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THE CMC/3DPNS COMPUTER PROGRAM FOR PREDICTION OF THREE-DIMENSIONAL, SUBSONIC, TURBULENT AERODYNAMIC JUNCTURE REGION FLOW

VOLUME III - PROGRAMMERS' MANUAL

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FLOW CHARTS

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SUMMARY

THE CMC FLUID MECHANICS COMPUTER PROGRAM SYSTEM IS BEING DEVELOPED TO TRANSMIT THE THEORETICAL EVOLUTION OF FINITE ELEMENT NUMERICAL SOLUTION METHODOLOGY, APPLIED TO NONLINEAR FIELD PROBLEMS INTO A VERSATILE COMPUTER CODE FOR COMPREHENSIVE FLOWFIELD ANALYSIS. THIS REPORT IS VOLUME III OF A THREE VOLUME SET AND PRESENTS A DETAILED VIEW OF THE CODE FROM THE STANDPOINT OF A COMPUTER PROGRAMMER'S USE.

A SYSTEM MACRO FLOW CHART IS PRESENTED ALONG WITH DETAILED FLOW CHARTS OF SEVERAL ROUTINES WHICH ARE DEEMED NECESSARY TO INTERACT WITH A THEORETICIAN / USER TO MODIFY THE OPERATION OF THE PROGRAM.

DESCRIPTIONS OF ALL SUBROUTINES ARE GIVEN AND, WHERE PERTINENT, DETAILS OF USAGE, PRIMARILY FOR INPUT AND OUTPUT ROUTINES.

DESCRIPTION OF INTEGER AND REAL SCALARS ARE GIVEN ALONG WITH A CROSS REFERENCE LIST DENOTING SUBROUTINE USAGE FOR THESE SCALARS.

DESCRIPTION OF ENTRY POINTS IN DYNAMIC STORAGE VECTOR 'IZ'. THE LENGTHS OF EACH VECTOR ACCOMPANY THE SCALAR DEFINITIONS.

A LISTING OF THE ROUTINES PECULIAR TO THE STANDARD TEST CASE IS INCLUDED ALONG WITH A LISTING OF THE INPUT DECK AND PRINTOUT (WHICH INCLUDES DEBUG INFORMATION) FOR THIS CASE.

THE THEORETICAL DESCRIPTION FOR 3DPNS IS GIVEN IN VOLUME I.

THE USER ORIENTED DESCRIPTION IS GIVEN IN VOLUME II.

INTRODUCTION

ALL VARIANTS OF THE CMC SYSTEM ARE BUILT UPON THE MACRO-STRUCTURE ILLUSTRATED IN FIG. 1. THE MAIN EXECUTIVE ROUTINE ALLOCATES CORE USING A VARIABLE DIMENSIONING SCHEME, BASED UPON THE TOTAL DEGREES OF FREEDOM OF THE PROBLEM. THE SIZE OF THE LARGEST PROBLEM THAT CAN BE SOLVED IS THUS LIMITED BY THE CORE SIZE OF THE COMPUTER IN USE. THE PRECISE MIX BETWEEN NUMBER OF DEPENDENT VARIABLES (AND PARAMETERS), AND FINENESS OF THE DIS-CRETIZATION, IS USER-SPECIFIABLE AND WIDELY VARIABLE.

THE INPUT MODULE SERVES ITS STANDARD FUNCTION FOR ALL DEPENDENT VARIABLE, PARAMETER AND GEOMETRIC COORDINATE ARRAYS.

THE DISCRETIZATION MODULE FORMS THE FINITE ELEMENT DISCRETIZATION OF THE SOLUTION DOMAIN.

THE INITIALIZATION MODULE COMPUTES THE REMAINING INITIAL PARAMETRIC DATA REQUIRED TO START THE SOLUTION.

THE INTEGRATION MODULE CONSTITUTES THE PRIMARY EXECUTION SEQUENCE OF PROBLEM SOLUTION. IT IS BASED UPON AN IMPLICIT INTEGRATION ALGORITHM FOR THE COLUMN VECTOR OF UNKNOWNS FOR THE SOLUTION WHICH THE DISCRETIZED DESCRIPTION IS INITIAL VALUED.

CALLS TO AUXILIARY ROUTINES FOR PARAMETER EVALUATION, E.G., VICOSITY, STRESSES, PHI, PP, ETC., AS SPECIFIED FUNCTIONS OF DEPENDENT AND / OR INDEPENDENT VARIABLES ARE GOVERNED BY THE INTEGRATION MODULE.

THE USER HAS CONSIDERABLE LATITUDE TO ADAPT 3DPNS COMDC TO THE SPECIFICS OF THEIR PARTICULAR PROBLEM AT THIS POINT BY DIRECTLY INSERTING USER WRITTEN SUBROUTINES INTO THE FLOW STREAM TO COMPUTE SPECIAL FORMS OF THESE PARAMETERS.

THE OUTPUT MODULE IS SIMILARLY ADDRESSED FROM THE INTEGRATION SEQUENCE AND SERVES ITS STANDARD FUNCTION VIA A HIGHLY AUTOMATED ARRAY DISPLAY ALGORITHM.

PROGRAM DESCRIPTION

THE 3DPNS VARIANT OF CMC IS WRITTEN TO BE READILY EXECUTED ON ANY LARGE SCALE COMPUTER SUCH AS THE IBM 370, 3031, CYBER-175, CYBER-203 OR UNIVAC 1108. IT IS PROGRAMMED IN FORTRAN IV EXCLUSIVELY, EXCEPT FOR CERTAIN MACHINE-DEPENDENT ROUTINES, E.G., DATE, ADDRESS, ERROR HANDLING, ETC.

THE PROGRAM USES ABOUT 100K WORDS OF MEMORY FOR A SOLUTION REGION INVOLVING ABOUT 200 NODES AND ABOUT 12 DEGREES OF FREEDOM PER NODE. OUTPUT CAN BE STORED ON DISC, TAPE OR PUNCHED CARDS FOR FUTURE RESTARTS.

CONSIDERABLE EFFORT HAS BEEN DEVOTED TO CONSTRUCTION OF CMC/3DPNS IN A UNIFORM AND CONSISTENT MANNER.

A COMPREHENSIVE SUBROUTINE SUBSTRUCTURE IS UTILIZED TO ALLOW FUNCTIONAL PROCESSING IN A CONSISTENT AND READILY FOLLOWED SEQUENCE. INPUT FORMATS ARE CONSISTENT AND FLEXIBLE, AND PROGRAM INPUT CONTROLS ARE STANDARDIZED. CONSISTENT NOTATION OF VARIABLE NAMES IS EMPLOYED IN ALL SUBROUTINES AND ONLY THREE MAJOR ARRAYS ARE MAINTAINED.

THE COMMON BLOCK / VARBLE / CONTAINS THE 'IARRAY' AND THE 'RARRAY' VECTORS OF SCALARS. THE IARRAY CONTAINS A LIST OF ALL THE INTEGER SCALARS USED IN COMMON THROUGHOUT THE PROGRAM. THE RARRAY CONTAINS A LIST OF ALL THE REAL SCALARS USED IN COMMON THROUGHOUT THE PROGRAM.

THE COMMON BLOCK / ARRAYS / CONTAINS THE 'IZ' ARRAY. THIS ARRAY CONTAINS ALL THE VARIABLE DIMENSIONED VECTORS, MATRICES AND HOLLERITH DATA WHICH ARE USED BY THE PROGRAM.

THE SOURCE LISTING OF CMC/3DPNS IS NOT INCLUDED IN THIS DOCUMENT DUE TO ITS EXCESSIVE LENGTH (APPROX. 17000 CARDS). THE SUBROUTINES FOR THE 3DPNS VARIANT OF THE COMOC PROGRAM ARE DESCRIBED IN THIS MANUAL.

- -

THE FOLLOWING IS A LIST OF COMMON BLOCKS WHICH ARE USED
TO STORE DATA WHICH MAY BE DESTROYED BY OVERLAY PROGRAMS,
OR WHICH IS NEEDED ACROSS CERTAIN SUBROUTINES.
THE LENGTH OF THE COMMON BLOCKS ARE SHOWN IN PARENTHESIS.

- -

```
/ARRAYS/ (SET IN MAIN)
/CONPPR/ (10) BDINPT, BLOCK DATA, CONTES, DERVDX, IMPLCT, IMPSLV,
         PPRES, PRSGRD, RNLDST, TCHECK,
/DERIV / (100) BCONDT,DERVBL, DFCFBL, DRVBUG, IMPLCT, IMPSLV,
         INDEX, PPRES, STCODE,
/DISCRT/ (10) BLOCK DATA, DSCRTZ,
/IMPDAT/ (20) BDINPT, LINK2, IMPSLV,
/JADRES/ (30)
/NEWGOM/ (10) BLOCK DATA, NWGEOM,
/NPINTQ/ (30)
/OUTDUM/ (75) BDINPT, BLOCK DATA, REOUTP,
/PLOTFE/ (46) BDINPT, BLOCK DATA, FEPLOT,
/PPRSET/ (41) BDINPT, LINK2, GETPPR,
/PRGDUM/ (50) PRSGRD,
/RDREND/ (1) BDINPT, ADDDEL, DELELM, REDREL,
/STDMAT/ (30) BDINPT, BCONDT,DERVBL, FEDIMN, PPRES, STRF,
/VARBLE/ (1000)
```

DESCRIPTION OF CONTROL WORD INPUT (BDINPT)

A CONTROL CARD WITH THE FOLLOWING PARAMETERS IS READ IN -

PARAMETER	FORMAT	CARD COLS	DESCRIPTION
V1	A8	1 - 8	CONTROL VARIABLE.
NMUL	FREE	AFTER 8	N1, N2, . . ., NN NMUL IS A VECTOR 'N' LONG. IT CAN CONTAIN EITHER INTEGER OR REAL VALUES.

FOR CLARITY OF READING THIS SECTION, THE FOLLOWING EQUIVALENCES WILL BE ASSUMED IN SUBROUTINE BDINPT.

```
F1, N1  =  FMUL(1), NMUL(1)
F2, N2  =  FMUL(2), NMUL(2)
F3, N3  =  FMUL(3), NMUL(3)
F4, N4  =  FMUL(4), NMUL(4)
F5, N5  =  FMUL(5), NMUL(5)
F6, N6  =  FMUL(6), NMUL(6)
F7, N7  =  FMUL(7), NMUL(7)
F8, N8  =  FMUL(8), NMUL(8)
F9, N9  =  FMUL(9), NMUL(9)
```

IF KDUMP = 1 IN NAMEO1, THEN THE ENTIRE INPUT CARD IS PRINTED IMMEDIATELY AFTER BEING READ FOLLOWED BY THE DATA THAT IS BEING STORED ALONG WITH THE DATA'S ENTRY POSITION IN THE IZ ARRAY (SEE IAINTG AND IAREAL)

THIS ROUTINE LOOKS FIRST FOR A MATCH OF V1 WITH CERTAIN KEY WORDS WHICH WILL EITHER CAUSE A SUBROUTINE TO BE CALLED OR PROGRAM FLOW TO OCCUR.

DESCRIPTION OF CONTROL WORD INPUT (BDINPT)

THE KEY WORDS THAT ARE SCANNED ARE -

1. (BLANK) - RETURN TO SCAN ANOTHER CARD.
2. COMMENT - PRINT THIS CARD AS A COMMENT.
3. COMOC - PRINT THE COMOC TITLE PAGE TWO TIMES.
4. COMTITLE - READ A TITLE CARD WHICH WILL APPEAR ON COMOC.
5. DESCRIPT N1 - CALL DSCRPT AND PROCESS ACCORDING TO N1.

   N1
   BLANK - READ AND WRITE INFORMATION CARDS.
   203 - READ TITLES FOR DEP. VAR. OUTPUT HEADING.
   204 - READ DESCRIPTIVE TITLE FOR HEADING AT BEGINNING OF OUTPUT HEADER.
   332 - READ TITLES FOR PARAMETERS PRINTED IN THE OUTPUT HEADER.
6. END - RETURN CONTROL TO MAIN PROGRAM.
7. EXIT - CALL EXIT.
8. FEDIMN - CALL DIMENSIONALIZATION ROUTINE FEDIMN.
9. FENAME - CALL FENAME TO SET DEFAULT SCALARS AND THEN CALL NMELST TO READ IN NAME01 AND NAME02 NAMELISTS.
10. ICOND - CALL ICOND TO PRINT INTEGER AND REAL SCALARS.
11. IARRAY N1, N2, N3, N4, ETC. - SET IARRAY(N1) = N2, IARRAY(N3) = N4, ETC.
12. INPUT N1 - SET INPUT UNIT TO N1.
13. KBNO N1 - ENTER FIXED NODES FOR DEP. VARIABLE N1 BY CALLING SUBROUTINE GETBND.

    KBNO N1, 1 - ENTER FIXED NODES FOR DEP. VARIABLE N1 BY CALLING SUBROUTINE GETBCD WHEN N2 .EQ. 1.
14. LINK1 N1 - CALL LINK1(N1)
15. LINK2 N1 - CALL LINK2(N1)
16. LINK3 N1 - CALL LINK3(N1, U, Y) WHERE U, Y HAVE MEANING. WHEN N1 = 1.
17. LINK4 N1 - CALL LINK4(N1, K) WHERE K IS A DUMMY INTEGER.
18. LINK5 N1 - CALL LINK5(N1)
19. NAMELIST - CALL ENTRY 'NMELST' IN SUBROUTINE FENAME TO READ IN NAME01 AND NAME02 NAMELISTS.
20. PLUS N1 N2 N3 . . . ETC. R(N1) = R(N2) + R(N3) + . . . + R(NN)
21. QKNINT - START THE INTEGRATION PROCESS.
22. RARRAY N1 N2 . . . F1 . . . FN . . . NN - R(N1) = R(N2) * . F1 * * FN * . * R(NN)
23. VYYEND N1 - DENOTES END OF INPUT FOR DEP. VAR. N1.
24. ZZZZZZ - CALL SUBROUTINE ZZZZZZ.
25. 2DBL - SET NM = 2.
26. 2DFNS - SET NM = 2.

DESCRIPTION OF CONTROL WORD INPUT

\ \ \ \ - - - VECTOR OPERATIONS - - - \ \ \ \

THE FOLLOWING INDICES WILL PREVAIL WHEN SUBSCRIPT NOTATION IS USED.

```
IZ1  =  IZ(N2) + N6
IZ2  =  IZ(N3) + N7
IZ3  =  IZ(N4) + N8
IZ4  =  IZ(N3) + N4
IZ5  =  IZ(N2) + N3
IZ6  =  IZ(N4) + N5
IZ7  =  IZ(N6) + N7
IZ8  =  IZ(N2) + N4
IZ9  =  IZ(N3) + N5

R(N) =  RARRAY(N)
I(N) =  IARRAY(N)
```

COMMAND NAME IS LOCATED IN COLUMNS 1 - 8 STARTING IN COL. 1.
ENTRIES START AFTER COLUMN 8.

COMMAND NAME	ENTRIES	DESCRIPTION
1. ABSVAL	N1 N2 N3	SET RZ(IZ(N2)) = ABS(RZ(IZ(N3)), I = 1, N1
2. INDEXSET	N1 N2 N3 N4 N5 N6 N7	DO FOR I = 1, N1 K = IZ(IZ5) - 1 RZ(IZ6+K) = RZ(IZ7+I)
3. INTEGER		ALLOWS NEW VALUES TO READ INTO A SEQUENCE OF LOCATIONS IN THE VINTGR, IZINTG AND IAINTG VECTOR
4. MATSUM		CALL MATSUM (RZ(IZ(N2)), RZ(IZ(N3)), R(N4), RZ(IZ(N5)), N1)
5. PDUMP	N1 N2 N3	CALL PDUMP (IZ(IZ(N2)), IZ(IZ(N3)), N1)

6. READ	N1 N2 N3 N4	IF (N2 .EQ. 0) N2 = NNODE
		IF (N2 .GT. 0) N2 = IARRAY(N2)
		IF (N4 .EQ. 999) IZ4 = N3
		READ (N1) RZ(IZ4) , I = 1, N2

7. REAL		ALLOWS NEW VALUES TO READ IN A SEQUENCE OF LOCATIONS IN THE VREAL, IZREAL AND IZREAL VECTORS.
8. RECIP	N1 N2 0 0 0 N6	CALL RECIP (N1, RZ(IZ1))
9. RETRIEVE	N1 N2	CALL NBNDRY (1, IZ(N2), IZ(IYY)) WITH NP = N1
10. RESTOR	N1 N2	CALL RESTOR (N1, IZ(N2), IZ(IYY))
11. SETVAL	N1 N2 N3 N4 N5	CALL SETVAL (RZ(IZ1), RZ(IZ2), R(N4), R(N5), N1)

DESCRIPTION OF CONTROL WORD INPUT

```
12. SQRT N1 N2 ... NJ ... NN
                        R(N1)  = R(N2)**EXPNT
                        R(N3)  = R(N4)**EXPNT
                         .  .  . ETC. BY PAIRS. (EVEN NO. OF ENTRIES).
      FOR AN ODD NUMBER OF ENTRIES, THEN
      SQRT N1 N2 N3  -  R2(I20) = R2(I29)**EXPNT, I = 1, N1
      WHERE EXPNT = 0.5 UNLESS 'POWER          F1' CARD PRECEDES
      THE SQRT CARD, THEN EXPNT = F1.
13. VECMUL N1 N2 N3 N4
                          R2(I21)  =  R2(I22) * R2(I23)**FPOWER
                          WHERE FPOWER = 1.0 OR F9, IF F9 .NE. 0.0.
14. WRITE N1 N2 N3 N4
                    IF ( N2 .EQ. 0 ) N2 = NNODE
                    IF ( N2 .GT. 0 ) N2 = IARRAY(N2)
                    IF ( N3 .GT. 0 .AND. N1 .EQ. 6 )
                       CALL OUTVEC ( N2, I2(I24), PTF )
                    IF ( N3 .LT. 0 .AND. N1 .EQ. 6 )
                       CALL OUTNOD ( N2, I2(I24), PTF )
                    IF ( N1 .EQ. 7 )
                       WRITE (7,9540) ((R2(I24+I-1),I=1,N2)
                    IF ( N1 .NE. 6 .AND. N1 .NE. 7 )
                       WRITE (N1) ((R2(I24+I-1),I=1,N2)
```

DESCRIPTION OF INTEGER TYPE INPUT (BDINPT)

THE FOLLOWING COMMANDS ARE UTILIZED TO LOCATE STORAGE ADDRESSES FOR INTEGER ARRAY DATA SPECIFICATION. THE CARDS ARE DIRECTLY FOLLOWED BY INTEGER DATA CARDS IN FREE FORMAT. THE READ SCAN IS TERMINATED BY A 'T' OR BLANK CARD.

* * * NOTE * * *
'K' DENOTES THE LOCATION IN THE VECTOR 'VINTGR' WHICH CONTAINS THE COMMAND NAMES FOR INTEGER TYPE INPUT.

IZ(IZINTG(K)) = LOCATION IN THE IZ ARRAY AT WHICH TO BEGIN STORING INTEGER ENTRIES.

IARRAY(IAINTG(K)) = NUMBER OF ENTRIES STORED STARTING AT IZ(IZINTG(K)).

IF N1 .EQ. 1, ENTER LITERAL DATA. (SEE SUBROUTINE GETBND)
IF N1 .NE. 1, ENTER NUMERICAL DATA DIRECTLY.

EXAMPLE:

```
IOSAVE
   1248  2248  3248  1247  9248, 5248  6248  7248  T
IOMULT
 3*2  21  4*2, 8*1  T
```

K	COMMAND NAME	IZINTG (K)	IAINTG (K)	DESCRIPTION
7	IPINT	5	31	SOLUTION SEQUENCE VECTOR.
12	LINKCALL	121	125	LINK NOS. TO BE CALLED AT END OF IMPLCT.
14	IOMULT	123	67	OUTPUT VARIABLE MULTIPLIER FROM RARRAY.
15	IOSAVE	124	60	VARIABLE LIST TO BE DISPLAYED AT OUTPUT.
16	CNTPTS	127	47	CONTOUR NODES T. BE USED IN CONTES, DFCFB - TRBTHK, WLFLXS, ETC. * * * NOTE * * * WHEN CNTPTS AND CNTNDS ARE USED, IARRAY(47) SHOULD BE SET TO AT LEAST THE NO. OF ENTRIES IN CNTPTS TO ALLOW FOR STORAGE ALLOCATION.
17	CNTNDS	128	128	NO. OF NODES IN EACH CONTOUR LINE.
18	IBORD	38	131	COUNTER-CLOCKWISE LIST OF BOUNDARY.
19	IPSIBD	14	67	DIAGONAL FLAG REVERSAL VECTOR.
21	IONUMB	131	142	LIST OF ENTRIES IN RARRAY TO BE DISPLAYED AT START OF EACH OUTPUT.
22	MPARA	133	67	LIST OF MULTIPLIERS IN RARRAY USED TO MULTIPLY IONUMB ENTRIES.
28	ELEMENTS	26	67	READ IN ELEMENT NODE CONNECTIONS.

* * * NOTE -
IAINTG(K) OR IAREAL(K) = 67 IMPLIES PRESET LENGTH IS NOT CHANGED.

DESCRIPTION OF REAL TYPE INPUT (BDINPT)

THE FOLLOWING COMMANDS ARE UTILIZED TO LOCATE STORAGE ADDRESSES FOR REAL ARRAY DATA SPECIFICATION. THE NAME CARDS ARE DIRECTLY FOLLOWED BY REAL DATA CARDS IN FREE FORMAT. THE READ SCAN IS TERMINATED BY A 'T' OR BLANK CARD.

* * * NOTE * * *
'K' DENOTES THE LOCATION IN THE VECTOR 'VREAL' WHICH CONTAINS THE COMMAND NAMES FOR REAL TYPE INPUT.

IZ(IZREAL(K)) = LOCATION IN THE IZ ARRAY AT WHICH TO BEGIN STORING REAL ENTRIES.

IARRAY(IAREAL(K)) = NUMBER OF ENTRIES STORED STARTING AT IZ(IZREAL(K)).

THESE CONTROL CARDS CAN CONTAIN A GROUP OF MULTIPLIERS FOR THE ENTERED DATA.
THE MULTIPLIER ENTRIES CAN BE OF THREE TYPES:
1. +/- REAL NO.
2. +N, SELECTS RARRAY(N) AS MULTIPLIER.
3. -N, SELECTS RARRAY(N) AS DIVISOR.

EXAMPLE:

```
DEFVAR      2      3   100.0   -27
   30*22.5   26.7   35.3   10*50.0   T
```

MULTIPLIES EACH VECTOR ENTRY OF DEF. VAR. #2 BY 100.0 * RARRAY(3) / RARRAY(27)

K	COMMAND NAME	IZREAL (K)	IAREAL (K)	DESCRIPTION.
1	VU2POS	63	177	X STATION FOR VARIABLE GRID CHANGE IN TRANSVERSE DIRECTION.
2	VU2VAL	64	67	SCALE FACTOR FOR GRID CHANGE IN TRANSVERSE DIRECTION.
3	VU3POS	65	178	X STATION FOR VARIABLE GRID CHANGE IN NORMAL DIRECTION.
4	VU3VAL	66	67	SCALE FACTOR FOR VARIABLE GRID CHANGE IN NORMAL DIRECTION. DEFAULT = 1.0 / ALC
9	VX1COR	89	16	X1-COORDINATES AT NODE POINTS.
10	VX2COR	90	16	X2-COORDINATES AT NODE POINTS.

DESCRIPTION OF REAL TYPE INPUT

K	COMMAND NAME	IZREAL (K)	IAREAL (K)	DESCRIPTION.
16	VPRESS	91	67	PRESSURE VALUES AT NODE POINTS. DEFAULT = PINF
18	VYY	72	67	DEPENDENT VAR. DIST. AT NODE POINTS.
23	VSUTHLD	133	67	STLDVR, STLDTR, STLDCR, STLDEX, STLCON ENTRIES FOR SUTHERLANDS LAW. DEF. .1163E-4, 494.0, 204.0, 1.5, 0.0
25	VX3ST	139	161	DOWNSTREAM STATIONS AT WHICH PRESSURE IS DEFINED.
26	VPVSX	140	67	DOWNSTREAM PRESSURES AT VX3ST. DEFAULT = XMUINF
29	RARRAY	0	67	RARRAY(NX) = AMULT, WHERE AMULT = COMBINATION OF REMAINING ENTRIES.
33	DEPVAR	NN	67	DEPENDENT VAR. DIST. AT NODE POINTS. NN IS DETERMINED BY DEP. VAR. N1. NN = IYY + (NP-1) * NYY * NODE WHERE NP IS THE LOCATION OF N1 IN THE IPINT VECTOR.

THE AMULT MULTIPLIER FOR THIS CASE CONSISTS OF THE PRODUCT OF THE REMAINING CONTROL NOS. AFTER N1.

SUBROUTINE DESCRIPTIONS.

THE FOLLOWING PAGES CONTAIN A BRIEF DESCRIPTION OF THE SUBROUTINES IN THE COMOC COMPUTER PROGRAM.

NAMES IN PARENTHESES INDICATE CALLING ROUTINES.

IF NO NAME IS ENTERED THEN SEVERAL ROUTINES PLACE CALL.

CONTROL ROUTINES

MAIN

THIS IS THE MAIN CONTROL PROGRAM WHICH INITIALIZES THE RARRAY, IARRAY AND THE IZ ARRAYS TO ZERO.
TO CHANGE THE VARIABLE SOTRAGE CAPACITY OF THE IZ ARRAY, RESET THE DIMENSION OF 'IZ' AND, ACCORDINGLY, THE VALUE OF 'IZSIZE'.
AFTER INITIALIZATION THE CONTROL ROUTINE BDINPT IS CALLED.

BDINPT (MAIN)

THIS IS THE CONTROL ROUTINE WHICH INITIALIZES VECTORS AND CONTROLS THE FLOW OF THE PROGRAM ACCORDING TO USER INPUT.
(SEE TABLE 1 FOR INPUT DESCRIPTION.)

LINK1 SUB. LINK1 (KK)

PLACE CALLS TO THE FOLLOWING ROUTINES ACCORDING TO THE VALUE OF KK:

2. NODELM
3. GEOMFL
4. GETPPR
5. PRSGRD
7. BCONDT

LINK2 SUB. LINK2 (KK)

PLACE CALLS TO THE FOLLOWING ROUTINES ACCORDING TO THE VALUE OF KK:

1. DFCFNS
2. DFCFBL
3. WLFLXS
4. CONTES
5. REOUTP
6. TRANSFER TO FEOUTP PORTION OF REOUTP.
7. STRF
9. DRHOBL
10. TBLINP
13. XYCRDM
14. DSCRTZ
15. TRBT! ;
23. CPSTUP

CONTROL ROUTINES

LINK3 SUB. LINK3 (KK, U, Y)

PLACE CALLS TO THE FOLLOWING ROUTINES
ACCORDING TO THE VALUE OF KK:

1. NBNDRY
2. RITE
4. DIMEN
5. SUMKEY

LINK4 SUB. LINK4 (KK, NN)

PLACE CALLS TO THE FOLLOWING ROUTINES
ACCORDING TO THE VALUE OF KK:

2. IMPLCT
9. POTENT

LINK5 SUB. LINK5 (KK)

PLACE CALLS TO THE FOLLOWING ROUTINES
ACCORDING TO THE VALUE OF KK:

1. NWGEOM
2. CALL ROUTINES FROM LINKCALL LIST AT END OF IMPLCT.
3. CPINIT
5. SCHPRN
6. SETDIF

GENERAL PURPOSE ROUTINES

ASMVEC
BOOLEAN ASSEMBLY OF ELEMENT MATRIX INTO GLOBAL MATRIX.

AVRG SUB. AVRG (IND, ARR, NUMB)
COMPUTE THE ARITHMETIC AVERAGE OF 'NUMB' ENTRIES
IN THE ARRAY 'ARR' INDEXED BY THE ENTRIES OF 'IND'.

CSFINP (NODPCP)
CUBIC SPLINE FIT FOR A MONOTONICALLY INCREASING FUNCTION.

DUDY (WLFLXS)
THREE POINT INTEGRATION FORMULA FOR COMPUTING DUDY.

LOC (MPRD)
COMPUTE VECTOR SUBSCRIPT FOR AN ELEMENT IN A MATRIX OF
SPECIFIED STORAGE MODE.

LOCATE SUB. LOCATE (NA, NN, M, N)
FIND THE LOCATION OF 'M' IN THE ARRAY 'NA' AND STORE IT IN 'N'.

LOOK SUB. LOOK (M, TIN, CIN, TFIN, COUT)
FIND 'TFIN' IN 'TIN' VECTOR. PERFORM LINEAR INTERPOLATION
OF 'TIN', 'CIN' AND PLACE IN 'COUT'.

LOOKAV (NWGEOM) SUB. LOOKAV (M, TIN, CIN, TFIN, COUT, OSNEL)
SIMILAR TO 'LOOK' EXCEPT THAT TRANSITION POINTS ARE RELAXED
BY SCALAR 'RELAX' TO PROVIDE 'SMOOTH' TRANSITION OF GEOMETRY.

MATSUM SUB. MATSUM (A, B, COEF, C, N)

```
      IARRAY(347) = INCLFT
      IARRAY(348) = INCRGT
      KRINC = 1
      NN = N * INCLFT
      DO 200 I = 1, NN, INCLFT
      A(I) = B(I) + COEF * C(KRINC)
      KRINC = KRINC + INCRGT
  200 CONTINUE
      INCLFT = 0
      INCRGT = 0
```

GENERAL PURPOSE ROUTINES

MINMAX (DSCRTZ,ORDER,SETSCL)
SUB. MINMAX (XN, XM, ILIM, NAR, IMN, IMX)
COMPUTE THE MINIMUM 'XN' AND MAXIMUM 'XM' ENTRIES IN AN ARRAY
'NAR' AT LOCATIONS 'IMN' AND 'IMX' IN THE ARRAY.

MNMX (ELEM) SUB. MNMX (NN, INA, MN, MX, LOW, LHI)
FROM AN INTEGER VECTOR INA CONTAINING NN ENTRIES,
STORE THE FOLLOWING:
LOW - POSITION IN 'INA' OF MINIMUM.
LHI - POSITION IN 'INA' OF MAXIMUM.
MN - MINIMUM VALUE IN 'INA'.
MX - MAXIMUM VALUE IN 'INA'

MPRD (GEOMFL)
MULTIPLY TWO MATRICES AND STORE IN RESULTANT MATRIX.
C = A * B

NBNDRY (LINK3(1))
THE VALUE OF 'NBSET' DETERMINES THE OPERATION OF THIS ROUTINE,
NBSET = 1, STORE THE DEPENDENT VARIABLE INTO 'YY' VECTOR.
NBSET = 0, STORE THE DEPENDENT VARIABLE FROM 'YY' VECTOR.

NODFIX (BDINPT,DFCFBL) SUB. NODFIX (IB, INFIX)
COMPUTE FIXED NODES AS A FUNCTION OF INPUT IN BDINPT.
IN DFCFBL, COMPUTE FIXED NODES FOR TKE - DISS. AS FCT. OF YPLUS.

ORDER (COLS,ROWS,XYSCAL)
ORDER 3 ARRAYS ACCORDING TO THEIR X1 AND X2 COORDINATES.
THE THIRD ARRAY WILL CONTAIN THEIR ARRAY LOCATIONS.

RECIP SUB. RECIP (NN, A)
FOR NON-ZERO ENTRIES IN 'A', STORE 1.0/A BACK INTO 'A'.

RESET SUB. RESET (NN, A, V)
RESET 'NN' ENTRIES OF ARRAY 'A' TO THE VALUE 'V'.

RESETI SUB. RESETI (NN, NVEC, NVAL)
RESET 'NN' ENTRIES OF ARRAY 'NVEC' TO THE VALUE 'NVAL'.

RESTOR SUB. RESTOR (NN, A, YY)
SETS DEP. VARIABLE 'NN' IF SOME ENTRIES ARE CHANGED
WITHOUT INTEGRATION OR ITERATION.
NI = FCT(NN)
YY(NI+I) = A(I) FOR I = 1, NNODE

GENERAL PURPOSE ROUTINES

SETRZS

```
      SUB  SETRZS ( IOUT, IN, C, D, N )
```

COMPUTE RZ(IOUT+I-1) = C * RZ(IN+I-1) + D, FOR I = 1, N

SETVAL

```
      SUB. SETVAL ( A, B, C, D, N )
      IARRAY(347) = INCLFT
      IARRAY(348) = INCRGT
      KRINC = 1
      NN = N * INCLFT
      DO 200 I = 1, NN, INCLFT
      A(I) = C * B(KRINC) + D
      KRINC = KRINC + INCRGT
200   CONTINUE
      INCLFT = 0
      INCRGT = 0
```

VARMAX (FEDIMN,FEPLOT) SUB. VARMAX (NK, VAR, XMAX)
FOR +NK, FIND MAXIMUM VALUE IN VECTOR 'VAR' AND STORE IN 'XMAX'
FOR -NK, FIND MINIMUM VALUE IN VECTOR 'VAR' AND STORE IN 'XMAX'.

VECMUL

```
      SUB. VECMUL ( NPT, C, A, B )
```

FOR I = 1, NPT, STORE:

```
      C(I) = A(I) * B(I)
```

INPUT ROUTINES

ADDDEL (ELEM,GETBCD,GETBND)
ADD OR DELETE ENTRIES IN AN INTEGER ARRAY DEPENDING ON THE VALUE OF 'KTYP'.
KTYP = 1, DELETE
KTYP = 2, ADD

BNDSET (GETBCD,GETBND)
DETERMINE NODES TO BE INSERTED INTO BOUNDARY ARRAY.

DESCRP(KA) (BDINPT) SUB. DESCRP(KA)
FOR DIFFERENT VALUES OF KA, PRINT THE FOLLOWING.

0,1	READ/WRITE PROBLEM DESCRIPTION.
3	READ/WRITE IARRAY ENTRY AND DESCRIPTION (10A4,I10,5A4), RARRAY ENTRY AND DESCRIPTION (10A4,I10,5A4).
203	READ TITLE FOR OUTPUT STATION HEADING.
204	READ TITLE FOR 'COMOC' COVER PAGE.

GETBCD (BDINPT)
INPUT IS SIMILAR TO GETBND EXCEPT THAT THERE IS ONLY ONE BLOCK PER CARD.

KEYWORD	FORMAT	BLOCK COLS.	DESCRIPTION
(SAME) KEYWORD	A8 FORMAT	1 - 8 BLOCK COLS.	SAME DEF. AS IN GETBND. DESCRIPTION
KODE1	FREE	AFTER 8	SAME AS KODE1 IN GETBND.
KODE2	FREE	AFTER KODE1	SAME AS KODE2 IN GETBND.
KODE3	FREE	AFTER KODE2	SAME AS KODE3 IN GETBND.
A1	FREE	AFTER KODE3	VALUE OF A1 FOR THIS BOUNDARY.
MA1	FREE	AFTER A1	RARRAY MULT. FOR A1.
A3	FREE	AFTER MA1	VALUE FOR A3 BOUNDARY CONDITION.
MA3	FREE	AFTER A3	RARRAY MULT. FOR A3.
			+MA1 = MULTIPLY BY RARRAY(MA1)
			-MA1 = DIVIDE BY RARRAY(MA1)

GETBCM (GETBCD)
EXTRACT BOUNDARY CONDITION VECTORS FROM INPUT DATA.

INPUT ROUTINES

GETBND (BDINPT)
ESTABLISHES THE BOUNDARY NODE VECTOR FOR EACH DEP. VAR. USING EITHER THE WORD 'ADD' OR SIMPLE GEOMETRY OF THE PROBLEM
WITH THE FOLLOWING KEYWORDS AND CODES -
EACH CARD IS DIVIDED INTO FOUR IDENTICAL BLOCKS OF 20 COLUMNS EACH.
ALL BLOCKS ARE OF THE SAME FROMAT SO THAT A DESCRIPTION OF ONE BLOCK ONLY WILL BE GIVEN.
THE BLOCKS START IN COL. 1, 21, 41 AND 61.

KEYWORD	FORMAT	BLOCK COLS.	DESCRIPTION
TOP	A8	1 - 8	ACROSS TOP FROM LEFT TO RIGHT.
-TOP	A8	1 - 8	ACROSS TOP FROM RIGHT TO LEFT.
BOTTOM	A8	1 - 8	ACROSS BOTTOM FROM LEFT TO RIGHT.
-BOTTOM	A8	1 - 8	ACROSS BOTTOM FROM RIGHT TO LEFT.
RIGHT	A8	1 - 8	UP RIGHT HAND SIDE.
-RIGHT	A8	1 - 8	DOWN RIGHT HAND SIDE.
LEFT	A8	1 - 8	UP LEFT HAND SIDE.
-LEFT	A8	1 - 8	DOWN LEFT HAND SIDE.
(BLANK)	A8	1 - 8	IGNORE BLOCK.
ADD	A8	1 - 8	CALL ADDDEL TO INSERT ENTRIES. IGNORE BLOCK COLS. 9 - 20.
DELETE	A8	1 - 8	CALL ADDDEL TO DELETE ENTRIES. IGNORE BLOCK COLS. 9 - 20.
DONE	A8	1 - 8	LEAVE ROUTINE.

FOR THE FOLLOWING KEYWORDS, THE THREE CODES (WE'LL CALL THEM KODE1, KODE2 AND KODE3 FOR CONVENIENCE) WILL DETERMINE WHICH NODES WILL BE SELECTED.

KEYWORD	FORMAT	BLOCK COLS.	DESCRIPTION
KODE1	I4	9 - 12	ROW OR COLUMN DISPLACEMENT FROM EDGE BEING DESCRIBED (DEF. = 0).
KODE2	I4	13 - 16	POS. IN LINE TO START (DEF. = FIRST)
KODE3	I4	17 - 20	POS. IN LINE TO END (DEF. = LAST)

READER (BDINPT,DSCRTZ,READV) SUB. READER (L1, F1, KNTR)
WHEN DATA CARD IS READ, STORE
1. INTEGERS IN 'L1' VECTOR
2. REALS IN 'F1' VECTOR

INITIALIZATION ROUTINES

BRDSHW (BDINPT)
DISTRIBUTE U1 PROFILE OVER DOMAIN ACCOR NG TO BRADSHAW DATA.
CASE NO. 1400 FROM 1967 STANFORD PROCEEDINGS.

CPINIT (DIMEN)
COMPUTE CPINF AT TSINF.

DIMEN (LINK3(4))
COMPUTE NON-DIMENSIONALIZING FACTORS USED IN PROGRAM.

FEDIMN (BDINPT)
SET UP DIMENSIONS OF VARIABLE LENGTH ARRAYS USED IN THE SYSTEM.
IF 'KDUMP' = 1, PRINT LOCATION OF ENTRY POINTS IN 'IZ' ARRAY.

FENAME (BDINPT)
THIS ROUTINE CONTAINS A LIST OF ALL EQUIVALENCED VARIABLES
IN THE IARRAY AND RARRAY VECTORS.
MOST DEFAULT VALUES ARE ALSO SET IN THIS ROUTINE.
CALL NMELST TO READ IN NAME01 AND NAME02 NAMELISTS.

FINDBE (BDINPT)
DETERMINE A SERIES OF BOUNDARY ELEMENTS AS A FUNCTION OF
INPUTING BOUNDARY NODES IN COUNTER-CLOCKWISE ORDER.
ON FIRST PASS, IF IBORD IS READ, FIND BORDER ELEMENTS
AND REORDER NODES SO THAT FIRST TWO ARE ON THE BOUNDARY.

GEOMDR (GEOMFL)
COMPUTE ENTRIES FOR B112 AND B113 MATRICES.

GEOMFL (LINK1(3))
GENERATE THE UNIQUE ELEMENT MATRICES AND VECTORS.
SET UP THICKNESS VECTOR ITK.
GENERATE LENGTH * THICKNESS ARRAY IX1P2.
GENERATE AREA * THICKNESS ARRAY IAREA.
GENERATE B112 MATRIX.
GENERATE B113 MATRIX.
IF KODG .GT. 0, PRINT ELEMENT NO., NODES OF ELEMENT AND
COORDINATES OF NODES FOR ELEMENTS FROM 'IBOT' TO 'ITOP'.
AFTER THE ELEMENT LOOP IS COMPLETED, PRINT THE VECTORS AND
MATRICES THAT WERE GENERATED IN THE ELEMENT LOOP.

GETALC (XYCRDM)
COMPUTE 'ALC' AS THE SHORTEST SIDE OF ALL THE ELEMENTS,
IF IT IS NOT READ IN NAME02.

INITIALIZATION ROUTINES

INDEX (BDINPT,LINK3)
SET UP BASE LOCATIONS FOR VARIABLES TO BE USED IN SOLUTION.
SET BASE ADDRESSES FOR ELEMENT MATRICEX AND VECTORS
USED IN 'DERVBL' ELEMENT ASSEMBLY LOOP.

JNCINP (TBLINP)
DISTRIBUTE U1, TKE AND DISS. OVER JUNCTURE REGION DOMAIN.

NMELST (ENTRY POINT IN FENAME)
READ NAMELISTS 'NAME01' AND 'NAME02' WITHOUT AFFECTING
SCALARS IN FENAME THAT MAY HAVE BEEN CHANGED SINCE
CALL TO FENAME.

NODPCP (BDINPT)
PLACE PC BOUNDARY DATA ALONG DOMAIN BOUNDARY.
DISTRIBUTE PC DATA OVER ENTIRE DOMAIN USING STRF.

GRID DISCRETIZATION ROUTINES

COLS (DSCRTZ)
COMPUTE THE NUMBER OF COLUMNS, 'LCOL', IN THE OUTPUT DISPLAY AND SET UP THE FOLLOWING ARRAY,
INCOL(J) - NO. OF NODES IN COLUMN J.

DELADD (ADDDEL)
ADD ENTRIES TO AN INTEGER ARRAY 'NSIDE' AT A TIME.

DELELM (DELNOD)
DELETE ENTRIES IN AN INTEGER ARRAY 'NSIDE' AT A TIME.

DELETE (DSCRTZ)
DELETE NODES THAT ARE NOT CONNECTED TO ANY ELEMENTS.

DELNOD (ADDDEL)
SET UP CALL TO DELELM AND SUPPRESS ZERO ENTRIES IN A VECTOR.

DSCRTZ (LINK2(14))

SET UP SOLUTION DOMAIN DISCRETIZATION.

SET UP SCALE FACTORS, GENERATE NODES AND ELEMENTS, COMPUTE ROW AND COLUMN KEYS FOR SOLUTION AND PRINTOUT, AND SCALE INPUT COORDINATES BY REFL.

THE FOLLOWING KEYWORDS ARE USED TO TRANSFER FLOW -

TYPE I - THIS TYPE OF INPUT IS FOR RECTANGULAR GEOMETRY.

KEYWORD	FORMAT	COLS.	DESCRIPTION
VX2SCL	A8	1-8	READ THE FOLLOWING IN FREE FORMAT X0 - START OF X2 GEOMETRY. NDIV1 - NO. OF DIVISIONS IN FIRST INTERVAL. X2 - X2 POS. AT END OF INTERVAL. PR1 - PROGRESSION RATIO FOR SPACING. NDIV2 - NO. OF DIV. IN 2ND INTERVAL. X2 - X2 POS. AT END OF 2ND INT. PR2 - PROG. RATIO FOR SPACING. . . . CONTINUE WITH NDIV3 X3 PR3, UNTIL A SCAN DELIMITER 'T' OR A BLANK CARD IS ENCOUNTERED.
VX1SCL	A8	1-8	SAME AS VX2SCL BUT FOR DIRECTION 2.

GRID DISCRETIZATION ROUTINES

DSCRTZ CONT. TYPE I INPUT.

KEYWORD	FORMAT	COLS.	DESCRIPTION
NDECRD	A8	1-8	
N1	FREE	AFTER COL. 8 ON NDECRD CARD.	FOR N1 EQ -1, A RECTANGULAR GRID IS FORMED FROM THE VX1SCL AND VX2SCL INPUT. FOR N1 NE -1, READ IN RECTANGULAR MESHES, 4 PER CARD IN FREE FORMAT. TERMINATE READ WITH A BLANK CARD. NRL, NRU, NCL, NCU NRL - LOWER ROW NUMBER NRU - UPPER ROW NUMBER. NCL - LOWER COLUMN NUMBER. NCU - UPPER COLUMN NUMBER. E. G. 3 8, 1 6 PRODUCES A MESH OF NODES FROM ROW 3 THRU ROW 8 AND FROM COLUMNS 1 THRU 6 WITH SCALE FACTORS GENERATED ACCORDING TO THE PR(I)'S.
ELEM	A8	1-8	GENERATE ELEMENTS FROM RECTANGULAR MESH.
N1	FREE	AFTER COL. 8	ON 'ELEM' CARD +1 = ADD ELEMENTS IN ELEM.
N2	FREE	AFTER N1	-1 = DELETE ELEMENTS IN ELEM.
N3	FREE	AFTER N2	TURN DIAGONALS BELOW ROW N3.
N4	FREE	AFTER N3	TURN DIAGONALS RIGHT OF COL. N4.
DONE	A8	1-8	SCALE X1COR BY XSCALE SCALE X2COR BY YSCALE AND RETURN.

* * * NOTE * * * VX1SCL IS OPTIONAL FOR 1D ELEMENTS.

E.G. CREATE A GRID 41 ROWS BY 25 COLUMNS

```
LINK2      14     T    CALL DSCRTZ
VX1SCL
   0.0,  12 1.0 1.25, 12 2.0 0.8 T
VX2SCL
   0.0,  20 2.0 1.1,  20 5.0 1.0 T
NDECRD
  1  41,  1  25  0  T
ELEM
DONE
```

GRID DISCRETIZATION ROUTINES

DSCRTZ CONT. TYPE II

THIS TYPE OF INPUT IS TO BE USED FOR NON-RECTANGULAR GEOMETRIES.

KEYWORD	FORMAT	COLS.	DESCRIPTION
STYPE	A8	1-8	NO. OF SIDES / SUPER ELEMENT.
SELCN	A8	1-8	NODE CONNECTIONS FOR SUPER ELEMENTS. EIGHT (8) / SET. N1, N2, N3, N4, N5, N6, N7, N8 N1 AND N2 DETERMINE DIRECTION 1. N2 AND N3 DETERMINE DIRECTION 2. N7 = N8 = 0 FOR TIANGLES.
NETA	A8	1-8	READ NO. OF DIVISIONS IN DIR. 1 OF SUPER ELEMENTS.
NEPS	A8	1-8	READ NO. OF DIVISIONS IN DIR. 2 OF SUPER ELEMENTS.
DEPVAR DEP. VAR.	A8 LIST	1-8	DATA INPUT ON SUPER NODE SEQUENCE, NVAR OF THESE ARE TO BE ENTERED.
	FREE	AFTER	COL. 8 LIST OF DEP. VARIABLES TO BE ENTERED. SET STARTS WITH 89, 90 FOR ETA, EPS, COORDINATES, AFTER THAT (IF MORE) THE ORDER IS UNIMPORTANT.

A CHECK IS MADE TO SEE IF NSNODE * NVAR EQUALS THE NUMBER OF ENTRIES IN THIS SET. IF THEY ARE NOT, THE DATA IS PRINTED OUT AND EXIT IS CALLED.

ANY OTHER KEYWORD ENCOUNTERED WILL CAUSE A RETURN FROM DSCRTZ.

GRID DISCRETIZATION ROUTINES

DSCRTZ CONT. TYPE II CONT.

E. G.
READ THE FOLLOWING IN NAMELIST 'NAME01'
NIZS = 250, NSNODE = 19, NSELEM = 2, NVAR = 3, NODES = 600, JPR = 1,

ADD THE FOLLOWING CARDS AFTER 'FEDIMN' AND 'IPINT' INPUT DATA.

```
LINK4     9    T  CALL POTENT TO SET UP STORAGE FOR DISCRETIZER.
PSIBD
   1    -2    T   SUPER ELEMENT 2 HAS DIAGONALS OPPOSITE OF 1.
LINK2     14    T   CALL DSCRTZ TO READ IN SUPER ELEMENT DATA.

NETA
   20    20    T    20 ELEMENTS ALONG ETA SIDE OF S.E. 1 AND 2.
NEPS
   12    12   T     12 ELEMENTS ALONG EPS SIDE OF S.E. 1 AND 2.
STYPE
   4  4    T    S. E. 1 AND 2 ARE BOTH QUADRILATERALS.
SELCN
   9 10 3 1 12 13 19 2,
   1 3 14 15 19 16 17 18 T  1ST 8 ARE S.E. 1 CONNECTIONS, ETC.
DEPVAR       289 290 1248 T TRANS. COORD., NORMAL COORD., U1 VEL.
   0.0 0.9 0.02  5*0.0 0.1 0.1 0.0 1.2 0.9 .02 0.0  1.101 1.2
  1.101  1.2
  0.0 0.0 .02 5*0.0 0.0 .02 3*0.0 2*0.1 4*0.0,
  2*0.0 .758 6*0.0 .783 3*0.0 .783 0.0
 4*0.0  T  1ST SET = TRANSVERSE, 2ND SET = NORMAL, 3RD SET = U1.
DONE
```

GRID DISCRETIZATION ROUTINES

ELEM (DSCRTZ)
GENERATE ELEMENTS AS A FUNCTION OF NODE COORDINATE INPUT.
USED PRIMARILY FOR A RECTANGULAR DOMAIN.

NDECRD (DSCRTZ)
GENERATE NODE COORDINATES FROM SUPER ELEMENT INPUT DATA.

NODELM (LINK1(2))
SET UP THE ARRAYS 'IELS' AND 'IELEM' TO STORE THE NUMBER OF ELEMENTS PER NODE AND A LIST OF ELEMENTS CONNECTED TO EACH NODE. ALSO 'AVTHK' AND 'AVAREA'.

PRATIO (DSCRTZ)
COMPUTE NODES USING PROGRESSION RATIO AND END POINTS.

REORDR (FINDBE)
REORDER THE NODES OF AN ELEMENT SO THAT THE FIRST TWO WILL BE BOUNDARY NODE SPECIFICATION IN THE 'IBORD' VECTOR MUST BE COUNTER-CLOCKWISE.

ROWS (DSCRTZ)
COMPUTE THE NUMBER OF ROWS, 'KROW', IN THE OUTPUT DISPLAY AND SET UP THE FOLLOWING ARRAYS,
INROW(I) - NO. OF NODES IN ROW I.
INDRW(I) - COLUMN NUMBERS OF NODES IN ROW I.
INDEX(J) - ROW NUMBERS OF NODES IN COLUMN J.
NOCOL(I) - STARTING COLUMN NO. FOR ROW I.

XYSCAL (DSCRTZ)
COMPRESS A VECTOR OF NUMBERS 'X1' BY SCALE FACT 'SCFT'.
FIND 'XYD = MAX(X1) - MIN(X1) * SCFT'
IF TWO ADJACENT POINTS OF ARRAY 'X1' ARE WITHIN 'XYD' OF EACH OTHER, SET THE UPPER VALUE EQUAL TO THE LOWER VALUE.

TYPE II GRID DISCRETIZATION ROUTINES

REFINED DISCRETIZATION ROUTINES. (NON-RECTANGULAR GRID)

BND (REFINE)
GENERATE BOUNDARY CONDITION VECTOR FROM
SUPER ELEMENT BOUNDARY CONDITIONS.

CARRAY (REFINE)
SET UP SUPER ELEMENT COORDINATE ARRAY.

ELKEY (REFINE)
GENERATES REFINED GRID FINITE ELEMENT CONNECTION DATA.

EXTRCT (REFINE)
EXTRACTS REFINED GRID FINITE ELEMENT DATA FROM REFINED NODAL DATA.

EXT1D (BND)
SAME AS EXTRCT BUT FOR BOUNDARY FINITE ELEMENTS.

MESH (DSCRTZ,POTENT)
GENERATE GRID MESH FOR VARIOUS TYPES OF INPUT.

POTENI (LINK4(9))
SETS UP TEMPORARY STORAGE LOCATIONS IN IZ ARRAY FOR
GRID GENERATION.

QUADR (REFINE)
PERFORMS BI-QUADRATIC TRANSFORMATION OF QUADRILATERAL
SUBREGION DATA AND GENERATES REFINED GRID DATA.
IF KDUMP .EQ. 1, PRINT PRATIOS AND RSCALES.

REFINE (MESH)
PERFORMS GRID REFINEMENT OVER TWO-DIMENSIONAL SOLUTION DOMAIN.

SELBND (REFINE)
RENUMBERS THE SUBREGION GENERATED BOUNDARY GRIDPOINTS.

SELINK (REFINE)
FORMS SUBREGION CONNECTION TABLE.

SETDSN (REFINE)
PERFORMS SUBREGION ELEMENT TO SUBREGION NODE DATA TRANSFER.

TRIANG (REFINE)
PERFORMS QUADRATIC TRANSFORMATION OF TRIANGULAR SUBREGION DATA
AND GENERATES REFINED GRID DATA.

XCOORD (REFINE)
TRANSFORMS SUBREGION COORDINATES TO RECTANGULAR CARTESIAN.

INTEGRATION ROUTINES

BCONDT (LINK1(7))
DUMMY ROUTINE FOR THE PRESENT.

BLSPRN (SCHPRN)
PLACES CALLS TO PPRES AND STRF TO GENERATE PHI AND PP.

CONTES (LINK2(4))
RUNNING SMOOTH CONTINUITY EQUATION SOLVER TO COMPUTE U2 UP
COLUMNS OF NODES AFTER VSTART HAS BEEN REACHED.
IF IWRIT .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT.

DERVBL (LINK1(8))
FORM THE DERIVATIVE OF THE ORDINARY DIFFERENTIAL EQUATION FIRST
ON U1-VELOCITY (GLOBAL CONTINUITY) AND OTHER DEPENDENT
VARIABLES INCLUDING TURBULENT KINETIC ENERGY, DISSIPATION FUNCTION,
LONGITUDINAL AND LATERAL MOMENTUM, IF DESIRED.
IF KOD5 .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT
FOR ELEMENTS CONTAINING NODES 'IBOT' AND 'ITOP'.

DERVDX (CONTES)
3-POINT FORWARD DIFF. FORMULA TO COMPUTE DERIVATIVE
IN DOWNSTREAM DIRECTION.

DFCFBL (LINK2(2))
COMPUTE TURBULENT VISCOSITIES FOR DEPENDENT VARIABLES FROM
1. TKE - DISSIPATION EQUATIONS OR
2. MIXING LENGTH THEORY, OR
3. COMBINATION OF BOTH TKE - DISS. AND MLT.
IF IWRIT .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT.

DFCFNS (LINK2(1))
COMPUTE LAMINAR VISCOSITY ACCORDING TO TEMP. AT NODES
USING SUTHERLAND'S LAW.

DRHOBL (LINK2(9))
CALL IF IGAS = 0 IN NAME01
COMPUTES THE TEMPERATURE AND DENSITY USING A SIMPLIFIED
ENERGY EQUATION. ISOENERGETIC MIXING FLOW WITH 2 SPECIES.

GETFSL (DFCFBL,TRBTHK)
FIND BOUNDARY LAYER THICKNESS, DELTA, AND NODE AT WHICH IT OCCURS.

INTEGRATION ROUTINES

GETPPR (LINK1(4),NODPPR)
 COMPUTE PRESSURE GRADIENT FROM THREE POINT INT. SCHEME USING
   INVISCID PRESSURES.
   IF IDIFRT .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT.

JNCPPR (NODPPR)
 GENERATE PRESSURE AND PRESSURE GRADIENT VECTORS FROM TABLE DATA.

NODPPR (IMPLCT)
 SET MULTIPLIERS FOR PP RHS TERM 2.
 CALL DPSISQ TO DETERMINE IF THIS IS A DATA PRINT/PUNCH POINT.
 CALL JNCPPR TO COMPUTE PRESS. AND PRESSURE GRADIANT FOR NEXT STEP.

NWGEOM (LINK5(1))
 COMPUTE H21, G22, G23, F1 AND F2 FOR NORMAL DIRECTION;
         H31, H32, H33, G1 AND G2 FOR CROSS DIRECTION
         WHEN RUNNING VARIABLE GEOMETRY.

PPRES (BLSPRN)
 COMPUTE PHI.
 COMPUTE PERTURBATION PRESSURE.
 COMPUTE GRADIENT PHI CONTRIBUTION TO U2, U3 MOMENTUM EQNS.
    IF KOD6 .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT
     FOR ELEMENTS CONTAINING NODES 'IBOT' AND 'ITOP'.

PRSGRD (LINK1(5))
 COMPUTE AXIAL PRESSURE GRADIENT.
    IF IDIFRT .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT.

QKNINT (BDINPT)
 INTEGRATION CONTROL ROUTINE TO TRANSFER CALL TO OUTPUT
  PACKAGE AT PRINT STATIONS.

RNLDST (BLSPRN)
 COMPUTE REYNOLD STRESSES FROM TKE, DISS. FUNCTIONS.
   IF KDUMP .EQ. 1 .AND. KOUNT .LE. 2, PRINT DEBUG INFORMATION.

SCHPRN (LINK5(5),IMPSLV,ZZZZZZ)
 USUALLY A USER PROVIDED SUBROUTINE TO CONTROL FLOW OF PROGRAM
    AT THE END OF EACH ITERATION.

SETDIF (LINK5(6),IMPSLV)
 COMPUTE EFFECTIVE VISCOSITY FOR DEP. VAR. USING DFCFNS & DFCFBL.

INTEGRATION ROUTINES

SOLVER (IMPLCT,QKNINT)
CONTROL ROUTINE TO DETERMINE WHICH INTEGRATION SCHEME TO USE.

TAUW (WLFLXS)
COMPUTE SKIN FRICTION USING PATANKER AND SPALDING
OR LUDWIEG - TILLMAN.
IF IDIFRT .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT.

TCHECK (DERVDX,GETPPR) SUB. TCHECK (TL, KODE)
CHECK FOR ENOUGH POINTS TO COMPUTE THREE POINT INTEGRATION.

TRAPIN (PRSGRD,TRBTHK)
TRAPEZOIDAL INTEGRATION.

TRBTHK (IMPSLV)
COMPUTE AND PRINT INTEGRAL PARAMETERS DELTA-* AND THETA.

WLFLXS (LINK2(3))
COMPUTE THE SKIN FRICTION DISTRIBUTION AND HEAT TRANSFER
DISTRIBUTION ALONG THE WALL.
IF IDIFRT .GT. 0, PRINT DEBUG INFORMATION AT PRINT POINT.

XYCRDM (LINK2(13))
GENERATE VECTORS FOR GRID OUTPUT ROWS AND COLUMNS,
SCALE COORDINATES WHEN RUNNING VARIABLE GEOMETRY.

ZZZZZZ (BDINPT,IMPSLV)
USUALLY A USER PROVIDED SUBROUTINE TO CONTROL PROGRAM FLOW AT
THE END OF EACH ITERATION.

IMPLICIT SOLVER ROUTINES

ASMMAT (DERVBL)
ASSEMBLE TRI-PENTA-ETC. DIAGONAL MATRIX.

BANDET (IMPSLV)
DECOMPOSE JACOBIAN INTO L-U DECOMPOSITION.

BANDSL (IMPSLV)
SOLVE FOR DQ USING L-U DECOMPOSITION AND BACK SUBSTITUTION.

FILTER (IMPSLV,SCHPRN) SUB. FILTER (LV, KVAD, LW, KWAD)
AVERAGE U2, U3 DELTA-Q IN IMPSLV.
AVERAGE U2, U3 VELOCITIES OVER ELEMENTS.

IMPLCT (LINK4(2))
IMPLICIT SOLUTION CONTROL ROUTINE.
FOR CERTAIN ERRORS, 'TIME' IS SET TO -1.0 AND SELECTED DEBUG
INFORMATION IS PRINTED ALONG WITH A NODE MAP AND STANDARD PRINT.

IMPSLV (DERVBL)
IMPLICIT SOLVER ROUTINE USING BANDET AND BANDSL.
IF NR .GE. NELPAS, PRINT DEBUG INFORMATION AT PRINT POINT;
AND IF NIT .GT. 0, PRINT JACOBIAN AND L/U DECOMPOSITION.

SETIMP (IMPSLV,STCODE)
STORE THE J-TH LEVEL OF DEPENDENT VARIABLES FOR NEXT STEP.

STCODE (BDINPT,DERVBL)
PREDICT SOLUTION FOR CERTAIN VARIABLES (IF CALLED FOR).

BANDED CHOLESKY SOLUTION ROUTINES.

ASMSQ (STRF)
BOOLEAN ASSEMBLY OF SQUARE SYMMETRIC MATRIX.

BANCHO (STRF)
SYMMETRIC BANDED CHOLESKY LINEAR ALGEBRAIC EQUATION SOLVER.

STRF (LINK2(7),BLSPRN)
IMPLICIT EQUATION SOLVER USING BANDED CHOLESKY BACK SUBSTITUTION.
SOLVES FOR: PHI AND PP.
AT INITIALIZATION - DISTRIBUTES PC OVER DOMAIN IN NODPCP.
IF IPWRIT .GT. 0, PRINT DEBUG INFORMATION FOR ELEMENTS
FROM 'IBOT' TO 'ITOP'.

SUMKEY (LINK3(5))
COMPUTE ELEMENT LINKING KEYS FOR SOLVER ROUTINE BANCHO.

OUTPUT ROUTINES

CALORD (BDINPT)
PRINT CALL ORDER OF ROUTINES USED FOR VARIABLE PARAMETERS.
PRINT INTEGRATION VARIABLE NOS. AND DEPENDENT VARIABLE NOS.
PRINT LIST OF PARAMETERS TO BE PRINTED IN OUTPUT ROUTINE.
PRINT PLOT INFORMATION.

COMOC (BDINPT)
PRINT THE COMOC SYMBOL ON TWO PAGES ALONG WITH ASSOC. TITLE CARDS.

DPSISQ (NODPPR)
DETERMINE IF THIS IS A PRINT/PUNCH DATA STATION AND SET
APPROPRIATE FLAGS.

DRVBUG (DERVBL)
DEBUG PRINT ROUTINE FOR DERVBL.
THIS ROUTINE IS CALLED AT A PRINT POINT WHEN
KODS .GT. 0 AND AN ELEMENT CONTAINS NODE 'IBOT' OR 'ITOP'.

FEPLOT (STOUT1)
GENERATE DATA TO BE USED FOR PLOT PACKAGES.
THIS ROUTINE IS CALLED AT THE END OF A PRINT POINT WHEN:
KPNT .GT. 0 AND KOUT .GT. 0 AND KPLVAR .GT. 0

ICOND (BDINPT)
PRINT INTEGER AND REAL SCALAR CONDITIONS.
IARRAY(1) - IARRAY(500)
RARRAY(1) - RARRAY(500)

OUTNOD SUB. OUTNOD (NN, IRRAY, TITLE)
PRINT AN INTEGER ARRAY ALONG WITH A 32 CHARACTER TITLE.

OUTPG (GEOMFL)
PRINT THE ELEMENT NO. AND NODE CONNECTIONS AND NODE
COORDINATES FROM THE GEOMETRY ROUTINE 'GEOMFL'.
THIS ROUTINE IS CALLED WHEN KODG .GT. 0 AND THE ELEMENT
NO. IS IN THE RANGE FROM 'IBOT' TO 'ITOP'.

OUTPUT ROUTINES

OUTVEC SUB. OUTVEC (NN, ARRAY, TITLE)
PRINT A REAL ARRAY ALONG WITH A 32 CHARACTER TITLE.

PBLANK (REOUTP) SUB. PBLANK (N, P)
INSERT 'N' BLANKS IN THE OUTPUT VECTOR 'P'.

PLILNK (REOUTP)
CONVERT A FLOATING POINT NUMBER INTO 'A' FORMAT.

PRINTA SUB. PRINTA (P, NPLC, VAR)
PRINT A LIST OF 'NPLC' REAL NUMBERS 'VAR' IN 'A' FORMAT.

REOUTP (LINK2(5))
PRINT THE ARRAY GEOMETRY AND NODE NUMBERS IN A PATTERN THAT
RESEMBLES PROBLEM GEOMETRY.
(FEOUTP) (LINK2(6)) FEOUTP IS A TRANSFER POINT IN REOUTP
WHEN KROW .LT. 0.
PRINT OUTPUT PARAMETERS IN A PATTERN THAT RESEMBLES
PROBLEM GEOMETRY.
IF MAX. SCALE FACTOR EXCEEDS 'NSM' (DEF. = 10),
TERMINATE THE PROGRAM.
IF OUTPUT PRINT NO. 'KOUNT', EXCEEDS PRINT LIMIT 'LPRINT'
TERMINATE THE PROBLEM.
IF NEWPRT .GT. 0, PRINT SCALAR OUTPUT 'NEWPRT' COLUMNS ACROSS.
IF NMOUT .EW. 2, PRINT VECTOR OUTPUT WITH A CALL TO OUTVEC.

RITE (LINK3(2)) SUB. RITE (NMB, KEY, TITLE, NTITL)
COMPUTE ' NUMBER = (KEY-1)*10 + NMB ',
GO TO STATEMENT ACCORDING TO VALUE OF 'NUMBER'.
IF 'NUMBER' IS OUT OF RANGE, WRITE TITLE INFORMATION.

SCALEV (REOUTP)
CALL SCALE ROUTINE FOR UP TO 10 OUTPUT VARIABLES AT A TIME.

SETSCL (SCALEV) SUB. SETSCL (ARRAY, ILIM, IT)
SET SCALE FACTOR FOR AN ARRAY OF REAL NUMBERS
AND NORMALIZE THE ARRAY BY 10**IT.

STOUT1 (REOUTP) SUB. STOUT1 (MTM, NVOUT)
DIMENSIONALIZE OUTPUT VARIABLES FOR DISPLAY PURPOSES.

DUMMY ROUTINES

GETADD (FEDIMN) SUB. GETADD (IVAR, IADD)
INSTALLATION ROUTINE TO GET MACHINE ADDRESS
OF VARIABLE 'IVAR' AND STORE IT IN 'IADD'.

GETDAT (RDATE,RITE) SUB. GETDAT (DATE)
INSTALLATION ROUTINE TO GET CURRENT DATE ON SYSTEM
AND STORE IT IN 'DATE'. (DIMENSION OF DATE IS 2).

GETTIM
INSTALLATION ROUTINE TO GET CURRENT CPU TIME.

LINK36 (LINK3(6))
USER ROUTINE TO BE USED AS NEEDED.

PDUMP (BDINPT,FEDIMN) SUB. PDUMP (A, B, N)
INSTALLATION ROUTINE TO DUMP CORE FROM 'A' TO 'B'
IN FORMAT 'N'.

RDATE
PLACES CALL TO GETDAT.

TIMETK SUB. TIMETK (T)
INSTALLATION ROUTINE TO STORE CURRENT CPU TIME INTO 'T'.

THE FOLLOWING CONTAINS A SEQUENTIAL LIST OF THE ENTRIES IN 'IARRAY'. THE REFERENCES ARE TO THE SUBROUTINES IN WHICH THEY ARE USED. IF NO REFERENCE IS GIVEN, THEN THE VARIABLE IS USED IN NUMEROUS ROUTINES.

SEQUENTIAL IARRAY ENTRIES

NO.	ENTRY	REFERENCES
1	ND	DFCFNS,
6	KODG	GEOMFL,
7	KOD5	BCONDT, DERVBL, INDEX, PPRES, STCODE,
8	KPRINT	CONTES,
14	NELEM	
16	NNODE	
19	NOE	
20	NPRNT	LINK3,
22	NC	LINK2,
23	NB	LINK2,
26	KOUNT	BDINPT, LINK2, QKNINT, RNLDST,
27	NSKIP	BDINPT, BCONDT, FEDIMN, GETBCD, POTENT,
28	IPASS	LINK2, DERVBL, IMPLCT, STCODE, STRF,
30	NP	
31	NEQ	
32	IWLSEP	XYCRDM,
34	LPRINT	LINK2, QKNINT,
37	NEWPRT	REOUTP,
38	NOUTVC	REOUTP,
40	NOUTS	REOUTP,
42	INPUT	E .INPT, DESCRP, GETBND,READV1,
43	NEQADD	BLSIUS, CONTES, DFCFBL, IMPLCT, IMPSLV,
46	NF	LINK2, DESCRP, FEDIMN,
47	LG	
50	LCOL	
52	KROW	
53	NDB	LINK2, IMPLCT,
54	NHHALF	LINK2, IMPLCT,
55	NODE	
58	NEQKNN	
59	NCPTAB	CPINIT, FEDIMN,
60	NMBOUT	LINK2, CALORD, DESCRP, FEDIMN, STOUT1,
61	KDUMP	
62	NTITL	BDINPT, LINK2, LINK3, COMOC, DESCRP, DIMEN, FEDIMN,
64	NSM	LINK2,
68	NI	LINK3, NBNDRY,
86	KPNT	

SEQUENTIAL IARRAY ENTRIES

NO.	ENTRY	REFERENCES
88	NLINE	COMOC, DFCFBL, TRBTHK,
90	NYY	LINK2, LINK3, DERVBL, DSCRTZ, FEDIMN, INDEX, JNCFPR, NODFCF, FPRES, STCODE, STOUT1, STRF,
91	NZZ	FEDIMN, INDEX, STOUT1,
92	IZSIZE	MAIN, FEDIMN, FOTENT, RITE, STRF,
94	NIZS	FEDIMN, IMPLCT,
96	IBASE	BDINPT, LINK2, DSCRTZ, STOUT1,
97	ITKE	DFCFBL,
99	IBL	BDINPT, LINK1, LINK2, LINK3, BCONDT, COMOC, DFCFNS, DIMEN, FEDIMN, FILTER, GEOMFL, IMPLCT, IMPSLV, RITE, STRF,
100	IREND	BDINPT, LINK2, LINK5, FEDIMN, FOTENT, RITE, STRF,
102	KOUT	BDINPT, LINK2, CALORD, IMPLCT, QKNINT, STOUT1,
105	IFTSPL	TAUW,
107	NE1E2	DFCFBL, JNCINP,
108	NCNADD	FILTER, IMPLCT, FPRES,
113	KPLVAR	BDINPT, LINK2, CALORD, FEDIMN, STOUT1,
122	IWRIT	CONTES, DFCFBL, GETFSL, IMPLCT, TAUW, WLFLXS,
125	NCALLS	LINK5, CALORD, FEDIMN,
127	IDIFRT	LINK1, GETFPR, IMPLCT, JNCFPR, PRSGRD,
131	NBORD	BDINPT,
132	IPWRIT	LINK3, STRF,
133	ITOP	BCONDT, DERVBL, GEOMFL, IMPLCT, FPRES, STRF,
142	NOUTPR	LINK2, FEDIMN,
151	KWFLXS	WLFLXS,
152	INITKE	DFCFBL,
153	NPUNCH	DIMEN, DSCRTZ, FINDBE,
157	NPASS	IMPLCT, QKNINT,
161	NPVSX	BDINPT, BRDSHW, DIMEN, DPSISQ, FEDIMN, GETFPR, JNCINP, JNCFPR, NODFCF, PBLANK,
162	IEPSET	DFCFBL,
166	N3DPNS	BDINPT, LINK1, COMOC, CONTES, DERVBL, IMPLCT, RITE, STCODE,
167	KNTPAS	DPSISQ, IMPLCT,
169	KCDC	BDINPT,
173	NCOMOC	COMOC, DESCRP, RITE,
174	NCOMTD	BDINPT, COMOC, DESCRP, RITE,
177	NU2POS	FEDIMN, NWGEOM,
178	NU3POS	CONTES, FEDIMN, NWGEOM,
179	LOC	DIMEN, GETFSL, GETFPR, LOOK, LOOKAV,
186	ITDA	CALORD, TRBTHK,
187	ITDB	STOUT1,

SEQUENTIAL IARRAY ENTRIES

NO.	ENTRY	REFERENCES
189	NSTD	BDINPT, FEDIMN,
190	NMOUT	LINK2, LOOK,
191	NM	
192	N2M	DERVBL, FEDIMN, GEOMFL, RNLDST, STRF,
193	NM2	DERVBL, DRVBUG, FEDIMN, GEOMFL, PPRES, RNLDST, STRF,
194	NDF	BDINPT, LINK3, FEDIMN, IMPLCT, INDEX, STCODE,
195	KFXBND	WLFLXS,
196	ITWALL	WLFLXS,
197	NTPRNT	LINK2, TRBTHK,
203	NTCRDM	POTENT, XYCRDM,
205	ITIMER	LINK1, LINK2, LINK3, LINK4, LINK5, SOLVER,
206	NMDL	DERVBL, DRVBUG, FEDIMN, RNLDST, STCODE,
208	NVRHS	LINK2, BCONDT, NODPCP, PPRES, STRF,
210	NCOMPG	BDINPT, LINK4, FEDIMN, PRSGRD,
212	MLTRHS	FEDIMN, PPRES, STRF,
215	ISUPRS	BDINPT, LINK2,
225	NVRH	LINK2, BCONDT, NODPCP, PPRES, STRF,
233	NODES	POTENT,
250	IPHI	BDINPT, LINK3, GEOMFL, RITE,
251	NSNODE	DSCRTZ, MESH, POTENT,
252	NSELEM	DSCRTZ, MESH, POTENT,
260	NVAR	DSCRTZ, MESH, POTENT,
286	NEQAV2	IMPLCT,
287	NEQAV3	IMPLCT,
291	JFR	QUADR,
295	IPLOTV	CALORD,
301	NIMPLT	
303	NITER	
304	NELPAS	
305	NBAND	ASMMAT, DERVBL, IMPSLV, INDEX,
306	NMBJAC	DERVBL, IMPSLV, INDEX,
307	NCONV	BLSZZZ, DERVBL, DFCFBL, IMPSLV, PPRES, PRSGRD, TRBTHK,
310	NFMROW	DERVBL, IMPSLV, INDEX, STCODE,
312	IUONLY	DPSISQ, IMPSLV, PPRES,
313	NR	IMPSLV, JNCPPR, STCODE,
316	NIT	IMPSLV,
317	NDBGPT	DERVBL, IMPLCT, IMPSLV, PPRES, STCODE, STRF,
320	ICHI	IMPLCT,
322	ISTART	IMPLCT,
323	NLAST	IMPLCT,

SEQUENTIAL IARRAY ENTRIES

NO.	ENTRY	REFERENCES
324	NCNTIT	BLSPRN, FILTER, IMPLCT, IMPSLV, PPRES,
327	IDDXST	BLSIUS, GETPPR, IMPLCT, IMPSLV,
329	NRJACB	IMPSLV,
336	NPDBUG	DERVBL,
339	NPRGDB	PRSGRD,
340	NNROW	JNCINP,NODPCP,STRTCH,
344	IBLAS	IMPSLV,
347	INCLFT	MATSUM, SETVAL,
348	INCRGT	MATSUM, SETVAL,
349	LPUNCH	DPSISQ,
350	LPUNIT	DPSISQ,
351	LPSUP	DPSISQ,
352	LPPNCH	DPSISQ,
353	LPLOT	DPSISQ,
354	LPLTPR	DPSISQ, REOUTP,
371	NPVSXT	NODPCP,
380	K8SAV	PPRES,
389	KOD6	BCONDT, GETPPR, IMPLCT, PPRES,
394	NTABPT	DPSISQ, JNCPPR, NODPCP,
396	JNCPCP	JNCPPR,

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SEQUENTIAL RARRAY ENTRIES

NO.	ENTRY	REFERENCES
1	FACT	LINK2, BCONDT, DIMEN, FEPLOT, GETPPR, JNCPPR,
2	ONE	TRBTHK,
3	ALC	
4	THK	DIMEN, GEOMFL,
7	HSINIT	DIMEN,
9	PINF	BRDSHW, DIMEN, DRHOBL, GETPPR, JNCPPR, PBLANK,
10	RHOINF	DFCFBL, DFCFNS, DIMEN, DRHOBL, WLFLXS,
13	DELP	DIMEN, IMPLCT, QKNINT,
14	EPS	DIMEN, IMPLCT, IMPSLV, PPRES, STRF,
15	H	LINK2, BLSPRN, DERVDX, DIMEN, DPSISQ, IMPLCT, IMPSLV, INDEX, JNCPPR, LOOKAV,
16	HMAX	DIMEN, IMPLCT, IMPSLV,
17	HMIN	LINK2, BLSIUS, DIMEN, IMPLCT, PRSGRD,
21	RE	BCONDT, BLSIUS, CONTES, DERVBL, DERVNS, DFCFBL, DIMEN, INDEX, SETDIF, TAUW, TRBTHK,
22	TF	LINK2, CONTES, DERVBL, DIMEN, DPSISQ, IMPLCT, IMPSLV, QKNINT,
23	TIME	
24	TO	BLSIUS, CONTES, DIMEN, DPSISQ, DRHOBL, IMPLCT, JNCPPR, NWGEOM, STCODE,
26	TWOPI	DIMEN, GEOMFL,
27	UINF	BCONDT, BLSIUS, CPINIT, DFCFBL, DIMEN, DRHOBL, INDEX, JNCPPR, PRSGRD, WLFLXS,
28	RUNIV	DIMEN, DRHOBL, PRSGRD,
30	CPOINF	CPINIT, DIMEN, FEDIMN,
31	G	BCONDT, DIMEN, FEDIMN, PRSGRD,
32	RTCON1	CPINIT, DIMEN,
35	TD	DIMEN, DPSISQ,
36	PEDDIM	DIMEN, GETPPR, JNCPPR, PRSGRD,
38	XMUINF	BCONDT, DFCFBL, DIMEN, SETDIF,
39	PEDGE	DIMEN, DRHOBL, GETPPR, JNCPPR, PRSGRD,
40	TRATIO	DIMEN, DRHOBL,
42	TKEDGE	DFCFBL,
43	REFL	LINK2, DFCFBL, DIMEN, DSCRTZ, JNCPPR, PBLANK, PRATIO,

SEQUENTIAL RARRAY ENTRIES

NO.	ENTRY	REFERENCES
47	REFLRE	DIMEN,
48	TIMESV	IMPLCT, IMPSLV, PRSGRD,
50	SSINIT	DIMEN, IMPLCT, QKNINT,
56	RTCONS	CPINIT, DIMEN,
58	TOFINF	CPINIT, DFCFNS, DIMEN, DRHOBL, FEDIMN, PRSGRD,
59	FACTMU	DFCFBL, DIMEN, WLFLXS,
60	GAMMAF	DIMEN, DRHOBL, PRSGRD,
61	XMACHO	DIMEN, DRHOBL,
62	CONV	
63	UEDGE	BRDSHW, DIMEN, DRHOBL, GETPPR, PPRES, TRBTHK,
66	XMF	DIMEN,
67	PR	FEDIMN,
68	EP4MD	PRSGRD,
70	CONRHO	DIMEN, STRF,
71	STLDVR	DIMEN, DFCFNS,
72	STLDTR	DIMEN, DFCFNS,
73	STLDCR	DIMEN, DFCFNS,
74	STLDEX	DIMEN, DFCFNS,
75	STLCON	DIMEN, DFCFNS,
79	FACTP	BDINPT, DIMEN, STRF,
80	FACTH	DIMEN,
82	PIBAR	JNCINP,
83	COMPX	DSCRTZ,
84	COMPY	DSCRTZ,
86	AVD	DFCFBL, DIMEN,
89	EPSINF	DIMEN,
90	TKEINF	DFCFBL, DIMEN,
95	EPTEST	DERVBL, DFCFBL,
98	XPRIME	DIMEN, GETPPR, JNCPPR, PRSGRD,
99	PPRCON	DIMEN, GETPPR, JNCPPR, PRSGRD,
100	PPRIME	DIMEN, GETPPR, JNCPPR, PRSGRD,
102	VSTART	BLSIUS, CONTES, DIMEN,
103	DEPLT	DIMEN, QKNINT,
104	VELCST	DIMEN, DIMEN, DRHOBL,
109	XMA	DIMEN, DRHOBL, PRSGRD,
110	XMH	DIMEN,
111	TWELVE	BRDSHW,
115	ARSCAL	PRSGRD,
124	CON	DFCFBL,
125	XLAM	DFCFBL, GETFSL,

SEQUENTIAL RARRAY ENTRIES

NO.	ENTRY	REFERENCES
129	SCT	DFCFBL, FEDIMN,
135	ENERGY	DERVBL,
136	OSMAX	BCONDT, DFCFBL, NWGEOM, PRSGRD, XYCRDM,
137	AVDF	DFCFBL,
138	RUESQ	TAUW, WLFLXS,
139	H31	BCONDT, DERVBL, DERVNS, NWGEOM, PPRES, RNLDST, STRF, XYCRDM,
140	G32	BCONDT, DERVBL, NWGEOM, PPRES, XYCRDM,
141	G33	BCONDT, DERVBL, NWGEOM, PPRES, XYCRDM,
142	G1	NWGEOM, XYCRDM,
143	C4EDSW	DFCFBL, DIMEN,
145	E1E2SW	DFCFBL, DIMEN,
154	XMACHS	LINK3, DERVBL, DIMEN, DRHOBL, PRSGRD,
155	TSINF	CPINIT, DIMEN,
156	AINF	DIMEN, DRHOBL,
160	CPINF	CPINIT, DIMEN,
171	EULER	DERVBL, DIMEN, DRHOBL, GETPPR, JNCPPR, NODPCP, PPRES, PRSGRD,
179	RADCON	BCONDT, DIMEN, INDEX,
181	C1KORE	INDEX,
182	C1DORF	INDEX,
183	C2DORF	INDEX,
184	C2KORE	INDEX,
185	PRDIS	DERVBL,
186	H21	LINK1, BCONDT, CONTES, DERVBL, DERVNS, IMPLCT, NWGEOM, PPRES, PRSGRD, RNLDST, STRF, XYCRDM,
187	G22	BCONDT, CONTES, DERVBL, NWGEOM, PPRES, XYCRDM,
188	G23	BCONDT, CONTES, DERVBL, NWGEOM, PPRES, PRSGRD, XYCRDM,
189	F1	LINK1, NWGEOM, XYCRDM,
190	SLOPE	GETPPR, JNCPPR, LOOKAV, NWGEOM,
193	XNWGEO	CONTES, DFCFBL, DFSISQ, DRVBUG, NWGEOM,
196	THETAP	GETPPR, IMPLCT, IMPSLV, INDEX,
198	YPLUS	DFCFBL,
199	RNULOC	DFCFBL,
201	XTC	TRBTHK,
202	UWALL	TRBTHK,
203	UEDGEN	DERVBL, TRBTHK,
204	ENER	DERVBL, DERVNS,
205	DELSTR	DFCFBL,
206	THETA	DERVBL, TRBTHK,
207	CONVRG	IMPLCT, IMPSLV,
209	BLTH	DFCFBL, TRBTHK,

SEQUENTIAL RARRAY ENTRIES

NO.	ENTRY	REFERENCES
210	SHPFAC	TRBTHK,
211	CFOV2	TRBTHK,
216	PGBASE	PRSGRD,
217	PGVAR	PRSGRD,
263	GSCALE	PPRES,
268	PHICOD	BLSPRN, PPRES,
270	RUPRIM	BLSZZZ, CONTES, IMPSLV, STCODE,
271	OSUSQ	DFCFBL,
272	OMEGXP	DFCFBL,
273	XDELTA	DFCFBL,
274	EPSMIN	DFCFBL,
275	AOMGEX	DFCFBL,
276	GAMFAC	DFCFBL,
277	GAMEXP	DFCFBL,
279	BEXP	DFCFBL,
280	RUEDSW	DFCFBL,
282	U2STRS	DERVBL,
284	TSADD	IMPLCT,
285	RELAX	LOOKAV,
289	RHOIM	DERVBL,
290	ROMULT	DRHOBL,
300	TMNTS	LINK2,
301	SIMPLT	DIMEN, IMPLCT, STCODE,
302	CHISTP	IMPLCT,
303	CHIEPS	IMPLCT,
305	TMULT	DIMEN, IMPLCT,
309	CPHI1	DIMEN,
310	CPHI2	DIMEN,
311	CC1	DIMEN, RNLDST,
312	CC2	DIMEN, RNLDST,
313	CC3	DIMEN, RNLDST,
314	CC4	DFCFBL, DIMEN, INDEX, RNLDST,
315	C2C4	DIMEN,
316	DRVGPH	DERVBL,
318	DCHECK	IMPLCT,
319	DSTART	IMPLCT,
320	YSCAL	STOUT1,
321	STPMLT	IMPSLV,
322	CH1TST	IMPLCT,
339	PCFACT	DERVBL,
340	PPFACT	DERVBL,
345	PUMULT	DERVBL,

SEQUENTIAL RARRAY ENTRIES

NO.	ENTRY	REFERENCES
346	VLDMLT	DERVBL,
347	TSCALE	GETPPR, IMPLCT, JNCPPR, PRSGRD,
348	VCMULT	DERVBL,
351	PSTAG	DIMEN, GETPPR, JNCPPR, PBLANK, PRSGRD,
353	GUMULT	DERVBL,
354	UINFX	DIMEN,
356	CE	SETDIF,
357	CW	SETDIF,
358	EFMULT	DFCFBL,
359	RETHM	DERVBL,
360	RHSCAL	RNLDST,
361	OS6	FEDIMN,
362	OS12	DERVBL, DERVNS, FEDIMN, GEOMFL, IMPLCT, INDEX, PPRES,
363	OS60	FEDIMN,
364	CK	DFCFBL,
365	CD	GETFSL, INDEX,
368	ESCF	DFCFBL,
371	UBAR	DERVBL, DRHOBL, PRSGRD,
372	TBAR	DERVBL, DRHOBL, PRSGRD,
373	XMDOTC	DERVBL, PRSGRD,
374	TAREA	DERVBL, PRSGRD,
375	OSH1SQ	DERVBL, IMPLCT, NWGEOM, XYCRDM,
383	WSMAX	BCONDT, NWGEOM, XYCRDM,
385	UCMULT	DERVBL,
386	H21L	NWGEOM, XYCRDM,
387	H31L	NWGEOM, XYCRDM,
390	DYNPRS	NODPCP,
393	AMB	PPRES,
394	T2FIX	PPRES,
396	OSG	PPRES,
397	T3FIX	PPRES,
398	T2PFIX	PPRES,
399	TU1U2P	DERVBL,
458	U1MIN	SETUP,

INTEGER SCALAR VARIABLES (IARRAY)
CROSS REFERENCE LIST

* * * NOTE * * *
VALUES IN PARENTHESIS ARE DEFAULT CONDITIONS.

ALPHANUMERIC IARRAY ENTRIES

IARRAY ENTRY	NAME	DESCRIPTION
96	IBASE	- (200) BASE NO. FOR IZ ENTRIES.
261	IBC	- NUMBER OF BOUNDARY CONDITION TYPES.
99	IBL	- 1 = BOUNDARY LAYER PROGRAM
344	IBLAS	- EPS EXPONENT FOR U2, U3 CONVERGENCE CRITERION.
207	IBOT	- 1ST ELEMENT AT WHICH TO PRINT DEBUG INFORMATION.
327	IDDXST	- (1)
127	IDIFRT	- NO. OF TIMES TO PRINT INTER. OUTPUT IN LINK1, GETPPR, JNCPPR AND PRSGRD.
162	IEPSET	- 1 = FORCE COMPUTATION OF DISSIPATION FUNCTION.
347	INCLFT	- OUTPUT VECTOR INCREMENT FOR SETVAL AND MATSUM. 1ST INPUT VECTOR INCREMENT FOR MATSUM.
348	INCRGT	- INPUT VECTOR INCREMENT FOR SETVAL. 2ND INPUT VECTOR INCREMENT FOR MATSUM.
158	INITCN	- INITIALIZER IN CONTES.
152	INITKE	- 1 = TKE, DISSIPATION ARE ALREADY INITIALIZED.
295	IPLOTV	- DATA SET NUMBER ON WHICH TO STORE DATA FOR PLOTTING.
42	INPUT	- (5) INPUT LOGICAL UNIT NUMBER.
28	IPASS	- NO. OF CALLS TO DERVBL.
105	IPTSPL	- (0) = USE LUDWIEG - TILLMAN FORMULA FOR TAU WALL. - 1 = USE PATANKER AND SPALDING'S FORMULA FOR TAU WALL.
132	IPWRIT	- DEBUG CODE IN LINK3 AND STRF FOR INTERMEDIATE OUTPUT.
294	IRAT	- SET = TO 1 WHEN N3DPNS IS FIRST TURNED ON.
100	IREND	- END POSITION IN 'IZ' ARRAY.
259	ISIDE	- NUMBER OF SIDES / SUPER ELEMENT.
322	ISTART	- STARTUP CODE IN IMPLCT.
215	ISUPRS	- 1 = SUPPRESS PRINTOUT OF: A. STARTUP IN BDINPT. B. NODE MAP. C. OUTPUT STATIONS.

ALPHANUMERIC IARRAY ENTRIES

IARRAY ENTRY	NAME	DESCRIPTION
186	ITDA	- UNIT NO. ON WHICH TO STORE INTEGRAL PARAMETER DATA FOR PLOTTING.
187	ITDB	- UNIT NO. ON WHICH TO STORE 'PLOTS' DATA FOR PLOTTING.
205	ITIMER	- SET = NO. OF TIMES TO CALL TIMETK SUBROUTINE. NOTE: TIMETK NEEDS TO BE DEFINED FOR YOUR INSTALLATION.
97	ITKE	- 0 = DO NOT INTEGRATE TKE - DISS. EQUATIONS. 1 = USE TKE - DISS. TO COMPUTE TURBULENT VISCOSITY.
133	ITOP	- 2ND ELEMENT AT WHICH TO PRINT DEBUG INFORMATION.
196	ITWALL	- 1 = USE DUDY FOR TAU WALL.
312	IUONLY	- (2) NO. OF STEPS UNTIL CONVERGENCE ON U1 ONLY.
122	IWRIT	- DEBUG PRINT FLAG IN CONTES, DFCFBL, GETFSL AND TAUW.
92	IZSIZE	- MAXIMUM DIMENSION OF IZ VECTOR.
291	JFR	- 1 = MIDSIDE NODES FOR ETA DIRECTION ARE PROGRESSION RATIOS.
169	KCDC	- 1 = RESET NLINE TO 50 AND DUMP KODE TO 2.
61	KDUMP	- PRINT INPUT CARDS AND DATA GENERATED IN BDINPT.
167	KNTPAS	- (99) MAXIMUM NO. OF INTEGRATION STEPS BETWEEN PRINTS.
6	KODG	- PRINT GEOMETRY OUTPUT IF .NE. 0.
7	KOD5	- PRINT INTERMEDIATE DERVBL OUTPUT KOD5 TIMES.
26	KOUNT	- RUNNING COUNT OF OUTPUT. (LIMITED BY LPRINT.)
113	KPLVAR	- (10) NO. OF VARIABLES TO BE PLOTTED OR PUNCHED.
86	KPNT	- 1 = PRINT STATION (SET DURING EXECUTION.)
8	KPRINT	- PRESENT VALUE OF PRINT COUNTER.
52	KROW	- (100) NO. OF ROWS IN DISCRETIZATION.
151	KWFLXS	- (LCOL) NO. OF SLICES AT WHICH TO COMPUTE TAU WALL.
50	LCOL	- (20) NO. OF COLUMNS IN DISCRETIZATION.
47	LG	- NO. OF COLS. IN SOLUTION FIELD. - IF .NE. 0 ON INPUT, THEN CNTPTS AND CNTNDS ARE - TO BE READ IN.
330	LMDJAC	- (1) COMPUTE JACOBIAN EACH ITERATION.
214	LMLT	- (LG) NO. OF CONTOURS FOR WHICH TO COMPUTE MIX. LENGTH TURBULENT VISCOSITY.
179	LOC	- INTERVAL NO. FOUND IN LOOK SUBROUTINE.
172	LOWD	- (2) USE LAMINAR VISC. BELOW LOWD AND MLT FROM LOWD ON.
376	LPHI	- +/- 1 TO EVALUATE PHI OR PP RHS IN PPRES.
353	LPLOT	- FLAG TO INITIATE PRINT OF DATA AT PLOT STATION. (SEE DPSISQ AND REOUTP)
354	LPLTPR	- FLAG TO ACTUATE PRINT OF DATA AT PLOT STATION (REOUTP)
352	LPPNCH	- NO. OF PASSES BEFORE LPUNIT TAKES AFFECT FOR K, EPS.
34	LPRINT	- (100) LIMIT ON OUTPUT COUNT.
351	LPSUP	- NO. OF DATA STATIONS BEFORE LPLTPR TAKES AFFECT.
350	LPUNIT	- UNIT NO. ON WHICH TO STORE PP, U1, U2, U3, K, EPS DATA.

ALPHANUMERIC IARRAY ENTRIES

IARRAY ENTRY	NAME	DESCRIPTION
212	MLTRHS	- (1) NUMBER OF RIGHT HAND SIDES TO SOLVE FOR IN STRF.
377	MONE	- -1 IN PFRES TO ALTERNATE SIGN OF LPHI.
23	NB	- (4) NO. OF CHAR. IN EACH WORD OF OUTPUT VAR. TITLE.
305	NBAND	- (2*LCOL+3) MAXIMUM BANDWIDTH OF JACOBIAN MATRIX.
170	NBC	- MAX. NO. OF BOUNDARY COND. FOR ANY ONE DEP. VAR.
131	NBORD	- NO. OF NODES AROUND BORDER OF DISCRETIZATION.
22	NC	- (8) NO. OF CHARACTERS IN OUTPUT FORMAT.
125	NCALLS	- (10) NO. OF ROUTINES TO CALL AT END OF INTEGRATION STEP.
108	NCNADD	- BEGIN U2, U3 INTEGRATION AFTER NCNADD INTEGRATION STEPS.
173	NCOMOC	- NO. OF CARDS READ IN FOR COMOC TITLE PAGE.
210	NCOMPG	- (35) NO. OF ENTRIES TO PRINT FROM PRGDUM COMMON BLOCK.
174	NCOMTD	- NO. OF CARDS READ IN FOR TITLE INFORMATION.
307	NCONV	- NON-CONVERGENCE FLAG SET IN IMPSLV.
13	NCOORD	- FLAG FOR GENERATING AXI-SYMMETRIC DATA IN GEOMFL.
59	NCPTAB	- (1) NO. OF ENTRIES IN SPECIFIC HEAT TABLE.
1	ND	- INITIALIZATION PARAMETER IN DFCFNS.
317	NDBGPT	- NO. OF ENTRIES TO PRINT IN VECTORS FOR DEBUGGING.
124	NDERIV	- (2) = CALL DERVBL.
194	NDP	- (10) SPACE ALLOCATION IN IIPINT VECTOR.
14	NELEM	- NUMBER OF ELEMENTS IN SOLUTION.
304	NELPAS	- INTEGRATION STEP COUNTER.
31	NEQ	- (5) MAXIMUM NO. OF VARIABLES TO BE SOLVED.
43	NEQADD	- NO. OF DIFF. EQNS. INITIALLY NOT SOLVED. - E.G. -2 = DELAY INT. TKE AND DISS. UNTIL C4EDSW IS SATISFIED.
286	NEQAV2	- WHEN NCNADD IS SATISFIED, NEQADD = NEQAV2 + NEQAV3.
287	NEQAV3	- WHEN NCNADD IS SATISFIED, NEQADD = NEQAV2 + NEQAV3.
58	NEQKNN	- (1) NO. OF DEP. VAR. TO BE INTEG. IN QKNUIN.
37	NEWPRT	- (5) NO. OF SCALARS TO PRINT ACROSS A PAGE (MAX. = 8).
107	NE1E2	- 0 = DO NOT USE MIXING LENGTH THEORY FOR DIFF. COEF. 1 = USE MLT FOR SOLUTION OF DIFF. COEF. 2 = DELAY USING MLT UNTIL E1E2SW IS SATISFIED.
46	NF	- (4) NO. OF 'NB' BYTE WORDS IN TITLE FOR EACH DEP. VAR.
54	NHHALF	- PASS AT WHICH MAXIMUM ITERATIONS TOOK PLACE.
53	NDB	- CURRENT PASS (FOR PRINT POINT).
68	NI	- STARTING LOC. IN DEP. VAR. MATRIX FOR THIS VARIABLE.
301	NIMPLT	- (1) IMPLICIT INTEGRATION SCHEME BEING USED.

ALPHANUMERIC IARRAY ENTRIES

IARRAY ENTRY	NAME	DESCRIPTION
316	NIT	- 1 = FLAG FOR DEBUG PRINT OF: A. JACOBIAN B. L/U DECOMPOSITION
302	NITER	- ITERATION COUNTER.
94	NIZS	- (200) NO. OF IZ ENTRY POINTS THAT CAN BE STORED.
323	NLAST	- KODE FOR LAST STATION WHEN DX .LT. H.
88	NLINE	- (60) LINE COUNT OUTPUT CONTROL.
191	NM	- (3) TYPE OF ELEMENTS IN SOLUTION. - 2 = LINE (ONE-DIMENSIONAL). - 3 = TRIANGLE (TWO-DIMENSIONAL).
306	NMBJAC	- (NBAND*NNODE) NO. OF ENTRIES IN JACOBIAN.
60	NMBOUT	- (30) NO. OF VARIABLES TO BE PRINTED.
206	NMDL	- (8) ALLOW EXTRA STORAGE IN IZ(71) AND IZ(72-76) LENGTH OF IZ(71) = MAXIMUM (NODE, NODE*NMDL) IZ(71) +2 * NODE THRU IZ(71) + 7 * NODE CONTAIN THE REYNOLD STRESSES. LENGTH OF IZ(72-76) = MAXIMUM (NODE, (NODE/2)*NMDL)
190	NMOUT	- (3) = PRINT OUTPUT IN GEOMETRY FORM. 2 = PRINT OUTPUT IN NODE NO. SEQUENCE.
193	NM2	- NM**2. USED FOR STORING FULL MATRICES.
16	NNODE	- NUMBER OF NODES IN SOLUTION.
340	NNROW	- NO. OF COLS. (ROWS) ON ONE SIDE OF JUNCTURE CORNER.
55	NODE	- (100) VARIABLE DIMENSIONING PARAMETER IN FEDIMN.
233	NODES	- (NODE) VECTOR LENGTH FOR REFINE GRID GENERATOR.
19	NOE	- NO. OF EQUATIONS BEING SOLVED FOR DEP. VAR. 'NP'.
325	NOUEDG	- FLAG TO STORE UEDGE FROM CP INFORMATION INTO U1 VECTOR.
142	NOUTPR	- (100) NO. OF SCALARS TO PRINT IN OUTPUT.
40	NOUTS	- (10) NO. OF OUTPUT VECTORS TO PROCESS AT ONE TIME.
38	NOUTVC	- (8) NO. OF OUTPUT SCALARS ACROSS PAGE AT PRINT STATION WHEN OUTVEC IS CALLED FOR NMOUT = 2.
30	NP	- DEP. VARIABLE BEING SOLVED AT THIS TIME.
157	NPASS	- NO. OF PASSES THRU DERVBL.
336	NPDBUG	- NO. OF ITERATIONS FOR DEBUG IN DERVBL AT DEBUG POINT.
198	NPGRDT	- (4) STARTUP COUNTER USED IN PRSGRD.
199	NPGRDV	- (4) STARTUP COUNTER USED IN PRSGRD.
20	NPRNT	- (132) NO. OF PRINT POSITIONS ON A LINE OF OUTPUT.
153	NPUNCH	- SET = 7 IF ELEMENTS AND NODES ARE TO BE PUNCHED IN DIMEN.
161	NPVSX	- (2) NO. OF PRESSURES IN P VS X TABLE.
371	NPVSXT	- NO. OF ENTRIES IN EACH TABLE. (USED WITH NTABPT).
313	NR	- NO. OF PRINTS FOR IMPLICIT INTEGRATION DEBUG.
328	NRJACB	- (1) COMPUTE JACOBIAN EACH ITERATION.
67	NS	- GENERAL DUMMY PARAMETER.
154	NSD	- INITIALIZATION CODE IN DFCFBL.
252	NSELEM	- NO. OF SUPER ELEMENTS IN GRID GENERATOR.
146	NSFDBE	- RESET CONDITION FLAG IN 'FINDBE'.
27	NSKIP	- (NODE) NO. OF BOUNDARY LOC. / DEP. VAR.

ALPHANUMERIC IARRAY ENTRIES

IARRAY ENTRY	NAME	DESCRIPTION
64	NSM	(10) STOP PROGRAM IF ANY OUTPUT EXP. IS .GT. NSM.
251	NSNODE	NO. OF SUPER NODES IN GRID GENERATOR.
189	NSTD	(8) NO. OF STANDARD MATRICES TO BE STORED.
155	NS2	INITIALIZATION CODE IN DFCFBL.
394	NTABPT	NO. OF TABLES TO BE READ IN CPSTUP.
140	NTCNTS	STARTUP PARAMETER IN CONTES.
203	NTCRDM	STARTUP PARAMETER IN XYCRDM.
62	NTITL	(10) NO. OF TITLE CARDS TO BE READ IN AND PRINTED AT THE BEGINNING OF EACH OUTPUT SET.
197	NTPRNT	99999 = DO NOT PRINT INTEGRAL PARAMETERS IN TRBTHK.
177	NU2POS	(20) MAX. NO. OF ENTRIES FOR VAR. GEOMETRY DEFINITION. (CROSS PLANE)
178	NU3POS	(20) MAX. NO. OF ENTRIES FOR VAR. GEOMETRY DEFINITION. (TRANSVERSE PLANE)
260	NVAR	NUMBER OF VARIABLES TO BE DISTRIBUTED OVER REFINED GRID.
90	NYY	(4) SETS (NODE) / DEP. VAR. LOCATION IN IYY VECTOR.
91	NZZ	(4) SETS (NODE) / DEP. VAR. LOCATION IN IZZ VECTOR.
192	N2M	(NM*2) USED FOR STORING SYMMETRIC MATRICES.
166	N3DPNS	SET = 1 WHEN JV .LE. (NEQKNN+NEQADD) IN IMPLCT.

REAL SCALAR VARIABLES (RARRAY)
CROSS REFERENCE LIST

* * * NOTE * * *
VALUES IN PARENTHESIS ARE DEFAULT CONDITIONS.

ALPHANUMERIC RARRAY ENTRIES

RARRAY ENTRY	NAME	DESCRIPTION
156	AINF	- REFERENCE SPEED OF SOUND.
5	AJ	- (778.28) JOULES CONSTANT.
3	ALC	- (MIN. SIDE) CHARACTERISTIC ELEMENT SIZE.
393	AM8	- TERM 8 MULTIPLIER IN PPRES FOR PP EQUATION.
275	AOMGEX	- (2.0) EXPONENT ON WALL DAMPING FACTOR 'OMEGA'
86	AVD	- (25.3) DAMPING FACTOR IN DFCFBL.
137	AVDP	AVDP = AVD * SQRT(RHO/RHOWAL) * ANULOC / ENUT
279	BEXP	- (4.0) GAMMA = 0.01 * DELTAY * (Y/DELTA)**BEXP
209	BLTH	- BOUNDARY LAYER THICKNESS, DELTA.
176	CBTOKJ	- (4.184) SPECIFIC HEAT BRITISH TO MKS.
311	CC1	- COEF. FOR REYNOLD STRESSES COMPUTED FROM CPHI1 AND CPH2 IN DIMEN.
312	CC2	- SAME AS CC1.
313	CC3	- SAME AS CC1.
314	CC4	- SAME AS CC1.
365	CD	- (0.09) TKE - DISS. COEF.
356	CE	- (1.0) DIFF. COEF. MULTIPLIER FOR TKE.
303	CHIEPS	- (1.0E-4) CONVERGENCE FACTOR FOR IMPLICIT INTEGRATION.
302	CHISTP	- (4.0) MAX. NO. OF ITERATIONS FOR INCREASING STEP SIZE.
322	CHITST	- (10.0) MAX. NO. OF ITER. BEFORE DECREASING STEP SIZE.
304	CIMPTH	- (0.5) RELAXATION FACTOR FOR IMPLICIT INTEGRATION.
364	CK	- (1.0) TKE - DISS. COEF.
211	CFOV2	- SKIN FRICTION
83	COMPX	- COMPRESSION FACTOR FOR OUTPUT COL. VECTOR INDICATES PERCENT OF X3 AXIS TO BE USED TO SHORTEN SPACING INTERVALS.
84	COMPY	- COMPRESSION FACTOR FOR OUTPUT ROW VECTOR. SAME AS COMPX, BUT FOR X2 AXIS.
124	CON	- (0.435) KARMANN'S CONSTANT USED IN MLT IN DFCFBL.
70	CONRHO	- IF .GT. 0.0, SET ALL RHO = CONRHO.
62	CONV	- (1.0) OUTPUT SCALE FACTOR = 1.0 / REFL.

ALPHANUMERIC RARRAY ENTRIES

RARRAY ENTRY	NAME	DESCRIPTION
207	CONVRG	- REAL NO. EQUIVALENT OF NCONV (NO. OF ITERATIONS).
309	CPHI1	- (2.8) EMPIRICAL CONSTANT FOR COMPUTING CC1 - CC4
310	CPHI2	- (0.45) EMPIRICAL CONSTANT FOR COMPUTING CC1 - CC4
158	CPA	- (.24*32.174) SPECIFIC HEAT OF AIR.
159	CPH	- (3.445*32.174) SPECIFIC HEAT OF HYDROGEN.
160	CPINF	- SPECIFIC HEAT COMPUTED IN CPINIT.
30	CPOINF	- (0.24*31.174) REFERENCE SPEDIFIC HEAT.
153	CVCP	- (4186.0) SPEC. HEAT CONVERSION FACTOR.
148	CVH	- (1.0) ENTHALPY CONVERSION FACTOR.
151	CVP	- (4.725E-4) PRESSURE CONVERSION FACTOR.
152	CVRHO	- (16.02) DENSITY CONVERSION FACTOR.
150	CVT	- (1.0) TEMPERATURE CONVERSION FACTOR.
149	CVU	- (0.3048) VELOCITY CONVERSION FACTOR.
357	CW	- (1.0) SCALE FACTOR FOR DISSIPATION DIFF. COEF.
182	C1DORF	- (1.44) DISS. FCT. PRODUCTION TERM COEFFICIENT.
183	C1KORE	- (1.0) TKE PRODUCTION TERM COEFFICIENT.
183	C2DORF	- (1.92) DISS. FCT. DISSIPATION TERM COEFFICIENT.
184	C2KORE	- (1.0) TKE DISSIPATION TERM COEFFICIENT.
315	C2C4	- (CC2*CC4) COEF. FOR DIFFUSION COEFFICIENTS.
143	C4EDSW	- (30000.0) TKE - DISS. STARTUP POSITION IN DFCFBL.
318	DCHECK	- (DSTART*SSINIT)**3)
336	DELCHK	- (DELTST*DELMLT) GEN. AND DISS. TERMS FOR TKE, EPS ARE SET TO 0.0 WHEN, DELUSQ .LT. DELCHK.
338	DELMLT	- (1.0E-5) SCALE FACTOR FOR DELCHK.
13	DELP	-(2.0) PERCENT INTERVAL FOR PRINTOUT.
205	DELSTR	- DISPLACEMENT THICKNESS.
337	DELTST	- FIRST DERVBL PASS FOR LARGEST GRAD*U**2 ON ELEMENT.
103	DEPLT	- (101.0) PERCENT OF TD TO BE USED FOR PLOTTING STATIONS.
165	DRTODK	- (5.0/9.0) DEGREES RANKINE TO DEGREES KELVIN
319	DSTART	- (10.0) SCALE FACTOR FOR DCHECK.
390	DYNPRS	- SET .GT. 0.0 FOR CONSTANT PRESSURE FIELD.
175	EBTOKJ	- (2.3244) ENTHALPY BRITISH TO MKS.
358	EFMULT	- (-0.01) ABS(EFMULT) BECOMES LARGEST LEVEL OF TKE INITIALIZED.
90	EKNINF	- (UINF**2) TKE NON-D FACTOR.
204	ENER	- DIMENSIONAL ENERGY FOR U1 VELOCITY.
135	ENERGY	- NON-DIM. ENERGY FOR U1 VELOCITY.
108	ENMULT	- DIMENSIONALIZING FACTOR FOR ENERGY. (XMUINF*RE*UINF*UINF/(G*ALC**(NM-1))
14	EPS	- CONVERGENCE FACTOR FOR INTEGRATION STEP.
89	EPSINF	- (UINF**3/ALC) NON-D FACTOR FOR DISSIPATION.
274	EPSMIN	- (1.0E-5) SCALE FACTOR ON XMUINF FOR MINIMUM LEVEL OF DIFFUSION.

ALPHANUMERIC RARRAY ENTRIES

RARRAY ENTRY	NAME	DESCRIPTION
95	EPTEST	* EPMULT = ZERO TEST FOR DISSIPATION USED IN DERVBL.
68	EP4MD	(1.0) MULTIPLIER FOR XMDOT IN PRSORD.
368	ESCF	(3.0) SCALE FACTOR IN TKE AND DISS. LENGTH.
171	EULER	(PSTAG/(RHOINF*UINF**2) EULER NUMBER.
145	E1E2SW	(30000.0) STATION AT WHICH TO SET NE1E2 = 3 - NE1E2.
1	FACT	(ALC) NON-DIMEN. FACTOR.
80	FACTH	(1.0 / (CPOINF*TOFINF))
59	FACTMU	(RHOINF*UINF*ALC)
79	FACTP	(1.0 / FACTMU)
163	FTTOCM	(30.48) FEET TO CENTIMETERS.
162	FTTOIN	(12.0) FEET TO INCHES.
164	FTTOMT	(0.3048) FEET TO METERS.
189	F1	Y-COORDINATE OF F1 CURVE.
329	F10	LAST VALUE OF F1 CURVE.
327	F2	Y-COORDINATE OF F2 CURVE.
31	G	(1.0) GRAVITATION CONSTANT.
277	GAMEXP	(9.0) GAMMA = 1.0/(1.0 + GAMFAC*(Y/DELTA)**GAMEXP)
276	GAMFAC	(1.0E-20) SEE GAMEXP DEFINITION.
60	GAMMAF	(1.4) FACTOR USED IN GAS LAWS.
263	GSCALE	(0.1) SCALE FACTOR FOR U1 MULT. OF GRADIENT(PHI) IN PPRES.
353	GUMULT	KODE TO ADD GRADIENT(PHI) TO RHS OF U2, U3 EQNS.
142	G1	Z-COORDINATE OF G1 CURVE.
381	G10	LAST VALUE OF G1.
328	G2	Z-COORDINATE OF G1 CURVE.
187	G22	VARIABLE GEOMETRY FACTOR.
188	G23	VARIABLE GEOMETRY SCALE FACTOR.
140	G32	VARIABLE FACTOR.
141	G33	VARIABLE FACTOR.
15	H	CURRENT TRIAL STEP SIZE.
16	HMAX	(2.0) MAX. PERCENT OF TD TO USE AS STEP SIZE.
45	HS	CURRENT STEP SIZE.
7	HSINIT	(1.0E-5) START INTEGRATION STEP SIZE AT THIS VALUE.
12	HT	OUTPUT VAR. FOR TIME STEP = HS * FACT / REFL
186	H21	(1.0) GRID GROWTH SCALE FACTOR.
386	H21L	LAST VALUE OF H21. (USED IN XYCRDM)
139	H31	(1.0) GRID GROWTH SCALE FACTOR.
387	H31L	LAST VALUE OF H31. (USED IN XYCRDM)
272	OMEGXP	(1.5) TKEEXP = 2.0 * (2.0 - OMEGXP)
2	ONE	(1.0) PROGRAM CONSTANT.
396	OSG	ADD STRESSES TO PP EQUATION IN PPRES.
375	OSH1SQ	(1.0 / H21**2)

ALPHANUMERIC RARRAY ENTRIES

RARRAY ENTRY	NAME	DESCRIPTION
136	OSMAX	HEIGHT OF SOLUTION DOMAIN AT INITIAL STATION.
271	OSUSQ	(1.0/TKEINF) MINIMUM TKE LEVEL ALLOWED.
362	OS12	1.0/FACTORIAL(NM+1)
361	OS6	1.0/FACTORIAL(NM)
363	OS60	(2.0/FACTORIAL(NM+2))
339	PCFACT	ADD PC TERM TO U2, U3 EQUATIONS.
174	PDFTOC	(0.01602) POUNDS/FT**3 TO GRAMS/CM**3
170	PDFTOK	(16.02) POUNDS/FT**3 TO KG/M**3
36	PEDDIM	DIMENSIONAL PRESSURE = PEDGE * PSTAG.
39	PEDGE	NON-DIM. PRESSURE AT PRESENT STATION.
268	PHICOD	(1.0/H) GRADIENT PHI MULTIPLIER AT END OF PPRES.
82	PIBAR	UTAU COEF. FOR COMP. U1 IN JNCINP.
9	PINF	FREESTREAM PRESSURE. DEF. = 1ST VALUE IN P VS X TABLE
180	PMSKGS	(1.0/2.2) POUNDS / KG.
340	PPFACT	USE PP TERM IN U2, U3 EQUATIONS.
99	PPRCON	(RHOINF*UINF**2/ALC)
100	PPRIME	PRSSURE GRADIENT COMPUTED IN PRESSURE ROUTINE.
67	PR	(1.0) PRANDTL NUMBER.
185	PRDIS	(1.3) DISSIPATION PRANDTL NUMBER.
166	PSFTOA	(4.725E-4) POUNDS/FT**2 TO PSIA
169	PSFTOI	(6.924E-3) POUNDS/FT**2 TO POUNDS/IN**2
168	PSFTON	(47.88) POUNDS/FT**2 TO NEWTONS/M**2
167	PSFTOT	(0.3591) POUNDS/FT**2 TO TORR.
351	PSTAG	(PINF+0.5*RHOINF*UINF**2)
20	PTIM	PRINT TIME PARAMETER IN 'IMPLCT'.
345	PUMULT	WHEN = 1, USE EDDY VISCOSITY FOR U2, U3 DIFF. TERM.
179	RADCON	(57.2957759) CONVERSION FACTOR RADIANS TO DEGREES.
21	RE	(RHOINF*UINF*ALC/XMUINF) REYNOLD'S NO.
43	REFL	(1.0) REFERENCE LENGTH.
47	REFLRE	(RHOINF*UINF*REFL/XMUINF) REYNOLD'S NO. BASED ON REFL.
285	RELAX	(0.6) RELAXATION FACTOR FOR GRID GROWTH IN LOOKAV.
289	RHOIM	(1.0) USE WALL DAMPING FOR TKE, EPS EQNS. IN DERVBL.
10	RHOINF	(PINF*XMA/(RUNIV*TSINF) FREESTREAM DENSITY.
157	RHOUIN	RHOINF * UINF
360	RHSCAL	ADDIT. TERMS FOR REYNOLD STRESSES IN RNLDST.
199	RNULOC	1.0 = USE LOCAL VISCOSITY FOR VAN DRIEST DAMPING FACTOR.
290	ROMULT	(PINF*XMA/(RHOINF*RUNIV*TOFINF) CONV. FACTOR IN DRHOBL.
119	ROUALC	RHOINF * UINF * ALC**2
116	RR	CPH / CPA
32	RTCON1	2.0 * G * AJ
56	RTCON5	UINF**2 / (RTCON1*CPOINF*TOFINF)
117	RTOHM1	RR * (TOH/TOA - 1.0)

ALPHANUMERIC RARRAY ENTRIES

RARRAY ENTRY	NAME	DESCRIPTION
280	RUEDSW	(10.0) IF (Y/DELTA .GT. RUEDSW) EPSDIM = GAMREF*UEDGE*DSTAR*GAMMA
138	RUESQ	RHOEDG * UEDG * UEDG
28	RUNIV	(1545.33*32.174) UNIVERSAL GAS CONSTANT.
129	SCT	(1.0) CONSTANT SCHMIDT NUMBER.
210	SHPFAC	SHAPE FACTOR.
301	SIMPLT	(TO) STATION AT WHICH TO START IMPLICIT INT.
190	SLOPE	SLOPE OF VARIABLES COMPUTED IN LOOK.
50	SSINIT	(HSINIT / FACT)
75	STLCON	WHEN .GT. 0.0, HAVE CONSTANT VISCOSITY.
73	STLDCR	(204.0) REF. CON. TEMP. IN SUTHERLAND.
74	STLDEX	(1.5) EXPONENT USED IN SUTHERLAND.
72	STLDTR	(492.0) REF. TEMP. USED IN SUTHERLAND.
71	STLDVR	(1.163E-5) VISCOSITY USED IN SUTHERLAND.
321	STPMLT	(1.1) STEP SIZE MULTIPLIER WHEN ALL VARIABLES CONVERGE ON 1ST ITERATION.
374	TAREA	TOTAL COMPUTATIONAL AREA.
372	TBAR	MASS WEIGHTED AVERAGE TEMPERATURE.
35	TD	(1.0) TOTAL SOLUTION TIME (DISTANCE) FROM TO.
22	TF	(TF=TO+TD) FINAL STATION.
206	THETA	MOMENTUM THICKNESS.
4	THK	(1.0) DEF. NON-DIM. THICKNESS OF ELEMENTS.
23	TIME	CURRENT STATION.
48	TIMESV	SAVED TIME LOCATION FOR IMPLICIT INTEGRATION.
42	TKEDGE	LIMIT ON FREESTREAM EDDY VISCOSITY COMP. IN DFCFBL.
90	TKEINF	(UINF**2)
300	TMNTS	TIME (MINUTES) OF CPU USED.
305	TMULT	(1.04) STEP SIZE MULTIPLIER.
24	TO	STARTING TIME (DISTANCE).
146	TOA	(533.0) AIR REFERENCE TEMP. FOR COMPUTATIONS IN DIMEN.
58	TOFINF	(533.0) REFERENCE TEMPERATURE.
147	TOH	(520.0) H2 REF. TEMPERATURE FOR COMPUTATIONS IN DIMEN.
40	TRATIO	1.0 + (GAMMAF-1.0) * XMACHS**2 / 2.0
284	TSADD	INITIAL LEVEL FOR SCALE FACTOR 'TSCALE'
347	TSCALE	SCALE FACTOR FOR T2FIX, T3FIX AND T2PFIX IN PPRES.
155	TSINF	STATIC TEMPERATURE COMPUTED IN CPINIT.
111	TWELVE	(12.0) LENGTH SCALE USED IN BRDSHW.
26	TWOPI	(2.0*PI)
394	T2FIX	ADD U2 CONVECTION TO RHS OF PP EQUATION.
398	T2PFIX	ADD U2' AND U3' TO RHS OF PP EQUATION.
397	T3FIX	ADD U3 CONVECTION TO RHS OF PP EQUATION.
371	UBAR	MASS WEIGHTED AVERAGE VELOCITY.

ALPHANUMERIC RARRAY ENTRIES

RARRAY ENTRY	NAME	DESCRIPTION
385	UCMULT	(1.0) CONVECTION TERM MULTIPLIER FOR U1, TKE, EPS.
203	UED	EDGE VELOCITY.
63	UEDGE	UINF / UINFX USED IN BRDSHW.
27	UINF	FREESTREAM VELOCITY.
354	UINFX	(UINF)
202	UWALL	VELOCITY JUST OF WALL.
458	U1MIN	MINIMUM LEVEL OF U1 ALLOWED WHEN 'SETUP' IS CALLED.
282	U2STRS	ADD REYNOLD STRESSES TO U2, U3 EQUATIONS.
120	VARB	PACKED WORD OF VAR. BEING INTEGRATED. E.G. 12356.0 = U1, U2, U3, K, E
348	VCMULT	CONVECTION TERM ADDED TO U2, U3 EQUATIONS.
104	VELCST	UINF**2 / (2.0*G*AJ*CPA*TOA)
177	VLBTON	(1.488) VISCOSITY BRITISH TO MKS.
178	VLBTOP	(14.88) VISCOSITY BRITISH TO CGS.
346	VLDMLT	LAMINAR DIFFUSION ADDED TO U2, U3 EQUATIONS.
102	VSTART	(101.0) PERCENT OF TD AT WHICH TO START U2, U3 COMPUTATIONS IN CONTES.
383	WSMAX	WIDTH OF SOLUTION DOMAIN AT INITIAL STATION.
273	XDELTA	(0.01) FOR EPSDIM .GT. EPSMAX * XDELTA, EPSDIM = EPSMAX * XDELTA.
125	XLAM	(0.09) CONSTANT USED IN DFCFBL.
109	XMA	(28.97) MOLECULAR WEIGHT OF AIR.
61	XMACHO	MACH NUMBER.
154	XMACHS	LOCAL MACH NUMBER.
373	XMDOTC	AVERAGE MAS FLOW.
66	XMF	(29.4) MOLECULAR WEIGHT OF FLUID.
172	XMFACT	(UINF*SQRT (XMA/(TOFINF*GAMMAF*G*RUNIV)))
110	XMH	(2.016) MOLECULAR WEIGHT OF HYDROGEN.
38	XMUINF	FREESTREAM VISCOSITY.
98	XPRIME	NON-DIM. PRESUURE GRADIENT AT PRESENT STATION.
52	XSCALE	(1.0) X1COR SCALE FACTOR.
11	XT	DIMENSIONAL STATION.
201	XTC	PRESENT STATION FOR INTEGRAL PARAMETER PRINT.
330	YMULT	(1.0) SCALE FACTOR FOR GRID MULTIPLIER.
324	YNRMAD	(F10) DISPLACEMENT OF COORD. IN Y DIRECTION.
198	YPLUS	Y+ VALUE AT WHICH TO SWITCH FROM MLT TO TKE.
53	YSCALE	(1.0) X2COR SCALE FACTOR.
382	ZMULT	(1.0) SCALE FACTOR FOR GRID MULTIPLIER.
325	ZNRMAD	(G10) DISPLACEMENT OF COORD. IN Z DIRECTION.

THE FOLLOWING IS A LIST OF ENTRIES AT THE BEGINNING OF THE IZ ARRAY (1ST 'NIZS' ENTRIES) WHICH CONTAIN ENTRY POINTS IN THE REMAINDER OF THE IZ ARRAY (STARTING AT IZ(NIZS+1)) WHICH ARE THE STARTING LOCATIONS FOR THE VARIABLE LENGTH VECTORS USED IN THE PROGRAM.

* * * NOTE * * *
VALUES IN PARENTHESIS DENOTE DIMENSION OF VECTORS.

LOCATION IN IARRAY FOR DIMENSIONALIZING SCALARS.

113 -	KPLVAR,	52 -	KROW,	50 -	LCOL,	47 -	LG,
170 -	NBC,	25 -	NCALLS,	210 -	NCOMFG,	59 -	NCPTAB,
194 -	NDP,	31 -	NEQ,	58 -	NEQKNN,	46 -	NF,
191 -	NM,	192 -	N2M,	193 -	NM2,	60 -	NMBOUT,
206 -	NMDL,	55 -	NODE,	142 -	NOUTPR,	162 -	NPVSX,
371 -	NPVSXT,	27 -	NSKIP,	121 -	NSPEC,	189 -	NSTD,
62 -	NTITL,	176 -	NTKS,	177 -	NU2POS,	178 -	NU3POS,
112 -	NWALLS,	90 -	NYY,	91 -	NZZ,	252 -	NSELEM

DEFINITIONS FOR OTHER DIMENSIONS BASED ON ABOVE SCALARS.

```
MAXDEP  =  MAXO ( NODE, NODE*NMDL )
MAXVAR  =  MAXO ( NODE, MAXDEP/2  )
MGLC    =  MAXO ( LCOL, LG*NWALLS )
NEMD    =  NODE * 1.81
```

IZ ARRAY ENTRY POINTS

IZ NTRY	NAME	DIM.	DEFINITION
1	ICOL	(LCOL)	- DISCRETIZATION COLUMN LOCATIONS.
2	IROW	(KROW)	- DISCRETIZATION ROW LOCATIONS.
3	IFMTHD	(NF*NMBOUT+20)	- HEADINGS FOR OUTPUT VARIABLES.
4	ITITLE	(NTITL*20+20)	- TITLE FOR START OF EACH OUTPUT PHASE.
5	IIPINT	(NDP*10+NSPEC)	- 1ST NDP LOCATIONS - DEPENDENT VARIABLES. - 2ND NDP LOCATIONS - PREDICTED VARIABLES. - 3RD NDP LOCATIONS - LOCATION OF IND. VARIABLES. - 4TH NDP LOCATIONS - LOCATION OF PREDICTED VARIABLES.
6	IKBNO	(NDP)	- NO. OF BOUNDARY NODES / DEP. VARIABLE.
10	IINCOL	(LCOL*2)	- NO. OF NODES PER COLUMN.
11	IINROW	(KROW)	- NO. OF NODES PER ROW.
14	IPSIBD	(NSELEM)	- DIAGONAL REVERSAL KEY FOR TYPE II ELEMENTS.
18	ICPTAB	(NCPTAB)	- SPECIFIC HEAT TABLE ENTRIES.
19	ITTAB	(NCPTAB)	- TEMPERATURE TABLE ENTRIES.
20	IIUSED	(NODE)	- COUNTER USED IN OUTPUT ROUTINE.
25	IIBND	(NODE*NEQ)	- RE-ORDERED NODES / DEP. VAR. TO ACCOUNT - FOR BOUNDARY CONDITIONS.
26	IINODE	(NEMD*NM)	- ARRAY OF ELEMENT CONNECTIONS (NM/ELEMENT).
27	IJBOND	(NODE)	- NODE SOLUTION ORDER USED IN BANCHO.
28	IKEYCL	(NODE)	- COLUMN KEYS FOR BANCHO.
29	IKEYDG	(NODE)	- DIAGONAL KEYS FOR BANCHO.
30	IKEYRW	(NODE)	- ROW KEYS FOR BANCHO.
32	INWN	(NODE)	- TEMPORARY STORAGE.
33	IINDEX	(NODE)	- ORDER OF NODES BY COLUMNS FROM LEFT TO RIGHT.
34	IINDRW	(NODE)	- ORDER OF NODES BY ROWS FROM TOP TO BOTTOM.
35	INOCOL	(NODE)	- OUTPUT COLUMN POSITION OF NODES BY ROWS.
36	IIELS	(NODE*2)	- NO. OF ELEMENTS CONNECTED TO NODES.
37	IIELEM	(NODE*6)	- LIST OF ELEMENTS CONNECTED TO NODES.
38	IIBORD	(NODE)	- LIST OF BORDER NODES IN COUNTER-CLOCKWISE ORDER.
39	IRHOE	(NODE*2)	- TEMP. STORAGE FOR RHO*K, RHO*EPS.
		NSTDMX = 2*NM + N2M + 2*NM2 + 2*NM**3 + 50	
43	IC200	(NSTDMX)	- STORAGE FOR STANDARD MATRICES.
45	ISMSTR	(NSTD+5)	- ENTRY POINTS IN IZ FOR STANDARD MATRICES.
		NBCND = NSKIP + 6*NBC + 1	
46	IBCNST	(NEQ*NBCND+10)	- STORAGE FOR BOUNDARY CONDITIONS.
		NDIFST = NODE * (NEQ+NEQKNN) + NEQ + 10	
47	IDIF	(NDIFST)	- DIFFUSION COEFFICIENTS / DEP. VARIABLE.
48	IYY	(NYY*NODE)	- 4 SETS OF VALUES / DEP. VARIABLE.
49	IZZ	(NZZ*NODE)	- 4 SETS OF VALUES / DEP. VARIABLE.
50	IX1P2	(NEMD)	- ELEMENT LENGTHS COMPUTED IN GEOMFL.
52	IYDIM	(NODE)	- NOT USED.

IZ ARRAY ENTRY POINTS

IZ ENTRY	NAME	DIM.	DEFINITION
53	IPCOL	(LCOL)	- COLUMN COORDINATES FOR OUTPUT PAGE.
54	IPROW	(KROW)	- ROW COORDINATES FOR OUTPUT PAGE.
56	IAMXLT	(NODE*4)	- MIXING LENGTH, DUDY, WALL DAMPING AND DIFFUSION LENGTH.
61	ITBRTK	(MGLC*NTKS+2)	- STORAGE FOR INTEGRAL PARAMETERS.
63	IU2POS	(NU2POS*2)	- DOWNSTREAM PLOS. FOR CROSS COORD. CHANGE.
64	IU2VAL	(NU2POS*2)	- SCALE FACTOR FOR CROSS COORD. CHANGE.
65	IU3POS	(NU3POS*2)	- DOWNSTREAM POS. FOR TRANSVERSE COORD. CHANGE.
66	IU3VAL	(NU3POS*2)	- SCALE FACTOR FOR TRANSVERSE COORDINATE CHANGE.
71	IOUT1	(MAXDEP)	- TEMPORARY STORAGE. - (IOUT1+2*NODE) THRU (IOUT1+7*NODE) CONTAIN REYNOLD STRESSES.
72 ↓ TO	IOUT2	(MAXVAR)	- TEMPORARY STORAGE. - (IOUT2 + NODE) CONTAINS GAMMA IN SUB. DFCFBL.
76	IOUT6	(MAXVAR)	- TEMPORARY STORAGE.
77	IAREA	(NEMD)	- AREA OF ELEMENTS COMPUTED IN GEOMFL.
78	ICP	(NODE)	- NODAL VALUES OF SPECIFIC HEAT.
79	IH	(NODE)	- NODAL VALUES OF ENTHALPY.
80	IPSI	(NODE)	- TEMPORARY STORAGE FOR EQUATION SOLVING IN STRF.
82	IQ	(NODE)	- TEMPORARY STORAGE.
83	IQP	(NODE)	- TEMPORARY STORAGE.
84	IRHO	(NODE*3)	- NODAL VALUES OF DENSITY, RHO*U1 AND AVE. RHO*U1.
85	ITEMP	(NODE)	- NODAL VALUES OF TEMPERATURE.
86	IRHSP	(NODE)	- RIGHT HAND SIDE FOR EQUATION SOLVING IN STRF.
88	ITK	(NEMD)	- ELEMENT THICKNESS DISTRIBUTION.
89	IX1COR	(NODE)	- NODAL VALUES OF TRANSVERSE COORDINATES.
90	IX2COR	(NODE)	- NODAL VALUES OF NORMAL COORDINATES.
91	IPRESS	(NODE*2)	- NODAL VALUES OF PRESSURE.
92	IAMU	(NODE)	- NODAL VALUES OF LAMINAR VISCOSITY.
95	INORMY	(NODE*2)	- NORMALIZED TRANSVERSE COORDINATES.
96	INORMZ	(NODE*2)	- NORMALIZED VALUE OF CROSS COORDINATES.
99	NJST	(NODE*3)	- STORAGE FOR RHS IN STRF.
100	IPRVAL	(NCOMPG+10)	- RESTART STORAGE FOR PRSGRD VARIABLES.
101	IQL	(NODE*8)	- STORAGE FOR DERVDX ROUTINE.
102	IQPL	(NODE*?)	- STORAGE FOR DERVDX ROUTINE.
103	IVEL	(NODE)	- TEMPORARY STORAGE FOR RHO * U2.
104	IW	(NODE)	- TEMPORARY STORAGE FOR RHO * U3.
105	IPRGRD	(NODE*3)	- NODAL VALUES OF DPDX.
108	IYNOD	(NODE*NWALLS)	- TRANSVERSE COORD. USED IN CONTES, DFCFBL, TRBTHK, WLFLXS, ETC.
109	IGEOM1	(NEMD*NM)	- NATURAL COORDINATE DERIVATIVE COMP. IN GEOMFL.
110	IGEOM2	(NEMD*NM)	- NATURAL COORDINATE DERIVATIVE COMP. IN GEOMFL.

IZ ARRAY ENTRY POINTS

IZ ENTRY	NAME	DIM.	DEFINITION
111	IPLOTS	(KPLVAR*2)	- LIST OF VARIABLES TO BE PLOTTED.
112	IPLTYP	(KPLVAR*2)	- TYPE OF PLOT TO BE GENERATED.
113	IPLSCL	(KPLVAR*10)	- PLOT SCALE FACTORS.
114	ISCHMT	(NODE)	- NODAL VALUES OF SCHMIDT NUMBERS.
121	ICALL	(NCALLS*2)	- LIST OF LINK NOS. AND ENTRIES TO CALL AT END OF IMPLCT.
		NMB = NMBOUT + 4	
123	IOMULT	(NMB*2)	- LIST OF MULTIPLIERS FOR OUTPUT VARIABLES.
124	IOSAVE	(NMB)	- LIST OF VARIABLES TO BE PRINTED IN OUTPUT. MM = MAXO(15,NSPEC,NPVSXT+2)
		MMNODE = NODE * MINO(MM,NMBOUT)	
125	INOUT	(MMNODE)	- TEMP. STORAGE FOR OUTPUT VAR. AND SOURCE DATA.
127	IICNCL	(MGLC*2)	- NO. OF NODES / COL. USED IN CONTES, DFCFBL, TRBTHK, ETC.
128	IICNDX	(NODE*NWALLS+LCOL)	- LIST OF NODES / COL. USED IN CONTES, DFCFBL, TRBTHK, ETC.
131	IIPAR	(NOUTPR)	- LIST OF PARAMETERS TO PRINT AT START OF OUTPUT.
132	IOPAR	(NOUTPR*4+20)	- TITLE INFORMATION FOR PARAMETERS AT BEGINNING OF OUTPUT.
133	ISUTLD	(10)	- LIST OF CONSTANTS USED IN SUTHLD.
134	IPR	(NODE)	- NODAL VALUES OF PRANDTL NUMBER.
135	IMPAR	(NOUTPR)	- LIST OF MULT. FOR PARAM. AT START OF OUTPUT.
136	IEPS	(NODE)	- NODAL VALUES OF TURB. VISC. COMPUTED IN DFCFBL.
137	ISKNFR	(MGLC*4+10)	- SKIN FRICTION DIST. BY COLUMN.
138	ISTN	(MGLC)	- STANTON NO. DIST. BY COLUMN.
139	IX3ST	(NPVSX)	- LIST OF DOWNSTREAM STATIONS IN PRESSURE TABLE.
		NPNONP = NPVSX + IPCFIT*NODE	
140	IPVSX	(NPNONP)	- LIST OF DOWNSTREAM PRESSURES IN PRESSURE TABLE.
		NDNENM = NODE + NEQ*(4*NM+20)	
143	NVDEP	(NDNENM)	- ELEMENT ADDRESS LOCATIONS USED IN BCONDT, DERVBL AND PPRES.
146	IMXLT	(LG*4)	- MIXING LENGTH FROM GETFSL.
150	IBSAV	(NEMD*NM)	- TERM B STORAGE IN PPRES.
151	IPSAV	(NODE*3)	- PHI, U2RHS, U3RHS TEMP. STORAGE IN PPRES.
197	IDOUTP	(REST OF STORAGE)	- TEMPORARY MATRIX STORAGE.

IZ ARRAY ENTRY POINTS

201-240 ARE TEMPORARY LOCATIONS FOR TYPE II GRID GENERATION.
'NIZS' IN NAME01 NEEDS TO BE SET TO 250 TO ALLOCATE STORAGE.

LOCATION IN IARRAY FOR SCALARS.

261 - IBC, 27 - NSKIP, 55 - NODE, 252 - NSELEM,
259 - NSIDE, 251 - NSNODE, 260 - NVAR

DEFINITIONS FOR OTHER DIMESIONS BASED ON ABOVE SCALARS:

KSEL = NSELEM + 5
KSLNSD = KSEL * NSIDE * 4
KSNODE = NSNODE + 5
KSNVAR = KSNODE * NVAR
NNVAR = (NODE+5) * NVAR
NODVAR = NODE * NVAR

IZ ENTRY	NAME	DIM.	DEFINITION
201	NZONE	(KSEL)	- SUPER ELEMENT NUMBERS.
202	ISHAPE	(KSEL)	- ORDER OF GENERATED ELEMENTS IN REFINE.
203	IDLZ	(KSEL)	- TYPE OF ELEMENTS DESIRED / SUPER ELEMENT.
206	NZ	(KSEL)	- NO. OF DIVISIONS IN 3RD DIRECTION.
207	ITYPE	(KSEL)	- TYPE OF SUPER ELEMENT 1 = TRIANGLE. 2 = QUADRILATERAL.
208	NCOL	(KSEL)	- NUMBER OF COLUMNS IN SUPER ELEMENT.
209	MELEM	(KSEL)	- SUPER ELEMENT TO ELEMENT.
210	NELK	(KSEL)	- TYPE OF SUPER ELEMENT LINK.
211	Q	(KSEL)	- SUPER NODE TO ELEMENT.
212	KQ	(KSEL)	- Q KEY.
213	KF	(KSEL)	- F KEY.
214	KTK	(KSEL)	- THK KEY.
215	IBCTYP	(50*IBC)	- BOUNDARY TYPE KEY.
216	BOUND	(50*IBC)	- BOUNDARY COEFFICIENTS.
217	IDUM	(NODE+5)	- DUMMY NODE COUNTER IN REFINE.
		NSKIBC = NSKIP*IBC	
218	BC	(NSKIBC)	- GENERATED BOUNDARY CONDITION ARRAY.
219	NODF	(NODE)	- VECTOR OF BOUNDARY NODES.
220	KTFIX	(NODE)	- FIXED DEP. VAR. NODE KEYS.
221	IRNSTB	(KSEL*8)	- NOT USED
222	JELF	(NODE)	- VECTOR OF BOUNDARY ELEMENTS.
223	KBND	(NODE)	- SUPER ELEMENT BOUNDARY KEYS.
224	IRTH	(NODE)	- NOT USED

IZ ARRAY ENTRY POINTS

IZ ENTRY	NAME	DIM.	DEFINITION
225	AA	(KSNODE)	- NON-RECTANGULAR CARTESIAN COORDINATES DIR. 1.
226	BB	(KSNODE)	- NON-RECTANGULAR CARTESIAN COORDINATES DIR. 2.
227	SNODE	(KSNODE)	- SUPER NODE NUMBER VECTOR.
228	SGRID	(KSNVAR)	- VARIABLE ARRAYS RETURNED FROM REFINE.
229	DUM	(NNVAR)	- DUMMY STORAGE IN REFINE.
230	ELNK	(KSLNSD)	- SUPER NODE CONNECTION TABLE.
231	MATL	(NEMD)	- GENERATED SUPER ELEMENT TO ELEMENT DATA.
232	COORD	(NODVAR)	- FINITE ELEMENT NODE COORDINATES.
233	INX	(KSEL)	- NO. OF DIVISIONS IN 1ST DIRECTION.
234	INY	(KSEL)	- NO. OF DIVISIONS IN 2ND DIRECTION.
235	NDVEC	(NODE)	- ELEMENT CONNECTIONS FOR GRID GENERATION.
236		(KSNVAR)	- NOT USED
237	ELCORD	(NNVAR)	- ELEMENT COORD. FOR GRID GENERATION.
238	KYND	(NNVAR)	- ELEMENT NODE CONNECTIONS.
239	IDM2	- TEMPORARY STORAGE FOR CSFINP.	
240	IELNOD	(NODE)	- DUMMY STORAGE.

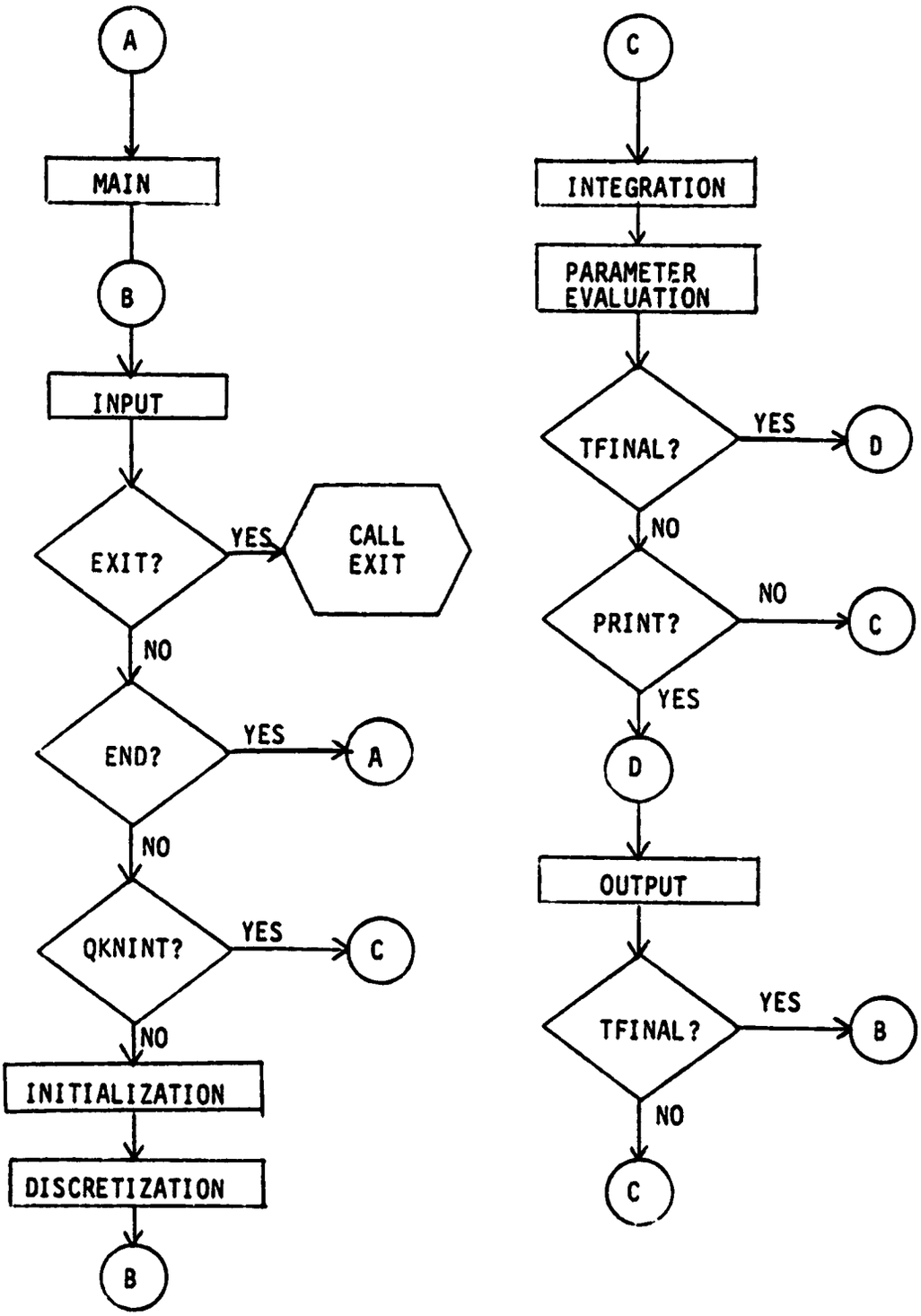

Figure 1. CMC Macro Structure

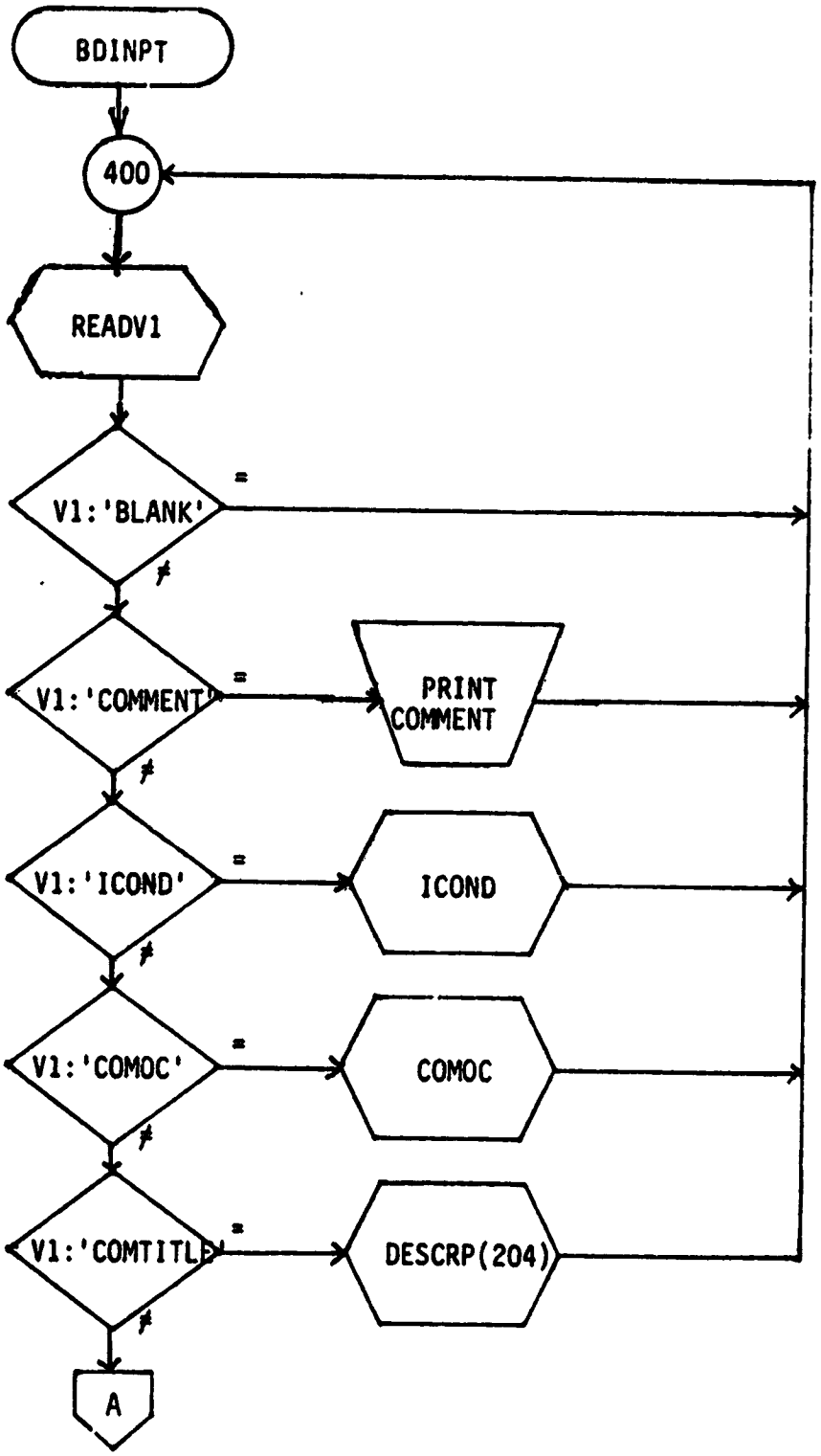

Figure 2. BDINPT flow chart

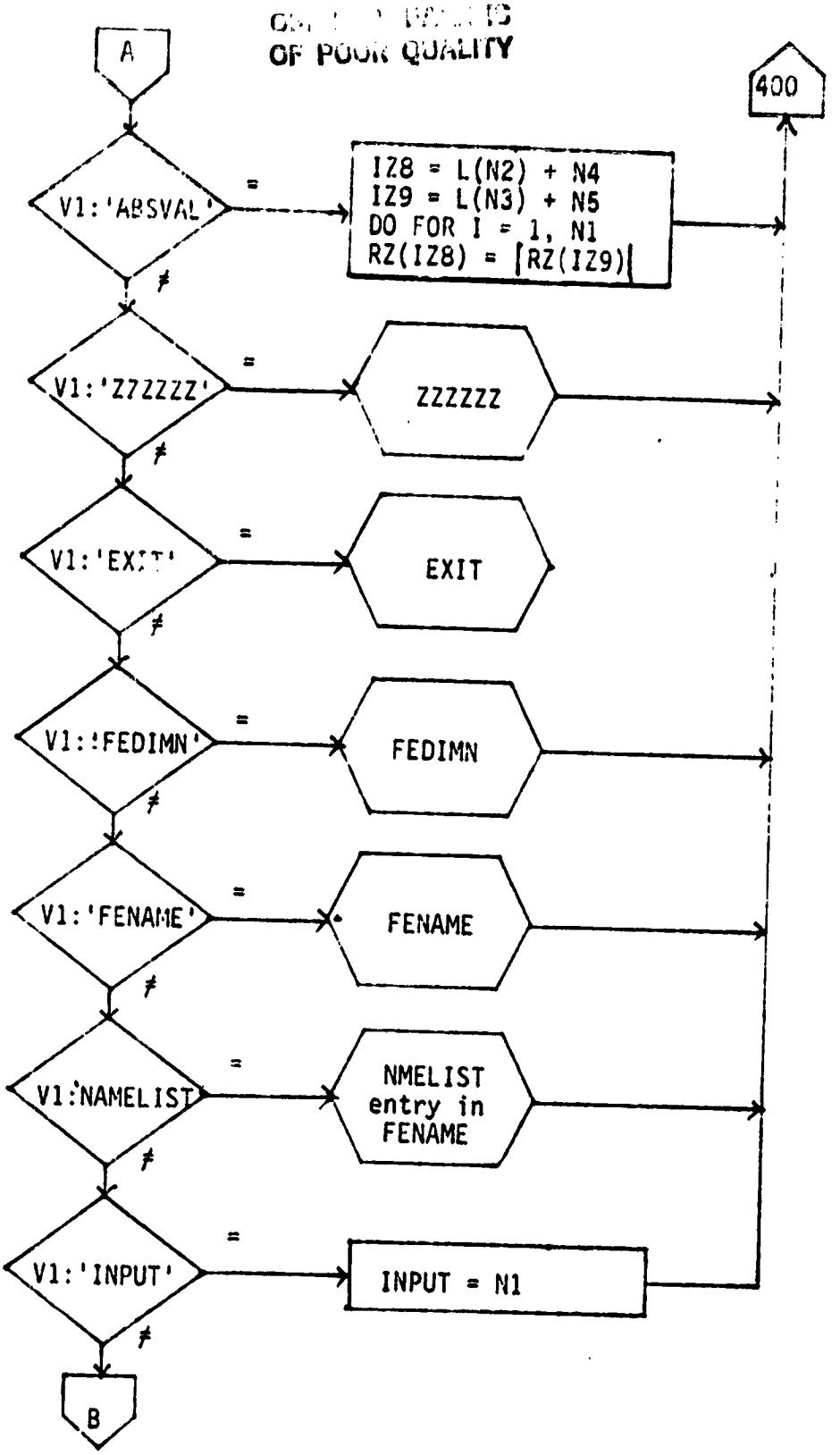

Figure 2. BDINPT flow chart (cont.)

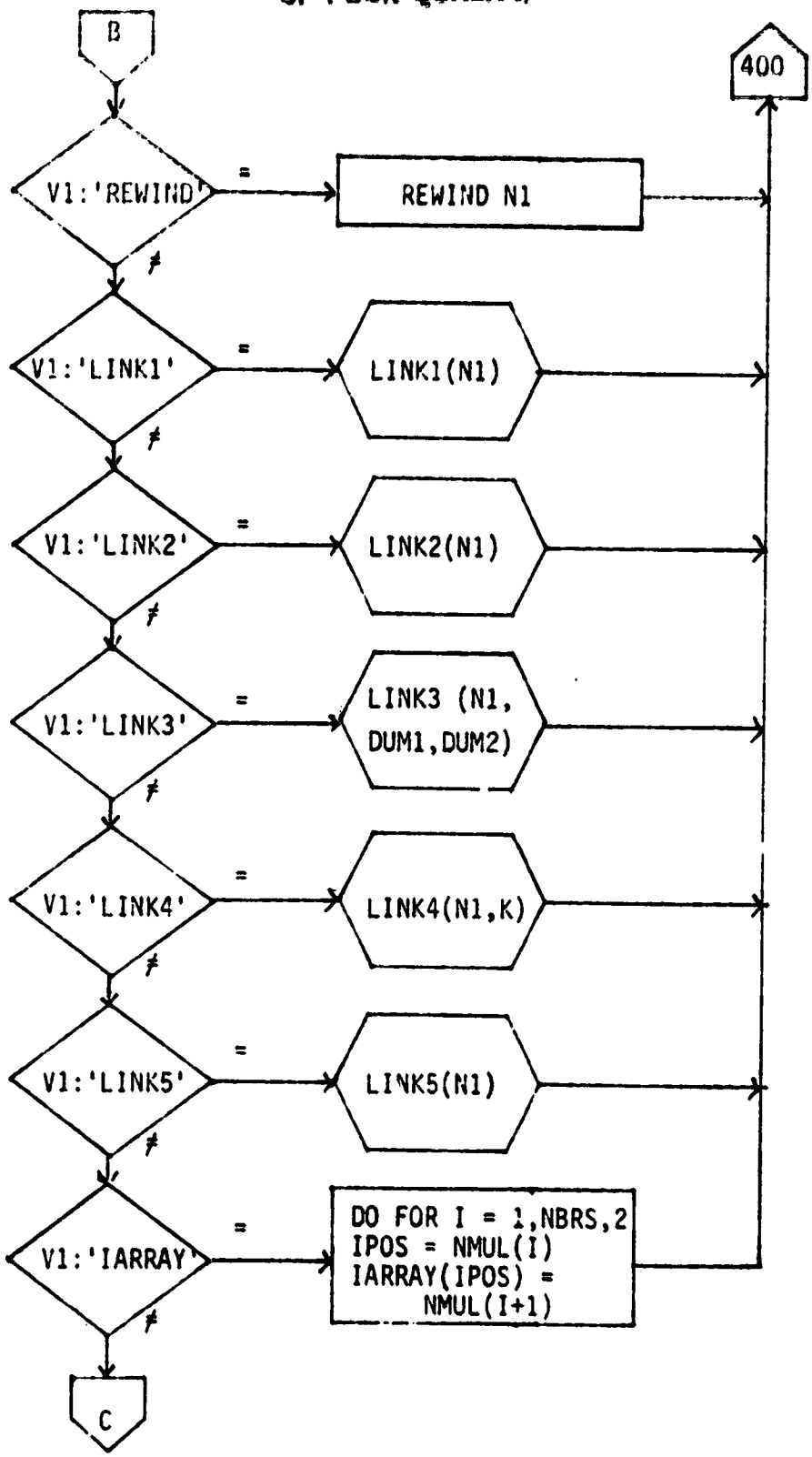

Figure 2. RDINPT flow chart (cont.)

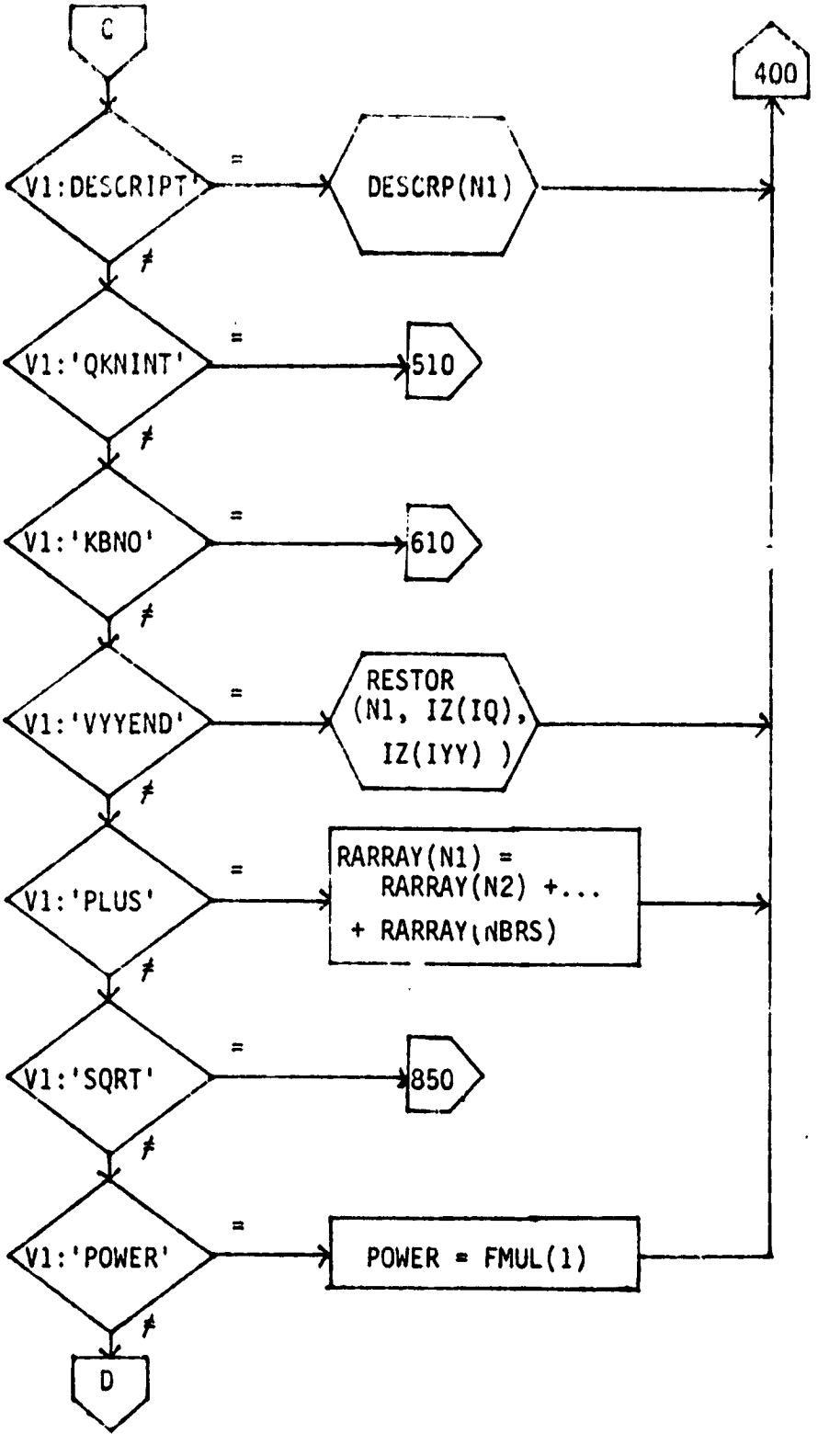

Figure 2. BDINPT flow chart (cont.)

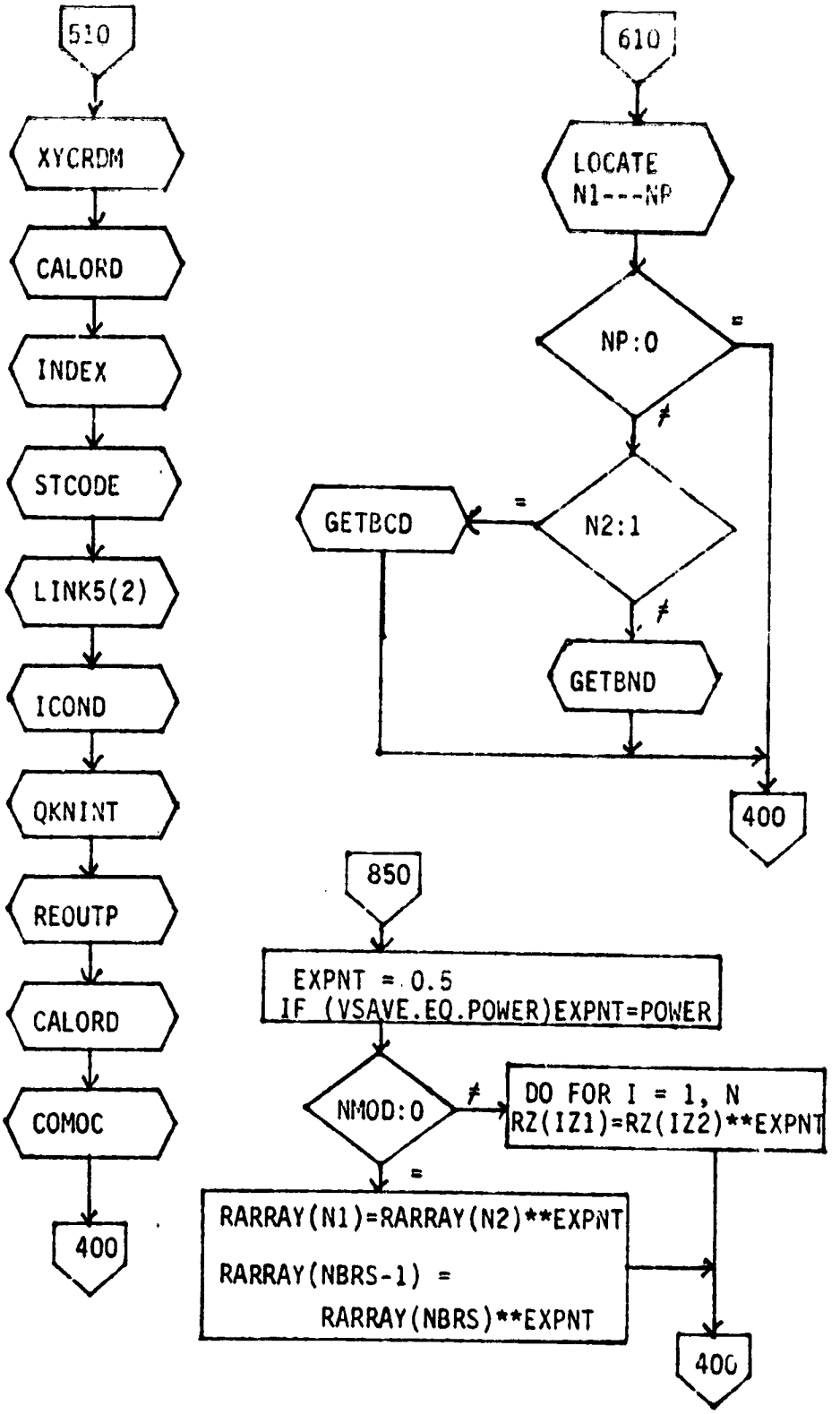

Figure 2. BDINPT flow chart (cont.)

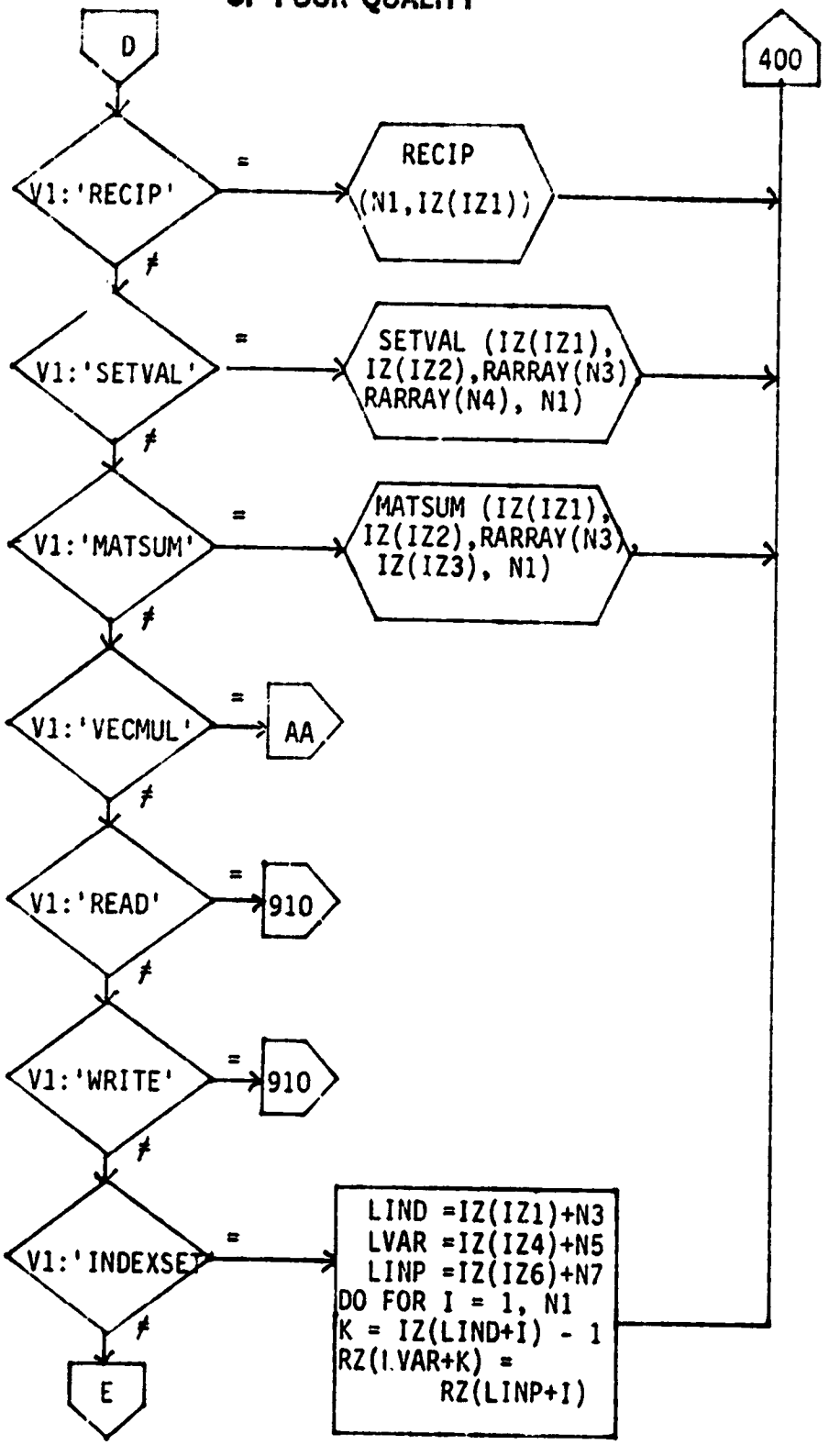

Figure 2. BDINPT flow chart (cont.)

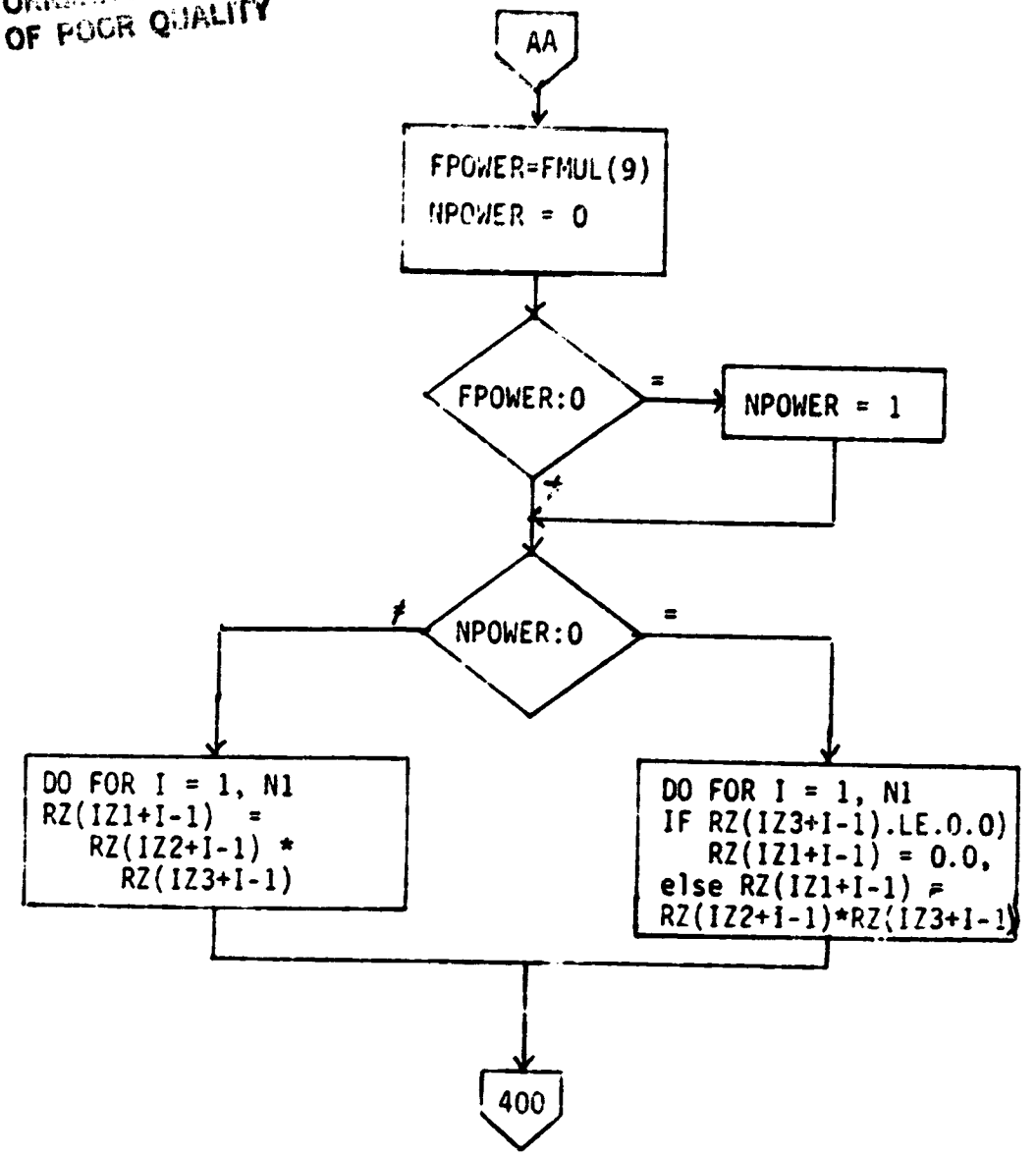

Figure 2. BDINPT flow chart (cont.)

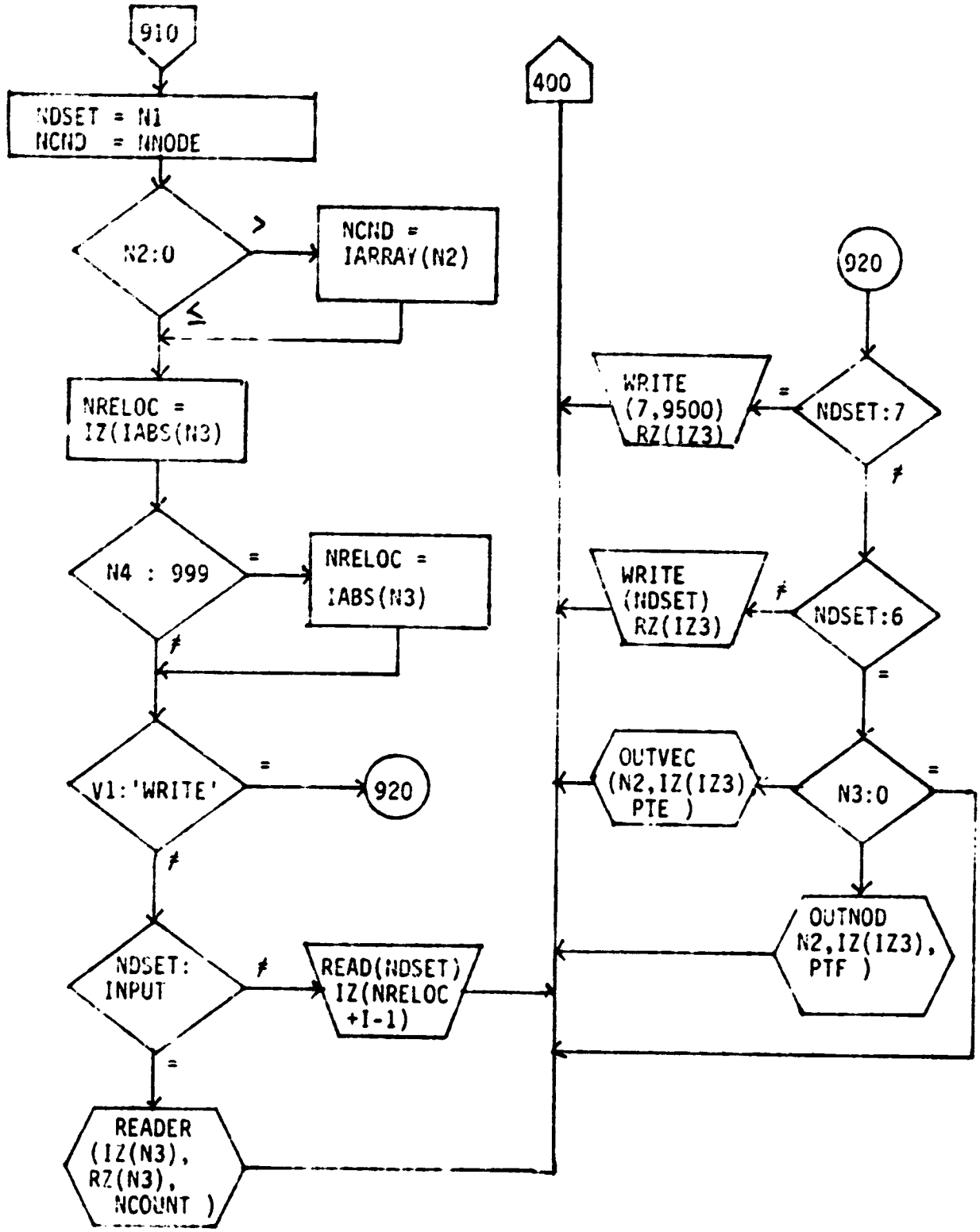

Figure 2. BDINPT flow chart (cont.)

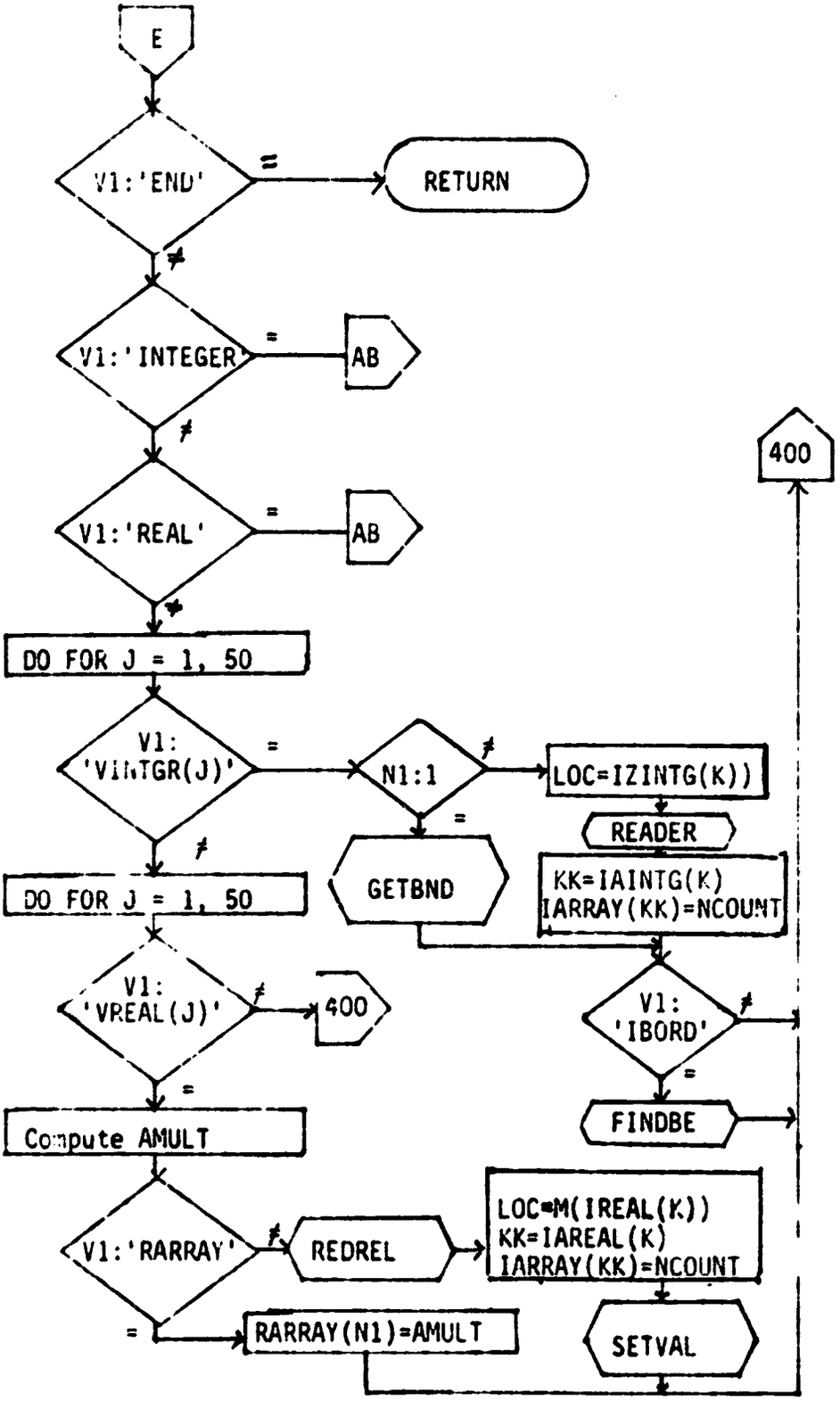

Figure 2. BDINPT flow chart (cont.)

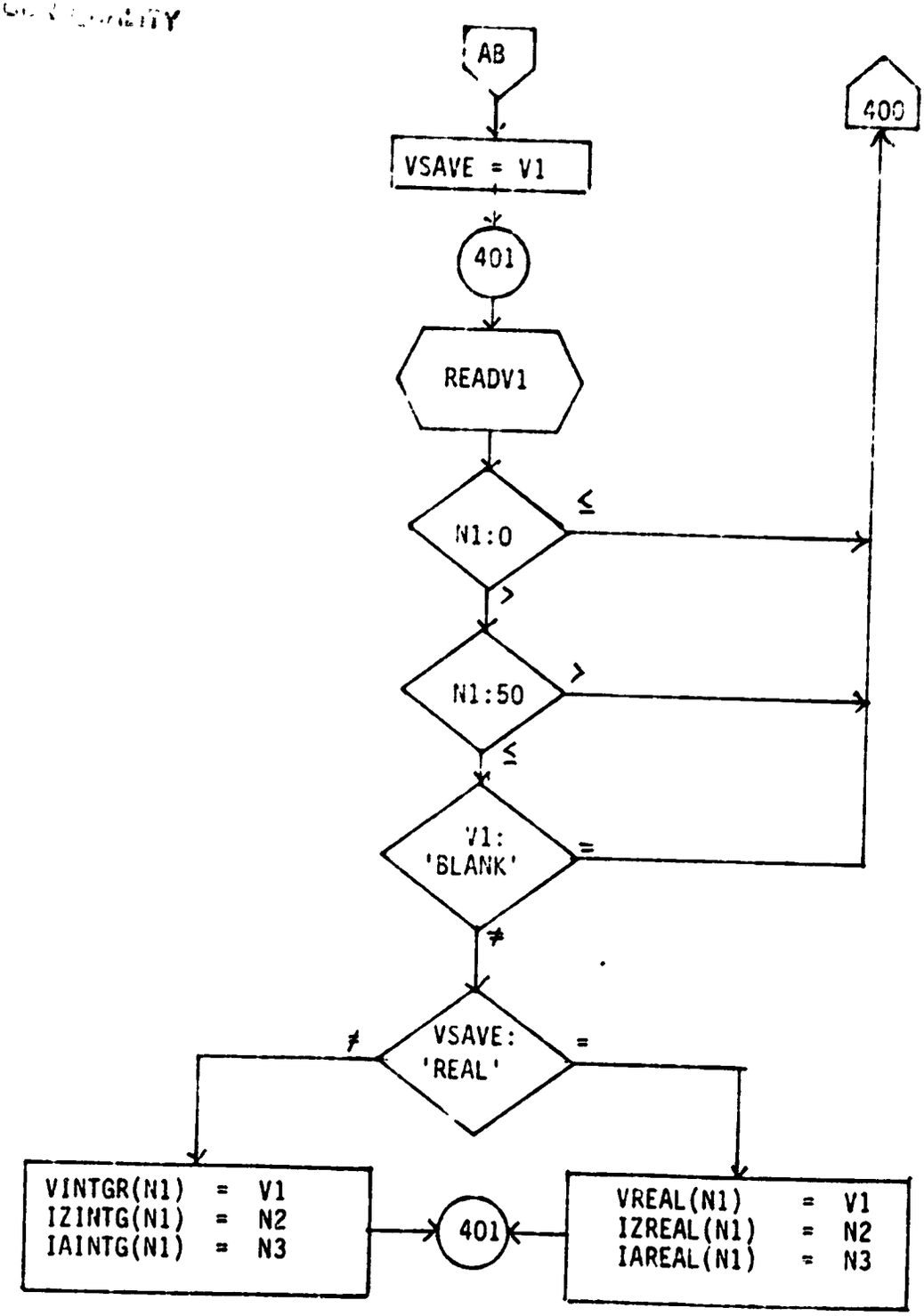

Figure 2. BDINPT flow chart (concl.)

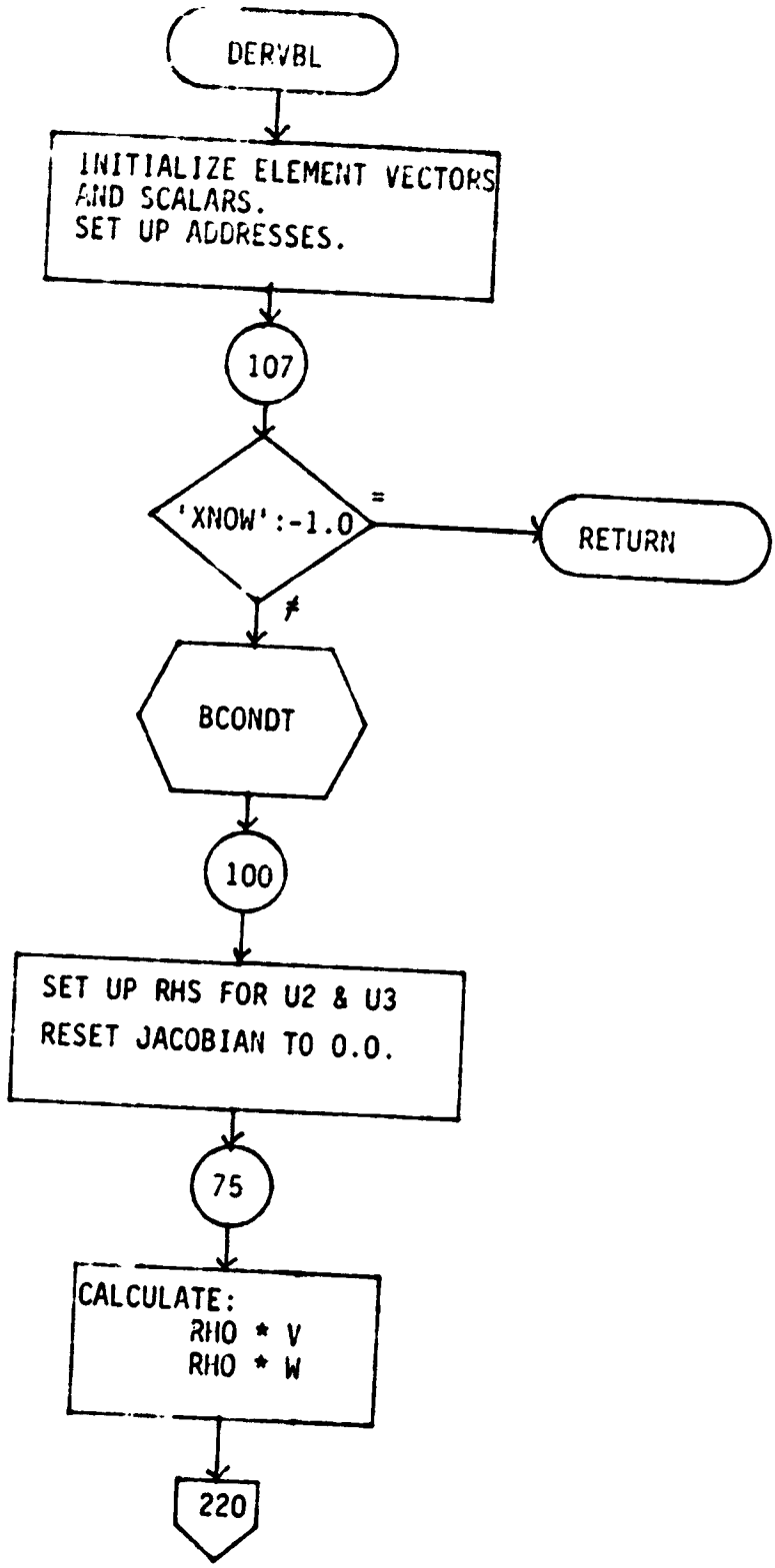

Figure 3. DERVBL flow chart

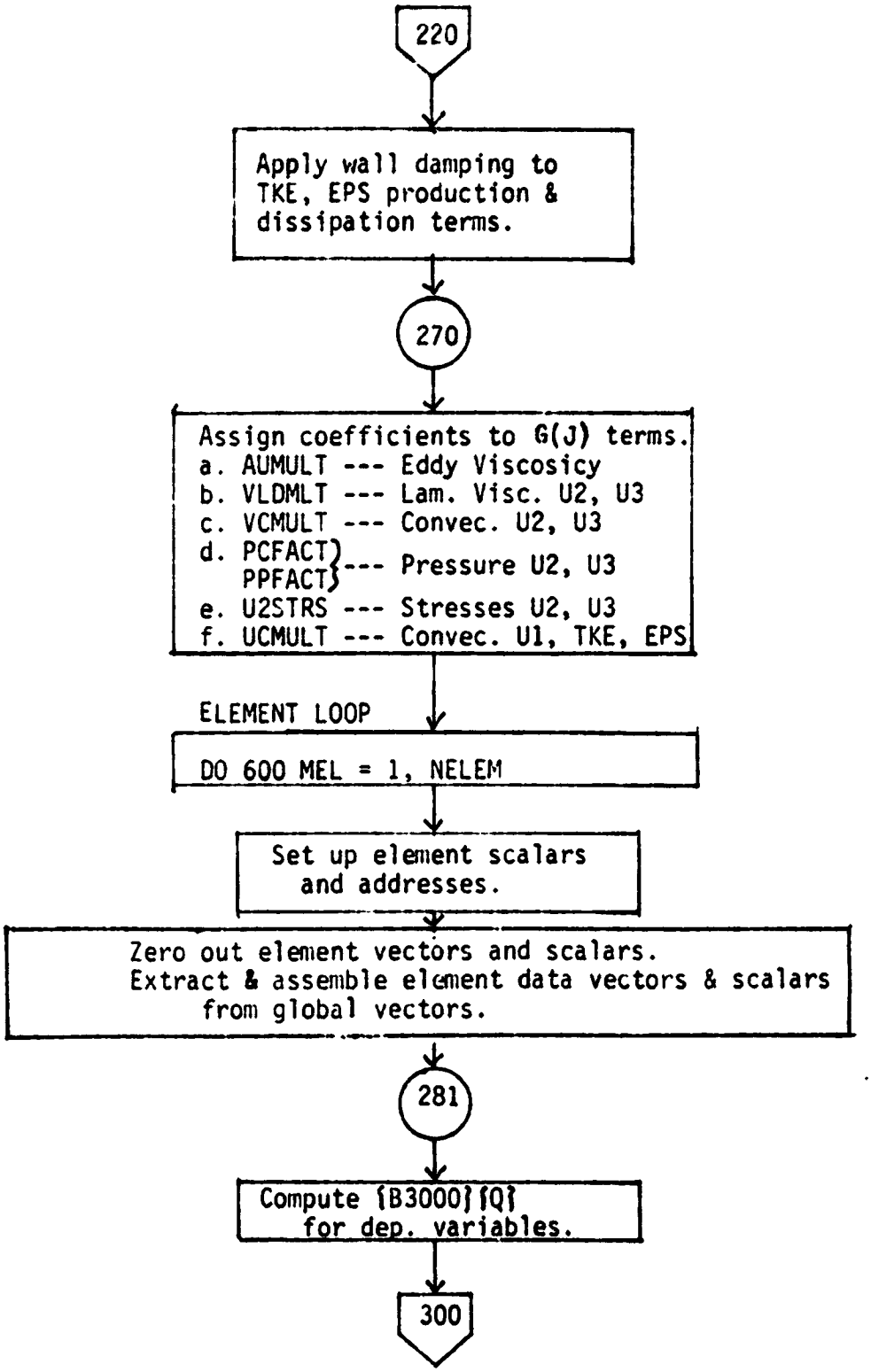

Figure 3. DERVBL flow chart (cont.)

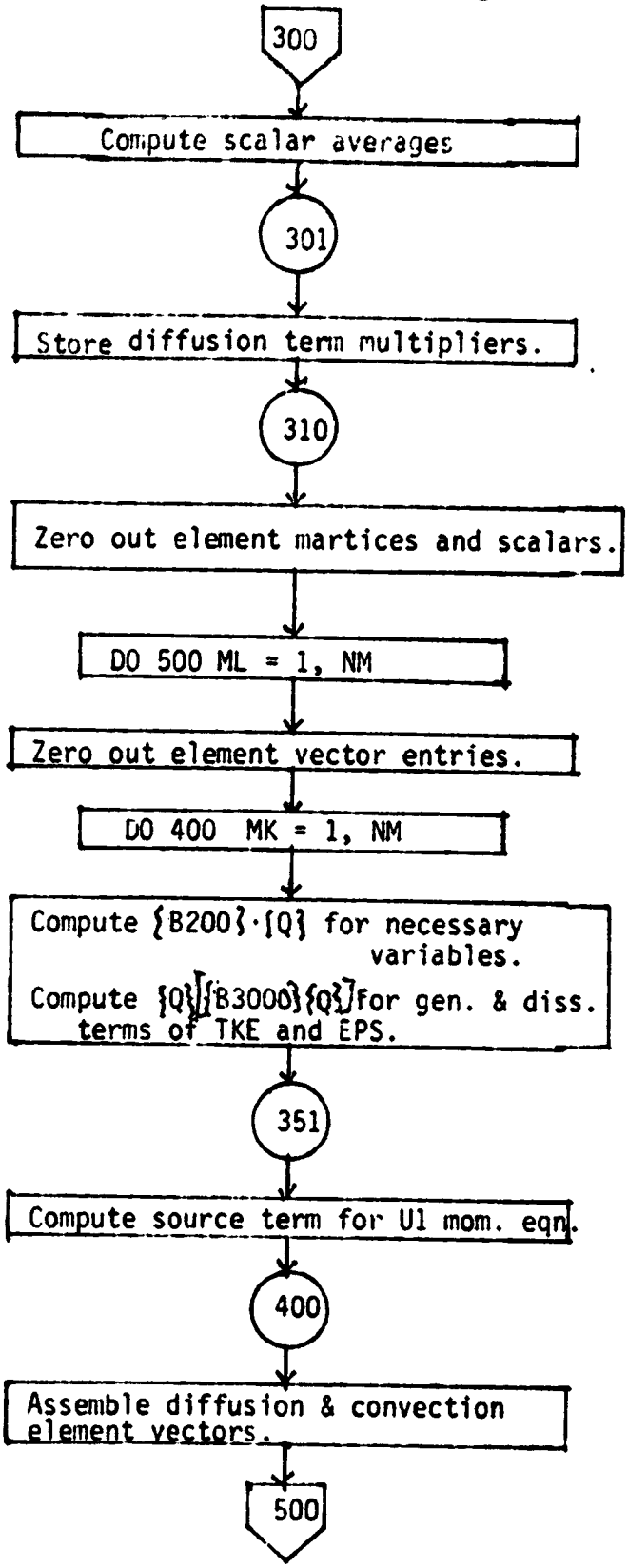

Figure 3. DERVBL flow chart (cont.)

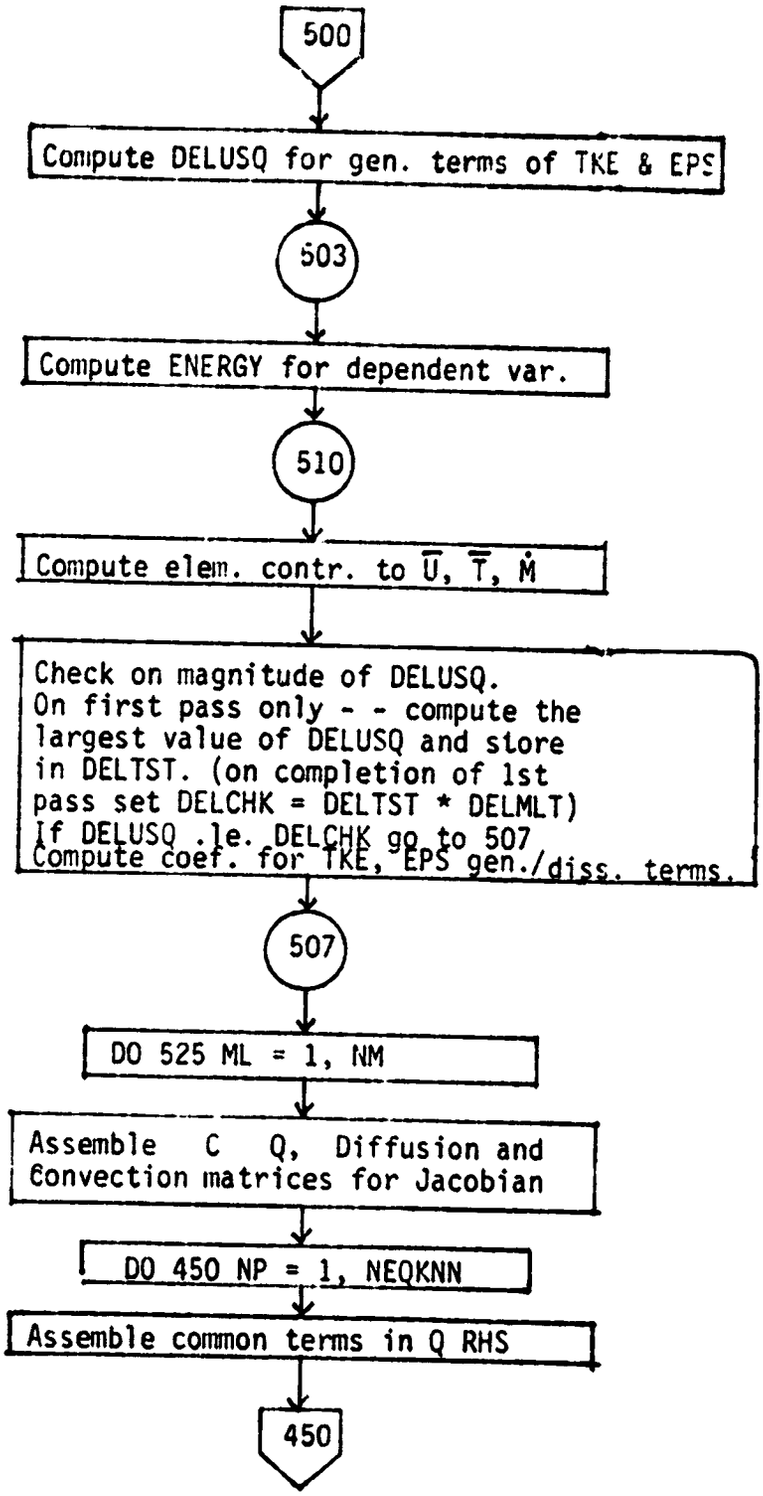

Figure 3. DERVBL flow chart (cont.)

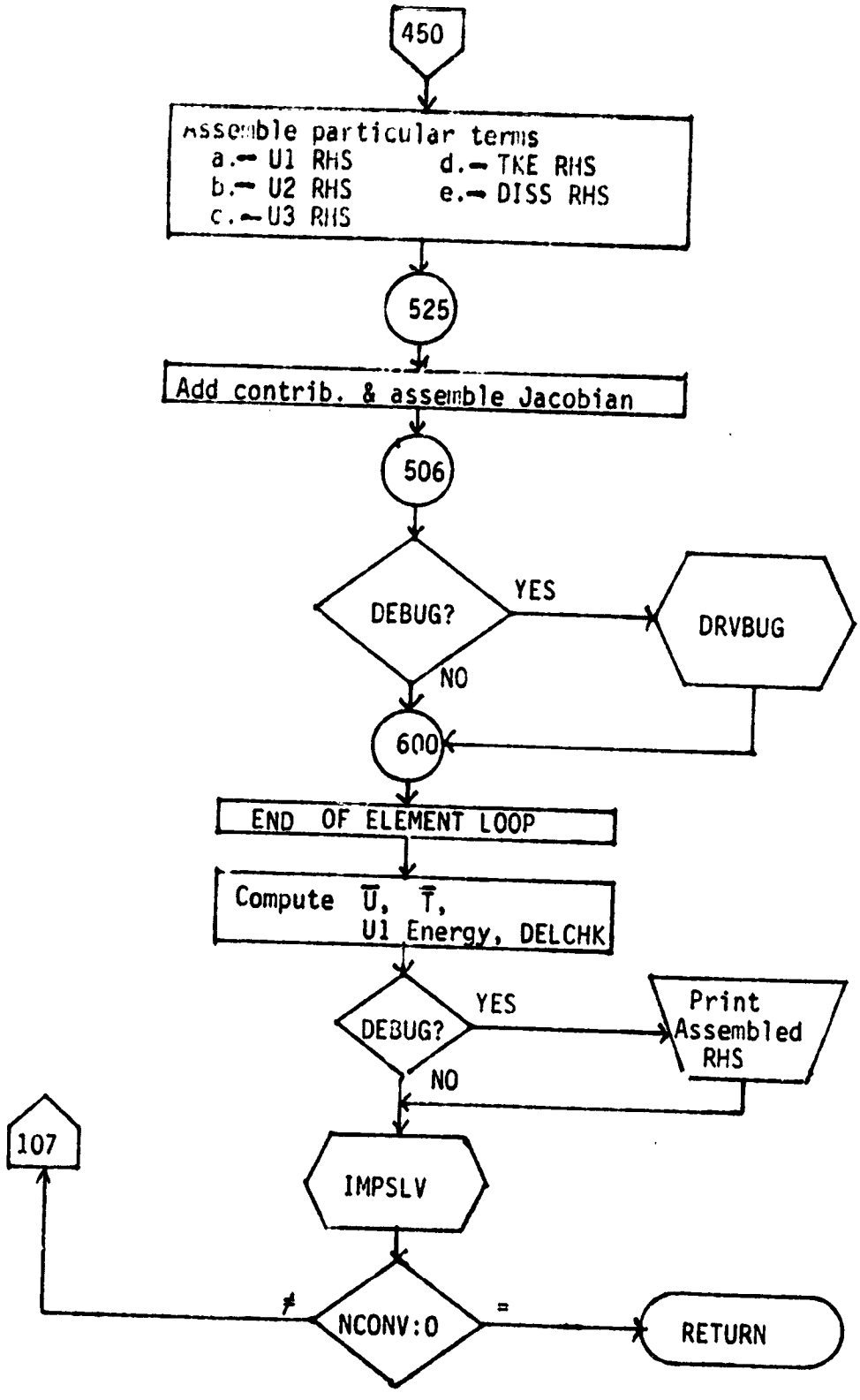

Figure 3. DERVBL flow chart (concl.)

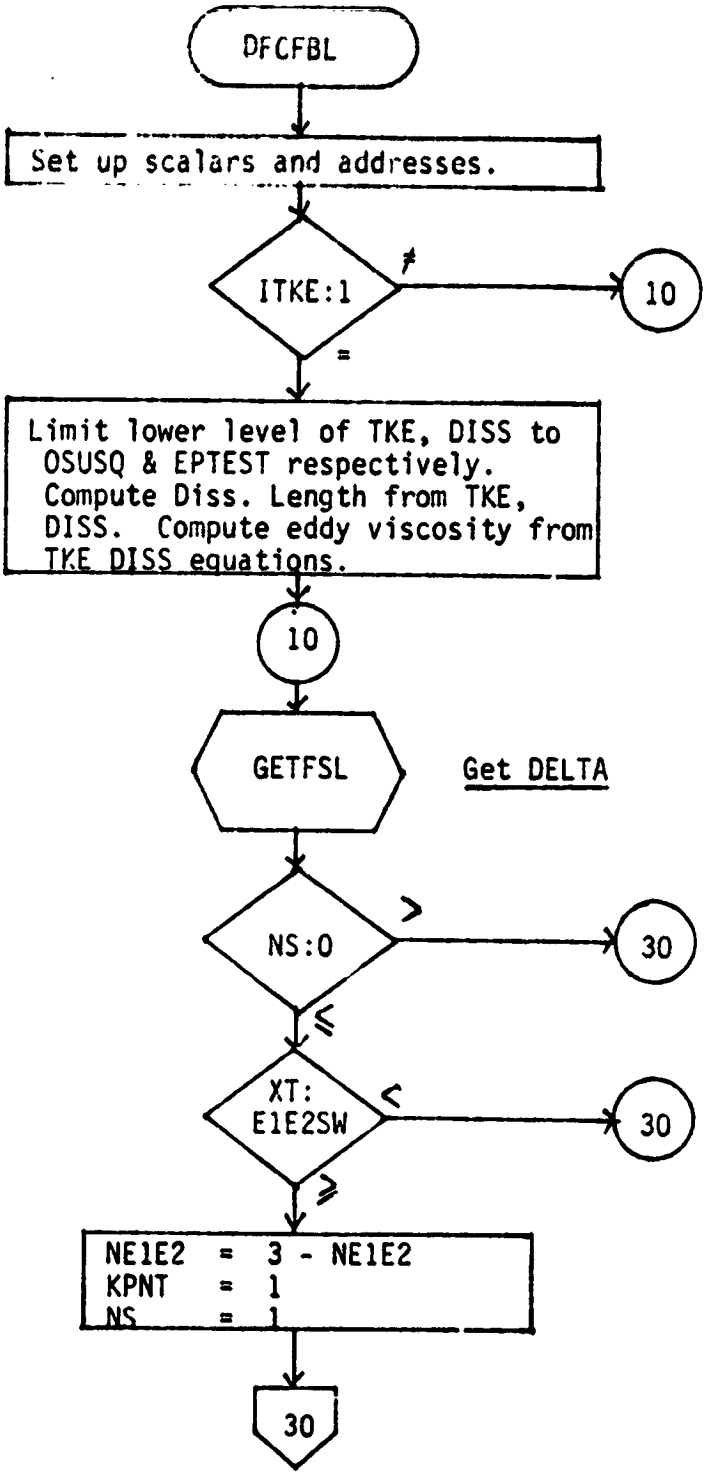

Figure 4. DFCFBL flow chart

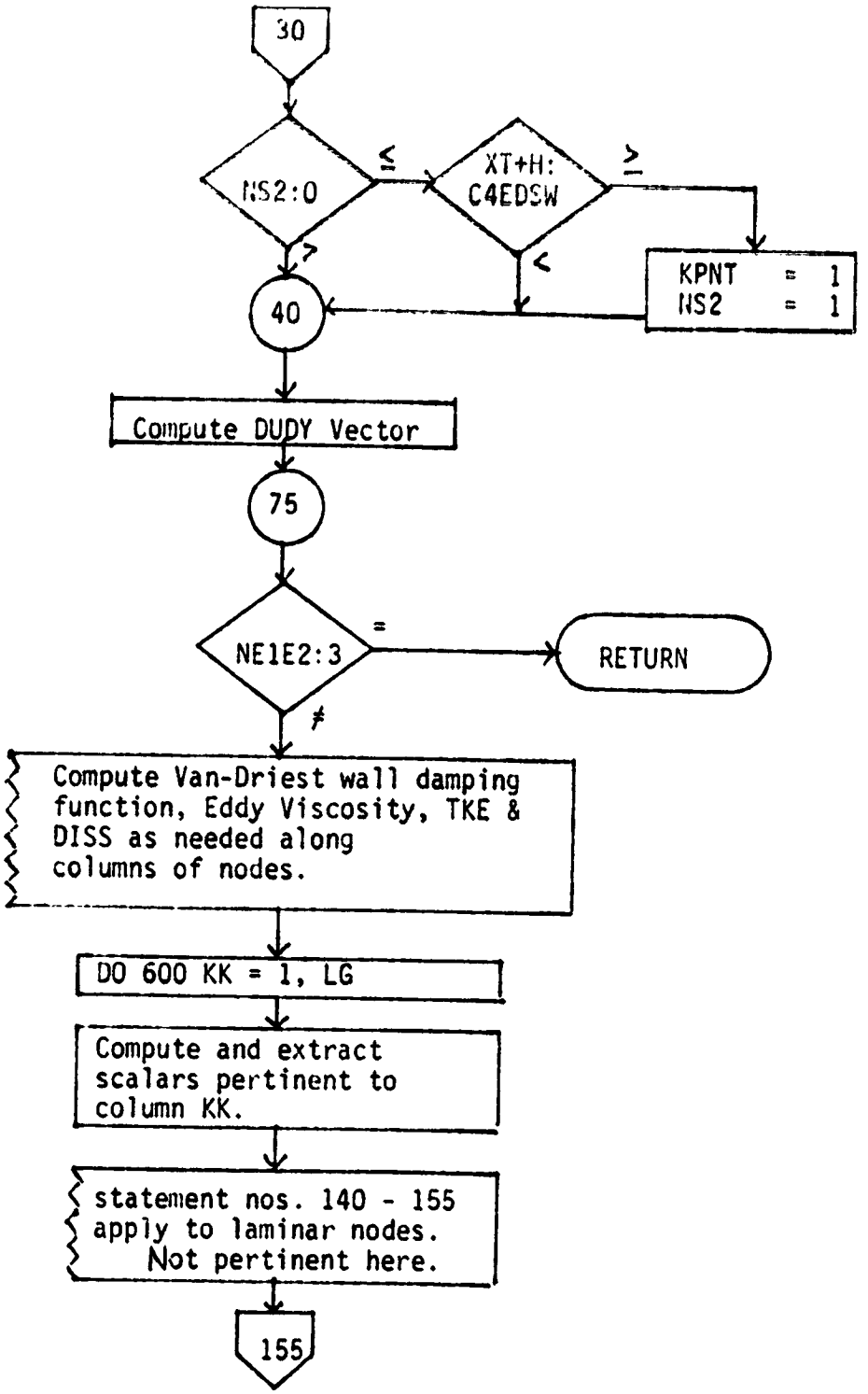

Figure 4. DFCFBL flow chart (cont.)

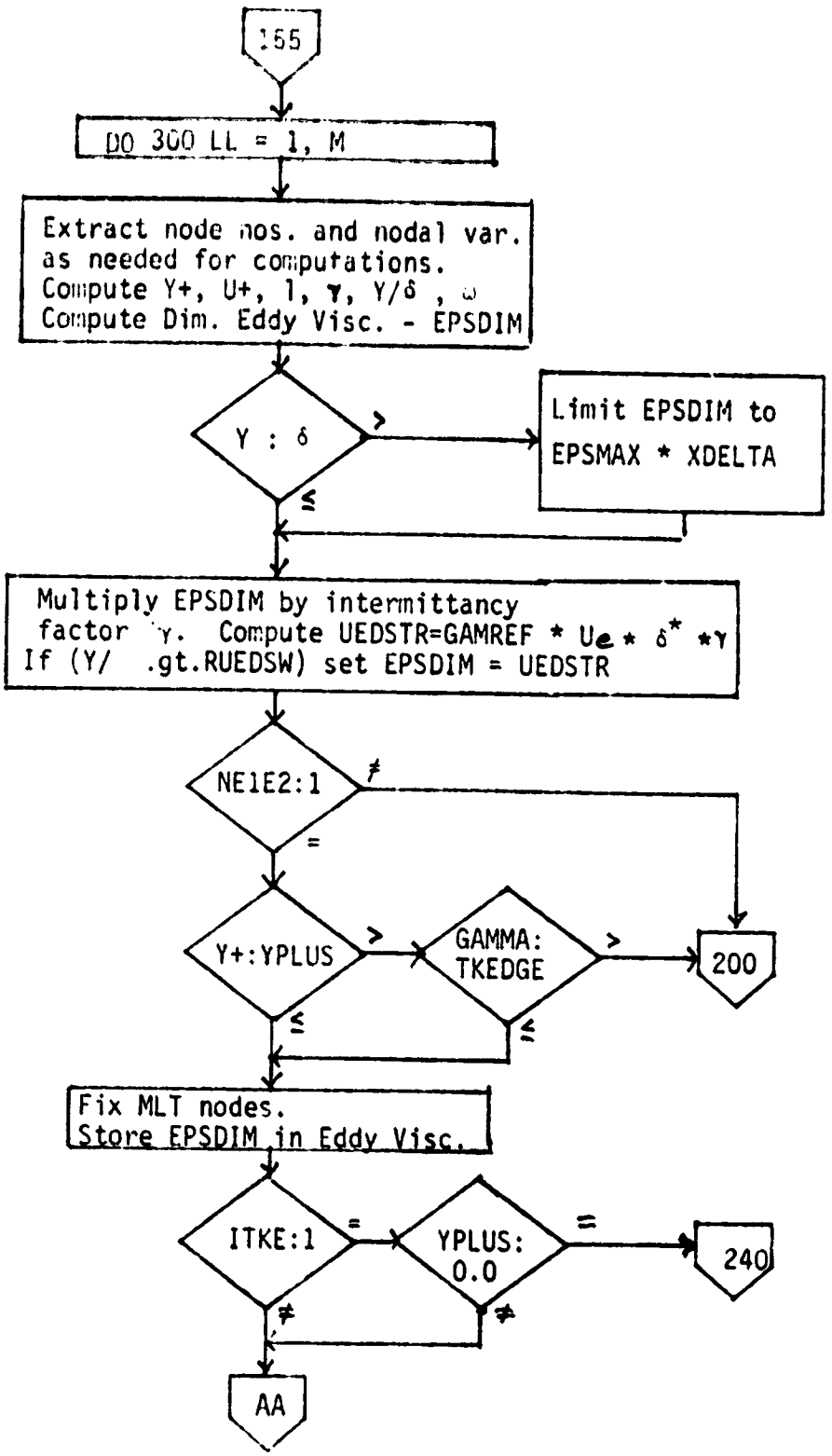

Figure 4. DFCFBL flow chart (cont.)

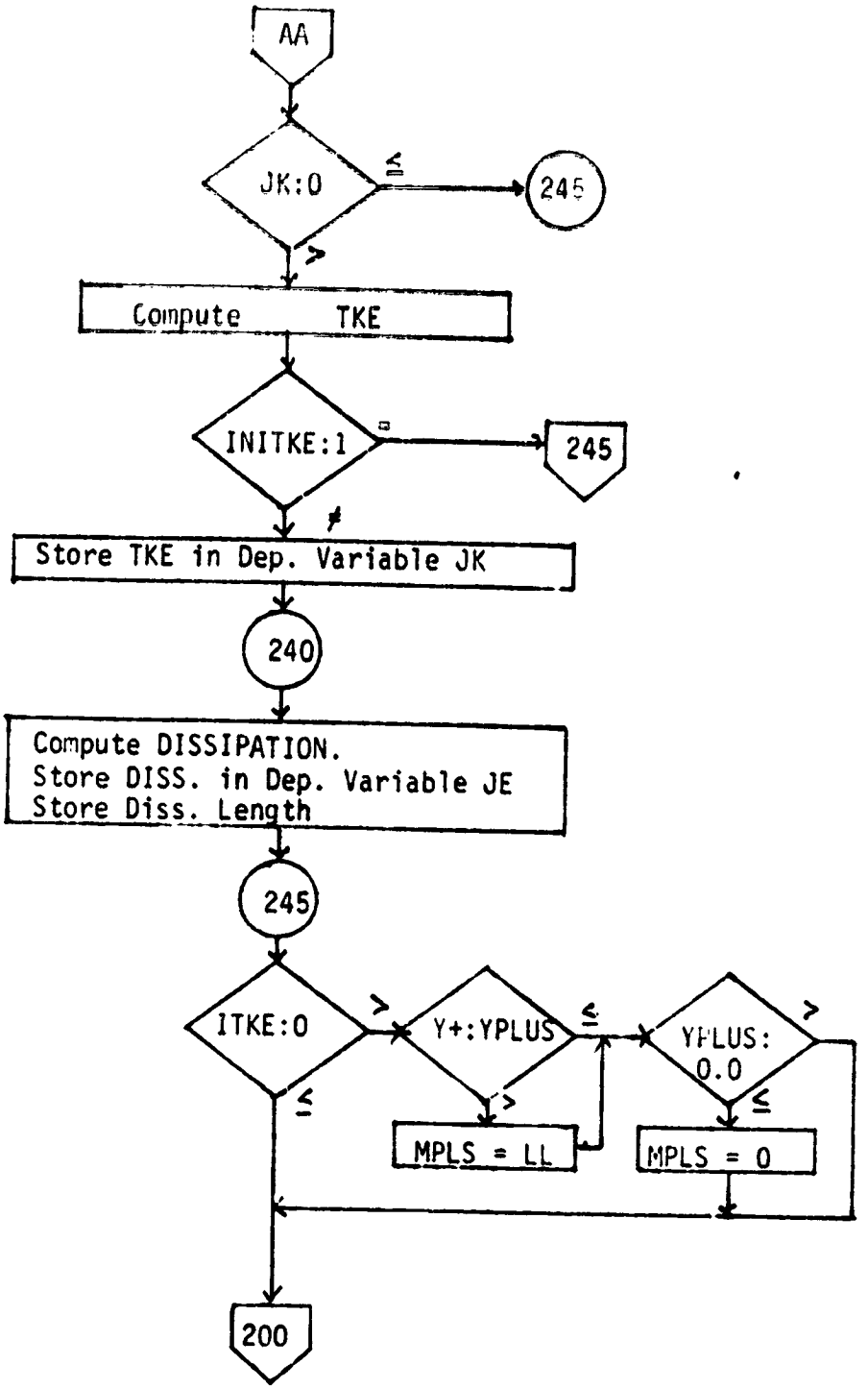

Figure 4. DFCFBL flow chart (cont.)

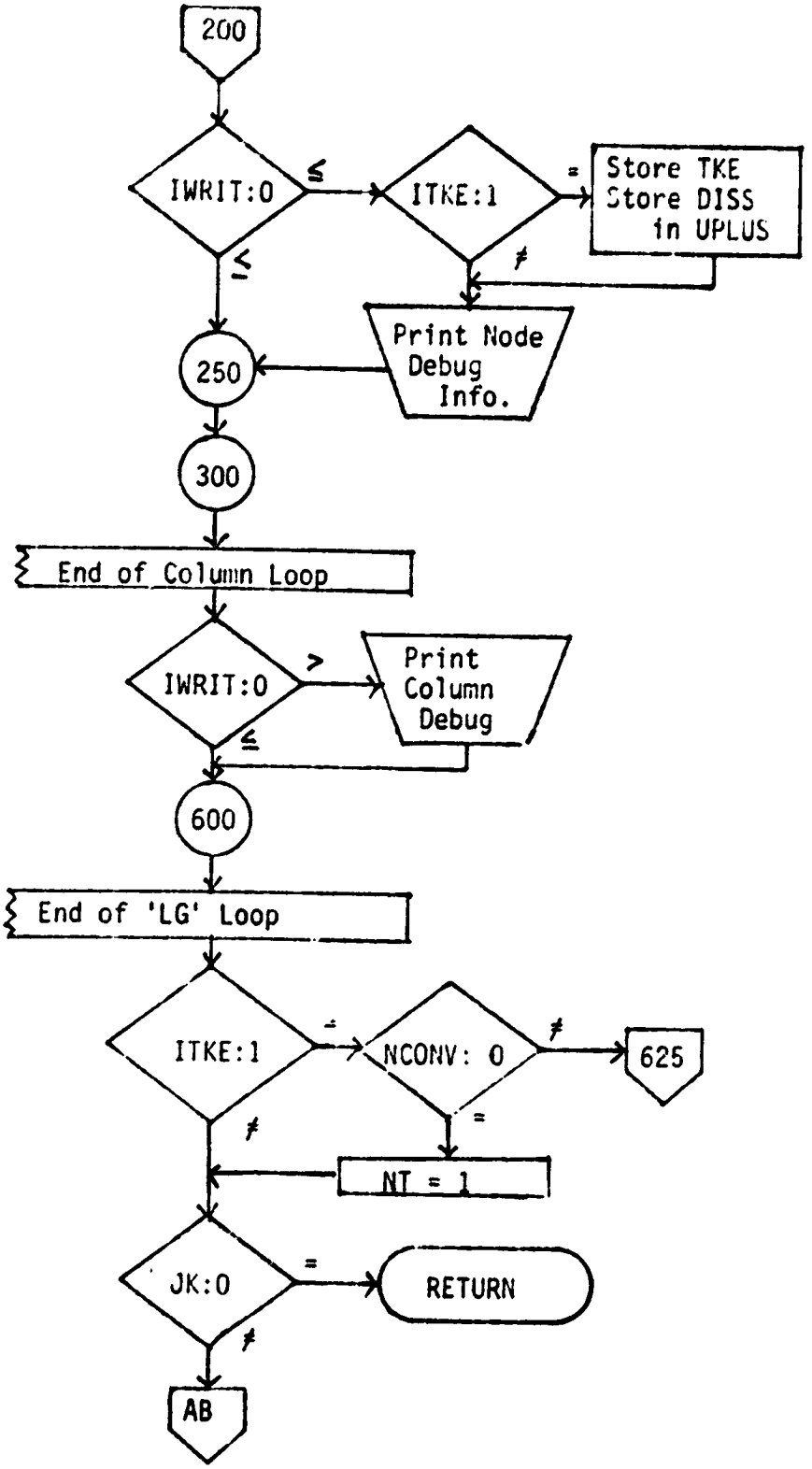

Figure 4. DFCFBL flow chart (cont.)

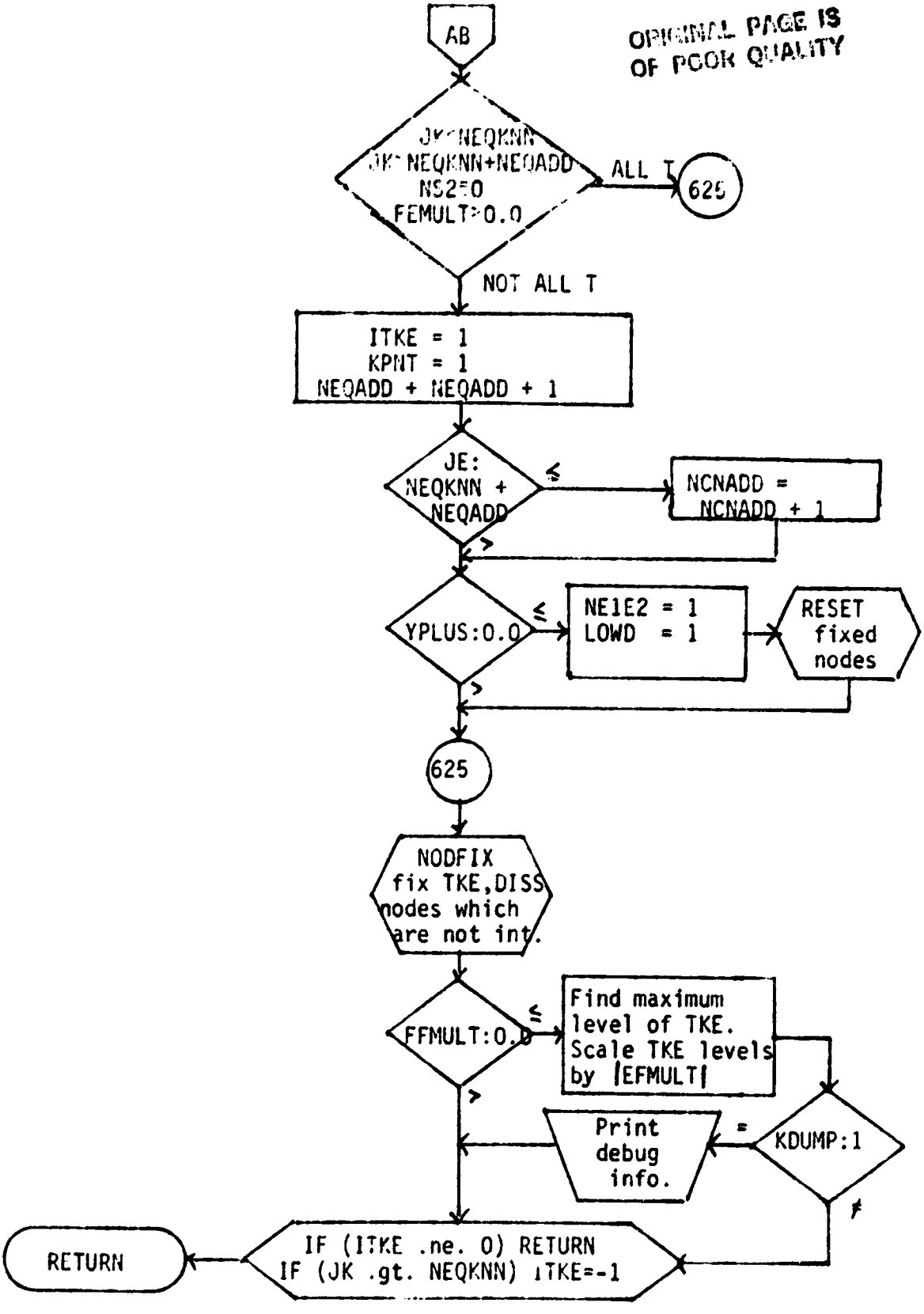

Figure 4. DFCFBL flow chart (concl.)

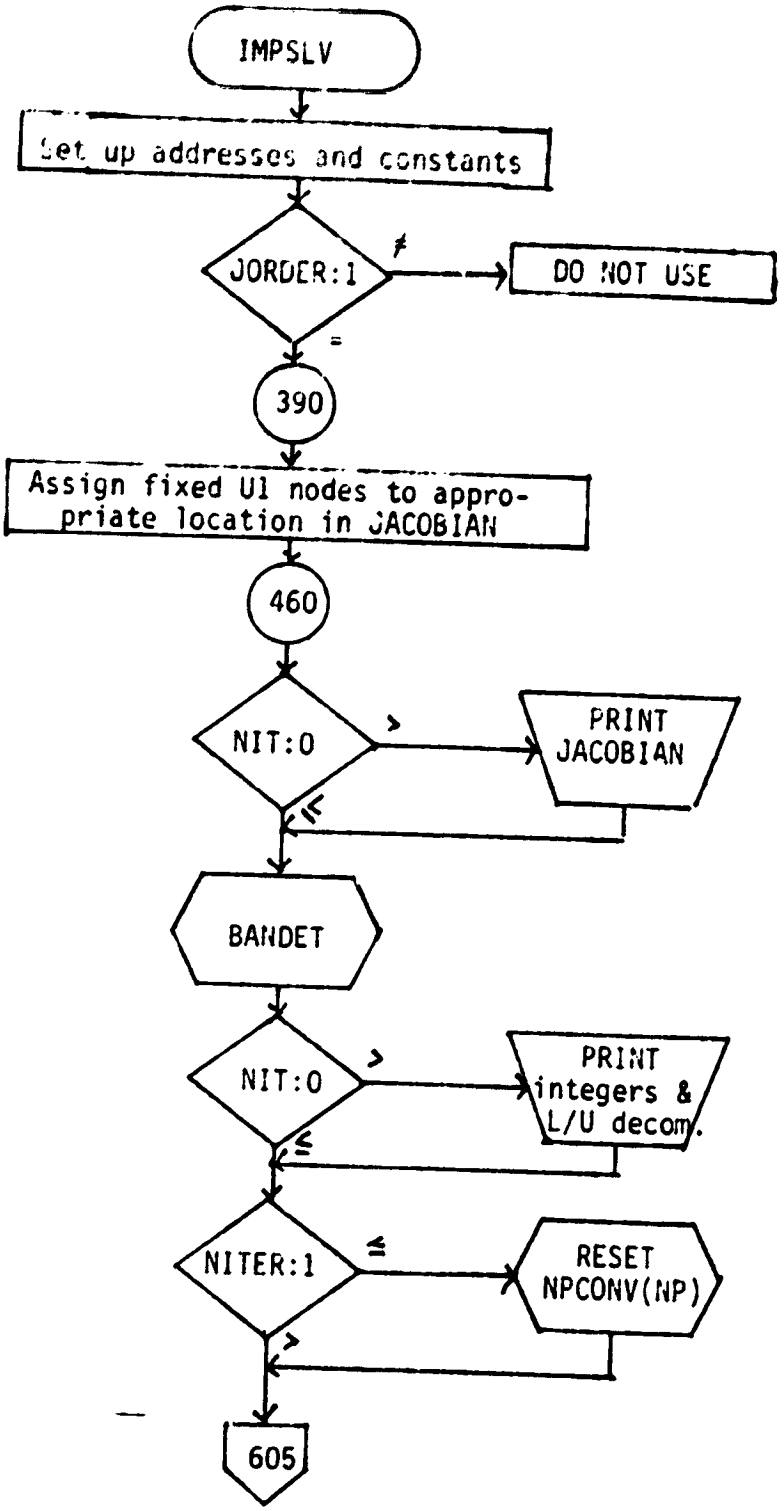

Figure 5. IMPSLV flow chart

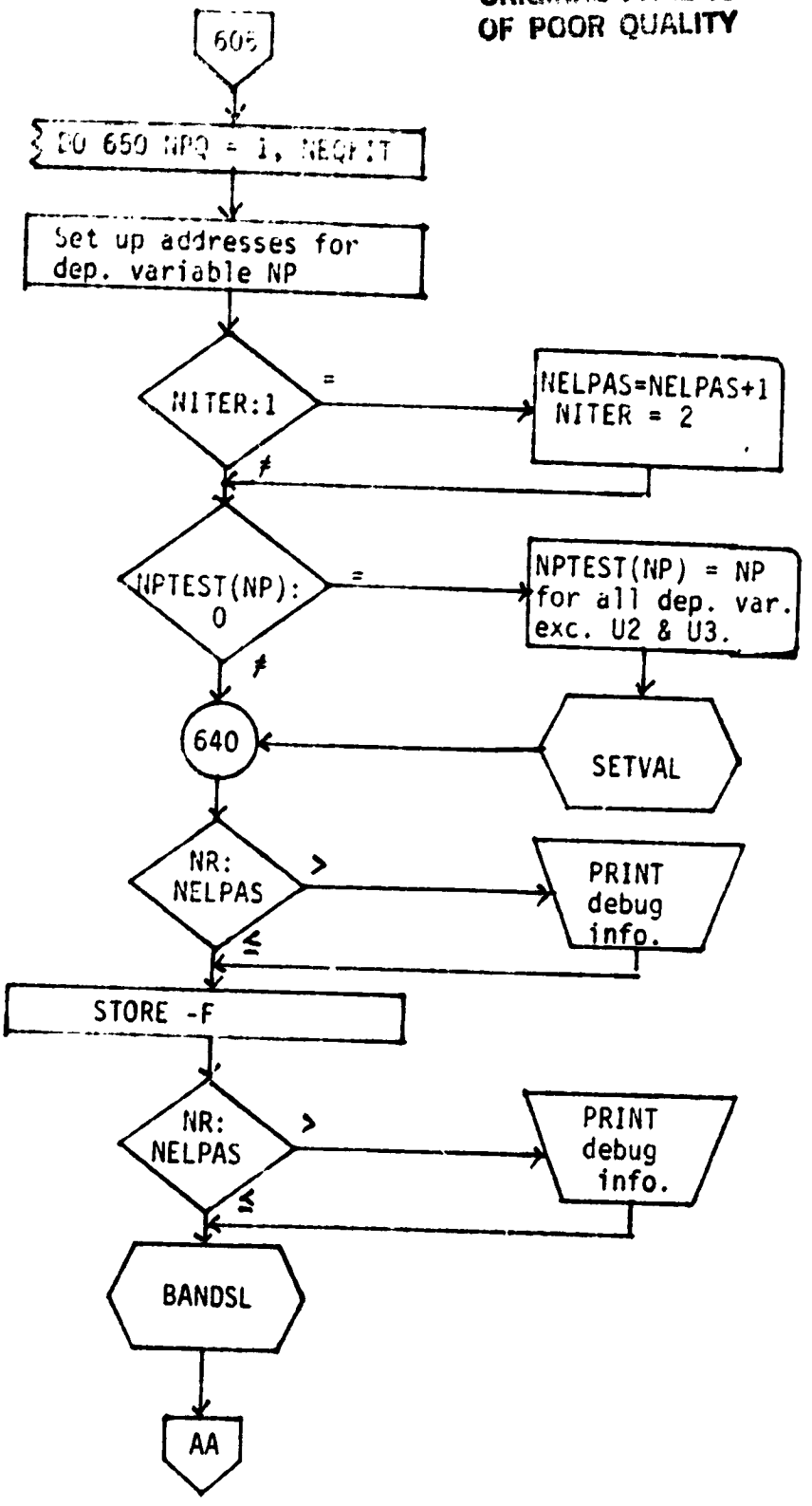

Figure 5. IMPSLV flow chart (cont.)

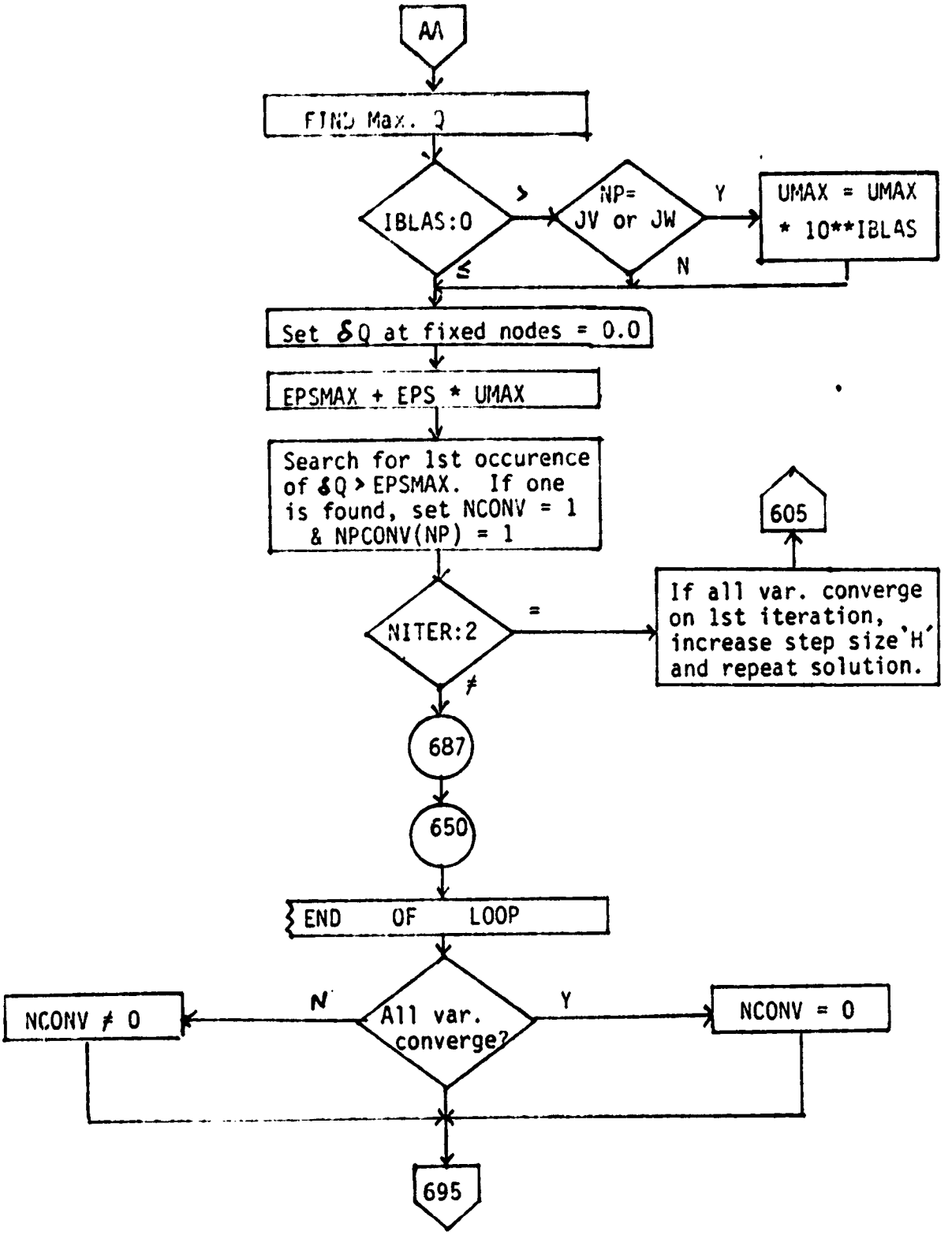

Figure 5. IMPSLV flow chart (cont.)

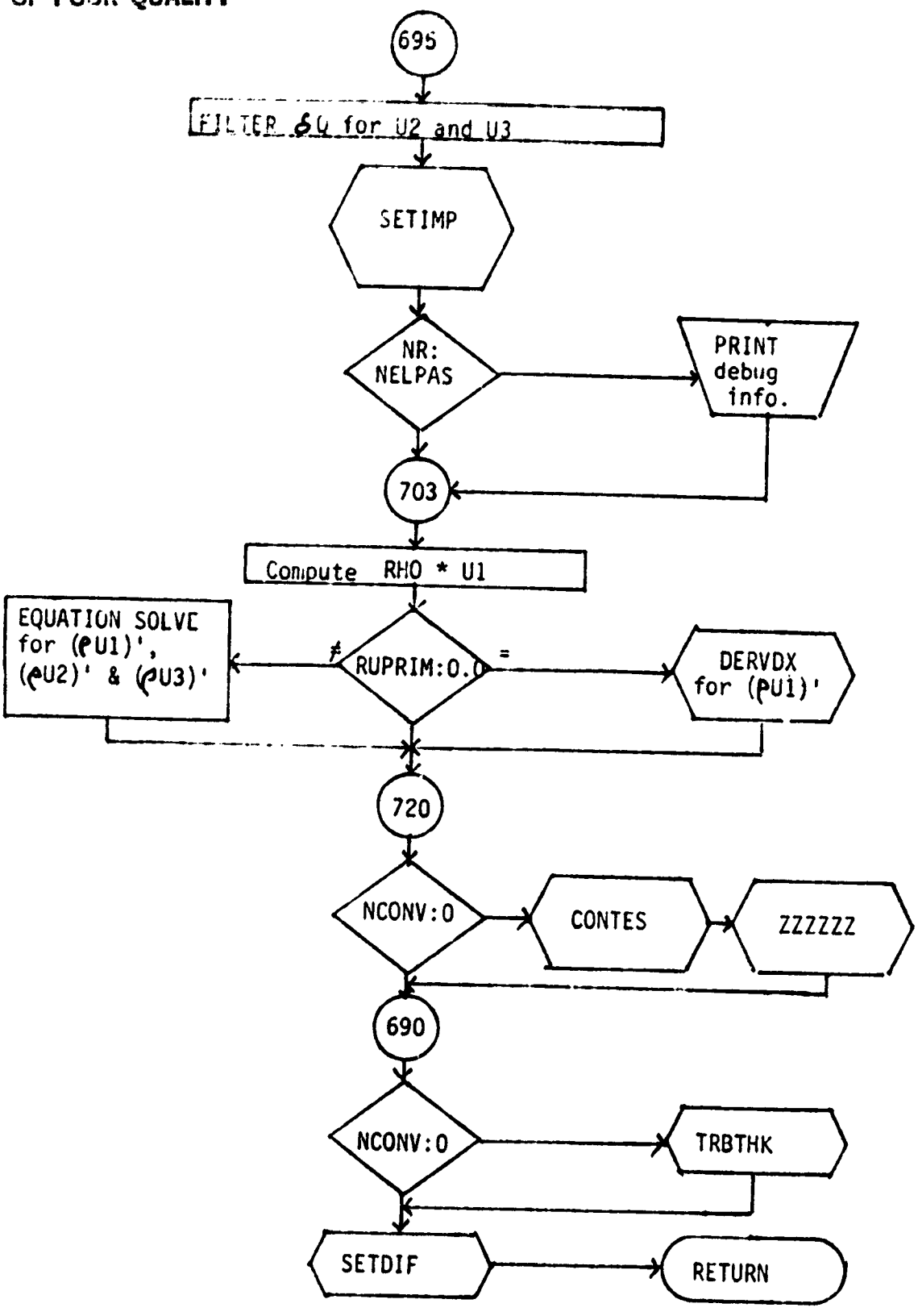

Figure 5. IMPSLV flow chart (concl.)

```
      PROGRAM JNCTUR(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT )

- - - C - O - M - O - C - - -

      DIMENSION RZ(1), L(400)
      EQUIVALENCE ( RZ(1), IZ(1), L(1) )

      COMMON  / VARBLE / IARRAY(00500), RARRAY(0500)

      EQUIVALENCE ( IARRAY(00092), IZSIZE )

      COMMON / ARRAYS / IZ(350000)

      NZSIZE  =  350000
      CALL RESETI (   500, IARRAY,   0 )
      CALL RESET  (   500, RARRAY, 0.0 )
      IZSIZE  =  NZSIZE
      CALL RESETI ( IZSIZE, IZ, 0 )
      WRITE ( 6, 9600 ) IZSIZE
 9600 FORMAT ( 1H , 35H WING JUNCTURE TEST CASE. IZSIZE = , I7 )
      CALL BDINPT
      STOP
      END
      BLOCK       DATA

      DIMENSION    TITLE(/),    VNAME(3,10), INAME( 6)
      COMMON / PLOTFE / NTITL, INAME, NOBDNO, NS, NV, VNAME, TITLE
      COMMON / CONFPR / DERV2(10)
      COMMON / AFYSAV / DFYSAV(102)
      COMMON / FSHAPE / D(60)
      COMMON / DISCRT / IDSC(10)
      COMMON / MANOUT / MANY(20)
      COMMON / NEWGOM / DGEOM(10)
      COMMON / NPINTQ / JJ(30)
      COMMON / JADRES / JAD(30)
      COMMON / OUTDUM /
     1 FMT1(10),   FMT2(09), FMT3(17), RNMB(11), DUM(28)
      DATA  FMT1 /4H(1H ,4H,   ,4H   8, 4H  A1, 4H,4X,, 4H   1,
     * 4H   2, 4H   0, 4H  A1, 4H )  /
      DATA  FMT2 / 4H(1HO, 4H,1X,, 4H1HE,, 4H I2,, 4H   1, 4H   2,
     * 4H   8, 4H  A1, 4H )  /
      DATA  FMT3 / 4H(  1,4H   6,4HX,  ,4H    ,4H   1,4H(   ,4H   4,
     1  4H   A,4H   4,4H,1HE,4H,I3,,4H    ,4H   1,4HX )),3*1H  /
      DATA  RNMB  / 4H   0, 4H   1, 4H   2, 4H   3, 4H   4, 4H   5,
     $      4H   6, 4H   7, 4H   8, 4H   9, 4H  10 /
      DATA  DUM / 28*0. / /
```

APPENDIX A.
SUBROUTINES FOR 3DPNS
TEST CASE

```
 DATA  NTITL, INAME, NOBDNO, NS, NV, TITLE, VNAME  /
1 6,  76, 21, 27, 38, -182, 0, 0, 0, 0,
2 4H  ST, 4HANDA, 4HRD F, 4HPINT, 4H VAR, 4HIABL, 4HES  ,
3 3*1H  , 4H    , 4HSTAT, 4HION , 4HREYN, 4HOLDS, 4H NO.,
4 4H  RE, 4HF. V, 4HEL. , 4H REF, 4H. VI, 4HSC. , 4HVARI,
5 4HABLE, 4H NO., 12*1H  /
 DATA  MANY / 39, 47, 56, 91, 66, 101, 102, 105, 12*0 /
 DATA  DFYSAV / 102*0.0 /
 DATA  DERV2 / 10*0.0 /
 DATA  D / 5*0.0, 0.25, 0.0, 1.0, 0.0, 0.5, 0.0, -1.0, 0.075,
1  9*0.0, 1.2, 37*0.0 /
 DATA  IDSC / 4*1, 6*0 /
 DATA  DGEOM / 10*0.0 /
 DATA  JJ / 30*0 /
 END
```

```
SUBROUTINE COMOC
      DUMMY SUBROUTINE TO SUPPRESS PRINTOUT OF TITLE PAGE.
      IF YOU DESIRE THIS PRINT, REMOVE THIS DUMMY SUBROUTINE.
RETURN
END
```

```
SUBROUTINE CONTES
      DUMMY SUBROUTINE CALL BY 'LINKCAL ' ENTRIES IN INPUT DATA.
RETURN
END
```

```
SUBROUTINE OUTVEC ( NN, ARRAY, TITLE )

        THIS IS A SPECIAL OUTVEC FOR THE JUNCTURE CORNER ONLY.
        FOR THE MORE GENERAL CASE, REMOVE THIS SUBROUTINE.

DIMENSION  ARRAY(1), TITLE(8)
CALL JNCVEC ( NN, ARRAY, TITLE )
RETURN
END
```

```
SUBROUTINE TBLINP

         'JNCINP' INITIALIZES THE DATA FOR A JUNCTURE REGION.

CALL JNCINP
RETURN
END
```

APPENDIX A.
SUBROUTINES FOR 3DPNS
TEST CASE

INPUT DATA DECK

```
  WING FUSELAGE JUNCTURE FLOW.
 FENAME
  $NAME01
       NIZS = 250, NSNODE = 19, NSELEM = 2, NDP = 10, LG = 22,
       NVAR = 3, KNTPAS = 200, NMOUT = 2, NOUTVC = 10, NOUTS = 1,
       NED = 9, NEQAV2 = 1, NEQAV3 = 1, NEQKNN = 5, NEQADD = -4,
       NPVSXT = 7,  NTADPT = 14, NCNADD = 0, NE1E2 = 1,
       LPUNIT = 0, LPSUP = 6, LPPNCH = 2, JPR = 1, NMBOUT = 50,
       NODE = 193, LCOL = 75, KROW = 75, NPVSX = 2660,
       NNROW = 9,  NBAND = 23,  NODES = 170, NLINE = 140,
       KOD5 = 2, KOD6 = 3, KODC = 1, KDUMP = 1, KPNT = 1, IWRIT = 2,
       IPWRIT = 2, IBOT = 2, ITOP = 4, NR = 10, NIT = 1, NDBGPT = 8,
  $END
  $NAME02
       UINF = 100.0, PINF = 2116.8, CHIEPS = 3.0E-4, DELP = 101.0,
       COMPX = 2., COMPY = 1., OSC = 1., EPMULT = 1., DSTART = 1.,
       U2STRS = 1.0, C4EDSW = .001, PCFACT = 1., PPFACT = 1.,
       VCMULT = 1.0, VLDMLT = 1.0, OSUSR = 1.0E-5, EPSMIN = 1.0E-5,
       TO = .011, TD = .589, TSADD = .05, DELMLT = 1.0E-4,
       RARRAY(384) = 1.0, RARRAY(385) = 1.0,
  $END
FEDIMN          T  ESTABLISH VECTOR ADDRESSES FROM DATA INPUT.
IPINT           T  INPUT DEPENDENT VARIABLE NUMBERS.
  1 5 6 2 3 7 8 9 0 0,  10*0,  10*11 1  T
LINK4      9    T  CALL POTENT TO ESTABLISH VECTORS FOR TYPE II DISC.
PSIBD           T  ESTABLISH DIRECTION OF DIAGONALS.
    1  -2  T
LINK2       14  T  CALL DSCRTZ TO GENERATE DISCRETIZATION.
NETA         T  NO. OF ELEMENTS IN ETA DIR. FOR EACH SUPER ELEMENT.
     9  9  T
NEPS        T  NO. OF ELEMENTS IN EPS DIR. FOR EACH SUPER ELEMENT.
     9  9  T
STYPE        T  TYPE OF SUPER ELEMENTS. 4 - QUADRILATERAL
    2*4  T
SELCN       T  SUPER ELEMENT NODE CONNECTIONS.
       9  10  3  1  12  13  19  2,
     1  2  14  15  19  16  17  18  T
DEPVAR   289  290  1248 T VAR. TO BE DISTRIBUTED. 289=Z, 290=Y, 1248=U1.
  0.00, 0.869565 .01918 .0 .025 .05 .025 .0 .0999 .0999
  .2 1.35 .869565,  .01918  0.0,  1.15 1.35 1.15 1.35
  0.0  0.0  .01918 .05 0.0 0.025 .05 .025 0.0 .01918
  .0  .0009 .01918 0.0999 0.0999 .08 .0009 .09 .0009
   0.0 0.0 .758 0.0 0.0 .5 .5 0.0 0.0  .720 .58 .783 0.0
  .783 0.0 .58 .720  0.0  .71  T
DONE        T  END OF INPUT FOR DSCRTZ.
READ        5  63  -26  T  REARRANGE LOWER RIGHT CORNER ELEMENTS.
    11 1 2,  2  12  11  T
READ        5  63  -26   918  T  REARRANGE UPPER LEFT CORNER ELEMENTS.
    181  171  182,  171  172  182  T
READ            5  63  -26  972  T ADD ELEMENT TO INTERIOR CORNER.
   110  100  90  T
IARRAY      14  325  T  SET NELEM = 325
DESCRIPT  204     T  TITLE FOR OUTPUT SECTION.
   WING / FUSELAGE JUNCTURE FLOW.

DONE        T   END OF TITLE
```

Debug

APPENDIX B.
DATA DECK FOR 3DPNS JUNCTURE

INPUT DATA DECK

```
CONTITLE        T   SCALAR PRINTOUT FOR OUTPUT SECTION.
   WING / FUSELAGE JUNCTURE FLOW.
DONE
DESCRIPT  332   T  IOPAR   PARAMETER TITLES FOR OUTPUT.
 REFERENCE       ENGLISH-FT       ENGLISH-IN       M-K-S              C-G-S
 LENGTH.........  .FT........  .IN.........  .M..........  .CM.........
 VELOCITY.......  .FT/S.......  .N.A........  .M/S........  .CM/S.......
 DENSITY........  .LBM/FT3....  .N.A........  KG/M3.......  ..G/CC......
 TEMPERATURE....  .RANKINE....  .N.A........  .KELVIN.....  .N.A........
 ENTHALPY.......  .BTU/LBM....  .N.A........  .KJ/KG......  .N.A........
 FROZ.SPEC.HEAT.  .BTU/LBM-R..  .N.A........  .KJ/KG-K....  .N.A........
 VISCOSITY......  .LBM/FT-S...  .N.A........  .NT-S/M2....  .POISE......
 LOCAL PRESSURE.  .PSF........  .PSI........  KNT/M2......  .TORR.......
 LOCAL SOLUTION.  .MACH NO....  .DPDX1......  .ENERGY.....  .INT. VAR...
 T2PF1X.........  .H21........  .G22........  .G23........  .F1.........
 NUCLEON M'S....  .H31........  .G32........  .G33........  .G1.........
 X1/LREF........  .DX1/LREF...  .EPSILON....  .DX1N/LREF..  .REYL NE NO.
DONE
MPARA      -1
  5*2,  2 2 162 164 163,  3*2 164 163,  3*2 170 174,
  3*2  165 2,  2 -175 3*2,  3*2 176 2,  3*2 177 178,
  2  2 169 168 167,  3*2 108 2,  5*2,  5*2,  5*2  1
IONUMB     -1
   999,  5*200,  999, 200 4*43,  200 27 200 27  27,
   200 10 200 10 10,  200 58 200 58 200,
   200 97 200 97 200,  200 30 200 30 200,
   200 38 200  38 38,  999,  39 4*36,  300 154 100 135 122,
  398 4*I1 186,  200 4*I1 139,  11  12  14  85  47  1
IBORD        T  COUNTER-CLOCKWISE LIST OF BOUNDARY NODES.
     10*I1 1,  17*I10 20,  10*I-1 190,  18*I-10 171  1
KBNO       1  T  FIXED NODES FOR DEP. VAR. NO. 1
ADD                 DONE
    19*I10  1  T  FIX WALL NODES.
KBNO       2  T  FIXED NODES FOR DEP. VAR. NO. 2
ADD                 DONE
    19*I10  1  T  FIX WALL NODES.
KBNO       3  T  FIXED NODES FOR DEP. VAR. NO. 3
ADD                 DONE
    19*I10  1  T  FIX WALL NODES.
KBNO       7  T  FIXED NODES FOR DEP. VAR. NO. 7
ADD                 DONE
  19*I10  1  T  FIX WALL ONLY FOR PP
KBNO       8  T  FIXED NODES FOR DEP. VAR. NO. 8
ADD                 DONE
  19*I10  10  T
KBNO       9  T  FIXED NODES FOR DEP. VAR. NO. 9
ADD                 DONE
  9*I10 10,  9*I10 110  T
```

APPENDIX B.
DATA DECK FOR 3DPNS JUNCTURE

INPUT DATA DECK

```
CNTPTS      T SPECIFIY 19 SETS OF 10 NODES EACH.
  19*10  T
CNTNDS      T  SPECIFY ALL NODE NOS. IN THE 19 SETS.
  190*I1  1  T
IARRAY    47  19  T  SET LG - 47
LINK3      4  T  CALL DIMEN TO NON-DIMENSIONALIZE INPUT.

LINK1      3   T  CALL GEOMFL TO COMPUTE LENGTHS AND AREAS.
IARRAY      61    1  T  SET KDUMP = 1
CNTPTS       T  SET UP TWO VECTORS OF LENGTH 19 FOR NODPCP.
  19  19  T
CNTNDS       T  SPECIFY NODES IN BOTH VECTORS.
  10*I-10 100,  9*I-1 9,  10*I10 100,  9*1-1  189  T
IARRAY    47  2  T  SET LG = 2
LINK2        23    T  CALL CPSTUP TO READ IN CP DATA.
   0.0        0.02784   0.04731   0.07165   0.10210   0.14010   0.19000
   0.00999
   0.46940   0.46940   0.42770   0.38980   0.36030   0.33690   0.31740
   0.01914
   0.38290   0.38290   0.35650   0.32150   0.29170   0.26730   0.24680
   0.03126
   0.29870   0.29870   0.28500   0.25710   0.22970   0.20600   0.18560
   0.04628
   0.21490   0.21490   0.21020   0.19090   0.16830   0.14700   0.12800
   0.06409
   0.13190   0.13190   0.13350   0.12220   0.10560   0.08826   0.07195
   0.08458
   0.05079   0.05079   0.05659   0.05191   0.04182   0.02944   0.01691
   0.13310
  -0.10500  -0.10500  -0.09411  -0.08947  -0.08799  -0.08917  -0.09175
   0.16090
  -0.1788   -0.1788   -0.1664   -0.1584   -0.1522   -0.1480   -0.14510
   0.22240
  -0.3151   -0.3151   -0.3012   -0.2879   -0.2739   -0.2601   -0.2466
   0.2908
  -0.4296   -0.4296   -0.4155   -0.3982   -0.3783   -0.3571   -0.3345
   0.40250
  -0.54460  -0.54460  -0.53120  -0.51030  -0.48480  -0.45640  -0.42500
   0.50
  -0.57430  -0.57430  -0.56140  -0.53960  -0.51270  -0.48250  -0.44880
   0.5975
  -0.54460  -0.54460  -0.53120  -0.51030  -0.48480  -0.45640  -0.42500
   0.71
  -0.4296   -0.4296   -0.4155   -0.3982   -0.3783   -0.357    -0.3345
     T
LINK2       30  T  CALL NODPCP TO ESTABLISH CP TABLES.
```

APPENDIX B.
DATA DECK FOR 3DPNS JUNCTURE

INPUT DATA DECK

```
CNTPTS       T  RESET CNTPTS FOR SOLUTION.
  19*10  T
CNTNDS       T  RESET CNTNDS FOR SOLUTION.
  190*11  1  T
IARRAY     47  19  T  SET LC = 19
LINK1       2  T  CALL NODELM TO SET UP ELEMENT INFO. ATTACHED TO NODES.
LINK1      11   T  CALL NODPPR
LINK2      10   T   CALL TBLINP TO DISTRIBUTE U1 ALONG COLUMNS OF NODES.
IARRAY        76    1  T  KREDGB = 1    REDREL DEBUG.
LINK1       11  T    CALL NODPPR
IARRAY        76  0  T   KREDBG = 0  TURN OFF REDREL DEBUG.
IARRAY       61  0  T  SET KDUMP = 0
LINK2      3   T  CALL WLFLXS
RARRAY       63  1.0  T  SET UEDGE = 1.0
LINK2      15  T  CALL TRBTHK
LINK2      3  T  CALL WLFLXS
LINK5      6  T  CALL SETDIF
DESCRIPT    203   T  TITLES FOR OUTPUT DEPENDENT VARIABLES.
U1/UREF          U2/UREF          U3/UREF          NU/NUREF         TKE/TKEREF
DISS/DISSREF     PP / PSTAG       U'               U'U'             U'W'
V'               V'W'             W'
DONE
IOSAVE       T  SPECIFY PRINTOUT VARIABLES.
  1248 2248 3248 1247 3248,  6248 7248 3271 4271 5271,
  6271 7271 8271  T
IOMULT       T  SPECIFY MULTIPLIERS AND OPERATORS FOR PRINT VARIABLES.
  3*2 21  9*2,  13*1  T
LINK2      15  T  CALL TRBTHK
LINK2      3  T  CALL WLFLXS
LINK5      6  T  CALL SETDIF
LINKCALL     T  ORDER OF CALLS AT END OF STEP IN IMPLCT.
   2  4   T   CONT 3 DUMMY CALL.
RARRAY     95  0.9E-3  T  SET EPTEST
LINK5      4   T  CALL RNLDST
IARRAY     107  0  T  SET NE1E2 = 0
KBNO       5  T  FIXED NODES FOR DEP. VAR. NO. 5
ADD                 DONE
  19*I10  1,  19*I10  10  T  FIX WALL AND FREESTREAM NODES.
KBNO       6  T  FIXED NODES FOR DEP. VAR. NO. 6
ADD                 DONE
  19*I10  1,  19*I10  10  T  FIX WALL AND FREESTREAM NODES.
GKNINT       T  CALL INTEGRATION PACKAGE.
EXIT         T   EXIT PROGRAM
CASE END
```

APPENDIX B.
DATA DECK FOR 3DPNS JUNCTURE

WING JUNCTION TEST CASE. IZ(1) = [illegible]

IZ ENTRY POINTS FOR VECTORS Some typical entries are recorded.

```
 1-  251<-COL   2-  351<-ROW    3-  451      4-  671      5-  891<-IPINT  6  991      7      0      8-     0      9  1091      10  1191
11- 1205       12- 1305        13- 1305     14  1305<-PSIBD 15- 1305    16- 1305    17  1305   18- 1305    19- 1305     20  1305
21-    0       22-    0        23- 1500     24- 1693     25- 1886    26- 3623    27  4496   28- 4863    29- 5056     30- 5249
31  5442       32- 5446        33- 5639     34- 5832     35- 6025    36- 6218    37  6604   38- 7751    39  7947     40     0
41-    0       42-    0        43- 8341     44-    0     45- 8475    46- 8488    47 10244   48-10965<-IIP 49  [illegible]+177  50- [illegible]1
51     0       52-27210        53-27403     54-27503     55-27603    56-27796    57-28568    58-28761    59-    0     60  [illegible]6
61-29147       62-30429        63-30622     64-30662     65-30702    66-30742    67-30782    68-30975    69-31168     70  31210
71-31174       72-32718        73-33490     74-34262     75-35034    76-35806    77-36578    78-36927    79-37120     80  [illegible]13
81-37506       82-37699        83-37892     84-38285     85-38864    86-39057    87-39250    88-39846    89-40195     90  40388
91-40581       92-40967        93-41160     94-41353     95-41546    96-41932    97-42318    98-40511    99-42704     100 42963
101-43328      102-44872       103-45258    104-45451    105-45644   106-    0   107-    0   108-46223   109-46996    110 47042
111-49089      112-49109       113-49129    114-49229    115-49422   116-49423   117-49772   118-49802   119-49832    120 50025
121-50218      122-    0       123-50260    124-50368    125-50422   126-53317   127 53703   128-53959   129-54831    130-54959
131-55087      132-55187       133-55607    134-55617    135-55810   136-55910   137-56103   138-56625   139 56793    140-[illegible]81
141-    0      142-    0       143-62073    144-62554    145-55910   146-62747   147 62875   148-    0   149-    0    150-[illegible]75
151 63928      152    0        153-    0    154-    0    155-    0   156-    0   157     0   158-    0   159     0    160-    0
161-    0      162-    0       163-    0    164-    0    165-    0   166     0   167-    0   168-    0   169-    0    170-    0
171-    0      172-    0       173-    0    174-    0    175-    0   176-    0   177-    0   178     0   179     0    180-    0
181-    0      182-    0       183-    0    184-    0    185-    0   186-    0   187     0   188-    0   189     0    190     0
191     0      192-    0       193-    0    194-    0    195-    0   196     0   197-64507 OUTR 98-64507  199         200     0
```

IPINT 30 ENTRIES. IZ(891) = IPINT(1) etc...

```
891-    1  892-    5  893-    6  894-    2  895-    3  896-    7  897-    8  898-    9  899-    0  900     4
901-    0  902-    0  903-    0  904-    0  905-    0  906-    0  907-    0  908-    0  909-    0  910     0
911-    1  912-    2  913-    3  914-    4  915-    5  916-    6  917     7  918-    8  919-    9  920    10
```

SIZE OF IZ ARRAY = 69049

PSIBD 2 ENTRIES. Super Element NO. 2 has opposite diagonals from Super Element NO. 1 since PSIBD(2) is negative.

```
1305    1  1306-   -2
```

DEP. VAR. VECTOR. IPINT + 2*NDF. 1 2 3 4 5 6 7 8 9 10

LOCATION OF DEPENDENT VAR. Dep. Var. NO. 1 is in loc. 1. Dep. Var. NO. 2 is in loc. 4. etc... (SEE PAGE 107 FOR DESCRIPTION OF ENTRIES)

```
 1-    1    2-    4    3-    5    4-    0    5-    2    6-    3    7-    6    8-    7    9-    8   10-    0
11-    0   12-    0   13-    0   14-    0   15-    0
```

LOCATION OF PREDICTED VARIABLES.
ADDRESSES OF DEP. VARIABLES.

```
12965    15281    16053      0    13737    14509    16825    17597    18369      0
 JUAD     JVAD     JWAD     JHAD     JKAD     JEAD     JSAD     JPAD   JPHIAD
```

This print is turned on by setting KDUMP = 1. The 'IZ' entry points for vectors is printed out in subroutine BDINPT.
These values denote the displacement from IZ(1), where the particular entries are stored.

PSIBD consists of flags (+or-) to indicate the direction of the diagonals in the quadrilaterals formed in Super Elements.
+1 ⇒diag. in Super Element #1 are lower left to upper right. -2 ⇒diag. in Super El. #2 are lower right to upper left.

The location of dependent variables are also stored in Common Block NPINTQ.

The addresses of dependent variables are also stored in Common Block JADRES.

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
 DEBUG FROM GEOMFL -   TURNED ON BY SETTING KODG = 1.
                       IBOT = 3,  ITOP = 4.

 ELEMENT     3      NODE   2        NODE   3        NODE  12

             X1     .99900E-01      .99900E-01      .81782E-01

             X2     .48317E-03      .11354E-02      .48317E-03


 ELEMENT     4      NODE   3        NODE  13        NODE  12

             X1     .99900E-01      .81901E-01      .81782E-01

             X2     .11354E-02      .11354E-02      .48317E-03
```

For this debug, IBOT and ITOP denote a range of elements for which debug information is printed. Other subroutines use them only as element pointers which contain them as node points.

X1 is the lateral direction of the discretization.

X2 is the normal direction of the discretization.

```
    AREA TIMES THICKNESS    ( entries are for associated elements,  this is only a partial list.)
 1 4.39818E-06   2 4.37691E-06   3 5.90882E-06   4 5.87005E-06   5 7.92457E-06   6 7.85392E-06   7 1.06028E-05   8 1.04740E-05
 9 1.41399E-05  10 1.39053E-05  11 1.87721E-05  12 1.83444E-05  13 2.47649E-05  14 2.39854E-05  15 3.23803E-05  16 3.09597E-05
17 4.17956E-05  18 3.92065E-05  19 3.82450E-06  20 3.80600E-06  21 5.13811E-06  22 5.10439E-06  23 6.89093E-06  24 6.82949E-06

   GEOM2    (sample entries for B112 matrix,  1st three entries for element #1, next three for element #2 etc...)
1-5.49281E+01   2 5.49281E+01   3 0.00000E+00   4 5.51951E+01   5-5.51951E+01   6 0.00000E+00   7 5.51951E+01   8 0.00000E+00
9-5.51951E+01  10 5.55596E+01  11-5.55596E+01  12 0.00000E+00  13 5.55596E+01  14 0.00000E+00  15-5.55596E+01  16 5.60594E+01

   SETG1     (sample entries for the reciprocal of the no. of elements connected to respective node having derivatives in X1 direction.)
 1          1.000000      .500000      .500000      .500000      .500000      .500000      .500000      .500000      .500000      1.000000
 2           .500000      .250000      .250000      .250000      .250000      .250000      .250000      .250000      .250000       .500000

18           .500000      .200000      .200000      .200000      .200000      .200000      .200000      .200000      .200000       .333333
19          1.000000      .333333      .333333      .333333      .333333      .333333      .333333      .333333      .333333       .500000

   SETG2     (sample entries for the reciprocal of the no. of elements connected to respective node having derivatives in X2 direction.)
 1          1.000000      .333333      .333333      .333333      .333333      .333333      .333333      .333333      .333333       .500000
 2           .500000      .200000      .200000      .200000      .200000      .200000      .200000      .200000      .200000       .333333

18           .500000      .250000      .250000      .250000      .250000      .250000      .250000      .250000      .250000       .500000
19          1.000000      .500000      .500000      .500000      .500000      .500000      .500000      .500000      .500000      1.000000
```

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

DEBUG FROM POINT AND CPSTOP. SET WITH NDBUG = 1.

```
     CNTPTS      2 ENTRIES.
53703-     19 53704-     19

     CNTNDS     38 ENTRIES.
53759-    100 53960-     90 53961-     80 53962-     70 53963-     60 53964-     50 53965-     40 53966     30 53967-     20 53968-     10
53969-      9 53970-      8 53971-      7 53972-      6 53973       5 53974-      4 53975       3 53976-      2 53977-      1 53978-    100
53979-    110 53980-    120 53981-    130 53982-    140 53983-    150 53984-    160 53985-    170 53986-    180 53987-    190 53988-    189
53989-    188 53990-    187 53991-    186 53992-    185 53993-    184 53994-    183 53995-    182 53996-    181
```

STATION

PRINT POINTS

```
                9.99000E-03  1.91400E-02  3.12600E-02

      HEIGHT        CP(X1)       CP(X2)       CP(X3)
0.00000E+00  4.69400E-01  3.82900E-01  2.98700E-01
2.78400E-02  4.69400E-01  3.82900E-01  2.98700E-01
4.73100E-02  4.27700E-01  3.56500E-01  2.85000E-01
7.16500E-02  3.89800E-01  3.21500E-01  2.57100E-01
1.02100E-01  3.60300E-01  2.91700E-01  2.29700E-01
```

Typical printout for input Cps at selected (downstream) stations.
These stations also specify print points for the solution.

```
7.99000E-03  1.91400E-02  3.12600E-02

SQRT(1-CP1)  SQRT(1-CP2)  SQRT(1-CP3)
7.28423E-01  7.85557E-01  8.37437E-01
7.28423E-01  7.85557E-01  8.37437E-01
7.56505E-01  8.02185E-01  8.45577E-01
7.81153E-01  8.23711E-01  8.61916E-01
7.99812E-01  8.41606E-01  8.77667E-01
```

STATION

PRINT POINTS

```
                4.62800E-02  6.40900E-02  8.45800E-02

      HEIGHT        CP(X1)       CP(X2)       CP(X3)
0.00000E+00  2.14900E-01  1.31900E-01  5.07900E-02
2.78400E-02  2.14900E-01  1.31900E-01  5.07900E-02
4.73100E-02  2.10200E-01  1.33500E-01  5.65900E-02
7.16500E-02  1.90900E-01  1.22200E-01  5.19100E-02
1.02100E-01  1.68300E-01  1.05600E-01  4.18200E-02
```

For this printout X1, X2 and X3 are associated with downstream stations.

Height is the distance away from the surface.

SQRT(1-CPn) denotes the velocity assoc. with the corresponding Cp.

```
4.62800E-02  6.40900E-02  8.45800E-02

SQRT(1-CP1)  SQRT(1-CP2)  SQRT(1-CP3)
8.86059E-01  9.31719E-01  9.74274E-01
8.86059E-01  9.31719E-01  9.74274E-01
8.88707E-01  9.30860E-01  9.71293E-01
8.99500E-01  9.36910E-01  9.73699E-01
9.11976E-01  9.45727E-01  9.78867E-01
```

This debug illustrates the use of CNTPTS and CNTNDS to distribute data over particular nodes in a domain.
CNTPTS indicates two sets of 19 nodes specifying the fixed nodes in the X1 and X2 direction used for equation solving and distributing the Cps over the domain. This information is used in subroutine NODPCP where the Cps are stored along the boundary before the equation solver STRF is called for distribution of the Cps.

In addition to the 6 sets of data shown on this page, there are 8 more similar sets (not shown) for a total of 14 sets.
NPVSXT denotes how many Cps will be read for each set. (for this case NPVSXT = 7).
NTABPT denotes how many sets are being distributed. (for this case NTABPT = 14).
The size of NPVSX must be large enough to handle all these tables hence it must be set to a minimum of NODE*NTABPT.
This storage can be reduced by saving only the input data and generating new tables as they are needed in subroutine JNCPPR by using coding from NODPCP. This will also require saving CNTPTS and CNTNDS in special vectors so that they can be used in NODPCP.

C-2

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

```
DEBUG FROM LINK3 AND STRF.    SET NDBG = 'N', IDBGIT = 'M'.
     'N' = NO. OF PRINT POINTS AT WHICH TO GET DEBUG FROM LINK3.
     'M' = NO. OF PRINT POINTS AT WHICH TO GET DEBUG FROM STRF.
           IBOT = 3, ITOP = 4.
```

for this debug, IBOT and ITOP point to two element for which debug information is desired (for this case 3 and 4)

```
NO. OF FIXED NODES.
KBND FIXED NODES.          NO.        19   No. of fixed nodes for the variable being solved.
                                      19    0     0     19    19    19    19    18
IIBND FOR DEP. VAR.                   No. of fixed nodes for each of the NEQ variables in the problem.

 1-   1     2-   2     3-   3     4-   4     5-   5     6-   6     7-   7     8-   8     9-   9     10-  172
 11-  10    12-  11    13-  12    14-  13    15-  14    16-  15    17-  16    18-  17    19-  18    20-  173
  :    :                                                                                          :    :
181-  163   182-  164   183-  165   184-  166   185-  167   186-  168   187-  169   188-  170   189-  171   190-  190

KEYDAG AFTER 515 LINK3.          Equation no. for variable being solved.
                    All entries in 'KEYDAG' are set to 2 except the fixed nodes, which are set to 1. (Info. used in BANCHO).
 1-   2     2-   2     3-   2     4-   2     5-   2     6-   2     7-   2     8-   2     9-   2     10-  1
 11-  2     12-  2     13-  2     14-  2     15-  2     16-  2     17-  2     18-  2     19-  2     20-  1
  :    :                                                                                          :    :
181-  2     182-  2     183-  2     184-  2     185-  2     186-  2     187-  2     188-  2     189-  2     190-  1

ELEMENT    3 ---  AREA =      .59088E-05, RHOAV =      .59088E-05, KEYS =      2     3     11
    B211S * RHOAV * AREA                1.39060E+01 -1.38880E+01  1.38880E+01 -1.80012E-02  0.00000E+00  1.80012E-02

ELEMENT    4 ---  AREA =      .58701E-05, RHOAV =      .58701E-05, KEYS =      3     12    11
    B211S * RHOAV * AREA                1.87219E-02 -1.09841E-01  1.39978E+01  9.11192E-02 -1.38880E+01  1.37969E+01
    RHS ON ENTRY TO STRF                3 ENTRIES =   9.96507E-01
    SOLUTION VECTOR BEFORE BANCHO       3 ENTRIES =   0.00000E+00
    RHS VECTOR FOR BANCHO.              3 ENTRIES =   0.00000E+00

                                        Only 3 entries out of NNODE are printed out since
                                        NDBGPT is set = 3.

 STRF JACOBIAN ASSEMBLY
 1 1.88531E+01   2-1.88399E+01   3 3.27596E+01   4-1.38880E+01   5 2.41510E+01   6-1.02199E+01   7 1.77815E+01   8-7.50279E+00
 9 1.30733E+01  10-5.49013E+00  11 9.59975E+00  12-3.99927E+00  13 7.04664E+00  14-2.89492E+00  15 5.18431E+00  16-2.07689E+00
17 3.04787E+00  18-1.32697E-02  19 9.11192E-02  20 0.00000E+00  21 0.00000E+00  22 0.00000E+00  23 0.00000E+00  24 0.00000E+00
25 0.00000E+00  26 0.00000E+00  27 3.53425E+01  28-1.22897E-01  29 9.11192E-02  30 0.00000E+00  31 0.00000E+00  32 0.00000E+00
 :    :                                                                                                          :    :
1641 0.00000E+001642-1.38880E+011643 2.41510E+011644 9.11191E-021645-1.49942E-011646 0.00000E+001647 0.00000E+001648 0.00000E+00
1649 0.00000E+001650 0.00000E+001651 0.00000E+001652 0.00000E+001653-1.02199E+011654 1.77815E+011655 9.11191E-021656-1.71504E-01
1657 0.00000E+001658 0.00000E+001659 0.00000E+001660 0.00000E+001661 0.00000E+001662 0.00000E+001663 0.00000E+001664-7.50279E+00
1665 1.30733E+011666 9.11191E-021667-2.01473E-011668 0.00000E+001669 0.00000E+001670 0.00000E+001671 0.00000E+001672 0.00000E+00
1673 0.00000E+001674 0.00000E+001675-5.49012E+001676 9.59974E+001677 9.11191E-021678-2.43571E-011679 0.00000E+001680 0.00000E+00
1681 0.00000E+001682 0.00000E+001683 0.00000E+001684 0.00000E+001685 0.00000E+001686-3.99926E+001687 7.04664E+001688 9.11191E-02
1689-3.03617E-011690 0.00000E+001691 0.00000E+001692 0.00000E+001693 0.00000E+001694 0.00000E+001695 0.00000E+001696 0.00000E+00
1697-2.89492E+001698 5.18431E+001699 9.11191E-021700-3.91155E-011701 0.00000E+001702 0.00000E+001703 0.00000E+001704 0.00000E+00
1705 0.00000E+001706 0.00000E+001707 0.00000E+001708-2.07689E+001709 3.84787E+00
```

$\nabla^2\phi = 0$

This debug from STRF is generated during the Cp initialization phase. Cp is placed along the fixed boundary nodes and from this input, it is distributed throughout to solution domain with a call to STRF.

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

```
      CONTINUED DEBUG FROM NODPCP.  KDUMP = 1.

   PRESSURE STATIONS. FROM NODPCP.
 1 9.99000E-03   2 1.91400E-02   3 3.12600E-02   4 4.62800E-02   5 6.40900E-02   6 8.45800E-02   7 1.33100E-01   8 1.66900E-01
 9 2.22400E-01  10 2.90800E-01  11 4.02500E-01  12 5.00000E-01  13 5.97500E-01  14 7.10000E-01

   PRESSURE TABLE.
 1          .991767     .992372     .996625     .996248     .995896     .995538     .995169     .994793     .994035     .993667
 2          .995896     .995538     .995169     .994793     .994035     .993667     .992968     .992372     .991764     .991606
 3          .994034     .993667     .992968     .992372     .991764     .991605     .991766     .992372     .996626     .996249
 :            :           :           :           :           :           :           :           :           :           :
19          .996574     .996198     .995851     .995503     .995144     .994778     .994038     .993678     .992992     .992405

      DEBUG FROM BDINPT.  KDUMP = 1.

     CNTPTS     19 ENTRIES.
53703-    10 53704-    10 53705-    10 53706-    10 53707-    10 53708-    10 53709-    10 53710-    10 53711-    10 53712-    10
53713-    10 53714-    10 53715-    10 53716-    10 53717-    10 53718-    10 53719-    10 53720-    10 53721-    10

     CNTNDS    190 ENTRIES.
53959-     1 53960-     2 53961-     3 53962-     4 53963-     5 53964-     6 53965-     7 53966-     8 53967-     9 53968-    10
53969-    11 53970-    12 53971-    13 53972-    14 53973-    15 53974-    16 53975-    17 53976-    18 53977-    19 53978-    20
53979-    21 53980-    22 53981-    23 53982-    24 53983-    25 53984-    26 53985-    27 53986-    28 53987-    29 53988-    30

54139-   181 54140-   182 54141-   183 54142-   184 54143-   185 54144-   186 54145-   187 54146-   188 54147-   189 54148-   190
```

The PRESSURE STATIONS are those that were used to input Cp information and will be used as print points

The PRESSURE TABLE shows the distribution of pressures that were generated in NODPCP for the initial station.

Note: Only the first 3 and last 1 rows of information are listed here although all would be printed in general.

After returning from NODPCP (LINK2(3D)) CNTPTS and CNTNDS are reset to follow columns of nodes perpendicular to the walls.

These vectors will be used will be used to compute integral parameters, skin friction and turbulent viscosity.

DEBUG FROM JNCINP. SET KDUMP = 1.

OUTPUT FROM TBLINP

I	YNOW	ALOGYS	COSPIY	USD	U
1	0.00000E+00	0.00000E+00	1.00000E+00	6.33222E-01	0.00000E+00
2	4.83167E-04	-3.68126E+00	9.99217E-01	6.33229E-01	2.45143E-01
3	1.13544E-03	-2.82485E+00	9.95680E-01	6.33259E-01	3.29385E-01
4	2.01601E-03	-2.25275E+00	9.86401E-01	6.33340E-01	3.88673E-01
5	3.20479E-03	-1.78922E+00	9.65753E-01	6.33522E-01	4.41553E-01
6	4.80963E-03	-1.38325E+00	9.23420E-01	6.33902E-01	4.96669E-01
7	6.97617E-03	-1.01137E+00	8.41182E-01	6.34668E-01	5.61357E-01
8	9.90099E-03	-6.61233E-01	6.88870E-01	6.36192E-01	6.41463E-01
9	1.38495E-02	-3.25619E-01	4.22820E-01	6.39239E-01	7.33277E-01
10	1.91800E-02	-7.10543E-15	-1.73205E-07	6.45539E-01	8.03455E-01

DELTA CFOV2, UTAU PIBAR .19180E-01 .00000E+00 .42182E+01 .16000E+01

This debug shows a typical printout of the velocity profile generated from the freestream Cp along a column of nodes. Cole's law is used to generate intermediate velocities. Since this is a symmetric problem, only 10 columns of UI are computed and these are then reflected across the center column. This ensures a symmetric set of input data.

The entries in column 'I' denote NODE numbers.

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

DEBUG OUTPUT FROM WLFLXS. SET IWRIT = 'N'.
'N' = NO. OF PRINT POINT DESIRED.

COL	RHOCF	UCF	YCF	XMUCF	RU2	RSTAR	SSTAR	REY	RUESO	TAUW	TBUDY
1	2.3308E-03	2.4514E+01	4.8317E-04	4.0744E-07	2.2411E-01	1.0841E+01	1.0568E-01	6.7758E+01	1.5046E+01	2.3684E-02	2.0029E-02

DEBUG OUTPUT FROM WLFLXS

COL	RHOCF	UCF	YCF	XMUCF	RU2	RSTAR	SSTAR	REY	RUESO	TAUW	TBUDY
2	2.3308E-03	2.3990E+01	4.9112E-04	4.0744E-07	2.1463E-01	1.0784E+01	1.0613E-01	6.7401E+01	1.4742E+01	2.2779E-02	1.9200E-02

PRINTOUT FROM TBKTHK

CURRENT X1/LREF	VELOCITY U1/UINF WALL	EDGE	ENERGY E	DISP. THK. DEL STAR	MOM. THK. THETA	EN. DIS.THK DELTA 3	THETA REYNL. NO.	BNDY THK. DELTA	SHAPE FCT. H	SKIN FRIC. CF/2		
1.1000E-02	2.4514E-01	8.0345E-01	0.0000E+00	4.8368E-03	2.8482E-03	0.0000E+00	0.0000E+00	1.8631E-02	1.6982E+00	1.5741E-03	0	0

DEBUG FROM TAUW. SET IWRIT = 'N'.
'N' = NO. OF DESIRED DEBUG PRINTS.

DEBUG OUTPUT FROM TAUW

COL	OF	DISP	THETA	RTHETA	H	CFLT	TAUWAL
1	19	4.8368E-03	2.8482E-03	1.3091E+03	1.6982E+00	2.5362E-03	1.9080E-02

DEBUG FROM DFCFBL. SET IWRIT = 'N'.
IWRIT IS DECREMENTED BY 1 EACH TIME KPNT = 1.

DUDY DEBUG FROM DFCFBL. Three point formula used to compute dudy. This dudy is used in forming nu-turbulent = $\omega^3 du/dy$

IP0	IP1	UM1	UM2	YM1	YM2	DU1	DU2	DU3	A	B	DUDY
1	2	2.4514E-01	3.2938E-01	4.8317E-04	1.1354E-03	5.0737E+02	1.2915E+02	2.9009E+02	4.8317E-04	2.4514E-01	3.4642E+02
2	3	3.2938E-01	3.8867E-01	1.1354E-03	2.0160E-03	1.2915E+02	6.7330E+01	9.3636E+01	1.1354E-03	3.2938E-01	1.0284E+02
3	4	3.8867E-01	4.4155E-01	2.0160E-03	3.2048E-03	6.7330E+01	4.4482E+01	5.4205E+01	2.0160E-03	3.8867E-01	5.7607E+01

DEBUG OUTPUT FROM DFCFBL, COLUMN 1

NODE	VISCOSITY	MIX.LENGTH**2	OMEGA**2	DUDY	EN	AVDP	TEXP	YPLUS	U+/EPS	TAF
-1	0.00000E+00	0.00000E+00	0.00000E+00	0.0000E+00	0.0000E+00	1.5458E-03	1.0000E+00	0.0000E+00	1.00E-06	1.00E-05
-2	1.10275E-06	4.41747E-08	2.68441E-01	3.4642E+02	4.8317E-06	1.5458E-03	1.0464E+00	7.9082E+00	1.25E-01	1.42E-03
-3	6.79145E-06	2.43955E-07	5.20282E-01	1.0284E+02	6.5228E-06	1.5458E-03	1.0020E+00	1.8584E+01	1.81E-02	1.34E-03
-4	2.35204E-05	7.69070E-07	7.28418E-01	5.7607E+01	8.8057E-06	1.5458E-03	1.0003E+00	3.2997E+01	1.00E-02	1.86E-03
-5	5.96435E-05	1.94347E-06	8.74228E-01	4.0168E+01	1.1888E-05	1.5458E-03	1.0001E+00	5.2454E+01	8.58E-03	2.74E-03
-6	1.24362E-04	4.19997E-06	9.55467E-01	3.2435E+01	1.6048E-05	1.5458E-03	1.0000E+00	7.8721E+01	9.77E-03	4.22E-03
-7	1.18349E-04	4.19997E-06	9.89036E-01	2.8807E+01	2.1665E-05	1.5458E-03	1.0000E+00	1.1418E+02	6.84E-03	3.45E-03
-8	1.07283E-04	4.19997E-06	9.98347E-01	2.5629E+01	2.9248E-05	1.5458E-03	1.0000E+00	1.6205E+02	4.82E-03	2.75E-03
-9	7.96119E-05	4.19997E-06	9.99872E-01	1.8960E+01	3.9485E-05	1.5458E-03	1.0000E+00	2.2668E+02	1.95E-03	1.51E-03
-10	1.52174E-05	4.19997E-06	9.99996E-01	0.0000E+00	5.3305E-05	1.5458E-03	1.0005E+00	3.1393E+02	1.00E-06	1.00E-05

TAUW	UTAUW	TRDWAL	UPLUS	VPLUSW	PPLUS	ACONS	DELTA
1.9080E-02	2.8613E+00	1.7480E-04	1.0000E-06	0.0000E+00	0.0000E+00	2.0627E-03	1.8630E-02

THE ABOVE PRINTOUT IS REPEATED FOR ALL COLUMNS OF NODES.

THE NEGATIVE SIGN BEFORE THE NODE NO. INDICATES THAT Nu^t IS NOT COMPUTED FOR THAT NODE. When this is the case, the column headed U+/EPS denotes that EPS (dissipation length) is the entry in that column.

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
          5 VARIABLES BEING INTEGRATED.
 1    5    6    2    3

          8 VARIABLES IN SOLUTION.
 1    5    6    2    3    7    8    9

ORDER OF CALLS AT END OF DKNUIN

   LINK2( 4) - CONTES

   PRINTOUT VARIABLES

 1248   2248   3248   1247   5248   6248   7248   3271   4271   5271
 6271   7271   8271

   PRINTOUT VARIABLE MULTIPLIERS.

   2      2      2     21      2      2      2      2      2      2
   2      2      2

   PRINTOUT VARIABLE FACTORS. (N)
       N .EQ. 1) STRAIGHT PRINT.
       N .EQ. 2) MULT. LAST VEC. BY THIS ONE - STORE IN LAST.
       N .EQ. 3) ADD TO LAST VEC. - STORE IN LAST VEC. LOC.
       N .GE. 4) RAISE ENTRIES TO (N-2) POWER.
       N .LT. 0) TAKE NTH ROOT OF ENTRIES IF .GT. 0.0

   1      1      1      1      1      1      1      1      1      1
   1      1      1


     DEBUG FROM INDEX.   TURNED ON WITH KODS .GT. 0.
    THIS DEBUG PRINTS THE REAL AND SCALAR ENTRIES IN THE
     COMMON BLOCK 'DERIV'.



   THIRD, OSRE, ETC...
 1 3.33333E-01   2 1.00000E+00   3 1.64667E-02   4 0.00000E+00   5 0.00000E+00   6-8.33333E-02   7 8.33333E-02   8 1.60000E-01
 9 1.63544E-03  10 1.13573E-03  11 3.22823E+19  12 9.31856E-01  13-2.00000E+00  14-5.00000E+09  15 0.00000E+00  16 0.00000E+00
17 0.00000E+00  18 0.00000E+00  19 0.00000E+00  20 1.66667E-02  21-1.66667E-02  22 1.20000E-02  23-1.60000E-02  24 0.00000E+00

   IJMY, IJMZ, ETC...

   1-12965      2-19913      3-13158      4-20106      5-44293      6-62099      7-62125      8-62151      9-62229     10-62239
  11-62249     12-62259     13-62279     14-62299     15-62309     16-62319     17-62329     18-62339     19-62349     20-62359
  21-    8     22-28375     23-   10     24-    7     25-    1     26-    1     27-    1     28-    1     29-62079     30-62076
  31-62073     32-62082     33-62085     34-62099     35-62151     36-62230     37-62259     38-62279     39-12964     40-15280
  41-16052     42-19913     43-22229     44-23001     45-   10     46-   26     47-13736     48-14508     49-21457     50-20685
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APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

STATUS OF IARRAY VALUES. (THESE CAN BE PRINTED OUT AT any TIME BY CALLING SUB. ICOND.)

1	ND	=	1	2	MLTDIF	=	0	3	IKDU	=	1	4	KEYMTD	=	1	5	NOMEGM	=	0
6	KODG	=	0	7	KOD5	=	2	8	KPRINT	=	0	9	NRSTRT	=	0	10	NV	=	0
11	NPTDOF	=	1	12	NCC	=	0	13	NCOORD	=	0	14	NFLEM	=	325	15	NN	=	0
16	NNODC	=	190	17	NNS	=	0	18	NPART	=	2	19	NDE	=	171	20	NPRNT	=	137
21	NROW	=	2	22	NC	=	8	23	NB	=	4	24	NPTEL	=	3	25	NIND	=	4
26	KOUNT	=	1	27	NSKIP	=	193	28	IPASS	=	0	29	IRUN	=	0	30	NP	=	8
31	NEQ	=	8	32	IWLSEP	=	19	33	NBUG	=	0	34	LPRINT	=	100	35	NPSICC	=	0
36	NPRSCC	=	0	37	NFWPRT	=	0	38	NOUTVC	=	10	39	NDRVDX	=	0	40	NOUTS	=	1
41	N2WAKE	=	0	42	INPUT	=	5	43	NEQADD	=	-2	44	NSTORE	=	0	45	NLXP	=	19
46	NF	=	4	47	LG	=	19	48	NDOF	=	0	49	NDEL	=	3	50	LCOL	=	30
51	NDBL	=	0	52	KRDU	=	46	53	NM2	=	0	54	NMHALF	=	0	55	NODE	=	193
56	NDOUTZ	=	0	57	IASVEC	=	0	58	NEQKNN	=	5	59	NCPTAB	=	1	60	NNBOUT	=	13
61	KDUMP	=	0	62	NTITL	=	3	63	NIND	=	1047	64	NSM	=	10	65	NJ	=	0
66	NRHOSS	=	0	67	NS	=	26	68	NI	=	4633	69	NDSET	=	0	70	NDTSET	=	0
71	ISTATN	=	0	72	IVALUE	=	0	73	ISTAD	=	0	74	IRRAY	=	0	75		=	0
76		=	0	77		=	0	78		=	0	79	NDO	=	9	80	NPRDCT	=	0
81	IVUVAL	=	0	82	IVSTA	=	0	83	IFSLT	=	0	84	NVARD	=	172	85	NVARI	=	171
86	KPNT	=	1	87	NRTAPE	=	0	88	NLINE	=	60	89	NEMD	=	349	90	NYY	=	4
91	NZZ	=	4	92	IZSIZE	=	80000	93	NTK	=	2	94	NIZS	=	250	95	NVELTB	=	0
96	IBASE	=	200	97	ITKE	=	1	98	INAT	=	1	99	IBL	=	1	100	IKEND	=	66216
101	NPRESS	=	0	102	KOUT	=	0	103	NTM	=	0	104	NFLIP	=	1	105	IPTSPL	=	0
106	KK	=	19	107	NE1E2	=	0	108	NCNADD	=	8	109	NTAPER	=	0	110	NPRESH	=	0
111	IMAX	=	9	112	NWALLS	=	4	113	KPLVAR	=	0	114	NSSD	=	0	115	IFORCE	=	49049
116	IGINIT	=	0	117	IBUG1	=	0	118	IBUG2	=	0	119	NGBUG	=	0	120	IFR	=	0
121	NSPEC	=	4	122	IWRIT	=	0	123	IGAS	=	0	124	NDERIV	=	2	125	NCALLS	=	2
126	ISPEED	=	0	127	IDIFRT	=	-2	128	ICNTND	=	190	129	IMATAB	=	2	130	NGETH	=	1
131	NBORD	=	52	132	IPWRIT	=	-12	133	ITOP	=	4	134	NPSIBD	=	2	135	NPSBDL	=	0
136	KSAV	=	0	137	LPSIA1	=	0	138	LPSIAM	=	0	139	INGAS	=	0	140	NTCNTS	=	0
141	KFSL	=	0	142	NOUTPR	=	68	143	ICALLS	=	0	144	ITRAN	=	0	145	IMIN	=	0
146	NSFDBE	=	1	147	NPAST	=	0	148	NONC	=	0	149	IT	=	0	150	NDBND	=	0
151	KWFLXS	=	0	152	INITKE	=	0	153	NPUNCH	=	0	154	NSDFCF	=	0	155	NS2DFC	=	1
156	ITWOCL	=	0	157	NPASS	=	0	158	INITCN	=	0	159	IL	=	1	160	IM	=	1
161	NPVSX	=	2640	162	IEPSET	=	0	163	NPSIST	=	0	164	NPSIND	=	0	165		=	0
166	N3DPNS	=	0	167	KNTPAS	=	200	168	NDPRES	=	0	169	KCDC	=	0	170	NBC	=	0
171	NBCND	=	194	172	LOUD	=	1	173	NCOMOC	=	0	174	NCOMTD	=	3	175	IFSL	=	0
176	NTKS	=	10	177	NU2POS	=	3	178	NU3POS	=	3	179	LOC	=	1	180	NSTRT	=	11
181	NVELP	=	0	182	LOGS	=	0	183	IRSLHS	=	0	184	NGTPRS	=	11	185	IP	=	0
186	ITDA	=	0	187	ITDB	=	0	188	NBUF	=	0	189	NSTD	=	8	190	NNOUT	=	2
191	NM	=	3	192	N2M	=	6	193	NM2	=	9	194	NDP	=	10	195	KFXBAD	=	0
196	ITWALL	=	0	197	NTPRNT	=	2	198	NPGRDT	=	4	199	NPGRDV	=	4	200	INTPSI	=	0
201	NSTRFP	=	1	202	NSTRF	=	14	203	NTCRDM	=	1	204	INTOMG	=	0	205	ITIMER	=	0
206	NMDL	=	8	207	IBDT	=	3	208	NVRMS	=	8	209	NBIPRS	=	0	210	NCOMPG	=	35
211	IBIDRV	=	0	212	MLTRHS	=	1	213	IPHIPR	=	0	214	LMLT	=	0	215	ISUPRS	=	0
216	ITPSCL	=	0	217	NOPSCL	=	0	218	NCLPSI	=	7	219	KR	=	0	220	NBCNDT	=	0
221	NCYL	=	0	222		=	0	223	MLTLHS	=	3	224	ILHS	=	0	225	NVRH	=	7
226		=	0	227		=	0	228		=	0	229		=	0	230		=	0
231	IADSET	=	0	232	NPHOD	=	200	233	NODES	=	170	234	KNTARF	=	0	235	KNTSHP	=	0
236	NSAF	=	0	237	NARFPR	=	0	238	NSHAPF	=	0	239	NARF	=	0	240	NGRDSH	=	0
241	NWAKE	=	0	242	INAF	=	0	243	NODFT	=	0	244	NODTOT	=	0	245	NAF	=	0
246	NLC	=	0	247	NEG	=	1	248	KFIX	=	0	249	JSHP	=	0	250	IPHI	=	0

ORIGINAL PAGE IS
OF POOR QUALITY

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

STATUS OF IARRAY VALUES.

251	NSNODE	=	19	252	NSELEM	=	2	253	JCOORD	=	0	254	IPIN	=	0	255	IDIAGI	=	0
256	IPC	=	0	257	NFLUX	=	0	258	NFX	=	0	259	ISIDE	=	4	260	NVAR	=	3
261	IBC	=	0	262	NDCNT	=	0	263	LOCR	=	190	264	LNEL	=	190	265	KSIDE	=	3
266	JSIDE	=	0	267	KTE	=	0	268	NDIVNF	=	0	269	NPOI	=	1	270	ITERPF	=	0
271	IPRINT	=	0	272	KSKIP	=	0	273	NSTAG	=	0	274	NU	=	0	275	NL	=	0
276	NUS	=	0	277	NPTS	=	101	278	NNPT	=	0	279	NDIM	=	200	280	NSEL	=	2
281	IVYY	=	0	282	NV	=	0	283	NO1	=	0	284	NO2	=	0	285	NACA4D	=	0
286	NEQAV2	=	1	287	NEQAV3	=	1	288	NSORC	=	0	289	IPLOT	=	0	290	JOAD	=	0
291	JPR	=	1	292	JCYL	=	0	293	IAXSYM	=	0	294	IRAT	=	0	295	IPLOTV	=	0
296	IPCDEF	=	0	297	IPPSET	=	0	298	NPSETS	=	0	299	IPCFIT	=	0	300		=	0
301	NIMPLT	=	1	302	NNCNTP	=	0	303	NITER	=	0	304	NELPAS	=	0	305	NBAND	=	23
306	NMDJAC	=	4370	307	NCON	=	0	308	N3NROW	=	384	309	N4NROW	=	579	310	NFNROW	=	384
311	JORDER	=	1	312	IUONLY	=	4	313	NR	=	1	314	KODE	=	0	315	NPT	=	0
316	NIT	=	1	317	NDBGPT	=	3	318	KKSKIP	=	0	319	KDPASS	=	0	320	ICHI	=	0
321	IPRNT	=	0	322	ISTART	=	0	323	NLAST	=	0	324	NCNTIT	=	0	325	NOUEDG	=	0
326		=	0	327	IDDXST	=	2	328	NVISC	=	136	329	NRJACB	=	1	330	LMDJAC	=	0
331	NCONSV	=	0	332	JACSAV	=	0	333	INOCRN	=	1	334	ITRMAX	=	0	335	MAXPAS	=	0
336	NPDBUG	=	40	337	NTRLST	=	0	338		=	0	339		=	0	340		=	9
341		=	0	342		=	0	343	NODD23	=	0	344	IBLAS	=	0	345	IU1CON	=	0
346	NSPRED	=	0	347		=	1	348		=	1	349		=	0	350		=	0
351		=	0	352		=	2	353		=	0	354		=	0	355		=	0
356		=	0	357		=	0	358		=	0	359		=	0	360		=	0
361		=	0	362		=	0	363		=	0	364		=	0	365		=	0
366	NPHIST	=	0	367	NPHICD	=	0	368	KEPASS	=	1	369	ISCHPR	=	0	370	ISKP	=	0
371	NPVSXT	=	10	372	NFISTR	=	0	373	KCNTR	=	0	374	NSAV1	=	190	375	ICORN	=	1
376	LPHI	=	-1	377	NONE	=	-1	378	IUPRIN	=	0	379	NPKS	=	0	380	KBSAV	=	-1
381	KTVSET	=	0	382	NCLPRS	=	0	383	NRHS0	=	0	384	IMOD	=	0	385	IWHICH	=	3
386	LSKIP	=	0	387	IVGEO	=	0	388	ICOMP	=	0	389	KOD6	=	5	390	NXPOS	=	0
391	NPRES	=	-1	392	NRHOC	=	0	393	IDRVW	=	0	394	NTABPT	=	14	395	NRSYSK	=	0
396		=	0	397		=	0	398		=	0	399		=	0	400		=	0
401		=	0	402		=	0	403		=	0	404		=	0	405		=	0
406		=	0	407		=	0	408		=	0	409		=	0	410		=	0
411		=	0	412		=	0	413		=	0	414		=	0	415		=	0
416		=	0	417		=	0	418		=	0	419		=	0	420		=	0
421		=	0	422		=	0	423		=	0	424		=	0	425		=	0
426		=	0	427		=	0	428		=	0	429		=	0	430		=	0
431		=	0	432		=	0	433		=	0	434		=	0	435		=	0
436		=	0	437		=	0	438		=	0	439		=	0	440		=	0
441		=	0	442		=	0	443		=	0	444		=	0	445		=	0
446		=	0	447		=	0	448		=	0	449		=	0	450		=	250
451		=	0	452		=	0	453		=	0	454		=	0	455		=	0
456		=	0	457		=	0	458		=	0	459		=	0	460		=	0
461		=	0	462		=	0	463		=	0	464		=	0	465		=	0
466		=	0	467		=	0	468		=	0	469		=	0	470		=	0
471		=	0	472		=	0	473		=	0	474		=	0	475		=	0
476		=	0	477		=	0	478		=	0	479		=	0	480		=	0
481		=	0	482		=	0	483		=	0	484		=	0	485		=	0
486		=	0	487		=	0	488		=	0	489		=	0	490		=	0
491		=	0	492		=	0	493		=	0	494		=	0	495		=	0
496		=	0	497		=	0	498		=	0	499		=	0	500		=	0

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

STATUS OF RARRAY VALUES.

1	FACT	=	1.0000E+00	2	ONE	=	1.0000E+00	3	ALC	=	1.0000E+00	4	TNN	=	1.0000E+00	5	AJ	=	7.7828E+00
6	SOUND	=	0.0000E+00	7	HSINIT	=	1.0000E-03	8	RMINS1	=	-1.0000E+00	9	PINF	=	2.1168E+03	10	RHOINF	=	2.1330E-03
11	XT	=	0.0000E+00	12	HT	=	0.0000E+00	13	DELP	=	5.9489E-01	14	EPS	=	1.0000E-02	15	N	=	1.0000E-03
16	HMAX	=	5.8900E-03	17	HMIN	=	0.0000E+00	18	ODIEPS	=	0.0000E+00	19	ENTEPS	=	0.0000E+00	20	PTIN	=	6.0589E-01
21	RE	=	5.7206E+05	22	TF	=	6.0000E-01	23	TIME	=	1.1000E-02	24	TD	=	1.1000E-02	25	TPAS	=	0.0000E+00
26	TWOPI	=	6.2832E+00	27	UINF	=	1.0000E+02	28	RUNIV	=	4.9719E+04	29	ZT	=	0.0000E+00	30	CFDINF	=	7.7218E+00
36	PEDDIM	=	2.1168E+03	37	XLE	=	1.0000E+00	38	XMUINF	=	4.0744E-07	39	PEDGE	=	9.9647E-01	40	TRATIO	=	1.0016E+00
41	FSMLT	=	1.0000E+00	42	TKEDGE	=	1.0000E+00	43	REFL	=	1.0000E+00	44	SQ2	=	1.4142E+00	45	HS	=	0.0000E+00
46	XMDXR	=	0.0000E+00	47	REFLRE	=	5.7206E+05	48	TIMESV	=	0.0000E+00	49	RTFST	=	1.0000E-02	50	SSINIT	=	1.0000E-03
51	VELU	=	0.0000E+00	52	XSCALE	=	1.0000E+00	53	YSCALE	=	1.0000E+00	54	TURB	=	0.0000E+00	55	RTCON4	=	5.4969E-03
56	RTCON5	=	0.0000E+00	57	RTCON6	=	1.0994E-02	58	TOFINF	=	5.3000E+02	59	FACTMU	=	2.3308E-01	60	GAMMAF	=	1.4000E+00
61	XMACHD	=	8.8615E-02	62	CONV	=	1.0000E+00	63	UEDGF	=	1.0000E+00	64	YINTLT	=	0.0000E+00	65	ZTEST	=	1.0000E-05
66	XMF	=	2.9400E+01	67	PR	=	1.0000E+00	68	EPSMD	=	1.0000E+00	69	DISS	=	0.0000E+00	70	CONRHO	=	1.0000E+00
71	STLDVR	=	3.8478E-07	72	STLDTR	=	4.9200E+02	73	STLDCR	=	2.0400E+02	74	STLDFX	=	1.5000E+00	75	STLCON	=	0.0000E+00
76	YTT	=	0.0000E+00	77	CON1	=	5.5562E-01	78	CON2	=	1.0483E-03	79	FACTP	=	4.2903E+00	80	FACTM	=	2.4435E-04
81	UTAU	=	4.0927E+00	82	PIBAR	=	1.0000E+00	83	COMPX	=	2.0000E+00	84	COMPY	=	1.0000E+00	85	HMIND	=	0.0000E+00
86	AVD	=	2.5300E+01	87	ARNEW	=	0.0000E+00	88	HMMIN	=	0.0000E+00	89	EPSINF	=	1.0000E+06	90	TKEINF	=	1.0000E+04
91	RVEL	=	0.0000E+00	92	PFSLL	=	1.0000E-01	93	PFSLH	=	9.0000E-01	94	RATO2	=	0.0000E+00	95	EPTEST	=	9.0000E-04
96	PSISIR	=	0.0000E+00	97	HINF	=	4.0925E+03	98	XPRIME	=	0.0000E+00	99	PPRCON	=	2.3308E+01	100	PPRIME	=	0.0000E+00
101	YUP	=	5.3675E+01	102	VSTART	=	5.8900E+01	103	DEPLT	=	5.9489E-01	104	VELCST	=	1.5610E-03	105	RDCST	=	1.3370E+01
106	PTPL	=	6.0589E-01	107	VELD	=	0.0000E+00	108	ENMULT	=	2.3308E+03	109	XMA	=	2.8970E+01	110	XMN	=	2.0160E+00
111	DELX3	=	0.0000E+00	112	X3LAST	=	0.0000E+00	113	DLAST	=	0.0000E+00	114	DLXM1	=	0.0000E+00	115	ARSCAL	=	0.0000E+00
116	RX	=	1.4354E+01	117	RTONM1	=	1.3004E+01	118	XMSDF	=	0.0000E+00	119	RDUALC	=	2.3308E-01	120	SCAL	=	0.0000E+00
121	HDOT	=	0.0000E+00	122	HRSDOT	=	0.0000E+00	123	DR	=	1.0000E+00	124	CON	=	4.3500E-01	125	XLAM	=	1.1000E-01
126	TWOMSC	=	1.0000E+00	127	PMSSCL	=	1.0000E+10	128	TENEL1	=	1.0000E-20	129	SCT	=	1.0000E+00	130	TENEL2	=	1.0000E-20
131	SPLIT	=	2.8350E-02	132	HRCON	=	2.9126E-02	133	PCNT	=	1.0000E-02	134	Q3MAX	=	0.0000E+00	135	ENERGY	=	0.0000E+00
136	QSMAX	=	9.9900E-02	137	AVDP	=	1.5458E-03	138	RUESQ	=	1.5046E+01	139	M31	=	1.0000E+00	140	G32	=	0.0000E+00
141	G33	=	0.0000E+00	142	G1	=	2.1295E-15	143	C4EDSW	=	1.0000E-03	144	PLMTKE	=	1.0000E+00	145	EIEDSW	=	1.0000E+04
146	TDA	=	5.3300E+02	147	TDH	=	5.2000E+02	148	CVH	=	1.0000E+00	149	CVU	=	3.0480E-01	150	CVT	=	1.0000E+00
151	CVP	=	4.7250E-04	152	CVRHO	=	1.6020E+01	153	CVCP	=	4.1860E+03	154	XMACHS	=	8.8615E-02	155	TSINF	=	5.2917E+02
161	PRFACT	=	0.0000E+00	162	FTTOIN	=	1.2000E+01	163	FTTOCM	=	3.0480E+01	164	FTTOMT	=	3.0480E-01	165	DRTODK	=	5.5556E-01
166	PSFTDA	=	4.7250E-04	167	PSFTOT	=	3.5910E-01	168	PSFTON	=	4.7880E+01	169	PSFTOI	=	6.9440E-03	170	PIFTOK	=	1.6020E+01
171	EULER	=	9.1318E+01	172	XMFACT	=	8.9271E-02	173	TMPTST	=	0.0000E+00	174	PDFTOC	=	1.6020E-02	175	EDTOKJ	=	2.3244E+00
176	CDTOKJ	=	4.1840E+00	177	VLBTON	=	1.4880E+00	178	VLBTOP	=	1.4880E+01	179	RADCON	=	1.7453E-02	180	PRSAGS	=	4.5455E-01
181	C1KORE	=	1.0000E+00	182	C1DORF	=	1.4400E+00	183	C2DORF	=	1.9200E+00	184	C2KORE	=	1.0000E+00	185	PRDIS	=	1.3000E+00
186	H21	=	1.0000E+00	187	G22	=	0.0000E+00	188	G23	=	0.0000E+00	189	F1	=	0.0000E+00	190	SLOPE	=	1.9710E-03
191	ADUCT	=	1.0000E+00	192	XLAST	=	0.0000E+00	193	XMAGED	=	1.0000E+00	194	XTTT	=	0.0000E+00	195	YTT	=	0.0000E+00
196	THETAP	=	0.0000E+00	197	YF3SF1	=	1.0000E+00	198	YPLUS	=	0.0000E+00	199	RMULOC	=	0.0000E+00	200		=	0.0000E+00
201	XTC	=	1.1000E-02	202	UWALL	=	2.4514E-01	203	UEDGEN	=	8.0345E-01	204	ENER	=	0.0000E+00	205	DELSTR	=	4.8348E-03
206	THETA	=	2.8482E-03	207	CONVRG	=	0.0000E+00	208	VEDGEN	=	0.0000E+00	209	RLTH	=	1.8631E-02	210	SHAPEF	=	1.6982E+00
211	CFOV2	=	1.2681E-03	212		=	0.0000E+00	213		=	0.0000E+00	214		=	0.0000E+00	215		=	0.0000E+00
216		=	0.0000E+00	217		=	0.0000E+00	218		=	0.0000E+00	219		=	0.0000E+00	220		=	0.0000E+00
221		=	0.0000E+00	222		=	0.0000E+00	223		=	0.0000E+00	224		=	0.0000E+00	225		=	0.0000E+00
226		=	0.0000E+00	227		=	0.0000E+00	228		=	0.0000E+00	229		=	0.0000E+00	230		=	0.0000E+00
231		=	0.0000E+00	232		=	0.0000E+00	233		=	0.0000E+00	234		=	0.0000E+00	235		=	0.0000E+00
236		=	0.0000E+00	237		=	0.0000E+00	238		=	0.0000E+00	239		=	0.0000E+00	240		=	0.0000E+00
241		=	0.0000E+00	242		=	0.0000E+00	243		=	0.0000E+00	244		=	0.0000E+00	245		=	0.0000E+00
246		=	0.0000E+00	247		=	0.0000E+00	248		=	0.0000E+00	249		=	0.0000E+00	250		=	0.0000E+00

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

STATUS OF KARRAY VALUES.

251	ALPHA	=	0.0000E+00	252	BETA	=	0.0000E+00	253	TEANG	=	0.0000E+00	254	THAAI	=	1.0000E+00	255	RNN	=	0.0000E+00
256	SANGLE	=	0.0000E+00	257	TRIFOF	=	0.0000E+00	258	TRIFUP	=	0.0000E+00	259	APHIM	=	0.0000E+00	260	PIO180	=	0.0000E+00
261	SRATIO	=	0.0000E+00	262	C3PO	=	0.0000E+00	263	PALPH	=	0.0000E+00	264	XNLSLD	=	0.0000E+00	265	XIN SIN	=	0.0000E+00
266	GATIO	=	0.0000E+00	267	RATSAV	=	0.0000E+00	268	PHICOD	=	0.0000E+00	269	PHISAV	=	0.0000E+00	270	RUFRIN	=	0.0000E+00
271	OSUSQ	=	1.0000E-05	272	OMEGXP	=	1.5000E+00	273	XDELTA	=	1.0000E-02	274	EPSMIN	=	1.0000E-05	275	AUMAX	=	2.0000E+00
276	GAMFAC	=	1.0000E-20	277	GAMEXP	=	9.0000E+00	278	AEXP	=	1.0000E+00	279	BEXP	=	4.0000E+00	280	RUEPSM	=	1.0000E+00
281		=	0.0000E+00	282		=	1.0000E+00	283		=	0.0000E+00	284		=	5.0000E-02	285		=	0.0000E+00
286	GAMMA	=	0.0000E+00	287	PPRHOU	=	0.0000E+00	288	PFACTR	=	0.0000E+00	289	RHOIN	=	1.0000E+00	290		=	0.0000E+00
291	XSET	=	0.0000E+00	292	XDELT	=	0.0000E+00	293	XTST	=	0.0000E+00	294	XEND	=	0.0000E+00	295	XST	=	0.0000E+00
296	EPSMX	=	0.0000E+00	297	CFLOW	=	0.0000E+00	298	XFLOW	=	0.0000E+00	299	EPSMAX	=	0.0000E+00	300	TANTS	=	0.0000E+00
301	SIMPLT	=	1.1000E-02	302	CHISTP	=	5.0000E+00	303	CHIEPS	=	3.0000E-04	304	CIMPTH	=	5.0000E-01	305	TMULT	=	1.2100E+00
306	AMRHOU	=	1.0000E+00	307	AMCON	=	1.0000E+00	308	AMDIF	=	-1.0000E+00	309	CPHI1	=	2.8000E+00	310	CPHI2	=	4.5000E-01
311	CC1	=	9.3780E-01	312	CC2	=	6.6984E-02	313	CC3	=	5.6459E-01	314	CC4	=	6.8144E-02	315	C2C4	=	4.5647E-03
316	DRVGPH	=	0.0000E+00	317	PPRGPH	=	0.0000E+00	318	DCHECK	=	0.0000E+00	319	DSTART	=	1.0000E+00	320	YSCAL	=	0.0000E+00
321	STPMLT	=	0.0000E+00	322	CHITST	=	1.0000E+01	323		=	0.0000E+00	324	YNRMAD	=	0.0000E+00	325	ZNRMAD	=	2.1295E-15
326	CHIM1	=	0.0000E+00	327	F2	=	0.0000E+00	328	G2	=	0.0000E+00	329	F1D	=	0.0000E+00	330	YMULT	=	1.0000E+00
331	PRN	=	6.9000E-01	332	PRC1	=	2.1000E-01	333	PRC2	=	5.2500E+00	334	PRC3	=	2.0000E-01	335	PRC4	=	5.0000E+00
336	DELCHK	=	0.0000E+00	337	DELTST	=	0.0000E+00	338	DELMLT	=	1.0000E-04	339	PCFACT	=	1.0000E+00	340	PFFACT	=	1.0000E+00
341	YFAC	=	1.0000E+00	342	ZFAC	=	1.0000E+00	343	U23PP1	=	0.0000E+00	344	ARH	=	0.0000E+00	345	PUMULT	=	0.0000E+00
346	VLDMLT	=	1.0000E+00	347		=	0.0000E+00	348	VCMULT	=	1.0000E+00	349	YBASE	=	0.0000E+00	350	TKFIX	=	0.0000E+00
351	PSTAG	=	2.1285E+03	352	PNIRMS	=	0.0000E+00	353	GUMULT	=	1.0000E+00	354	UINFX	=	1.0000E+00	355	EPMULT	=	1.0000E+00
356	CE	=	1.0000E+00	357	CW	=	1.0000E+00	358	EFMULT	=	1.0000E+00	359	RETHM	=	1.0000E+00	360	RHSMU	=	1.0000E+00
361	OS6	=	1.6667E-01	362	OS12	=	8.3333E-02	363	OS60	=	8.3333E-02	364	CR	=	1.0000E+00	365	CD	=	9.0000E-02
366	XEM	=	1.0000E+00	367	YLTKE	=	4.3500E-01	368	ESCF	=	1.0000E+00	369	DCTSLP	=	0.0000E+00	370	FROUTM	=	0.0000E+00
371	UBAR	=	0.0000E+00	372	TBAR	=	0.0000E+00	373	XNDOTC	=	0.0000E+00	374	TAREA	=	0.0000E+00	375	OSM1SQ	=	1.0000E+00
376	EX2	=	2.0000E+00	377	C3F	=	0.0000E+00	378	SK	=	0.0000E+00	379	S	=	0.0000E+00	380	SMULT	=	0.0000E+00
381	G1C	=	2.1295E-15	382	ZMULT	=	1.0000E+00	383	WSMAX	=	9.9900E-02	384	DELTL	=	0.0000E+00	385	SAVRAT	=	0.0000E+00
386	H21L	=	1.0000E+00	387	H31L	=	1.0000E+00	388	PSHIFT	=	0.0000E+00	389	STGFRS	=	0.0000E+00	390	DYNPRS	=	1.0000E+00
391	PRSCAL	=	0.0000E+00	392	RHSMLT	=	0.0000E+00	393	AMB	=	0.0000E+00	394	T2FIX	=	0.0000E+00	395	RHOD	=	0.0000E+00
396	OSG	=	1.0000E+00	397	T3FIX	=	0.0000E+00	398	T2PFIX	=	0.0000E+00	399	TU1U2P	=	0.0000E+00	400		=	0.0000E+00
401		=	0.0000E+00	402		=	0.0000E+00	403		=	0.0000E+00	404		=	0.0000E+00	405		=	0.0000E+00
406		=	0.0000E+00	407		=	0.0000E+00	408		=	0.0000E+00	409		=	0.0000E+00	410		=	0.0000E+00
411		=	0.0000E+00	412		=	0.0000E+00	413		=	0.0000E+00	414		=	0.0000E+00	415		=	0.0000E+00
416		=	0.0000E+00	417		=	0.0000E+00	418		=	0.0000E+00	419		=	0.0000E+00	420		=	0.0000E+00
421		=	0.0000E+00	422		=	0.0000E+00	423		=	0.0000E+00	424		=	0.0000E+00	425		=	0.0000E+00
426		=	0.0000E+00	427		=	0.0000E+00	428		=	0.0000E+00	429		=	0.0000E+00	430		=	0.0000E+00
431		=	0.0000E+00	432		=	0.0000E+00	433		=	0.0000E+00	434		=	0.0000E+00	435		=	0.0000E+00
436		=	0.0000E+00	437		=	0.0000E+00	438		=	0.0000E+00	439		=	0.0000E+00	440		=	0.0000E+00
441		=	0.0000E+00	442		=	0.0000E+00	443		=	0.0000E+00	444		=	0.0000E+00	445		=	0.0000E+00
446		=	0.0000E+00	447		=	0.0000E+00	448		=	0.0000E+00	449		=	0.0000E+00	450		=	0.0000E+00
451		=	0.0000E+00	452		=	0.0000E+00	453		=	0.0000E+00	454		=	0.0000E+00	455		=	0.0000E+00
456		=	0.0000E+00	457		=	0.0000E+00	458		=	0.0000E+00	459		=	0.0000E+00	460		=	0.0000E+00
461		=	0.0000E+00	462		=	0.0000E+00	463		=	0.0000E+00	464		=	0.0000E+00	465		=	0.0000E+00
466		=	0.0000E+00	467		=	0.0000E+00	468		=	0.0000E+00	469		=	0.0000E+00	470		=	0.0000E+00
471		=	0.0000E+00	472		=	0.0000E+00	473		=	0.0000E+00	474		=	0.0000E+00	475		=	0.0000E+00
476		=	0.0000E+00	477		=	0.0000E+00	478		=	0.0000E+00	479		=	0.0000E+00	480		=	0.0000E+00
481		=	0.0000E+00	482		=	0.0000E+00	483		=	0.0000E+00	484		=	0.0000E+00	485		=	0.0000E+00
486		=	0.0000E+00	487		=	0.0000E+00	488		=	0.0000E+00	489		=	0.0000E+00	490		=	0.0000E+00
491		=	0.0000E+00	492		=	0.0000E+00	493		=	0.0000E+00	494		=	0.0000E+00	495		=	0.0000E+00
496		=	0.0000E+00	497		=	0.0000E+00	498		=	0.0000E+00	499		=	0.0000E+00	500		=	0.0000E+00

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

NODE AND COORDINATE MAP OF DISCRETIZATION

This node map is printed out by calling LINK2(5) (RIOUTP). It may also be called if LINK2(6) is called before the map is printed (this allows for certain print parameters to be set) For a non-rectangular grid (such as this is), it may be necessary to 'compress' the coordinates. This is done by setting COMPX and/or COMPY equal to a percentage of domain span for which output (not computational) nodes will overlap. For this case COMPX = 2.0 and COMPY = 1.0.

X2COR SCALE FACTOR ..... X2LOR ...NODE NUMBERS... .....

X1COR SCALE FACTOR ... X1COR ...

```
 - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X -
   E -1
 9990000   181     184     186     187     188     189                     190
 8518973                                         179                     180
 8349874                             177     178
 8257089   171     174     176
 7239818                                                                 170
 7058205                                         169
 6923677                             167     168
 6750211           165     166
 6655031   161     164
 6127510                                                                 160
 5872444                                         159
 5683506                             158
 5543551                             157
 5363089   153     155
 5160286   151                                                           150
 4841347                                         149
 4605096                             148
 4319221                                                                 140
 4300465           145     146
 4133315   143     144
 3944741   141                                   139
 3587861                             138                                 130
 3309667                   136
 3165084           134                           129
 2951895   131                                                           120
 2951916                             128
 2398881                   126                   119                     110
 2226535           124
 2142844   121                       118
 1918000                   117                   109                     100             090             080
 1526259           115               108
 1384951   113     114                           099             089             079                             069
 1251201   111                       107
 1047454                   106
 0933099           105               098                     088                     078             068
 0697617   103     104               097             087             077                     067
 0480963                   096       086             076                     066                             056
 0320479           095     085                     075                     065                             055
 0113544   093     094     083             073     074                     063             053             054
 0         091             081             071                     061                     051
```

E-1 0000000 0201601 0595144 0701924 1047454 1279559 1455339 1698918 2066637 2156692 2448103 2619937 2971777 3113407

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

C O M O C
3-DIMENSIONAL BOUNDARY LAYER OPTION

REFERENCE	ENGLISH-FT	ENGLISH-IN	M-K-S	C-G-S	
LENGTH.....	.FT.....	.IN.....	.M.....	.CM.....	THIS PORTION IS PRINTED
	1000000E+01	1200000E+02	3048000E+00	3048000E+02	
VELOCITY.....	.FT/S.....	.N.A.....	.M/S.....	.CM/S.....	ON 1ST PRINTOUT ONLY.
	1000010E+03		3048000E+02	3048000E+04	
DENSITY.....	.LBM/FT3....	.N.A.....	KG/M3.....	G/CC.....	
	2330814E-02		3733965E-01	3733965E-04	
TEMPERATURE....	.RANKINE....	.N.A.....	.KELVIN.....	.N.A.....	
	5300000E+03		2944444E+03		
ENTHALPY.....	.BTU/LBM....	.N.A.....	.KJ/KG.....	.N.A.....	
	1760684E+04		4092533E+04		
FROZ.SPEC.HEAT.	.BTU/LBM-R..	.N.A.....	.KJ/KG-K....	.N.A.....	
	7721760E+01		3230784E+02		
VISCOSITY.....	.LBM/FT-S...	.N.A.....	.NT-S/M2....	.POISE.....	
	4074412E-06		6062725E-06	6062725E-05	
LOCAL PRESSURE.	.PSF.....	.PSI.....	KNT/M2.....	.TORR.....	THIS PORTION IS PRINTED ON ALL
9964654E+00	2116800E+04	1469906E+02	1013524E+06	7601429E+03	SUBSEQUENT PRINTS.
LOCAL SOLUTION.	.MACH NO....	.DPDX1.....	.ENERGY.....	.INT. VAR...	
0 E+00	8861539E-01	0 E+00	5847034E+00	0 E+00	
T2PFIX.....	.M21.....	.G22.....	.G23.....	.F1.....	
0 E+00	1000000E+01	0 E+00	0 E+00	0 E+00	
NUGEOM H'S.....	.M31.....	.G32.....	.G33.....	.G1.....	
	1000000E+01	0 E+00	0 E+00	2129497E-14	
X1/LREF.....	.DX1/LREF...	.EPSILON....	.DX1M/LREF..	.REFL RE NO.	
1100000E-01	1000000E-02	1000000E-01	0 E+00	5720616E+06	

N-	N+	PASSES	PRINT	OF
0	0	1	0	100

U1/UREF E 0

1	.000000	.245143	.329385	.388673	.441553	.496669	.561357	.641463	.733277	.803455
2	.000000	.239900	.324071	.383332	.436194	.491274	.555854	.635679	.726811	.795295
:	:									:
19	.000000	.245143	.329385	.388673	.441553	.496669	.561357	.641463	.733277	.803455

U2/UREF 190 ENTRIES = 0.00000E+00 WHEN ALL ENTRIES ARE IDENTICAL, ONLY 1 VALUE IS PRINTED.

U3/UREF 190 ENTRIES = 0.00000E+00

NU/NUREF E 2

1	.000000	.000455	.010517	.071431	.260856	.649475	.662265	.611700	.455312	.038982
2	.000000	.000457	.010753	.072920	.265799	.659840	.671307	.618195	.456708	.038982
:	:									:
19	.000000	.000455	.010517	.071431	.260856	.649475	.662265	.611700	.455312	.038982

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

TKE/TKEREF E -2

1	.001000	.142311	.134246	.185961	.274136	.422168	.344705	.275407	.150944	.001000
2	.001000	.137481	.134270	.186026	.274086	.421065	.342798	.272426	.147132	.001000
:	:	:	:	:	:	:	:	:	:	:
19	.001000	.142311	.134246	.185961	.274136	.422168	.344705	.275407	.150944	.001000

DISS/DISSREF E 0

1	.000001	.125148	.018083	.010019	.008583	.009766	.006842	.004818	.001951	.000001
2	.000001	.118545	.017751	.009845	.008433	.009589	.006677	.004665	.001847	.000001
:	:	:	:	:	:	:	:	:	:	:
19	.000001	.125148	.018083	.010019	.008583	.009766	.006842	.004818	.001951	.000001

PP / PSTAG 190 ENTRIES = 0.00000E+00

U' E -2

1	.000000	.009698	.034986	.110808	.294999	.644410	.614612	.521422	.267849	.001425
2	.000000	.009397	.035737	.115827	.308899	.663426	.628782	.528487	.252667	.001434
:	:	:	:	:	:	:	:	:	:	:
19	.000000	.009698	.034986	.110808	.294999	.644410	.614612	.521422	.267849	.001425

U'V' E -2

1	.000000	-.000002	-.000034	-.000309	-.001244	-.003298	-.003584	-.003620	-.002805	-.000026
2	.000000	-.000004	-.000068	-.000534	-.002034	-.005179	-.005514	-.005496	-.004079	-.000035
:	:	:	:	:	:	:	:	:	:	:
19	.000000	-.003186	-.010044	-.057917	-.165082	-.348257	-.323345	-.271864	-.137425	-.000703

U'W' E -2

1	.000000	-.003186	-.010044	-.057917	-.165082	-.348257	-.323345	-.271864	-.137425	-.000703
2	.000000	-.002857	-.013247	-.065088	-.176230	-.359779	-.330876	-.275277	-.128500	-.000709
:	:	:	:	:	:	:	:	:	:	:
19	.000000	-.000002	-.000034	-.000309	-.001244	-.003298	-.003584	-.003620	-.002805	-.000026

V' E -2

1	.000000	.005790	.020517	.055738	.118285	.217571	.190337	.154932	.085160	.000564
2	.000000	.005617	.020588	.055888	.118424	.217112	.189272	.153194	.082933	.000563
:	:	:	:	:	:	:	:	:	:	:
19	.000000	05709	.019610	.037515	.019781	-.065357	-.107987	-.108972	-.041046	.000078

V'W' E -3

1	.000000	-.000001	-.000069	-.001989	-.014947	-.053674	-.066226	-.070224	-.049307	-.000363
2	.000000	-.000001	-.000144	-.003769	-.025770	-.086952	-.104635	-.109241	-.069112	-.000493
:	:	:	:	:	:	:	:	:	:	:
19	.000000	-.000001	-.000069	-.001989	-.014947	-.053674	-.066226	-.070224	-.049307	-.000363

W' E -2

1	.000000	.005709	.019610	.037515	.019781	-.065357	-.107987	-.108972	-.041046	.000078
2	.000000	.005549	.019049	.032898	.006289	-.085437	-.124781	-.120411	-.031557	.000070
:	:	:	:	:	:	:	:	:	:	:
19	.000000	.005790	.020517	.055738	.118285	.217571	.190337	.154932	.085160	.000564

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
   SKIN FRICTION DISTRIBUTION(CF/2)
 1 1.26810E-03   2 1.25874E-03   3 1.22440E-03   4 1.18291E-03   5 1.14511E-03   6 1.12045E-03   7 1.11183E-03   8 1.11503E-03
 9 1.12279E-03  10 1.12600E-03  11 1.12279E-03  12 1.11503E-03  13 1.11183E-03  14 1.12045E-03  15 1.14511E-03  16 1.18291E-03
17 1.22440E-03  18 1.25874E-03  19 1.26810E-03

   DISPLACEMENT THICKNESS.
 1 4.83684E-03   2 4.91501E-03   3 5.16960E-03   4 5.50774E-03   5 5.86811E-03   6 6.19299E-03   7 6.44962E-03   8 6.53917E-03
 9 6.77506E-03  10 6.86833E-03  11 6.77506E-03  12 6.63813E-03  13 6.44961E-03  14 6.19299E-03  15 5.86811E-03  16 5.50774E-03
17 5.16960E-03  18 4.91501E-03  19 4.83684E-03

   MOMENTUM THICKNESS.
 1 2.84816E-03   2 2.88710E-03   3 3.01509E-03   4 3.18497E-03   5 3.36702E-03   6 3.53728E-03   7 3.68294E-03   8 3.80218E-03
 9 3.89683E-03  10 3.95887E-03  11 3.89683E-03  12 3.80218E-03  13 3.68296E-03  14 3.53728E-03  15 3.36702E-03  16 3.18497E-03
17 3.01509E-03  18 2.88710E-03  19 2.84916E-03
LINK2( 6) TIME =      0.00000E+00 SEC      TOTAL TIME TO HERE =      0.00000E+00 SEC.
```

THE ENTRIES IN THE 'IPINT' VECTOR HAVE THE FOLLOWING INTERPRETATIONS FOR THIS PROBLEM.

1 - U1 MOMENTUM EQUATION (Downstream velocity).
2 - U2 MOMENTUM EQUATION (Normal velocity).
3 - U3 MOMENTUM EQUATION (Transverse velocity).
4 - ENTHALPY - (not used for this system).
5 - TKE - TURBULENT KINETIC ENERGY
6 - ε - DISSIPATION LENGTH SCALE
} (Used to compute $\mu^t = C_\mu K^2/\varepsilon$ and the Reynold Stresses τ_{ij}).
7 - PP - PARTICULAR PRESSURE (RHS formed in PPRES when LPHI = -1).
8 - PC - COMPLEMENTARY PRESSURE (Pressure table input using sub. CPSTUF and NODPCP).
9 - ϕ - SOLUTION TO THE POISSON EQUATION $\nabla^2\phi = \partial u/\partial x$. (RHS formed in PPRES when LPHI = 1).
(PPRES is called from subroutine BLSPRN).

The number of equations being integrated is derived from the expression
NEQKIT = NEQKNN + NEQADD where
NEQKNN is the maximum no. that can be integrated;
NEQADD is initialized to zero or negative no. to delay integration of some variables.
When NELPAS reaches the value of the flag NCNADD, then NEQADD = NEQADD + NEQAV2 + NEQAV3. (sub. IMPLCT)
When X_1 reaches C4EDSW, then NEQADD = NEQADD + 2. (sub. DFCFBL).
For this problem since IPINT = (1, 5, 6, 2, 3, 7, 8, 9), NEQKNN = 5. NEQADD = -4, C4EDSW = .001,
NEQAV2 = 1, NEQAV3 = 1 and NCNADD = 8.
NEQKIT will be 1 until X_1 is greater than .001 which makes NEQADD will have the value -2.
When NELPAS reaches 8 (the value of NCNADD), NEQADD becomes 0 and NEQKIT becomes 5, at
which time all 5 integration variables will be solved.

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
DEBUG FROM DERVBL ( PRINTED FROM DRVBUG ).

THIS INFORMATION IS PRINTED FOR ALL ELEMENTS CONTAINING
  NODE 'IBOT' OR 'ITOP' ( IN THIS CASE 'IBOT' = 3, 'ITOP' = 4.

-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-/-

-8-8-8-8-8- ELEMENT     3,  NODES     2    3    12

    AREA         AMLHS          RHM2          PMULT        G23FCT        B112FR        B112ML         VPVP          VPWP          B113ML
5.90882E-06  4.92402E-07 -8.33333E-02 -4.49652E-05  0.00000E+00 -7.80829E-03  0.00000E+00  6.07980E-10 -1.40528E-13 -5.[illegible]E+01

  DIFMUL( 1) = -1.4264E-11    DIFMUL( 2) = -1.4264E-11    DIFMUL( 3) = -3.0271E-12    DIFMUL( 4) = -1.0329E-11
  DIFMUL( 5) = -1.0329E-11

  NB112Q( 1) =  1.2915E+02    NB112Q( 2) = -1.2364E-01    NB112Q( 3) = -1.6414E+02    NB112Q( 4) =  0.0000E+00
  NB112Q( 5) =  0.0000E+00    NB112Q( 6) =  0.0000E+00    NB112Q( 7) = -2.5452E-04    NB112Q( 8) =  0.0000E+00

  NB113Q( 1) =  2.8943E-01    NB113Q( 2) =  2.4458E-03    NB113Q( 3) =  4.7487E-01    NB113Q( 4) =  0.0000E+00
  NB113Q( 5) =  0.0000E+00    NB113Q( 6) =  0.0000E+00    NB113Q( 7) = -2.8860E-03    NB113Q( 8) =  0.0000E+00

     AVEDIF          AVED          AVEK         DELUSQ        C1KEML        C2KEML        C1DFML        C2DFML
  -.14264E-10    .86592E-01    .13801E-02    .16680E+05    .17841E-05   -.49240E-06    .16119E-03   -.59317E-04

   DEPENDENT VAR. BY NP LOC.  (1st 3 entries for U1, next 3 for TKE, etc. using the ordering in the IPINT vector.)
 1 2.45143E-01   2 3.29385E-01   3 2.39900E-01   4 1.42311E-03   5 1.34246E-03   6 1.37481E-03   7 1.25148E-01   8 1.80828E-02
 9 1.16545E-01  10 0.00000E+00  11 0.00000E+00  12 0.00000E+00  13 0.00000E+00  14 0.00000E+00  15 0.00000E+00  16 0.00000E+00
17 0.00000E+00  18 0.00000E+00  19 9.96492E-01  20 9.96492E-01  21 9.96544E-01  22 0.00000E+00  23 0.00000E+00  24 0.00000E+00
     SA CONTRIBUTION                   1.05957E+00  1.14381E+00  1.05433E+00

DEPENDENT VARIABLE NO.       1     1     1     1     1     1     1     1     1     1
    DEPENDENT VARIABLE.                2.45143E-01  3.29385E-01  2.39900E-01
     VISCOSITY.                       -1.82753E-06 -3.58655E-06 -1.82803E-06
     DIFFUSION CONTRIBUTION.          -1.97983E+05  1.97999E+05 -1.59752E+01
     CONVECTION CONTRIBUTION.            3 ENTRIES =    0.00000E+00
    G ASSEMBLY FOR DEP. VARIABLE.     -5.33242E-06 -2.82428E-06 -8.13967E-06
    Q(P) - Q(J) FOR IMPLICIT.            3 ENTRIES =    0.00000E+00
    CODIF FOR IMPLICIT.                  3 ENTRIES =    0.00000E+00

DEPENDENT VARIABLE NO.       5     5     5     5     5     5     5     5     5     5
    DEPENDENT VARIABLE.                1.42311E-03  1.34246E-03  1.37481E-03
     VISCOSITY.                       -1.82753E-06 -3.58655E-06 -1.82803E-06
     DIFFUSION CONTRIBUTION.           1.89706E+02 -1.89559E+02 -1.47137E-01
     CONVECTION CONTRIBUTION.            3 ENTRIES =    0.00000E+00
    G ASSEMBLY FOR DEP. VARIABLE.     -4.90638E-08 -2.34425E-09 -4.77827E-08
    Q(P) - Q(J) FOR IMPLICIT.            3 ENTRIES =    0.00000E+00
    CODIF FOR IMPLICIT.                  3 ENTRIES =    0.00000E+00
```

The 3 entries for each of these parameters are listed by node connection as specified above, i.e. NODES 2, 3 and 12.

ORIGINAL PAGE IS OF POOR QUALITY

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

```
DEPENDENT VARIABLE NO.      6    6    6    6    6    6    6    6    6    6
    DEPENDENT VARIABLE.                 1.25148E-01  1.80828E-02  1.16545E-01
     VISCOSITY.                        -6.11291E-08 -1.41424E-06 -6.15154E-08
     DIFFUSION CONTRIBUTION.            2.51671E+05 -2.51644E+05 -2.62105E+01
     CONVECTION CONTRIBUTION.             3 ENTRIES =   0.00000E+00
    G ASSEMBLY FOR DEP. VARIABLE.      -1.54500E-06 -9.83142E-08 -8.08542E-07
    Q(P) - Q(J) FOR IMPLICIT.            3 ENTRIES =   0.00000E+00
    CODIF FOR IMPLICIT.                  3 ENTRIES =   0.00000E+00

DEPENDENT VARIABLE NO.      2    2    2    2    2    2    2    2    2    2
    DEPENDENT VARIABLE.                  3 ENTRIES =   0.00000E+00
     VISCOSITY.                        -1.74807E-06 -1.74815E-06 -1.74807E-06
     DIFFUSION CONTRIBUTION.             3 ENTRIES =   0.00000E+00
     CONVECTION CONTRIBUTION.            3 ENTRIES =   0.00000E+00
    G ASSEMBLY FOR DEP. VARIABLE.      -6.63814E-07  9.78229E-07  4.28030E-07
    Q(P) - Q(J) FOR IMPLICIT.            3 ENTRIES =   0.00000E+00
    CODIF FOR IMPLICIT.                  3 ENTRIES =   0.00000E+00

DEPENDENT VARIABLE NO.      3    3    3    3    3    3    3    3    3    3
    DEPENDENT VARIABLE.                  3 ENTRIES =   0.00000E+00
     VISCOSITY.                        -1.74807E-06 -1.74815E-06 -1.74807E-06
     DIFFUSION CONTRIBUTION.             3 ENTRIES =   0.00000E+00
     CONVECTION CONTRIBUTION.            3 ENTRIES =   0.00000E+00
    G ASSEMBLY FOR DEP. VARIABLE.       1.33484E-06  5.18855E-07  8.59672E-07
    Q(P) - Q(J) FOR IMPLICIT.            3 ENTRIES =   0.00000E+00
    CODIF FOR IMPLICIT.                  3 ENTRIES =   0.00000E+00
     RG TKE PRODUCTION.                 3.37835E-03  4.68898E-03  3.35340E-03
     RM EPS/F PRODUCTION.        RHO    3.37835E-03  4.68898E-03  3.35340E-03
     RD TKE-EPS/F DISSIPATION.   RL     3.13644E-02  2.72411E-02  3.07792E-02
    U2M                                  3 ENTRIES =   0.00000E+00

     RHOU @ B3000 PRODUCT.
 1 2.60943E+00   2 1.38896E+00   3 1.29947E+00   4 1.38896E+00   5 2.94639E+00   6 1.38371E+00   7 1.29947E+00   8 1.38371E+00
 9 2.58845E+00

     DEBUG FOR IMPLICIT JACOBIAN.
    AMLCE =      .98480E-07 AMLDIF =     -.14264E-10 AMLCON =      .49240E-06 IJAC(I) =     1    2   10

     DIFFUSION CONT.FOR JACOBIAN.
 1-1.17671E+03   2 1.17519E+03   3 1.52325E+00   4 1.17519E+03   5-1.17519E+03   6 0.00000E+00   7 1.52325E+00   8 0.00000E+00
 9-1.52325E+00
    CONVECTION CONT.FOR JACOBIAN.       9 ENTRIES =   0.00000E+00

    SUM OF ALL CONT.FOR JACOBIAN.
 1 2.73762E-07   2 1.20022E-07   3 1.27951E-07   4 1.20022E-07   5 3.06925E-07   6 1.36268E-07   7 1.27951E-07   8 1.36268E-07
 9 2.54934E-07


          G(J)  for U1              8.19572E-06 -5.33242E-06  1.52999E-06
          G(J)  for TKE             4.69678E-08 -4.90638E-08  6.90601E-08
          G(J)  for EPS            -1.26794E-07 -1.54500E-06  2.43423E-08
          G(J)  for U2             -1.62959E-07 -6.63814E-07 -1.12298E-06
          G(J)  for U3              3.91832E-07  1.33484E-06  1.92804E-06
```


APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
DEBUG FROM IMPSLV.   SET NK = 'N',  NIT = '1',
  'N' = MAXIMUM NO. OF PASSES FOR WHICH TO PRINT
        DEBUG INFO. FROM IMPSLV. ( PRINT ONLY WHEN N'NT = 1 )
    NIT = 1 TO GET DEBUG OF JACOBIAN INFORMATION.


 'JACOBIAN ASSEMBLY'  NBAND = 23, NDBGPT = 3, GIVES 69 LOCATIONS.

 1 0.00000E+00   2 0.00000E+00   3 0.00000E+00   4 0.00000E+00   5 0.00000E+00   6 0.00000E+00   7 0.00000E+00   8 0.00000E+00
 9 0.00000E+00  10 0.00000E+00  11 0.00000E+00  12 1.00000E+30  13 1.92233E-08  14 0.00000E+00  15 0.00000E+00  16 0.00000E+00
17 0.00000E+00  18 0.00000E+00  19 0.00000E+00  20 0.00000E+00  21 0.00000E+00  22 1.79580E-08  23 0.00000E+00  24 0.00000E+00
25 0.00000E+00  26 0.00000E+00  27 0.00000E+00  28 0.00000E+00  29 0.00000E+00  30 0.00000E+00  31 0.00000E+00  32 0.00000E+00
33 0.00000E+00  34 1.92233E-08  35 5.40607E-07  36 1.20022E-07  37 0.00000E+00  38 0.00000E+00  39 0.00000E+00  40 0.00000E+00
41 0.00000E+00  42 0.00000E+00  43 0.00000E+00  44 8.92875E-08  45 1.98622E-07  46 0.00000E+00  47 0.00000E+00  48 0.00000E+00
49 0.00000E+00  50 0.00000E+00  51 0.00000E+00  52 0.00000E+00  53 0.00000E+00  54 0.00000E+00  55 0.00000E+00  56 0.00000E+00
57 1.20022E-07  58 1.09458E-06  59 1.95942E-07  60 0.00000E+00  61 0.00000E+00  62 0.00000E+00  63 0.00000E+00  64 0.00000E+00
65 0.00000E+00  66 0.00000E+00  67 2.79502E-07  68 3.75024E-07  69 0.00000E+00


   L DECOMPOSITION.    LOWER DECOMPOSITION OF JACOBIAN.
 1 1.92233E-38   2 2.22013E-01   3 1.83136E-01   4 1.50200E-01   5 1.25531E-01   6 1.38087E-01   7 1.74224E-01   8 1.98247E-01
 9 2.07543E-01  10 6.73557E-09  11 2.35274E-38  12 1.45294E-01  13 1.13768E-01  14 7.99305E-02  15 5.78092E-02  16 8.38577E-02
17 1.21244E-01  18 1.51142E-01  19 1.68343E-01  20 5.49938E-10  21 3.13509E-38  22 1.66437E-01  23 1.32713E-01  24 9.62432E-02
25 7.25259E-02  26 9.88444E-02  27 1.37974E-01  28 1.66826E-01  29 1.73839E-01  30 3.65305E-09  31 2.56012E-38  32 1.65431E-01
33 1.28919E-01

   U DECOMPOSITION.    UPPER DECOMPOSITION OF JACOBIAN.
 1 1.00000E+30   2 1.92233E-08   3 0.00000E+00   4 0.00000E+00   5 0.00000E+00   6 0.00000E+00   7 0.00000E+00   8 0.00000E+00
 9 0.00000E+00  10 0.00000E+00  11 1.79580E-08  12 0.00000E+00  13 0.00000E+00  14 0.00000E+00  15 0.00000E+00  16 0.00000E+00
17 0.00000E+00  18 0.00000E+00  19 0.00000E+00  20 0.00000E+00  21 0.00000E+00  22 0.00000E+00  23 0.00000E+00  24 5.40607E-07
25 1.20022E-07  26 0.00000E+00  27 0.00000E+00  28 0.00000E+00  29 0.00000E+00  30 0.00000E+00  31 0.00000E+00  32 0.00000E+00
33 8.92875E-08  34 1.98622E-07  35 0.00000E+00  36 0.00000E+00  37 0.00000E+00  38 0.00000E+00  39 0.00000E+00  40 0.00000E+00
41 0.00000E+00  42 0.00000E+00  43 0.00000E+00  44 0.00000E+00  45 0.00000E+00  46 0.00000E+00  47 1.06993E-06  48 1.95942E-07
49 0.00000E+00  50 0.00000E+00  51 0.00000E+00  52 0.00000E+00  53 0.00000E+00  54 0.00000E+00  55-1.98238E-08  56 2.35405E-07
57 3.75024E-07  58 0.00000E+00  59 0.00000E+00  60 0.00000E+00  61 0.00000E+00  62 0.00000E+00  63 0.00000E+00  64 0.00000E+00
65 0.00000E+00  66 0.00000E+00  67 0.00000E+00  68 0.00000E+00  69 0.00000E+00
```

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
 DEBUG FROM IMPSLV.    SET NR = 'N'.
   'N' = MAXIMUM NO. OF PASSES FOR WHICH TO PRINT DEBUG.
       DEBUG IS PRINTED ONLY WHEN KPNT = 1.  (AT PRINT POINT).

   Q(J) FROM LAST STEP.  (U1)        0.00000E+00  2.45143E-01  3.29385E-01

   H * (1.0-THETA) * G(J)            4.09786E-09 -2.66621E-09  7.64994E-10
   C * (Q(P)-Q(J))                     3 ENTRIES =   0.00000E+00
   H * THETA * G(P)                  4.09786E-09 -2.66621E-09  7.64994E-10
  -F =-CS(QP-QJ) - HS(T*GP+OMT*GJ)   8.19572E-09 -5.33242E-09  1.52999E-09
   DELTA-Q FROM BANDSL.              8.35181E-39 -8.11966E-03  3.06222E-03

PASS, ITER, NP, NBOUND, NODE    1    2    1  171    2   -8.11966E-03    2.41036E-04
   Q(J) FROM LAST STEP.  (TKE)       1.00000E-05  1.42311E-03  1.34246E-03

   H * (1.0-THETA) * G(J)            2.34839E-11 -2.45319E-11  3.45300E-11
   C * (Q(P)-Q(J))                     3 ENTRIES =   0.00000E+00
   H * THETA * G(P)                  2.34839E-11 -2.45319E-11  3.45300E-11
  -F =-CS(QP-QJ) - HS(T*GP+OMT*GJ)   4.69678E-11 -4.90638E-11  6.90601E-11
   DELTA-Q FROM BANDSL.              4.84051E-41 -7.47671E-05  5.27731E-05

PASS, ITER, NP, NBOUND, NODE    1    2    5  152    2   -7.47671E-05    1.27665E-06
   Q(J) FROM LAST STEP.  (EPS)       1.00000E-06  1.25148E-01  1.80828E-02

   H * (1.0-THETA) * G(J)           -6.33981E-11 -7.72502E-10  1.21712E-11
   C * (Q(P)-Q(J))                   4.84644E-11  1.12505E-10  0.00000E+00
   H * THETA * G(P)                 -6.33981E-11 -7.72502E-10  1.21712E-11
  -F =-CS(QP-QJ) - HS(T*GP+OMT*GJ)  -1.75261E-10 -1.65751E-09  2.43423E-11
   DELTA-Q FROM BANDSL.             -1.33284E-40 -2.18366E-03  5.16394E-04

PASS, ITER, NP, NBOUND, NODE    1    2    6  152    2   -2.18366E-03    3.75445E-05
   Q(P) FROM SETIMP.                 0.00000E+00  2.37024E-01  3.32447E-01  U1
   Q(P) FROM SETIMP.                 1.00000E-05  1.34834E-03  1.39523E-03  TKE
   Q(P) FROM SETIMP.                 9.00000E-04  1.22965E-01  1.85992E-02  EPS

U2 VELOCITY.                    190 ENTRIES =   0.00000E+00

PAI FROM PPRES.                 190 ENTRIES =   0.00000E+00
```

Q(P) = Q(J) + DQ(P)

The no. of entries in these print vectors is limited by NDBGPT which is set to 3 for this run.

The printout on the line starting with PASS contains the following information:

- PASS - Pass counter (NELPAS)
- ITER - Iteration counter (NITER)
- NP - Dep. variable (1=U1, 5=TKE, 6=EPS, etc.)
- NBOUND - No. of NON-boundary nodes, i.e. No. of equations beings solved.
- NODE - The first node which fails to converge.
- 1st real - The value of Delta-Q at NODE.
- 2nd real - Convergence criterion for dep. var. Q = EPSILON * $|Q_{max}|$

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
DEBUG PRINT FROM PPRES.   TURNED ON WITH KODE = 'N'.
          'N' = NO. OF PRINT POINTS AT WHICH TO PRINT DEBUG.
        DEBUG IS PRINTED FOR ELEMENTS WHICH CONTAIN
          NODES 'IBOT' AND 'ITOP'.

   FIRST PASS THRU PPRES COMPUTES PHI.

 - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - *

    PASS    1. ITERATION     2. ELEMENT    3. NODES -     2     3    12

        AREA        RHU112       RHV112         D200          CTD       RHUPRM       FIPOIS        REY22        REY23
         RHU        RHU113       RHW113           U2          CTE        FIMLT       FJPOIS     RZ(NJST)        REY33  NODE

  5.90882E-06  1.46293E+02  0.00000E+00  8.33333E-02  0.00000E+00 -1.16549E+01 -2.14818E+00  5.24850E-05 -1.20521E-09
  3.32447E-01  2.05416E-01  0.00000E+00  0.00000E+00  0.00000E+00 -1.96961E-06  0.00000E+00  4.23107E-06  5.30847E-05     3

 - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - *
    RIGHT HAND SIDE FROM PPRES.       2.97598E-06  2.40185E-05 -2.70202E-06

                                PRINT LIMITED BY NDBGPT.


    SECOND PASS THRU PPRES COMPUTES PP.

DEBUG PRINT FROM PPRES

 - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - *

    PASS    1. ITERATION     2. ELEMENT    3. NODES -     2     3    12

        AREA         G2G3         G3G3           RH         DUDX         DVDX         DWDX      T3C1(ML)
      B112RH          CTD          STR          RHV         B112V         B112W         B112WR          U2PR
      B113RH          CTE          STS          RHW         B113W         B113V         B113VR          U3PR

  5.90882E-06  0.00000E+00  0.00000E+00  3.00000E+00 -1.16549E+01  0.00000E+00  0.00000E+00 -3.8849BE+00
 7.27596E-11  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
 1.36424E-12  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00

       T2PFIX      U2PR(ML)      U3PR(ML)        T2FIX          CVW         SSAMB          TBML     TBSAV(ML)
        T7C1U      B112(ML)        T3FIX         T3ML          DSG         RSTRS          POIS          AREA     RZ(NJST)  NODE

 0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  2.20515E+01  0.00000E+00
 0.00000E+00  1.53309E+03  0.00000E+00  0.00000E+00  1.00000E+00 -3.51019E+02 -3.51019E+02  5.90882E-06 -2.07411E-03     3

 - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - * - *
    RIGHT HAND SIDE FROM PPRES.       1.11781E-05  1.15871E-05 -1.08769E-06
```

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

```
     CONTINUED DEBUG FROM IMPSLV.

     C * (Q(P)-Q(J))                    -2.86983E-10 -4.94147E-09  1.30358E-09
     H * THETA * G(P)                    3.95702E-09 -2.32112E-09  5.92023E-10
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)     8.34187E-09 -4.58606E-11  5.34375E-11
     DELTA-Q FROM BANDSL.                8.34337E-39 -8.05514E-05  4.63627E-05

 PASS, ITER, NP, NBOUND, NODE    1    3    1  171   24    2.81700E-04    2.40950E-04    0.00000E+00    3.00000E-06    1.00000E-06
     C * (Q(P)-Q(J))                   -2.64259E-12 -4.50391E-11  6.93032E-11
     H * THETA * G(P)                   2.20147E-11 -2.19649E-11  3.81641E-11
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)    4.81412E-11 -1.45776E-12  3.39094E-12
     DELTA-Q FROM BANDSL.               4.81996E-41 -3.13314E-06  2.75518E-06

 PASS, ITER, NP, NBOUND, NODE    1    3    5  152    2   -3.13314E-06    1.27557E-06    0.00000E+00    3.00000E-06    1.00000E-06
     C * (Q(P)-Q(J))                   -2.95181E-11 -1.44446E-09 -1.33727E-11
     H * THETA * G(P)                  -9.27383E-11 -9.01990E-10  2.13813E-10
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)   -1.26618E-10 -2.30033E-10  2.39357E-10
     DELTA-Q FROM BANDSL.              -1.19193E-40 -3.98132E-04  2.82616E-04

 PASS, ITER, NP, NBOUND, NODE    1    3    6  152    2   -3.98132E-04    3.68894E-05    0.00000E+00    3.00000E-06    1.00000E-06
     Q(P) FROM SETIMP.                  0.00000E+00  2.36943E-01  3.32493E-01
     Q(P) FROM SETIMP.                  1.00000E-05  1.34521E-03  1.39799E-03
     Q(P) FROM SETIMP.                  9.00000E-04  1.22566E-01  1.88818E-02

U2 VELOCITY.                      190 ENTRIES =   0.00000E+00

     PHI FROM PPRES.
 1        -.000033    -.000033    -.000035    -.000038    -.000039    -.000035    -.000026    -.000015    -.000004     .000000
 2        -.000038    -.000039    -.000041    -.000042    -.000043    -.000038    -.000028    -.000016    -.000005     .000000
 :            :                                                                                                          :
19        -.000033    -.000033    -.000035    -.000038    -.000039    -.000035    -.000026    -.000015    -.000004     .000000
```


APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

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 CONTINUED DEBUG FROM IMPSLV.
     C * (Q(P)-Q(J))                    -2.89782E-10 -4.98322E-09  1.35574E-09
     H * THETA * G(P)                    3.95557E-09 -2.32248E-09  6.01746E-10
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)     8.34321E-09 -5.46777E-12  1.09977E-11
     DELTA-Q FROM BANDSL.                8.34335E-39 -7.68101E-06  7.72217E-06

 PASS, ITER, NP, NBOUND, NODE    1    4    1  171    0    0.00000E+00    2.40949E-04

     C * (Q(P)-Q(J))                    -2.75287E-12 -4.63387E-11  7.26025E-11
     H * THETA * G(P)                    2.19643E-11 -2.17912E-11  3.79652E-11
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)     4.82011E-11  1.56027E-14 -1.07271E-13
     DELTA-Q FROM BANDSL.                4.82001E-41  5.56980E-08 -2.34575E-07

 PASS, ITER, NP, NBOUND, NODE    1    4    5  152   55   -1.36229E-06    1.27142E-06
     C * (Q(P)-Q(J))                    -4.35825E-11 -1.65613E-09  2.01739E-10
     H * THETA * G(P)                   -9.21808E-11 -8.91016E-10  1.95339E-10
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)    -1.11996E-10 -7.38571E-12  5.77051E-12
     DELTA-Q FROM BANDSL.               -1.11717E-40 -1.49724E-05  7.28487E-06

 PASS, ITER, NP, NBOUND, NODE    1    4    6  152    0    0.00000E+00    3.67699E-05
     Q(P) FROM SETIMP.                   0.00000E+00  2.36935E-01  3.32501E-01
     D(P) FROM SETIMP.                   1.00000E-05  1.34526E-03  1.39775E-03
     B(P) FROM SETIMP.                   9.00000E-04  1.22552E-01  1.88891E-02

U2 VELOCITY.                        190 ENTRIES =   0.00000E+00
     PHI FROM PPRES.
  1         -.000033    -.000033    -.000035    -.000038    -.000039    -.000035    -.000026    -.000015    -.000004     .000000
  2         -.000038    -.000039    -.000041    -.000042    -.000043    -.000038    -.000028    -.000016    -.000005     .000000
 19         -.000033    -.000033    -.000035    -.000038    -.000039    -.000035    -.000026    -.000015    -.000004     .000000
     C * (Q(P)-Q(J))                    -2.90049E-10 -4.98823E-09  1.36626E-09
     H * THETA * G(P)                    3.95545E-09 -2.32240E-09  6.02390E-10
     F =-C*(QP-QJ) + H*(T*GP+OMT*GJ)     8.34334E-09 -3.85938E-13  1.12270E-12
     DELTA-Q FROM BANDSL.                8.34337E-39 -7.44317E-07  1.22978E-06

 PASS, ITER, NP, NBOUND, NODE    1    5    1  171    0    0.00000E+00    2.40949E-04
                        ON CONVERGENCE, Delta-Q is NOT added to Q.
  CURRENT    VELOCITY U1/UINF        ENERGY     DISP. THK. MOM. THK. EN. DIS.THK    THETA     BNDY THK.  SHAPE FCT. SKIN FRIC.
  X1/LREF       WALL       EDGE        E        DEL STAR   THETA      DELTA 3    REYNL. NO.    DELTA        H          CF/2
1.2000E-02 2.3694E-01 8.0316E-01 5.8189E-01 4.8330E-03 2.8469E-03 4.0000E+00 0.0000E+00 1.8633E-02 1.6976E+00 1.2681E-03    1    0
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APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

C O M O C
3-DIMENSIONAL BOUNDARY LAYER OPTION

LOCAL PRESSURE.	.PSF.....	.PSI.....	KNT/M2.....	.TORK.....
9964244E+00	2116800E+04	1469906E+02	1013524E+06	7601429E+03
LOCAL SOLUTION.	.MACH NO....	.DPDX1.....	.ENERGY.....	.INT. VAR...
0 E+00	8861539E-01	0 E+00	5818919E+00	1110000E+03
T2PFIX.....	.M21.....	.G22.....	.G23.....	.F1.....
0 E+00	1000000E+01	0 E+00	0 E+00	0 E+00
NWGEOM M'S.....	.M31.....	.G32.....	.G33.....	.G1.....
	1000000E+01	0 E+00	0 E+00	2129497E-14
X1/LREF.....	.DX1/LREF...	.EPSILON....	.DX1M/LREF..	.REFL RE NO.
1200000E-01	1000000E-02	3000000E-03	1000000E-02	5720616E+06

N- 1 N+ 1 PASSES 4 PRINT 1 OF 100

U1/UREF E 0

1	.000000	.236935	.332501	.390135	.443871	.497769	.560908	.641092	.732753	.803164
2	.000000	.233248	.326030	.385439	.438775	.491927	.555533	.635346	.726371	.794778
:	:	:	:	:	:	:	:	:	:	:
19	.000000	.236935	.332501	.390135	.443871	.497769	.560908	.641092	.732753	.803164

U2/UREF 190 ENTRIES = 0.00000E+00

U3/UREF 190 ENTRIES = 0.00000E+00

MU/MUREF E 2

1	.000000	.000415	.010909	.076618	.282196	.623445	.695188	.619130	.458887	.000043
2	.000000	.000419	.010921	.077737	.298882	.632680	.697649	.630509	.457263	.000043
:	:	:	:	:	:	:	:	:	:	:
19	.000000	.000415	.010909	.076618	.282196	.623445	.695188	.619130	.458887	.000043

TKE/TKEREF E -2

1	.001000	.134526	.139775	.197088	.298340	.419900	.368620	.282703	.154971	.001000
2	.001000	.129890	.139726	.197762	.305911	.419043	.363769	.281554	.149999	.001000
:	:	:	:	:	:	:	:	:	:	:
19	.001000	.134526	.139775	.197088	.298340	.419900	.368620	.282703	.154971	.001000

DISS/DISSREF E 0

1	.000900	.122552	.018889	.010488	.009395	.010064	.007453	.005015	.002040	.000900
2	.000900	.113570	.018910	.010430	.009338	.009882	.007234	.004885	.001918	.000900
:	:	:	:	:	:	:	:	:	:	:
19	.000900	.122552	.018889	.010488	.009395	.010064	.007453	.005015	.002040	.000900

PP / PSTAB E -4

1	.000000	-.005545	-.021454	-.041816	-.022182	.042063	.102792	.109234	.022860	-.011504
2	.000000	-.005501	-.021099	-.036762	-.011676	.061020	.124774	.125643	.011537	-.003509
:	:	:	:	:	:	:	:	:	:	:
19	.000000	-.005545	-.021454	-.041816	-.022182	.042063	.102792	.109234	.022860	-.011504

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

CURRENT X1/LREF	VELOCITY U1/UINF WALL	EDGE	ENERGY E	DISP. THK. DEL STAR	MOM. THK. THETA	EN. DIS.THK DELTA 3	THETA REYNL. NO.	BNDY THK. DELTA	SHAPE FCT. H	SKIN FRIC. CF/2		
1.5000E-02	2.7460E-01	8.1385E-01	5.8145E-01	4.6319E-03	2.8167E-03	4.0000E+00	-1.0766E+00	1.8622E-02	1.6444E+00	1.3372E-03	4	0
1.6000E-02	2.8803E-01	8.1815E-01	5.8270E-01	4.5584E-03	2.8027E-03	4.0000E+00	-1.0766E+00	1.8617E-02	1.6264E+00	1.3788E-03	5	0
1.7006E-02	3.0023E-01	8.2244E-01	5.8428E-01	4.4879E-03	2.7878E-03	4.0000E+00	-1.0766E+00	1.8613E-02	1.6098E+00	1.4177E-03	6	1
1.8100E-02	3.1252E-01	8.2713E-01	5.8647E-01	4.4135E-03	2.7706E-03	4.0000E+00	-1.0766E+00	1.8608E-02	1.5930E+00	1.4550E-03	7	2

NELPAS, ITER, ENERGY(PHI) 8 2 9.4290E-03
NELPAS, ITER, ENERGY(PHI) 8 3 9.5291E-03
NELPAS, ITER, ENERGY(PHI) 8 4 9.0580E-03
NELPAS, ITER, ENERGY(PHI) 8 5 8.6119E-03
NELPAS, ITER, ENERGY(PHI) 8 6 8.1873E-03
NELPAS, ITER, ENERGY(PHI) 8 7 7.7836E-03
NELPAS, ITER, ENERGY(PHI) 8 8 7.3998E-03
NELPAS, ITER, ENERGY(PHI) 8 9 7.0349E-03
NELPAS, ITER, ENERGY(PHI) 8 10 6.6880E-03

1.9310E-02	3.2520E-01	8.3241E-01	5.9090E-01	4.3323E-03	2.7493E-03	9.0000E+00	-1.0355E+00	1.8602E-02	1.5758E+00	1.4940E-03	8	3

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

C O M O C
3-DIMENSIONAL PARABOLIC NAVIER-STOKES OPTION

LOCAL PRESSURE.	.PSF.....	.PSI.....	KNT/M2.....	.TORR.....
9961265E+00	2116800E+04	1469906E+02	1013524E+06	7601429E+03
LOCAL SOLUTION.	.MACH NO....	.DPDX1.....	.ENERGY.....	.INT. VAR...
0 E+00	8861539E-01	-1035526E+01	5908971E+00	1111100E+05
T2PFIX.....	.H21.....	.G22.....	.G23.....	.F1.....
0 E+00	1000000E+01	0 E+00	0 E+00	0 E+00
NWGEOM H'S.....	.H31.....	.G32.....	.G33.....	.G1.....
	1000000E+01	0 E+00	0 E+00	2129497E-14
X1/LREF.....	.DX1/LREF...	.EPSILON....	.DX1M/LREF..	.REFL RE NO.
1931000E-01	1210000E-02	3000000E-03	1000000E-02	5720616E+06

- X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X - X -

N-	N+	PASSES	PRINT	DF
8	8	37	4	100

U1/UREF E 0

1	.000000	.325195	.411668	.464704	.508523	.552343	.605449	.676576	.763340	.832406
2	.000000	.309264	.408470	.461499	.503537	.546746	.600245	.671717	.757706	.823000
.	.	.	.	.	.	.	.	.	.	.
18	.000000	.309264	.408470	.461499	.503537	.546746	.600245	.671717	.757	.823000
19	.000000	.325195	.411668	.464704	.508523	.552343	.605449	.676576	.767	.832406

U2/UREF E -1

1	.000000	-.004475	-.003107	-.001077	.000901	.002260	.002645	.002048	.000873	.002372
2	.000000	-.003010	-.004962	-.005776	-.005967	-.005796	-.004805	-.003006	-.000286	.003841
.	.	.	.	.	.	.	.	.	.	.
18	.000000	-.007810	-.032392	-.064150	-.101075	-.144133	-.193696	-.247168	-.316019	-.388503
19	.000000	-.007840	-.030296	-.061640	-.099341	-.143588	-.195309	-.254340	-.322050	-.387569

U3/UREF E -1

1	.000000	-.007840	-.030296	-.061639	-.099340	-.143587	-.195308	-.254337	-.322047	-.387564
2	.000000	-.007810	-.032391	-.064148	-.101073	-.144131	-.193693	-.247163	-.316014	-.388495
.	.	.	.	.	.	.	.	.	.	.
18	.000000	-.003018	-.004966	-.005781	-.005972	-.005801	-.004809	-.003009	-.000288	.003841
19	.000000	-.004477	-.003108	-.001078	.000900	.002259	.002644	.002048	.000873	.002372

MU/MUREF E 3

1	.000000	.000035	.001729	.013324	.037209	.061857	.076271	.071426	.047490	.000004
2	.000000	.000037	.001859	.014322	.038750	.063390	.077195	.072485	.045977	.000004
.	.	.	.	.	.	.	.	.	.	.
18	.000000	.000037	.001859	.014322	.038750	.063390	.077195	.072485	.045977	.000004
19	.000000	.000035	.001729	.013324	.037209	.061857	.076271	.071426	.047490	.000004

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

TKE/TKEREF E -2

1	.001000	.106178	.180293	.297517	.397084	.459280	.457567	.356567	.179178	.001000
2	.001000	.103403	.197153	.317728	.409967	.464735	.456521	.353990	.170095	.001000
18	.001000	.103403	.197153	.317728	.409967	.464735	.456521	.353990	.170095	.001000
19	.001000	.106178	.180293	.297517	.397084	.459280	.457567	.356567	.179178	.001000

DISS/DISSREF E 0

1	.000900	.109415	.023162	.015326	.013465	.012502	.010568	.006929	.002635	.000900
2	.000900	.098792	.025836	.016290	.013796	.012497	.010395	.006729	.002453	.000900
18	.000900	.098792	.025836	.016290	.013796	.012497	.010395	.006729	.002453	.000900
19	.000900	.109415	.023162	.015326	.013465	.012502	.010568	.006929	.002635	.000900

PP / PSTAG E -4

1	.000000	-.005481	-.034240	-.090598	-.137574	-.154301	-.106835	-.031342	-.034953	-.012828
2	.000000	-.005609	-.037637	-.095826	-.142437	-.147739	-.084985	-.015968	-.044176	-.007546
18	.000000	-.005609	-.037637	-.095827	-.142439	-.147741	-.084989	-.015972	-.044180	-.007550
19	.000000	-.005481	-.034240	-.090599	-.137575	-.154303	-.106837	-.031345	-.034957	-.012831

CURRENT X1/LREF	VELOCITY U1/UINF WALL	EDGE	ENERGY E	DISP. THK. DEL STAR	MOM. THK. THETA	EN. DIS.THK DELTA 3	THETA REYNL. NO.	BNDY THK. DELTA	SHAPE FCT. H	SKIN FRIC. CF/2		
2.0520E-02	3.3521E-01	8.3730E-01	5.9999E-01	4.2560E-03	2.7257E-03	4.0000E+00-7.8399E-01		1.8593E-02	1.5614E+00	1.5352E-03	9	0
2.1730E-02	3.4332E-01	8.4192E-01	6.1399E-01	4.1835E-03	2.7000E-03	9.0000E+00-7.8399E-01		1.8583E-02	1.5494E+00	1.5711E-03	10	1
4.4720E-02	4.8344E-01	9.1758E-01	9.3005E-01	3.2830E-03	2.3174E-03	9.0000E+00-6.3931E-01		1.8409E-02	1.4167E+00	1.9920E-03	29	10
4.5930E-02	4.8905E-01	9.2087E-01	9.3843E-01	3.2520E-03	2.3020E-03	5.0000E+00-6.3931E-01		1.8402E-02	1.4127E+00	2.0071E-03	30	11
NELPAS, ITER, ENERGY(PHI)		31	2	2.3645E-04								
NELPAS, ITER, ENERGY(PHI)		31	3	1.2996E-04								
NELPAS, ITER, ENERGY(PHI)		31	4	9.4591E-05								
4.7140E-02	4.9387E-01	9.2459E-01	9.4590E-01	3.2229E-03	2.2874E-03	4.0000E+00-5.7199E-01		1.8395E-02	1.4090E+00	2.0215E-03	31	12
4.8350E-02	4.9754E-01	9.2809E-01	9.5141E-01	3.1966E-03	2.2738E-03	4.0000E+00-5.4458E-01		1.8389E-02	1.4058E+00	2.0347E-03	32	0
4.9560E-02	5.0055E-01	9.2969E-01	9.5547E-01	3.1716E-03	2.2607E-03	4.0000E+00-5.4458E-01		1.8383E-02	1.4029E+00	2.0464E-03	33	1
6.6156E-02	5.2987E-01	9.6619E-01	9.7973E-01	2.8822E-03	2.6973E-03	5.0000E+00-4.7151E-01		1.8365E-02	1.3742E+00	2.1619E-03	45	0
6.8105E-02	5.3165E-01	9.6993E-01	9.8000E-01	2.8557E-03	2.0811E-03	4.0000E+00-4.7151E-01		1.8298E-02	1.3722E+00	2.1726E-03	46	1
7.0053E-02	5.3324E-01	9.7361E-01	9.8011E-01	2.8301E-03	2.0653E-03	5.0000E+00-4.7151E-01		1.8291E-02	1.3703E+00	2.1819E-03	47	2
7.2002E-02	5.3494E-01	9.7726E-01	9.8034E-01	2.8050E-03	2.0497E-03	4.0000E+00-4.7151E-01		1.8283E-02	1.3685E+00	2.1904E-03	48	3
7.3951E-02	5.3672E-01	9.8087E-01	9.8108E-01	2.7804E-03	2.0344E-03	4.0000E+00-4.7151E-01		1.8275E-02	1.3667E+00	2.1991E-03	49	4
7.5899E-02	5.3857E-01	9.8447E-01	9.8238E-01	2.7564E-03	2.0192E-03	4.0000E+00-4.7151E-01		1.8267E-02	1.3651E+00	2.2073E-03	50	5
7.7848E-02	5.4049E-01	9.8804E-01	9.8425E-01	2.7329E-03	2.0043E-03	4.0000E+00-4.7151E-01		1.8259E-02	1.3635E+00	2.2152E-03	51	6
7.9797E-02	5.4246E-01	9.9158E-01	9.8663E-01	2.7095E-03	1.9896E-03	4.0000E+00-4.7151E-01		1.8251E-02	1.3620E+00	2.2229E-03	52	7
8.1746E-02	5.4450E-01	9.9509E-01	9.8951E-01	2.6874E-03	1.9751E-03	4.0000E+00-4.7151E-01		1.8243E-02	1.3606E+00	2.2303E-03	53	8
8.3889E-02	5.4684E-01	9.9894E-01	9.9313E-01	2.6631E-03	1.9594E-03	4.0000E+00-4.7151E-01		1.8234E-02	1.3591E+00	2.2376E-03	54	9
NELPAS, ITER, ENERGY(PHI)		55	2	1.8695E-04								
NELPAS, ITER, ENERGY(PHI)		55	3	1.0499E-04								
NELPAS, ITER, ENERGY(PHI)		55	4	6.5503E-05								
NELPAS, ITER, ENERGY(PHI)		55	5	4.6649E-05								
8.6247E-02	5.4884E-01	1.0030E+00	9.9645E-01	2.6384E-03	1.9432E-03	5.0000E+00-4.1408E-01		1.8226E-02	1.3577E+00	2.2453E-03	55	10

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

C O M O C
3-DIMENSIONAL PARABOLIC NAVIER-STOKES OPTION

LOCAL PRESSURE.	.FSF.....	.PSI.....	KNT/M2.....	.TORR.....
9947331E+00	2116800E+04	1469906E+02	1013524E+06	7601429E+03
LOCAL SOLUTION.	.MACH NO....	.DPDX1.....	.ENERGY.....	.INT. VAR...
0 E+00	8861539E-01	-4140765E+00	9964458E+00	1111100E+05
T2PFIX.....	.M21.....	.G22.....	.G23.....	.F1.....
4100000E+00	1000000E+01	0 E+00	0 E+00	0 E+00
NWGEOM H'S.....	.M31.....	.G32.....	.G33.....	.G1.....
	1000000E+01	0 E+00	0 E+00	2129497E-1
X1/LREF.....	.DX1/LREF...	.EPSILON....	.DX1M/LREF..	.REFL RE NO.
8624716E-01	2357948E-02	3000000E-03	1000000E-02	5720616E+06

N- 8 N+ 55 PASSES 263 PRINT 8 OF 100

U1/UREF E 1

1	.000000	.054820	.071770	.076240	.078755	.081239	.084510	.089166	.095261	.100297
2	.000000	.053809	.070166	.075331	.078402	.081314	.084865	.089576	.095513	.099611
.	.									.
18	.000000	.053829	.070178	.075334	.078400	.081309	.084859	.089569	.095507	.099607
19	.000000	.054884	.071792	.076248	.078757	.081239	.084506	.089158	.095254	.100295

U2/UREF E -1

1	.000000	.306767	.561832	.667357	.680459	.623752	.512626	.351620	.155119	.029372
2	.000000	.326234	.497816	.558449	.541152	.467817	.351400	.196407	.040246	-.043714
.	.									.
18	.000000	.000938	-.014382	-.038812	-.082771	-.137210	-.217928	-.308641	-.432071	-.556128
19	.000000	-.001867	-.013704	-.033556	-.069587	-.122421	-.185370	-.275124	-.380138	-.504823

U3/UREF E -1

1	.000000	-.001528	-.013233	-.033697	-.069824	-.123161	-.187930	-.280428	-.386855	-.512637
2	.000000	.000795	-.014517	-.038866	-.083461	-.138999	-.220031	-.312724	-.438400	-.583932
.	.									.
18	.000000	.301766	.462161	.524165	.511958	.444225	.334657	.187179	.036862	-.044880
19	.000000	.296686	.525195	.627322	.643260	.591279	.486603	.334404	.147026	.026519

NU/NUREF E 3

1	.000000	.000465	.006626	.028458	.062271	.087168	.092437	.078777	.042287	.000004
2	.000000	.000563	.005168	.018438	.039890	.061868	.074355	.067458	.031215	.000004
.	.									.
18	.000000	.000563	.005166	.018437	.039874	.061812	.074276	.067436	.031266	.000004
19	.000000	.000465	.006641	.028538	.062397	.087252	.092439	.078779	.042338	.000004

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

CURRENT X1/LREF	VELOCITY U1/UINF WALL	EDGE	ENERGY E	DISP. THK. DEL STAR	MOM. THK. THETA	EN. DIS.THK DELTA 3	THETA REYNL. NO.	BNDY THK. DELTA	SHAPE FCT. H	SKIN FRIC. CF/2		
8.8605E-02	5.4987E-01	1.0067E+00	9.9827E-01	2.6164E-03	1.9284E-03	4.0000E+00	-3.9028E-01	1.8218E-02	1.3568E+00	2.2527E-03	56	0
9.0963E-02	5.5042E-01	1.0102E+00	9.9959E-01	2.5958E-03	1.9142E-03	4.0000E+00	-3.9028E-01	1.8211E-02	1.3560E+00	2.2585E-03	57	1
1.1605E-01	5.6569E-01	1.0467E+00	1.0402E+00	2.3961E-03	1.7747E-03	4.0000E+00	-3.9028E-01	1.8128E-02	1.3501E+00	2.3039E-03	67	11
1.1951E-01	5.6885E-01	1.0515E+00	1.0494E+00	2.3709E-03	1.7569E-03	4.0000E+00	-3.9028E-01	1.8115E-02	1.3495E+00	2.3091E-03	68	12
1.2330E-01	5.7252E-01	1.0569E+00	1.0601E+00	2.3437E-03	1.7375E-03	4.0000E+00	-3.9028E-01	1.8100E-02	1.3489E+00	2.3148E-03	69	13
1.2748E-01	5.7670E-01	1.0627E+00	1.0726E+00	2.3145E-03	1.7164E-03	4.0000E+00	-3.9028E-01	1.8082E-02	1.3483E+00	2.3208E-03	70	14
1.3208E-01	5.8139E-01	1.0692E+00	1.0869E+00	2.2832E-03	1.6941E-03	4.0000E+00	-3.9028E-01	1.8062E-02	1.3478E+00	2.3270E-03	71	15

NELFAS, ITER, ENERGY[PHI] 72 2 1.6444E-04
NELFAS, ITER, ENERGY[PHI] 72 3 1.0902E-04
NELFAS, ITER, ENERGY[PHI] 72 4 8.1039E-05

PRINT POINT AT STATION .137.

1.3713E-01	5.8536E-01	1.0758E+00	1.1010E+00	2.2522E-03	1.6712E-03	4.0000E+00	-3.3938E-01	1.8039E-02	1.3477E+00	2.3334E-03	72	14
1.4269E-01	5.8719E-01	1.0825E+00	1.1134E+00	2.2230E-03	1.6485E-03	4.0000E+00	-3.2645E-01	1.8016E-02	1.3485E+00	2.3383E-03	73	0
1.4858E-01	5.8814E-01	1.0895E+00	1.1253E+00	2.1945E-03	1.6257E-03	4.0000E+00	-3.2645E-01	1.7990E-02	1.3499E+00	2.3399E-03	74	1
1.5447E-01	5.8946E-01	1.0963E+00	1.1374E+00	2.1669E-03	1.6035E-03	4.0000E+00	-3.2645E-01	1.7963E-02	1.3514E+00	2.3396E-03	75	2
1.6036E-01	5.9134E-01	1.1031E+00	1.1510E+00	2.1399E-03	1.5819E-03	4.0000E+00	-3.2645E-01	1.7934E-02	1.3528E+00	2.3390E-03	76	3

NELFAS, ITER, ENERGY[PHI] 77 2 1.3567E-04
NELFAS, ITER, ENERGY[PHI] 77 3 8.9620E-05
NELFAS, ITER, ENERGY[PHI] 77 4 6.6310E-05
NELFAS, ITER, ENERGY[PHI] 77 5 5.6133E-05

PRINT POINT AT STATION .166.

1.6625E-01	5.9190E-01	1.1095E+00	1.1630E+00	2.1160E-03	1.5619E-03	5.0000E+00	-2.8012E-01	1.7904E-02	1.3548E+00	2.3383E-03	77	4
1.7214E-01	5.9023E-01	1.1153E+00	1.1720E+00	2.0959E-03	1.5438E-03	4.0000E+00	-2.7545E-01	1.7876E-02	1.3576E+00	2.3355E-03	78	0
2.1337E-01	5.9580E-01	1.1540E+00	1.2571E+00	1.9668E-03	1.4322E-03	4.0000E+00	-2.7545E-01	1.7654E-02	1.3733E+00	2.3018E-03	85	7
2.1926E-01	5.9800E-01	1.1594E+00	1.2721E+00	1.9499E-03	1.4179E-03	4.0000E+00	-2.7545E-01	1.7618E-02	1.3752E+00	2.2979E-03	86	8

NELFAS, ITER, ENERGY[PHI] 87 2 8.0878E-05
NELFAS, ITER, ENERGY[PHI] 87 3 5.5227E-05
NELFAS, ITER, ENERGY[PHI] 87 4 4.1976E-05

PRINT POINT AT STATION .225.

2.2515E-01	5.9947E-01	1.1644E+00	1.2860E+00	1.9345E-03	1.4045E-03	4.0000E+00	-2.4468E-01	1.7582E-02	1.3774E+00	2.2944E-03	87	9
2.3104E-01	5.9857E-01	1.1689E+00	1.2960E+00	1.9227E-03	1.3930E-03	4.0000E+00	-2.0956E-01	1.7549E-02	1.3803E+00	2.2898E-03	88	0
2.7816E-01	5.9974E-01	1.2005E+00	1.3778E+00	1.8468E-03	1.3186E-03	4.0000E+00	-2.0956E-01	1.7276E-02	1.4006E+00	2.2333E-03	96	8
2.8405E-01	6.0129E-01	1.2044E+00	1.3912E+00	1.8378E-03	1.3103E-03	4.0000E+00	-2.0956E-01	1.7239E-02	1.4026E+00	2.2277E-03	97	9
2.8994E-01	6.0301E-01	1.2082E+00	1.4050E+00	1.8289E-03	1.3022E-03	4.0000E+00	-2.0956E-01	1.7200E-02	1.4045E+00	2.2226E-03	98	10

NELFAS, ITER, ENERGY[PHI] 99 2 1.6206E-04
NELFAS, ITER, ENERGY[PHI] 99 3 1.0098E-04
NELFAS, ITER, ENERGY[PHI] 99 4 6.5540E-05
NELFAS, ITER, ENERGY[PHI] 99 5 4.5904E-05

2.9583E-01	6.0257E-01	1.2115E+00	1.4153E+00	1.8228E-03	1.2954E-03	5.0000E+00	-1.4141E-01	1.7164E-02	1.4071E+00	2.2177E-03	99	11

APPENDIX C.
SAMPLE PRINTOUT FOR 3DFNS

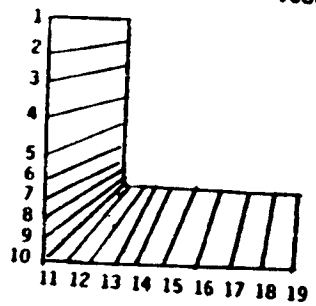
C O M O C
3-DIMENSIONAL PARABOLIC NAVIER-STOKES OPTION

LOCAL PRESSURE. 9924216E+00	.PSF..... 2116800E+04	.PSI..... 1469906E+02	KNT/M2..... 1013524E+06	.TORR..... 7601429E+03
LOCAL SOLUTION. 0 E+00	.MACH NO.... 8861539E-01	.DPDX1..... -1414141E+00	.ENERGY..... 1415338E+01	.INT. VAR... 1111100E+05
T2PFIX..... 8500000E+00	.M21..... 1000000E+01	.G22..... 0 E+00	.G23..... 0 E+00	.F1..... 0 E+00
NWGEOM M'S.....	.M31..... 1000000E+01	.G32..... 0 E+00	.G33..... 0 E+00	.G1..... 2129497E-14
X1/LREF..... 2958304E+00	.DX1/LREF... 5890000E-02	.EPSILON.... 3000000E-03	.DX1M/LREF.. 1000000E-02	.REFL RE NO. 5720616E+06

- X - X - X - X - X - X - X - X - X - X - Y - X - X - X - X - X - X - X - X - X - X - X - X - X - X -

N- 8 N+ 99 PASSES 448 PRINT 12 DF 100

	U1/UREF	E 1								
1	.000000	.060127	.087297	.098487	.104451	.108336	.111488	.114704	.118338	.121205
2	.000000	.059417	.086208	.098345	.104919	.109070	.112358	.115646	.119202	.121357
3	.000000	.061270	.088804	.100685	.106774	.110488	.113454	.116473	.119811	.121894
4	.000000	.059949	.086840	.099001	.105675	.109852	.113135	.116310	.119719	.121858
5	.000000	.061409	.087457	.099419	.106039	.110088	.113213	.116193	.119422	.121531
6	.000000	.060700	.086431	.098725	.105736	.110002	.113167	.116048	.119104	.121114
7	.000000	.061004	.086253	.098560	.105690	.109983	.113141	.115982	.118926	.120858
8	.000000	.061566	.087485	.099621	.106154	.110020	.112979	.115779	.118760	.120705
9	.000000	.057428	.084652	.097305	.104143	.108207	.111448	.114607	.118066	.120194
10	.000000	.045470	.069377	.084880	.095436	.102294	.107503	.111811	.115892	.119881
11	.000000	.053887	.080829	.094652	.102821	.107603	.111187	.114488	.117997	.120173
12	.000000	.059673	.085573	.098227	.105387	.109642	.112804	.115688	.118685	.120666
13	.000000	.061017	.086839	.099035	.105965	.110108	.113186	.115981	.118888	.120825
14	.000000	.061637	.087441	.099449	.106132	.110171	.113214	.116036	.119060	.121071
15	.000000	.061621	.087751	.099651	.106175	.110141	.113215	.116165	.119367	.121475
16	.000000	.060220	.086996	.099092	.105716	.109853	.113108	.116266	.119659	.121797
17	.000000	.061452	.088988	.100789	.106814	.110485	.113427	.116423	.119738	.121823
18	.000000	.059480	.086253	.098345	.104891	.109030	.112313	.115594	.119142	.121301
19	.000000	.060257	.087477	.098586	.104482	.108328	.111454	.114649	.118265	.121148



A special output subroutine (JNCVEC) was written to handle this problem.
The first row contains the nodes normal to the body and furthest away from the juncture.
Row 10 contains the nodes starting at the juncture and going to the freestream.
Row 19 contains the nodes normal to the wing and furthest away from the juncture.

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

	U2/UREF	E -1								
1	.000000	.309938	.605413	.788334	.868569	.859300	.775794	.614824	.380946	.214396
2	.000000	.343111	.579724	.710496	.742656	.698803	.590199	.416354	.219313	.102343
3	.000000	.288416	.481950	.549124	.535702	.465708	.351671	.210787	.077281	.001378
4	.000000	.271530	.401498	.417238	.372946	.289906	.184106	.074946	-.018291	-.070962
5	.000000	.221007	.315824	.301054	.236362	.151385	.063088	-.016059	-.079071	-.109727
6	.000000	.215525	.286351	.234035	.148941	.069665	-.000776	-.056628	-.097398	-.114720
7	.000000	.210365	.243431	.149315	.062169	.003898	-.039712	-.067482	-.092760	-.094624
8	.000000	.194939	.163679	.059923	.002335	-.030814	-.043859	-.065285	-.081331	-.074970
9	.000000	.093660	.023269	.015899	-.017949	-.011879	-.016948	-.073032	-.084132	-.133669
10	.000000	-.024192	-.012453	.014205	-.027981	.035207	-.034141	-.046699	-.052996	-.123813
11	.000000	.015416	-.005893	.025705	-.025133	-.001185	-.028921	-.055048	-.081061	-.171764
12	.000000	-.005286	-.005327	-.003020	-.032549	-.015334	-.060163	-.075[illegible]	-.086996	-.141107
13	.000000	.001323	-.008645	.001877	-.038977	-.023634	-.069050	-.092429	-.105249	-.166455
14	.000000	.000203	-.005451	-.006301	-.039065	-.037835	-.089370	-.108118	-.142697	-.210805
15	.000000	-.000130	-.007691	-.010191	-.043136	-.043520	-.099262	-.133054	-.178924	-.259552
16	.000000	.003686	-.004271	-.006026	-.034602	-.052293	-.110093	-.155233	-.220025	-.302087
17	.000000	-.000755	-.008409	-.015603	-.042049	-.070727	-.128359	-.184412	-.248934	-.337358
18	.000000	.002528	-.000948	-.006899	-.024890	-.053662	-.095775	-.159752	-.231097	-.318430
19	.000000	.000181	-.000567	-.005380	-.014190	-.037497	-.066307	-.121103	-.185270	-.272077

	U3/UREF	E -1								
1	.000000	.000108	.000900	-.003858	-.012914	-.035537	-.064613	-.120261	-.185299	-.271894
2	.000000	.002604	-.000397	-.005546	-.022783	-.051303	-.092998	-.156019	-.230534	-.319336
3	.000000	-.000718	-.006921	-.013243	-.039662	-.068564	-.124270	-.181807	-.250484	-.340802
4	.000000	.004693	-.004475	-.004833	-.032286	-.050797	-.109515	-.154480	-.221711	-.304359
5	.000000	-.001059	-.006114	-.006819	-.036537	-.038852	-.096951	-.130948	-.183181	-.264019
6	.000000	.002754	-.001912	-.003672	-.032928	-.033471	-.087380	-.108992	-.147141	-.214161
7	.000000	.000061	.000387	.005168	-.037272	-.027823	-.071574	-.094153	-.111507	-.173713
8	.000000	-.005137	-.010777	-.020448	-.047721	-.034598	-.074239	-.085330	-.096232	-.163065
9	.000000	.002042	-.029719	-.006312	-.047190	-.028018	-.047958	-.069909	-.089999	-.170095
10	.000000	.012004	.003158	.008218	-.042624	.014382	-.048780	-.061446	-.064959	-.124891
11	.000000	.053286	.031395	.015495	-.024897	-.021962	-.023839	-.075195	-.081719	-.125080
12	.000000	.047236	.055868	.028125	-.005938	-.031164	-.041782	-.061245	-.074182	-.063083
13	.000000	.076794	.087560	.048203	.032420	-.007023	-.042559	-.065796	-.088767	-.089547
14	.000000	.134559	.168593	.141618	.094958	.040303	-.015550	-.062923	-.097292	-.110986
15	.000000	.161777	.233603	.224777	.179059	.114064	.041428	-.027536	-.086123	-.112446
16	.000000	.216649	.330769	.353732	.320673	.250042	.154894	.054480	-.032684	-.082080
17	.000000	.244714	.420178	.493809	.488955	.426412	.318908	.183490	.055279	-.016374
18	.000000	.317048	.534187	.663771	.700580	.661412	.555858	.383584	.189469	.077300
19	.000000	.296637	.573297	.747810	.828641	.822768	.741726	.580035	.345428	.181480

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

	NU/NUREF	E 2								
1	.000000	.006624	.051344	.136113	.251461	.383665	.478049	.473941	.285615	.000043
2	.000000	.006663	.037829	.091990	.174182	.282761	.373260	.367354	.172983	.000043
3	.000000	.007670	.043850	.111078	.220082	.357267	.456735	.435842	.205747	.000043
4	.000000	.008385	.046432	.106052	.192682	.304441	.398986	.397576	.198939	.000043
5	.000000	.009336	.050444	.113059	.204215	.321268	.419138	.418794	.216155	.000043
6	.000000	.010263	.053383	.113160	.194469	.306649	.412536	.426491	.229771	.000043
7	.000000	.011130	.055837	.117425	.192938	.293976	.395661	.418552	.233192	.000043
8	.000000	.011827	.051938	.118193	.208930	.319123	.418159	.434310	.243855	.000043
9	.000000	.012017	.045783	.106460	.233315	.403972	.535781	.552214	.308837	.000043
10	.000000	.012497	.047322	.078967	.124504	.212060	.352443	.477029	.376846	.000043
11	.000000	.012365	.047272	.097740	.195165	.348176	.495949	.541742	.330382	.000043
12	.000000	.011973	.051218	.114966	.205677	.320965	.427866	.451663	.263062	.000043
13	.000000	.011072	.053366	.116042	.197985	.305118	.408033	.428893	.242026	.000043
14	.000000	.010130	.052452	.114335	.199771	.313509	.416392	.427224	.230996	.000043
15	.000000	.009258	.050544	.113176	.203163	.318446	.415508	.416508	.216365	.000043
16	.000000	.008345	.046599	.106023	.192757	.304053	.398962	.397999	.199220	.000043
17	.000000	.007627	.043884	.111237	.220881	.358590	.457687	.435985	.205945	.000043
18	.000000	.006643	.037863	.091886	.173574	.281313	.371327	.3 7783	.172843	.000043
19	.000000	.006613	.051442	.136907	.253554	.387011	.482001	.478199	.289862	.000043
	TKE/TKEREF	E -1								
1	.000100	.147246	.102141	.068928	.053585	.046345	.041172	.032525	.015470	.000100
2	.000100	.135821	.090620	.060989	.048377	.042770	.037678	.027575	.010177	.000100
3	.000100	.148929	.095981	.064440	.050967	.044508	.038255	.027288	.010354	.000100
4	.000100	.153157	.097614	.065739	.050964	.043808	.037392	.027000	.011048	.000100
5	.000100	.159822	.099623	.067499	.051712	.043906	.037360	.027562	.012310	.000100
6	.000100	.164832	.102759	.069876	.052545	.043734	.037072	.027871	.013193	.000100
7	.000100	.171068	.105270	.071391	.053418	.043934	.037112	.028175	.013783	.000100
8	.000100	.171232	.102190	.066241	.051053	.043568	.037752	.029243	.014573	.000100
9	.000100	.156393	.094662	.059576	.047403	.043072	.039585	.032189	.016383	.000100
10	.000100	.129140	.095378	.065037	.050187	.045514	.043365	.038116	.024093	.000100
11	.000100	.158957	.103244	.065398	.049780	.043918	.040003	.032555	.016713	.000100
12	.000100	.168641	.103595	.067416	.051868	.044103	.038220	.029737	.015062	.000100
13	.000100	.168933	.102772	.068331	.051926	.043406	.037048	.028334	.014054	.000100
14	.000100	.163245	.100076	.067355	.051192	.043061	.036767	.027804	.013297	.000100
15	.000100	.152392	.098911	.066791	.051048	.043306	.036924	.027355	.012357	.000100
16	.000100	.152390	.096983	.065314	.050480	.043339	.037042	.026852	.011139	.000100
17	.000100	.148398	.095295	.063963	.050546	.044147	.037967	.027145	.010436	.000100
18	.000100	.135464	.090228	.060716	.048111	.042511	.037462	.027457	.010204	.000100
19	.000100	.147044	.101734	.068648	.053418	.046227	.041103	.032566	.015651	.000100

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

DISS/DISSREF E 1

1	.000090	.274194	.046793	.011658	.004309	.002174	.001382	.000870	.000327	.000090
2	.000090	.233636	.050215	.013534	.005074	.002512	.001482	.000807	.000233	.000090
3	.000090	.261303	.050638	.012752	.004484	.002155	.001249	.000666	.000203	.000090
4	.000090	.264457	.050791	.014065	.005138	.002452	.001366	.000715	.000239	.000090
5	.000090	.276358	.050580	.014136	.005014	.002335	.001298	.000707	.000273	.000090
6	.000090	.279835	.052158	.015293	.005451	.002428	.001299	.000710	.000295	.000090
7	.000090	.291676	.053723	.015543	.005692	.002557	.001357	.000739	.000318	.000090
8	.000090	.289618	.055941	.013433	.004813	.002317	.001329	.000768	.000340	.000090
9	.000090	.240858	.054822	.012092	.003717	.001789	.001140	.000731	.000339	.000090
10	.000090	.146354	.051718	.019136	.007782	.003804	.002080	.001187	.000600	.000090
11	.000090	.234519	.062155	.015778	.004895	.002158	.001258	.000763	.000330	.000090
12	.000090	.273290	.057776	.014262	.005043	.002360	.001331	.000763	.000336	.000090
13	.000090	.286533	.053218	.014415	.005242	.002405	.001311	.000730	.000318	.000090
14	.000090	.280951	.050563	.014087	.005038	.002303	.001265	.000705	.000298	.000090
15	.000090	.277654	.049809	.013832	.004912	.002	.001279	.000700	.000275	.000090
16	.000090	.263468	.050001	.013893	.005053	.0024	.001341	.000706	.000243	.000090
17	.000090	.261203	.049910	.012550	.004394	.002113	.001228	.000659	.000206	.000090
18	.000090	.233144	.049741	.013429	.005036	.002495	.001473	.000803	.000235	.000090
19	.000090	.274199	.046364	.011500	.004248	.002144	.001366	.000865	.000329	.000090

PP / PSTAG E -4

1	.000000	-.164834	-.308349	-.257894	-.173313	-.086230	.013574	.142916	.322586	.441540
2	.000000	-.153521	-.270407	-.220039	-.155435	-.074017	-.005555	.124531	.268745	.350236
3	.000000	-.187372	-.313095	-.265822	-.205057	-.136292	-.088994	.044217	.152865	.231872
4	.000000	-.209607	-.341834	-.307078	-.243711	-.199352	-.175867	-.066007	.010559	.094524
5	.000000	-.239330	-.373811	-.352230	-.275839	-.255798	-.255503	-.160534	-.109103	-.021210
6	.000000	-.260019	-.402674	-.379978	-.297754	-.289857	-.289392	-.217653	-.182005	-.097905
7	.000000	-.282783	-.417110	-.403578	-.311966	-.291064	-.316221	-.247915	-.215711	-.139910
8	.000000	-.293967	-.420945	-.378045	-.296204	-.295333	-.329795	-.248486	-.233012	-.158166
9	.000000	-.273416	-.381741	-.357233	-.284130	-.265769	-.319118	-.248748	-.240415	-.153522
10	.000000	-.218443	-.374196	-.370259	-.274967	-.283169	-.307258	-.299708	-.280255	-.144837
11	.000000	-.271410	-.405029	-.368150	-.290494	-.267625	-.323269	-.242583	-.238267	-.149242
12	.000000	-.286652	-.419567	-.381738	-.290566	-.292861	-.330506	-.243045	-.233433	-.153600
13	.000000	-.280652	-.405577	-.391057	-.302635	-.286452	-.320414	-.244559	-.214430	-.140449
14	.000000	-.259510	-.393052	-.371182	-.295680	-.285310	-.293841	-.220077	-.189848	-.106760
15	.000000	-.239680	-.373635	-.352819	-.277699	-.256764	-.266254	-.170983	-.124807	-.041170
16	.000000	-.209746	-.342404	-.309688	-.248470	-.207954	-.190773	-.088515	-.016718	.064040
17	.000000	-.188261	-.314288	-.269432	-.211627	-.149545	-.108644	.019805	.118627	.194267
18	.000000	-.154339	-.272123	-.224363	-.163287	-.085770	-.024741	.098347	.234018	.311636
19	.000000	-.166034	-.310016	-.261309	-.180967	-.098834	-.004234	.116721	.287356	.402413

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

	U'	E -2								
1	.000000	.307191	.584655	.582007	.513756	.456683	.407496	.320638	.151701	.000899
2	.000000	.284781	.522447	.517834	.461712	.423172	.367300	.273577	.096778	.000868
3	.000000	.335138	.576720	.555321	.486956	.436879	.365729	.274167	.097137	.000849
4	.000000	.361084	.604579	.573937	.493538	.430886	.357217	.273161	.102625	.000845
5	.000000	.403688	.642580	.596088	.507656	.430896	.353298	.278950	.114014	.000836
6	.000000	.436702	.679875	.624094	.518296	.425846	.351997	.280487	.122477	.000842
7	.000000	.474464	.718938	.641202	.528630	.433595	.348122	.281235	.129116	.000824
8	.000000	.504316	.715080	.600281	.507368	.426301	.350191	.295772	.136650	.000840
9	.000000	.465718	.672392	.540640	.464140	.427320	.369940	.326861	.150710	.000912
10	.000000	.350555	.661211	.570048	.510007	.438178	.406900	.375572	.212536	.000884
11	.000000	.457583	.722762	.588508	.488435	.435649	.372376	.333217	.154348	.000913
12	.000000	.488403	.720330	.609207	.518950	.433124	.354383	.302565	.140129	.000824
13	.000000	.471320	.700634	.611971	.514264	.428624	.344585	.284006	.132359	.000817
14	.000000	.436700	.665678	.601290	.503937	.421001	.347993	.280738	.122954	.000838
15	.000000	.403280	.638307	.589589	.501105	.426383	.347502	.277425	.114881	.000830
16	.000000	.359896	.601216	.570563	.489057	.426393	.353402	.270729	.103548	.000844
17	.000000	.334301	.572881	.551393	.483192	.432830	.36239	.273627	.098063	.000849
18	.000000	.284098	.520260	.515542	.459028	.420841	.364820	.272398	.097009	.000867
19	.000000	.307103	.582744	.580064	.512153	.455459	.407266	.321158	.153342	.000896
	U'V'	E -2								
1	.000000	-.000035	-.000319	-.000293	.000567	.001936	.003369	.004044	.002282	.000008
2	.000000	.000013	.000223	.001038	.002277	.003593	.004448	.003904	.001212	.000007
3	.000000	.000071	.000281	.000477	.000792	.001211	.001555	.001355	.000431	.000002
4	.000000	-.000043	-.000405	-.000827	-.000861	-.000622	-.000431	-.000578	-.000436	-.000005
5	.000000	.000055	-.000075	-.000195	-.000027	.000118	-.000181	-.001029	-.000942	-.000008
6	.000000	-.000071	-.000448	-.000705	-.000507	-.000268	-.000416	-.001049	-.000958	-.000007
7	.000000	.000065	.000361	.000976	.001055	.000359	-.000642	-.001365	-.000912	-.000006
8	.000000	-.000337	-.000714	-.001583	-.004083	-.007648	-.009965	-.008674	-.003393	-.000019
9	.000000	-.002409	-.009835	-.016928	-.024298	-.031598	-.034016	-.027794	-.010762	-.000012
10	.000000	-.064220	-.095589	-.087370	-.070508	-.063440	-.059971	-.050811	-.028382	-.000060
11	.000000	-.172284	-.179275	-.140277	-.106000	-.082878	-.070526	-.056260	-.019804	-.000051
12	.000000	-.180133	-.173058	-.148196	-.120404	-.095650	-.078514	-.059001	-.021391	-.000074
13	.000000	-.173112	-.166372	-.151962	-.121043	-.094722	-.077995	-.058239	-.019986	-.000076
14	.000000	-.159767	-.159063	-.148864	-.117748	-.094452	-.079394	-.059576	-.019561	-.000076
15	.000000	-.147760	-.153117	-.145759	-.116714	-.096157	-.082166	-.061384	-.019137	-.000079
16	.000000	-.131764	-.145287	-.139522	-.115059	-.097596	-.084840	-.063137	-.018259	-.000082
17	.000000	-.122512	-.138257	-.132172	-.112502	-.097765	-.086489	-.064835	-.017804	-.000085
18	.000000	-.103661	-.127137	-.124714	-.109253	-.096115	-.085732	-.065255	-.017969	-.000085
19	.000000	-.118159	-.137037	-.136320	-.119155	-.103294	-.092021	-.075916	-.032554	-.000108

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

	U'W'	E -2							
1	.000000	-.118132	-.137521	-.136981	-.119761	-.103642	-.092156	-.075817	-.032146	-.000107
2	.000000	-.103890	-.127684	-.125219	-.109865	-.096601	-.086115	-.065550	-.017936	-.000085
3	.000000	-.122789	-.139222	-.133100	-.113580	-.098550	-.087072	-.065238	-.017708	-.000085
4	.000000	-.132269	-.146193	-.140192	-.116275	-.098796	-.085655	-.063537	-.018167	-.000082
5	.000000	-.148060	-.154034	-.146937	-.118087	-.097794	-.083423	-.062139	-.019168	-.000079
6	.000000	-.159931	-.163116	-.155239	-.120878	-.096169	-.080239	-.059882	-.019408	-.000075
7	.000000	-.174367	-.171134	-.161100	-.124952	-.095688	-.077812	-.057721	-.019402	-.000073
8	.000000	-.184987	-.171616	-.166451	-.117798	-.093110	-.076362	-.057345	-.020148	-.000069
9	.000000	-.174020	-.162869	-.122955	-.094992	-.076056	-.066407	-.053712	-.018466	-.000047
10	.000000	-.061871	-.089639	-.079344	-.063550	-.058127	-.056574	-.048897	-.027537	-.000057
11	.000000	-.002259	-.009279	-.015529	-.021445	-.028225	-.031575	-.026835	-.010749	-.000011
12	.000000	-.000894	-.003004	-.004962	-.007110	-.009674	-.011169	-.009363	-.003665	-.000020
13	.000000	-.000207	-.000802	-.001252	-.001425	-.001659	-.001904	-.001950	-.001083	-.000007
14	.000000	-.000058	-.000327	-.000523	-.000374	-.000183	-.000339	-.000966	-.000929	-.000007
15	.000000	.000099	.000186	.000305	.000522	.000573	.000108	-.000900	-.000914	-.000008
16	.000000	-.000043	-.000390	-.000749	-.000733	-.000489	-.000323	-.000495	-.000412	-.000005
17	.000000	.000081	.000311	.000524	.000856	.001269	.001581	.001352	.000434	.000002
18	.000000	.000012	.000217	.001040	.002293	.003621	.004481	.003926	.001215	.000007
19	.000000	-.000039	-.000358	-.000386	.000448	.001829	.003312	.004064	.002339	.000008

	V'	E -2							
1	.000000	.178542	.339687	.329823	.284302	.244573	.208640	.156969	.074529	.000511
2	.000000	.165855	.302525	.291821	.255455	.223634	.188679	.133964	.051121	.000528
3	.000000	.194871	.334280	.314859	.271762	.234916	.195659	.137624	.053638	.000535
4	.000000	.209589	.348785	.324858	.273158	.232997	.194087	.138965	.058117	.000540
5	.000000	.233662	.369950	.339687	.279835	.236820	.199318	.147099	.067096	.000557
6	.000000	.252429	.392044	.356104	.286954	.239746	.202391	.154306	.074387	.000568
7	.000000	.274773	.411279	.365751	.290898	.240504	.205209	.158957	.079013	.000591
8	.000000	.289457	.409132	.344053	.281692	.245353	.217311	.163173	.082035	.000549
9	.000000	.266551	.381074	.312540	.261068	.251969	.221687	.179152	.093624	.000525
10	.000000	.201362	.341249	.340803	.244157	.256282	.204979	.154763	.074763	.000631
11	.000000	.247555	.368638	.330161	.253739	.212184	.251810	.146736	.104518	.000667
12	.000000	.259529	.377801	.337991	.245171	.231485	.237734	.134587	.090737	.000812
13	.000000	.253691	.363888	.345120	.255369	.226199	.233041	.134047	.080110	.000782
14	.000000	.234679	.353924	.329957	.254417	.233684	.224000	.131596	.081373	.000748
15	.000000	.218870	.341577	.323471	.255161	.233556	.234519	.133962	.077215	.000790
16	.000000	.196322	.324418	.304417	.261205	.237721	.232384	.140604	.072024	.000781
17	.000000	.183237	.313940	.294416	.269594	.245745	.241085	.144391	.066680	.000777
18	.000000	.156579	.285316	.270650	.253294	.230138	.227582	.161677	.064634	.000747
19	.000000	.168209	.321721	.306464	.273064	.251694	.232605	.196518	.094740	.000710

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

V'W' E -3

1	.000000	-.086946	-.159784	-.176285	-.045815	.162079	.363676	.496875	.247483	.000732
2	.000000	-.068376	-.130990	-.093530	.042343	.235265	.390977	.404712	.108765	.000399
3	.000000	-.071324	-.083663	-.011640	.128157	.307974	.393325	.329092	.084718	.000380
4	.000000	-.063839	-.032729	.050785	.176496	.321033	.354207	.261316	.072285	.000341
5	.000000	-.054102	-.006118	.091557	.193266	.274662	.254226	.177005	.053503	.000230
6	.000000	-.060370	.031239	.157533	.208779	.230952	.214048	.119782	.041475	.000241
7	.000000	-.055574	.092628	.193781	.173846	.166179	.106293	.045348	.025873	-.000062
8	.000000	-.039074	.144518	.125569	.108585	-.002712	-.022674	.055904	-.010810	.000003
9	.000000	.022818	.017389	-.030615	.009853	-.216618	.150646	.008827	-.007289	.000425
10	.000000	.015571	-.142968	.011552	-.235935	-.119420	.123782	-.250434	-.080888	.000304
11	.000000	-.011261	.010722	-.029536	.011954	-.207791	.130591	.018155	.002547	.000483
12	.000000	-.018429	.018143	.041692	.065473	.001353	-.012575	.060447	-.020807	-.000073
13	.000000	-.011765	.013512	.055064	.096375	.130032	.084558	.037441	.028897	-.000083
14	.000000	-.032300	.024520	.091208	.142959	.184718	.185067	.101621	.032844	.000236
15	.000000	-.039112	-.005386	.067900	.147480	.224335	.212970	.165146	.052932	.000190
16	.000000	-.051933	-.038417	.034646	.148851	.289753	.329681	.240229	.068734	.000327
17	.000000	-.060527	-.087389	-.025795	.111947	.288533	.377737	.320161	.082323	.000360
18	.000000	-.061284	-.126347	-.099373	.031652	.224377	.383475	.398690	.106462	.000380
19	.000000	-.082117	-.150195	-.174042	-.052349	.152129	.363590	.504691	.249817	.000707

W' E -2

1	.000000	.168202	.322708	.307893	.273622	.251919	.233535	.196488	.093794	.000708
2	.000000	.156974	.286454	.271650	.254188	.231702	.228033	.162826	.064765	.000747
3	.000000	.183620	.315731	.296339	.272039	.246529	.241786	.149373	.066759	.000779
4	.000000	.197148	.326198	.306151	.263740	.240574	.234237	.140705	.072102	.000782
5	.000000	.219022	.342808	.325198	.258023	.240053	.234953	.136953	.078232	.000781
6	.000000	.235075	.362642	.339180	.259219	.241909	.224622	.134855	.080372	.000760
7	.000000	.255566	.375120	.358627	.265687	.231687	.229728	.136817	.080075	.000772
8	.000000	.266864	.381233	.335191	.249093	.230385	.232532	.135594	.086044	.000781
9	.000000	.250126	.346568	.299216	.244087	.205368	.244226	.147170	.100856	.000660
10	.000000	.201435	.344277	.342184	.248094	.253179	.253218	.202763	.150759	.000618
11	.000000	.264064	.411032	.341790	.273743	.254402	.222033	.178219	.092836	.000517
12	.000000	.281121	.413530	.351037	.286725	.247602	.218561	.165536	.085366	.000551
13	.000000	.271567	.400314	.351684	.285043	.240068	.207210	.161137	.080751	.000596
14	.000000	.252059	.382732	.343613	.280360	.237119	.201630	.154962	.075576	.000568
15	.000000	.233408	.367390	.335777	.276018	.233889	.197897	.146687	.067744	.000562
16	.000000	.208836	.346745	.322587	.270272	.230498	.192873	.139381	.059078	.000543
17	.000000	.194349	.331991	.312428	.269258	.232825	.194281	.137282	.054332	.000537
18	.000000	.165413	.301115	.290354	.253849	.222037	.187534	.133842	.051596	.000531
19	.000000	.178475	.338443	.328375	.283193	.243644	.207937	.157166	.075831	.000515

SKIN FRICTION DISTRIBUTION(CF/2)

1	2.21767E-03	2	2.16005E-03	3	2.18497E-03	4	2.11790E-03	5	2.12119E-03	6	2.09428E-03	7	2.05405E-03	8	2.00752E-03
9	1.88364E-03	10	1.66551E-03	11	1.97302E-03	12	2.05356E-03	13	2.04645E-03	14	2.06886E-03	15	2.11394E-03	16	2.11130E-03
17	2.17910E-03	18	2.15760E-03	19	2.21218E-03										

DISPLACEMENT THICKNESS.

1	1.82284E-03	2	1.78984E-03	3	1.75688E-03	4	1.91674E-03	5	1.95273E-03	6	2.01066E-03	7	2.08926E-03	8	2.22458E-03
9	2.55495E-03	10	3.43512E-03	11	2.42070E-03	12	2.15542E-03	13	2.11042E-03	14	2.04544E-03	15	1.96582E-03	16	1.92420E-03
17	1.76440E-03	18	1.79154E-03	19	1.82753E-03										

MOMENTUM THICKNESS.

1	1.29543E-03	2	1.25158E-03	3	1.23301E-03	4	1.33968E-03	5	1.36898E-03	6	1.40485E-03	7	1.45266E-03	8	1.54163E-03
9	1.74526E-03	10	2.29353E-03	11	1.68079E-03	12	1.50466E-03	13	1.46667E-03	14	1.42355E-03	15	1.37701E-03	16	1.34352E-03
17	1.23736E-03	18	1.25223E-03	19	1.29761E-03										

CURRENT VELOCITY U1/UINF			ENERGY	DISP. THK.	MOM. THK.	EN. DIS.THK	THETA	BNDY THK.	SHAPE FCT.	SKIN FRIC.		
X1/LREF	WALL	EDGE	E	DEL STAR	THETA	DELTA 3	REYNL. NO.	DELTA	H	CF/2		
3.0172E-01	5.9893E-01	1.2140E+00	1.4199E+00	1.8208E-03	1.2906E-03	4.0000E+00	-1.2977E-01	1.7132E-02	1.4109E+00	2.2101E-03	100	0

OF POOR QUALITY

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS

DAYFILE FROM CYBER-203

```
18:15:19 RS1462D          VS1462M          XXXXXX  XXXXXX           000W8SCC         10/13/81
18:15:22    FILE PROG7    RECEIVED FROM ACCESS STATION.
18:15:22
18:15:23    FILE DATA7    RECEIVED FROM ACCESS STATION.
18:15:23
18:15:23 JUNCTURE,T200.
18:15:23  STORE XXXXXX 400SDS JUNCTUR7     S
18:15:23 TV,8.
18:15:23 FORTRAN,I=PROG7,L=COMPU,B=BINARY/0400,O=BK.
18:15:23 FORTRAN R1.4 CYCLE G11A     BUILT 07/28/81 09:46
18:15:23 COMPILING JNCTUR
18:15:24       NO ERRORS
18:15:24 COMPILING BLK_DATA
18:15:24       NO ERRORS
18:15:41    13.826 SECONDS COMPILATION TIME
18:15:41  ALL DONE
18:15:41  RETURN CODE =          4
18:15:41
18:15:41        JUNCTURE CORNER CYBER 203 OUTPUT.
18:15:41
18:15:41 TV,4.
18:15:41 PATTACH,BRADP.
18:15:42 POOL     BRADP     ATTACHED
18:15:42  ALL DONE
18:15:42 LOAD(BINARY,FRTV03B,BRADSHWB,FRTV01B,FRTV00B,CM=GO,01000,GRLPALL= ,OU=MAPJ).
18:15:42  LOAD R1.4 CYCLE 62
18:15:42 ORIGIN NOT ON LARGE PAGE BOUNDARY - ORIGIN =     0000000000400000
18:15:43 LENGTHS DONT MATCH FOR COMMON BLOCK ARRAYS
18:15:43 LENGTHS DONT MATCH FOR COMMON BLOCK ARRAYS
18:15:58 ** WARNING **   UNSATISFIED EXTERNAL(S) DETECTED DURING LOAD
18:15:58
18:16:01  ALL DONE
18:16:01  RETURN CODE =          4
18:16:01 GO(TAPE5=DATA7,TAPE6=OUTPUT,TAPE3=RSTRT).
18:16:06  ERROR 74 IN OUTNOD AT LINE 5
18:19:34    FILE OUTPUT   EXTENDED, NEW LENGTH =     213
18:23:09 NO TIME LEFT FOR  32GO
18:23:09
18:23:09 ***DUMP(32GO     )
18:23:11  ALL DONE
18:23:11 EXIT.
18:23:12 LARGE PAGE IMPLICIT DISK ACCESSES                      3
18:23:12 SMALL PAGE IMPLICIT DISK ACCESSES                     62
18:23:12 IMPLICIT SECTORS WRITTEN                             754
18:23:12 LARGE PAGE FAULTS                                      9
18:23:12 SMALL PAGE FAULTS                                    850
18:23:12 USERS O/S CALLS                                     1147
18:23:12 USERS AVERAGE WORKING SET SIZE                       508
18:23:12 USERS CPU SECONDS                             361.300903
18:23:12 USERS CM USAGE(PAGE.SECONDS)                  183619.232468
18:23:12 SYSTEM CPU SECONDS                              2.631981
18:23:12 COMPUTER RESOURCE UNITS(CRU)                         211
18:23:12 **COMPLETE**
```

APPENDIX C.
SAMPLE PRINTOUT FOR 3DPNS