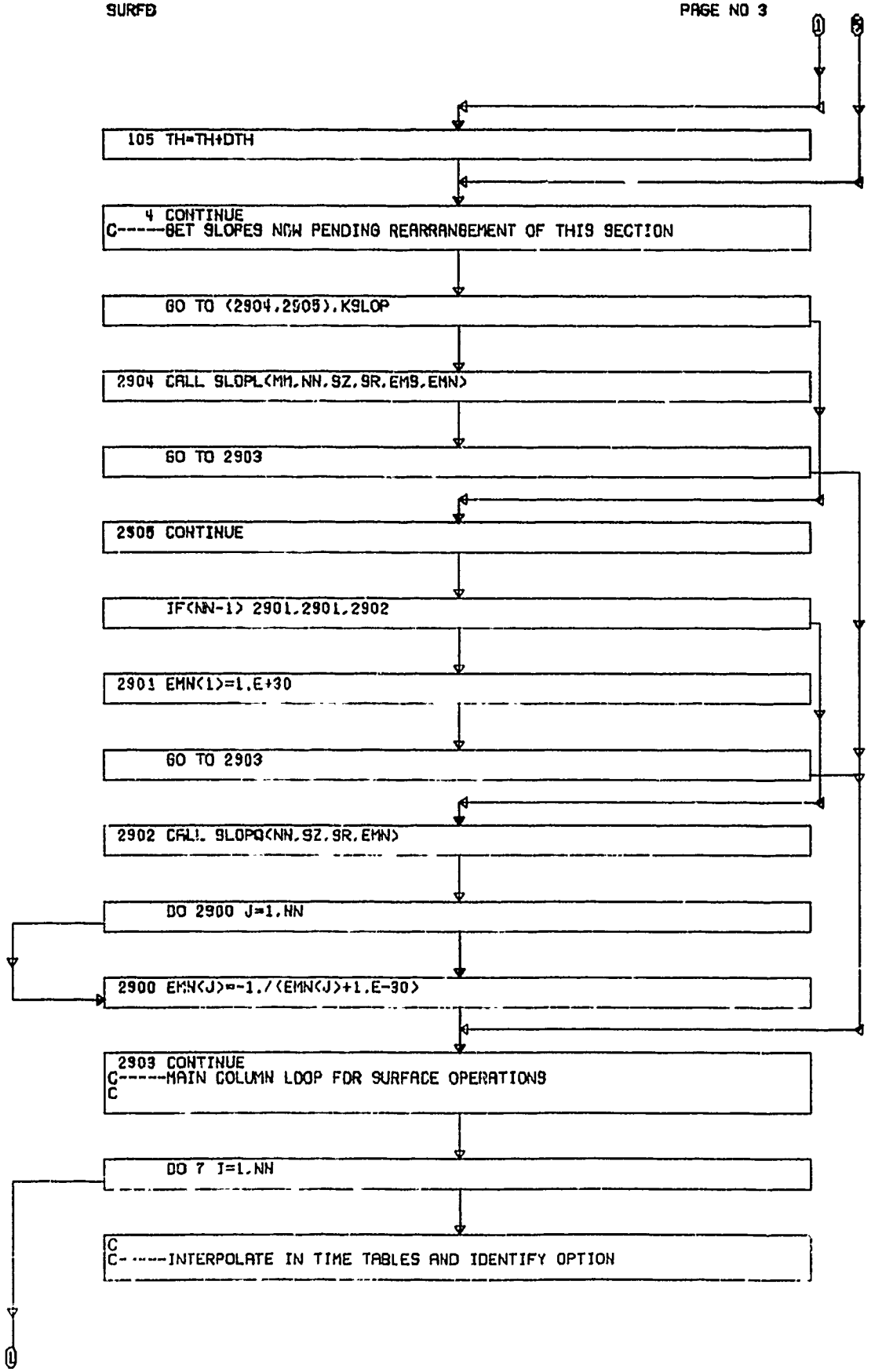

IF(EMS(I)) 311,312,311
312 EMN(I)=1.0E+15
GO TO 310
311 EMN(I)=-1./EMS(I)
310 CONTINUE
RETURN
500 FORMAT(2I5)
END

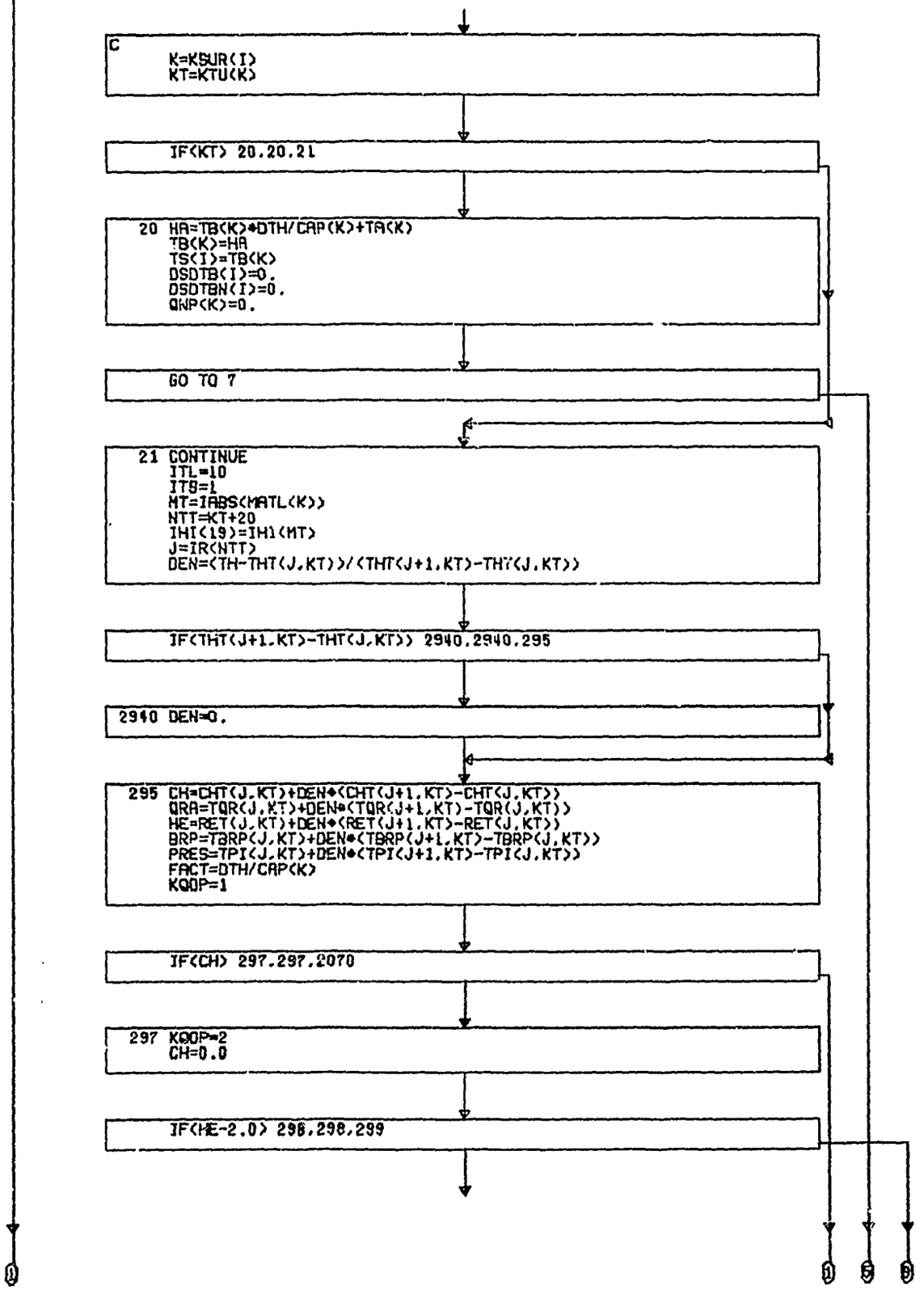

SUBROUTINE SLOPQ(NUMX,X,P,EM)
C
C
C S U B R O U T I N E S L O P Q
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
C SLOPE EVALUATION ROUTINE
30 EM(2) = (P(2) - P(1)) / (X(2) - X(1))
EM(1) = EM(2)
Z(1)=0.0
QC = EM(1)
DO 96 I = 1 , NUMX
IPO = I + 1
IPT = I + 2
IT = IPO - NUMX
IF (IT) 33 , 31 , 32
31 QB=QC
GO TO 41
32 GO TO 40
33 XOT = X(I) - X(IPO)
XTT = X(IPO) - X(IPT)
XTO = X(IPT) - X(I)
AA = P(I) / (XOT * XTO)
XOTT=XOT*XTT
37 AB=P(I+1)/XOTT
AC = P(IPT) / (XTT * XTO)
AAA = AA * XTT
ABB = AB * XTO
ACC = AC * XOT
QA = QC
QB = EM(I)
QC = EM (IPO)
EM(IPO) = AB * (XOT - XTT) + ACC - AAA
EM(IPT) = AC * (XTT - XTO) + AAA - ABB

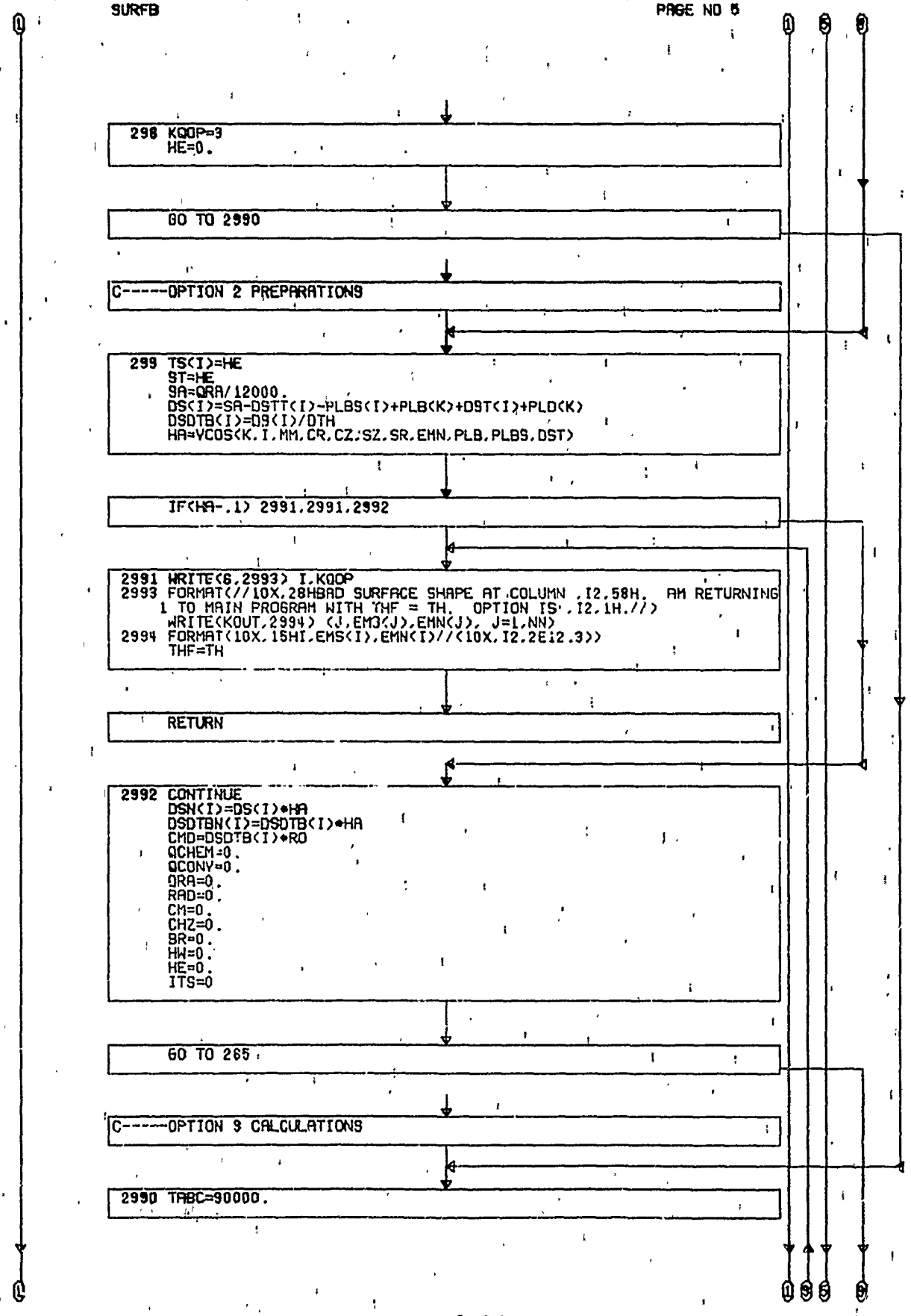

SLOPQ
PAGE NO 2
1
5
9
EM(I)= AA * (XTO - XOT) + ABB - ACC
34 QE = EM(I)
IF(I-2) 96,41,35
35 EM(I) = (QE + QA) /2.
41 EM(I) = (EM(I) + QB) /2.
40 XD=X(I)-X(I-1)
96 CONTINUE
RETURN
END

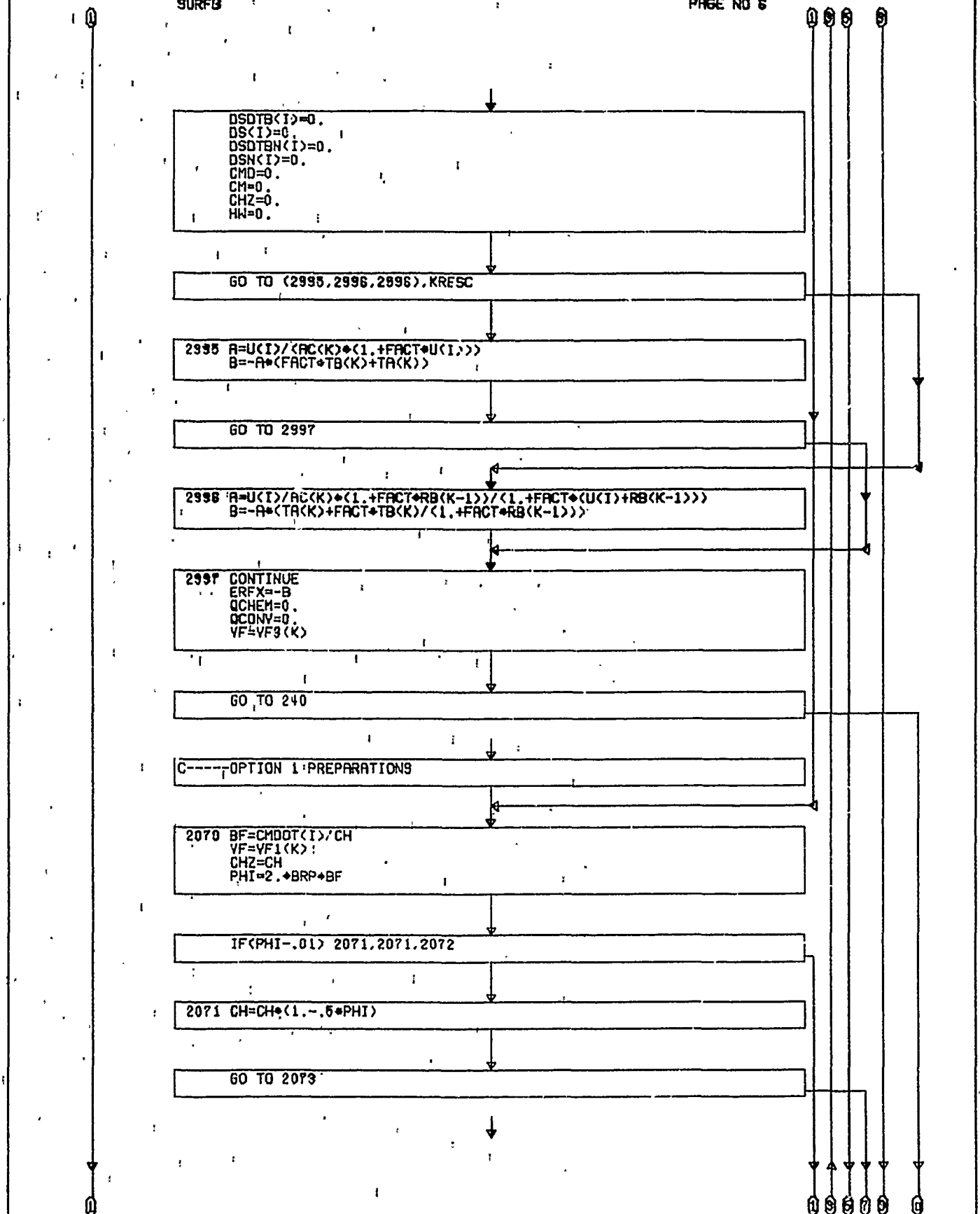

SUBROUTINE SURFB
C
C
C S U B R O U T I N E S U R F B
C
C SEE THE FULL LISTING OF THIS ROUTINE FOR--
C + DIMENSION STATEMENTS
C + COMMON STATEMENTS
C + INCLUDE STATEMENTS
C + EQUIVALENCE STATEMENTS
C + DATA STATEMENTS
C
C-----ADJUSTMENT OF TIME STEP ACCORDING TO LIMITATIONS OF TIME TABLES
DTHS=DTH
TH=TH+DTH
DO 290 J=1,NN
K=KSUR(J)
KT=KTU(K)
IF(KT) 290,290,296
296 NTT=KT+20
I=IR(NTT)
291 IF(THT(I+1,KT)-TH+0.00001) 294,290,290
294 IF(I+1-IHI(NTT)) 292,290,290
292 I=I+1
IF(THT(I+1,KT)-THT(I,KT)) 291,293,291
293 TH=TH-DTH
THDS=THT(I,KT)-.01
DTH=AMAX1(.01,THT(I,KT)-TH)
TH=TH+DTH

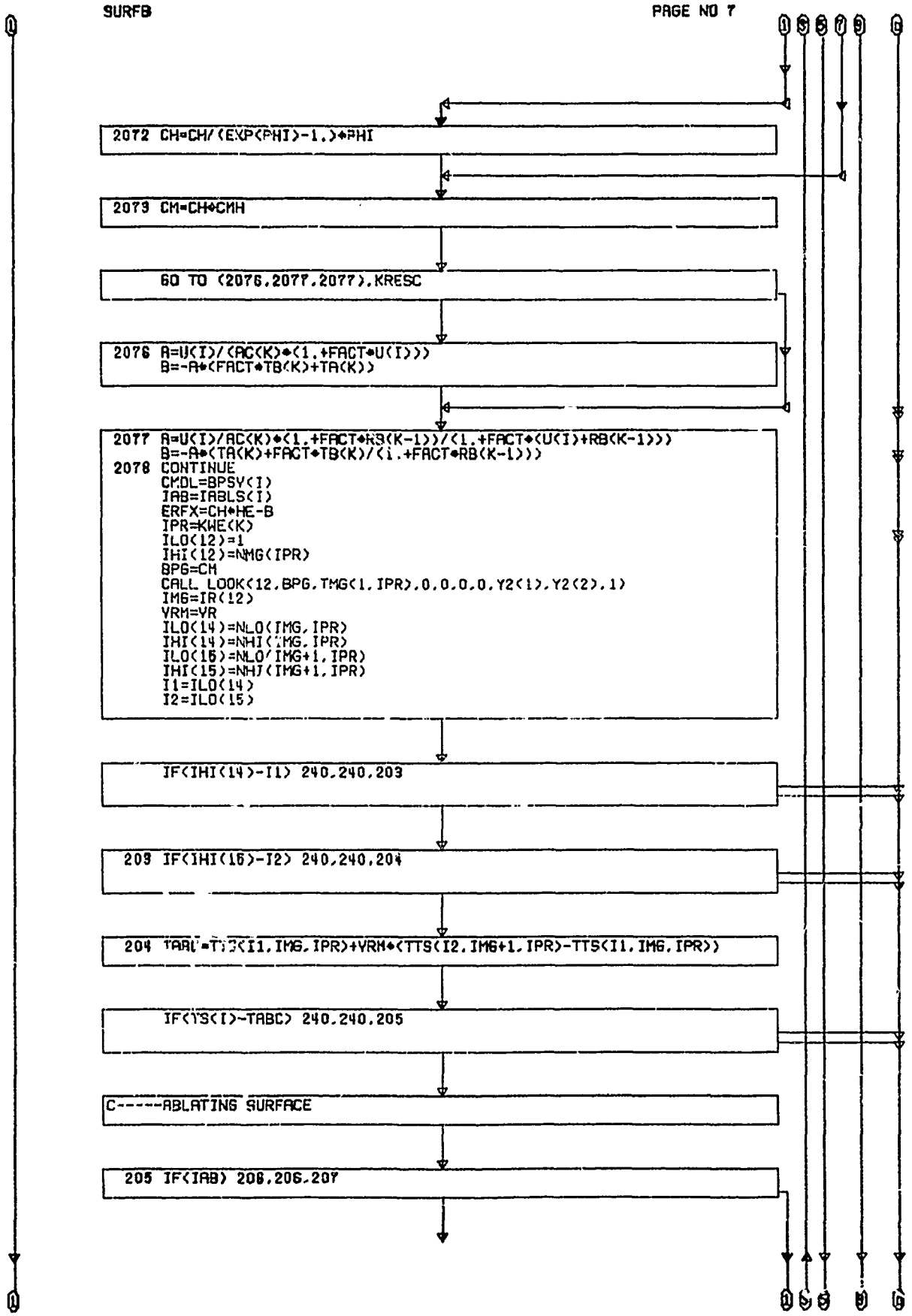

GO TO 291
290 IR(NTT)=I
C-----DEFINE ALLOWABLE TIME STEP
K=0
TH=TH-DTH
DO 2 I=1,NN
DSDT(I)=D9DTB(I)
K=KSUR(I)
DTH=AMIN1(DTH,PLBS(I)/(10.*DSDT(I)+.0000(1),(PLBS(I)/500.+PLB(K))/
1(DSDT(I)+.000001))
IF(DTH-1.0E-12) 106,106,107
106 WRITE (6,108)
108 FORMAT(10X,19HTOO SMALL TIME STEP//)
WRITE(6,109) I
109 FORMAT(10X,6HCOLUMN,I3//)
THF=TH
RETURN
107 CONTINUE
2 CONTINUE
HA=TH+DTH
IF(HA-PRT) 105,105,104
104 DTH=PRT-TH
TH=PRT
GO TO 4

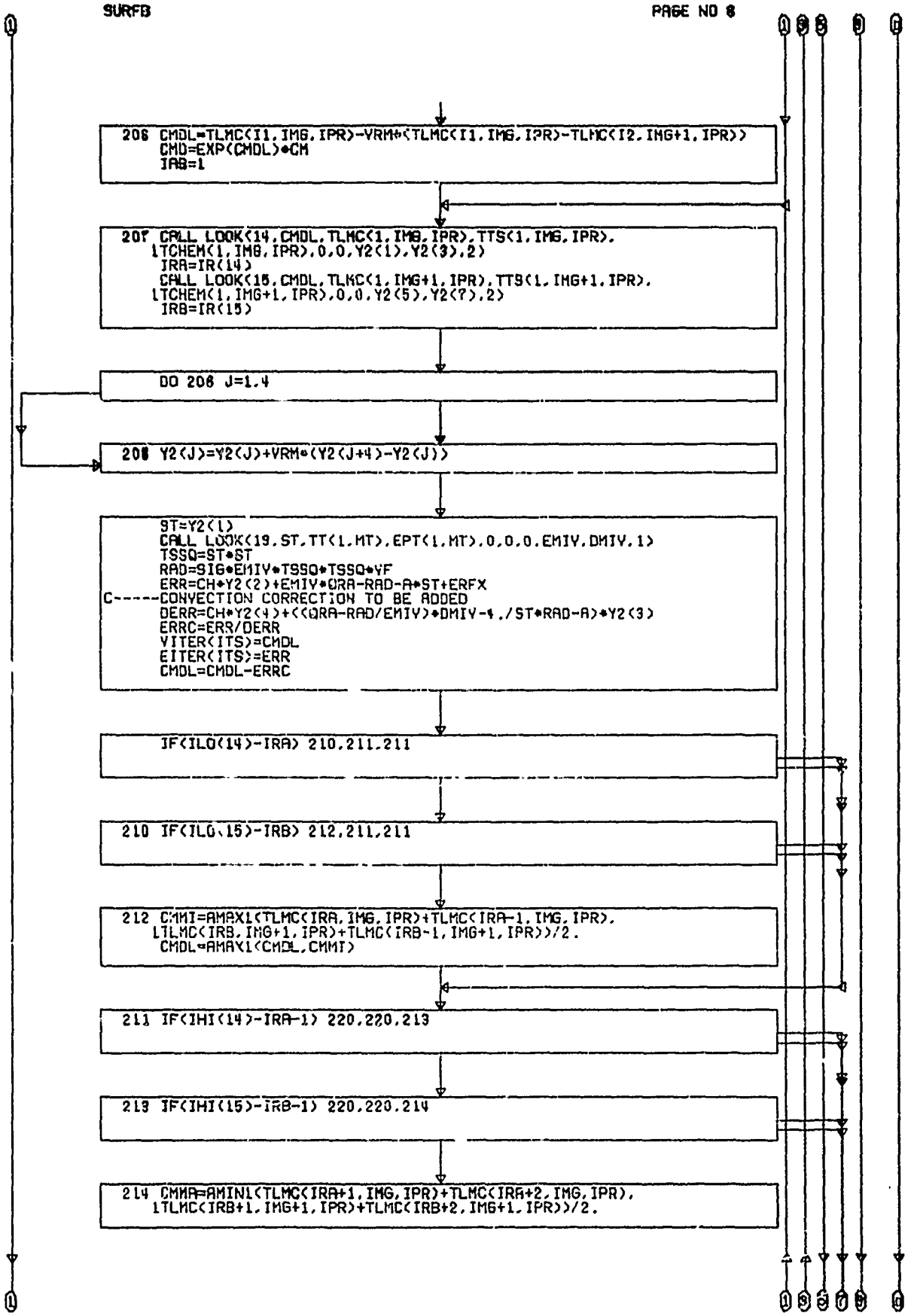

105 TH=TH+DTH
4 CONTINUE
C-----GET SLOPES NOW PENDING REARRANGEMENT OF THIS SECTION
GO TO (2904,2905),KSLOP
2904 CALL SLOPL(MM,NN,SZ,SR,EMS,EMN)
GO TO 2903
2905 CONTINUE
IF(NN-1) 2901,2901,2902
2901 EMN(1)=1.E+30
GO TO 2903
2902 CALL SLOPQ(NN,SZ,SR,EMN)
DO 2900 J=1,NN
2900 EMN(J)=-1./(EMN(J)+1.E-30)
2903 CONTINUE
C-----MAIN COLUMN LOOP FOR SURFACE OPERATIONS
C
DO 7 I=1,NN
C
C-----INTERPOLATE IN TIME TABLES AND IDENTIFY OPTION

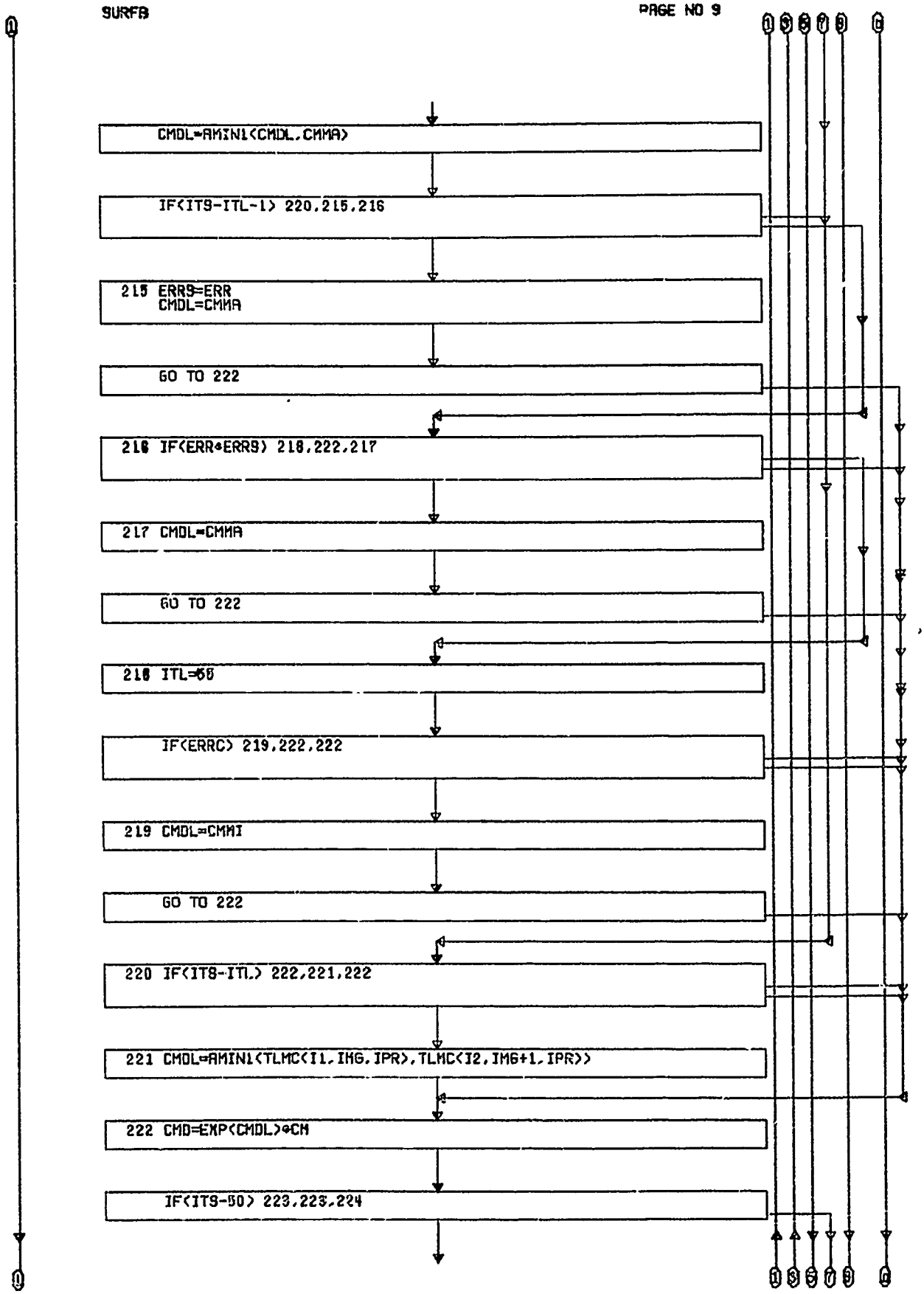

C
K=KSUR(I)
KT=KTU(K)
IF(KT) 20,20,21
20 HA=TB(K)+DTH/CAP(K)+TA(K)
TB(K)=HA
TS(I)=TB(K)
DSDTB(I)=0.
DSDTBN(I)=0.
QWP(K)=0.
GO TO 7
21 CONTINUE
ITL=10
ITG=1
MT=IABS(MATL(K))
NTT=KT+20
IHI(19)=IH1(MT)
J=IR(NTT)
DEN=(TH-THT(J,KT))/(THT(J+1,KT)-THT(J,KT))
IF(THT(J+1,KT)-THT(J,KT)) 2940,2940,295
2940 DEN=0.
295 CH=CHT(J,KT)+DEN*(CHT(J+1,KT)-CHT(J,KT))
QRA=TQR(J,KT)+DEN*(TQR(J+1,KT)-TQR(J,KT))
HE=RET(J,KT)+DEN*(RET(J+1,KT)-RET(J,KT))
BRP=TBRP(J,KT)+DEN*(TBRP(J+1,KT)-TBRP(J,KT))
PRES=TPI(J,KT)+DEN*(TPI(J+1,KT)-TPI(J,KT))
FACT=DTH/CAP(K)
KQQP=1
IF(CH) 297,297,2070
297 KQQP=2
CH=0.0
IF(HE-2.0) 298,298,299

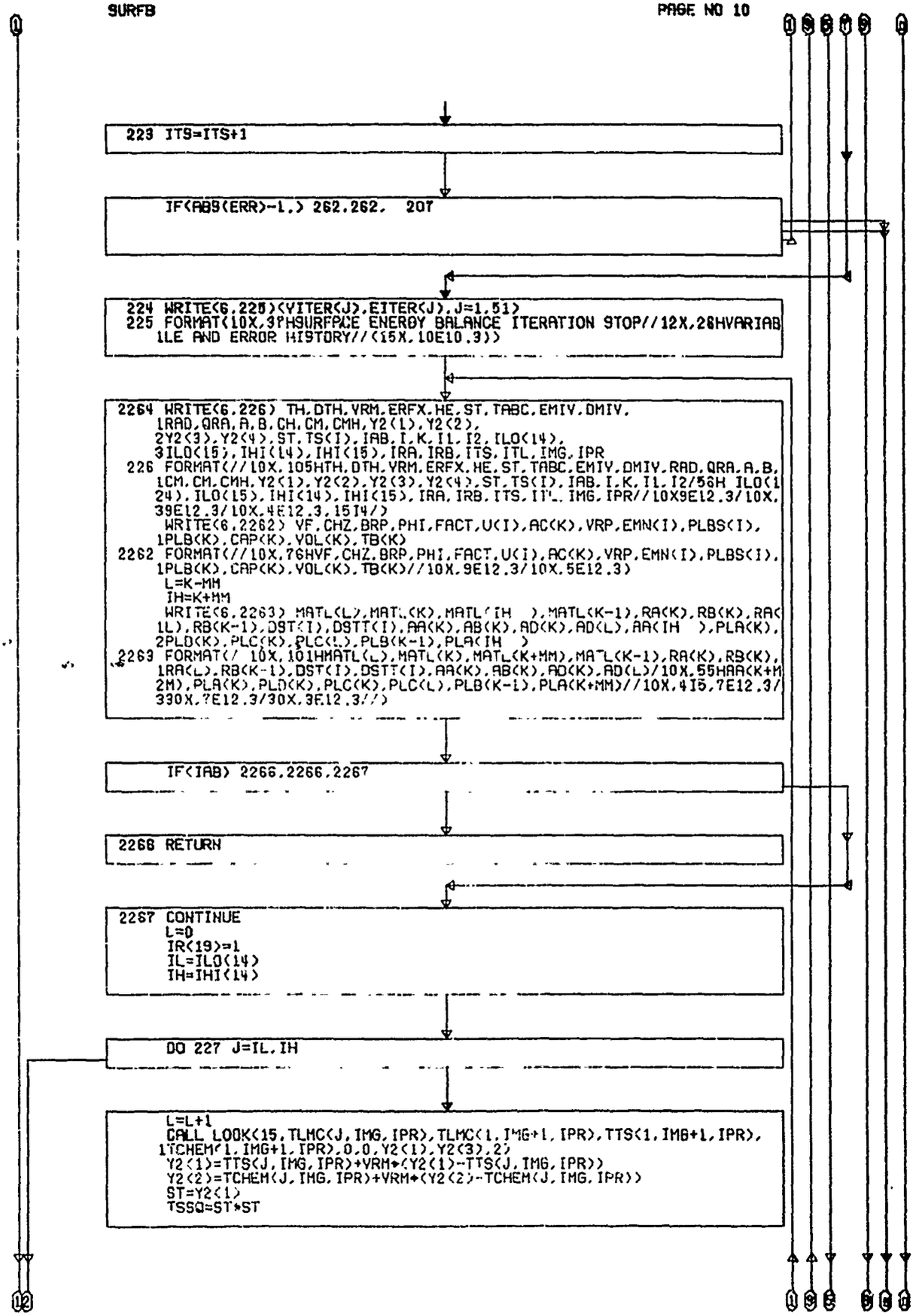

298 KQOP=3
HE=0.
GO TO 2990
C-----OPTION 2 PREPARATIONS
299 TS(I)=HE
ST=HE
SA=QRA/12000.
DS(I)=SA-DSTT(I)-PLBS(I)+PLB(K)+DST(I)+PLD(K)
DSDTB(I)=DS(I)/DTH
HA=VCOS(K,I,MM,CR,CZ,SZ,SR,EMN,PLB,PLBS,DST)
IF(HA-.1) 2991,2991,2992
2991 WRITE(6,2993) I,KQOP
2993 FORMAT(//10X,28HBAD SURFACE SHAPE AT COLUMN ,I2,58H. AM RETURNING
1 TO MAIN PROGRAM WITH THF = TH. OPTION IS ,I2,1H.//)
WRITE(KOUT,2994) (J,EMJ(J),EMN(J), J=1,NN)
2994 FORMAT(10X,15HI,EMS(I),EMN(I)//(10X,I2,2E12.3))
THF=TH
RETURN
2992 CONTINUE
DSN(I)=DS(I)*HA
DSDTBN(I)=DSDTB(I)*HA
CMD=DSDTB(I)*RO
QCHEM=0.
QCONV=0.
QRA=0.
RAD=0.
CM=0.
CHZ=0.
SR=0.
HW=0.
HE=0.
ITS=0
GO TO 265
C-----OPTION 9 CALCULATIONS
2990 TABC=90000.

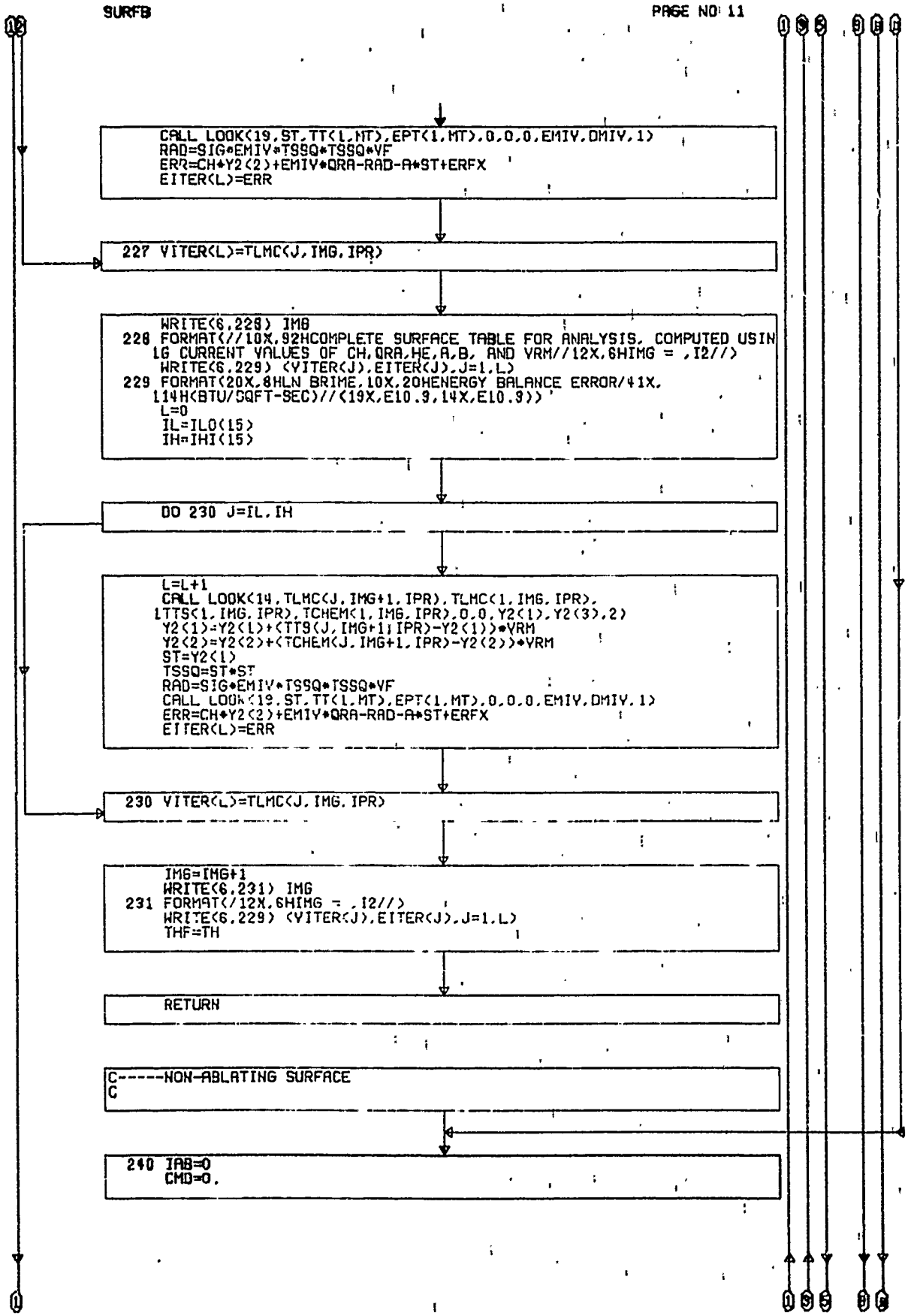

DSDTB(I)=0.
DS(I)=0.
DSDTBN(I)=0.
DSN(I)=0.
CMD=0.
CM=0.
CHZ=0.
HW=0.
GO TO (2995,2996,2996),KRESC
2995 A=U(I)/(AC(K)*(1.+FACT*U(I)))
B=-A*(FACT*TB(K)+TA(K))
GO TO 2997
2996 A=U(I)/AC(K)*(1.+FACT*RB(K-1))/(1.+FACT*(U(I)+RB(K-1)))
B=-A*(TA(K)+FACT*TB(K)/(1.+FACT*RB(K-1)))
2997 CONTINUE
ERFX=-B
QCHEM=0.
QCONV=0.
VF=VF3(K)
GO TO 240
C-----OPTION 1:PREPARATIONS
2070 BF=CMDOT(I)/CH
VF=VF1(K)
CHZ=CH
PHI=2.*BRP*BF
IF(PHI-.01) 2071,2071,2072
2071 CH=CH*(1.-.5*PHI)
GO TO 2073

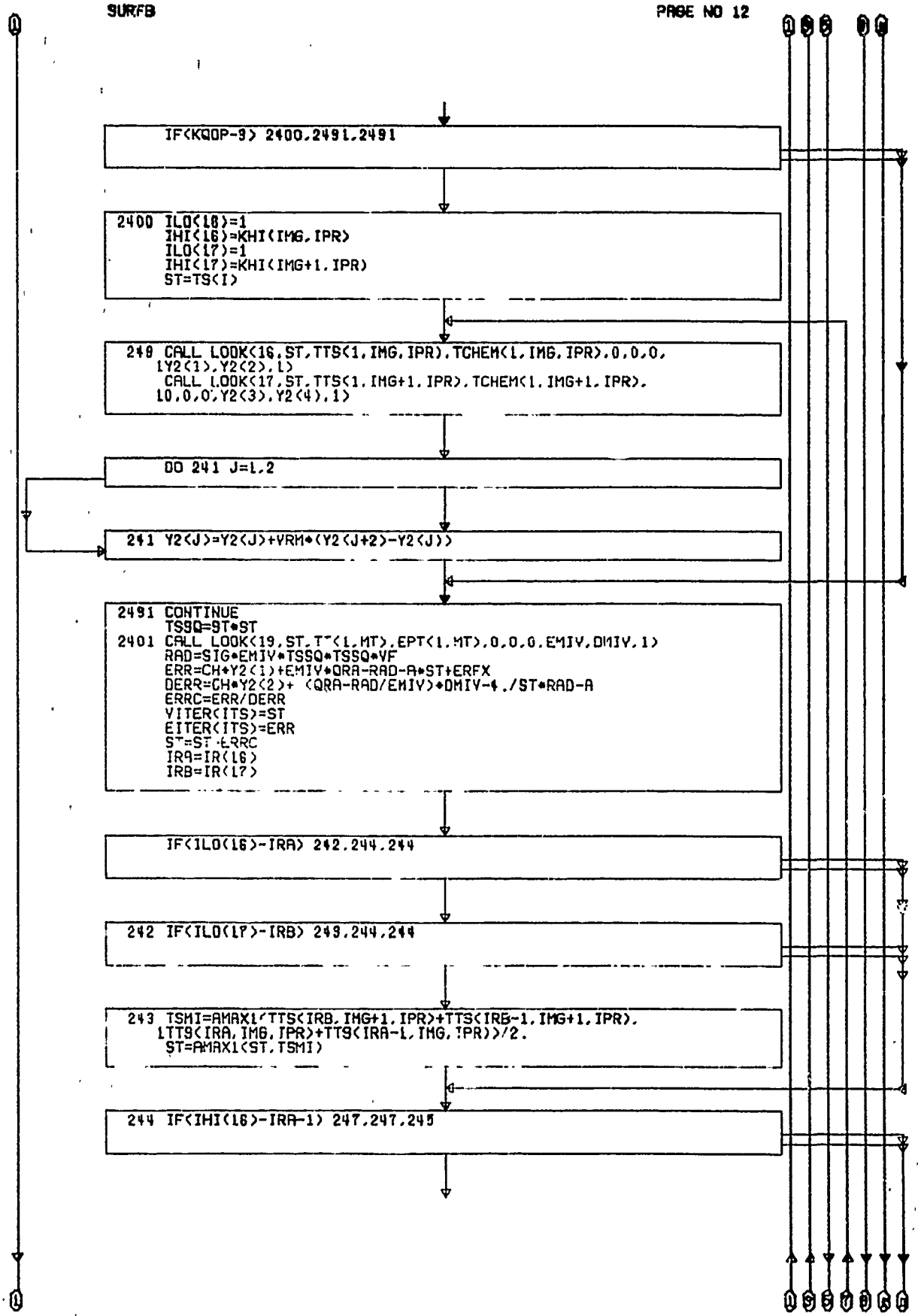

2072 CH=CH/(EXP(PHI)-1.)*PHI
2073 CM=CH*CMH
GO TO (2076,2077,2077),KRESC
2076 A=U(I)/(AC(K)*(1.+FACT*U(I)))
B=-A*(FACT*TB(K)+TA(K))
2077 A=U(I)/AC(K)*(1.+FACT*RB(K-1))/(1.+FACT*(U(I)+RB(K-1)))
B=-A*(TA(K)+FACT*TB(K)/(1.+FACT*RB(K-1)))
2078 CONTINUE
CMDL=BPSV(I)
IAB=IABLS(I)
ERFX=CH*HE-B
IPR=KWE(K)
ILO(12)=1
IHI(12)=NMG(IPR)
BPG=CM
CALL LOOK(12,BPG,TMG(1,IPR),0,0,0,0,Y2(1),Y2(2),1)
IMG=IR(12)
VRM=VR
ILO(14)=NLO(IMG,IPR)
IHI(14)=NHI(IMG,IPR)
ILO(15)=NLO(IMG+1,IPR)
IHI(15)=NHI(IMG+1,IPR)
I1=ILO(14)
I2=ILO(15)
IF(IHI(14)-I1) 240,240,203
203 IF(IHI(15)-I2) 240,240,204
204 TABC=TTS(I1,IMG,IPR)+VRM*(TTS(I2,IMG+1,IPR)-TTS(I1,IMG,IPR))
IF(TS(I)-TABC) 240,240,205
C-----ABLATING SURFACE
205 IF(IAB) 208,206,207

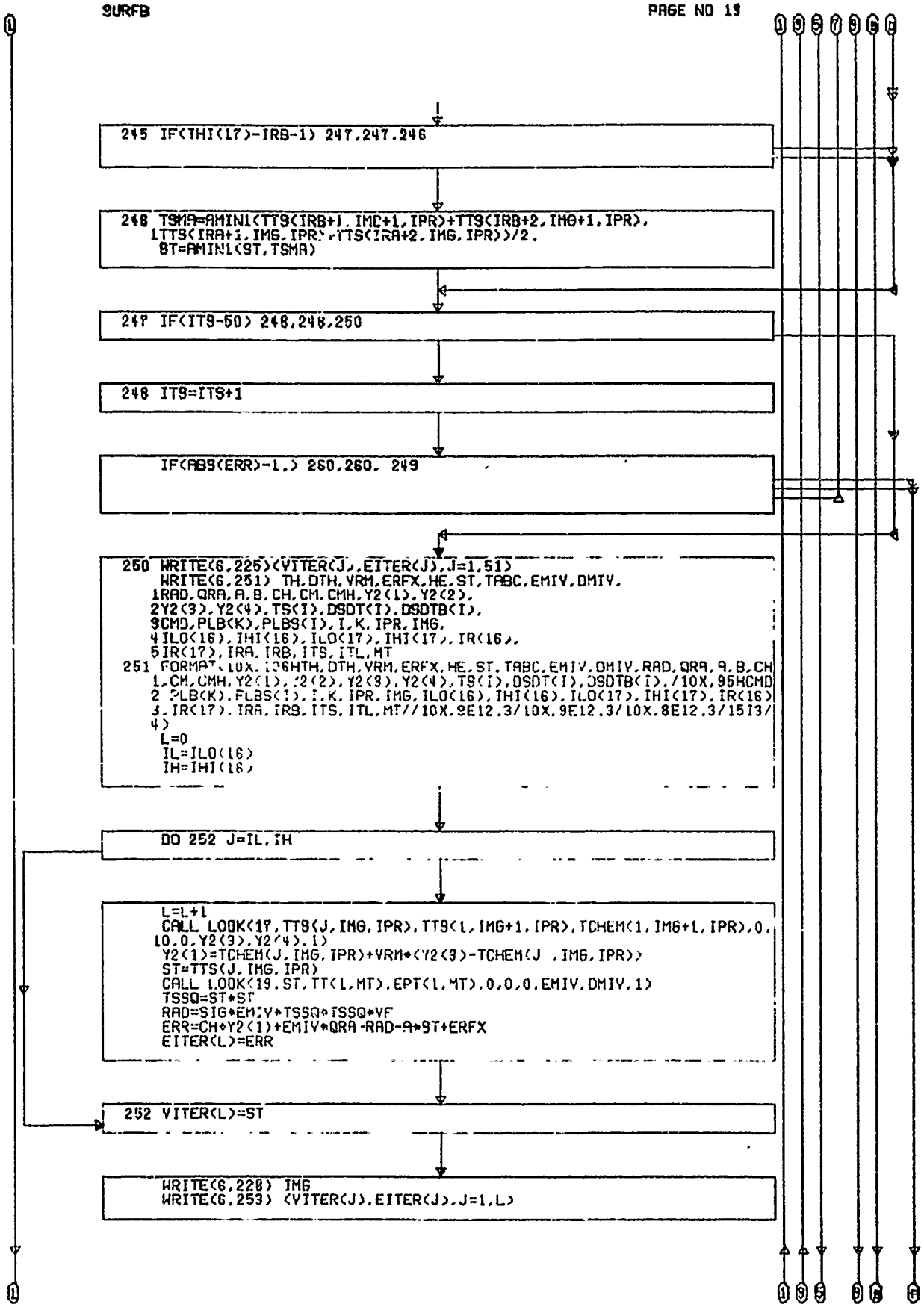

206 CMDL=TLMC(I1,IMG,IPR)-VRM*(TLMC(I1,IMG,IPR)-TLMC(I2,IMG+1,IPR))
CMD=EXP(CMDL)*CM
IRB=1
207 CALL LOOK(14,CMDL,TLMC(1,IMG,IPR),TTS(1,IMG,IPR),
1TCHEM(1,IMG,IPR),0,0,Y2(1),Y2(3),2)
IRA=IR(14)
CALL LOOK(15,CMDL,TLMC(1,IMG+1,IPR),TTS(1,IMG+1,IPR),
1TCHEM(1,IMG+1,IPR),0,0,Y2(5),Y2(7),2)
IRB=IR(15)
DO 208 J=1,4
208 Y2(J)=Y2(J)+VRM*(Y2(J+4)-Y2(J))
ST=Y2(1)
CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
TSSQ=ST*ST
RAD=SIG*EMIV*TSSQ*TSSQ*YF
ERR=CH*Y2(2)+EMIV*QRA-RAD-A*ST+ERFX
C-----CONVECTION CORRECTION TO BE ADDED
DERR=CH*Y2(4)+((QRA-RAD/EMIV)*DMIV-4./ST*RAD-A)*Y2(3)
ERRC=ERR/DERR
VITER(ITS)=CMDL
EITER(ITS)=ERR
CMDL=CMDL-ERRC
IF(ILG(14)-IRA) 210,211,211
210 IF(ILG(15)-IRB) 212,211,211
212 CMMI=AMAX1(TLMC(IRA,IMG,IPR)+TLMC(IRA-1,IMG,IPR),
1TLMC(IRB,IMG+1,IPR)+TLMC(IRB-1,IMG+1,IPR))/2.
CMDL=AMAX1(CMDL,CMMI)
211 IF(IHI(14)-IRA-1) 220,220,213
213 IF(IHI(15)-IRB-1) 220,220,214
214 CMMA=AMIN1(TLMC(IRA+1,IMG,IPR)+TLMC(IRA+2,IMG,IPR),
1TLMC(IRB+1,IMG+1,IPR)+TLMC(IRB+2,IMG+1,IPR))/2.

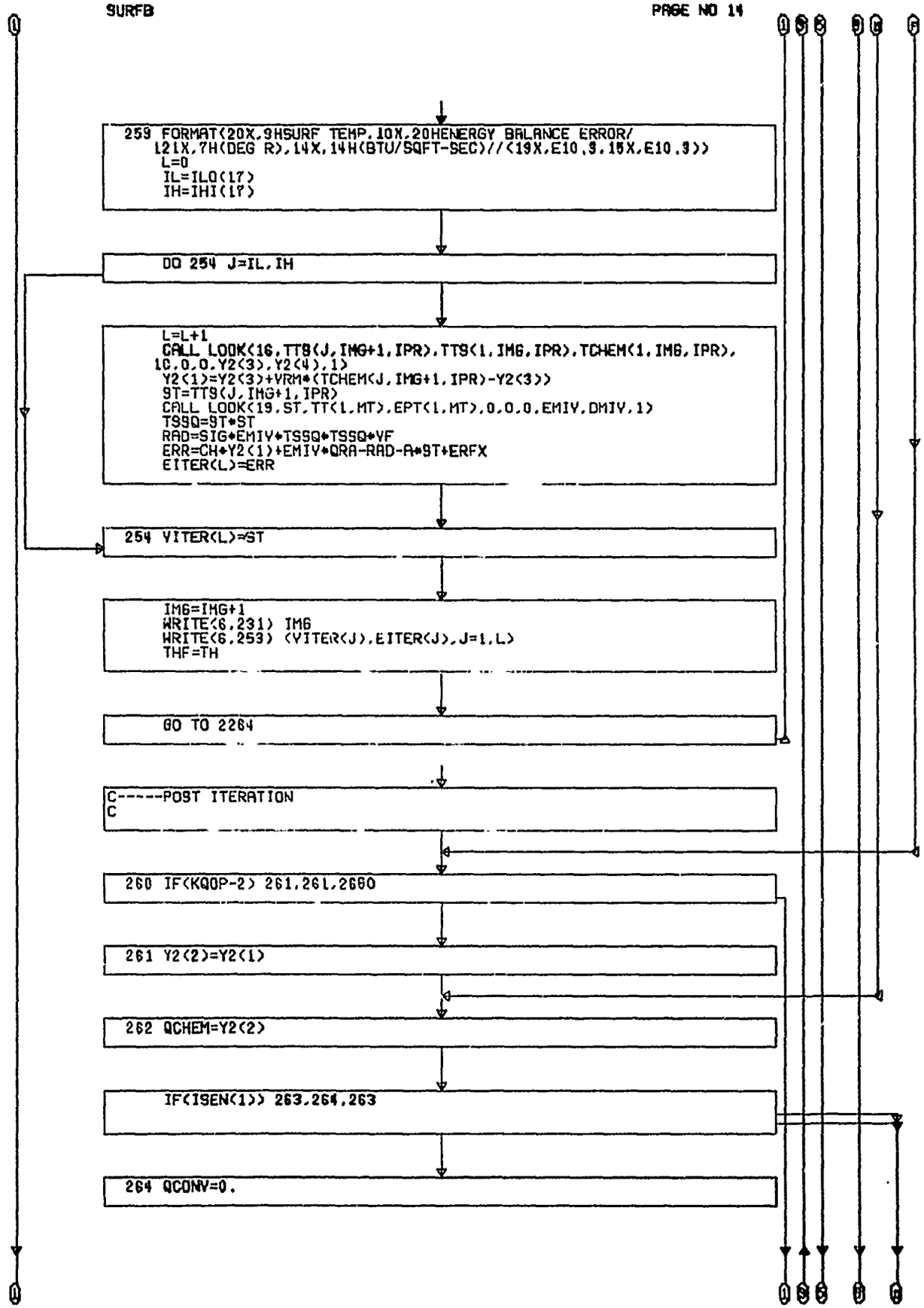

CMDL=AMIN1(CMDL,CMMA)
IF(ITS-ITL-1) 220,215,216
215 ERRS=ERR
CMDL=CMMA
GO TO 222
216 IF(ERR*ERRS) 218,222,217
217 CMDL=CMMA
GO TO 222
218 ITL=50
IF(ERRC) 219,222,222
219 CMDL=CMMI
GO TO 222
220 IF(ITS-ITL) 222,221,222
221 CMDL=AMIN1(TLMC(I1,IMG,IPR),TLMC(I2,IM6+1,IPR))
222 CMD=EXP(CMDL)*CM
IF(ITS-50) 223,223,224

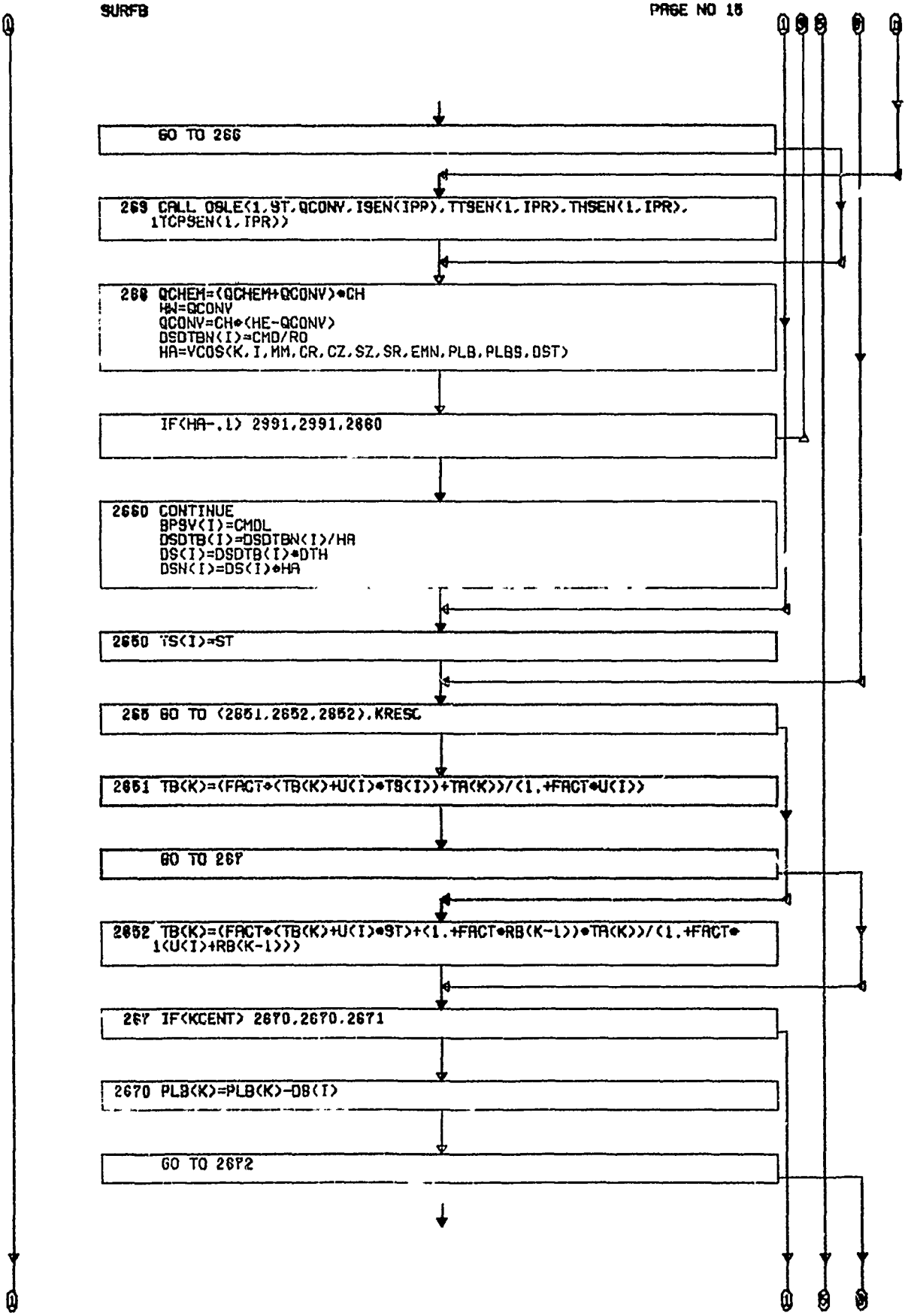

223 ITS=ITS+1
IF(ABS(ERR)-1.) 262.262. 207
224 WRITE(6,225)(YITER(J),EITER(J),J=1,51)
225 FORMAT(10X,39HSURFACE ENERGY BALANCE ITERATION STOP//12X,26HVARIABLE AND ERROR HISTORY//(15X,10E10.3))
2264 WRITE(6,226) TH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,OMIV,
1RAD,QRA,A,B,CH,CM,CMH,Y2(1),Y2(2),
2Y2(3),Y2(4),ST,TS(I),IAB,I,K,I1,I2,ILO(14),
3ILO(15),IHI(14),IHI(15),IRA,IRB,ITS,ITL,IMG,IPR
226 FORMAT(//10X,10HTH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,OMIV,RAD,QRA,A,B,
1CM,CM,CMH,Y2(1),Y2(2),Y2(3),Y2(4),ST,TS(I),IAB,I,K,I1,I2/5&H ILO(14),ILO(15),IHI(14),IHI(15),IRA,IRB,ITS,ITL,IMG,IPR//10X9E12.3/10X,39E12.3/10X,4E12.3,15I4/)
WRITE(6,2262) VF,CHZ,BRP,PHI,FACT,U(I),AC(K),VRP,EMN(I),PLBS(I),
1PLB(K),CAP(K),VOL(K),TB(K)
2262 FORMAT(//10X,7&HVF,CHZ,BRP,PHI,FACT,U(I),AC(K),VRP,EMN(I),PLBS(I),
1PLB(K),CAP(K),VOL(K),TB(K)//10X,9E12.3/10X,5E12.3)
L=K-MM
IH=K+MM
WRITE(6,2263) MATL(L),MATL(K),MATL(IH),MATL(K-1),RA(K),RB(K),RA(
1L),RB(K-1),DST(I),DSTT(I),AA(K),AB(K),AD(K),AD(L),AA(IH),PLA(K),
2PLD(K),PLC(K),PLC(L),PLB(K-1),PLA(IH)
2263 FORMAT(/ 10X,101HMATL(L),MATL(K),MATL(K+MM),MATL(K-1),RA(K),RB(K),
1RA(L),RB(K-1),DST(I),DSTT(I),AA(K),AB(K),AD(K),AD(L)/10X,55HAA(K+MM),PLA(K),PLD(K),PLC(K),PLC(L),PLB(K-1),PLA(K+MM)//10X,4I5,7E12.3/30X,7E12.3/30X,3E12.3//)
IF(IAB) 2266,2266,2267
2266 RETURN
2267 CONTINUE
L=0
IR(19)=1
IL=ILO(14)
IH=IHI(14)
DO 227 J=IL,IH
L=L+1
CALL LOOK(15,TLMC(J,IMG,IPR),TLMC(1,IMG+1,IPR),TTS(1,IMG+1,IPR),
1TCHEM(1,IMG+1,IPR),0,0,Y2(1),Y2(3),2)
Y2(1)=TTS(J,IMG,IPR)+VRM*(Y2(1)-TTS(J,IMG,IPR))
Y2(2)=TCHEM(J,IMG,IPR)+VRM*(Y2(2)-TCHEM(J,IMG,IPR))
ST=Y2(1)
TSSQ=ST*ST

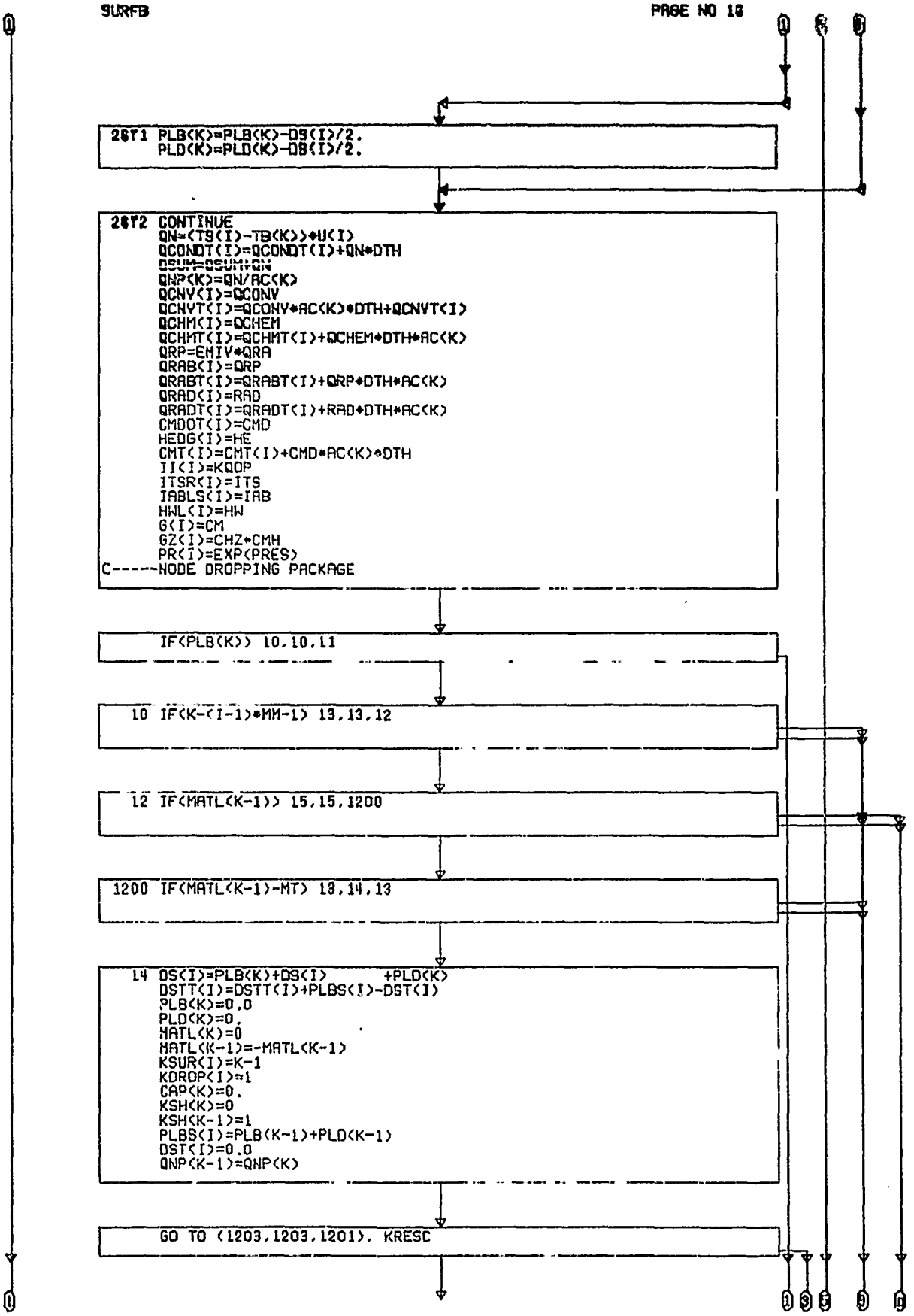

CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
RAD=SIG*EMIV*TSSQ*TSSQ*VF
ERR=CH*Y2(2)+EMIV*QRA-RAD-A*ST+ERFX
EITER(L)=ERR
227 VITER(L)=TLMC(J,IMG,IPR)
WRITE(6,228) IMB
228 FORMAT(//10X,92HCOMPLETE SURFACE TABLE FOR ANALYSIS, COMPUTED USIN
LG CURRENT VALUES OF CH,QRA,HE,A,B, AND VRM//12X,6HIMG = ,I2//)
WRITE(6,229) (VITER(J),EITER(J),J=1,L)
229 FORMAT(20X,8HLN BRIME,10X,20HENERGY BALANCE ERROR/41X,
L14H(BTU/SQFT-SEC)//(19X,E10.9,14X,E10.9))
L=0
IL=ILO(15)
IH=IHI(15)
DO 230 J=IL,IH
L=L+1
CALL LOOK(14,TLMC(J,IMG+1,IPR),TLMC(1,IMG,IPR),
LTTS(1,IMG,IPR),TCHEM(1,IMG,IPR),0,0,Y2(1),Y2(3),2)
Y2(1)=Y2(L)+(TTS(J,IMG+1,IPR)-Y2(1))*VRM
Y2(2)=Y2(2)+(TCHEM(J,IMG+1,IPR)-Y2(2))*VRM
ST=Y2(1)
TSSQ=ST*ST
RAD=SIG*EMIV*TSSQ*TSSQ*VF
CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
ERR=CH*Y2(2)+EMIV*QRA-RAD-A*ST+ERFX
EITER(L)=ERR
230 VITER(L)=TLMC(J,IMG,IPR)
IMG=IMG+1
WRITE(6,231) IMG
231 FORMAT(/12X,6HIMG = ,I2//)
WRITE(6,229) (VITER(J),EITER(J),J=1,L)
THF=TH
RETURN
C-----NON-ABLATING SURFACE
C
240 IAB=0
CMD=0.

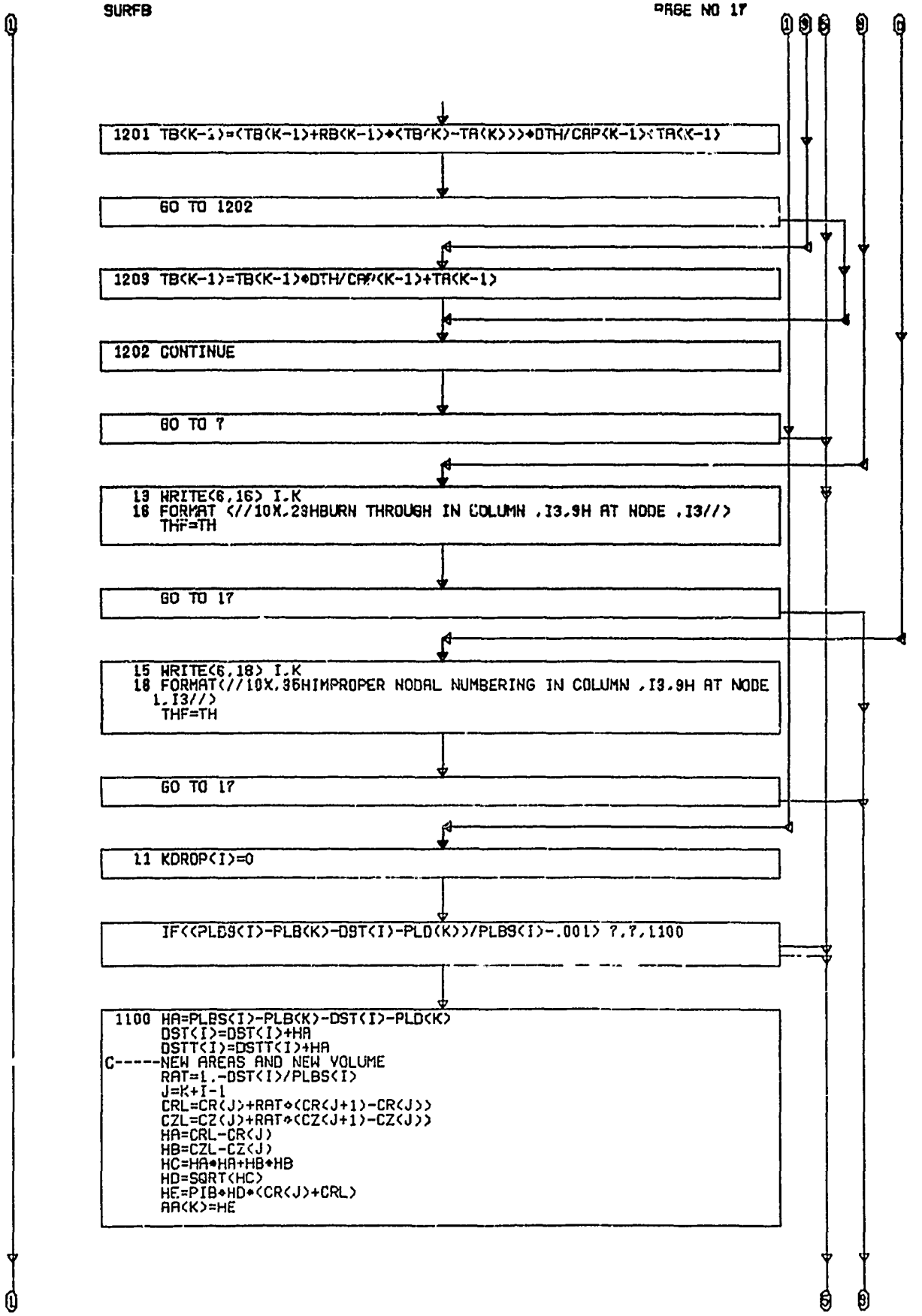

IF(KQOP-9) 2400,2491,2491
2400 ILO(16)=1
IHI(16)=KHI(IMG,IPR)
ILO(17)=1
IHI(17)=KHI(IMG+1,IPR)
ST=TS(I)
249 CALL LOOK(16,ST,TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),0,0,0,
1Y2(1),Y2(2),1)
CALL LOOK(17,ST,TTS(1,IMG+1,IPR),TCHEM(1,IMG+1,IPR),
10,0,0,Y2(3),Y2(4),1)
DO 241 J=1,2
241 Y2(J)=Y2(J)+VRM*(Y2(J+2)-Y2(J))
2491 CONTINUE
TSSQ=ST*ST
2401 CALL LOOK(19,ST,T(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
RAD=SIG*EMIV*TSSQ*TSSQ*VF
ERR=CH*Y2(1)+EMIV*QRA-RAD-A*ST+ERFX
DERR=CH*Y2(2)+ (QRA-RAD/EMIV)*DMIV-4./ST*RAD-A
ERRC=ERR/DERR
VITER(ITS)=ST
EITER(ITS)=ERR
ST=ST-ERRC
IRA=IR(16)
IRB=IR(17)
IF(ILO(16)-IRA) 242,244,244
242 IF(ILO(17)-IRB) 243,244,244
243 TSMI=AMAX1(TTS(IRB,IMG+1,IPR)+TTS(IRB-1,IMG+1,IPR),
1TTS(IRA,IMG,IPR)+TTS(IRA-1,IMG,IPR))/2.
ST=AMAX1(ST,TSMI)
244 IF(IHI(16)-IRA-1) 247,247,245

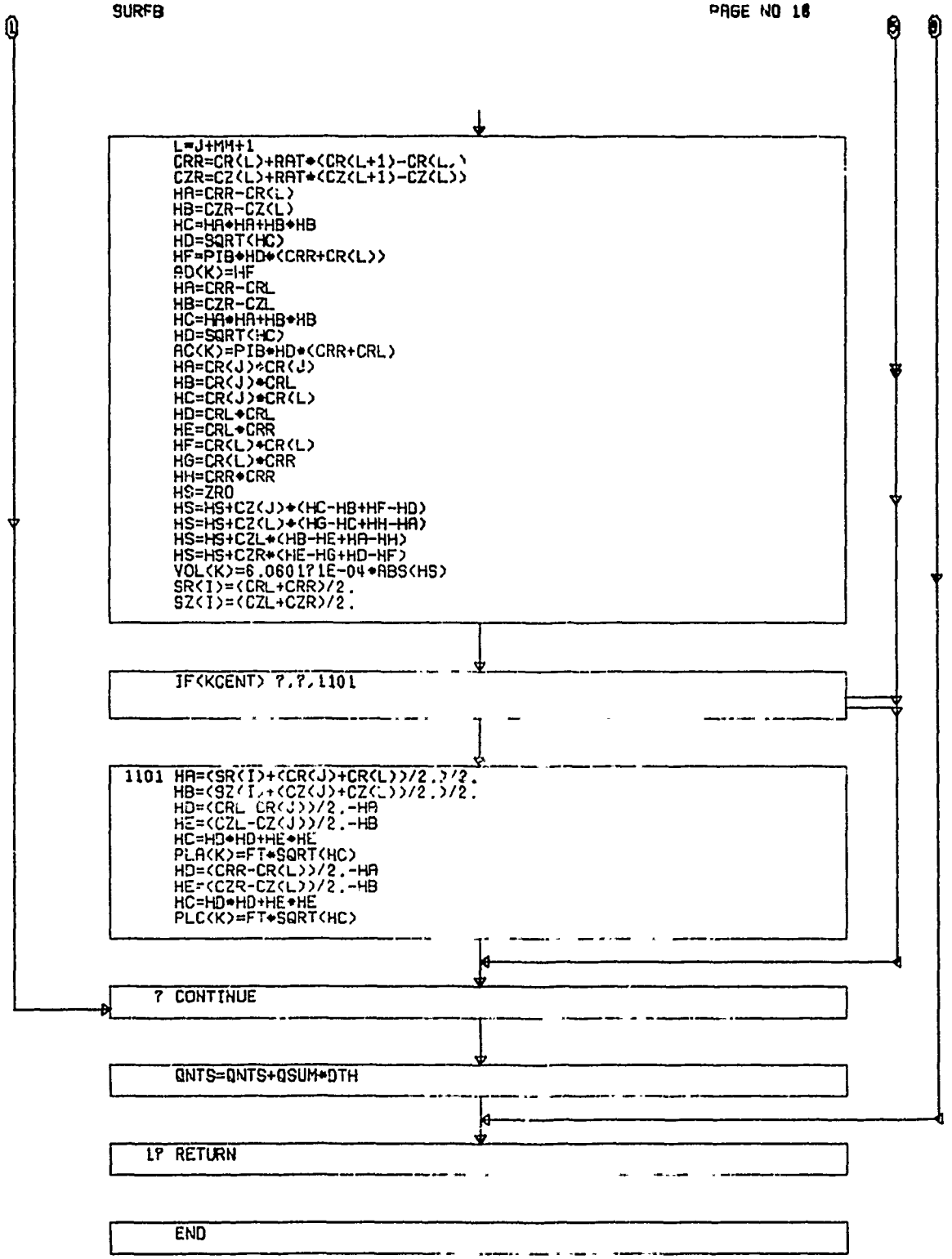

245 IF(THI(17)-IRB-1) 247,247,246
248 TSMA=AMIN1(TTS(IRB+1,IMG+1,IPR)+TTS(IRB+2,IMG+1,IPR),
1TTS(IRA+1,IMG,IPR)+TTS(IRA+2,IMG,IPR))/2.
ST=AMIN1(ST,TSMA)
247 IF(ITS-50) 248,248,250
248 ITS=ITS+1
IF(ABS(ERR)-1.) 260,260, 249
260 WRITE(6,225)(VITER(J),EITER(J),J=1,51)
WRITE(6,251) TH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,DMIV,
1RAD,QRA,A,B,CH,CM,CMH,Y2(1),Y2(2),
2Y2(3),Y2(4),TS(I),DSDT(I),DSDTB(I),
3CMD,PLB(K),PLBS(I),I,K,IPR,IMG,
4ILO(16),IHI(16),ILO(17),IHI(17),IR(16),
5IR(17),IRA,IRB,ITS,ITL,MT
251 FORMAT(10X,13HTH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,DMIV,RAD,QRA,A,B,CH
1,CM,CMH,Y2(1),Y2(2),Y2(3),Y2(4),TS(I),DSDT(I),DSDTB(I)/10X,9HCMD
2 PLB(K),PLBS(I),I,K,IPR,IMG,ILO(16),IHI(16),ILO(17),IHI(17),IR(16)
3,IR(17),IRA,IRB,ITS,ITL,MT//10X,9E12.3/10X,9E12.3/10X,8E12.3/15I3/1
4)
L=0
IL=ILO(16)
IH=IHI(16)
DO 252 J=IL,IH
L=L+1
CALL LOOK(17,TTS(J,IMG,IPR),TTS(L,IMG+1,IPR),TCHEM(1,IMG+L,IPR),0,
10,0,Y2(3),Y2(4),1)
Y2(1)=TCHEM(J,IMG,IPR)+VRM*(Y2(3)-TCHEM(J,IMG,IPR))
ST=TTS(J,IMG,IPR)
CALL LOOK(19,ST,TT(L,MT),EPT(L,MT),0,0,0,EMIV,DMIV,1)
TSSQ=ST*ST
RAD=SIG*EMIV*TSSQ*TSSQ*VF
ERR=CH*Y2(1)+EMIV*QRA-RAD-A*ST+ERFX
EITER(L)=ERR
252 VITER(L)=ST
WRITE(6,228) IMG
WRITE(6,253) (VITER(J),EITER(J),J=1,L)


259 FORMAT(20X,9HSURF TEMP,10X,20HENERGY BALANCE ERROR/
121X,7H(DEG R),14X,14H(BTU/SQFT-SEC)//(19X,E10.3,15X,E10.3))
L=0
IL=ILO(17)
IH=IHI(17)
DO 254 J=IL,IH
L=L+1
CALL LOOK(16,TTS(J,IMG+1,IPR),TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),
1C,0,0,Y2(3),Y2(4),1)
Y2(1)=Y2(3)+VRM*(TCHEM(J,IMG+1,IPR)-Y2(3))
ST=TTS(J,IMG+1,IPR)
CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
TSSQ=ST*ST
RAD=SIG*EMIV*TSSQ*TSSQ*VF
ERR=CH*Y2(1)+EMIV*QRA-RAD-A*ST+ERFX
EITER(L)=ERR
254 VITER(L)=ST
IMG=IMG+1
WRITE(6,231) IMG
WRITE(6,253) (VITER(J),EITER(J),J=1,L)
THF=TH
GO TO 2264
C-----POST ITERATION
C
260 IF(KQOP-2) 261,261,2660
261 Y2(2)=Y2(1)
262 QCHEM=Y2(2)
IF(ISEN(1)) 263,264,263
264 QCONV=0.


GO TO 266
269 CALL OSLE(1,ST,QCONV,ISEN(IPR),TTSEN(1,IPR),THSEN(1,IPR),
1TCPSEN(1,IPR))
268 QCHEM=(QCHEM+QCONV)*CH
HW=QCONV
QCONV=CH*(HE-QCONV)
DSDTBN(I)=CMD/RO
HA=VCOS(K,I,MM,CR,CZ,SZ,SR,EMN,PLB,PLBS,DST)
IF(HA-.1) 2991,2991,2660
2660 CONTINUE
BPSV(I)=CMDL
DSDTB(I)=DSDTBN(I)/HA
DS(I)=DSDTB(I)*DTH
DSN(I)=DS(I)*HA
2650 TS(I)=ST
265 GO TO (2651,2652,2652),KRESC
2651 TB(K)=(FACT*(TB(K)+U(I)*TB(I))+TA(K))/(1.+FACT*U(I))
GO TO 267
2652 TB(K)=(FACT*(TB(K)+U(I)*ST)+(1.+FACT*RB(K-1))*TA(K))/(1.+FACT*
1(U(I)+RB(K-1)))
267 IF(KCENT) 2670,2670,2671
2670 PLB(K)=PLB(K)-DB(I)
GO TO 2672


2671 PLB(K)=PLB(K)-DS(I)/2.
PLD(K)=PLD(K)-DS(I)/2.
2672 CONTINUE
QN=(TS(I)-TB(K))*U(I)
QCONDT(I)=QCONDT(I)+QN*DTH
QSUM=QSUM+QN
QNP(K)=QN/AC(K)
QCNV(I)=QCONV
QCNVT(I)=QCONV*AC(K)*DTH+QCNVT(I)
QCHM(I)=QCHEM
QCHMT(I)=QCHMT(I)+QCHEM*DTH*AC(K)
QRP=EMIV*QRA
QRAB(I)=QRP
QRABT(I)=QRABT(I)+QRP*DTH*AC(K)
QRAD(I)=RAD
QRADT(I)=QRADT(I)+RAD*DTH*AC(K)
CMDOT(I)=CMD
HEDG(I)=HE
CMT(I)=CMT(I)+CMD*AC(K)*DTH
II(I)=KOOP
ITSR(I)=ITS
IABLS(I)=IAB
HWL(I)=HW
G(I)=CM
GZ(I)=CHZ+CMH
PR(I)=EXP(PRES)
C-----NODE DROPPING PACKAGE
IF(PLB(K)) 10,10,11
10 IF(K-(I-1)*MM-1) 13,13,12
12 IF(MATL(K-1)) 15,15,1200
1200 IF(MATL(K-1)-MT) 13,14,13
14 DS(I)=PLB(K)+DS(I) +PLD(K)
DSTT(I)=DSTT(I)+PLBS(I)-DST(I)
PLB(K)=0.0
PLD(K)=0.
MATL(K)=0
MATL(K-1)=-MATL(K-1)
KSUR(I)=K-1
KDROP(I)=1
CAP(K)=0.
KSH(K)=0
KSH(K-1)=1
PLBS(I)=PLB(K-1)+PLD(K-1)
DST(I)=0.0
QNP(K-1)=QNP(K)
GO TO (1203,1203,1201), KRESC


1201 TB(K-1)=(TB(K-1)+RB(K-1)*(TB(K)-TA(K)))*DTH/CAP(K-1)+TA(K-1)
GO TO 1202
1209 TB(K-1)=TB(K-1)*DTH/CAP(K-1)+TA(K-1)
1202 CONTINUE
GO TO 7
13 WRITE(6,16) I,K
16 FORMAT (//10X,29HBURN THROUGH IN COLUMN ,I3,9H AT NODE ,I3//)
THF=TH
GO TO 17
15 WRITE(6,18) I,K
18 FORMAT(//10X,36HIMPROPER NODAL NUMBERING IN COLUMN ,I3,9H AT NODE
1,I3//)
THF=TH
GO TO 17
11 KDROP(I)=0
IF((PLBS(I)-PLB(K)-DST(I)-PLD(K))/PLBS(I)-.001) 7,7,1100
1100 HA=PLBS(I)-PLB(K)-DST(I)-PLD(K)
DST(I)=DST(I)+HA
DSTT(I)=DSTT(I)+HA
C-----NEW AREAS AND NEW VOLUME
RAT=1.-DST(I)/PLBS(I)
J=K+I-1
CRL=CR(J)+RAT*(CR(J+1)-CR(J))
CZL=CZ(J)+RAT*(CZ(J+1)-CZ(J))
HA=CRL-CR(J)
HB=CZL-CZ(J)
HC=HA*HA+HB*HB
HD=SQRT(HC)
HE=PIB*HD*(CR(J)+CRL)
AA(K)=HE


L=J+MM+1
CRR=CR(L)+RAT*(CR(L+1)-CR(L))
CZR=CZ(L)+RAT*(CZ(L+1)-CZ(L))
HA=CRR-CR(L)
HB=CZR-CZ(L)
HC=HA*HA+HB*HB
HD=SQRT(HC)
HF=PIB*HD*(CRR+CR(L))
AO(K)=HF
HA=CRR-CRL
HB=CZR-CZL
HC=HA*HA+HB*HB
HD=SQRT(HC)
AC(K)=PIB*HD*(CRR+CRL)
HA=CR(J)*CR(J)
HB=CR(J)*CRL
HC=CR(J)*CR(L)
HD=CRL*CRL
HE=CRL*CRR
HF=CR(L)*CR(L)
HG=CR(L)*CRR
HH=CRR*CRR
HS=ZRO
HS=HS+CZ(J)*(HC-HB+HF-HD)
HS=HS+CZ(L)*(HG-HC+HH-HA)
HS=HS+CZL*(HB-HE+HA-HH)
HS=HS+CZR*(HE-HG+HD-HF)
VOL(K)=6.06017?1E-04*ABS(HS)
SR(I)=(CRL+CRR)/2.
SZ(I)=(CZL+CZR)/2.
IF(KCENT) 7,7,1101
1101 HA=(SR(I)+(CR(J)+CR(L))/2.)/2.
HB=(SZ(I)+(CZ(J)+CZ(L))/2.)/2.
HD=(CRL-CR(J))/2.-HA
HE=(CZL-CZ(J))/2.-HB
HC=HD*HD+HE*HE
PLA(K)=FT*SQRT(HC)
HD=(CRR-CR(L))/2.-HA
HE=(CZR-CZ(L))/2.-HB
HC=HD*HD+HE*HE
PLC(K)=FT*SQRT(HC)
7 CONTINUE
QNTS=QNTS+QSUM*DTH
1? RETURN
END

```
      FUNCTION VCOS(K,I,MM,CR,CZ,SZ,SR,EMN,PLB,PLBS,DST)
C
C*****************************************************************
C*                                                               *
C*          S U B R O U T I N E   V C O S                        *
C*                                                               *
C*****************************************************************
C*                                                               *
C*          SEE THE FULL LISTING OF THIS ROUTINE FOR--           *
C*                    +  DIMENSION STATEMENTS                    *
C*                       +  COMMON STATEMENTS                    *
C*                          +  INCLUDE STATEMENTS                *
C*                             +  EQUIVALENCE STATEMENTS         *
C*                                +  DATA STATEMENTS             *
C*                                                               *
C*****************************************************************
C
C-----SPECIAL ANDERSON/SCHAEFER/ARC RESTRICTED VERSION
      DIMENSION CR(1),CZ(1),SZ(1),SR(1),EMN(1),PLB(1)
      DIMENSION PLBS(1),DST(1)
      KOUT=6
      J=K+I-1
      L=J+MM+1
      R1=(CR(J)+CR(L))/2.
      Z1=(CZ(J)+CZ(L))/2.
      DZ=SZ(I)-Z1+1.E-15
      DIST=PLBS(I)-DST(I)
      EMNA=ABS(EMN(I))
      VCOS=DZ/(DIST  *SQRT(1.+EMNA**2))*(EMN(I)/EMNA+(SR(I)-R1)/DZ*EMNA)
     1/12.0
      VCOS=ABS(VCOS)
      RETURN

      END
```

SECTION 4

LISTINGS OF FORTRAN IV SOURCE DECKS

Listings of Fortran IV source code decks are presented in this section. The main program, ARCAST, is listed first. Following ARCAST are the twelve subroutines present in ASTHMA listed in alphabetical order.

```
C     * * * * * ARCAST/RPL * * * * *                                          ARCA0001
C                                                                             ARCA0002
      INCLUDE DIMS.LIST                                                       ARCA0003
C                                                                             ARCA0004
C-----DIMENSIONED AS SURFACE NODES (NUMBER OF COLUMNS)                        ARCA0005
      COMMON ASUR(40),TS(40),QSDT(40),QSDTB(40),QS(40),QST(40),U(40)          ARCA0006
      COMMON PLAS(40),QSTT(40),QCONDT(40),QCNV(40),QCNVT(40),QCHM(40),        ARCA0007
     1QCHMT(40),QRAB(40),QRABT(40),QRAD(40),QRADT(40),QSDTBN(40),QSN(40)ARCA0008
      COMMON CMDOT(40),HEDG(40),CHT(40),HWL(40),G(40),QZ(40),PR(40)           ARCA0009
      COMMON II(40),SZ(40),SR(40),EMN(40),ITSR(40)                            ARCA0010
      COMMON IABLS(40),KUKUP(40)                                              ARCA0011
C-----DIMENSIONED AS PROPERTY TABLES, ENTRIES X MATERIALS                     ARCA0012
      COMMON TT(15,6),RT(15,6),CPT(15,6),CNT(15,6),CNT2(15,6),                ARCA0013
     1EPT(15,6),TTMX(6)                                                       ARCA0014
      DIMENSION TMZ(15,6)                                                     ARCA0015
C-----DIMENSIONED AS TIME    LCS, ENTRIES X TABLE NO                          ARCA0016
      COMMON THT(35,10),CHT(35,10),RET(35,10),TQR(35,10),TPI(35,10),          ARCA0017
     1THRP(35,10)                                                             ARCA0018
      DIMENSION NBW(10)                                                       ARCA0019
      DATA NBW/10*2/                                                          ARCA0020
      DIMENSION IUPT(35)                                                      ARCA0021
C-----MISCELLANEOUS QUANTITIES                                                ARCA0022
      COMMON RECORD(30),TMPR(5),MPR(5),NNPR(5)                                ARCA0023
      COMMON VITER(51),EITER(51),IAB,RO                                       ARCA0024
      COMMON VKIN,CMH,CM,CH                                                   ARCA0025
      COMMON TH,QTH,PRT,THI,THF,DLTH,ETA,ITS,DTHS                             ARCA0026
      COMMON FV,FT,PIB,ZRO,KUOP,MM,NN,NMT,NHT,QNTS,QSUM,SIG                   ARCA0027
      COMMON KRESL,KSLOP,KCENT                                                ARCA0028
C-----SURFACE THERMOCHEMISTRY DIMENSIONED (25,8,5)                            ARCA0029
      COMMON/ENDOT/TPR(5),NMG(5),TMG(8,5),NLO(8,5),NMI(8,5),                  ARCA0030
     1AMI(8,5),TTSEN(25,5),TMSEN(25,5),TCPSEN(25,5),                          ARCA0031
     2TLMC(25,8,3),ISEN(5),TTS(25,8,5),TCHEM(25,8,5),NPR                      ARCA0032
      DIMENSION IZSEN(25,5),ICZSEN(25,5),TSURF(25),TSEN(25),IZ(25)            ARCA0033
      DIMENSION AMTL(5),DELMF(5)                                              ARCA0034
      COMMON/LK/KOUT,IEX,IEN,VR,IMI(40),ILO(40),IR(40)                        ARCA0035
      COMMON/BACK/EBW,HBW,SGEP,SG4EP,TR4,EPSW,HCONV,TRES,HC,AO,QWL,TWL,       ARCA0036
     1STAB,IM2                                                                ARCA0037
      DIMENSION TPN(8),Y2(4),D2(4)                                            ARCA0038
      DIMENSION PRT1(4),TPTC0(8)                                              ARCA0039
      DIMENSION IFORM(11),JFORM(11)                                           ARCA0040
      DATA IFORM/6H(16,15,F12.2,18,15,F12.2,18,15,F12.2,18,15,F12.2,18,ARCA0041
     *15,F12.2)     /                                                        ARCA0042
      DATA ISKIP/6H,A6,6X/                                                    ARCA0043
      DATA BLANK/6H      /                                                    ARCA0044
      EQUIVALENCE (MO,Y2(1)),(NM,Y2(2)),(MF,Y2(3))                            ARCA0045
  300 FORMAT(2I3,10E6.4,/I1)                                                  ARCA0046
  301 FORMAT(4E7.5)                                                           ARCA0047
  302 FORMAT(4I1,I2,6E6.4)                                                    ARCA0048
  303 FORMAT(I2,F6.2,5F10.5)                                                  ARCA0049
 3030 FORMAT(I2,6E6.4)                                                        ARCA0050
  304 FORMAT(1H1,25X,71HAEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MAARCA0051
     1TERIAL ABLATION PROGRAM/113X,4HPAGE,I3//)                               ARCA0052
  305 FORMAT(12A6)                                                            ARCA0053
  306 FORMAT(//11H INPUT DATA//27H   DIMENSIONS OF INPUT DATA//114H    IIARCA0054
     1ME              SEC                  TEMPERATURE   DEG R              ARCA0055
     2          DENSITY            LB PER CUBIC FT/112H   SPECIFIC HEAT   ARCA0056
     3   BTU PER LB DEG R   CONDUCTIVITY  BTU PER FT SEC DEG R      EMISARCA0057
     4SIVITY          DIMENSIONLESS/105H   HEAT COEFFICIENT  LB PER SQ FTARCA0058
     5 SEC   ENTHALPY      BTU PER LB                NODAL COORDINATES  ARCA0059
     6INCHES/44H   RESISTANCES        SQ FT SEC DEG R PER BTU///20H   PROARCA0060
     7BLEM CONSTANTS//A5H   NMAX NMAX       INIT TIME    FINL TIME    PRNTARCA0061
     8TIME    TIME INCR   TIME CNST          /)                          ARCA0062
  307 FORMAT(//20H   NODAL COORDINATES//5X,1HI,5X,1HJ,5X,6HRC(I,J),7X,6HZARCA0063
     1C(I,J),7X,6HRN(I,J),7X,6HZN(I,J)/)                                      ARCA0064
  308 FORMAT(13H   NODAL DATA//97H   MATL IMTA SIDE ENTB MTTB   HEAT CNSARCA0065
     1I   INIT TEMP   CONT RES A  CONT RES B      VF1          VF3/)       ARCA0066
  309 FORMAT(29H   MATERIAL PROPERTIES TABLES/)                               ARCA0067
  310 FORMAT(/15H   MATERIAL NO.I3//73H      TEMP        DENSITY    SPEC ARCA0068
     1HEAT    CONDUCT     EMISSIV     CONDUCT2/)                           ARCA0069
  311 FORMAT(//25H   HEATING TABLES, OPTION,I2/)                              ARCA0070
  312 FORMAT(17H   HEAT TABLE NO.I3//50H       TIME      HEAT COEFF  RECOVARCA0071
     1 ENTH   RAD FACTOR/)                                                    ARCA0072
  313 FORMAT(//22H   WALL ENTHALPY TABLE//34H       TEMP       ENTH 1      ARCA0073
     1 ENTH 2/)                                                               ARCA0074
  314 FORMAT(1X,2I5,5X,6(E11.4,1X)//)                                         ARCA0075
  315 FORMAT(1X,8E12.4)                                                       ARCA0076
  316 FORMAT(1X,5I5,2X,6(1PE11.3,1X))                                         ARCA0077
  317 FORMAT(17H   HEAT TABLE NO.I3//37H       TIME         TEMP      RECOVARCA0078
     1 ENTH/)                                                                 ARCA0079
  318 FORMAT(3X,I3,3X,I3,1X,4E13.5)                                           ARCA0080
  319 FORMAT(///12H OUTPUT DATA//2HH   DIMENSIONS OF OUTPUT DATA//118H   ARCA0081
     1 TIME          SEC                        QTOT,SUR,INT    BTU      ARCA0082
     2          CONVECTIVE HEAT COEFF  LB PER SQ FT SEC/115H   TEMPERATARCA0083
     3URE  DEG R                    QNET AND QCONV  BTU PER SQ FT SEC    ARCA0084
     4  QTOT                    BTU PER SQ FT//)                           ARCA0085
  320 FORMAT(2I2)                                                             ARCA0086
  321 FORMAT(I2,10E7.5)                                                       ARCA0087
  322 FORMAT(//30H H VS  TEMPERATURE, TABLE NO. I2/3X4HTEMP9X1HH8X4HTEMPARCA0088
     19X1HH8X4HTEMP9X1HH8X4HTEMP9X1HH8X4HTEMP9X1HH)                           ARCA0089
  323 FORMAT(//25H H VS  TIME, TABLE NO. I2/3X4HTIME9X1HH8X4HTIME9X1HH8XARCA0090
```

```
     14HTIME9X1HH8X4HTIME9X1HH8X4HTIME9X1HH)                                  ARCA0091
  324 FORMAT(10E11.3)                                                         ARCA0092
  332 FORMAT(/ 11IH                NODE       TEMP       NODE       TEMP     ARCA0093
     1  NODE       TEMP       NODE       TEMP       NODE       TEMP/)       ARCA0094
  333 FORMAT(10X,5(I5,I4,E12.4))                                              ARCA0095
  334 FORMAT(16X,                                                             ARCA0096
     1          72H   TIME        QTOT,SUR    QTOT,INT   CNSV ENER  CRNODEARCA0097
     2 ITER  NODE D-TIME,2X,11H ACT D-TIME/)                                  ARCA0098
  335 FORMAT(10X,4(E11.4,1X),2I3,I5,2E13.5/)                                  ARCA0099
  337 FORMAT(//11X,2I4,5E12.4)                                                ARCA0100
  534 FORMAT (1H //23X40H---TIME DEPENDENT BOUNDARY CONDITIONS---/1H )        ARCA0101
  535 FORMAT (9X,4HTIME,8X,4HPROB,3X,8HRECOVERY,3X,9HRADIATION,4X,4HHEATARCA0102
     15X,8HPRESSURE,3X,7HBLOWING/9X,5H(SEC),7X,4HOPTN,2X,8HENTHALPY,3X, ARCA0103
     29HHEAT RATE,4X,5HCOEFF,14X,9HREDUCTION/28X,8H(BTU/LB),2X,11H(BTU/SARCA0104
     3U FT-,1X,10H(LB/SQ FT-,3X,5H(ATM),3X,9HPARAMETER /40X,7HSECOND), ARCA0105
     44X,7HSECOND))                                                           ARCA0106
 5350 FORMAT (9X,4HTIME,8X,4HPROB,3X,8HRECOVERY,3X,9HRADIATION,4X,4HHEATARCA0107
     15X,8HPRESSURE,3X,7HBLOWING/9X,5H(SEC),7X,4HOPTN,3X,8HENTHALPY,3X, ARCA0108
     29HHEAT RATE,4X,5HCOEFF,14X,9HREDUCTION/28X,8H(BTU/LB),2X,11H(BTU/SARCA0109
     3U FT-,1X,10H(BTU/SQ FT,3X,5H(ATM),3X,9HPARAMETER /40X,7HSECOND), ARCA0110
     44X,9H-SEC-DOR))                                                         ARCA0111
  536 FORMAT (6X,F8.2,8X,I2,4X,2(F8.2,3X),F8.4,3X,F8.5,3X,F8.3)               ARCA0112
  537 FORMAT (1H /9X,69HCH/CHO = PHI/(EXP(PHI)-1.) WHERE PHI = 2.*BRP*M ARCA0113
     1UOT/CHO, BRP IN TABLE)                                                  ARCA0114
  538 FORMAT(//22X30H---SURFACE EQUILIBRIUM DATA---)                          ARCA0115
  552 FORMAT (9X,4HTIME,8X,4HPROB,3X,7HSURFACE,4X,7HSURFACE/9X,5H(SEC), ARCA0116
     17X,4HOPTN,5X,4HTEMP,5X,9HRECESSION/28X,7H(DEG R),5X,6H(MILS))           ARCA0117
  556 FORMAT (9X,4HTIME,8X,4HPROB,5X,4HVIEW,5X,9HRADIATION/9X,5H(SEC), ARCA0118
     17X,4HOPTN,4X,6HFACTOR,4X,9HHEAT RATE/36X,11H(BTU/SQ FT-/40X,        ARCA0119
     27HSECOND))                                                              ARCA0120
 5780 FORMAT(E6.4,6X,E8.5,E6.4,F4.2,E7.5,6X,2E8.5,A6,I1,12X,I2)               ARCA0121
 5781 FORMAT(E6.4,E8.5,6X,E6.4,F4.2,E7.5,6X,2E8.5,A6,I1,12X,I2)               ARCA0122
 5782 FORMAT(E6.4,8X,E6.4,E6.4,F4.2,E7.5,6X,2E8.5,A6,I1,12X,I2)               ARCA0123
 5784 FORMAT(//6A,14HKINETICS PRM =E10.3,8X,10HPRESSURE =,F9.4,4H ATM//ARCA0124
     17X,2(4HTEMP,5X,26HM-DOT-  CHEM.PROD  SURFACE,3X)/6X,2(36H(DEG R)  ARCA0125
     2GMAR/CM   (BTU/LB)  SPECIES,2X))                                        ARCA0126
 5790 FORMAT (6X,26HNO RADIUS CORRECTION ON CH)                               ARCA0127
 5791 FORMAT(3F8.3,F9.4,F5.3,2F9.3,I2,2X,A6)                                  ARCA0128
 5792 FORMAT(//6A,3HP =,F9.4,4H ATM//6X,3(25HTEMPERATURE  EDGE ENTH   )/ARCA0129
     16X,3(25H  (DEG R)    AT I=WALL   ))                                     ARCA0130
 5793 FORMAT (//6X,37HBAD SURFACE EQUILIBRIUM TABLE OF TYPE,I2)               ARCA0131
 5794 FORMAT (//6X,74HEQUAL MASS AND HEAT TRANSFER COEFFICIENTS AND EQUAARCA0132
     1L DIFFUSION COEFFICIENTS)                                               ARCA0133
 5795 FORMAT(5A,F8.2,2X,F7.4,2X,F8.2,4X,A6,1A,F8.2,2X,F7.4,2X,F8.2,4X,A6ARCA0134
     1)                                                                       ARCA0135
 5796 FORMAT(2F10.0,3(9X,I1),5(I1,F5.0))                                      ARCA0136
 5797 FORMAT(//6A,45HRATIO OF MASS TO HEAT TRANSFER COEFFICIENTS =,F6.3/ARCA0137
     1 6X,28HUNEQUAL DIFFUSION EXPONENT =,F6.3)                               ARCA0138
 5798 FORMAT                    (6X,F9.2,4X,F9.2,3X,F9.2,4X,F9.ARCA0139
     22,3X,F9.2,4X,F9.2)                                                      ARCA0140
 5799 FORMAT (6X,56HHEAT TRANSFER COEFFICIENT MULTIPLIED BY (R INITIAL/RARCA0141
     1 CURRENT)**1.8)                                                         ARCA0142
  481 FORMAT(/34X20HBACK WALL CONVECTION10X9HBACK WALL10X9HRESERVOIR/     ARCA0143
     132X23HCOEF BTU/FTSQ-SEC-DEG R8X10HEMISSIVITY8X11HTEMPERATURE/       ARCA0144
     237XF10.4,10XF6.3,10XF10.2)                                              ARCA0145
  819 FORMAT(25H1OUT OF RANGE OF H TABLES/5X7H TEMP= E9.4,10X6HTIME= E9.ARCA0146
     14)                                                                      ARCA0147
  820 FORMAT(54H IS LARGER THAN THE LAST ENTRY IN THE WALL ENTH. TABLE) ARCA0148
  821 FORMAT(55H IS SMALLER THAN THE FIRST ENTRY IN THE WALL ENTH.TABLE)ARCA0149
  822 FORMAT.24HOTHE TEMPERATURE OF NODE214)                                  ARCA0150
  823 FORMAT(49X1_ LARGER THAN THE LAST ENTRY IN MATL. PROP. TAB.I3)           ARCA0151
  824 FORMAT(51H1S SMALLER THAN THE FIRST ENTRY IN MATL. PROP. TAB.I3)         ARCA0152
C-----GENERAL CONSTANTS                                                       ARCA0153
      PV=.5                                                                   ARCA0154
      PT=.083333333                                                           ARCA0155
      RANK = 459.688                                                          ARCA0156
      ZRO=0.0                                                                 ARCA0157
      PIB=.021810616                                                          ARCA0158
      INC=5                                                                   ARCA0159
      INPUT=5                                                                 ARCA0160
      KOUT=6                                                                  ARCA0161
      SIG=.4813E-12                                                           ARCA0162
      NPG=1                                                                   ARCA0163
C-----MAIN INPUT BLOCK INCLUDING OUTPUT LISTING OF INPUT                      ARCA0164
  225 WRITE (6,304)         NPG                                             ARCA0165
      READ (5,305)              (RECORD(I),I=1,36)                          ARCA0166
      WRITE (6,305)               (RECORD(I),I=1,36)                        ARCA0167
      WRITE (6,306)                                                         ARCA0168
      READ (5,300) MM,NN,TMI,THF,THP,ULTH,ETA,DH2,BRP,HCONV,EPSW,TRES,      ARCA0169
     1KASE,KSTRP,KRESC,KSLOP,KCENT,KLOG,KORTG                               ARCA0170
      KSLOP=KSLOP+1                                                         ARCA0171
      KRESC=KRESC+1                                                         ARCA0172
      SGEP=SIG*EPSW                                                         ARCA0173
      SG4EP=4.0*SGEP                                                        ARCA0174
      TR2=TRES**2                                                           ARCA0175
      TR4=TR2**2                                                            ARCA0176
      IF(ETA) 2253,2253,2254                                                ARCA0177
 2253 ETA=0.75                                                              ARCA0178
 2254 CONTINUE                                                              ARCA0179
      WRITE(6,314) MM,NN,TMI,THF,THP,ULTH,ETA                               ARCA0180
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      WRITE(KOUT,581) HCONV,EPSW,TRES                                   ARCA0181
      IF(THF) 2255,2255,2267                                            ARCA0182
 2267 TPTCG(1)=1.E+30                                                   ARCA0183
      GO TO 2256                                                        ARCA0184
 2255 READ(INPUT,2252) (PRTI(I),TPTCG(I),I=1,8)                         ARCA0185
      TPTCG(8)=THF                                                      ARCA0186
      DO 2257 I=1,7                                                     ARCA0187
      IF(TPTCG(I)) 2258,2258,2257                                       ARCA0188
 2258 TPTCG(I)=THF                                                      ARCA0189
 2257 CONTINUE                                                          ARCA0190
      CALL LCOUNT (5,LCT,NPG,RECORD(35))                                ARCA0191
      WRITE (KOUT,2259)                                                 ARCA0192
 2259 FORMAT(//49X,21HOUTPUT TIME INTERVALS)                            ARCA0193
      WRITE(KOUT,2260) PRTI(1),THI,TPTCG(1)                             ARCA0194
 2260 FORMAT(/21X,17HOUTPUT INTERVAL =,F7.4,13H SECONDS FROM,F9.4,       ARCA0195
     114H SECONDS UNTIL,F9.4,8H SECONDS)                                ARCA0196
      IF(TPTCG(1)-THF) 2261,2263,2263                                   ARCA0197
 2261 DO 2262 I=2,8                                                     ARCA0198
      IF(TPTCG(I)-THF) 2262,2264,2264                                   ARCA0199
 2264 CALL LCOUNT(1,LCT,NPG,RECORD(35))                                 ARCA0200
      WRITE(KOUT,2265) PRTI(I),TPTCG(I-1)                               ARCA0201
 2265 FORMAT(/21X,17HOUTPUT INTERVAL =, F7.4,13H SECONDS FROM,          ARCA0202
     1F9.4,25H SECONDS UNTIL FINAL TIME//)                              ARCA0203
      GO TO 2263                                                        ARCA0204
 2262 CALL LCOUNT (1,LCT,NPG,RECORD(35))                               ARCA0205
 2262 WRITE(KOUT,2260) PRTI(I),TPTCG(I-1),TPTCG(I)                     ARCA0206
 2263 THF=PRTI(1)                                                       ARCA0207
      IF(THF) 2268,2268,2256                                            ARCA0208
 2268 THF=THI                                                           ARCA0209
 2256 CONTINUE                                                          ARCA0210
      IF(KSTRP-2) 2250,2251,2251                                        ARCA0211
 2251 READ (5,2252) (TPH(I),I=1,8)                                      ARCA0212
 2252 FORMAT (8F10.0)                                                   ARCA0213
 2250 CONTINUE                                                          ARCA0214
      N=NN+1                                                            ARCA0215
      M=MM+1                                                            ARCA0216
      K=0                                                               ARCA0217
      DO 200 J=1,N                                                      ARCA0218
      DO 200 I=1,M                                                      ARCA0219
      K=K+1                                                             ARCA0220
      READ (5,301)  AA(K),AB(K),AC(K),AD(K)                             ARCA0221
      CR(K)=AA(K)                                                       ARCA0222
  200 CZ(K)=AB(K)                                                       ARCA0223
      CALL LCOUNT(-MM*NN-4,LCT,NPG,RECORD(35))                          ARCA0224
      WRITE (6,308)                                                     ARCA0225
      K=0                                                               ARCA0226
      DO 201 J=1,NN                                                     ARCA0227
      DO 201 I=1,MM                                                     ARCA0228
      K=K+1                                                             ARCA0229
      READ (5,302)            MATL(K),KTH(K),KSH(K),KWE(K),KTU(K),CON(K)ARCA0230
     1,TA(K),CRA(K),CRB(K),VF1(K),VF3(K)                                ARCA0231
      KT=KTU(K)                                                         ARCA0232
      IF(KT) 2007,2009,2002                                             ARCA0233
 2002 IF(KSH(K)-1) 2005,2005,2003                                       ARCA0234
 2003 IF(KBW(KT)) 2007,2007,2004                                        ARCA0235
 2004 KBW(KT)=1                                                         ARCA0236
      GO TO 2009                                                        ARCA0237
 2005 IF(KBW(KT)-1) 2006,2007,2006                                      ARCA0238
 2006 KBW(KT)=0                                                         ARCA0239
      GO TO 2009                                                        ARCA0240
 2007 WRITE(KOUT,2008) KT,K,J,I,KSH(K)                                  ARCA0241
 2008 FORMAT(//10X,25HASSIGNMENT OF TIME TABLE I2,9H TO NODE ,I3,70H CONARCA0242
     1FLICTS IN BACK WALL/FRONT WALL SENSE WITH AN EARLIER ASSIGNMENT OFARCA0243
     2/10X,32HTHIS TABLE. QUIT JOB. COLUMN IS ,I3,9H, ROW IS ,I3,17H, SIARCA0244
     3DE HEATED IS ,I1)                                                 ARCA0245
      STOP                                                              ARCA0246
 2009 CONTINUE                                                          ARCA0247
      IF(CRA(K)) 2000,2001,2001                                         ARCA0248
 2000 CRA(K)=-CRA(K)                                                    ARCA0249
      KGAP(K)=1                                                         ARCA0250
      GO TO 201                                                         ARCA0251
 2001 KGAP(K)=0                                                         ARCA0252
  201 WRITE (6,310)              MATL(K),KTH(K),KSH(K),KWE(K),KTU(K),CONARCA0253
     1(K),TA(K),CRA(K),CRB(K),VF1(K),VF3(K)                             ARCA0254
      CALL LCOUNT(2,LCT,NPG,RECORD(35))                                 ARCA0255
      WRITE (6,309)                                                     ARCA0256
      READ (5,303)            NAT                                       ARCA0257
      J=0                                                               ARCA0258
  202 J=J+1                                                             ARCA0259
      CALL LCOUNT(5,LCT,NPG,RECORD(35))                                 ARCA0260
      WRITE (6,310)                J                                    ARCA0261
      I=1                                                               ARCA0262
  203 READ(5,3030) NC,IT(I,J),RT(I,J),CPT(I,J),CNT(I,J),EPT(I,J),CNT2(I,ARCA0263
     1J)                                                                ARCA0264
      RT(I,J)=RT(1,J)                                                   ARCA0265
      CALL LCOUNT(1,LCT,NPG,RECORD(35))                                 ARCA0266
      WRITE (6,315)                IT(I,J),RT(I,J),CPT(I,J),CNT(I,J),EPT(IARCA0267
     1,J),CNT2(I,J)                                                     ARCA0268
      IF (NC) 205,204,205                                               ARCA0269
  204 I=I+1                                                             ARCA0270
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      GO TO 203                                                          ARCA0271
  205 TTMX(J)=TT(I,J)                                                    ARCA0272
      ILO(J)=1                                                           ARCA0273
      IHI(J)=I                                                           ARCA0274
      IR(J)=1                                                            ARCA0275
      THZ(1,J)=0.                                                        ARCA0276
      IF(J-1) 2053,2050,2053                                             ARCA0277
 2050 CONTINUE                                                           ARCA0278
      ILO(19)=1                                                          ARCA0279
      IHI(19)=I                                                          ARCA0280
      IR(19)=1                                                           ARCA0281
 2053 CONTINUE                                                           ARCA0282
      DO 2051 L=2,I                                                      ARCA0283
 2051 THZ(L,J)=THZ(L-1,J)+(CPT(L,J)+CPT(L-1,J))/2.*(TT(L,J)-TT(L-1,J))  ARCA0284
      TZ=536.                                                            ARCA0285
      CALL LOOK(J,TZ,TT(1,J),THZ(1,J),0,0,0,HSH,HA,1)                    ARCA0286
      DO 2052 L=1,I                                                      ARCA0287
 2052 THZ(L,J)=THZ(L,J)-HSH                                              ARCA0288
      IF(J-NMT)202,206,206                                               ARCA0289
C-----TIME (HEATING) TABLES                                              ARCA0290
  206 CALL LCOUNT(4,LCT,NPG,RECORD(35))                                  ARCA0291
      WRITE(6,574)                                                       ARCA0292
      J=0                                                                ARCA0293
      KNN=0                                                              ARCA0294
  207 J=J+1                                                              ARCA0295
      NTH=0                                                              ARCA0296
      IS=0                                                               ARCA0297
      KN=0                                                               ARCA0298
      NOPT=0                                                             ARCA0299
  371 NTH=NTH+1                                                          ARCA0300
      READ(5,303) NC,THT(NTH,J),RET(NTH,J),TQR(NTH,J),CHT(NTH,J),        ARCA0301
     1TPI(NTH,J),TBRP(NTH,J)                                             ARCA0302
      IF(TBRP(NTH,J)) 374,375,374                                        ARCA0303
  375 TBRP(NTH,J)=BRP                                                    ARCA0304
  374 IJ=1                                                               ARCA0305
      IF(CHT(NTH,J)) 342,342,343                                         ARCA0306
  342 IJ=2                                                               ARCA0307
      IF(PET(NTH,J)-2.) 344,344,343                                      ARCA0308
  344 IJ=3                                                               ARCA0309
  343 IOPT(NTH)=IJ                                                       ARCA0310
      IF(IJ-IS) 345,346,345                                              ARCA0311
  345 NOPT=NOPT+1                                                        ARCA0312
      IS=IJ                                                              ARCA0313
  346 IF(NC) 372,371,372                                                 ARCA0314
  372 ILO(J+20)=1                                                        ARCA0315
      IHI(J+20)=NTH                                                      ARCA0316
      IR(J+20)=1                                                         ARCA0317
      CALL LCOUNT(-3,LCT,NPG,RECORD(35))                                 ARCA0318
      WRITE(6,5380) J                                                    ARCA0319
 5380 FORMAT(/15A+18HTIME TABLE NUMBER ,I2/)                             ARCA0320
      IS=0                                                               ARCA0321
      DO 3476 I=1,NTH                                                    ARCA0322
      CALL LCOUNT(1,LCT,NPG,RECORD(35))                                  ARCA0323
      IJ=IOPT(I)                                                         ARCA0324
      IF(IJ-IS) 347,349,347                                              ARCA0325
  347 IS=IJ                                                              ARCA0326
      LCTX=4                                                             ARCA0327
      IF(IJ.EQ.2) LCTX=3                                                 ARCA0328
      CALL LCOUNT(LCTX,LCT,NPG,RECORD(35))                               ARCA0329
      GO TO (3471,3472,3473),IJ                                          ARCA0330
 3471 KT=KBW(J)+1                                                        ARCA0331
      GO TO (3477,3478),KT                                               ARCA0332
 3477 WRITE(KOUT,535)                                                    ARCA0333
      GO TO 3479                                                         ARCA0334
 3478 WRITE(KOUT,5350)                                                   ARCA0335
 3479 CONTINUE                                                           ARCA0336
      KN=1                                                               ARCA0337
      GO TO 3474                                                         ARCA0338
 3472 WRITE(KOUT,552)                                                    ARCA0339
      GO TO 3475                                                         ARCA0340
 3473 WRITE(KOUT,556)                                                    ARCA0341
      GO TO 3475                                                         ARCA0342
  349 GO TO (3474,3475,3475),IJ                                          ARCA0343
 3474 WRITE(6,536) THT(I,J),IJ,RET(I,J),TQR(I,J),CHT(I,J),               ARCA0344
     1TPI(I,J),TBRP(I,J)                                                 ARCA0345
      GO TO 3476                                                         ARCA0346
 3475 WRITE(6,536) THT(I,J),IJ,RET(I,J),TQR(I,J)                         ARCA0347
 3476 CONTINUE                                                           ARCA0348
      KNT=J                                                              ARCA0349
      IF(KN) 3732,3732,373                                               ARCA0350
  373 DO 3731 I=1,NTH                                                    ARCA0351
 3731 TPI(I,J)=ALOG(AMAX1(TPI(I,J),.000001))                             ARCA0352
      KNN=1                                                              ARCA0353
 3732 IF(NC) 207,207,3733                                                ARCA0354
 3733 IF(KNN) 1390,1390,328                                              ARCA0355
  328 CALL LCOUNT(2,LCT,NPG,RECORD(35))                                  ARCA0356
      WRITE(6,5)                                                         ARCA0357
C-----SURFACE THERMOCHEMISTRY TABLES                                     ARCA0358
      READ(INPUT,5796) CMHS,VFZ,NR,NST,KTCTB,(KMTL(I),DELHF(I),I=1,5)    ARCA0359
      KTCTB=KTCTB+1                                                      ARCA0360
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      VKIN=VF2                                                          ARCA0361
      DH2S=DH2                                                          ARCA0362
      IF(NST) 2900,2900,2901                                            ARCA0363
 2900 CMH=CMHS                                                          ARCA0364
      GO TO 2902                                                        ARCA0365
 2901 IF(KNST-777) 2909,2903,2909                                       ARCA0366
 2903 IF(CMH-CMHS) 2907,2905,2907                                       ARCA0367
 2905 CALL LCOUNT(4,LCT,NPG,RECORD(35))                                 ARCA0368
      WRITE(KOUT,2906)                                                  ARCA0369
 2906 FORMAT(//10X,50HSURFACE TABLES ARE THE SAME AS IN PREVIOUS PROBLEMARCA0370
     1//)                                                               ARCA0371
      GO TO 1390                                                        ARCA0372
 2907 CALL LCOUNT(4,LCT,NPG,RECORD(35))                                 ARCA0373
      WRITE(KOUT,2908)                                                  ARCA0374
 2908 FORMAT(//10X,72HPREVIOUS SURFACE TABLES CALLED FOR BUT CM/CH RATIOARCA0375
     1 HAS CHANGED, QUIT JOB//)                                         ARCA0376
      STOP                                                              ARCA0377
 2909 CALL LCOUNT(4,LCT,NPG,RECORD(35))                                 ARCA0378
      WRITE(KOUT,2910)                                                  ARCA0379
 2910 FORMAT(//10X,70HPREVIOUS SURFACE TABLES CALLED FOR BUT THIS IS FIRARCA0380
     1ST PROBLEM, QUIT JOB//)                                           ARCA0381
      STOP                                                              ARCA0382
 2902 KNST=777                                                          ARCA0383
      IF (RSV) 3280,3280,3281                                           ARCA0384
 3280 NR=0                                                              ARCA0385
 3281 CONTINUE                                                          ARCA0386
      WLS=-1                                                            ARCA0387
      NSEN=-1                                                           ARCA0388
      IP=1                                                              ARCA0389
      IPN=1                                                             ARCA0390
      I=1                                                               ARCA0391
      IN=1                                                              ARCA0392
      J=0                                                               ARCA0393
 2800 J=J+1                                                             ARCA0394
      GO TO (2911,2912,2913,2914),KTCTB                                 ARCA0395
 2911 READ(INCH,5780) PSV,TLMC(J,I,IP),DMS,WLQ,TTS(J,I,IP),TCHEM(J,I,IP)ARCA0396
     1,TSEN(J),TSURF(J),JNG                                             ARCA0397
      GO TO 2916                                                        ARCA0398
 2912 READ(INCH,5781) PSV,TLMC(J,I,IP),DMS,WLQ,TTS(J,I,IP),TCHEM(J,I,IP)ARCA0399
     1,TSEN(J),TSURF(J),JNG                                             ARCA0400
      GO TO 2916                                                        ARCA0401
 2913 READ(INCH,5782) PSV,TLMC(J,I,IP),DMS,WLQ,TTS(J,I,IP),TCHEM(J,I,IP)ARCA0402
     1,TSEN(J),TSURF(J),JNG                                             ARCA0403
 2916 JNG=JNG-1                                                         ARCA0404
      GO TO 2915                                                        ARCA0405
 2914 READ(INCH,5791) PSV,DMS,TLMC(J,I,IP),TTS(J,I,IP),WLQ,TCHEM(J,I,IP)ARCA0406
     1,TSEN(J),JNG,TSURF(J)                                             ARCA0407
 2915 CONTINUE                                                          ARCA0408
      IF(JNG) 2817,2817,2821                                            ARCA0409
 2817 TSURF(J)=BLANK                                                    ARCA0410
 2821 CONTINUE                                                          ARCA0411
      IF(TTS(J,I,IP)) 2803,2832,2801                                    ARCA0412
 2801 TTS(J,I,IP)=TTS(J,I,IP)*1.8                                       ARCA0413
      TCHEM(J,I,IP)=TCHEM(J,I,IP)*1.8                                   ARCA0414
      TSEN(J)=TSEN(J)*1.8                                               ARCA0415
      GO TO 2805                                                        ARCA0416
 2803 TTS(J,I,IP)=-TTS(J,I,IP)                                          ARCA0417
 2805 IF(WLS) 2809,2807,2807                                            ARCA0418
 2807 IX=4                                                              ARCA0419
      IF(WLS-WLQ) 2824,2811,2824                                        ARCA0420
 2809 WLS=WLQ                                                           ARCA0421
 2811 IF(NSEN) 2802,2828,2828                                           ARCA0422
 2802 IF(JNG) 2800,2804,2804                                            ARCA0423
 2804 NSEN=J-1                                                          ARCA0424
      ISEN(IP)=NSEN                                                     ARCA0425
      IF (NSEN-1) 8806,7806,7806                                        ARCA0426
 7806 DO 2806 L=1,NSEN                                                  ARCA0427
      TTSEN(L,IP)=TTS(L,1,IP)                                           ARCA0428
      TZSEN(L,IP)=TCHEM(L,1,IP)                                         ARCA0429
 2806 THSEN(L,IP)=TSEN(L)                                               ARCA0430
 8806 CONTINUE                                                          ARCA0431
      IF(NSEN-1) 2820,2820,2808                                         ARCA0432
 2808 CALL SLOPQ(NSEN,TTSEN(1,IP),THSEN(1,IP),TCPSEN(1,IP))            ARCA0433
      CALL SLOPQ(NSEN,TTSEN(1,IP),TZSEN(1,IP),TCZSEN(1,IP))            ARCA0434
      LLL=(NSEN-1)/3+1                                                  ARCA0435
      IF(IP-1) 2815,2813,2815                                           ARCA0436
 2813 CALL LCOUNT(9,LCT,NPG,RECORD(35))                                 ARCA0437
      WRITE (KOUT,538)                                                  ARCA0438
      WRITE (KOUT,5797) CMH,WLQ                                         ARCA0439
      IF (NR) 2818,2818,2816                                            ARCA0440
 2816 WRITE (KOUT,5799)                                                 ARCA0441
      GO TO 2815                                                        ARCA0442
 2818 WRITE (KOUT,5790)                                                 ARCA0443
 2815 CONTINUE                                                          ARCA0444
      LL=IP-1                                                           ARCA0445
      IF(LL) 28150,28151,28150                                          ARCA0446
28150 CALL LCOUNT(7,LCT,NPG,RECORD(35))                                 ARCA0447
      WRITE(KOUT,713)                                                   ARCA0448
  713 FORMAT(1H )                                                       ARCA0449
      WRITE(KOUT,712) LL,KT,DH2                                         ARCA0450
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  712 FORMAT(5X,74HTHIS COMPLETES THE INPUT AND DISPLAY OF SURFACE THERMARCA0451
     1OCHEMISTRY TABLE NO. ,I1,1H./5X,70HTHIS TABLE HAS INCORPORATED BY ARCA0452
     2USER ASSIGNMENT THE SPECIFIC HEAT OF MATERIAL/5X,4HNO. ,I1,34H ANDARCA0453
     3 A HEAT OF FORMATION VALUE OF ,F6.0,31H BTU/LB AT 536 DEGREES RANKARCA0454
     4INE.//)                                                          ARCA0455
 2815 LLLM=MAXO(LLL,0)                                                 ARCA0456
      CALL LCOUNT(LLLM+6,LCT,NPG,RECORD(35))                           ARCA0457
      WRITE(KOUT,5792)PSV                                              ARCA0458
      IF (LLL-1) 9819,8819,8819                                        ARCA0459
 8819 DO 2819 LL=1,LLL                                                 ARCA0460
      IF (NSEN-LL) 7819,6819,6819                                      ARCA0461
 6819 INT=(NSEN-LL)/LLL                                                ARCA0462
      M2=LL+INT*LLL                                                    ARCA0463
      WRITE (KOUT,5798) (TTSEN(L,IP),THSEN(L,IP),L=LL,M2  ,LLL)       ARCA0464
 7819 CONTINUE                                                         ARCA0465
 2819 CONTINUE                                                         ARCA0466
 9819 CONTINUE                                                         ARCA0467
      GO TO 2862                                                       ARCA0468
 2820 NSEN=0                                                           ARCA0469
      IX=3                                                             ARCA0470
      IF(CMH-1.) 2824,2822,2824                                        ARCA0471
 2822 IX=2                                                             ARCA0472
      IF(WLG) 2824,2826,2824                                           ARCA0473
 2824 WRITE (KOUT,5793) IX                                             ARCA0474
                                                                  TIXE LLARCA0475
      STOP                                                             ARCA0476
 2826 IF(IP-1) 2862,2861,2862                                          ARCA0477
 2828 IF(TTS(J,I,IP)) 2829,2832,2829                                   ARCA0478
 2829 IF(PSV-TPR(IP)) 2832,2830,2832                                   ARCA0479
 2830 IF(DMS-TMG(I,IP)) 2834,2800,2834                                 ARCA0480
 2832 IPN=IP+1                                                         ARCA0481
      NMG(IP)=I                                                        ARCA0482
      IN=0                                                             ARCA0483
      NSEN=-NSEN                                                       ARCA0484
 2834 IN=IN+1                                                          ARCA0485
      KMI(I,IP)=J-1                                                    ARCA0486
      NMC=J-1                                                          ARCA0487
      IX=5                                                             ARCA0488
      IF(NMC-1) 2824,2824,4852                                         ARCA0489
 4852 CONTINUE                                                         ARCA0490
      CALL ORDERD(NMC,TLMC(1,I,IP),IZ)                                 ARCA0491
      CALL SEQUA(NMC,IZ,TTS(1,I,IP),TCHEM(1,I,IP),TSEN(1),TSURF(1))    ARCA0492
      IX=0                                                             ARCA0493
      IG=1                                                             ARCA0494
      BPG=0.                                                           ARCA0495
      HGA=0.                                                           ARCA0496
      KT=KMTL(IP)                                                      ARCA0497
      IF(KT) 28360,28360,28361                                         ARCA0498
28360 DH2=DH25                                                         ARCA0499
      KT=1                                                             ARCA0500
      GO TO 28362                                                      ARCA0501
28361 DH2=DELHF(IP)                                                    ARCA0502
28362 CONTINUE                                                         ARCA0503
      NLO(I,IP)=1                                                      ARCA0504
      KMI(I,IP)=1                                                      ARCA0505
 2852 DO 2852 K=1,NMC                                                  ARCA0506
      BP=BPG+TLMC(K,I,IP)                                              ARCA0507
      CALL LOOK(KT,TTS(K,I,IP),TT(1,KT),TH2(1,KT),0,0,0,HCH,CT2,1)    ARCA0508
      HCH=HCH+DH2                                                      ARCA0509
      IF(NSEN) 2838,2836,2838                                          ARCA0510
 2836 TCHEM(K,I,IP)=BPG*HGA+TLMC(K,I,IP)*HCH-BP*TSEN(K)                ARCA0511
      GO TO 2841                                                       ARCA0512
 2838 CALL OGLE(I,TTS(K,I,IP),HZ,ISEN(IP),TTSEN(1,IP),TZSEN(1,IP),TCZSENARCA0513
     1(1,IP))                                                          ARCA0514
      CALL OGLE(I,TTS(K,I,IP),HE,ISEN(IP),TTSEN(1,IP),THSEN(1,IP),TCPSENARCA0515
     1(1,IP))                                                          ARCA0516
      TCHEM(K,I,IP)=BPG*HGA+TLMC(K,I,IP)*HCH-BP*TSEN(K)+HZ-TCHEM(K,I,IP)ARCA0517
      TSEN(K)=HE                                                       ARCA0518
 2840 IF(TSURF(K)-BLANK) 2844,2842,2844                                ARCA0519
 2842 NLO(I,IP)=K+1                                                    ARCA0520
      IF(IG+IX-1) 2846,2846,2824                                       ARCA0521
 2844 IX=1                                                             ARCA0522
 2846 IF(K-IG) 2852,2852,2848                                          ARCA0523
 2848 IF(TTS(K,I,IP)-TTS(K-1,I,IP)) 2850,2850,2851                     ARCA0524
 2850 IG=NMC                                                           ARCA0525
      GO TO 2852                                                       ARCA0526
 2851 KMI(I,IP)=K                                                      ARCA0527
 2852 CONTINUE                                                         ARCA0528
      LLL=(NMC-1)/2+1                                                  ARCA0529
      CALL LCOUNT(LLL+6          ,LCT,NPG,RECORD(35))                  ARCA0530
      IF (LLL-1) 6010,6009,6009                                        ARCA0531
 6009 WRITE(KOUT,5789) TMG(I,IP),TPR(IP)                               ARCA0532
      DO 6006 LL=1,LLL                                                 ARCA0533
      IF (NMC-LL) 6008,6007,6007                                       ARCA0534
 6007 INT=(NMC-LL)/LLL                                                 ARCA0535
      M2=LL+INT*LLL                                                    ARCA0536
      WRITE(KOUT,5795)                    (TTS(L,I,IP),TLMC(L,I,IP),TCHEMARCA0537
     1(L,I,IP),TSURF(L),L=LL,M2 ,LLL)                                  ARCA0538
 6008 CONTINUE                                                         ARCA0539
 6006 CONTINUE                                                         ARCA0540
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6010 CONTINUE                                                          ARCA0541
     IF (NMC-1) 4856,3856,3856                                         ARCA0542
3856 DO 2856 K=1,NMC                                                   ARCA0543
     TCHEM(K,I,IP)=CMH*TCHEM(K,I,IP)-TSEN(K)                           ARCA0544
     IF(K-NLO(I,IP)) 2856,2854,2854                                    ARCA0545
2854 VK=K                                                              ARCA0546
     TLMC(K,I,IP)=ALOG(AMAX1(TLMC(K,I,IP),VK*1.E-10))                  ARCA0547
2856 CONTINUE                                                          ARCA0548
4856 CONTINUE                                                          ARCA0549
     CALL SSWTCH(3,JJ)                                                 ARCA0550
     GO TO (710,711),JJ                                                ARCA0551
 710 CALL LCOUNT(LLL+6,LCT,NPG,RECORD(35))                             ARCA0552
     IF (LLL-1) 6015,6014,6014                                         ARCA0553
6014 WRITE(KOUT,5787)                                                  ARCA0554
5787 FORMAT(///3X,39H---DUMPED VERSION OF PRECEDING TABLE---//)        ARCA0555
     WRITE(KOUT,5789) IMG(I,IP),TPR(IP)                                ARCA0556
     DO 6011 LL=1,LLL                                                  ARCA0557
     IF (NMC-LL) 6013,6012,6012                                        ARCA0558
6012 INT=(NMC-LL)/LLL                                                  ARCA0559
     M2=LL+INT*LLL                                                     ARCA0560
     WRITE(KOUT,5788)                    (TTS(L,I,IP),TLMC(L,I,IP),TCHEMARCA0561
    1(L,I,IP),TSEN(L) ,L=LL,M2 ,LLL)                                   ARCA0562
5788 FORMAT(5X,F8.2,2X,F7.4,2X,F8.2,2X,F8.2,2X,F8.2,1X,F8.2,2X,F7.4,2X,F8.2,2X,ARCA0563
    1F8.2)                                                             ARCA0564
6013 CONTINUE                                                          ARCA0565
6011 CONTINUE                                                          ARCA0566
6015 CONTINUE                                                          ARCA0567
 711 CONTINUE                                                          ARCA0568
     IF(TTS(J,I,IP)) 2862,2870,2862                                    ARCA0569
2861 CALL LCOUNT(8              ,LCT,NPG,RECORD(35))                   ARCA0570
     WRITE (KOUT,538)                                                  ARCA0571
     WRITE(KOUT,5794)                                                  ARCA0572
     IF (NR) 2863,2863,2864                                            ARCA0573
2864 WRITE (KOUT,5799)                                                 ARCA0574
     GO TO 2862                                                        ARCA0575
2863 WRITE (KOUT,5790)                                                 ARCA0576
2862 TPR(IPN)=PSV                                                      ARCA0577
     IMG(IN,IPN)=DMS                                                   ARCA0578
     TLMC(1,IN,IPN)=TLMC(J,I,IP)                                       ARCA0579
     TTS (1,IN,IPN)=TTS (J,I,IP)                                       ARCA0580
     TCHEM(1,IN,IPN)=TCHEM(J,I,IP)                                     ARCA0581
     TSURF(1)=TSURF(J)                                                 ARCA0582
     TSEN(1)=TSEN(J)                                                   ARCA0583
     J=1                                                               ARCA0584
     I=IN                                                              ARCA0585
     IP=IPN                                                            ARCA0586
     GO TO 2800                                                        ARCA0587
2870 NPR=IP                                                            ARCA0588
     IR(12)=1                                                          ARCA0589
     ILO(12)=1                                                         ARCA0590
     IHI(12)=1                                                         ARCA0591
     DO 2872 I=1,IP                                                    ARCA0592
2872 TPR(I)=ALOG(TPR(I))                                               ARCA0593
     IR(13)=1                                                          ARCA0594
     IHI(13)=NPR                                                       ARCA0595
     ILO(13)=1                                                         ARCA0596
     WRITE(KOUT,713)                                                   ARCA0597
     WRITE(KOUT,712) NPR,KT,DH2                                        ARCA0598
     CALL SSWTCH(3,KSSW)                                               ARCA0599
     GO TO (700,1390),KSSW                                             ARCA0600
 700 CALL LCOUNT(3,LCT,NPG,RECORD(35))                                 ARCA0601
     WRITE(KOUT,703)                                                   ARCA0602
 703 FORMAT(//10X,48HDUMP OF TABLE INDICES NLO(I,J),NHI(I,J),KHI(I,J)) ARCA0603
     DO 701 J=1,NPR                                                    ARCA0604
     CALL LCOUNT(3,LCT,NPG,RECORD(35))                                 ARCA0605
     WRITE(KOUT,704) J                                                 ARCA0606
 704 FORMAT(/15X,6HIPR = ,I2/1H )                                      ARCA0607
     L=NMC(J)                                                          ARCA0608
     CALL LCOUNT(L,LCT,NPG,RECORD(35))                                 ARCA0609
     WRITE(KOUT,702) (NLO(I,J),NHI(I,J),KHI(I,J),I=1,L)                ARCA0610
 702 FORMAT(20X,3(2X,I2))                                              ARCA0611
 701 CONTINUE                                                          ARCA0612
1390 CONTINUE                                                          ARCA0613
     DO 705 IP=1,NPR                                                   ARCA0614
     IF(NMC(IP)-1) 7051,7052,705                                       ARCA0615
7051 IX=6                                                              ARCA0616
     WRITE(KOUT,5793) IX                                               ARCA0617
     STOP                                                              ARCA0618
7052 NMC=NHI(1,IP)                                                     ARCA0619
     NHI(2,IP)=NHI(1,IP)                                               ARCA0620
     NLO(2,IP)=NLO(1,IP)                                               ARCA0621
     KHI(2,IP)=KHI(1,IP)                                               ARCA0622
     IMG(2,IP)=IMG(1,IP)*1.001                                         ARCA0623
     DO 7053 J=1,NMC                                                   ARCA0624
     TTS(J,2,IP)=TTS(J,1,IP)                                           ARCA0625
     TLMC(J,2,IP)=TLMC(J,1,IP)                                         ARCA0626
7053 TCHEM(J,2,IP)=TCHEM(J,1,IP)                                       ARCA0627
 705 CONTINUE                                                          ARCA0628
C-----INITIALIZATIONS                                                  ARCA0629
     IM=IMI                                                            ARCA0630
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      PRT=TM1+THF                                                       ARCA0631
      UNTS=ZRO                                                          ARCA0632
      UNT1=ZRO                                                          ARCA0633
      UTHR = 100.0                                                      ARCA0634
      KK=MM*NN                                                          ARCA0635
      IAR=0                                                             ARCA0636
      KO=RT(1,1)                                                        ARCA0637
      CMD=0.                                                            ARCA0638
C-----NOTE TABLE II GIVES K IN M DIRECTION                              ARCA0639
      DO 216  I = 1 , NMT                                               ARCA0640
      IF (CNT2(1,1) .NE. 0.0)  GO TO 216                                ARCA0641
      DO 215  J = 1,15                                                  ARCA0642
      CNT2(J,I) = CNT(J,1)                                              ARCA0643
  215 CONTINUE                                                          ARCA0644
  216 CONTINUE                                                          ARCA0645
      DO 825 I=1,NN                                                     ARCA0646
      USDT(I)=0.0                                                       ARCA0647
      USDTR(I)=0.0                                                      ARCA0648
      US(I)=0.0                                                         ARCA0649
      UST(I)=0.0                                                        ARCA0650
      USTT(I)=0.0                                                       ARCA0651
      UCONDT(I)=0.                                                      ARCA0652
      USDTBN(I)=0.                                                      ARCA0653
      USN(I)=0.                                                         ARCA0654
      UCNV(I)=0.                                                        ARCA0655
      UCNVT(I)=0.                                                       ARCA0656
      IABLS(I)=0                                                        ARCA0657
      UCHM(I)=0.                                                        ARCA0658
      UCHMT(I)=0.                                                       ARCA0659
      URAB(I)=0.                                                        ARCA0660
      URABT(I)=0.                                                       ARCA0661
      URAD(I)=0.                                                        ARCA0662
      URADT(I)=0.                                                       ARCA0663
      CMDOT(I)=0.                                                       ARCA0664
      CMT(I)=0.                                                         ARCA0665
      KDROP(I)=0                                                        ARCA0666
  825 TS(I)=0.0                                                         ARCA0667
C-----SURFACE IDENTIFICATION AND CHECKING                               ARCA0668
      M=0                                                               ARCA0669
      K=0                                                               ARCA0670
      DO 828 J=1,NN                                                     ARCA0671
      L=-1                                                              ARCA0672
      KT=0                                                              ARCA0673
      DO 826 I=1,MM                                                     ARCA0674
      K=K+1                                                             ARCA0675
      KTS=KT                                                            ARCA0676
      KT=MATL(K)                                                        ARCA0677
      IF(KT) 827,827,826                                                ARCA0678
  827 IF(KTS) 826,826,829                                               ARCA0679
  829 L=L+1                                                             ARCA0680
      KCAN=K-1                                                          ARCA0681
  826 CONTINUE                                                          ARCA0682
      IF(KT) 8291,8261,8260                                             ARCA0683
 8260 L=L+1                                                             ARCA0684
      KCAN=K                                                            ARCA0685
C-----FORMERLY EXCLUDED RULES HERE                                      ARCA0686
C8261 IF(L) 8291,8262,8291                                              ARCA0687
 8261 CONTINUE                                                          ARCA0688
 8262 KSUR(J)=KCAN                                                      ARCA0689
      MATL(KCAN)=-MATL(KCAN)                                            ARCA0690
      TS(J)=TA(KCAN)                                                    ARCA0691
      KSH(KCAN)=1                                                       ARCA0692
      GO TO 828                                                         ARCA0693
 8291 CALL LCOUNT(2,LCT,NPG,RECORD(35))                                 ARCA0694
      WRITE(6,8292) J                                                   ARCA0695
 8292 FORMAT(/10A,33HERRONEOUS NODAL LAYOUT IN COLUMN ,I3/)             ARCA0696
      M=M+1                                                             ARCA0697
  828 CONTINUE                                                          ARCA0698
      IF(M) 8281,8281,8280                                              ARCA0699
 8280 TH=THF                                                            ARCA0700
      GO TO 468                                                         ARCA0701
 8281 CONTINUE                                                          ARCA0702
      IFIN = 1                                                          ARCA0703
      CALL LCOUNT(6,LCT,NPG,RECORD(35))                                 ARCA0704
      WRITE (6,307)                                                     ARCA0705
C-----GEOMETRY CALCULATIONS                                             ARCA0706
      DO 8283 I=1,NN                                                    ARCA0707
      K=KSUR(I)                                                         ARCA0708
      J=K+1                                                             ARCA0709
      L=J+MM+1                                                          ARCA0710
      SR(I)=(CR(J)+CR(L))/2.                                            ARCA0711
 8283 SZ(I)=(CZ(J)+CZ(L))/2.                                            ARCA0712
      K=0                                                               ARCA0713
      L=MM+1                                                            ARCA0714
      N=L                                                               ARCA0715
      4=0                                                               ARCA0716
      DO 1 J=1,NN                                                       ARCA0717
      DO 2 I=1,MM                                                       ARCA0718
      K=K+1                                                             ARCA0719
      L=L+1                                                             ARCA0720
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      M=M+1                                                          ARCA0721
      IF (AC(K)) 4,3,4                                               ARCA0722
C-----PROVISIONS FOR EITHER CENTERED OR BACKSHIFTED NODES            ARCA0723
    3 IF(KCENT) 3000,3000,3001                                       ARCA0724
 3001 AC(K)=.25*(AA(K)+AA(K+1)+AA(L)+AA(L+1))                        ARCA0725
      GO TO 4                                                        ARCA0726
 3000 AC(K)=0.50*(AA(K)+AA(L))                                       ARCA0727
    4 IF (AD(K)) 6,5,6                                               ARCA0728
    5 IF(KCENT) 3002,3002,3003                                       ARCA0729
 3003 AD(K)=.25*(AB(K)+AB(K+1)+AB(L)+AB(L+1))                        ARCA0730
      GO TO 6                                                        ARCA0731
 3002 AD(K)=0.50*(AB(K)+AB(L))                                       ARCA0732
    6 CALL LCOUNT(1,LCT,NPG,RECORD(35))                              ARCA0733
      WRITE(6,318) I,J,AA(K),AB(K),AC(K),AD(K)                       ARCA0734
      IF(KCENT) 3008,3008,3009                                       ARCA0735
 3009 HA=FV*(AA(K)+AA(K+1))-AC(K)                                    ARCA0736
      HB=FV*(AB(K)+AB(K+1))-AD(K)                                    ARCA0737
      GO TO 3010                                                     ARCA0738
 3008 CONTINUE                                                       ARCA0739
      HA=AA(K)-AC(K)                                                 ARCA0740
      HB=AB(K)-AD(K)                                                 ARCA0741
 3010 CONTINUE                                                       ARCA0742
      HC=HA*HA+HB*HB                                                 ARCA0743
        PLA(M) =FT*SQRT (HC)                                         ARCA0744
      HA=FV*(AA(K+1)+AA(L+1))-AC(K)                                  ARCA0745
      HB=FV*(AB(K+1)+AB(L+1))-AD(K)                                  ARCA0746
      HC=HA*HA+HB*HB                                                 ARCA0747
       PLB(M)=FT*SQRT (HC)                                           ARCA0748
      IF(KCENT) 3011,3011,3012                                       ARCA0749
 3012 HA=FV*(AA(L)+AA(L+1))-AC(K)                                    ARCA0750
      HB=FV*(AB(L)+AB(L+1))-AD(K)                                    ARCA0751
      GO TO 3013                                                     ARCA0752
 3011 CONTINUE                                                       ARCA0753
      HA=AA(L)-AC(K)                                                 ARCA0754
      HB=AB(L)-AD(K)                                                 ARCA0755
 3013 CONTINUE                                                       ARCA0756
      HC=HA*HA+HB*HB                                                 ARCA0757
      PLC(M)=FT*SQRT (HC)                                            ARCA0758
      IF(KCENT) 3005,3005,3006                                       ARCA0759
 3006 HA=FV*(AA(K)+AA(L))-AC(K)                                      ARCA0760
      HB=FV*(AB(K)+AB(L))-AD(K)                                      ARCA0761
      HC=HA*HA+HB*HB                                                 ARCA0762
      PLD(M)=FT*SQRT(HC)                                             ARCA0763
      GO TO 3007                                                     ARCA0764
 3005 PLD(M)=ZRO                                                     ARCA0765
 3007 CONTINUE                                                       ARCA0766
      HA=AA(K)*AA(K)                                                 ARCA0767
      HB=AA(K)*AA(K+1)                                               ARCA0768
      HC=AA(K)*AA(L)                                                 ARCA0769
      HD=AA(K+1)*AA(K+1)                                             ARCA0770
      HE=AA(K+1)*AA(L+1)                                             ARCA0771
      HF=AA(L)*AA(L)                                                 ARCA0772
      HG=AA(L)*AA(L+1)                                               ARCA0773
      HH=AA(L+1)*AA(L+1)                                             ARCA0774
      HS=ZRO                                                         ARCA0775
      HS=HS+AB(K)*(HC-HB+HF-HD)                                      ARCA0776
      HS=HS+AB(K+1)*(HB-HE+HA-HH)                                    ARCA0777
      HS=HS+AB(L)*(HG-HC+HH-HA)                                      ARCA0778
      HS=HS+AB(L+1)*(HE-HG+HD-HF)                                    ARCA0779
      VOL(M)=6.666171E-04*ABS (HS)                                   ARCA0780
    2 CONTINUE                                                       ARCA0781
      K=K+1                                                          ARCA0782
      L=L+1                                                          ARCA0783
      CALL LCOUNT(1,LCT,NPG,RECORD(35))                              ARCA0784
      WRITE(6,318) N,J,AA(K),AB(K)                                   ARCA0785
    1 CONTINUE                                                       ARCA0786
      IF(KORTG) 3025,3025,3019                                       ARCA0787
 3019 K=0                                                            ARCA0788
      L = MM+1                                                       ARCA0789
      M = 0                                                          ARCA0790
      DO 3020 J=1,NN                                                 ARCA0791
      DO 3021 I=1,MM                                                 ARCA0792
      K = K+1                                                        ARCA0793
      L = L+1                                                        ARCA0794
      M = M+1                                                        ARCA0795
      IF (I-MM) 3022,3023,3023                                       ARCA0796
 3022 CALL CUSIN(AC(K), AD(K), AC(K+1), AD(K+1), AA(K+1), AB(K+1),   ARCA0797
     1AA(L+1), AB(L+1), HA)                                          ARCA0798
      SINAC(M) = HA                                                  ARCA0799
 3023 IF(J-NN) 3024,3021,3021                                        ARCA0800
 3024 CALL CUSIN(AC(K), AD(K), AC(L), AD(L), AA(L+1), AB(L+1), AA(L), ARCA0801
     1AB(L), HA)                                                     ARCA0802
      SINAD(M)= HA                                                   ARCA0803
 3021 CONTINUE                                                       ARCA0804
      K = K+1                                                        ARCA0805
      L = L+1                                                        ARCA0806
 3020 CONTINUE                                                       ARCA0807
      CALL  SSWTCH(9,KSSW)                                           ARCA0808
      GO TO (3028,3025),KSSW                                         ARCA0809
 3028 CALL LCOUNT(3+KK, LCT,NPG, RECORD(35))                         ARCA0810
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      WRITE(KOUT,3029) (SINAC(M), SINAD(M), M=1,KK)                    ARCA0811
 3029 FORMAT(10X,32HDUMP OF CONDUCTANCE SINE FACTORS//10X,1SHSINAC     SARCA0812
     1INAD//(8X,F7.5,3X,F7.5))                                         ARCA0813
 3025 CONTINUE                                                         ARCA0814
      K = 0                                                            ARCA0815
      L = MM+1                                                         ARCA0816
      M = 0                                                            ARCA0817
      DO 3026 J=1,NN                                                   ARCA0818
      DO 3027 I=1,MM                                                   ARCA0819
      K = K+1                                                          ARCA0820
      L = L+1                                                          ARCA0821
      M = M+1                                                          ARCA0822
      HA=AA(K+1)-AA(K)                                                 ARCA0823
      HB=AB(K+1)-AB(K)                                                 ARCA0824
      HC=HA*HA+HB*HB                                                   ARCA0825
      HD=SQRT (HC)                                                     ARCA0826
      HE=PIB*HD*(AA(K)+AA(K+1))                                        ARCA0827
      HA=AA(L)-AA(K)                                                   ARCA0828
      HB=AB(L)-AB(K)                                                   ARCA0829
      HC=HA*HA+HB*HB                                                   ARCA0830
      HD=SQRT (HC)                                                     ARCA0831
      HF=PIB*HD*(AA(K)+AA(L))                                          ARCA0832
      AA(M)=HE                                                         ARCA0833
 3027 AB(M)=HF                                                         ARCA0834
      K=K+1                                                            ARCA0835
      L=L+1                                                            ARCA0836
    7 HA=AA(L)-AA(K)                                                   ARCA0837
      HB=AB(L)-AB(K)                                                   ARCA0838
      HC=HA*HA+HB*HB                                                   ARCA0839
      HD=SQRT (HC)                                                     ARCA0840
      AC(M)=PIB*HD*(AA(K)+AA(L))                                       ARCA0841
 3026 CONTINUE                                                         ARCA0842
      LU=MM+1                                                          ARCA0843
      LL=NN+1                                                          ARCA0844
      DO 12 I=1,LU                                                     ARCA0845
      K=K+1                                                            ARCA0846
      CALL LCOUNT(1,LCT,NPG,RECORD(35))                                ARCA0847
   12 WRITE(6,310) I,LL,AA(K),AB(K)                                    ARCA0848
      M=M-MM                                                           ARCA0849
      K=K-MM-1                                                         ARCA0850
      DO 8 I=1,MM                                                      ARCA0851
      K=K+1                                                            ARCA0852
      M=M+1                                                            ARCA0853
    9 HA=AA(K+1)-AA(K)                                                 ARCA0854
      HB=AB(K+1)-AB(K)                                                 ARCA0855
      HC=HA*HA+HB*HB                                                   ARCA0856
      HD=SQRT (HC)                                                     ARCA0857
      AD(M)=PIB*HD*(AA(K)+AA(K+1))                                     ARCA0858
    8 CONTINUE                                                         ARCA0859
      M=0                                                              ARCA0860
      L=MM                                                             ARCA0861
      K=MM-1                                                           ARCA0862
      N=NN-1                                                           ARCA0863
      DO 10 J=1,N                                                      ARCA0864
      DO 11 I=1,K                                                      ARCA0865
      M=M+1                                                            ARCA0866
      L=L+1                                                            ARCA0867
   13 AC(M)=AB(M+1)                                                    ARCA0868
   14 AD(M)=AA(L)                                                      ARCA0869
   11 CONTINUE                                                         ARCA0870
      M=M+1                                                            ARCA0871
      L=L+1                                                            ARCA0872
   18 AD(M)=AA(L)                                                      ARCA0873
   10 CONTINUE                                                         ARCA0874
      DO 1002 I=1,K                                                    ARCA0875
      M=M+1                                                            ARCA0876
 1002 AC(M)=AB(M+1)                                                    ARCA0877
      DO 1000 J=1,NN                                                   ARCA0878
      K=KSUM(J)                                                        ARCA0879
 1000 PLBS(J)=PLB(K)+PLD(K)                                            ARCA0880
      CALL LCOUNT(-10,LCT,NPG,RECORD(35))                              ARCA0881
      WRITE (6,319)                                                    ARCA0882
      ITER=0                                                           ARCA0883
C-----MAIN ITERATION LOOP                                              ARCA0884
   30 IF (DLTH) 31,31,32                                               ARCA0885
   31 DTH=100.                                                         ARCA0886
      GO TO 33                                                         ARCA0887
   32 DTH=DLTH                                                         ARCA0888
   33 ITER=ITER+1                                                      ARCA0889
C-----MATERIAL PROPERTIES,NODAL RESISTANCES AND CAPACITIES             ARCA0890
      I=0                                                              ARCA0891
      IF (KLOG) 4939,4939,4999                                         ARCA0892
 4939 L=MM                                                             ARCA0893
      DO 39 JJ=1,NN                                                    ARCA0894
      DO 40 III=1,MM                                                   ARCA0895
      I=I+1                                                            ARCA0896
      L=L+1                                                            ARCA0897
      IF(MATL(I)) 42,41,42                                             ARCA0898
   41 RA(I)=ZRO                                                        ARCA0899
      RB(I)=ZRO                                                        ARCA0900
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      GO TO 40                                                          ARCA0901
   42 KT=IABS(MATL(I))                                                  ARCA0902
      IF (TTMX(KT)-TA(I)) 43,43,44                                      ARCA0903
   43 HB=TA(I)                                                          ARCA0904
      GO TO 500                                                         ARCA0905
   44 IF (TA(I)-TT(1,KT)) 45,46,46                                      ARCA0906
   45 HB=TA(I)                                                          ARCA0907
      GO TO 501                                                         ARCA0908
   46 IT=1                                                              ARCA0909
   47 IF (TT(IT,KT)-TA(I)) 48,48,49                                     ARCA0910
   48 IT=IT+1                                                           ARCA0911
      GO TO 47                                                          ARCA0912
   49 JT=IT-1                                                           ARCA0913
      HC=(TA(I)-TT(JT,KT))/(TT(IT,KT)-TT(JT,KT))                        ARCA0914
      HD=CNT(JT,KT)+HC*(CNT(IT,KT)-CNT(JT,KT))                          ARCA0915
      HA=CRB(I)+PLC(I)/HD                                               ARCA0916
      HM = CNT2(JT,KT) + HC * (CNT2(IT,KT) - CNT2(JT,KT) )              ARCA0917
      HB = CRA(I) + PLB(I) / HM                                         ARCA0918
      HE=RT(JT,KT)+HC*(RT(IT,KT)-RT(JT,KT))                             ARCA0919
      HF=CPT(JT,KT)+HC*(CPT(IT,KT)-CPT(JT,KT))                          ARCA0920
      CAP(I)=VOL(I)*HE*HF                                               ARCA0921
   35 IF(MATL(I)+1) 50,50,51                                            ARCA0922
   50 U(JJ)=AC(I)/HB                                                    ARCA0923
      RB(I)=0.0                                                         ARCA0924
      GO TO 61                                                          ARCA0925
   51 N=KSH(I)-1                                                        ARCA0926
      IF (KGAP(I)) 5106,5106,5100                                       ARCA0927
 5106 IF (N) 5105,5105,5100                                             ARCA0928
 5100 EM2=EPT(JT,KT)+HC*(EPT(IT,KT)-EPT(JT,KT))                         ARCA0929
      HMS=HM                                                            ARCA0930
      EPSV(I) = EM2                                                     ARCA0931
      IF(N) 5105,5105,5102                                              ARCA0932
 5102 GO TO (5103,5104,5103),N                                          ARCA0933
 5103 CON(I)=HB                                                         ARCA0934
      GO TO 5105                                                        ARCA0935
 5104 CON(I)=HM                                                         ARCA0936
 5105 CONTINUE                                                          ARCA0937
      KT=IABS(MATL(I+1))                                                ARCA0938
      IF(KT) 53,52,53                                                   ARCA0939
   52 RB(I)=ZRO                                                         ARCA0940
      GO TO 61                                                          ARCA0941
C-----FORMERLY EXCLUDED HOLES HERE                                      ARCA0942
C   52 WRITE(6,831)                                                     ARCA0943
  831 FORMAT (10X,27HERRONEOUS NODAL ARRANGEMENT)                       ARCA0944
C     IM=IMP                                                            ARCA0945
C     GO TO 468                                                         ARCA0946
   53 IF (TTMX(KT)-TA(I+1)) 54,54,55                                    ARCA0947
   54 HB=TA(I+1)                                                        ARCA0948
      GO TO 500                                                         ARCA0949
   55 IF (TA(I+1)-TT(1,KT)) 56,57,57                                    ARCA0950
   56 HB=TA(I+1)                                                        ARCA0951
      GO TO 501                                                         ARCA0952
   57 IT=1                                                              ARCA0953
   58 IF (TT(IT,KT)-TA(I+1)) 59,59,60                                   ARCA0954
   59 IT=IT+1                                                           ARCA0955
      GO TO 58                                                          ARCA0956
   60 JT=IT-1                                                           ARCA0957
      HC=(TA(I+1)-TT(JT,KT))/(TT(IT,KT)-TT(JT,KT))                      ARCA0958
      HM = CNT2(JT,KT) + HC * (CNT2(IT,KT) - CNT2(JT,KT) )              ARCA0959
      HB = HB + PLB(I+1) / HM                                           ARCA0960
      RB(I)=AB(I+1)/HB                                                  ARCA0961
      IF(KGAP(I)) 61,61,6000                                            ARCA0962
 6000 EM1=EPT(JT,KT)+HC*(EPT(IT,KT)-EPT(JT,KT))                         ARCA0963
      CALL GAP(I,EM1,EM2,HM,HMS,SIG)                                    ARCA0964
   61 IF (JJ-NN) 63,62,63                                               ARCA0965
   62 RA(I)=ZRO                                                         ARCA0966
      GO TO 40                                                          ARCA0967
   63 KT=IABS(MATL(L))                                                  ARCA0968
      IF (KT) 65,64,65                                                  ARCA0969
   64 RA(I)=ZRO                                                         ARCA0970
      GO TO 40                                                          ARCA0971
   65 IF (TTMX(KT)-TA(L)) 66,66,67                                      ARCA0972
   66 HB=TA(L)                                                          ARCA0973
      GO TO 500                                                         ARCA0974
   67 IF (TA(L)-TT(1,KT)) 68,69,69                                      ARCA0975
   68 HB=TA(L)                                                          ARCA0976
      GO TO 501                                                         ARCA0977
   69 IT=1                                                              ARCA0978
   70 IF (TT(IT,KT)-TA(L)) 71,71,72                                     ARCA0979
   71 IT=IT+1                                                           ARCA0980
      GO TO 70                                                          ARCA0981
   72 JT=IT-1                                                           ARCA0982
      HC=(TA(L)-TT(JT,KT))/(TT(IT,KT)-TT(JT,KT))                        ARCA0983
      HD=CNT(JT,KT)+HC*(CNT(IT,KT)-CNT(JT,KT))                          ARCA0984
      IF(MATL(I)+IABS(MATL(I))) 7200,7202,7200                          ARCA0985
 7200 IF(KT+MATL(L)) 7201,7202,7201                                     ARCA0986
 7202 HA=HA/(AB(I)+.0000001)+PLA(L)/(HD*(AA(L)+.0000001))               ARCA0987
      RA(I)=1./HA                                                       ARCA0988
      GO TO 40                                                          ARCA0989
 7201 CONTINUE                                                          ARCA0990
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      HA=HA+PLA(L)/HD                                                    ARCA0991
      RA(I)=AA(L)/HA                                                     ARCA0992
   40 CONTINUE                                                           ARCA0993
   39 CONTINUE                                                           ARCA0994
      GO TO 221                                                          ARCA0995
C     NEW LOGIC                                                          ARCA0996
 4999 L=-MM                                                             ARCA0997
      DO 5039 JJ=1,NN                                                   ARCA0998
      DO 5040 III=1,MM                                                  ARCA0999
      I=I+1                                                             ARCA1000
      L=L+1                                                             ARCA1001
      IF (MATL(I)) 5042,5041,5042                                       ARCA1002
 5041 RA(I)=ZRO                                                         ARCA1003
      RB(I)=ZRO                                                         ARCA1004
      GO TO 5040                                                        ARCA1005
 5042 KT=IABS(MATL(I))                                                  ARCA1006
      CALL LOOK(KT,TA(1),II(1,KT) CNT(1,KT),CNT2(1,KT),CPT(1,KT),0,Y2(1)ARCA1007
     1   ,D2(1),3)                                                      ARCA1008
      IF (IEX) 500,5017,500                                             ARCA1009
 5017 RB(I)=CRA(I)*PLB(I)/HM                                            ARCA1010
      N=KSW(I)-1                                                        ARCA1011
      IF(N) 5021,5021,5018                                              ARCA1012
 5018 EPSV(I)=Y2(4)                                                     ARCA1013
      GO TO (5019,5020,5019),N                                          ARCA1014
 5019 CON(I)=Y2(1)                                                      ARCA1015
      GO TO 5021                                                        ARCA1016
 5020 CON(I)=Y2(2)                                                      ARCA1017
 5021 CONTINUE                                                          ARCA1018
      IF (JJ-NN) 4998,4997,4998                                         ARCA1019
 4997 RA(I)=0.                                                          ARCA1020
      GO TO 4996                                                        ARCA1021
 4998 RA(I)=CRB(I)*PLC(I)/HD                                            ARCA1022
 4996 CAP(I)=VOL(I)*RT(KT)*HF                                           ARCA1023
      IF (III-1) 5000,5000,5001                                         ARCA1024
 5001 IF (MATL(I-1)) 5000,5000,5002                                     ARCA1025
 5002 RB(I-1) = AB(I)/(RB(I-1)+PLD(I)/HM)                               ARCA1026
 5000 IF (MATL(I)+1) 5003,5003,5004                                     ARCA1027
 5003 U(JJ)=AC(I)/RB(I)                                                 ARCA1028
      RB(I)=0.0                                                         ARCA1029
      IF(JJ-1) 5007,5007,5006                                           ARCA1030
 5004 IF (JJ-1) 5009,5009,5005                                          ARCA1031
 5009 IF (NN-1) 5010,5010,5007                                          ARCA1032
 5010 RA(I)=0.                                                          ARCA1033
      GO TO 5007                                                        ARCA1034
 5005 IF (MATL(I)) 5006,5007,5008                                       ARCA1035
 5008 RA(L)=AA(I)/(RA(L)+PLA(I)/HD)                                     ARCA1036
      GO TO 5007                                                        ARCA1037
 5006 RA(L)=PLA(I)/(HD*AA(I)) + RA(L)/AD(L)                             ARCA1038
      RA(L)=1./RA(L)                                                    ARCA1039
 5007 CONTINUE                                                          ARCA1040
 5040 CONTINUE                                                          ARCA1041
 5039 CONTINUE                                                          ARCA1042
  221 CONTINUE                                                          ARCA1043
C-----ORTHOGONALITY CORRECTIONS                                         ARCA1044
      IF(KONTG) 2210,2210,5050                                          ARCA1045
 5050 M=0                                                               ARCA1046
      DO 5051 J=1,NN                                                    ARCA1047
      DO 5051 I=1,MM                                                    ARCA1048
      M = M+1                                                           ARCA1049
      KT = MATL(M)                                                      ARCA1050
      IF(KT) 5054,5052,5053                                             ARCA1051
 5053 RB(M) = RA(M) * SINAC(M)                                          ARCA1052
 5052 IF(J-NN) 5054,5051,5051                                           ARCA1053
 5054 RA(M) = RA(M) * SINAD(M)                                          ARCA1054
 5051 CONTINUE                                                          ARCA1055
 2210 CONTINUE                                                          ARCA1056
C-----HEAT FLUX LOOP                                                    ARCA1057
      QSUM=ZRO                                                          ARCA1058
      QWLS=ZRO                                                          ARCA1059
      KK=MM*NN                                                          ARCA1060
      I=0                                                               ARCA1061
      J=1                                                               ARCA1062
      K=-1                                                              ARCA1063
      L=MM                                                              ARCA1064
      M=-MM                                                             ARCA1065
      DO 76 JJ=1,NN                                                     ARCA1066
      DO 76 III=1,MM                                                    ARCA1067
      I=I+1                                                             ARCA1068
      J=J+1                                                             ARCA1069
      K=K+1                                                             ARCA1070
      L=L+1                                                             ARCA1071
      M=M+1                                                             ARCA1072
      IF (MATL(I)) 114,115,114                                          ARCA1073
  115 HB(I)=ZRO                                                         ARCA1074
      GO TO 76                                                          ARCA1075
  114 HA=ZRO                                                            ARCA1076
      HB=ZRO                                                            ARCA1077
      IF (K) 78,78,77                                                   ARCA1078
   77 HA=HA+TA(K)*RB(K)                                                 ARCA1079
      HB=HB+HB(K)                                                       ARCA1080
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   78 IF (J-KK) 79,79,80                                                ARCA1081
   79 HA=HA+TA(J)*RB(I)                                                 ARCA1082
      HB=HB+RB(I)                                                       ARCA1083
   80 IF (L-KK) 81,81,82                                                ARCA1084
   81 HA=HA+TA(L)*RA(I)                                                 ARCA1085
      HB=HB+RA(I)                                                       ARCA1086
   82 IF (M)184,84,83                                                   ARCA1087
   83 HA=HA+TA(M)*RA(M)                                                 ARCA1088
      HB=HB+RA(M)                                                       ARCA1089
   84 IF (CAP(I)) 85,86,85                                              ARCA1090
   86 TB(I)=HA/HB                                                       ARCA1091
      GO TO 76                                                          ARCA1092
   85 DEN=HB                                                            ARCA1093
      N=KSH(I)-1                                                        ARCA1094
      IF(N) 97,97,9800                                                  ARCA1095
 9800 KT=KTU(I)                                                         ARCA1096
      IF(KT) 9802,9802,9801                                             ARCA1097
 9801 DENSV=DEN                                                         ARCA1098
      CALL LOOK(KT+20,TH,THT(1,KT),CHT(1,KT),RET(1,KT),0,0,Y2,D2,2)     ARCA1099
      DEN=DENSV                                                         ARCA1100
      HBW=Y2(1)                                                         ARCA1101
      IF(HBW) 9816,9816,9803                                            ARCA1102
 9816 KSH(I)=3*KSH(I)                                                   ARCA1103
      CON(I)=Y2(2)                                                      ARCA1104
      GO TO 97                                                          ARCA1105
 9802 HBW=HCONV                                                         ARCA1106
 9803 IF(EPSV(I)) 9804,9804,9805                                        ARCA1107
 9804 EBW=EPSW                                                          ARCA1108
      GO TO 9806                                                        ARCA1109
 9805 EBW=EPSV(I)                                                       ARCA1110
      SGEP=SIG*EBW                                                      ARCA1111
      SG4EP=4.0*SGEP                                                    ARCA1112
 9806 IF(EBW*HBW) 97,97,9807                                            ARCA1113
 9807 GO TO (9808,9809,9810),N                                          ARCA1114
 9808 HC=PLC(I)/(CON(I)*AD(I))                                          ARCA1115
      AQ=AD(I)                                                          ARCA1116
      GO TO 9811                                                        ARCA1117
 9809 HC=PLO(I)/(CON(I)*AB(I))                                          ARCA1118
      AQ=AB(I)                                                          ARCA1119
      GO TO 9811                                                        ARCA1120
 9810 HC=PLA(I)/(CON(I)*AA(I))                                          ARCA1121
      AQ=AA(I)                                                          ARCA1122
 9811 CALL BAKWL(I)                                                     ARCA1123
      CALL SSWTCH(6,KSSW)                                               ARCA1124
      GO TO (9812,9813),KSSW                                            ARCA1125
 9812 IF(ITER-100) 9814,9814,9813                                       ARCA1126
 9814 WRITE(KOUT,9815) ITER,AQ,TRES,TWL,HBW,SGEP,TR4,SG4EP,QWL,STAB,    ARCA1127
     1TA(I),DEN                                                         ARCA1128
 9815 FORMAT(I5,11E10.3)                                                ARCA1129
 9813 CONTINUE                                                          ARCA1130
      HA=HA+QWL                                                         ARCA1131
      QWLS=QWLS+QWL                                                     ARCA1132
      DEN=DEN+STAB                                                      ARCA1133
   97 TB(I)=HA-TA(I)*HB                                                 ARCA1134
   98 IF (DLTH) 76,99,76                                                ARCA1135
   99 IF (KTH(I)) 76,76,1001                                            ARCA1136
 1001 IF(MATL(I)) 76,76,100                                             ARCA1137
  100 HC=ETA*CAP(I)/DEN                                                 ARCA1138
      IF (HC-DTH) 101,76,76                                             ARCA1139
  101 DTH=HC                                                            ARCA1140
      MCRIT=III                                                         ARCA1141
      NCRIT=JJ                                                          ARCA1142
   76 CONTINUE                                                          ARCA1143
   75 CONTINUE                                                          ARCA1144
C                                                                       ARCA1145
C-----GO TO SURFACE ENERGY BALANCE PACKAGE                              ARCA1146
      CALL SURFB                                                        ARCA1147
C                                                                       ARCA1148
C-----NEW TEMPERATURES LOOP                                             ARCA1149
  107 K=0                                                               ARCA1150
      DO 120 J=1,NN                                                     ARCA1151
      DO 121 I=1,MM                                                     ARCA1152
      K=K+1                                                             ARCA1153
      IF (MATL(K)) 121,121,136                                          ARCA1154
  136 IF(CAP(K)) 122,121,123                                            ARCA1155
  122 WRITE(6,127) K                                                    ARCA1156
  127 FORMAT(///10X,26HNEGATIVE CAPACITY AT NODE ,I3//)                 ARCA1157
      IHF=TH                                                            ARCA1158
      GO TO 468                                                         ARCA1159
  123 IF (KSH(K) -1) 124,125,1244                                       ARCA1160
  125 WRITE(6,126)  K                                                   ARCA1161
  126 FORMAT(///10X,34HNODAL BLUNDER AT 123, HEATED NODE ,I3,38H HAS MATERARCA1162
     1RIAL NUMBER GREATER THAN ZERO//)                                  ARCA1163
      IHF=TH                                                            ARCA1164
      GO TO 468                                                         ARCA1165
 1244 IF(MATL(K+1)) 1245,1243,1247                                      ARCA1166
 1245 WRITE(KOUT,1246) K                                                ARCA1167
 1246 FORMAT(///10X,27HBACK WALL NODE NEAR SURFACE//)                   ARCA1168
      IHF=TH                                                            ARCA1169
      GO TO 468                                                         ARCA1170
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 1247 IF(KSH(K)-4) 1243,1243,1248                                        ARCA1171
 1248 KSH(K)=KSH(K)/3                                                    ARCA1172
      QWL=-TB(K)*(CON(K)-TA(K))*CAP(K)/DTH                               ARCA1173
      QWLS=QWLS+QWL                                                      ARCA1174
      TB(K)=CON(K)                                                       ARCA1175
      GO TO 121                                                          ARCA1176
  124 IF(MATL(K+1)) 1240,1243,1243                                       ARCA1177
 1240 IF(KPESC-3) 1243,1241,1243                                         ARCA1178
 1241 IF(KDROP(J)) 1242,1242,1243                                        ARCA1179
 1242 TB(K)=(TB(K)+RB(K)*(TB(K+1)-TA(K+1)))*DTH/CAP(K)+TA(K)             ARCA1180
      GO TO 121                                                          ARCA1181
 1243 HA=TB(K)*DTH/CAP(K)+TA(K)                                          ARCA1182
      TB(K)=HA                                                           ARCA1183
  121 CONTINUE                                                           ARCA1184
  120 CONTINUE                                                           ARCA1185
      QNTS=QNTS+QWLS*DTH                                                 ARCA1186
      KK=MM*NN                                                           ARCA1187
  466 DO 467 I=1,KK                                                      ARCA1188
      QNTI=QNTI+CAP(I)*(TB(I)-TA(I))                                     ARCA1189
  467 TA(I)=TB(I)                                                        ARCA1190
      IF((DTHM .LT. DTHM) .AND. (TH .NE. PRT)) DTHM = DTH                ARCA1191
      CALL SSWTCH(5,KSSW)                                                ARCA1192
      GO TO (4671,4672),KSSW                                             ARCA1193
 4671 IF(ITER-3347) 4672,4672,4673                                       ARCA1194
 4673 IF(ITER-3450) 468,468,4672                                         ARCA1195
 4672 CONTINUE                                                           ARCA1196
      CALL SSWTCH(1,KSSW)                                                ARCA1197
      GO TO (468,4670),KSSW                                              ARCA1198
 4670 IF(TH-PRT) 4674,468,468                                            ARCA1199
 4674 IF(TH-THF) 472,468,468                                             ARCA1200
C----OUTPUT BLOCK                                                        ARCA1201
  468 CEC=QNTS/QNTI                                                      ARCA1202
      CALL LCOUNT(17,NN,LCT,NPG,RECORD(35))                              ARCA1203
      WRITE(6,3364) TH                                                   ARCA1204
 3364 FORMAT(//1X,50(1H*),F7.2,8H SECONDS,53(1H*)//52X,13H***GENERAL***)ARCA1205
      WRITE (6,3347)                                                     ARCA1206
      WRITE(6,335) TH,QNTS,QNTI,CEC,MCRIT,NCRIT,ITER,DTHS,DTHM           ARCA1207
      WRITE (6,336)                                                      ARCA1208
  336 FORMAT(///49X,20H***RELATED SURFACE***///40X,40H--------MISCELLANEOUSARCA1209
     1 SURFACE DATA--------//2X,25HROW COL OPTN  SURF   SURF,6X,4HH EDGE,ARCA1210
     25X,6HH RATE,3X,40HB-PRIME  MASS COEFF    CH/CH*)   PRESSURE,4X,6HMAARCA1211
     3OLOSS,10X,1HZ//16X,57HITER  TEMP(K)   (BTU/LB)   (BTU/LB)    TOT   (ARCA1212
     4LB/FT2-SEC),14X,5H(ATM),6X,4H(IN))                                 ARCA1213
      K=0                                                                ARCA1214
      DO 949 J=1,NN                                                      ARCA1215
      DO 949 I=1,MM                                                      ARCA1216
      K=K+1                                                              ARCA1217
      IF(KSH(K)-1) 949,950,949                                           ARCA1218
  950 HP=CMDOT(J)/G(J)                                                   ARCA1219
      HR=G(J)/GZ(J)                                                      ARCA1220
      K=SK(J)                                                            ARCA1221
      Z=SZ(J)                                                            ARCA1222
      ITS=ITSK(J)                                                        ARCA1223
      WRITE(6,3370) I,J,ILL(J),ITS,TS(J),HEDG(J),HWL(J),BP,G(J),BR,PR(J),ARCA1224
     1W,Z                                                                ARCA1225
 3370 FORMAT(2X,I3,1X,I3,3X,I1,2X,I5,2X,F7.1,2(2X,F9.2),2X,F7.4,3X,      ARCA1226
     1F9.5,3X,F7.5,3(2X,E10.3))                                          ARCA1227
  949 CONTINUE                                                           ARCA1228
      CALL LCOUNT(8,NN,LCT,NPG,RECORD(35))                               ARCA1229
      WRITE(6,3360)                                                      ARCA1230
 3360 FORMAT(///40X,39H---------SURFACE RATE QUANTITIES---------//1X,     ARCA1231
     1 31H-LOCATION-  --RECESSION RATES--,8X,14H--MASS RATES--,20X,      ARCA1232
     229H--SURFACE ENERGY FLUX RATES--/18X,10H(MILS/SEC),13X,            ARCA1233
     312H(LB/FT2-SEC),29X,13H(BTU/FT2-SEC))                              ARCA1234
      WRITE(6,3361)                                                      ARCA1235
 3361 FORMAT(60X,9HCONVECTED,4X,8HCHEMICAL,4X,9HRADIATION,3X,9HRADIATIONARCA1236
     1,2X,10HCONDUCTION/2X,56HROW COL   CENTER LINE  NORMAL     MOUT TOTARCA1237
     2AL   MOUT TCHEM,6X,2HIN,6A,21HGENERATION   ABSORBED,5X,7HEMITTED,  ARCA1238
     36X,4HAWAY)                                                         ARCA1239
      K=0                                                                ARCA1240
      DO 9510 J=1,NN                                                     ARCA1241
      DO 9510 I=1,MM                                                     ARCA1242
      K=K+1                                                              ARCA1243
      IF(KSH(K)-1) 9510,9511,9510                                        ARCA1244
 9511 HA=DSDTB(J)*12000.                                                 ARCA1245
      HB=DSDTBY(J)*12000.                                                ARCA1246
      WRITE(6,3362) I,J,HA,HB,CMDOT(J),QCNV(J),                          ARCA1247
     1QCHM(J),QRAB(J),QRAD(J),QNP(K)                                     ARCA1248
 3362 FORMAT(2X,I3,1X,I3,3X,2(F10.6,1A),2X,7(E10.3,2X))                  ARCA1249
 9510 CONTINUE                                                           ARCA1250
      CALL LCOUNT(6,NN,LCT,NPG,RECORD(35))                               ARCA1251
      WRITE(6,3363)                                                      ARCA1252
 3363 FORMAT(///38X,44H-----SURFACE TIME INTEGRATED QUANTITIES-----//    ARCA1253
     1 13X,46H--RECESSION TOTALS--  --MASS ABLATION TOTALS--,            ARCA1254
     215X,30H--SURFACE ENERGY FLUX TOTALS--/20X,6H(MILS),17X,            ARCA1255
     36H(LB/COL),33X,9H(BTU/COL))                                        ARCA1256
      WRITE(6,3361)                                                      ARCA1257
      K=0                                                                ARCA1258
      DO 9512 J=1,NN                                                     ARCA1259
      DO 9512 I=1,MM                                                     ARCA1260
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      K=K+1                                                              ARCA1261
      IF(KSH(K)-1) 9512,9513,9512                                        ARCA1262
 9513 HA=DSTT(J)*12000.                                                  ARCA1263
      HB=HA                                                              ARCA1264
      WRITE(6,3366) I,J,HA,HB,CMT(J),CMT(J),QCNVT(J),                    ARCA1265
     1QCMHT(J),QRABT(J),QRADT(J),QCONDT(J)                               ARCA1266
 3366 FORMAT(2X,I3,1X,I3,3X,2(F10.4,1X),2X,7(E10.3,2X))                  ARCA1267
 9512 CONTINUE                                                           ARCA1268
C-----EXTRA DIAGNOSTIC OUTPUT                                            ARCA1269
      CALL SSWTCH(4,KSSW)                                                ARCA1270
      GO TO (9496,9497),KSSW                                             ARCA1271
 9496 CALL LCOUNT(5*2*NN*LCT*NPG,RECORD(35))                             ARCA1272
 9493 FORMAT(//2X,10HEXTRA DUMP/2X,56HI,J,U,VOL,RA,RB,CAP,AA,AB,AC,AD,PLARCA1273
     1B,PLBS,EMN,PLA,PLC,PLD//)                                          ARCA1274
      K=0                                                                ARCA1275
      DO 9490 J=1,NN                                                     ARCA1276
      DO 9490 I=1,MM                                                     ARCA1277
      K=K+1                                                              ARCA1278
      IF(KSH(K)-1) 9490,9491,9490                                        ARCA1279
 9491 WRITE(6,9492) I,J,U(J),VOL(K),RA(K),RB(K),CAP(K),AA(K),AB(K),AC(K)ARCA1280
     1,AD(K),PLB(K),PLBS(J),EMN(J),PLA(K),PLC(K),PLD(K)                  ARCA1281
 9492 FORMAT(2X,I3,2X,I3,10E11.3/10X,5E11.3)                             ARCA1282
 9490 CONTINUE                                                           ARCA1283
      CALL LCOUNT(3*NN*LCT*NPG,RECORD(35))                               ARCA1284
      WRITE(6,9503)                                                      ARCA1285
 9503 FORMAT(//2X,40HI,J,DSDT,DSDTB,DS,DST,DSTT,MATL,KSH,KSUR/)          ARCA1286
      K=0                                                                ARCA1287
      DO 9500 J=1,NN                                                     ARCA1288
      DO 9500 I=1,MM                                                     ARCA1289
      K=K+1                                                              ARCA1290
      IF(KSH(K)-1) 9500,9501,9500                                        ARCA1291
 9501 WRITE(6,9502) I,J,DSDT(J),DSDTB(J),DS(J),DST(J),DSTT(J),MATL(K),   ARCA1292
     1KSH(K),KSUR(J)                                                     ARCA1293
 9502 FORMAT(2X,2I4,5E12.3,3I4)                                          ARCA1294
 9500 CONTINUE                                                           ARCA1295
      CALL LCOUNT(4,LCT,NPG,RECORD(35))                                  ARCA1296
      WRITE(6,9494) PRT,THI,THF,DLTH,ETA,FV,FT,PIB,ZRO,KQOP,MM,NN,KK,    ARCA1297
     1NMT,NMT                                                            ARCA1298
 9494 FORMAT(//2X,56HPRT,THI,THF,DLTH,ETA,FV,FT,PIB,ZRO,KQOP,MM,NN,KK,NMARCA1299
     1T,NMT/2X,9E11.3,I2,2I4,3I3//)                                      ARCA1300
 9497 CONTINUE                                                           ARCA1301
C-----OPTIONAL PUNCHED OUTPUT                                            ARCA1302
      IF(KSTRP-1) 849,842,8421                                           ARCA1303
 8421 DO 8422 I=1,8                                                      ARCA1304
      IF(ABS(TH-TPH(I))-.000001) 842,842,8422                            ARCA1305
 8422 CONTINUE                                                           ARCA1306
      GO TO 849                                                          ARCA1307
  842 K=0                                                                ARCA1308
      NS=0                                                               ARCA1309
      CALL LCOUNT(2,LCT,NPG,RECORD(35))                                  ARCA1310
      WRITE(6,8423) TH                                                   ARCA1311
 8423 FORMAT(/20A,26HPUNCHED OUTPUT PRODUCED AT,F10.5,8H SECONDS)        ARCA1312
      DO 840 J=1,NN                                                      ARCA1313
      DO 840 I=1,MM                                                      ARCA1314
      K=K+1                                                              ARCA1315
      IF(MATL(K)) 8420,840,841                                           ARCA1316
 8420 NS=NS+1                                                            ARCA1317
  841 NS=NS+1                                                            ARCA1318
  840 CONTINUE                                                           ARCA1319
      K=0                                                                ARCA1320
      N=0                                                                ARCA1321
      LL=0                                                               ARCA1322
      LR=MM+1                                                            ARCA1323
      DO 843 J=1,NN                                                      ARCA1324
      DO 844 I=1,MM                                                      ARCA1325
      K=K+1                                                              ARCA1326
      LL=LL+1                                                            ARCA1327
      LR=LR+1                                                            ARCA1328
      IF(MATL(K)) 845,844,845                                            ARCA1329
  845 N=N+1                                                              ARCA1330
      IF(KCENT) 8450,8450,8451                                           ARCA1331
 8450 CONTINUE                                                           ARCA1332
      Z=(CZ(LL)+CZ(LR))/2.0                                              ARCA1333
      R=(CR(LL)+CR(LR))/2.0                                              ARCA1334
      GO TO 8452                                                         ARCA1335
 8451 IF(MATL(K)) 8454,844,8453                                          ARCA1336
 8453 Z=(CZ(LL)+CZ(LR)+CZ(LL+1)+CZ(LR+1))/4.                             ARCA1337
      R=(CR(LL)+CR(LR)+CR(LL+1)+CR(LR+1))/4.                             ARCA1338
      GO TO 8452                                                         ARCA1339
 8454 Z=((CZ(LL)+CZ(LR))/2.+SZ(J))/2.                                    ARCA1340
      R=((CR(LL)+CR(LR))/2.+SR(J))/2.                                    ARCA1341
 8452 CONTINUE                                                           ARCA1342
      PUNCH 846, R,Z,TA(K)-1,J,MATL(K),TH,RECORD(35),RECORD(36),N,NS     ARCA1343
  846 FORMAT (3F10.3,8HINCHES,I3,1H/,I3,3HMAT,I2,F7.2,2HS ,2A6,1X,I3,   ARCA1344
     12HUF,I3)                                                           ARCA1345
      IF(MATL(K)) 847,844,844                                            ARCA1346
  847 N=N+1                                                              ARCA1347
      LL=LL+1                                                            ARCA1348
      LR=LR+1                                                            ARCA1349
      RAT=PLB(K)/PLBS(J)                                                 ARCA1350
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      R=SR(J)                                                          ARCA1351
      Z=SZ(J)                                                          ARCA1352
      MOUT=-MATL(K)                                                    ARCA1353
      PUNCH 848, R,Z,TS(J),J,MOUT,TH,RECORD(35),RECORD(36),N,NS        ARCA1354
  848 FORMAT (3F10.3,8HININDEGR,3X,1H/,I3,3HMAT,I2,F7.2,2HS ,2A6,1X,I3, ARCA1355
     12HOF,I3)                                                         ARCA1356
  844 CONTINUE                                                         ARCA1357
  843 CONTINUE                                                         ARCA1358
  849 CONTINUE                                                         ARCA1359
C-----TEMPERATURE PRINT OUT                                            ARCA1360
      CALL LCOUNT(-4,LCT,NPG,RECORD(35))                               ARCA1361
      WRITE(6,3305)                                                    ARCA1362
 3305 FORMAT(//49X,19H***IN-DEPTH DATA***/)                            ARCA1363
      CALL LCOUNT(3,LCT,NPG,RECORD(35))                                ARCA1364
      WRITE(6,2410)                                                    ARCA1365
 2410 FORMAT(/5(4X,2HROW  COL  TEMPERATURE)/)                          ARCA1366
      INICK=1                                                          ARCA1367
      JNICK=5                                                          ARCA1368
      JNICK=MIN0(JNICK,NN)                                             ARCA1369
  242 DO 241 L=1,MM                                                    ARCA1370
      J=0                                                              ARCA1371
      K=(INICK-1)*MM+L-MM                                              ARCA1372
      DO 247 I=1,11                                                    ARCA1373
  247 JFORM(I)=IFORM(I)                                                ARCA1374
      DO 240 I=INICK,JNICK                                             ARCA1375
      K=K+MM                                                           ARCA1376
      J=J+1                                                            ARCA1377
      MPR(J)=L                                                         ARCA1378
      NNPR(J)=I                                                        ARCA1379
      TMPR(J)=TA(K)                                                    ARCA1380
      IF (MATL(K).NE.0.AND.TMPR(J).GT.0.) GO TO 240                    ARCA1381
      JFORM(2*J)=1SKIP                                                 ARCA1382
      TMPR(J)=BLANK                                                    ARCA1383
  240 CONTINUE                                                         ARCA1384
      NPG1=NPG                                                         ARCA1385
      CALL LCOUNT(1,LCT,NPG,RECORD(35))                                ARCA1386
      IF (NPG.EQ.NPG1) GO TO 243                                       ARCA1387
      CALL LCOUNT(3,LCT,NPG,RECORD(35))                                ARCA1388
      WRITE(6,2410)                                                    ARCA1389
  243 WRITE(6,JFORM) (MPR(K),NNPR(K),TMPR(K),K=1,J)                    ARCA1390
  241 CONTINUE                                                         ARCA1391
      NPG1=NPG                                                         ARCA1392
      CALL LCOUNT(1,LCT,NPG,RECORD(35))                                ARCA1393
      IF (NPG1.EQ.NPG) GO TO 244                                       ARCA1394
      CALL LCOUNT(2,LCT,NPG,RECORD(35))                                ARCA1395
      WRITE(6,2410)                                                    ARCA1396
      GO TO 245                                                        ARCA1397
  244 WRITE(6,301)                                                     ARCA1398
  245 IF (JNICK.EQ.NN) GO TO 246                                       ARCA1399
      INICK=JNICK+1                                                    ARCA1400
      JNICK=MIN0(INICK+4,NN)                                           ARCA1401
      GO TO 242                                                        ARCA1402
  246 CONTINUE                                                         ARCA1403
C                                                                      ARCA1404
  469 IF(TH-THF) 472,470,470                                           ARCA1405
  470 CONTINUE                                                         ARCA1406
      IF (KASE) 471,471,225                                            ARCA1407
  471 STOP                                                             ARCA1408
  472 IF(TH-PRT) 30,4721,4721                                          ARCA1409
 4721 IF(TH-TPTCG(1)+.000001) 473,474,474                              ARCA1410
  473 PRT=AMIN1(PRT,THP,TPTCG(1))                                      ARCA1411
      DTHM=100.                                                        ARCA1412
      GO TO 30                                                         ARCA1413
  474 IF(PRTI(2)) 476,476,475                                          ARCA1414
  476 CALL LCOUNT(5,LCT,NPG,RECORD(35))                                ARCA1415
      WRITE (KOUT,477)                                                 ARCA1416
  477 FORMAT(//10X,62HHAVE ENCOUNTERED A ZERO OUTPUT INTERVAL, AM QUITTIARCA1417
     1ING THIS JOB//)                                                  ARCA1418
      GO TO 470                                                        ARCA1419
  475 THP=PRTI(2)                                                      ARCA1420
      DO 478 I=1,7                                                     ARCA1421
      IPTCG(I)=TPTCG(I+1)                                              ARCA1422
  478 PRTI(I)=PRTI(I+1)                                                ARCA1423
      GO TO 473                                                        ARCA1424
  500 WRITE(6,822) III,JJ                                              ARCA1425
      WRITE (6,823)              KT                                    ARCA1426
      THF=TH                                                           ARCA1427
      GO TO 468                                                        ARCA1428
  501 WRITE(6,822) III,JJ                                              ARCA1429
      WRITE (6,824)              KT                                    ARCA1430
      THF=TH                                                           ARCA1431
      GO TO 468                                                        ARCA1432
  505 WRITE(6,819) TA(I),TH                                            ARCA1433
      THF=TH                                                           ARCA1434
      GO TO 468                                                        ARCA1435
      END                                                              ARCA1436
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      SUBROUTINE BAKWL(I)                                                BAKW0001
C                                                                        BAKW0002
      INCLUDE DIMS,LIST                                                  BAKW0003
C                                                                        BAKW0004
      COMMON KSUR(40),TS(40),DSDT(40),DSDTB(40),DS(40),DST(40),U(40)     BAKW0005
      COMMON PLRS(40),DSTT(40),QCONDT(40),QCNV(40),QCNVT(40),QCHH(40),   BAKW0006
     1QCHHT(40),QRAB(40),QRABT(40),QRAD(40),QRADT(40),DSDTBN(40),DSN(40) BAKW0007
      COMMON CHOUT(40),HEDG(40),CHT(40),HWL(40),G(40),GZ(40),PR(40)      BAKW0008
      COMMON II(40),SZ(40),SR(40),EMN(40),ITSR(40)                       BAKW0009
      COMMON IABLS(40),KUROP(40)                                         BAKW0010
      COMMON TT(15,6),RT(15,6),CPT(15,6),CNT(15,6),CNT2(15,6),           BAKW0011
     1EPT(15,6),ITMX(6)                                                  BAKW0012
      COMMON THT(35,10),CHT(35,10),RLT(35,10),TQR(35,10),TPI(35,10),     BAKW0013
     1TBRP(35,10)                                                        BAKW0014
      COMMON RECORD(36),TMPR(5),HPR(5),NNPR(5)                           BAKW0015
      COMMON/LK/KOUT,IEX,DEN,VR,IHI(40),ILO(40),IR(40)                   BAKW0016
      COMMON/BACK/EBW,HBW,SGEP,SG4EP,TR4,EPSW,HCONV,TRES,HC,AQ,QWL,TWL,  BAKW0017
     1STAB,TR2                                                           BAKW0018
 9000 FORMAT(2I5,9E12.3)                                                 BAKW0019
C-----BACK-WALL OPTION 1 OPERATIONS FOR NODE I                           BAKW0020
      FACT=VF1(I)*SGEP*AQ                                                BAKW0021
      UC=HBW*AQ                                                          BAKW0022
      L=1                                                                BAKW0023
      IF (FACT) 400,400,100                                              BAKW0024
C-----SIMPLE NO RADIATION CASE                                           BAKW0025
  400 QWL=(TRES-TA(I))/(HC+1.0/UC)                                       BAKW0026
      STAB=AQ*(HBW*0.5 + SG4EP*TA(I)**3)                                 BAKW0027
      RETURN                                                             BAKW0028
C-----GENERAL CASE                                                       BAKW0029
  100 TWL=TA(I)                                                          BAKW0030
  101 UR=FACT*(TWL+TRES)*(TWL**2+TR2)                                    BAKW0031
      US=UR+UC                                                           BAKW0032
      RS=HC+1.0/US                                                       BAKW0033
      TWLN=TA(I)-(TA(I)-TRES)/RS*HC                                      BAKW0034
      CALL SSWTCH(6,KSSW)                                                BAKW0035
      GO TO(102,103),KSSW                                                BAKW0036
  102 CALL LCOUNT(1,LCT,NPG,RECORD(35))                                  BAKW0037
      WRITE(KOUT,9000) I,L,FACT,TWL,TWLN,UC,UR,US,RS,TRES,HC             BAKW0038
  103 IF(ABS(TWLN-TWL)-1.0) 105,105,104                                  BAKW0039
  104 TWL=TWLN                                                           BAKW0040
      L=L+1                                                              BAKW0041
      IF(L-51) 101,100,105                                               BAKW0042
  105 QWL= AQ*((TRES-TWL)*HBW + SGEP*(TR4-TWL**4))                       BAKW0043
      STAB=AQ*(HBW*0.5 + SG4EP*TA(I)**3)                                 BAKW0044
      RETURN                                                             BAKW0045
      END                                                                BAKW0046
```

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      SUBROUTINE CUSIN(RX1,RY1,RX2,RY2,ZX1,ZY1,ZX2,ZY2,STHET)          CUSI0001
      EPS = 1.E-34                                                     CUSI0002
      R1 = RX2-RX1                                                     CUSI0003
      R2 = RY2-RY1                                                     CUSI0004
      Z1 = ZX2-ZX1                                                     CUSI0005
      Z2 = ZY2-ZY1                                                     CUSI0006
      ZR = SQRT((R1*R1+R2*R2)*(Z1*Z1+Z2*Z2))                           CUSI0007
      IF (ZR-EPS) 50,50,30                                             CUSI0008
   30 DOT = (R1*Z1 + R2*Z2)/ZR                                         CUSI0009
      STHET = SQRT(1. - DOT*DOT)                                       CUSI0010
      RETURN                                                           CUSI0011
   50 STHET = 1.                                                       CUSI0012
      RETURN                                                           CUSI0013
      END                                                              CUSI0014
```

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      SUBROUTINE GAP(I,EM1,EM2,HM,HMS,SIG)                             GAP 0001
      RETURN                                                           GAP 0002
      END                                                              GAP 0003
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```
      SUBROUTINE LCOUNT (I,LCT,NPG,R)                                  LCOU0001
C                                                                      LCOU0002
      COMMON/LK/KOUT,IEX,DEN,VR,IM1(40),IL0(40),IR(40)                 LCOU0003
      DIMENSION R(2)                                                   LCOU0004
  551 FORMAT(1H1,25X,71HAEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MALCOU0005
     1TERIAL ABLATION PROGRAM/113X,4HPAGE,I3/10(3X,2A6)                LCOU0006
  552 FORMAT(1H1,25X,71HAEROTHERM AXI-SYMMETRIC TRANSIENT HEATING AND MALCOU0007
     1TERIAL ABLATION PROGRAM/111X6HPAGES ,I3/109X,8HTHROUGH ,I3/108X, LCOU0008
     2(2A6)                                                            LCOU0009
      IJK=I                                                            LCOU0010
      IF (IJK) 2,2,3                                                   LCOU0011
    2 IJK=-IJK                                                         LCOU0012
      GO TO 4                                                          LCOU0013
    3 LCT=LCT-IJK                                                      LCOU0014
      IF (LCT) 4,5,5                                                   LCOU0015
    4 NPG=NPG+1                                                        LCOU0016
      LCT=57-IJK                                                       LCOU0017
      WRITE (KOUT,551) NPG,R                                           LCOU0018
    5 RETURN                                                           LCOU0019
      END                                                              LCOU0020
```

```
      SUBROUTINE LOOK(II,XL,X,A,B,C,E,Y,D,IDN)                          LOOK0001
      COMMON/LK/KOUT,IEX,DEN,VR,IHI(40),ILO(40),IR(40)                  LOOK0002
      DIMENSION  X(1),Y(1),D(1)                                         LOOK0003
      DIMENSION A(1),B(1),C(1),E(1)                                     LOOK0004
      IH=IHI(II)                                                        LOOK0005
      IL=ILO(II)                                                        LOOK0006
      IEX=0                                                             LOOK0007
      IF(X(IH)-X(IL)) 30,30,29                                          LOOK0008
   30 IEX=1                                                             LOOK0009
      IF (XL-X(IH)) 3,2,31                                              LOOK0010
   31 IF (XL-X(IL)) 6,5,4                                               LOOK0011
   29 IF(XL-X(IH))1,2,3                                                 LOOK0012
    1 IF(XL-X(IL))4,5,6                                                 LOOK0013
    6 I=IR(II)                                                          LOOK0014
      I=MIN0(I,IH)                                                      LOOK0015
      I=MAX0(I,IL)                                                      LOOK0016
      IS=1                                                              LOOK0017
      IT=1                                                              LOOK0018
      GO TO 8                                                           LOOK0019
   11 I=I+1                                                             LOOK0020
      IS=0                                                              LOOK0021
    8 IF(I-X) 28,28,38                                                  LOOK0022
   28 IF(XL-X(I)) 7,10,9                                                LOOK0023
   38 IF(XL-X(I)) 9,10,7                                                LOOK0024
    7 I=I-1                                                             LOOK0025
      IT=0                                                              LOOK0026
      IF(IS)10,10,8                                                     LOOK0027
    9 IF(IT)10,10,11                                                    LOOK0028
    3 IEX=3                                                             LOOK0029
    2 I=IH-1                                                            LOOK0030
      GO TO 10                                                          LOOK0031
    4 IEX=2                                                             LOOK0032
    5 I=IL                                                              LOOK0033
   10 DEN=X(I+1)-X(I)                                                   LOOK0034
      IR(II)=I                                                          LOOK0035
      VR=XL-X(I)                                                        LOOK0036
      IF(IDN) 13,13,14                                                  LOOK0037
   14 GO TO (21,22,23,24),IDN                                           LOOK0038
   24 Y(4)=E(I)                                                         LOOK0039
      D(4)=E(I+1)-E(I)                                                  LOOK0040
   23 Y(3)=C(I)                                                         LOOK0041
      D(3)=C(I+1)-C(I)                                                  LOOK0042
   22 Y(2)=B(I)                                                         LOOK0043
      D(2)=B(I+1)-B(I)                                                  LOOK0044
   21 Y(1)=A(I)                                                         LOOK0045
      D(1)=A(I+1)-A(I)                                                  LOOK0046
      DO 12  J=1,IDN                                                    LOOK0047
   20 D(J)=D(J)/DEN                                                     LOOK0048
   12 Y(J)=Y(J)+D(J)*VR                                                 LOOK0049
   13 VR=VR/DEN                                                         LOOK0050
      CALL SSWTCH(2,JJ)                                                 LOOK0051
      GO TO (200,201),JJ                                                LOOK0052
  200 IF (IDN-2) 202,202,204                                            LOOK0053
  204 IF(II-1) 201,202,201                                              LOOK0054
  202 WRITE (KOUT,203) II,IL,IH,XL,IR(II),VR,DEN,IEX,IDN                LOOK0055
  203 FORMAT (3(2X,I2),2A,E10.3,2X,I2,F10.4,2X,E10.3,2(2X,I2))          LOOK0056
      IF (IDN-1) 2025,1025,1025                                         LOOK0057
 1025 WRITE(KOUT,205)(Y(K),D(K),K=1,IDN)                                LOOK0058
  205 FORMAT(4(2A,F10.3))                                               LOOK0059
 2025 CONTINUE                                                          LOOK0060
  201 CONTINUE                                                          LOOK0061
      RETURN                                                            LOOK0062
      END                                                               LOOK0063
```

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      SUBROUTINE UGLE(N,XAM,PRM,NUMX,X,P,EM)                            UGLE0001
      DIMENSION AAM(1),X(1),P(1),EM(1),PRM(1),UPDIM(1)                  UGLE0002
      XDIF=X(NUMX)-X(1)                                                 UGLE0003
      IS=1                                                              UGLE0004
    2 DO 600 J=1,N                                                      UGLE0005
      AA=XAM(J)                                                         UGLE0006
   59 IU=1                                                              UGLE0007
      IT=1                                                              UGLE0008
   61 IF(XDIF) 62,60,71                                                 UGLE0009
   71 IF(AA-X(IS)) 62,63,64                                             UGLE0010
   72 IF(AA-X(IS)-XDI) 62,63,64                                         UGLE0011
   62 IF(IS-1)671,671,68                                                UGLE0012
   68 IS=IS-1                                                           UGLE0013
      IT=2                                                              UGLE0014
      GO TO (651,652),IU                                                UGLE0015
  672 IS=NUMX                                                           UGLE0016
  671 I=IS                                                              UGLE0017
      PR=0.                                                             UGLE0018
      UPDI=EM(I)                                                        UGLE0019
      GO TO 67                                                          UGLE0020
   63 PR=P(IS)                                                          UGLE0021
      UPDI=EM(I+1)                                                      UGLE0022
      GO TO 691                                                         UGLE0023
   64 IS=IS+1                                                           UGLE0024
      IF(IS-NUMX)69,69,672                                              UGLE0025
   69 IU=2                                                              UGLE0026
      GO TO (651,652),IT                                                UGLE0027
   65 IS=IS-1                                                           UGLE0028
   66 I=IS                                                              UGLE0029
      B=(((P(I+1)-P(I))/(X(I+1)-X(I)))-EM(I))/(X(I+1)-X(I))             UGLE0030
      A=(((EM(I+1)-EM(I))/(X(I+1)-X(I)))-2.*B)/(X(I+1)-X(I))            UGLE0031
      H=(A*(XA-X(I+1))+B)*(XA-X(I))                                     UGLE0032
      UPDI=(A*H+EM(I))*F*(XA-X(I))*(XA-X(I))                            UGLE0033
   67 PR=(H+P(I))*(XA-X(I))+P(I)                                        UGLE0034
  691 CONTINUE                                                          UGLE0035
      PRM(J)=PR                                                         UGLE0036
  600 CONTINUE                                                          UGLE0037
   60 CONTINUE                                                          UGLE0038
    4 RETURN                                                            UGLE0039
      END                                                               UGLE0040
```

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      SUBROUTINE ORDERD (NX,X1,I1)                                      ORDE0001
      DIMENSION X1(1),I1(1)                                             ORDE0002
      DIMENSION LS(20)                                                  ORDE0003
      NM=IABS(NX)                                                       ORDE0004
      LS(1)=0                                                           ORDE0005
      LS(2)=1                                                           ORDE0006
      LS(3)=2                                                           ORDE0007
      LI=3                                                              ORDE0008
      I1(1)=1                                                           ORDE0009
      DO 1 N=2,NM                                                       ORDE0010
      I1(N)=N                                                           ORDE0011
      L=LS(LI)                                                          ORDE0012
      LA=LI                                                             ORDE0013
      J=N                                                               ORDE0014
      X1C=X1(J)                                                         ORDE0015
      I1C=I1(J)                                                         ORDE0016
      J=J-L                                                             ORDE0017
      IF(J) 31,31,34                                                    ORDE0018
   34 LI=LI+1                                                           ORDE0019
      LS(LI)=L+L                                                        ORDE0020
      GO TO 29                                                          ORDE0021
   33 LA=LA-1                                                           ORDE0022
      L=LS(LA)                                                          ORDE0023
      IF(L) 3,3,41                                                      ORDE0024
   41 J=J-L                                                             ORDE0025
   32 IF(J) 31,31,29                                                    ORDE0026
   31 LA=LA-1                                                           ORDE0027
      L=LS(LA)                                                          ORDE0028
      J=J+L                                                             ORDE0029
      IF(L) 4,4,32                                                      ORDE0030
   30 LA=LA-1                                                           ORDE0031
      L=LS(LA)                                                          ORDE0032
      IF(L) 4,4,42                                                      ORDE0033
   42 J=J+L                                                             ORDE0034
   29 IF(NX) 229,129,129                                                ORDE0035
  229 IF(X1C-X1(J)) 30,53,33                                            ORDE0036
  129 IF(X1(J)-X1C) 30,53,33                                            ORDE0037
   53 J=1                                                               ORDE0038
      GO TO 3                                                           ORDE0039
    4 J=J+1                                                             ORDE0040
    3 M=N-1                                                             ORDE0041
      MM=M                                                              ORDE0042
      DO 2 K=J,MM                                                       ORDE0043
      X1(M+1)=X1(M)                                                     ORDE0044
      I1(M+1)=I1(M)                                                     ORDE0045
    2 M=M-1                                                             ORDE0046
      I1(J)=I1C                                                         ORDE0047
    1 X1(J)=X1C                                                         ORDE0048
      RETURN                                                            ORDE0049
      END                                                               ORDE0050
```

```
      SUBROUTINE SEQUA(N,L,A,B,C,D)                                     SEQU0001
      DIMENSION A(1),B(1),C(1),D(1),L(1)                                SEQU0002
      IS=0                                                              SEQU0003
      DO 30 II=1,N                                                      SEQU0004
      I=II                                                              SEQU0005
   21 J=L(I)                                                            SEQU0006
      L(I)=I                                                            SEQU0007
      IF(J-I) 22,30,22                                                  SEQU0008
   22 IF(IS) 25,23,25                                                   SEQU0009
   23 SA=A(I)                                                           SEQU0010
      SB=B(I)                                                           SEQU0011
      SC=C(I)                                                           SEQU0012
      SD=D(I)                                                           SEQU0013
      IS=I                                                              SEQU0014
   26 A(I)=A(J)                                                         SEQU0015
      B(I)=B(J)                                                         SEQU0016
      C(I)=C(J)                                                         SEQU0017
      D(I)=D(J)                                                         SEQU0018
      I=J                                                               SEQU0019
      GO TO 21                                                          SEQU0020
   25 IF(IS-J) 26,28,26                                                 SEQU0021
   28 IS=0                                                              SEQU0022
      A(I)=SA                                                           SEQU0023
      B(I)=SB                                                           SEQU0024
      C(I)=SC                                                           SEQU0025
      D(I)=SD                                                           SEQU0026
   30 CONTINUE                                                          SEQU0027
      RETURN                                                            SEQU0028
      END                                                               SEQU0029
```

```
      SUBROUTINE SLOPL(N,N,X,Y,EMS,EMN)                                 SLOP0001
C                                                                       SLOP0002
      INCLUDE DIMS,LIST                                                 SLOP0003
C                                                                       SLOP0004
C-----DIMENSIONED AS SURFACE NODES (NUMBER OF COLUMNS)                  SLOP0005
      COMMON KSUR(40),TS(40),DSDT(40),DSDT8(40),DS(40),DST(40),U(40)    SLOP0006
      COMMON PLAS(40)                                                   SLOP0007
      DIMENSION X(1),Y(1),EMS(1),EMN(1)                                 SLOP0008
      IF(N-1) 100,100,101                                               SLOP0009
  100 J=M                                                               SLOP0010
      RAT=1.-DST(1)/PLAS(1)                                             SLOP0011
      CRL=CR(J)+RAT*(CR(J+1)-CR(J))                                     SLOP0012
      CZL=CZ(J)+RAT*(CZ(J+1)-CZ(J))                                     SLOP0013
      L=J+M+1                                                           SLOP0014
      CRR=CR(L)+RAT*(CR(L+1)-CR(L))                                     SLOP0015
      CZR=CZ(L)+RAT*(CZ(L+1)-CZ(L))                                     SLOP0016
      DZ=CZR-CZL                                                        SLOP0017
      DR=CRR-CRL                                                        SLOP0018
      IF(DZ) 151,150,151                                                SLOP0019
  150 S1=1.E+15                                                         SLOP0020
      GO TO 152                                                         SLOP0021
  151 IF(DR) 153,154,153                                                SLOP0022
  154 S1=1.E-15                                                         SLOP0023
      GO TO 152                                                         SLOP0024
  153 S1=DR/DZ                                                          SLOP0025
  152 S2=-1./S1                                                         SLOP0026
      EMS(1)=S1                                                         SLOP0027
      EMN(1)=S2                                                         SLOP0028
      RETURN                                                            SLOP0029
  101 S1=0.                                                             SLOP0030
      S2=0.                                                             SLOP0031
      NS=0                                                              SLOP0032
      DXS=X(2)-X(1)                                                     SLOP0033
      K=N-1                                                             SLOP0034
      DO 200 I=1,K                                                      SLOP0035
      DX=X(I+1)-X(I)                                                    SLOP0036
      DY=Y(I+1)-Y(I)                                                    SLOP0037
      IF(DX) 302,300,302                                                SLOP0038
  300 IF(DY) 301,320,301                                                SLOP0039
  320 NS=NS+1                                                           SLOP0040
      GO TO 200                                                         SLOP0041
  301 S2=2.E+15/ABS(DY)*DY                                              SLOP0042
      GO TO 303                                                         SLOP0043
  302 S2=DY/DX                                                          SLOP0044
      IF(DX*DXS) 304,303,303                                            SLOP0045
  304 IF(S1+S2) 307,306,307                                             SLOP0046
  306 EMS(I)=1.0E+15                                                    SLOP0047
      GO TO 305                                                         SLOP0048
  307 EMS(I)=2.*S1*S2/(S1+S2)                                           SLOP0049
      GO TO 305                                                         SLOP0050
  303 EMS(I)=(S1+S2)/2.                                                 SLOP0051
  305 DXS=DX                                                            SLOP0052
      IF(NS) 200,200,321                                                SLOP0053
  321 LL=I-NS                                                           SLOP0054
      LU=I-1                                                            SLOP0055
      NS=0                                                              SLOP0056
      DO 323 J=LL,LU                                                    SLOP0057
  323 EMS(J)=EMS(I)                                                     SLOP0058
  200 S1=S2                                                             SLOP0059
      EMS(1)=2.*EMS(1)                                                  SLOP0060
      EMS(N)=S2                                                         SLOP0061
      DO 310 I=1,N                                                      SLOP0062
      IF(EMS(I)) 311,312,311                                            SLOP0063
  312 EMN(I)=1.0E+15                                                    SLOP0064
      GO TO 310                                                         SLOP0065
  311 EMN(I)=-1./EMS(I)                                                 SLOP0066
  310 CONTINUE                                                          SLOP0067
      RETURN                                                            SLOP0068
  500 FORMAT(2I5)                                                       SLOP0069
      END                                                               SLOP0070
```

```
      SUBROUTINE SLOPQ(NUMX,X,P,EM)                                     SLOP0001
C     SLOPE EVALUATION ROUTINE                                          SLOP0002
C                                                                       SLOP0003
      DIMENSION X(1), P(1), EM(1), Z(1)                                 SLOP0004
   30 EM(2) = ( P(2) - P(1) ) / ( X(2) - X(1) )                         SLOP0005
      EM(1) = EM(2)                                                     SLOP0006
      Z(1)=0.0                                                          SLOP0007
      QC = EM(1)                                                        SLOP0008
      DO 36 I = 1 , NUMX                                                SLOP0009
      IP0 = I + 1                                                       SLOP0010
      IP1 = I + 2                                                       SLOP0011
      IT = IP0 - NUMX                                                   SLOP0012
      IF (IT) 33 , 31 , 32                                              SLOP0013
   31 QB=QC                                                             SLOP0014
      GO TO 41                                                          SLOP0015
   32 GO TO 40                                                          SLOP0016
   33 XDT = X(I) - X(IP0)                                               SLOP0017
      XTT = X(IP0) - X(IP1)                                             SLOP0018
      XTD = X(IP1) - X(I)                                               SLOP0019
      AA = P(I) / ( XDT * XTD )                                         SLOP0020
      XDTT=XDT*XTT                                                      SLOP0021
   37 AB=P(I+1)/XDTT                                                    SLOP0022
      AC = P(IP1) / ( XTT * XTD )                                       SLOP0023
      AAA = AA + XTT                                                    SLOP0024
      ABB = AB + XTD                                                    SLOP0025
      ACC = AC + XDT                                                    SLOP0026
      QA = QC                                                           SLOP0027
      QB = EM(I)                                                        SLOP0028
      QC = EM (IP0)                                                     SLOP0029
      EM(IP0) = AB * (XDT - XTT) + ACC - AAA                            SLOP0030
      EM(IP1) = AC * (XTT - XTD) + AAA - ABB                            SLOP0031
      EM(I) =   AA * (XTD - XDT) + ABB - ACC                            SLOP0032
   34 QE = EM(I)                                                        SLOP0033
      IF (I-2) 36,41,35                                                 SLOP0034
   35 EM(I) = ( QE + QA ) /2.                                           SLOP0035
   41 EM(I) = (EM(I) + QB ) /2.                                         SLOP0036
   40 XD=X(I)-X(I-1)                                                    SLOP0037
   36 CONTINUE                                                          SLOP0038
      RETURN                                                            SLOP0039
      END                                                               SLOP0040
```

```
      SUBROUTINE SURFB                                                  SURF0001
C                                                                       SURF0002
      INCLUDE DIMS,LIST                                                 SURF0003
C                                                                       SURF0004
C-----DIMENSIONED AS SURFACE NODES (NUMBER OF COLUMNS)                  SURF0005
      COMMON KSUR(40),TS(40),DSDT(40),DSDTB(40),DS(40),DST(40),U(40)    SURF0006
      COMMON PLBS(40),DSTT(40),QCONDT(40),QCNV(40),QCNVT(40),QCHM(40),  SURF0007
     1QCHMT(40),QRAB(40),QRABT(40),QRAD(40),QRADT(40),DSDTBN(40),DSN(40)SURF0008
      COMMON CMOUT(40),HEDG(40),CHT(40),HWL(40),G(40),GZ(40),PR(40)     SURF0009
      COMMON II(40),SZ(40),SR(40),EMN(40)                               SURF0010
      COMMON IISR(40)                                                   SURF0011
      COMMON IABLS(40),KDROP(40)                                        SURF0012
      DIMENSION EMS(40),BPSV(40)                                        SURF0013
C-----DIMENSIONED AS PROPERTY TABLES, ENTRIES X MATERIALS               SURF0014
      COMMON TT(15,6),RT(15,6),CPT(15,6),CNT(15,6),CNT2(15,6),          SURF0015
     1EPT(15,6),TTMX(6)                                                 SURF0016
C-----DIMENSIONED AS TIME TABLES, ENTRIES X TABLE NO                    SURF0017
      COMMON TMT(35,10),CHT(35,10),RET(35,10),TQR(35,10),TPI(35,10),    SURF0018
     1TTMRP(35,10)                                                      SURF0019
C-----MISCELLANEOUS QUANTITIES                                          SURF0020
      COMMON RECORD(36),IMPR(5),MPR(5),MNPR(5)                          SURF0021
      COMMON VITER(51),EITER(51),IAB,KO                                 SURF0022
      COMMON ZMIN,CMM,CM,CH                                             SURF0023
      COMMON TM,DTM,PRT,TMI,TMF,DLTM,ETA,TIS,DTMS                       SURF0024
      COMMON FV,FT,PIH,ZRO,KOOP,MM,NN,NMT,NMI,QNTS,QSUM,SIG            SURF0025
      COMMON KRESL,KSLOP,KCENT                                          SURF0026
      DIMENSION Y2(8)                                                   SURF0027
      COMMON/ENJOY/TPR(5),NMG(5),TMG(8,5),NLO(8,5),NMI(8,5),            SURF0028
     1KMI(8,5),TISEN(25,5),TMSEN(25,5),TCPSEN(25,5),                    SURF0029
     2ILMG(25,8,5),ISEN(5),TIS(25,8,5),TCMEM(25,8,5),NPR               SURF0030
      COMMON/LK/KOUT,IEX,DEN,VR,IMI(40),ILO(40),IR(40)                  SURF0031
      DATA BLANK/8H      /                                              SURF0032
C-----ADJUSTMENT OF TIME STEP ACCORDING TO LIMITATIONS OF TIME TABLES    SURF0033
      DTMS=DTM                                                          SURF0034
      TMS=TM+DTM                                                        SURF0035
      DO 240 J=1,NN                                                     SURF0036
      K=KSUR(J)                                                         SURF0037
      KT=KTQ(K)                                                         SURF0038
      IF(KT) 240,240,296                                                SURF0039
  296 NTT=KT+20                                                         SURF0040
      I=IR(NTT)                                                         SURF0041
  291 IF(TMT(I+1,KT)-TM+0.00001) 294,290,290                            SURF0042
  294 IF(I+1-IM1(NTT)) 292,290,290                                      SURF0043
  292 I=I+1                                                             SURF0044
      IF(TMT(I+1,KT)-TMT(I,KT)) 291,293,291                             SURF0045
  293 TMS=TM-DTM                                                        SURF0046
      TMDS=TMT(I,KT)-.01                                                SURF0047
      DTM=AMAX1(.01,TMT(I,KT)-TM)                                       SURF0048
      TMS=TM+DTM                                                        SURF0049
      GO TO 291                                                         SURF0050
  290 IR(KTT)=I                                                         SURF0051
C-----DETERMINE ALLOWABLE TIME STEP                                     SURF0052
      K=0                                                               SURF0053
      TMS=TM+DTM                                                        SURF0054
      DO 2 I=1,NN                                                       SURF0055
      DSDT(I)=DSDTB(I)                                                  SURF0056
      K=KSUR(I)                                                         SURF0057
      DTM=AMIN1(DTM,PLBS(I)/(10.*DSDT(I)+.000001),(PLBS(I)/500.+PLB(K))/SURF0058
     1(DSDT(I)+.000001))                                                SURF0059
      IF(DTM-1.0E-12) 106,106,107                                       SURF0060
  106 WRITE (6,108)                                                     SURF0061
  108 FORMAT(10X,14HTOO SMALL TIME STEP//)                              SURF0062
      WRITE(6,109) I                                                    SURF0063
  109 FORMAT(10X,8HCOLUMN=,I3//)                                        SURF0064
      TMS=TM                                                            SURF0065
      RETURN                                                            SURF0066
  107 CONTINUE                                                          SURF0067
    2 CONTINUE                                                          SURF0068
      TMS=TM+DTM                                                        SURF0069
      IF(TMS-PRT) 105,105,104                                           SURF0070
  104 DTM=PRT-TM                                                        SURF0071
      TMS=PRT                                                           SURF0072
      GO TO 4                                                           SURF0073
  105 TMS=TM+DTM                                                        SURF0074
    4 CONTINUE                                                          SURF0075
C-----GET SLOPES NOW PENDING REARRANGEMENT OF THIS SECTION              SURF0076
      GO TO (2904,2905),KSLOP                                           SURF0077
 2904 CALL SLOPL(MM,NN,SZ,SR,EMS,EMN)                                   SURF0078
      GO TO 2903                                                        SURF0079
 2905 CONTINUE                                                          SURF0080
      IF(NN-1) 2901,2901,2902                                           SURF0081
 2901 EMN(1)=1.E+30                                                     SURF0082
      GO TO 2903                                                        SURF0083
 2902 CALL SLOPO(NN,SZ,SR,EMN)                                          SURF0084
      DO 2900 J=1,NN                                                    SURF0085
 2900 EMN(J)=-1./(EMN(J)+1.E-30)                                        SURF0086
 2903 CONTINUE                                                          SURF0087
C-----MAIN COLUMN LOOP FOR SURFACE OPERATIONS                           SURF0088
C                                                                       SURF0089
      DO 7 I=1,NN                                                       SURF0090
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C                                                                       SURF0091
C-----INTERPOLATE IN TIME TABLES AND IDENTIFY OPTION                    SURF0092
C                                                                       SURF0093
      K=KSUR(I)                                                         SURF0094
      KT=KTU(K)                                                         SURF0095
      IF(KT) 20,20,21                                                   SURF0096
   20 HA=TB(K)*DTH/CAP(K)+TA(K)                                         SURF0097
      TB(K)=HA                                                          SURF0098
      TS(I)=TB(K)                                                       SURF0099
      DSDTA(I)=0.                                                       SURF0100
      DSDTBN(I)=0.                                                      SURF0101
      DNP(K)=0.                                                         SURF0102
      GO TO 7                                                           SURF0103
   21 CONTINUE                                                          SURF0104
      ITL=10                                                            SURF0105
      ITS=1                                                             SURF0106
      MT=IABS(MATL(K))                                                  SURF0107
      NTT=KT+20                                                         SURF0108
      IHI(1Y)=IHI(MT)                                                   SURF0109
      J=IR(NTT)                                                         SURF0110
      DEN=(TH-THT(J,KT))/(THT(J+1,KT)-THT(J,KT))                        SURF0111
      IF(THT(J+1,KT)-THT(J,KT)) 2940,2940,295                           SURF0112
 2940 DEN=0.                                                            SURF0113
  295 CH=CHT(J,KT)+DEN*(CHT(J+1,KT)-CHT(J,KT))                          SURF0114
      DRA=TDR(J,KT)+DEN*(TDR(J+1,KT)-TDR(J,KT))                         SURF0115
      HE=HET(J,KT)+DEN*(HET(J+1,KT)-HET(J,KT))                          SURF0116
      DRP=TBRP(J,KT)+DEN*(TBRP(J+1,KT)-TBRP(J,KT))                      SURF0117
      PRES=TPI(J,KT)+DEN*(TPI(J+1,KT)-TPI(J,KT))                        SURF0118
      FACT=DTH/CAP(K)                                                   SURF0119
      KOOP=1                                                            SURF0120
      IF(CH) 297,297,2070                                               SURF0121
  297 KOOP=2                                                            SURF0122
      CH=0.0                                                            SURF0123
      IF(HE-2.0) 298,298,299                                            SURF0124
  298 KOOP=3                                                            SURF0125
      HE=0.                                                             SURF0126
      GO TO 2990                                                        SURF0127
C-----OPTION 2 PREPARATIONS                                             SURF0128
  299 TS(I)=HE                                                          SURF0129
      ST=HE                                                             SURF0130
      SA=DRA/12000.                                                     SURF0131
      DS(I)=SA-DSTT(I)-PLBS(I)+PLB(K)+DST(I)+PLD(K)                     SURF0132
      DSDTA(I)=DS(I)/DTH                                                SURF0133
      HA=VCOS(K,1,MM,CR,CZ,SZ,SR,EMN,PLB,PLBS,DST)                      SURF0134
      IF(HA-.1) 2991,2991,2992                                          SURF0135
 2991 WRITE(6,2993) I,KOOP                                              SURF0136
 2993 FORMAT(//10X,28HBAD SURFACE SHAPE AT COLUMN ,I2,58H.  AM RETURNING SURF0137
     1 TO MAIN PROGRAM WITH THF = TH.  OPTION IS ,I2,1H.//)             SURF0138
      WRITE(KOUT,2994) (J,EMS(J),EMN(J), J=1,NN)                        SURF0139
 2994 FORMAT(10X,15HI,EMS(I),EMN(I)//(10X,I2,2E12.3))                  SURF0140
      THF=TH                                                            SURF0141
      RETURN                                                            SURF0142
 2992 CONTINUE                                                          SURF0143
      DSN(I)=DS(I)*HA                                                   SURF0144
      DSDTBN(I)=DSDTB(I)*HA                                             SURF0145
      CMD=DSDTB(I)*RO                                                   SURF0146
      QCHEM=0                                                           SURF0147
      QCONV=0.                                                          SURF0148
      QRA=0.                                                            SURF0149
      RAD=0.                                                            SURF0150
      CM=0.                                                             SURF0151
      CHZ=0.                                                            SURF0152
      HR=0.                                                             SURF0153
      HW=0.                                                             SURF0154
      HE=0.                                                             SURF0155
      ITS=0                                                             SURF0156
      GO TO 265                                                         SURF0157
C-----OPTION 3 CALCULATIONS                                             SURF0158
 2990 TABC=90000.                                                       SURF0159
      DSDTA(I)=0.                                                       SURF0160
      DS(I)=0.                                                          SURF0161
      DSDTBN(I)=0.                                                      SURF0162
      DSN(I)=0.                                                         SURF0163
      CMD=0.                                                            SURF0164
      CM=0.                                                             SURF0165
      CHZ=0.                                                            SURF0166
      HW=0.                                                             SURF0167
      GO TO (2995,2996,2996),KRESC                                      SURF0168
 2995 A=U(I)/(AC(K)*(1.+FACT*U(I)))                                     SURF0169
      B=-A*(FACT*TB(K)+TA(K))                                           SURF0170
      GO TO 2997                                                        SURF0171
 2996 A=U(I)/AC(K)*(1.+FACT*RB(K-1))/(1.+FACT*(U(I)+RB(K-1)))           SURF0172
      B=-A*(TA(K)+FACT*TB(K)/(1.+FACT*RB(K-1)))                         SURF0173
 2997 CONTINUE                                                          SURF0174
      ERFX=-1                                                           SURF0175
      QCHEM=0.                                                          SURF0176
      QCONV=0.                                                          SURF0177
      VF=VF3(K)                                                         SURF0178
      GO TO 240                                                         SURF0179
C-----OPTION 1 PREPARATIONS                                             SURF0180
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 2070 BF=CMDOT(I)/CH                                                    SURF0181
      VF=VF1(K)                                                         SURF0182
      CHZ=CH                                                            SURF0183
      PHI=2.*BRP*BF                                                     SURF0184
      IF(PHI-.01) 2071,207),2072                                        SURF0185
 2071 CH=CH*(1.-.5*PHI)                                                 SURF0186
      GO TO 2073                                                        SURF0187
 2072 CH=CH/(EXP(PHI)-1.)*PHI                                           SURF0188
 2073 CM=CH*CMM                                                         SURF0189
      GO TO (2076,2077,2077),KRESC                                      SURF0190
 2076 A=U(I)/(AC(K)*(1.+FACT*U(I)))                                     SURF0191
      B=-A*(FACT*TB(K)+TA(K))                                           SURF0192
 2077 A=U(I)/AC(K)*(1.+FACT*RB(K-1))/(1.+FACT*(U(I)+RB(K-1)))           SURF0193
      B=-A*(TA(K)+FACT*TB(K)/(1.+FACT*RB(K-1)))                         SURF0194
 2078 CONTINUE                                                          SURF0195
      CMDL=HPSV(1)                                                      SURF0196
      IAB=IABLS(1)                                                      SURF0197
      ERFX=CH*HE-8                                                      SURF0198
      IPR=KWE(K)                                                        SURF0199
      ILO(12)=1                                                         SURF0200
      IHI(12)=NMG(IPR)                                                  SURF0201
      BPG=CM                                                            SURF0202
      CALL LOOK(12,BPG,TMG(1,IPR),0,0,0,0,Y2(1),Y2(2),1)                SURF0203
      IMG=IR(12)                                                        SURF0204
      VRM=VR                                                            SURF0205
      ILO(14)=NLO(IMG,IPR)                                              SURF0206
      IHI(14)=NHI(IMG,IPR)                                              SURF0207
      ILO(15)=NLO(IMG+1,IPR)                                            SURF0208
      IHI(15)=NHI(IMG+1,IPR)                                            SURF0209
      I1=ILO(14)                                                        SURF0210
      I2=ILO(15)                                                        SURF0211
      IF(IHI(14)-I1) 240,240,203                                        SURF0212
  203 IF(IHI(15)-I2) 240,240,204                                        SURF0213
  204 TABC=TTS(I1,IMG,IPR)+VRM*(TTS(I2,IMG+1,IPR)-TTS(I1,IMG,IPR))      SURF0214
      IF(TS(I)-TABC) 240,240,205                                        SURF0215
C-----ABLATING SURFACE                                                  SURF0216
  205 IF(IAB) 206,206,207                                               SURF0217
  206 CMDL=TLMC(I1,IMG,IPR)-VRM*(TLMC(I1,IMG,IPR)-TLMC(I2,IMG+1,IPR))   SURF0218
      CMD=EXP(CMDL)*CM                                                  SURF0219
      IAB=1                                                             SURF0220
  207 CALL LOOK(14,CMDL,TLMC(1,IMG,IPR),TTS(1,IMG,IPR),                 SURF0221
     1TCHEM(1,IMG,IPR),0,0,Y2(1),Y2(3),2)                               SURF0222
      IRA=IR(14)                                                        SURF0223
      CALL LOOK(15,CMDL,TLMC(1,IMG+1,IPR),TTS(1,IMG+1,IPR),             SURF0224
     1TCHEM(1,IMG+1,IPR),0,0,Y2(5),Y2(7),2)                             SURF0225
      IRB=IR(15)                                                        SURF0226
      DO 208 J=1,4                                                      SURF0227
  208 Y2(J)=Y2(J)+VRM*(Y2(J+4)-Y2(J))                                   SURF0228
      ST=Y2(1)                                                          SURF0229
      CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,OMIV,1)             SURF0230
      TSSQ=ST*ST                                                        SURF0231
      RAD=SIG*EMIV*TSSQ*TSSQ*VF                                         SURF0232
      ERR=CH*Y2(2)+EMIV*QRA-RAD-A*ST+ERFX                               SURF0233
C-----CONVECTION CORRECTION TO BE ADDED                                 SURF0234
      DERR=CH*Y2(4)+((QRA-RAD/EMIV)*OMIV-4./ST*RAD-A)*Y2(3)             SURF0235
      ERRC=ERR/DERR                                                     SURF0236
      VITER(ITS)=CMDL                                                   SURF0237
      EITER(ITS)=ERR                                                    SURF0238
      CMDL=CMDL-ERRC                                                    SURF0239
      IF(ILO(14)-IRA) 210,211,211                                       SURF0240
  210 IF(ILO(15)-IRB) 212,211,211                                       SURF0241
  212 CMMI=AMAX1(TLMC(IRA,IMG,IPR)+TLMC(IRA-1,IMG,IPR),                 SURF0242
     1TLMC(IRB,IMG+1,IPR)+TLMC(IRB-1,IMG+1,IPR))/2.                     SURF0243
      CMDL=AMAX1(CMDL,CMMI)                                             SURF0244
  211 IF(IHI(14)-IRA-1) 220,220,213                                     SURF0245
  213 IF(IHI(15)-IRB-1) 220,220,214                                     SURF0246
  214 CMMA=AMIN1(TLMC(IRA+1,IMG,IPR)+TLMC(IRA+2,IMG,IPR),               SURF0247
     1TLMC(IRB+1,IMG+1,IPR)+TLMC(IRB+2,IMG+1,IPR))/2.                   SURF0248
      CMDL=AMIN1(CMDL,CMMA)                                             SURF0249
      IF(ITS-ITL-1) 220,215,216                                         SURF0250
  215 ERRS=ERR                                                          SURF0251
      CMDL=CMMA                                                         SURF0252
      GO TO 222                                                         SURF0253
  216 IF(ERR*ERRS) 218,222,217                                          SURF0254
  217 CMDL=CMMA                                                         SURF0255
      GO TO 222                                                         SURF0256
  218 ITL=55                                                            SURF0257
      IF(ERRC) 219,222,222                                              SURF0258
  219 CMDL=CMMI                                                         SURF0259
      GO TO 222                                                         SURF0260
  220 IF(ITS-ITL) 222,221,222                                           SURF0261
  221 CMDL=AMIN1(TLMC(I1,IMG,IPR),TLMC(I2,IMG+1,IPR))                   SURF0262
  222 CMD=EXP(CMDL)*CM                                                  SURF0263
      IF(ITS-50) 223,223,224                                            SURF0264
  223 ITS=ITS+1                                                         SURF0265
      IF(ABS(ERR)-1.) 262,262,  207                                     SURF0266
  224 WRITE(6,225)(VITER(J),EITER(J),J=1,51)                            SURF0267
  225 FORMAT(10X,37HSURFACE ENERGY BALANCE ITERATION STOP//12X,26HVARIABSURF0268
     1LE AND ERROR HISTORY//(15X,10E10.3))                              SURF0269
 2264 WRITE(6,226) TH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,OMIV,                SURF0270
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     1RAD,QRA,A,B,CH,CM,CMH,Y2(1),Y2(2),                                SURF0271
     2Y2(3),Y2(4),ST,TS(1),IAB,I,K,I1,I2,ILO(14),                       SURF0272
     3ILO(15),IHI(14),IHI(15),IRA,IRB,IT5,ITL,IMG,IPR                   SURF0273
  226 FORMAT(//10X,10SHTH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,OMIV,RAD,QRA,A,B,SURF0274
     1CH,CM,CMH,Y2(1),Y2(2),Y2(3),Y2(4),ST,TS(1),IAB,I,K,I1,I2/56H ILO(1SURF0275
     24),ILO(15),IHI(14),IHI(15),IRA,IRB,IT5,ITL,IMG,IPR//10X9E12.3/10X,SURF0276
     39E12.3/10X,4E12.3,1514/)                                          SURF0277
      WRITE(6,2262) VF,CHZ,BRP,PHI,FACT,U(I),AC(K),VRP,EMN(I),PLBS(I),  SURF0278
     1PLB(K),CAP(K),VOL(K),TB(K)                                        SURF0279
 2262 FORMAT(//10X,76HVF,CHZ,BRP,PHI,FACT,U(I),AC(K),VRP,EMN(I),PLBS(I),SURF0280
     1PLB(K),CAP(K),VOL(K),TB(K)//10X,9E12.3/10X,5E12.3)                SURF0281
      L=K-MM                                                            SURF0282
      IH=K+MM                                                           SURF0283
      WRITE(6,2263) MATL(L),MATL(K),MATL(IH  ),MATL(K-1),RA(K),RB(K),RA(SURF0284
     1L),RB(K-1),DST(I),DSTT(I),AA(K),AB(K),AD(K),AD(L),AA(IH  ),PLA(K),SURF0285
     2PLD(K),PLC(K),PLC(L),PLB(K-1),PLA(IH  )                           SURF0286
 2263 FORMAT(//10X,101HMATL(L),MATL(K),MATL(K+MM),MATL(K-1),RA(K),RB(K),SURF0287
     1RA(L),RB(K-1),DST(I),DSTT(I),AA(K),AB(K),AD(K),AD(L)/10X,5SHAA(K+MSURF0288
     2M),PLA(K),PLD(K),PLC(K),PLC(L),PLB(K-1),PLA(K+MM)//10X,4I5,7E12.3/SURF0289
     330X,7E12.3/30X,3E12.3//)                                          SURF0290
      IF(IRB) 2206,2266,2267                                            SURF0291
 2266 RETURN                                                            SURF0292
 2267 CONTINUE                                                          SURF0293
      L=0                                                               SURF0294
      IR(19)=1                                                          SURF0295
      IL=ILO(14)                                                        SURF0296
      IH=IHI(14)                                                        SURF0297
      DO 227 J=IL,IH                                                    SURF0298
      L=L+1                                                             SURF0299
      CALL LOOK(15,TLMC(J,IMG,IPR),TLMC(1,IMG+1,IPR),TTS(1,IMG+1,IPR),  SURF0300
     1TCHEM(1,IMG+1,IPR),0,0,Y2(1),Y2(3),2)                             SURF0301
      Y2(1)=TTS(J,IMG,IPR)+VRM*(Y2(1)-TTS(J,IMG,IPR))                   SURF0302
      Y2(2)=TCHEM(J,IMG,IPR)+VRM*(Y2(2)-TCHEM(J,IMG,IPR))               SURF0303
      ST=Y2(1)                                                          SURF0304
      TSSQ=ST*ST                                                        SURF0305
      CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,OMIV,1)             SURF0306
      RAD=SIG*EMIV*TSSQ*TSSQ*VF                                         SURF0307
      ERR=CH*Y2(2)+EMIV*QRA-RAD-A*ST+ERFX                               SURF0308
      EITER(L)=ERR                                                      SURF0309
  227 VITER(L)=TLMC(J,IMG,IPR)                                          SURF0310
      WRITE(6,228) IMG                                                  SURF0311
  228 FORMAT(//10X,92HCOMPLETE SURFACE TABLE FOR ANALYSIS, COMPUTED USINSURF0312
     1G CURRENT VALUES OF CH,QRA,HE,A,B, AND VRM//12X,6HIMG = ,I2//)    SURF0313
      WRITE(6,229) (VITER(J),EITER(J),J=1,L)                            SURF0314
  229 FORMAT(20X,8HLN BRIME,10X,20HENERGY BALANCE ERROR/41X,            SURF0315
     114H(BTU/SQFT-SEC)//(19X,E10.3,14X,E10.3))                         SURF0316
      L=0                                                               SURF0317
      IL=ILO(15)                                                        SURF0318
      IH=IHI(15)                                                        SURF0319
      DO 230 J=IL,IH                                                    SURF0320
      L=L+1                                                             SURF0321
      CALL LOOK(14,TLMC(J,IMG+1,IPR),TLMC(1,IMG,IPR),                   SURF0322
     1TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),0,0,Y2(1),Y2(3),2)                SURF0323
      Y2(1)=Y2(1)+(TTS(J,IMG+1,IPR)-Y2(1))*VRM                          SURF0324
      Y2(2)=Y2(2)+(TCHEM(J,IMG+1,IPR)-Y2(2))*VRM                        SURF0325
      ST=Y2(1)                                                          SURF0326
      TSSQ=ST*ST                                                        SURF0327
      RAD=SIG*EMIV*TSSQ*TSSQ*VF                                         SURF0328
      CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,OMIV,1)             SURF0329
      ERR=CH*Y2(2)+EMIV*QRA-RAD-A*ST+ERFX                               SURF0330
      EITER(L)=ERR                                                      SURF0331
  230 VITER(L)=TLMC(J,IMG,IPR)                                          SURF0332
      IMG=IMG+1                                                         SURF0333
      WRITE(6,231) IMG                                                  SURF0334
  231 FORMAT(/12X,6HIMG = ,I2//)                                        SURF0335
      WRITE(6,229) (VITER(J),EITER(J),J=1,L)                            SURF0336
      IHF=TH                                                            SURF0337
      RETURN                                                            SURF0338
C--   NON-ABLATING SURFACE                                              SURF0339
C                                                                       SURF0340
  240 IAB=0                                                             SURF0341
      CMD=0.                                                            SURF0342
      IF(NGOUP-3) 2400,2491,2491                                        SURF0343
 2400 ILO(16)=1                                                         SURF0344
      IHI(16)=KHI(IMG,IPR)                                              SURF0345
      ILO(17)=1                                                         SURF0346
      IHI(17)=KHI(IMG+1,IPR)                                            SURF0347
      ST=TS(1)                                                          SURF0348
  249 CALL LOOK(16,ST,TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),0,0,0,            SURF0349
     1Y2(1),Y2(2),1)                                                    SURF0350
      CALL LOOK(17,ST,TTS(1,IMG+1,IPR),TCHEM(1,IMG+1,IPR),              SURF0351
     10,0,0,Y2(3),Y2(4),1)                                              SURF0352
      DO 241 J=1,2                                                      SURF0353
  241 Y2(J)=Y2(J)+VRM*(Y2(J+2)-Y2(J))                                   SURF0354
 2491 CONTINUE                                                          SURF0355
      TSSQ=ST*ST                                                        SURF0356
 2401 CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,OMIV,1)             SURF0357
      RAD=SIG*EMIV*TSSQ*TSSQ*VF                                         SURF0358
      ERR=CH*Y2(1)+EMIV*QRA-RAD-A*ST+ERFX                               SURF0359
      DERR=CH*Y2(2)+ (QRA-RAD/EMIV)*OMIV-4./ST*RAD-A                    SURF0360
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      ERRC=ERR/QERR
      VITER(ITS)=ST
      EITER(ITS)=ERR
      ST=ST-ERR
      IRA=IR(16)
      IRB=IR(17)
      IF(ILO(16)-IRA) 242,244,244
  242 IF(ILO(17)-IRB) 243,244,244
  243 TSMI=AMAX1(TTS(IRB,IMG+1,IPR)+TTS(IRB-1,IMG+1,IPR)+
     1TTS(IRA,IMG,IPR)+TTS(IRA-1,IMG,IPR))/2.
      ST=AMAX1(ST,TSMI)
  244 IF(IHI(16)-IRA-1) 247,247,245
  245 IF(IHI(17)-IRB-1) 247,247,246
  246 TSMA=AMIN1(TTS(IRB+1,IMG+1,IPR)+TTS(IRB+2,IMG+1,IPR)+
     1TTS(IRA+1,IMG,IPR)+TTS(IRA+2,IMG,IPR))/2.
      ST=AMIN1(ST,TSMA)
  247 IF(ITS-50) 248,248,250
  248 ITS=ITS+1
      IF(ABS(ERR)-1.) 260,260, 249
  250 WRITE(6,225) (VITER(J),EITER(J),J=1,51)
      WRITE(6,251) TH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,DMIV,
     1RAD,QRA,A,B,CH,CM,CMH,Y2(1),Y2(2),
     2Y2(3),Y2(4),TS(I),DSDT(I),DSDTB(I),
     3CMD,PLB(K),PLBS(I),I,K,IPR,IMG,
     4ILO(16),IHI(16),ILO(17),IHI(17),IR(16),
     5IR(17),IRA,IRB,ITS,ITL,MT
  251 FORMAT(10X,106HTH,DTH,VRM,ERFX,HE,ST,TABC,EMIV,DMIV,RAD,QRA,A,B,CH
     1,CM,CMH,Y2(1),Y2(2),Y2(3),Y2(4),TS(I),DSDT(I),DSDTB(I),/10X,95HCMD
     2,PLB(K),PLBS(I),I,K,IPR,IMG,ILO(16),IHI(16),ILO(17),IHI(17),IR(16)
     3,IR(17),IRA,IRB,ITS,ITL,MT//10X,9E12.3/10X,9E12.3/10X,8E12.3/1513/
     4)
      L=0
      IL=ILO(16)
      IH=IHI(16)
      DO 252 J=IL,IH
      L=L+1
      CALL LOOK(17,TTS(J,IMG,IPR),TTS(1,IMG+1,IPR),TCHEM(1,IMG+1,IPR),0,
     10,0,Y2(3),Y2(4),1)
      Y2(1)=TCHEM(J,IMG,IPR)+VRM*(Y2(3)-TCHEM(J ,IMG,IPR))
      ST=TTS(J,IMG,IPR)
      CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
      TSSQ=ST*ST
      RAD=SIG*EMIV*TSSQ*TSSQ*VF
      ERR=CH*Y2(1)+EMIV*QRA-RAD-A*ST+ERFX
      EITER(L)=ERR
  252 VITER(L)=ST
      WRITE(6,228) IMG
      WRITE(6,253) (VITER(J),EITER(J),J=1,L)
  253 FORMAT(20X,9HSURF TEMP,10X,20HENERGY BALANCE ERROR/
     121X,7H(DEG R),14X,14H(BTU/SQFT-SEC)//(19X,E10.3,15X,E10.3))
      L=0
      IL=ILO(17)
      IH=IHI(17)
      DO 254 J=IL,IH
      L=L+1
      CALL LOOK(16,TTS(J,IMG+1,IPR),TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),
     10,0,0,Y2(3),Y2(4),1)
      Y2(1)=Y2(3)+VRM*(TCHEM(J,IMG+1,IPR)-Y2(3))
      ST=TTS(J,IMG+1,IPR)
      CALL LOOK(19,ST,TT(1,MT),EPT(1,MT),0,0,0,EMIV,DMIV,1)
      TSSQ=ST*ST
      RAD=SIG*EMIV*TSSQ*TSSQ*VF
      ERR=CH*Y2(1)+EMIV*QRA-RAD-A*ST+ERFX
      EITER(L)=ERR
  254 VITER(L)=ST
      IMG=IMG+1
      WRITE(6,231) IMG
      WRITE(6,253) (VITER(J),EITER(J),J=1,L)
      THF=TH
      GO TO 2266
C-----POST ITERATION
C
  260 IF(KGOP-2) 261,261,2650
  261 Y2(2)=Y2(1)
  262 QCHEM=Y2(2)
      IF(ISEN(I)) 263,264,263
  264 QCONV=0.
      GO TO 266
  263 CALL QGLE(1,ST,QCONV,ISEN(IPR),TTSEN(1,IPR),THSEN(1,IPR),
     1TCPSEN(1,IPR))
  266 QCHEM=(QCHEM+QCONV)*CH
      HW=QCONV
      QCONV=CH*(HE-QCONV)
      DSDTBN(I)=CMD/RO
      HA=VCOS(K,I,MM,CR,CZ,SZ,SR,EMN,PLB,PLBS,DST)
      IF(HA-.1) 2991,2991,2660
 2660 CONTINUE
      BPSV(I)=CMUL
      DSDTB(I)=DSDTBN(I)/HA
      DS(I)=DSDTB(I)*DTH
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      USN(I)=DS(I)*HA                                                    SURF0451
 2650 TS(I)=ST                                                           SURF0452
  265 GO TO (2651,2652,2652),KRESC                                       SURF0453
 2651 TB(K)=(FACT*(TB(K)+U(I)*TS(I))+TA(K))/(1.+FACT*U(I))               SURF0454
      GO TO 267                                                          SURF0455
 2652 TB(K)=(FACT*(TB(K)+U(I)*ST)+(1.+FACT*RB(K-1))*TA(K))/(1.+FACT*     SURF0456
     1(U(I)+RB(K-1)))                                                    SURF0457
  267 IF(KCENT) 2670,2670,2671                                           SURF0458
 2670 PLB(K)=PLB(K)-DS(I)                                                SURF0459
      GO TO 2672                                                         SURF0460
 2671 PLB(K)=PLB(K)-DS(I)/2.                                             SURF0461
      PLD(K)=PLD(K)-DS(I)/2.                                             SURF0462
 2672 CONTINUE                                                           SURF0463
      QN=(TS(I)-TB(K))*U(I)                                              SURF0464
      QCONDT(I)=QCONDT(I)+QN*DTH                                         SURF0465
      QSUM=QSUM+QN                                                       SURF0466
      QNP(K)=QN/AC(K)                                                    SURF0467
      QCNV(I)=QCONV                                                      SURF0468
      QCNVT(I)=QCONV*AC(K)*DTH+QCNVT(I)                                  SURF0469
      QCHM(I)=QCHEM                                                      SURF0470
      QCHMT(I)=QCHMT(I)+QCHEM*DTH*AC(K)                                  SURF0471
      QRP=EMIV*QRA                                                       SURF0472
      QRAB(I)=QRP                                                        SURF0473
      QRABT(I)=QRABT(I)+QRP*DTH*AC(K)                                    SURF0474
      QRAD(I)=RAD                                                        SURF0475
      QRADT(I)=QRADT(I)+RAD*DTH*AC(K)                                    SURF0476
      CMDOT(I)=CMD                                                       SURF0477
      HEDG(I)=HE                                                         SURF0478
      CMT(I)=CMT(I)+CMD*AC(K)*DTH                                        SURF0479
      II(I)=KOOP                                                         SURF0480
      ITSK(I)=ITS                                                        SURF0481
      IABLS(I)=IAB                                                       SURF0482
      HWL(I)=HW                                                          SURF0483
      U(I)=CM                                                            SURF0484
      GZ(I)=CMZ*CMM                                                      SURF0485
      PR(I)=EXP(PRES)                                                    SURF0486
C-----NODE DROPPING PACKAGE                                              SURF0487
      IF(PLB(K)) 10,10,11                                                SURF0488
   10 IF(K-(I-1)*MM-1) 13,13,12                                          SURF0489
   12 IF(MATL(K-1)) 15,15,1200                                           SURF0490
 1200 IF(MATL(K-1)-MT) 13,14,13                                          SURF0491
   14 DS(I)=PLB(K)+DS(I)       +PLD(K)                                   SURF0492
      DSTT(I)=DSTT(I)+PLBS(I)-DST(I)                                     SURF0493
      PLB(K)=0.0                                                         SURF0494
      PLD(K)=0.                                                          SURF0495
      MATL(K)=0                                                          SURF0496
      MATL(K-1)=-MATL(K-1)                                               SURF0497
      KSUK(I)=K-1                                                        SURF0498
      KOKOP(I)=1                                                         SURF0499
      CAP(K)=0.                                                          SURF0500
      KSH(K)=0                                                           SURF0501
      KSH(K-1)=1                                                         SURF0502
      PLBS(I)=PLB(K-1)+PLD(K-1)                                          SURF0503
      DST(I)=0.0                                                         SURF0504
      QNP(K-1)=QNP(K)                                                    SURF0505
      GO TO (1203,1203,1201), KRESC                                      SURF0506
 1201 TB(K-1)=(TB(K-1)+RB(K-1)*(TB(K)-TA(K)))*DTH/CAP(K-1)+TA(K-1)       SURF0507
      GO TO 1202                                                         SURF0508
 1203 TB(K-1)=TB(K-1)*DTH/CAP(K-1)+TA(K-1)                               SURF0509
 1202 CONTINUE                                                           SURF0510
      GO TO 7                                                            SURF0511
   13 WRITE(6,16) I,K                                                    SURF0512
   16 FORMAT (//10X,23HBURN THROUGH IN COLUMN ,I3,9H AT NODE ,I3//)      SURF0513
      IHF=IH                                                             SURF0514
      GO TO 17                                                           SURF0515
   15 WRITE(6,18) I,K                                                    SURF0516
   18 FORMAT(//10X,35HIMPROPER NODAL NUMBERING IN COLUMN ,I3,9H AT NODE  SURF0517
     1,I3//)                                                             SURF0518
      IHF=IH                                                             SURF0519
      GO TO 17                                                           SURF0520
   11 KOKOP(I)=0                                                         SURF0521
      IF((PLBS(I)-PLB(K)-DST(I)-PLD(K))/PLBS(I)-.001) 7,7,1100           SURF0522
 1100 HA=PLBS(I)-PLB(K)-DST(I)-PLD(K)                                    SURF0523
      DST(I)=DST(I)+HA                                                   SURF0524
      DSTT(I)=DSTT(I)+HA                                                 SURF0525
C-----NEW AREAS AND NEW VOLUME                                           SURF0526
      RAT=1.-DST(I)/PLBS(I)                                              SURF0527
      J=K+I-1                                                            SURF0528
      CRL=CR(J)+RAT*(CR(J+1)-CR(J))                                      SURF0529
      CZL=CZ(J)+RAT*(CZ(J+1)-CZ(J))                                      SURF0530
      HA=CRL-CR(J)                                                       SURF0531
      HB=CZL-CZ(J)                                                       SURF0532
      HC=HA*HA+HB*HB                                                     SURF0533
      HD=SQRT(HC)                                                        SURF0534
      HE=PIB*HD*(CR(J)+CRL)                                              SURF0535
      AA(K)=HE                                                           SURF0536
      L=J+MM+1                                                           SURF0537
      CRR=CR(L)+RAT*(CR(L+1)-CR(L))                                      SURF0538
      CZR=CZ(L)+RAT*(CZ(L+1)-CZ(L))                                      SURF0539
      HA=CRR-CR(L)                                                       SURF0540
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      MB=CZR-CZ(L)                                                      SURF0541
      MC=MA*MA+MB*MB                                                    SURF0542
      MD=SQRT(MC)                                                       SURF0543
      ME=PI*0.5*(CRR+CR(L))                                             SURF0544
      AD(K)=ME                                                          SURF0545
      MA=CRR-CRL                                                        SURF0546
      MB=CZR-CZL                                                        SURF0547
      MC=MA*MA+MB*MB                                                    SURF0548
      MD=SQRT(MC)                                                       SURF0549
      AC(K)=MB*MD*(CRR+CRL)                                             SURF0550
      MA=CR(J)*CR(J)                                                    SURF0551
      MB=CR(J)*CRL                                                      SURF0552
      MC=CR(J)*CR(L)                                                    SURF0553
      MD=CRL*CRL                                                        SURF0554
      ME=CRL*CRR                                                        SURF0555
      MF=CR(L)*CR(L)                                                    SURF0556
      MG=CR(L)*CRR                                                      SURF0557
      MH=CRR*CRR                                                        SURF0558
      MS=ZRO                                                            SURF0559
      MS=MS+CZ(J)*(MC-MH+MF-MD)                                         SURF0560
      MS=MS+CZ(L)*(MG-MC+MH-MA)                                         SURF0561
      MS=MS+CZL*(MB-ME+MA-MH)                                           SURF0562
      MS=MS+CZR*(ME-MG+MD-MF)                                           SURF0563
      VOL(K)=6.00017E-04*ABS(MS)                                        SURF0564
      SR(I)=(CRL+CRR)/2.                                                SURF0565
      SZ(I)=(CZL+CZR)/2.                                                SURF0566
      IF(K.EQ.1) 7,7,1101                                               SURF0567
 1101 MA=(SR(I)+(CR(J)+CR(L))/2.)/2.                                    SURF0568
      MB=(SZ(I)+(CZ(J)+CZ(L))/2.)/2.                                    SURF0569
      MD=(CRL-CR(J))/2.-MA                                              SURF0570
      ME=(CZL-CZ(J))/2.-MB                                              SURF0571
      MC=MD*MD+ME*ME                                                    SURF0572
      PLA(K)=PI*SQRT(MC)                                                SURF0573
      MD=(CRR-CR(L))/2.-MA                                              SURF0574
      ME=(CZR-CZ(L))/2.-MB                                              SURF0575
      MC=MD*MD+ME*ME                                                    SURF0576
      PLC(K)=PI*SQRT(MC)                                                SURF0577
    7 CONTINUE                                                          SURF0578
      VOLS=VOLS+0.5*VOL*DTH                                             SURF0579
   17 RETURN                                                            SURF0580
      END                                                               SURF0581
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      FUNCTION VCOS(K,I,MM,CR,CZ,SZ,SR,EMN,PLB,PLBS,DST)                VCOS0001
C-----SPECIAL ANDERSON/SCHAEFER/ARC RESTRICTED VERSION                  VCOS0002
      DIMENSION CR(1),CZ(1),SZ(1),SR(1),EMN(1),PLB(1)                   VCOS0003
      DIMENSION PLBS(1),DST(1)                                          VCOS0004
      KOUT=6                                                            VCOS0005
      J=K+I-1                                                           VCOS0006
      L=J+MM+1                                                          VCOS0007
      R1=(CR(J)+CR(L))/2.                                               VCOS0008
      Z1=(CZ(J)+CZ(L))/2.                                               VCOS0009
      DZ=SZ(I)-Z1+1.E-15                                                VCOS0010
      DIST=PLBS(I)-DST(I)                                               VCOS0011
      EMNA=ABS(EMN(I))                                                  VCOS0012
      VCOS=DZ/(DIST  *SQRT(1.+EMNA**2))*(EMN(I)/EMNA+(SR(I)-R1)/DZ*EMNA)VCOS0013
     1/12.6                                                             VCOS0014
      VCOS=ABS(VCOS)                                                    VCOS0015
      RETURN                                                            VCOS0016
      END                                                               VCOS0017
```