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ATL TM 162

INSTRUCTIONS FOR THE USE OF THE

FORTRAN IV PROGRAM CØMPT

By

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ADVANCED TECHNOLOGY LABORATORIES, INC.

DECEMBER 1971

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PREPARED FOR

NASA HEADQUARTERS
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I.   INTRODUCTION

This is a manual for the program COMPT which computes the non-steady two
dimensional flow field resulting from the interaction of two successive
blade rows. The manual is designed to provide guidance in running the
program and a brief description of some of the numerical details. Tech-
nical details are found in Reference (1). A brief review of the main
features of the program follows.

The complete annular region of a set of blade rows is analyzed by consider-
ing only one blade passage in each blade row (see Reference 1). In order
to facilitate the computation, the computational region is chosen to en-
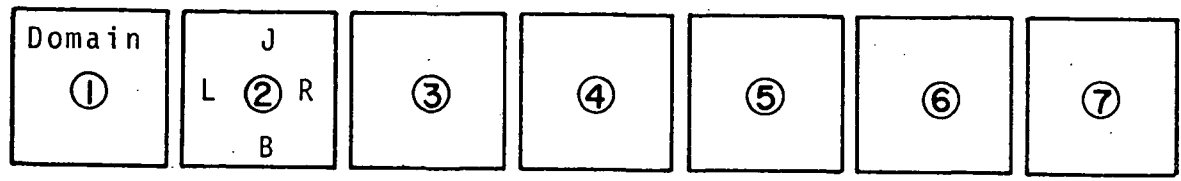compass seven domains as shown schematically in Figure (1a).
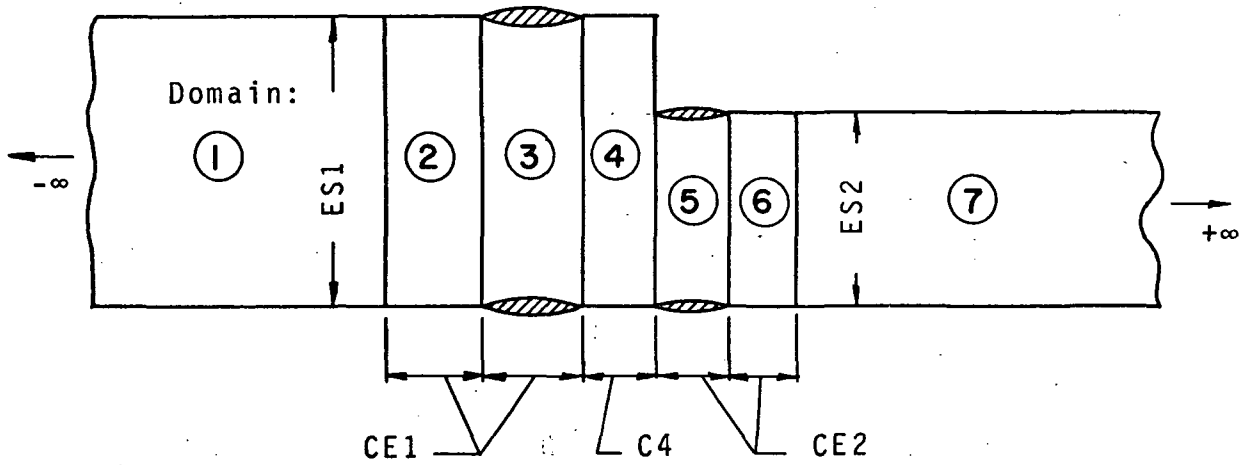
(a)   Physical Domains

(b)   Transformed Square Domains

FIGURE 1. TYPICAL PHYSICAL AND TRANSFORMED DOMAINS FOR A
           COMPRESSOR STAGE

These seven domains are stretched by transformations into seven equal square domains shown in Figure (1b). The time dependent solution is then computed in each domain using the Lax-Wendroff technique as described in Reference (2). The program takes about 0.7×10^{-3} seconds of central processing time per mesh point per time step when executed on a CDC 6600 computer using the FTN compiler (Scope 3.3). A typical computation may contain 847 points (11x11x7) and require of the order of 1000 to 2000 time steps to come to completion. This type run should take about 15 minutes of computer time, and require about 145,000 (octal) core locations.

II.   THE NUMERICAL COMPUTATION

The flow field is computed in each of the seven domains using equations
appropriate to each domain. Figure (2) shows a typical domain with the
types of grid points identified. After the flow at all interior and bound-
ary points in all seven domains has been evaluated, boundary conditions
are applied by specifying flow variable values at the exterior or virtual
points which are located one mesh spacing outside of the boundary, see
Reference (1) for details. The computation can then proceed to the next
step. Each step consists of two iterations shown schematically in
Figure (3). The first iteration proceeds from t to $t + \frac{\Delta t}{2}$ using time
derivatives evaluated at time t and the average value of the four neigh-
boring points as the initial value at time t, thus allowing a "damped"
value at $t + \frac{\Delta t}{2}$ to be computed. The second iteration then computes time
derivatives at $t + \frac{\Delta t}{2}$ using the values just evaluated there, and combines
these with the second iterate initial value which is a weighted average
of the central point value at time t and the previously computed average
of the four neighboring point at time t, to arrive at a new value at time
$t + \Delta t$. This procedure is followed for each of the interior and boundary
points and for each of the seven domains.

The boundary conditions are then applied to each domain by specifying the
values of the flow variables at the exterior of virtual points. These
values are obtained for the vertical or x=constant lines from the adjacent
domain (with interpolation and/or phase shift if necessary) and for the
horizontal or y=constant lines from the first set of interior points at
the opposite boundary (with phase shift if necessary).

The program itself handles these operations by means of the main program
COMPT and various subroutines. Figure (4) is a simplifed flow chart show-
ing the operations which are as follows. The main program, COMPT, handles
input and output operations, initializes all data and guides the computa-
tion through its iterations and boundary condition applications. The sub-
routines ITER1 and ITER2 handle the grid point computations for the first
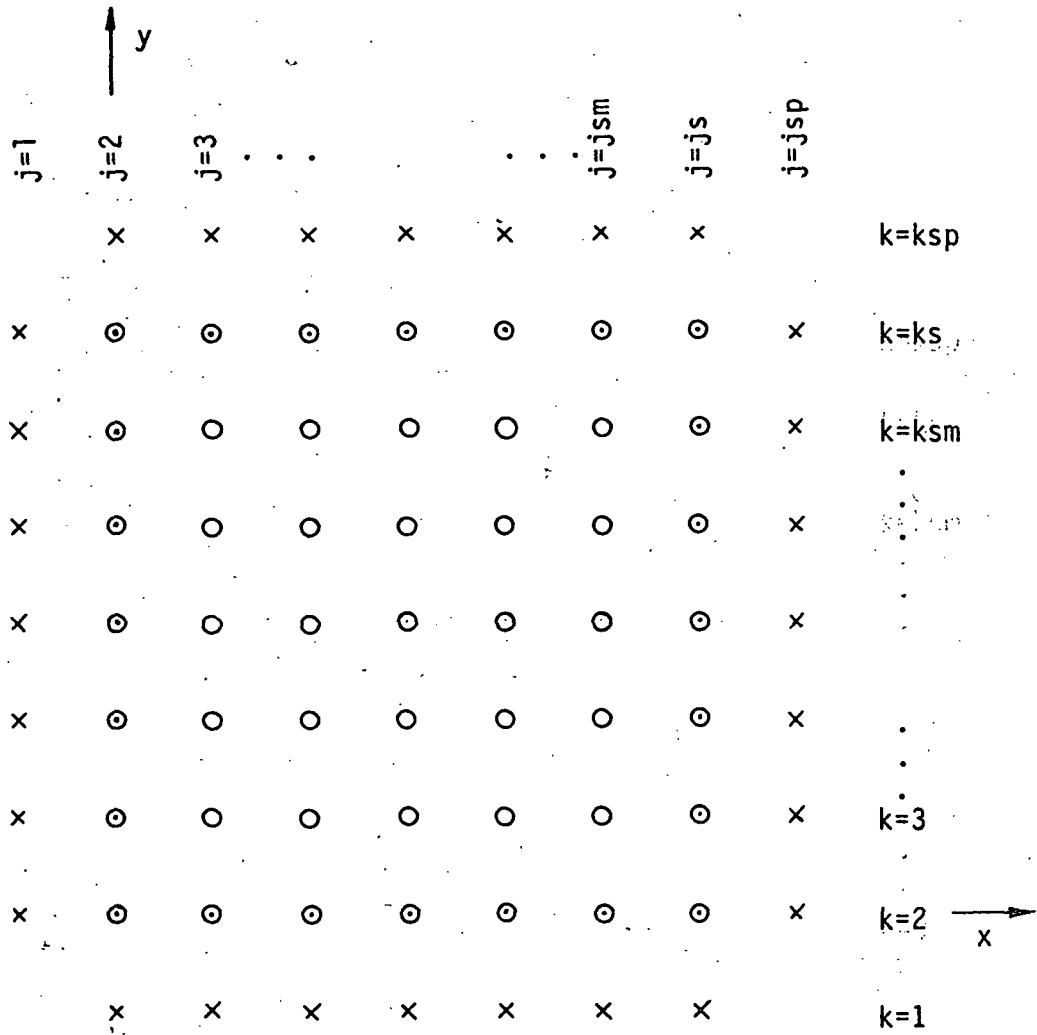
FIGURE 2.   SCHEMATIC OF A TYPICAL TRANSFORMED SQUARE DOMAIN

j   = x

j + 1 = x + Δx

j - 1 = x - Δx

k   = y

k + 1 = y + Δy
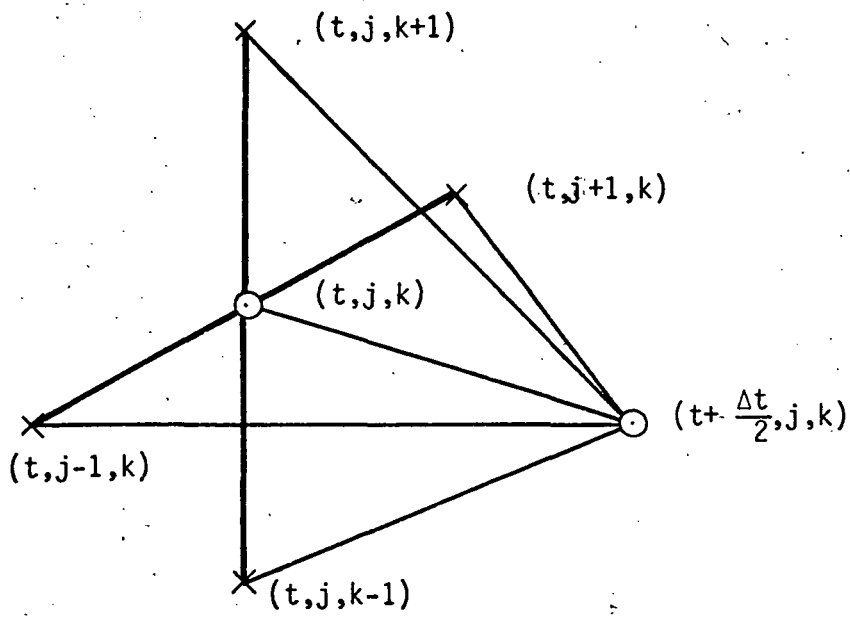
k - 1 = y - Δy
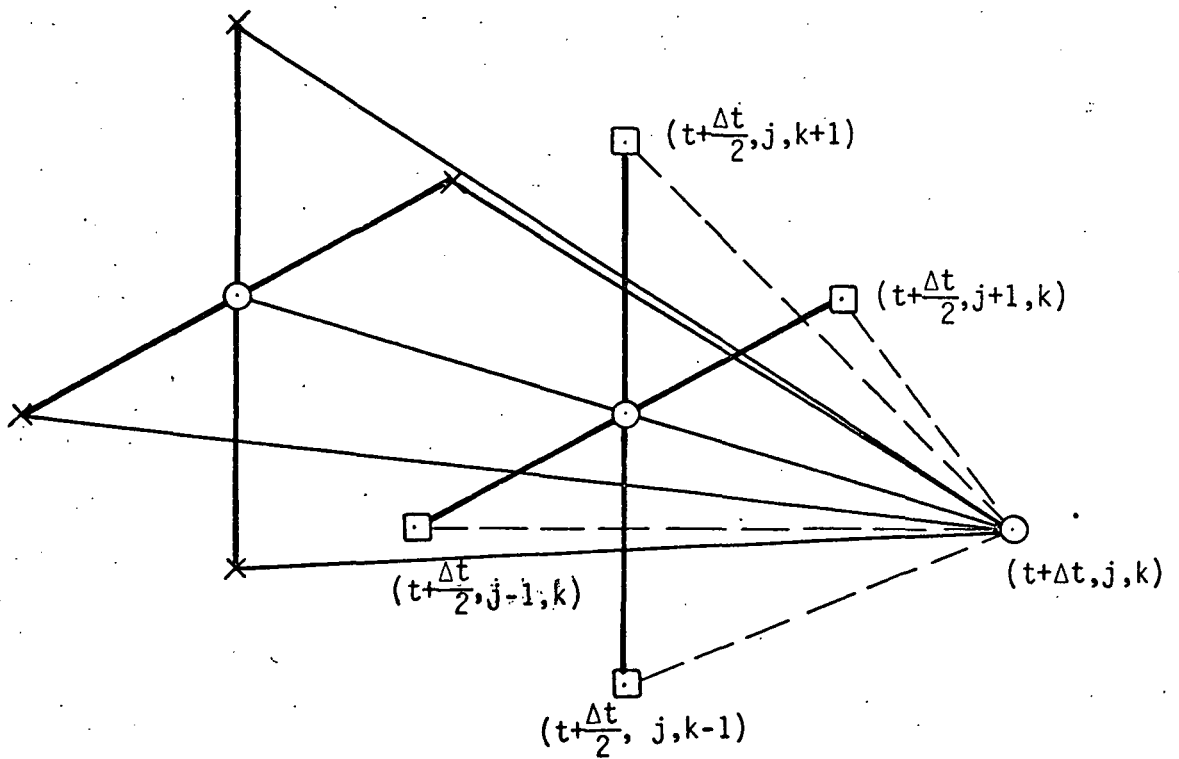
FIGURE 3.   THE TWO-STEP LAX-WENDROFF TECHNIQUE.
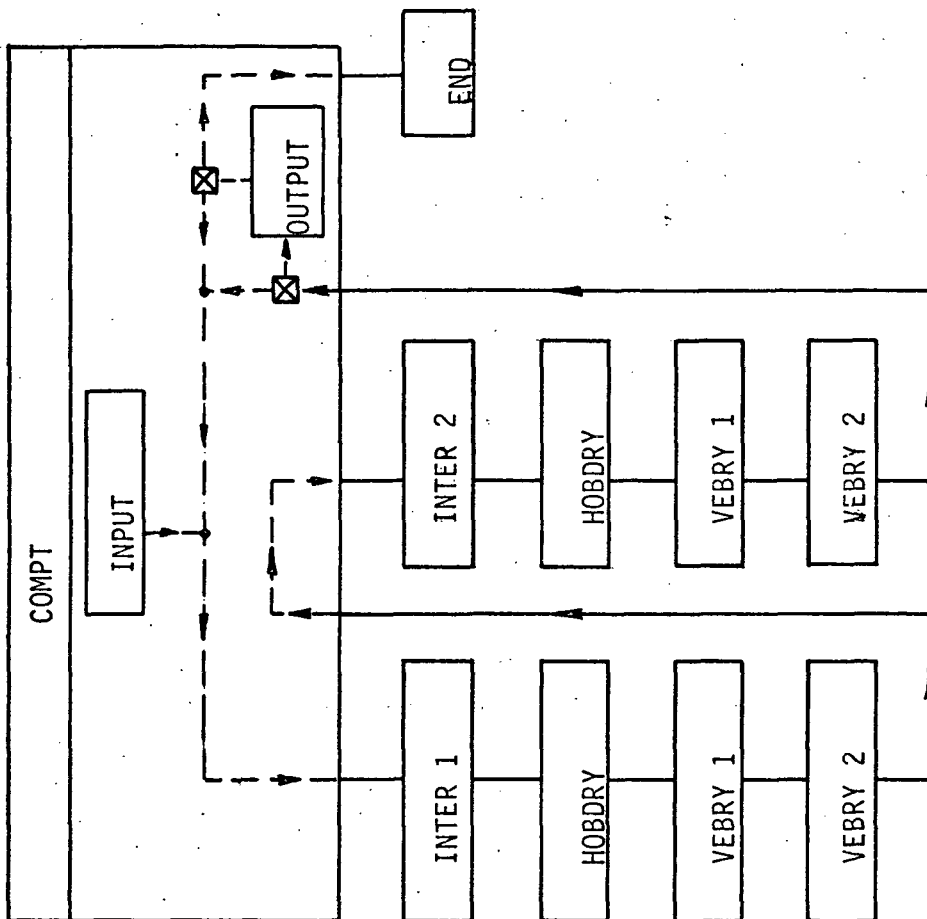
FIGURE 4.   FLOW CHART

and second iterations discussed above. The exterior boundary conditions
are specified by subroutines HOBDRY, VEBRY1 and VEBRY2. HOBDRY determines
all of the horizontal boundaries and some vertical ones while VEBDRY1 and
VEBDRY2 specify the remaining vertical boundaries. VEBDRY2 also handles
the conversion of the displacement thickness into an inviscid wake. The
remaining subroutines are QSOLV, AABB, FAT, AVERAG and PSOLV. QSOLV
solves for the pressure p gives ρu, $\rho u H$, $\rho u^2 + p$ and v/u. AABB specifies
parameters AA, BB and H, the shape factor, for the boundary layer compu-
tation, where

$$\frac{\partial \delta^*}{\partial x} = AA \ (R_e)^{-BB}.$$

FAT is a linear interpolation routine. AVERAG computes average properties
from properties at two points so that ρu, $\rho u^2 + p$, $\rho u v$ and $\rho u H$ are conserved.
Finally, subroutine PSOLV solves for the pressure p given ρu, $\rho u H$, $\rho u^2 + p$
and $\rho u v$.

III.   INPUT

The listing of the program is given in Appendix I. This will aid in identifying the input to the program. The program is started initially by input cards only. Later it can be restarted by cards only or combinations of card and tape (or disk) inputs. The basic input cards required are as follows:

Card Number	Name	Columns	Format	Value	Comment
1	ITAPEI	1-5	I5	0	read cards
				1	read cards and first tape file
				2	read cards and second tape file
2	ITAPEO	1-5	I5	0	no results are written on tape for restart
				8 or 9	for restart, results are written on tape 8 or 9
3	IPUNO	1-5	I5	0	no cards punched for restart
				7	for restart, cards are punched on output cards
4	IDIM	1-5	I5	1	MKS system
				2	FPS system
5	NONDIM	1-5	I5	0	dimensional initial input
				1	non-dimensional initial input
6	IDATA	1-5	I5	0	all data is constant 1 card read in (initial input only)
				1	many cards read in (initial or restart)(see last card)

Card Number	Name	Columns	Format	Value	Comment
7	IPRT	1-5	I5	integer	number of time steps between complete print-outs
8	IDEBUG	1-5	I5	0	NBLADE determines the number of time steps
				integer (n)	n time steps of computations (use for debugging)
9	ITEBUG	1-5	I5	0	only final iteration for each print time step to be printed
				1	both iterates printed
10	IDELTA	1-5	I5	0	inviscid
				1	viscous (computes δ^*)
11	NBLADE	1-5	I5	integer n_f	final value of number of blade spacings to be spanned in the computation (for equal spacing, IBJEQ= 0 can be any value; for unequal spacing only, $n_f=n_i+1$ where n_i is the starting value)
12	LBLADE	1-5	I5	0	blades aligned, DOMR=0 (do not use, test only)
				1	blade positions arbitrary
13	IBLEQ	1-5	I5	0	equal spacing
				1	NOBL<MOBL<2*NOBL (requires phase lag for boundary conditions)

Card Number	Name	Columns	Format	Value	Comment
14	IPI	1-5	I5	0	prints no complete field
				1	prints input field
				2	prints field with boundary conditions
				3	prints 1 and 2
15	IDA	1-5	I5	0	suppresses point print
				1-7	domain of point printed at each time step
	JA	6-10	I5	1-13	J value of point
	KA	11-15	I5	1-13	K value of point
16	IDB,JB,KB				
17	IDC,JC,KC				
18	IDD,JD,KD		Repeat of card I5 for 5 more points.		
19	IDE,JE,KE				
20	ID6,J6,K6				
21	IDCI	1-5	I5	0	suppresses print column
				1-7	domain of column printed each time step
	JC1			1-13	J value of column
22	IDC2,JC2		Repeat of card 21 for additional print column.		
23	IDS	1-5	I5	7	always use 7
24	IDP(1)	1-5	I5		
	IDP(2)	6-10	I5		
	IDP(3)	11-15	I5		
	IDP(4)	16-20	I5		
	IDP(5)	21-25	I5	0	no printout of this domain
	IDP(6)	26-30	I5	1	printout of this domain
	IDP(7)	31-35	I5		for each complete printout

Card Number	Name	Columns	Format	ID	1	2	3	4	5	6	7	Comment
25	JI(ID)	1-5	I5		3	2	2	3	2	3	3	
to												
31	JF(ID)	6-10	I5		(JS-1)	(JS-1)	JS	(JS-1)	(JS)	(JS)	(JS-1)	

Card Number	Name	Columns	Format	Value	Comment
32	JS	1-5	I5	(number of $\Delta\sigma$'s) + 3	
	KS	6-10	I5	(number of $\Delta\upsilon$'s) + 3	
33	ISLLE	1-5	I5	0	do not use
	ISLTE	6-10	I5	1	values other than these
34	COEFTH	1-15	EI5.8	0.0-1.0	use 0.5; leading and trailing edge computation modifier
35	NOBL	1-5	I5	N	number of blades in upstream row
	MOBL	6-10	I5	M	number of blades in downstream blade row
36	CEI	1-15	E15.8		dimensional axial chord component
	ES1	16-30	E15.8		dimensional peripheral blade spacing
37	RADLE1	1-15	E15.8	0.0	sharp leading edge
				finite	do not use
38	YUXLE(1)	1-15	E15.8		slope of leading edge lower surface
	YLXLE(1)	16-30	E15.8		slope of leading edge upper surface
39	YUIC	1-15	E15.8		coordinate of top of gap (i.e., lower blade surface
	YLIC	16-30	E15.8		coordinate of bottom of gap (i.e., upper blade surface)

Card Number	Name	Columns	Format	value	Comment
40 to (39+(JS-2))					Same as 39. Coordinates of remainder of blade spacing gap.
(39+(JS-2))+1 to (39+(JS-2))+(4+(JS-2))					Repeat cards 36 to (39+(JS-2)) for downstream set of blades (all 1's are replaced by 2's in the names)
(43+2(JS-2)+1	JV	1-5	I5		$3 \leq JV \leq (JS-1)$ determines C4=C2(JS-JV)
(43+2(JS-2))+2	OMR(1)	1-15	E15.8		(a) IBLEQ=0, arbitrary
	OMR(2)	16-30	E15.8		(b) IBLEQ=1; OMR(2) $\geq$ OMR(1)
+3	PI	1-15	E15.8		pressure ⎫
	TI	16-30	E15.8		temperature ⎬ at $-\infty$
	UI	31-45	E15.8		u velocity ⎪
	VOUI	46-60	E15.8		v/u ⎭
+4	WM	1-15	E15.8	29.	molecular weight
	GAMMA	16-30	E15.8	1.4	$\gamma = c_p/c_v$
+5	REYCR	1-15	E15.8		critical Reynolds number for turbulent flow
+6	XMU	1-15	E15.8		viscosity
+7	EN	1-15	E15.8		turbulent profile $u \sim (\frac{y}{\delta})**(\frac{1}{EN})$
	KAY	16-30	E15.8		assumed value for adverse pressure gradient effect on turbulent profile

Card Number	Name	Columns	Format	Value	Comment
+8	PHI	1-15	E15.8	0.1	numerical damping coefficient for second iterate

The above cards are always read in even for restart.
The following data comes from cards or tape depending on the value of ITAPEI.
The values given on the subsequent cards are for an initial start run. All values are automatically updated for restarts either on tape or on cards punched.

Card Number	Name	Columns	Format	Value	Comment
(43+2 (JS-2))+9	ISTART	1-15	I5	0	initial run
				1	restarts
+10	ITIME	1-5	I5	0	elapsed time steps (internally ITIME = ITIME + NNN if ITIME=0)
	IPT	6-10	I5	1	print counter
+11	NTIME	1-5	I5	0	large gap counter
	NPT	6-10	I5	1	gap print counter
	MTIME	11-15	I5	0	small gap counter
+12	IPHI	1-5	I5	0	phase lag parameter
	IPSI	6-10	I5	0	phase lag parameter
+13	TIME	1-15	E15.8	0.0	elapsed time (non-dimensional)
+14	UZ	1-15	E15.8		largest initial Mach number in flow field or largest expected.
+15	SPAIH	1-15	E15.8	0.0	parameters needed to compute + ∞ boundary
	SRUAI	16-30	E15.8	0.0	
	SRUVAI	31-45	E15.8	0.0	
	SRUZPP	46-60	E15.8	0.0	

Card Number	Name	Columns	Format	Value	Comment
+16	PC	1-15	E15.8	pressure	1 card only for
to last	TC	16-30	E15.81	temperature	initial run using
card	UC	31-45	E15.8	u-velocity	constant flow field;
	VOVC	46-60	E15.8	v/u	many cards for card restart or specifying variable initial flow field. (see card 6)

Several comments regarding some of these cards are in order. When a value is
commented upon not to be changed, the reason is that this card was either used
during debugging or a future change was anticipated. For the coordinates of
the blades, the first card (e.g., card number 39) defines the leading edge and
the two values YUIC and YLIC should differ by the corresponding spacing, e.g.,
ES1; the same holds true at the trailing edge. This applies to both sets of
blades. It is to be noted that the U refers to upper, meaning the upper edge
of the blade spacing gap and similarly L to lower. The values of the variables
for card numbers (43+(JS-2))+9 and larger, are those which are to be used in
initiating a run. Thereafter, for restart these cards are removed for a card
restart and replaced with the punch file from the run to be restarted. In case
of a restart using tapes or disks these cards may be left attached but will be
ignored.

IV.   OUTPUT

The output is almost self explanatory. Sample outputs are shown in Appendix II. First all variables read in are printed out. The input of the complete flow field can be suppressed by setting IPI (card 14) to 0 or 2. Then the whole initial field with boundary conditions is written at each point in each domain for which IDP(ID) (card 24) has been set to 1. Domains with IDP(ID)=0 will not be printed. The output identifies the time step ITIME, the time TIME, the domain ID and J value in that domain and its corresponding X coordinate and the mass flow MDOT across that section. Then a block of data, headed by the heading K, Y, P, RHO, U, V, E, T, H, M and CP for KS+1 values of K, gives all the data for that X station. The number of blocks in a domain equals the number of X stations in it. This type of information is repeated again after IPRT time cycles and after each blade gap and for the final time step. Intermediate data at each time step for up to 6 points and 2 columns is also printed. Also printed are the peripheral and axial force components per blade gap in the two sets of blades. PDAI is the axial force and PAIH is the peripheral force experienced by the fluid. For equal spacing the negative of these quantities becomes the forces on the blades. The displacement thickness on each blade side is also printed out following each blade domain as DSU and DSL and the viscous drag DRAGU and DRAGL as well as the axial individual force contributions PDAIU and PDAIL are also given.

V.   LIMITATIONS

The program has several limitations at the present time.

   (1)   The boundary layer displacement thickness evaluation
            is presently done only normal to the axial direction
            but can be extended to be calculated normal to any
            direction.

   (2)   The conversion of the displacement thickness into an
            inviscid wake is valid only for equal blade spacing.

   (3)   The unequal spacing logic changes have been FORTRAN de-
            bugged, however, sample calculations to test that the
            correct results are obtained have been carried out only
            for one time step and only for the special case IBLEQ=1
            and NOBL=10 and MOBL=10.

   (4)   The mean slope of the trailing edges of both blades and
            the leading edge of the upstream blade must be restricted
            to within the range of $\pm 45^\circ$ for unequal number of blades
            in the two blade rows (IBLEQ=1). The leading edge of the
            downstream blades must be restricted to within the range
            of

$$\pm \tan^{-1} \left[\frac{ES1}{CE2} (JS-2) \right]$$

REFERENCES

1. Alzner, E. and Erdos, J., "Unsteady Flow Through Compressor Stages," ATL TR 168, December 1971.

2. Richtmyer, R. D. and Morton, K. W., "Different Methods for Initial Value Problems," Second Edition, Interscience, New York, 1967.

APPENDIX I

PROGRAM LISTING

A listing of the FORTRAN IV program COMPT as executed on a CDC 6600 computer operating under the SCØPE 3.3 system, using the RUN(s) compiler and SETCORE (i.e., core is initialized to zero), follows:

```
                 PROGRAM COMPT(INPUT,OUTPUT,PUNCH,TAPE5=INPUT,TAPE6=CUTPUT,TAPE7
               1 PUNCH,TAPE8,TAPE9,TAPE1,TAPE2,TAPE3,TAPE4)
000003           DIMENSION      R1(7,13,13),P1(7,13,13),U1(7,13,13),V1(7,13,13),
               1 E1(7,13,13),R2(7,13,13),P2(7,13,13),U2(7,13,13),V2(7,13,13),
               2 E2(7,13,13),
               3 DSU(2,13,3),DSL(2,13,3),YU(2,13),YL(2,13),JI(7),JF(7)
               4 ,YUXLE(2),YLXLE(2),OMR(2)
               6 ,PDAI(2),PDAIU(2),PDAIL(2)
               7 ,DRAGU(2),DRAGL(2)
               8 ,IDP(7)
               9 ,PAII(2)
               9 ,P3(5,9,13),R3(5,9,13),U3(5,9,13),V3(5,9,13)
               9 ,PM(5,9,13),RM(5,9,13),UM(5,9,13),VM(5,9,13)
               9 ,P4(9,13),R4(9,13),U4(9,13),V4(9,13)
               9 ,P5(9,13),R5(9,13),U5(9,13),V5(9,13)
               9 ,P32(9,2),R32(9,2),U32(9,2),V32(9,2),
               9  PM2(9,2),RM2(9,2),UM2(9,2),VM2(9,2),
               9  P3S(9,2),R3S(9,2),U3S(9,2),V3S(9,2).
               9  PMS(9,2),RMS(9,2),UMS(9,2),VMS(9,2)
000003           COMMON R2,P2,U2,V2,E2
000003           COMMON/A/GAMMA,GAML1
000003           COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000003           COMMON/B1/ IBLEQ
000003           COMMON/B2/ IDEBUG
000003           COMMON/C/DSU,DSL
000003           COMMON/D/ ID,J,KJ,IDS,K
000003           COMMON/E/ JI,JF,JS,KS
000003           COMMON/F/YU,YL
000003           COMMON/G/ DX,RDX,R2DX,RDX2
000003           COMMON/H/DN,RDN,R2DN,RDN2
000003           COMMON/I/DT,RDT,R2DT,RDT2,DTO2
000003           COMMON/J/ES1,ES2,CE1,CE2,CS,CR,SS,SR,RADLE1,RADLE2,C4
000003           COMMON/K/ ISTART
000003           COMMON/L/RII,UII,EII,PII,VII
000003           COMMON/M/ XMU,IDELTA
000003           COMMON/N/ ITIME,NNN,NTIME
000003           COMMON/N1/ MMM,MTIME
000003           COMMON/N2/ NOBL,MOBL,ITIMEI
000003           COMMON/N3/ IPHI,IPSI
000003           COMMON/O/ PDAI,PDAIU,PDAIL
000003           COMMON/P/R1,P1,U1,V1,E1
000003           COMMON/P1/ P3,R3,U3,V3,P4,R4,U4,V4,P5,R5,U5,V5,PM,RM,UM,VM
000003           COMMON/P2/ P32,R32,U32,V32,PM2,RM2,UM2,VM2
000003           COMMON/P3/ P3S,R3S,U3S,V3S,PMS,RMS,UMS,VMS
000003           COMMON/Q/JSM,JSP,KSM,KSP
000003           COMMON/R/ X,YY
000003           COMMON/T/ LBLADE
000003           COMMON/U/ YUXLE,YLXLE
000003           COMMON/V/ JV
000003           COMMON/X/EN,KAY
000003           COMMON/Z/ DRAGU,DRAGL
000003           COMMON/ZA/ REYCR
000003           COMMON/ZB/ SPAIH,SRUAI,SRUVAI,SRU2PP
000003           COMMON/ZC/ PAIH2,RUAI1,RUVAI1,RU2PFE,NT
000003           COMMON/ZD/ISLLE,ISLTE
000003           COMMON/ZE/IDATA
```

```
000003              COMMON/ZG/ COEFTH
000003        10 FORMAT(4E15.8)
000003        15 FORMAT(3I5)
000003              WRITE(6,125)
000007              WRITE(6,150)
000013       150 FORMAT(/          20X,37HU N S T E A D Y   C O M P R E S S O R//
000013              READ(5,15) ITAPEI
000021              WRITE(6,153) ITAPEI
000027              READ(5,15) ITAPEO
000035              WRITE(6,154) ITAPEO
000043              READ(5,15) IPUNO
000051              WRITE(6,152) IPUNO
000057              READ(5,15) IDIM
000065              WRITE(6,156) IDIM
000073              READ(5,15) NONDIM
000101              WRITE(6,118) NONDIM
000107              READ(5,15) IDATA
000115              WRITE(6,121) IDATA
000123              READ(5,15) IPRT
000131              WRITE(6,101) IPRT
000137              READ(5,15) IDEBUG
000145              WRITE(6,137) IDEBUG
000153              READ(5,15) ITBUG
000161              WRITE(6,151) ITBUG
000167       151 FORMAT( 10X,10HITBUG     =,I5 )
000167              READ(5,15) IDELTA
000175              WRITE(6,120) IDELTA
000203              READ(5,15) NBLADE
000211              WRITE(6,113) NBLADE
000217              READ(5,15) LBLADE
000225              WRITE(6,128) LBLADE
000233              READ(5,15) IBLEQ
000241              WRITE(6,191) IBLEQ
000247       191 FORMAT(10X,10HIBLEQ     =,I5/)
000247              READ(5,15) IPI
000255              WRITE(6,136) IPI
000263              READ(5,15) IDA,JA,KA
000275              WRITE(6,132) IDA,JA,KA
000307              READ(5,15) IDB,JB,KB
000321              WRITE(6,133) IDB,JB,KB
000333              READ(5,15) IDC,JC,KC
000345              WRITE(6,134) IDC,JC,KC
000357              READ(5,15) IDD,JD,KD
000371              WRITE(6,135) IDD,JD,KD
000403              READ(5,15) IDE,JE,KE
000415              WRITE(6,144) IDE,JE,KE
000427              READ(5,15) ID6,J6,K6
000441              WRITE(6,145) ID6,J6,K6
000453              READ(5,15) IDC1,JC1
000463              WRITE(6,175) IDC1,JC1
000473              READ(5,15) IDC2,JC2
000503              WRITE(6,176) IDC2,JC2
000513       175 FORMAT( 10X,10HID,J-C1   =,2I5 )
000513       176 FORMAT( 10X,10HID,J-C2   =,2I5 )
000513              READ(5,15) IDS
000521              WRITE(6,108) IDS
000527              READ(5,16) (IDP(ID),ID=1,IDS)
000542        16 FORMAT(7I5)
```

```
000542              WRITE(6,129)IDS,(IDP(ID),ID=1,IDS)
000557              DO 59 ID=1,IDS
000561          59 READ(5,15) JI(ID),JF(ID)
000573              DO 199 ID=1,IDS
000574              WRITE(6,109) ID,JI(ID),ID,JF(ID)
000607         199 CONTINUE
000612              READ(5,15)JS,KS
000621              WRITE(6,110) JS,KS
000631              JSM=JS-1
000633              JSP=JS+1
000634              KSM=KS-1
000636              KSP=KS+1
000637              READ(5,15) ISLLE,ISLTE
000646              WRITE(6,160) ISLLE,ISLTE
000656              READ(5,10) COEFTH
000664              WRITE(6,174) COEFTH
000672         174 FORMAT( 10X,10HCOEFTH    =,E15.8/)
000672              READ(5,15)NOBL,MOBL
000702              WRITE(6,168) NOBL,MOBL
000712         168 FORMAT( 10X,10HNOBL       =,I5,20X,10HMOBL        =,I5/)
000712              READ(5,10) CE1,ES1
000722              WRITE(6,103) CE1,ES1
000732              READ(5,10) RADLE1
000740              RADLE1=RADLE1/CE1
000742              WRITE(6,105) RADLE1
000747              READ(5,10) YUXLE(1),YLXLE(1)
000757              WRITE(6,130) YUXLE(1),YLXLE(1)
000767              DO 77 J=2,JS
000771              READ(5,10)YU1C,YL1C
001000              YU(1,J)=YU1C/ES1
001003              YL(1,J)=YL1C/ES1
001005          77 CONTINUE
001010              DO 198 J=2,JS
001011              WRITE(6,111) J,YU(1,J),J,YL(1,J)
001027         198 CONTINUE
001032              WRITE(6,126)
001035              READ(5,10) CE2,ES2
001045              WRITE(6,104) CE2,ES2
001055              IF(FLOAT(NOBL)*ES1.EQ.FLOAT(MOBL)*ES2) GO TO 99
001062              WRITE(6,98)
001066          98 FORMAT(/5X,48HINPUT ERROR - (NOBL*ES1) SHOULD EQUAL (MOBL*ES2)/
001066              CALL EXIT
001067          99 CONTINUE
001067              READ(5,10) RADLE2
001075              RADLE2=RADLE2/CE2
001077              WRITE(6,106) RADLE2
001104              READ(5,10) YUXLE(2),YLXLE(2)
001114              WRITE(6,131) YUXLE(2),YLXLE(2)
001124              DO 78 J=2,JS
001126              READ(5,10) YU2C,YL2C
001135              YU(2,J)=YU2C/ES2
001140              YL(2,J)=YL2C/ES2
001142          78 CONTINUE
001144              DO 197 J=2,JS
001146              WRITE(6,112) J,YU(2,J),J,YL(2,J)
001164         197 CONTINUE
001167              CS=CE1
001170              CR=CE2
```

```
001172              SS=ES1
001173              SR=ES2
001175              WRITE(6,126)
001200              READ(5,15) JV
001206              JVI=JV
001210         79 CONTINUE
001210              C4=CE2/FLOAT(JS-JV)
001214              IF(C4.LT.CE1/FLOAT(JS-3)) JV=JV+1
001222              IF(JV.GT.JSM) GO TO 611
001226              IF(C4.LT.CE1/FLOAT(JS-3)) GO TO 79
001232              GO TO 612
001233        611 CONTINUE
001233              XJSM3=JS-3
001236              RJSM3=1.0/XJSM3
001237              WRITE(6,613) XJSM3,RJSM3
001247        613 FORMAT(/5X,20HINPUT DATA ERROR - (, E12.5,13H.GE.C2/C1.GE.,E12.
                  1 1H)/)
001247              CALL EXIT
001250        612 CONTINUE
001250              WRITE(6,143) JVI,JV
001260              WRITE(6,119) C4
001266              WRITE(6,125)
001272              READ(5,10) OMR(1),OMR(2)
001302              WRITE(6,114) OMR(1),OMR(2)
001312              READ(5,10) PI,TI,UI,VOUI
001326              WRITE(6,115) PI,TI,UI,VOUI
001342              READ(5,10) WM,GAMMA
001352              WRITE(6,116) WM,GAMMA
001362              READ(5,10) REYCR
001370              WRITE(6,161) REYCR
001376              READ(5,10) XMU
001404              WRITE(6,117) XMU
001412              READ(5,10) EN,KAY
001422              WRITE(6,107) EN,KAY
001432              READ(5,10) PHI
001440              WRITE(6,102) PHI
001446              GAML1=GAMMA-1.0
001450              IF(ITAPEI.NE.0) GO TO 480
001451              READ(5,15) ISTART
001457              READ(5,15) ITIME,IPT
001467              READ(5,15) NTIME,NPT,MTIME
001501              READ(5,15) IPHI,IPSI
001511              READ(5,10) TIME
001517              READ(5,10) UZ
001525              READ(5,10) SPAIH,SRUAI,SRUVAI,SRU2PP
001541              GO TO 481
001542        480 CONTINUE
001542        159 IF(ITAPEI.EQ.1) GO TO 166
001544              READ(3) DUM1
001551              READ(3) DUM2
001556              DO 167 ID=1,IDS
001560              READ(3) DUM3
001565              READ(3) DUM4
001572        167 CONTINUE
001575              DO411 ID=3,5,2
001576              READ(3) DUM5
001603        411 CONTINUE
001605        166 CONTINUE
```

```
001605          READ(3) ISTART,ITIME,IPT,NTIME,NPT,MTIME,IPHI,IPSI,TIME,UZ
001634          READ(3) SPAIH,SRUAI,SRUVAI,SRU2PP
001647      481 CONTINUE
001647          WRITE(6,127) ISTART
001655          WRITE(6,122) ITIME,IPT
001665          WRITE(6,173) NTIME,NPT,MTIME
001677          WRITE(6,184) IPHI,IPSI
001707          WRITE(6,123) TIME
001715          WRITE(6,169) UZ
001723          WRITE(6,155)  SPAIH,SRUAI,SRUVAI,SRU2PP
001737      153 FORMAT(10X,10HITAPEI     =,I5 )
001737      154 FORMAT(10X,10HITAPEO     =,I5 )
001737      152 FORMAT(10X,10HIPUNO      =,I5 )
001737      156 FORMAT(/10X,10HIDIM      =,I5 )
001737      118 FORMAT( 10X,10HMONDIM    =,I5 )
001737      121 FORMAT( 10X,10HIDATA     =,I5 )
001737      101 FORMAT(/10X,10HIPRT      =,I5 )
001737      137 FORMAT(10X,10HIDEBUG     =,I5 )
001737      120 FORMAT( 10X,10HIDELTA    =,I5 )
001737      113 FORMAT( 10X,10HNBLADE    =,I5 )
001737      128 FORMAT( 10X,10HLBLADE    =,I5/)
001737      136 FORMAT( 10X,10HIPI       =,I5 )
001737      132 FORMAT( 10X,10HID,J,K-A =,3I5 )
001737      133 FORMAT( 10X,10HID,J,K-B =,3I5 )
001737      134 FORMAT( 10X,10HID,J,K-C =,3I5 )
001737      135 FORMAT( 10X,10HID,J,K-D =,3I5 )
001737      144 FORMAT( 10X,10HID,J,K-E =,3I5 )
001737      145 FORMAT( 10X,10HID,J,K-6 =,3I5 )
001737      108 FORMAT(/10X,10HIDS       =,I5/)
001737      129 FORMAT( 10X,4HIDP(,I1,5H)    =,7I5/)
001737      109 FORMAT( 10X,3HJI(,I1,6H)     =,I5,20X,3HJF(,I1,6H)     =,I5 )
001737      110 FORMAT(/10X,10HJS        =,I5,20X,10HKS        =,I5 )
001737      160 FORMAT(/10X,10HISLLE     =,I5,20X,10HISLTE     =,I5/)
001737      103 FORMAT( 10X,10HCE1       =,E15.8,10X,10HES1       =,E15.8 )
001737      105 FORMAT( 10X,10HRADLE1    =,E15.8 )
001737      130 FORMAT( 10X,10HYUXLE(1) =,E15.8,10X,10HYLXLE(1) =,E15.8/)
001737      111 FORMAT( 10X,5HYU(1,,I2,3H) =,E15.8,10X,5HYL(1,,I2,3H) =,E15.8 )
001737      104 FORMAT( 10X,10HCE2       =,E15.8,10X,10HES2       =,E15.8 )
001737      106 FORMAT( 10X,10HRADLE2    =,E15.8 )
001737      131 FORMAT( 10X,10HYUXLE(2) =,E15.8,10X,10HYLXLE(2) =,E15.8/)
001737      143 FORMAT(10X,10HJV (IN)   =,I5,20X,10HJV        =,,I5/)
001737      119 FORMAT( 10X,10HC4        =E15.8/)
001737      112 FORMAT( 10X,5HYU(2,,I2,3H) =,E15.8,10X,5HYL(2,,I2,3H) =,E15.8 )
001737      114 FORMAT( 10X,10HOMR(1)    =,E15.8,10X,10HOMR(2)   =,E15.8 )
001737      115 FORMAT( 10X,10HPI        =,E15.8,10X,10HTI       =,E15.8/
            1 10X,10HUI       =,E15.8,10X,10HVOUI      =,E15.8 )
001737      116 FORMAT( 10X,10HWM        =,E15.8,10X,10HGAMMA    =,E15.8 )
001737      161 FORMAT(/10X,10HREYCR     =,E15.8 )
001737      117 FORMAT( 10X,10HXMU       =,E15.8 )
001737      107 FORMAT( 10X,10HEN        =,E15.8,10X,10HKAY      =,;E15.8 )
001737      102 FORMAT(/10X,10HPHI       =,E15.8/)
001737      127 FORMAT(/10X,10HISTART    =,I5 )
001737      122 FORMAT( 10X,10HITIME     =,I5,20X,10HIPT       =,I5 )
001737      173 FORMAT( 10X,10HNTIME     =,I5,20X,10HNPT        =,I5/27X,10HMTIME
            1=,I5 )
001737      184 FORMAT( 10X,10HIPHI      =,I5,20X,10HIPSI      =,I5 )
001737      123 FORMAT(/10X,10HTIME      =,E15.8 )
001737      169 FORMAT( 10X,10HUZ        =,E15.8 )
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001737      155 FORMAT(/10X,10HSPAIH     =,E15.8,10X,10HSRUAJ     =,E15.8/
                1 10X,10HSRUVAI    =,E15.8,10X,10HSRU2PP    =,E15,8 )
001737      124 FORMAT(/14X,1HP,17X,1HT,17X,1HU,16X,3HV/U,10X,2HID,3X1HJ,3X,1HK
001737      138 FORMAT(  6X,4E18,8,3I4)
001737      125 FORMAT(1H1)
001737      126 FORMAT(1X)
001737          IF(IDIM.EQ.2) GO TO 42
001741          GEE=9.80665
001743          JAY=426.928
001745          GO TO 47
001745       42 GEE=32.174
001747          JAY=778.16
001751       47 CONTINUE
001751          RRR=1.986
001753          AI=SQRT(GAMMA*GEE*JAY*RRR*TI/WM)
001763          TR=GAMMA*TI
001765          XMUR=PI*CE1/AI
001767          WRITE(6,147) PI,AI,TR,XMUR
002003      147 FORMAT(/10X,10HPI(REF)  =,E15.8,10X,10HAI(REF)  =,E15.8/
                1 10X,10HTR(REF)  =,E15.8,10X,10HXMUR(REF)=,E15,8/)
002003          IF(NONDIM.EQ.1) GO TO 53
002005          OMR(1)=OMR(1)/AI
002007          OMR(2)=OMR(2)/AI
002010       53 CONTINUE
002010          IF(ITIME.NE.0) GO TO 164
002011          IF(IDATA.NE.0) GO TO 52
002012          WRITE(6,124)
002016          READ(5,10) PC,TC,UC,VOUC
002032          WRITE(6,138) PC,TC,UC,VOUC,IDS,JS,KS
002054          IF(NONDIM.EQ.1) GO TO 51
002056          PC=PC/PI
002060          TC=TC/TR
002061          UC=UC/AI
002063       51 CONTINUE
002063       52 CONTINUE
002063          IF(IDATA.EQ.0) GO TO 488
002064          WRITE(6,125)
002070          WRITE(6,124)
002074      488 CONTINUE
002074          DO 30 ID=1,IDS
002076          IDL102=1
002077          IF(ID.GT.4) IDL102=2
002102          J1=JI(ID)
002104          J2=JF(ID)
002106          DO 40 J=J1,J2
002110          DO 50 K=2,KS
002111          IF(IDATA.EQ.0) GO TO 60
002112          READ(5,10) PC,TC,UC,VOUC
002125          WRITE(6,138) PC,TC,UC,VOUC,ID,J,K
002147          IF(NONDIM.EQ.1) GO TO 60
002151          PC=PC/PI
002153          TC=TC/TR
002154          UC=UC/AI
002156       60 CONTINUE
002156          VC=VOUC*UC-OMR(IDL102)
002162          RC=PC/TC
002164          EC=TC/GAML1+0.5*(UC*UC+VC*VC-OMR(IDL102)**2)
002173          R2(ID,J,K)=RC
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002200          P2(ID,J,K)=PC
002204          U2(ID,J,K)=UC
002210          V2(ID,J,K)=VC
002214          E2(ID,J,K)=EC
002220          QC=SQRT(UC*UC+VC*VC)
002225          IF(QC.GT.UZ) UZ=QC
002230       50 CONTINUE
002233       40 CONTINUE
002235       30 CONTINUE
002240          GO TO 165
002240      164 CONTINUE
002240          WRITE(6,437) ITIME
002246      437 FORMAT(/10X,7HITIME =,I6//14X,2HP2,10X,2HT2,10X,2HU2,9X,5HV2/U2
                1 4X,2HID,3X,1HJ,3X,1HK,6X,2HP1,10X,2HT1,10X,2HU1,9X,5HV1/U1/)
002246      438 FORMAT(8X,4E12.4,3I4,4E12.4)
002246      158 DO 157 ID=1,IDS
002250          IDL102=1
002251          IF(ID.GT.4) IDL102=2
002254          J1=JI(ID)
002256          J2=JF(ID)
002260          IF(ITAPEI.EQ.0) GO TO 432
002261          READ(3) ((P2(ID,J,K),R2(ID,J,K),U2(ID,J,K),V2(ID,J,K),
                1 J=J1,J2),K=2,KS)
002320          READ(3) ((P1(ID,J,K),R1(ID,J,K),U1(ID,J,K),V1(ID,J,K),
                1 J=J1,J2),K=2,KS)
002357      432 CONTINUE
002357          WRITE(6,126)
002363          DO 163 J=J1,J2
002365          WRITE(6,126)
002370          DO 163 K=2,KS
002372          IF(ITAPEI.EQ.0) GO TO 435
002373          PC=P2(ID,J,K)
002400          RC=R2(ID,J,K)
002404          UC=U2(ID,J,K)
002410          VC=V2(ID,J,K)
002414          PD=P1(ID,J,K)
002420          RD=R1(ID,J,K)
002424          UD=U1(ID,J,K)
002430          VD=V1(ID,J,K)
002434          GO TO 436
002434      435 READ(5,10) PC,RC,UC,VC
002450          READ(5,10) PD,RD,UD,VD
002464          P2(ID,J,K)=PC
002472          R2(ID,J,K)=RC
002476          U2(ID,J,K)=UC
002502          V2(ID,J,K)=VC
002506          P1(ID,J,K)=PD
002512          R1(ID,J,K)=RD
002516          U1(ID,J,K)=UD
002522          V1(ID,J,K)=VD
002526      436 CONTINUE
002526          VOUC=VC/UC
002530          TC=PC/RC
002532          VOUD=VD/UD
002534          TD=PD/RD
002536          EC=TC/GAML1+0.5*(UC*UC+VC*VC-OMR(IDL102)**2)
002545          ED=TD/GAML1+0.5*(UD*UD+VD*VD-OMR(IDL102)**2)
002554          E2(ID,J,K)=EC
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002562          E1(ID,J,K)=ED
002566          IF(IPI.NE.1.AND.IPI.NE.3) GO TO 162
002575          WRITE(6,438) PC,TC,UC,VOUC,ID,J,K,PD,TD,UD,VOUD
002626      162 CONTINUE
002626      163 CONTINUE
002633      157 CONTINUE
002636          DO 410 ID=3,5,2
002637          IDL102=(ID-1)/2
002641          J1=JI(ID)
002643          J3=JF(ID)+1
002645          IF(ITAPEI.EQ.0) GO TO 412
002646          READ(8) ((DSU(IDL102,J,KI),DSL(IDL102,J,KI),KI=1,3),J=J1,J3)
002673          GO TO 410
002674      412 CONTINUE
002674          DO 413 J=J1,J3
002676          DO 413 KI=1,3
002677      413 READ(5,10) DSU(IDL102,J,KI),DSL(IDL102,J,KI)
002722      410 CONTINUE
002724          DO 419 IDL102=1,2
002726          WRITE(6,420) IDL102
002733      420 FORMAT(//10X,8HIDL102 =,I3//11X,1HJ,5X,6HDSU(3),6X,6HDSU(2),6X,
               16HDSU(1),6X,6HDSL(3),6X,6HDSL(2),6X,6HDSL(1)/)
002733          DO 421 J=2,JSP
002735          WRITE(6,422) J,DSU(IDL102,J,3),DSU(IDL102,J,2),DSU(IDL102,J,1),
               1DSL(IDL102,J,3),DSL(IDL102,J,2),DSL(IDL102,J,1)
002765      422 FORMAT( 10X,I2,6E12.4 )
002765      421 CONTINUE
002770      419 CONTINUE
002772      165 CONTINUE
002772          DOMR=OMR(2)-OMR(1)
002774          AOMR=ABS(DOMR)
002776          PII=1.0
002777          IF(NONDIM.EQ.1) GO TO 92
003001          UII=UI/AI
003003          TII=TI/TR
003005          XMU=XMU/XMUR
003007          GO TO 93
003007       92 UII=UI
003011          TII=TI
003012       93 CONTINUE
003012          RII=PII/TII
003014          VII=VOUI*UII-OMR(1)
003017          EII=TII/GAML1+0.5*(UII*UII+VII*VII-OMR(1)**2)
003026          DX=1.0/FLOAT(JS-2)
003031          DM=1.0/FLOAT(KS-2)
003034          DX1=CE1/FLOAT(JS-2)
003037          DX2=CE2/FLOAT(JS-2)
003042          DY1=ES1/FLOAT(KS-2)
003045          DY2=ES2/FLOAT(KS-2)
003050          DX4=C4/FLOAT(JS-2)
003053          DMIN=AMIN1(DX1,DX2,DY1,DY2,DX4)
003064          ESM=AMAX1(ES1,ES2)
003070          IF(DOMR.EQ.0.0) GO TO 17
003071          NN=1.0+3.0*(1.0+UZ)*ESM/(DMIN*AOMR*FLOAT(KS-2))
003104          NO=NN*(KS-2)
003110          NOM=NO/NOBL
003113          IF(NOM*NOBL.EQ.NO) GO TO 97
003115          NOM=NOM+1
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003117        97 NNN=NOM*NOBL
003122           MMM=NOM*NOBL
003124           IF(ITIME.EQ.0) ITIME=ITIME+NNN
003127           ITIMEF=NBLADE*NNN+NNN

003132           DT=1.0/(AOMR*FLOAT(NNN))
003135           GO TO 19
003135        17 DT=(DMIN/CE1)/(3.0*(1.0+UZ))
003142           ITIMEF=NBLADE+NNN
003144        19 CONTINUE

003144           IF(IDEBUG.NE.0) ITIMEF=IDEBUG+NNN
003147           WRITE(6,126)
003153           WRITE(6,139) ITIMEF
003161       139 FORMAT(/10X,10HITIMEF   =,I5/)
003161           RDX=1.0/DX
003163           R2DX=0.5/DX
003165           RDX2=1.0/(DX*DX)
003167           RDN=1.0/DN
003171           R2DN=0.5/DN
003172           RDN2=1.0/(DN*DN)
003174           RDT=1.0/DT
003176           R2DT=0.5/DT
003177           RDT2=1.0/(DT*DT)
003201           DTO2=0.5*DT
003202           IF(YL(IDL102,JSM)+1.0-YU(IDL102,JSM).GT.2.0*DN) GO TO  9
003214           GO TO 12
003214         9 WRITE(6,11)
003220        11 FORMAT(//1X,18HBLADE IS TOO THICK//)
003220           CALL EXIT
003221        12 CONTINUE
003221           DO 400 ID=3,5,2
003223           IDL102=(ID-1)/2
003225           IF(ISLLE.EQ.0) GO TO 501
003226           YU(IDL102,1)=YU(IDL102,2)+YL(IDL102,2)-0.5*(YU(IDL102,3)+
                1 YL(IDL102,3))+0.5
003234           YL(IDL102,1)=YU(IDL102,1)-1.0
003237           GO TO 502
003237       501 YU(IDL102,1)=YU(IDL102,2)*2.0-YU(IDL102,3)
003243           YL(IDL102,1)=YL(IDL102,2)*2.0-YL(IDL102,3)
003245       502 CONTINUE
003245           IF(ISLTE.EQ.0) GO TO 503
003246           YU(IDL102,JSP)=YU(IDL102,JS)+YL(IDL102,JS)-0.5*(YU(IDL102,JSM)+
                1 YL(IDL102,JSM))+0.5
003264           YL(IDL102,JSP)=YU(IDL102,JSP)-1.0
003271           GO TO 504
003271       503 YU(IDL102,JSP)=YU(IDL102,JS)*2.0-YU(IDL102,JSM)
003300           YL(IDL102,JSP)=YL(IDL102,JS)*2.0-YL(IDL102,JSM)
003305       504 CONTINUE
003305           DO 400 LK=1,3
003307           DSL(IDL102,1,LK)=0.0
003313           DSU(IDL102,1,LK)=0.0
003316       400 CONTINUE
003321           ITIMEI=ITIME
003323           IF(IBLEQ.EQ.0) GO TO 1035
003324           IF(ISTART.NE.0) GO TO 1035
003325           DO 1036 ITAPEX=1,2
003326           DO 1037 I=1,NNN
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003327          WRITE(ITAPEX)I,(P2(1,J,3),R2(1,J,3),U2(1,J,3),V2(1,J,3),
              1                P2(2,J,3),R2(2,J,3),U2(2,J,3),V2(2,J,3),
              1                P2(4,J,3),R2(4,J,3),U2(4,J,3),V2(4,J,3),
              1                P2(6,J,3),R2(6,J,3),U2(6,J,3),V2(6,J,3),
              1                P2(7,J,3),R2(7,J,3),U2(7,J,3),V2(7,J,3),
              1        P2(1,J,KSM),R2(1,J,KSM),U2(1,J,KSM),V2(1,J,KSM),
              1        P2(2,J,KSM),R2(2,J,KSM),U2(2,J,KSM),V2(2,J,KSM),
              1        P2(4,J,KSM),R2(4,J,KSM),U2(4,J,KSM),V2(4,J,KSM),
              1        P2(6,J,KSM),R2(6,J,KSM),U2(6,J,KSM),V2(6,J,KSM),
              1        P2(7,J,KSM),R2(7,J,KSM),U2(7,J,KSM),V2(7,J,KSM),J=2,JS),
              1     (P2(4,JV,K),R2(4,JV,K),U2(4,JV,K),V2(4,JV,K),
              1       P2(5, 2,K),R2(5, 2,K),U2(5, 2,K),V2(5, 2,K),K=2,KS)
              1 ,(P2(ID,2,3),R2(ID,2,3),U2(ID,2,3),V2(ID,2,3),
              1 P2(ID,2,KSM),R2(ID,2,KSM),U2(ID,2,KSM),V2(ID,2,KSM),
              1 P2(ID,JS, 3),R2(ID,JS, 3),U2(ID,JS, 3),V2(ID,JS, 3),
              1 P2(ID,JS,KSM),R2(ID,JS,KSM),U2(ID,JS,KSM),V2(ID,JS,KSM),ID=3,5
003662     1037 CONTINUE
003665          REWIND 1
003667          REWIND 2
003671     1036 CONTINUE
003673     1035 CONTINUE
003673          GO TO 75

003674      100 ITER=1
003675          CALL ITER1
003676          IABC=0
003677          CALL HOBDRY(IABC)
003701          CALL VEBRY1(IABC)
003703          CALL VEBRY2(IABC)

003705          ITAPEX=3
003706          WRITE(ITAPEX)ITIME,(P2(1,J,3),R2(1,J,3),U2(1,J,3),V2(1,J,3),
              1                P2(2,J,3),R2(2,J,3),U2(2,J,3),V2(2,J,3),
              1                P2(4,J,3),R2(4,J,3),U2(4,J,3),V2(4,J,3),
              1                P2(6,J,3),R2(6,J,3),U2(6,J,3),V2(6,J,3),
              1                P2(7,J,3),R2(7,J,3),U2(7,J,3),V2(7,J,3),
              1        P2(1,J,KSM),R2(1,J,KSM),U2(1,J,KSM),V2(1,J,KSM),
              1        P2(2,J,KSM),R2(2,J,KSM),U2(2,J,KSM),V2(2,J,KSM),
              1        P2(4,J,KSM),R2(4,J,KSM),U2(4,J,KSM),V2(4,J,KSM),
              1        P2(6,J,KSM),R2(6,J,KSM),U2(6,J,KSM),V2(6,J,KSM),
              1        P2(7,J,KSM),R2(7,J,KSM),U2(7,J,KSM),V2(7,J,KSM),J=2,JS),
              1     (P2(4,JV,K),R2(4,JV,K),U2(4,JV,K),V2(4,JV,K),
              1       P2(5, 2,K),R2(5, 2,K),U2(5, 2,K),V2(5, 2,K),K=2,KS)
              1 ,(P2(ID,2,3),R2(ID,2,3),U2(ID,2,3),V2(ID,2,3),
              1 P2(ID,2,KSM),R2(ID,2,KSM),U2(ID,2,KSM),V2(ID,2,KSM),
              1 P2(ID,JS, 3),R2(ID,JS, 3),U2(ID,JS, 3),V2(ID,JS, 3),
              1 P2(ID,JS,KSM),R2(ID,JS,KSM),U2(ID,JS,KSM),V2(ID,JS,KSM),ID=3,5
004241          REWIND 3
004243          IF(ITBUG.EG.1) GO TO 1330
004245       75 CONTINUE
004245          ITER=2
004246          IF(ISTART.EQ.0) GO TO 76
004247          CALL ITER2
004250       76 CONTINUE
004250          IF(ITIME.NE.NNN) GO TO 189
004251          DO 180 ID=3,5,2
004253          IDL102=(ID-1)/2
004255          IF(ID.EQ.5) GO TO 182
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004257              ESS=ES1
004260              CEE=CE1
004262              GO TO 183
004262       182 ESS=ES2
004264              CEE=CE2
004265       183 CONTINUE
004265              DO 180 J=2,JS
004267              DO 180 K=2,KS
004270              YDR=YL(IDL102,J+1)+DN*FLOAT(K-2)*(YU(IDL102,J+1)-YL(IDL102,J+1)
004303              YDL=YL(IDL102,J-1)+DN*FLOAT(K-2)*(YU(IDL102,J-1)-YL(IDL102,J-1)
004315              THET=ATAN((ESS/CEE)*(YDR-YDL)*R2DX)
004324              IF(                             J.EQ.JS.AND.(K.EQ.2.OR.K.EQ.KS)) TH
              1 ATAN((ESS/CEE)*(YL(IDL102,J+1)-YL(IDL102,J)))*RDX
004347              IF(                             J.EQ. 2.AND.(K.EQ.2.OR.K.EQ.KS)) TH
              1 ATAN((ESS/CEE)*(YL(IDL102,J)-YL(IDL102,J-1)))*RDX
004373              QVEL=SQRT(U2(ID,J,K)**2+V2(ID,J,K)**2)
004407              UC=QVEL*COS(THET)
004412              VC=QVEL*SIN(THET)
004415              IF(ABS(VC).LT.1.0E-14) VC=0.0
004421              U2(ID,J,K)=UC
004425              V2(ID,J,K)=VC
004427       180 CONTINUE
004436              DO 188 ID=4,7
004437              IF(ID.EQ.5) GO TO 188
004441              J1=JI(ID)
004442              J2=JF(ID)
004444              DO 187 J=J1,J2
004446              KSO2P1=KS/2+1
004451              DO 187 K=2,KS
004452              IF(ID.EQ.4) U2(4,J,K)=U2(3,JS,KSO2P1)
004464              IF(ID.EQ.4) V2(4,J,K)=V2(3,JS,KSO2P1)
004477              IF(ID.EQ.6.OR.ID.EQ.7) U2(ID,J,K)=U2(5,JS,KSO2P1)
004517              IF(ID.EQ.6.OR.ID.EQ.7) V2(ID,J,K)=V2(5,JS,KSO2P1)
004537       187 CONTINUE
004544       188 CONTINUE
004546       189 CONTINUE
004546              IABC=0
004547              CALL HOUDRY(IABC)
004551              IF(ITIME.NE.NNN) GO TO 330
004553              IF(IDELTA.EQ.0) GO TO 330
004554              ID=1
004555              ID1=2
004556              ID2=3
004557       306 ID=ID+2
004561              ID1=ID1+2
004562              ID2=ID2+2
004563              IDL102=(ID-1)/2
004565              J1=JI(ID)
004567              J2=JF(ID)
004570              DO 307 J=J1,J2
004572              DSUC=DSU(IDL102,J,3)
004575              DSLC=DSL(IDL102,J,3)
004577              DELTC=(DSLC+DSUC)/(FLOAT(KS-2)*(1.0-(DSLC+DSUC)))
004605              RJ2I=0.0
004606              RJI=0.0
004607              RJHI=0.0
004610              DO 308 K=2,KS
004611              PC=P2(ID,J,K)
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```
004616          RC=R2(ID,J,K)
004623          UC=U2(ID,J,K)
004630          VC=V2(ID,J,K)
004634          EC=PC/RC/GAML1+0.5*(UC*UC+VC*VC-OMR(IDL102)**2)
004644          DRU=RC*UC*DN
004646          DRU2=DRU*UC+PC*DN
004651          DRUH=DRU*(EC+PC/RC)
004655          IF(K.NE.2.AND.K.NE.KS) GO TO 309
004664          DRU=DRU*0.5
004665          DRU2=DRU2*0.5
004666          DRUH=DRUH*0.5
004667      309 RUI=RUI+DRU
004671          RU2I=RU2I+DRU2
004673          RUHI=RUHI+DRUH
004675      308 CONTINUE
004700          DELRU=DELTC*RUI
004702          DELRU2=DELTC*RU2I
004703          DELRUH=DELTC*RUHI
004705          DO 311 K=2,KS
004706          PC=P2(ID,J,K)
004713          RC=R2(ID,J,K)
004720          UC=U2(ID,J,K)
004725          VC=V2(ID,J,K)
004731          EC=PC/RC/GAML1+0.5*(UC*UC+VC*VC-OMR(IDL102)**2)
004741          RUC=RC*UC
004743          RU2C=RUC*UC+PC
004745          RUHC=RUC*(EC+PC/RC)
004751          RUC=RUC+DELRU
004753          RU2C=RU2C+DELRU2
004755          RUHC=RUHC+DELRUH
004757          VOUC=VC/UC
004761          CALL QSOLV(RUC,RUHC,RU2C,VOUC,PC)
004764          RU2C=RU2C-PC
004766          UC=RU2C/RUC
004770          RC=RUC/UC
004771          VC=VOUC*UC
004773          HC=RUHC/RUC
004774          EC=HC-PC/RC
004777          P2(ID,J,K)=PC
005004          R2(ID,J,K)=RC
005007          U2(ID,J,K)=UC
005013          V2(ID,J,K)=VC
005017          E2(ID,J,K)=EC
005023      311 CONTINUE
005026      307 CONTINUE
005030          IDR=ID
005032          IABC=IABC+1
005033          CALL BODDRY(IABC)
005035      305 CONTINUE
005035          DO 310 ID=ID1,ID2
005037          ESS=ES1
005041          IF(ID.GE.5) ESS=ES2
005045          DRU2=(DRAGU(1)+DRAGL(1)               )*(ESS/ES1)/FLOAT(KS-2)
005054          IF(ID.GE.6) DRU2=DRU2+(DRAGU(2)+DRAGL(2)           )/FLOAT(KS-2)
005065          J1=JI(ID)
005067          J2=JF(ID)
005071          DO 315 J=J1,J2
005073          DO 320 K=2,KS
```

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005074              PC=P2(ID,J,K)
005101              RC=R2(ID,J,K)
005106              UC=U2(ID,J,K)
005113              VC=V2(ID,J,K)
005117              EC=E2(ID,J,K)
005123              RUC=RC*UC
005125              RU2C=RUC*UC+PC-DRU2
005130              RUHC=RUC*(EC+PC/RC)
005134              VJUC=VC/UC
005136              CALL DSOLV(RUC,RUHC,RU2C,VOUC,PC)
005142              RU2C=RU2C-PC
005144              UC=RU2C/RUC
005146              RC=RUC/UC
005147              HC=RUHC/RUC
005151              EC=HC-PC/RC
005154              VC=VOUC*UC
005156              P2(ID,J,K)=PC
005163              R2(ID,J,K)=RC
005167              U2(ID,J,K)=UC
005173              V2(ID,J,K)=VC
005177              E2(ID,J,K)=EC
005203        320 CONTINUE
005205        315 CONTINUE
005207        310 CONTINUE
005212              IABC=IABC+1
005213              CALL HOBDRY(IABC)

005215              ID=IDR
005217              IF(ID.EQ.3) GO TO 306
005221        330 CONTINUE

005221              CALL VEBRY1(IABC)
005223              CALL VEBRY2(IABC)

005225              ITAPEX=4
005226              WRITE(ITAPEX)ITIME,(P2(1,J,3),R2(1,J,3),U2(1,J,3),V2(1,J,3),
              1                    P2(2,J,3),R2(2,J,3),U2(2,J,3),V2(2,J,3),
              1                    P2(4,J,3),R2(4,J,3),U2(4,J,3),V2(4,J,3),
              1                    P2(6,J,3),R2(6,J,3),U2(6,J,3),V2(6,J,3),
              1                    P2(7,J,3),R2(7,J,3),U2(7,J,3),V2(7,J,3),
              1      P2(1,J,KSM),R2(1,J,KSM),U2(1,J,KSM),V2(1,J,KSM),
              1      P2(2,J,KSM),R2(2,J,KSM),U2(2,J,KSM),V2(2,J,KSM),
              1      P2(4,J,KSM),R2(4,J,KSM),U2(4,J,KSM),V2(4,J,KSM),
              1      P2(6,J,KSM),R2(6,J,KSM),U2(6,J,KSM),V2(6,J,KSM),
              1      P2(7,J,KSM),R2(7,J,KSM),U2(7,J,KSM),V2(7,J,KSM),J=2,JS),
              1      (P2(4,JV,K),R2(4,JV,K),U2(4,JV,K),V2(4,JV,K),
              1        P2(5, 2,K),R2(5, 2,K),U2(5, 2,K),V2(5, 2,K),K=2,KS)
              1 ,(P2(ID,2,3),R2(ID,2,3),U2(ID,2,3),V2(ID,2,3),
              1 P2(ID,2,KSM),R2(ID,2,KSM),U2(ID,2,KSM),V2(ID,2,KSM),
              1 P2(ID,JS, 3),R2(ID,JS, 3),U2(ID,JS, 3),V2(ID,JS, 3),
              1 P2(ID,JS,KSM),R2(ID,JS,KSM),U2(ID,JS,KSM),V2(ID,JS,KSM),ID=3,5
005561              REWIND 4

005563              DO 380 ID=3,5,2
005565              IDL1O2=1
005566              IF(ID.GT.4) IDL1O2=2
005571              PAIHL=0.0
005572              PAIHU=0.0
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005573              KSM2=KS-2
005575              DO 376 K=2,KS,KSM2
005576              DO 377 J=2,JS
005577              PC=P2(ID,J,K)
005604              DPA=PC*DX
005606              IF(J.EQ.2.OR.J.EQ.JS) DPA=0.5*DPA
005616              IF(K.EQ.KS) GO TO 378
005620              PAIHL=PAIHL+DPA
005622              GO TO 379
005623          378 PAIHU=PAIHU+DPA
005625          379 CONTINUE
005625          377 CONTINUE
005630          376 CONTINUE
005632          380 PAIH(IDL102)=PAIHL-PAIHU
005637              IF(ISTART.EQ.0) GO TO 87
005640              IF(IPT.EQ.IPRT) GO TO 87
005642              IPT=IPT+1
005643              IF(NPT.EQ.NNN) GO TO 88
005645              NPT=NPT+1
005646              IF(ITIME.EQ.ITIMEF) GO TO 89
005650              IF(IDA.NE.0) WRITE(6,140) ITIME,IDA,JA,KA,P2(IDA,JA,KA),
                  1 R2(IDA,JA,KA),U2(IDA,JA,KA),V2(IDA,JA,KA),E2(IDA,JA,KA)
005722              IF(IDB.NE.0) WRITE(6,141)          IDB,JB,KB,P2(IDB,JB,KB),
                  1 R2(IDB,JB,KB),U2(IDB,JB,KB),V2(IDB,JB,KB),E2(IDB,JB,KB)
005773              IF(IDC.NE.0) WRITE(6,141)          IDC,JC,KC,P2(IDC,JC,KC),
                  1 R2(IDC,JC,KC),U2(IDC,JC,KC),V2(IDC,JC,KC),E2(IDC,JC,KC)
006044              IF(IDD.NE.0) WRITE(6,141)          IDD,JD,KD,P2(IDD,JD,KD),
                  1 R2(IDD,JD,KD),U2(IDD,JD,KD),V2(IDD,JD,KD),E2(IDD,JD,KD)
006115              IF(IDE.NE.0) WRITE(6,141)          IDE,JE,KE,P2(IDE,JE,KE),
                  1 R2(IDE,JE,KE),U2(IDE,JE,KE),V2(IDE,JE,KE),E2(IDE,JE,KE)
006166              IF(ID6.NE.0) WRITE(6,141)          ID6,J6,K6,P2(ID6,J6,K6),
                  1 R2(ID6,J6,K6),U2(ID6,J6,K6),V2(ID6,J6,K6),E2(ID6,J6,K6)
006237          140 FORMAT(/5X,23HITIME,ID,J,K,P,R,U,V,E=,4I4,5E13.5 )
006237          141 FORMAT(5X,23H        ID,J,K,P,R,U,V,E-,4X,3I4,5E13.5 )
006237              IF(IDC1.EQ.0) GO TO 314
006240              WRITE(6,177) IDC1,JC1,IDC2,JC2
006254          177 FORMAT(/5X,7HIDC1 = ,I3,3X,6HJC1 = ,I3,3X,7HIDC2 = ,I3,3X,6HJC2
                  1,I3/)
006254              WRITE(6,181)
006260          181 FORMAT( 3X,1HK,5X,1HP,11X,1HR,11X,1HU,11X,1HV,11X,1HE,12X,1HP,1
                  1 1HR,11X,1HU,11X,1HV,11X,1HE )
006260              DO 316 K=2,KS
006262              IF(IDC2.EQ.0) GO TO 317
006263              WRITE(6,178) K,P2(IDC1,JC1,K),R2(IDC1,JC1,K),U2(IDC1,JC1,K),
                  1 V2(IDC1,JC1,K),E2(IDC1,JC1,K),P2(IDC2,JC2,K),R2(IDC2,JC2,K),
                  2 U2(IDC2,JC2,K),V2(IDC2,JC2,K),E2(IDC2,JC2,K)
006345          178 FORMAT( 1X,I3,5E12.5,1X,5E12.5 )
006345              GO TO 316
006346          317 WRITE(6,178) K,P2(IDC1,JC1,K),R2(IDC1,JC1,K),U2(IDC1,JC1,K),
                  1 V2(IDC1,JC1,K),E2(IDC1,JC1,K)
006404          316 CONTINUE
006407          314 CONTINUE
006407              WRITE(6,179) PDAI(1),PDAI(2),PAIH(1),PAIH(2)
006423          179 FORMAT(/5X,10HPDAI(1) = ,E15.8,5X,10HPDAI(2) = ,E15.8,5X,
                  1 10HPAIH(1) = ,E15.8,5X,10HPAIH(2) = ,E15.8 )
006423              GO TO 276
006424           87 IPT=1
006425              IF(NPT.EQ.NNN) NPT=0
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006430              NPT=NPT+1
006432              GO TO 89
006432        88 CONTINUE
006432              NPT=1
006433        89 CONTINUE
006433              FLNTIT=FLOAT(NTIME)-0.5*FLOAT(2-ITER)
006440              IF(IPI.NE.2.AND.IPI.NE.3) GO TO 273
006450      1330 CONTINUE
006450              DO 275 ID=1,IDS
006452              IF(IDP(ID).EQ.0) GO TO 275
006453              IDL102=1
006454              IF(ID.GT.4) IDL102=2
006457              J1M=JI(ID)-1
006462              J2P=JF(ID)+1
006463              WRITE(6,125)
006467              DO 285 J=J1M,J2P
006471              GO TO (21,22,22,24,25,25,27) ID
006504        21 IF(J.EQ.2) X=-1.0E+20
006510              IF (J.EQ.2) GO TO 28
006512              IF(J.EQ.JS) X=0.0
006515              IF(J.EQ.JS) GO TO 28
006516              X=ALOG(DX*FLOAT(J-2))
006523              GO TO 28
006523        22 X=DX*FLOAT(J-2)
006527              GO TO 28
006527        24 X=C4/CE1*DX*FLOAT(J-2)
006534              GO TO 28
006535        25 X=CE2/CE1*DX*FLOAT(J-2)
006542              GO TO 28
006543        27 IF(J.NE.JS) GO TO 41
006545              X=1.0E20
006547              GO TO 28
006547        41 X=-ALOG(1.0-DX*FLOAT(J-2))
006556              IF(J.EQ.2) X=0.0
006561        28 CONTINUE
006561              RUC=0.0
006562              DO67 K=2,KS
006564              RC=R2(ID,J,K)
006571              UC=U2(ID,J,K)
006576              DRUC=RC*UC*DN
006601              IF(K.EQ.2.OR.K.EQ.KS) DRUC=0.5*DRUC
006611        67 RUC=RUC+DRUC
006616              IF(ID.EQ.3.OR.ID.EQ.5) RUC=RUC*(YU(IDL102,J)-YL(IDL102,J))

006632              WRITE(6,265) ITIME,TIME,ID,J,X,RUC
006652      265 FORMAT( //25X,7HITIME =,I3,8H   TIME =,1E13,5,6H  ID =,I3,5H  J
             1 I3,5H  X =,1E13,5, 9H    MDOT =,1E13,5/)
006652              WRITE(6,266)
006656      266 FORMAT(3X,1HK,7X,1HY,12X,1HP,10X,3HRHO,11X,1HU,12X,1HV,12X,1HE,
             1 12X,1HT,12X,1HH,12X,1HM,11X,2HCP/)
006656              DO 295 K=1,KSP
006660              PC=P2(ID,J,K)
006665              RC=R2(ID,J,K)
006672              UC=U2(ID,J,K)
006677              VC=V2(ID,J,K)
006703              EC=E2(ID,J,K)
006707              TC=PC/RC
006711              HC=EC+TC
```

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006713          XM=SQRT((UC*UC+VC*VC)*PII/(TC*RII))
006722          CP=(PC-PII)/(0.5*RII*SQRT(UII**2+VII**2))
006733          GO TO (31,31,33,34,35,36,36) ID
006746      31 Y=DN*FLOAT(K-2)
006752          GO TO 38
006752      33 CONTINUE
006752          Y=YL(1,J)+DSL(1,J,3)+DN*FLOAT(K-2)*(YU(1,J)-DSU(1,J,3)-YL(1,J)+
               1 DSL(1,J,3))
006767          IF(J.EQ.1.AND.(K.EQ.2.OR.K.EQ.KS))Y=0.5*(YL(1,1)+YU(1,1)-1.0)+
               1 DN*FLOAT(K-2)
007011          GO TO 38
007012      34 Y=YL(1,JS)+DN*FLOAT(K-2)
007020          GO TO 38
007020      35 CONTINUE
007020          Y=YL(1,JS)+YL(2,J)+DSL(2,J,3)+DN*FLOAT(K-2)*(YU(2,J)-DSU(2,J,3)-
               1 YL(2,J)-DSL(2,J,3))+DOMR*DT*FLNTIT
007043          IF(J.EQ.1.AND.(K.EQ.2.OR.K.EQ.KS))Y=0.5*(YL(2,1)+YU(2,1)-1.0)+
               1 DN*FLOAT(K-2)+YL(1,JS)+DOMR*DT*FLNTIT
007072          GO TO 38
007073      36 CONTINUE
007073          Y=YL(1,JS)+DOMR*DT*FLNTIT        +YL(2,JS)+DN*FLOAT(K-2)
007107      38 WRITE(6,267) K,Y,PC,RC,UC,VC,EC,TC,HC,XM,CP
007141     267 FORMAT(2X,I2,10E13.5)
007141     295 CONTINUE
007144     285 CONTINUE
007146          IF(ID.NE.3.AND.ID.NE.5) GO TO 274
007156          WRITE(6,288) IDL102,DRAGU(IDL102),DRAGL(IDL102),PDAIU(IDL102),
               1 PDAIL(IDL102),PDAI(IDL102)
007175     288 FORMAT(///1X,6HIDL102,4X,5HDRAGU,8X,5HDRAGL,8X,5HPDAIU,8X,5HPDA
               1 0X,4 IPDAI//6X,I1,5E13.5//)
007175          WRITE(6,287)
007201     287 FORMAT(/6X,1HJ,5X,3HDSU,10X,3HDSL/)
007201          DO 286 J=2,JSP
007203          WRITE(6,289) J,DSU(IDL102,J,3),DSL(IDL102,J,3)
007217     289 FORMAT( 5X,I2,2E13.5 )
007217     286 CONTINUE
007222     274 CONTINUE
007222          WRITE(6,299)
007226     299 FORMAT(/////)
007226     275 CONTINUE
007231     273 CONTINUE
007231          WRITE(6,374) SPAIH,SRUAI,SRUVAI,SRU2PP
               1 ,PAIH2,RUAI1,RUVAI1,RU2PPE,NT
007257     374 FORMAT(///10X,7HSPAIH =,E12.5,3X,7HSRUAI =,E12.5,3X,7HSRUVAI=,
               1 E12.5,3X,7HSRU2PP=,E12.5//10X,7HPAIH2 =,E12.5,3X,7HRUAI1 =,E12
               2 3X,7 IRUVAI1=,E12.5,3X,7HRU2PPE=,E12.5//10X,7HNT     =,I5//)
007257          WRITE(6,179) PDAI(1),PDAI(2),PAIH(1),PAIH(2)
007273     276 CONTINUE
007273          IF(ITER.EQ.1.AND.ITBUG.EQ.1) GO TO 75
007302          JTIME=NTIME
007303          KTIME=MTIME
007305          NTIME=NTIME+1
007306          IF(NTIME.EQ.NNN) NTIME=0
007311          MTIME=MTIME+1
007312          IF(MTIME.EQ.MMM) MTIME=0
007314     300 CONTINUE
007314          IF(ITIME.NE.ITIMEF) GO TO 333
007316          NPT=NPT+1
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007320              ISTART=0
007321              IF(ITAPEO.EQ.0) GO TO 452
007322              WRITE(6,1111) ITAPEO,ITIME,SPAIH,P2(1,J1,2),P1(1,J1,2),DSU(1,J1
007345         1111 FORMAT(//1X, 17H TAPE8 IS WRITTEN//1X,55HITAPEO,ITIME,SPAIH,P2(
                    11,2),P1(1,J1,2),DSU(1,J1,1) = , / 2I5,4E15,7/)
007345              WRITE(ITAPEO) ISTART,ITIME,IPT,NTIME,NPT,MTIME,IPHI,IPSI,TIME,U
007374              WRITE(ITAPEO) SPAIH,SRUAI,SRUVAI,SRU2PP
007407              DO 457 ID=1,IDS
007411              IDL102=(ID-1)/2
007413              J1=JI(ID)
007415              J2=JF(ID)
007416              WRITE(ITAPEO)((P2(ID,J,K),R2(ID,J,K),U2(ID,J,K),V2(ID,J,K),
                    1 J=J1,J2),K=2,KS)
007455              WRITE(ITAPEO)((P1(ID,J,K),R1(ID,J,K),U1(ID,J,K),V1(ID,J,K),
                    1 J=J1,J2),K=2,KS)
007514          457 CONTINUE
007517              DO 440 ID=3,5,2
007520              IDL102=(ID-1)/2
007522              J1=JI(ID)
007524              J3=JF(ID)+1
007526              WRITE(ITAPEO)((DSU(IDL102,J,KI),DSL(IDL102,J,KI),KI=1,3),J=J1,J
007553          440 CONTINUE
007555          452 CONTINUE
007555              IF(IPUNO.EQ.0) GO TO 463
007556              WRITE(IPUNC,15) ISTART
007564              WRITE(IPUNC,15) ITIME,IPT
007574              WRITE(IPUNC,15) JTIME,NPT,KTIME
007606              WRITE(IPUNC,15) IPHI,IPSI
007616              WRITE(IPUNC,10) TIME
007624              WRITE(IPUNC,10) SPAIH,SRUAI,SRUVAI,SRU2PP
007640              DO 462 ID=1,IDS
007642              J1=JI(ID)
007644              J2=JF(ID)
007645              DO 462 J=J1,J2
007647              DO 462 K=2,KS
007650              WRITE(IPUNC,10) P2(ID,J,K),R2(ID,J,K),U2(ID,J,K),V2(ID,J,K)
007677              WRITE(IPUNC,10) P1(ID,J,K),R1(ID,J,K),U1(ID,J,K),V1(ID,J,K)
007723          462 CONTINUE
007733              DO 453 ID=3,5,2
007734              IDL102=(ID-1)/2
007736              J1=JI(ID)
007740              J3=JF(ID)+1
007742              DO 453 J=J1,J3
007744              DO 453 KI=1,3
007745          453 WRITE(IPUNC,10) DSU(IDL102,J,K),DSL(IDL102,J,KI)
007774          463 CONTINUE
007774              CALL EXIT

007775          333 CONTINUE
007775              DO 270 ID=1,IDS
007777              J1M=JI(ID)-1
010001              J2P=JF(ID)+1
010003              DO 280 J=J1M,J2P
010005              IF(ID.EQ.3.OR.ID.EQ.5) GO TO 64
010014              GO TO 63
010014           64 IDL102=(ID-1)/2

010017              DSU(IDL102,J,1)=DSU(IDL102,J,2)
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010023              DSL(IDL1C2,J,1)=DSL(IDL102,J,2)
010026              DSU(IDL1C2,J,2)=DSU(IDL102,J,3)

010030              DSL(IDL1C2,J,2)=DSL(IDL102,J,3)
010032           63 CONTINUE
010032              DO 290 K=1,KSP
010034              P1(ID,J,K)=P2(ID,J,K)
010044              R1(ID,J,K)=R2(ID,J,K)
010047              U1(ID,J,K)=U2(ID,J,K)
010051              V1(ID,J,K)=V2(ID,J,K)
010054              E1(ID,J,K)=E2(ID,J,K)

010056          290 CONTINUE
010061          280 CONTINUE
010063          270 CONTINUE
010065              ISTART=1
010066              ITIME=ITIME+1
010070              TIME=TIME+DT
010072              IF(IPT.GT.IPRT) IPT=1
010075              IF(IPT.EQ.1.AND.IDA.NE.0) WRITE(6,125)
010106              GO TO 100

010107              END
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               SUBROUTINE ITER1
000002         DIMENSION    R1(7,13,13),P1(7,13,13),U1(7,13,13),V1(7,13,13),
              1 E1(7,13,13),R2(7,13,13),P2(7,13,13),U2(7,13,13),V2(7,13,13),
              2 E2(7,13,13),
              3 DSU(2,13,3),DSL(2,13,3),YU(2,13),YL(2,13),JI(7),JF(7)
              4 ,YUXLE(2),YLXLE(2),OMR(2)
              9 ,RLL(2,13),ULL(2,13),VLL(2,13),ELL(2,13)
              9 ,RRR(2,13),URR(2,13),VRR(2,13),ERR(2,13)
000002         COMMON R2,P2,U2,V2,E2
000002         COMMON/A/GAMMA,GAML1
000002         COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000002         COMMON/C/DSU,DSL
000002         COMMON/D/ ID,J,KJ,IDS,K
000002         COMMON/E/ JI,JF,JS,KS
000002         COMMON/F/YU,YL
000002         COMMON/G/ DX,RDX,R2DX,RDX2
000002         COMMON/H/DN,RDN,R2DN,RDN2
000002         COMMON/I/DT,RDT,R2DT,RDT2,DTO2
000002         COMMON/J/ES1,ES2,CE1,CE2,CS,CR,SS,SR,RADLE1,RADLE2,C4
000002         COMMON/K/ ISTART
000002         COMMON/L/RII,UII,EII,PII,VII
000002         COMMON/M/ XMU,IDELTA
000002         COMMON/N/ ITIME,NNN,NTIME
000002         COMMON/P/R1,P1,U1,V1,E1
000002         COMMON/O/JSM,JSP,KSM,KSP
000002         COMMON/R/ X,YY
000002         COMMON/U/ YUXLE,YLXLE
000002         COMMON/ZG/ COEFTH
000002         COMMON/ZD/ISLLE,ISLTE
000002         COMMON/ZF/ RLL,ULL,VLL,ELL,RLU,ULU,VLU,ELU,RRL,URL,VRL,ERL,RRU,
              1 URU,VRU,ERU,RRR,URR,VRR,ERR
000002         RADLE=RADLE1
000004         DO 70 ID=1,IDS
000005         IF(ID.EQ.5) RADLE=RADLE2
000010         IDL102=1
000011         IF(ID.GT.4) IDL102=2
000014         IF(IDL102.EQ.2) GO TO 13
000016         CEE=CE1
000020         ESS=ES1
000021         GO TO 14
000022      13 CONTINUE
000022         CEE=CE2
000024         ESS=ES2
000025      14 CONTINUE
000025         YXM=0.5*           (YUXLE(IDL102)+YLXLE(IDL102))
000031         THM=ATAN(YXM)
000033         YXN=0.5*((YL(IDL102,JS)+DSL(IDL102,JS,3)+YU(IDL102,JS)-DSU(IDL1
              1 JS,3)-1.0)-(YL(IDL102,JSM)+DSL(IDL102,JSM,3)+YU(IDL102,JSM)-
              2 DSU(IDL102,JSM,3)-1.0))*RDX*ESS/CEE
000061         THN=ATAN(YXN)
000063         J1=JI(ID)
000065         J2=JF(ID)
000066         DO 80 J=J1,J2
000070         X=FLOAT(J-2)*DX
000073         DO 90 K=2,KS
000075         YY=FLOAT(K-2)*DN
000100         RC=R1(ID,J,K)
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000106          PC=P1(ID,J,K)
000112          UC=U1(ID,J,K)
000116          VC=V1(ID,J,K)
000122          IF((ID.EQ.3.OR.ID.EQ.5),AND.(          J.EQ.JS),AND.(K.EQ.2,OR.
               1 K.EQ.KS)) GO TO 7
000144          GO TO 6
000145        7 IF(IDELTA.EQ.1) GO TO 8
000147          UC=U1(ID+1,2,K)
000153          VC=V1(ID+1,2,K)
000156        8 CONTINUE
000156        6 CONTINUE
000156          IF((ID.EQ.3.OR.ID.EQ.5.),AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))
               1 GO TO 63
000201          GO TO 64
000202       63 QC=SQRT(UC*UC+VC*VC)
000207          UC=QC*COS(THM)
000212          VC=QC*SIN(THM)
000215       64 CONTINUE
000215          EC=E1(ID,J,K)
000223          TC=PC/RC
000225          HC=EC+TC
000227          RL=R1(ID,J-1,K)
000234          PL=P1(ID,J-1,K)
000240          UL=U1(ID,J-1,K)
000244          VL=V1(ID,J-1,K)
000250          EL=E1(ID,J-1,K)
000254          TL=PL/RL
000256          HL=EL+TL
000260          IF((ID.EQ.3.OR.ID.EQ.5),AND.J.EQ.J2          ,AND.
               1 IDELTA.EQ.0) GO TO 40
000274          GO TO 41
000274       40 CONTINUE
000274          IF(K.EQ.2) GO TO 42
000276          IF(K.EQ.KS) GO TO 44
000300          IF(ISLTE.EQ.0) GO TO 41
000301          KP=K+1
000303          IF(2*(K-2).LE.(KS-2)) KP=K-1
000310          PP=P1(ID,J-1,KP)
000316          RP=R1(ID,J-1,KP)
000322          UP=U1(ID,J-1,KP)
000326          VP=V1(ID,J-1,KP)
000332          YL1=YL(IDL102,JSM)+DSL(IDL102,JSM,3)
000337          YU1=YU(IDL102,JSM)-DSU(IDL102,JSM,3)
000341          YL2=YL(IDL102,JS)+DSL(IDL102,JS,3)
000346          YU2=YU(IDL102,JS)-DSU(IDL102,JS,3)
000350          Y1=YL1+FLOAT(K-2)*DN*(YU1-YL1)
000357          Y2=Y1+FLOAT(KP-K)*DN*(YU1-YL1)
000366          Y3=YL2-YXN*DX*CEE/ESS+DN*FLOAT(K-2)*(YU2-YL2)
000402          CALL FAT(Y3,Y1,Y2,PL,PP,PL)
000406          CALL FAT(Y3,Y1,Y2,RL,RP,RL)
000412          CALL FAT(Y3,Y1,Y2,UL,UP,UL)
000416          CALL FAT(Y3,Y1,Y2,VL,VP,VL)
000422          HL=GAMMA/GAML1*PL/RL+0.5*(UL*UL+VL*VL-OMR(IDL102)**2)
000434          GO TO 47
000434       44 CONTINUE
000434          RP=R1(ID,J-1,2)
000440          PP=P1(ID,J-1,2)
000442          UP=U1(ID,J-1,2)
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000445              VP=V1(ID,J-1,2)
000447              GO TO 43
000450        42 RP=R1(ID,J-1,KS)
000456              PP=P1(ID,J-1,KS)
000462              UP=U1(ID,J-1,KS)
000466              VP=V1(ID,J-1,KS)
000472        43 CONTINUE
000472              CALL AVERAG (RL,PL,UL,VL,RP,PP,UP,VP,RL,PL,UL,VL,HL)
000507        47 CONTINUE
000507              TL=PL/RL
000511              EL=HL-TL
000513        41 CONTINUE
000513              IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS).AND.
                  1 (RADLE.NE.0.0)) GO TO 61
000541              RR=R1(ID,J+1,K)
000547              PR=P1(ID,J+1,K)
000553              UR=U1(ID,J+1,K)
000557              VR=V1(ID,J+1,K)
000563              ER=E1(ID,J+1,K)
000567              TR=PR/RR
000571              IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))
                  1 GO TO 30
000612              GO TO 31
000613        30 CONTINUE
000613              IF(K.EQ.2) GO TO 32
000615              RP=R1(ID,J+1,2)
000621              PP=P1(ID,J+1,2)
000623              UP=U1(ID,J+1,2)
000626              VP=V1(ID,J+1,2)
000630              GO TO 33
000631        32 RP=R1(ID,J+1,KS)
000637              PP=P1(ID,J+1,KS)
000643              UP=U1(ID,J+1,KS)
000647              VP=V1(ID,J+1,KS)
000653        33 CONTINUE
000653              CALL AVERAG (RR,PR,UR,VR,RP,PP,UP,VP,RR,PR,UR,VR,HR)
000670              TR=PR/RR
000672              ER=HR-TR
000674        31 CONTINUE
000674              GO TO 62
000675        61 RR=2.0*RC-RL
000700              PI=RC*VC*VC/RADLE
000703              PR=PC+PN*DX
000706              UR=-UL
000707              VR=2.0*VC-VL
000712              TR=PR/RR
000714              ER=TR/GAML1+0.5*(UR*UR+VR*VR-OMR(IDL102)**2)
000723        62 CONTINUE
000723              HR=ER+TR
000725              IF(IDELTA.EQ.1) GO TO 23
000727              IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.JS.AND.K.EQ.  3) GO TO 22
000745              GO TO 23
000745        22 RB=R1(ID+1,2,K-1)
000751              PB=P1(ID+1,2,K-1)
000754              UB=U1(ID+1,2,K-1)
000757              VB=V1(ID+1,2,K-1)
000762              EB=E1(ID+1,2,K-1)
000765              GO TO 24
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000766        23 CONTINUE
000766           RB=R1(ID,J,K-1)
000774           PB=P1(ID,J,K-1)
001000           UB=U1(ID,J,K-1)
001004           VB=V1(ID,J,K-1)
001010           EB=E1(ID,J,K-1)
001014        24 CONTINUE
001014           TB=PB/RB
001016           HB=EB+TB
001020           IF(IDELTA.EQ.1) GO TO 27
001022           IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.JS.AND.K.EQ.KSM) GO TO 26
001040           GO TO 27
001040        26 RT=R1(ID+1,2,K+1)
001044           PT=P1(ID+1,2,K+1)
001047           UT=U1(ID+1,2,K+1)
001052           VT=V1(ID+1,2,K+1)
001055           ET=E1(ID+1,2,K+1)
001060           GO TO 28
001061        27 CONTINUE
001061           RT=R1(ID,J,K+1)
001067           PT=P1(ID,J,K+1)
001073           UT=U1(ID,J,K+1)
001077           VT=V1(ID,J,K+1)
001103           ET=E1(ID,J,K+1)
001107        28 CONTINUE
001107           TT=PT/RT
001111           HT=ET+TT
001113           IF((ID.EQ.3.OR.ID.EQ.5).AND.(              J.EQ.JS)) GO TO 21
001127           GO TO 20
001130        21 CONTINUE
001130           RLL(IDL1C2,K)=RL
001133           ULL(IDL1C2,K)=UL
001135           VLL(IDL1C2,K)=VL
001137           ELL(IDL1C2,K)=EL
001141        20 CONTINUE
001141           IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2) GO TO 91
001154           GO TO 92
001154        91 RRR(IDL1C2,K)=RR
001157           URR(IDL1C2,K)=UR
001161           VRR(IDL1C2,K)=VR
001163           ERR(IDL1C2,K)=ER
001165        92 CONTINUE
001165           IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))GOTO
001207           GO TO 11
001210        10 CONTINUE
001210           GB=SQRT(UB*UB+VB*VB)
001215           THB=THM-ATAN(YUXLE(IDL102))+ATAN(VB/UB)
001226           UB=QB*COS(THB)
001232           VB=QB*SIN(THB)
001235        12 GT=SQRT(UT*UT+VT*VT)
001242           THT=THM-ATAN(YLXLE(IDL102))+ATAN(VT/UT)
001253           UT=QT*COS(THT)
001257           VT=QT*SIN(THT)
001262        11 CONTINUE
001262           IF(COEFTH.EQ.0.0) GO TO 121
001263           IF(ID.NE.3.AND.ID.NE.5) GO TO 121
001273           IF(J.NE.2.AND.J.NE.JS) GO TO 121
001302           IF(K.GT.3.AND.K.LT.KSM) GO TO 121
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001312          THC=ATAN(VC/UC)
001316          IF(K.EQ.KSM) GO TO 122
001320          QB=SGRT(UB*UB+VB*VB)
001325          THB=(1.0-COEFTH)*ATAN(VB/UB)+COEFTH*THC
001335          UB=QB*COS(THB)
001340          VB=QE*SIN(THB)
001343          IF(K.EQ.3) GO TO 121
001345      122 QT=SGRT(UT*UT+VT*VT)
001352          THT=(1.0-COEFTH)*ATAN(VT/UT)+COEFTH*THC
001362          UT=QT*COS(THT)
001365          VT=QT*SIN(THT)
001370      121 CONTINUE
001370          FF1X=(RR*UR-RL*UL)*R2DX
001375          FF2X=(RR*UR*HR-RL*UL*HL)*R2DX
001403          FF3X=(RR*UR*UR+PR-RL*UL*UL-PL)*R2DX
001412          FF4X=(RR*UR*VR-RL*UL*VL)*R2DX
001420          GG1N=(RT*VT-RB*VB)*R2DN
001424          GG2N=(RT*VT*HT-RB*VB*HB)*R2DN
001433          GG3N=(RT*VT*UT-RB*VB*UB)*R2DN
001441          GG4N=(RT*VT*VT-RB*VB*VB+PT-PB)*R2DN
001450          EE1A=0.25*(RR+RL+RT+RB)
001455          EE2A=0.25*(RR*ER+RL*EL+RT*ET+RB*EB)
001466          EE3A=0.25*(RR*UR+RL*UL+RT*UT+RB*UB)
001476          EE4A=0.25*(RR*VR+RL*VL+RT*VT+RB*VB)
001506          GO TO (101,102,103,104,105,106,107) ID
001521      101 C1=1.0
001523          C2=CS/SS
001525          GO TO 111
001525      102 C1=1.0
001527          C2=CS/SS
001531          GO TO 112
001531      103 C1=1.0
001533          C2=CS
001534          GO TO 113
001535      104 C1=CS/C4
001537          C2=CS/SS
001541          GO TO 112
001541      105 C1=CS/CR
001543          C2=CS
001544          GO TO 113
001544      106 C1=CS/CR
001546          C2=CS/SR
001550          GO TO 112
001550      107 C1=CS/CR
001552          C2=CS/SR
001554          GO TO 110
001554      110 EE1P=EE1A-DTO2*(C1*(1.0-X)*FF1X+C2*GG1N)
001564          EE2P=EE2A-DTO2*(C1*(1.0-X)*FF2X+C2*GG2N)
001573          EE3P=EE3A-DTO2*(C1*(1.0-X)*FF3X+C2*GG3N)
001603          EE4P=EE4A-DTO2*(C1*(1.0-X)*FF4X+C2*GG4N)
001612          GO TO 120
001613      111 EE1P=EE1A-DTO2*(C1*X*FF1X+C2*GG1N)
001622          EE2P=EE2A-DTO2*(C1*X*FF2X+C2*GG2N)
001630          EE3P=EE3A-DTO2*(C1*X*FF3X+C2*GG3N)
001637          EE4P=EE4A-DTO2*(C1*X*FF4X+C2*GG4N)
001645          GO TO 120
001646      112 EE1P=EE1A-DTO2*(C1*FF1X+C2*GG1N)
001654          EE2P=EE2A-DTO2*(C1*FF2X+C2*GG2N)
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001662          EE2P=EE2A-DTO2*(C1*FF2X+C2*GG2N)
001670          EE3P=EE3A-DTO2*(C1*FF3X+C2*GG3N)
001676          EE4P=EE4A-DTO2*(C1*FF4X+C2*GG4N)
001704          GO TO 120
001705    113 EE1N=(RT-RB)*R2DN
001710          EE2N=(RT*ET-RB*EB)*R2DN
001714          EE3N=(RT*UT-RB*UB)*R2DN
001720          EE4N=(RT*VT-RB*VB)*R2DN
001724          FF1N=(RT*UT-RB*UB)*R2DN
001730          FF2N=(RT*UT*HT-RB*UB*HB)*R2DN
001736          FF3N=(RT*UT*UT+PT-RB*UB*UB-PB)*R2DN
001745          FF4N=(RT*UT*VT-RB*UB*VB)*R2DN

001753          IF(J.EQ.2) GO TO 85
001755          DSUC=DSU(IDL102,J, 3)
001757          DSLC=DSL(IDL102,J, 2)
001761          DSXU=(DSU(IDL102,J+1,2)-DSU(IDL102,J-1,2))*R2DX
001767          DSXL=(DSL(IDL102,J+1,2)-DSL(IDL102,J-1,2))*R2DX
001773          DSTL=(DSLC-DSL(IDL102,J,1))*RDT
001777          DSTU=(DSUC-DSU(IDL102,J,1))*RDT
002003          YT=YY*(-DSTU)+(1.0-YY)*(DSTL)
002007          IF(J.EQ.JS.AND.IDELTA.EQ.0.AND.(ISLTE.EQ.1        ))GO TO 83
002022          YX=YY*((YU(IDL102,J+1)-YU(IDL102,J-1))*R2DX-DSXU)+(1.0-YY)*
               1 ((YL(IDL102,J+1)-YL(IDL102,J-1))*R2DX+DSXL)
002042          GO TO 84
002043     83 YX=YXM*CEE/ESS
002046     84 CONTINUE
002046          YN=YU(IDL102,J)-DSUC-YL(IDL102,J)-DSLC
002056          GO TO 86
002056     85 YT=0.0
002057          YN=YU(IDL102,2)-YL(IDL102,2)
002062          YUX=YUXLE(IDL102)*CEE/ESS
002064          YLX=YLXLE(IDL102)*CEE/ESS
002066          YX=YY*YUX+(1.0-YY)*YLX
002072          IF(K.EQ.2.OR.K.EQ.KS) YX=YXM*CEE/ESS
002104     86 CONTINUE

002104          CQ=C2/ESS
002106          EE1P=EE1A-DTO2*(C1*FF1X+(CQ*GG1N-(C1*YX*FF1N+YT*EE1N))/YN)
002121          EE2P=EE2A-DTO2*(C1*FF2X+(CQ*GG2N-(C1*YX*FF2N+YT*EE2N))/YN)
002134          EE3P=EE3A-DTO2*(C1*FF3X+(CQ*GG3N-(C1*YX*FF3N+YT*EE3N))/YN)
002147          EE4P=EE4A-DTO2*(C1*FF4X+(CQ*GG4N-(C1*YX*FF4N+YT*EE4N))/YN)
002162          GO TO 120

002163    120 RP=EE1P
002165          EP=EE2P/RP
002166          UP=EE3P/RP
002170          VP=EE4P/RP
002171          Q2=0.5*(UP*UP+VP*VP-OMR(IDL102)**2)
002177          TP=GAML1*(EP-Q2)
002202          PP=RP*TP
002203          R2(ID,J,K)=RP
002210          P2(ID,J,K)=PP
002214          U2(ID,J,K)=UP
002220          V2(ID,J,K)=VP
002224          E2(ID,J,K)=EP

002230     90 CONTINUE
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002232        80 CONTINUE
002234        70 CONTINUE
002237           RETURN
002237           END
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                    SUBROUTINE ITER2
000002              DIMENSION    R1(7,13,13),P1(7,13,13),U1(7,13,13),V1(7,13,13),
                   1 E1(7,13,13),R2(7,13,13),P2(7,13,13),U2(7,13,13),V2(7,13,13),
                   2 E2(7,13,13),RJL(13),PJL(13),UJL(13),VJL(13),EJL(13),
                   3 DSU(2,13,3),DSL(2,13,3),YU(2,13),YL(2,13),JI(7),JF(7)
                   4 ,YUXLE(2),YLXLE(2),OMR(2)
                   9 ,RLL(2,13),ULL(2,13),VLL(2,13),ELL(2,13)
                   9 ,RRR(2,13),URR(2,13),VRR(2,13),ERR(2,13)
000002              COMMON R2,P2,U2,V2,E2
000002              COMMON/A/GAMMA,GAML1
000002              COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000002              COMMON/C/DSU,DSL
000002              COMMON/D/ ID,J,KJ,IDS,K
000002              COMMON/E/ JI,JF,JS,KS
000002              COMMON/F/YU,YL
000002              COMMON/G/ DX,RDX,R2DX,RDX2
000002              COMMON/H/DN,RDN,R2DN,RDN2
000002              COMMON/I/DT,RDT,R2DT,RDT2,DTO2
000002              COMMON/J/ES1,ES2,CE1,CE2,CS,CR,SS,SR,RADLE1,RADLE2,C4
000002              COMMON/K/ ISTART
000002              COMMON/L/RII,UII,EII,PII,VII
000002              COMMON/M/ XMU,IDELTA
000002              COMMON/N/ ITIME,NON,NTIME
000002              COMMON/P/R1,P1,U1,V1,E1
000002              COMMON/Q/JSM,JSP,KSM,KSP
000002              COMMON/R/ X,YY
000002              COMMON/U/ YUXLE,YLXLE
000002              COMMON/ZG/ COEFTH
000002              COMMON/ZD/ISLLE,ISLTE
000002              COMMON/ZF/ RLL,ULL,VLL,ELL,RLU,ULU,VLU,ELU,RRL,URL,VRL,ERL,RRU,
                   1 URU,VRU,ERU,RRR,URR,VRR,ERR
000002              Z=PHI/3.0
000004              RADLE=RADLE1
000006              DO 170 ID=1,IDS
000007              IF(ID.EQ.5) RADLE=RADLE2
000012              IDL102=1
000013              IF(ID.GT.4) IDL102=2
000016              IF(IDL102.EQ.2) GO TO 13
000020              CEE=CE1
000022              ESS=ES1
000023              GO TO 14
000024        13 CONTINUE
000024              CEE=CE2
000026              ESS=ES2
000027        14 CONTINUE
000027              YXM=0.5*          (YUXLE(IDL102)+YLXLE(IDL102))
000033              THM=ATAN(YXM)
000035              YXN=0.5*((YL(IDL102,JS)+DSL(IDL102,JS,3)+YU(IDL102,JS)-DSU(IDL1
                   1 JS,3)-1.0)-(YL(IDL102,JSM)+DSL(IDL102,JSM,3)+YU(IDL102,JSM)-
                   2 DSU(IDL102,JSM,3)-1.0))*RDX*ESS/CEE
000063              THN=ATAN(YXN)
000065              J1=JI(ID)
000067              J2=JF(ID)
000070              DO 180 J=J1,J2
000072              X=FLOAT(J-2)*DX
000075              DO 190 K=2,KS
000077              YY=FLOAT(K-2)*DN
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000102          IF(ISTART.EQ.0) GO TO 76
000103          RC=R1(ID,J,K)
000111          RL=R1(ID,J-1,K)
000115          RR=R1(ID,J+1,K)
000121          UC=U1(ID,J,K)
000125          VC=V1(ID,J,K)
000131          IF((ID.EG.3.OR.ID.EQ.5),AND.(              J.EQ.JS),AND.(K.EQ.2,OR.
               1 K.EQ.KS)) GO TO 7
000153          GO TO 6
000154        7 IF(IDELTA.EQ.1) GO TO 8
000156          UC=U1(ID+1,2,K)
000162          VC=V1(ID+1,2,K)
000165        8 CONTINUE
000165        6 CONTINUE
000165          IF((ID.EG.3.OR.ID.EQ.5.),AND.J.EQ.2.AND.(K.EQ.2,OR.K.EQ.KS))
               1 GO TO 63
000210          GO TO 64
000211       63 QC=SQRT(UC*UC+VC*VC)
000216          UC=OC*COS(THM)
000221          VC=OC*SIN(THM)
000224       64 CONTINUE
000224          EC=E1(ID,J,K)
000232          UR=U1(ID,J+1,K)
000236          VR=V1(ID,J+1,K)
000242          ER=E1(ID,J+1,K)
000246          UL=U1(ID,J-1,K)
000252          VL=V1(ID,J-1,K)
000256          EL=E1(ID,J-1,K)
000262          IF((ID.EG.3.OR.ID.EQ.5),AND.(              J.EQ.JS)) GO TO 21
000275          GO TO 25
000276       21 CONTINUE
000276          RL=RLL(IDL102,K)
000301          UL=ULL(IDL102,K)
000303          VL=VLL(IDL102,K)
000305          EL=ELL(IDL102,K)
000307       25 CONTINUE
000307          IF((ID.EG.3.OR.ID.EQ.5),AND.J.EQ.2.AND.(K.EQ.2,OR.K.EQ.KS))
               1 GO TO 91
000331          GO TO 92
000332       91 CONTINUE
000332          RR=RRR(IDL102,K)
000335          UR=URR(IDL102,K)
000337          VR=VRR(IDL102,K)
000341          ER=ERR(IDL102,K)
000343       92 CONTINUE
000343          IF(IDELTA.EQ.1) GO TO 23
000345          IF((ID.EG.3.OR.ID.EQ.5),AND.J.EQ.JS.AND.K.EQ,  3) GO TO 22
000363          GO TO 23
000363       22 RB=R1(ID+1,2,K-1)
000367          PB=P1(ID+1,2,K-1)
000372          UB=U1(ID+1,2,K-1)
000375          VB=V1(ID+1,2,K-1)
000400          EB=E1(ID+1,2,K-1)
000403          GO TO 24
000404       23 CONTINUE
000404          RB=R1(ID,J,K-1)
000412          UB=U1(ID,J,K-1)
000416          VB=V1(ID,J,K-1)
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000422              EB=E1(ID,J,K-1)
000426          24 CONTINUE
000426              IF(IDELTA.EQ.1) GO TO 27
000430              IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.JS.AND.K.EQ.KSM) GO TO 26
000446              GO TO 27
000446          26 RT=R1(ID+1,2,K+1)
000452              PT=P1(ID+1,2,K+1)
000455              UT=U1(ID+1,2,K+1)
000460              VT=V1(ID+1,2,K+1)
000463              ET=E1(ID+1,2,K+1)
000466              GO TO 28
000467          27 CONTINUE
000467              RT=R1(ID,J,K+1)
000475              UT=U1(ID,J,K+1)
000501              VT=V1(ID,J,K+1)
000505              ET=E1(ID,J,K+1)
000511          28 CONTINUE
000511              IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))GOTO
000533              GO TO 11
000534          10 CONTINUE
000534              QB=SQRT(UB*UB+VB*VB)
000541              THB=THM-ATAN(YUXLE(IDL102))+ATAN(VB/UB)
000552              UB=QB*COS(THB)
000556              VB=QB*SIN(THB)
000561          12 QT=SQRT(UT*UT+VT*VT)
000566              THT=THM-ATAN(YLXLE(IDL102))+ATAN(VT/UT)
000577              UT=QT*COS(THT)
000603              VT=QT*SIN(THT)
000606          11 CONTINUE
000606              IF(COEFTH.EQ.0.0) GO TO 121
000607              IF(ID.NE.3.AND.ID.NE.5) GO TO 121
000617              IF(J.NE.2.AND.J.NE.JS) GO TO 121
000626              IF(K.GT.3.AND.K.LT.KSM) GO TO 121
000636              THC=ATAN(VC/UC)
000642              IF(K.EQ.KSM) GO TO 122
000644              QB=SQRT(UB*UB+VB*VB)
000651              THB=(1.0-COEFTH)*ATAN(VB/UB)+COEFTH*THC
000661              UB=QB*COS(THB)
000664              VB=QB*SIN(THB)
000667              IF(K.EQ.3) GO TO 121
000671         122 QT=SQRT(UT*UT+VT*VT)
000676              THT=(1.0-COEFTH)*ATAN(VT/UT)+COEFTH*THC
000706              UT=QT*COS(THT)
000711              VT=QT*SIN(THT)
000714         121 CONTINUE
000714              EE1C=RC
000716              EE2C=RC*EC
000720              EE3C=RC*UC
000722              EE4C=RC*VC
000724              EE1A=0.25*(RL+RR+RT+RB)
000731              EE2A=0.25*(RL*EL+RR*ER+RB*EB+RT*ET)
000742              EE3A=0.25*(RL*UL+RR*UR+RB*UB+RT*UT)
000752              EE4A=0.25*(RL*VL+RR*VR+RB*VB+RT*VT)
000762              EE1D=EE1A-EE1C
000764              EE2D=EE2A-EE2C
000766              EE3D=EE3A-EE3C
000770              EE4D=EE4A-EE4C
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000772        76 CONTINUE
000772           RC=R2(ID,J,K)
001000           PC=P2(ID,J,K)
001004           UC=U2(ID,J,K)
001010           VC=V2(ID,J,K)
001014           IF((ID.EQ.3.OR.ID.EQ.5).AND.(          J.EQ.JS).AND.(K.EQ.2.OR.
               1 K.EQ.KS)) GO TO 3
001036           GO TO 2
001037         3 IF(IDELTA.EQ.1) GO TO 4
001041           UC=U2(ID+1,2,K)
001045           VC=V2(ID+1,2,K)
001050         4 CONTINUE
001050         2 CONTINUE
001050           IF((ID.EQ.3.OR.ID.EQ.5.).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))
               1 GO TO 65
001073           GO TO 66
001074        65 QC=SQRT(UC*UC+VC*VC)
001101           UC=QC*COS(THM)
001104           VC=QC*SIN(THM)
001107        66 CONTINUE
001107           EC=E2(ID,J,K)
001115           TC=PC/RC
001117           HC=EC+TC
001121           IF(ISTART.EQ.0) GO TO 222
001122           IF(J.EQ.J1) GO TO 130
001124           RL=RJL(K)
001126           PL=PJL(K)
001127           UL=UJL(K)
001131           VL=VJL(K)
001132           EL=EJL(K)
001134           GO TO 131
001134       130 CONTINUE
001134           RL=R2(ID,J-1,K)
001142           PL=P2(ID,J-1,K)
001146           UL=U2(ID,J-1,K)
001152           VL=V2(ID,J-1,K)
001156           EL=E2(ID,J-1,K)
001162       131 CONTINUE
001162           TL=PL/RL
001164           HL=EL+TL
001166           IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.JS          .AND
               1 IDELTA.EQ.0) GO TO 31
001203           GO TO 32
001203        31 CONTINUE
001203           IF(K.EQ.2) GO TO 36
001205           IF(K.EQ.KS) GO TO 33
001207           IF(ISLTE.EQ.0) GO TO 32
001210           KP=K+1
001212           IF(2*(K-2).LE.(KS-2)) KP=K-1
001217           PP=PJL(KP)
001221           RP=RJL(KP)
001223           UP=UJL(KP)
001224           VP=VJL(KP)
001226           YL1=YL(IDL102,JSM)+DSL(IDL102,JSM,3)
001233           YU1=YU(IDL102,JSM)-DSU(IDL102,JSM,3)
001235           YL2=YL(IDL102,JS)+DSL(IDL102,JS,3)
001242           YU2=YU(IDL102,JS)-DSU(IDL102,JS,3)
001244           Y1=YL1+FLOAT(K-2)*DN*(YU1-YL1)
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001253          Y2=Y1+FLOAT(KP-K)*DN*(YU1-YL1)
001262          Y3=YL2-YXN*DX*CEE/ESS+DN*FLOAT(K-2)*(YU2-YL2)
001276          CALL FAT(Y3,Y1,Y2,PL,PP,PL)
001302          CALL FAT(Y3,Y1,Y2,RL,RP,RL)
001306          CALL FAT(Y3,Y1,Y2,UL,UP,UL)
001312          CALL FAT(Y3,Y1,Y2,VL,VP,VL)
001316          HL=GAMMA/GAML1*PL/RL+0.5*(UL*UL+VL*VL-OMR(IDL102)**2)
001330          GO TO 37
001330       36 CONTINUE
001330          RP=RJL(KS)
001332          PP=PJL(KS)
001334          UP=UJL(KS)
001335          VP=VJL(KS)
001337          GO TO 34
001337       33 CONTINUE
001337          RP=RJL(2)
001341          PP=PJL(2)
001342          UP=UJL(2)
001344          VP=VJL(2)
001345       34 CONTINUE
001345          CALL AVERAG (RL,PL,UL,VL,RP,PP,UP,VP,RL,PL,UL,VL,HL)
001362       37 CONTINUE
001362          TL=PL/RL
001364          EL=UL-TL
001366       32 CONTINUE
001366          IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS).AND.
               1 (RADLE.NE.0.0)) GO TO 61
001414          RR=R2(ID,J+1,K)
001422          PR=P2(ID,J+1,K)
001426          UR=U2(ID,J+1,K)
001432          VR=V2(ID,J+1,K)
001436          ER=E2(ID,J+1,K)
001442          TR=PR/RR
001444          IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))
               1 GO TO 41
001465          GO TO 42
001466       41 CONTINUE
001466          IF(K.EQ.KS) GO TO 43
001470          RP=R2(ID,J+1,KS)
001475          PP=P2(ID,J+1,KS)
001502          UP=U2(ID,J+1,KS)
001507          VP=V2(ID,J+1,KS)
001513          GO TO 44
001513       43 RP=R2(ID,J+1,2)
001517          PP=P2(ID,J+1,2)
001521          UP=U2(ID,J+1,2)
001524          VP=V2(ID,J+1,2)
001526       44 CONTINUE
001526          CALL AVERAG (RR,PR,UR,VR,RP,PP,UP,VP,RR,PR,UR,VR,HR)
001543          TR=PR/RR
001545          ER=UR-TR
001547       42 CONTINUE
001547          GO TO 62
001550       61 RR=2.0*RC-RL
001553          PJ=RC*VC*VC/RADLE
001556          PR=PC+PJ*DX
001561          UR=-UL
001562          VR=2.0*VC-VL
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001565          TR=PR/RR
001567          ER=TR/GAML1+0.5*(UR*UR+VR*VR-OMR(IDL102)**2)
001576       62 CONTINUE
001576          HR=ER+TR
001600          IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.JS.AND.K.EQ.   3) GO TO 48
001616          GO TO 49
001616       48 RB=R2(ID+1,2,K-1)
001622          PB=P2(ID+1,2,K-1)
001625          UB=U2(ID+1,2,K-1)
001630          VB=V2(ID+1,2,K-1)
001633          EB=E2(ID+1,2,K-1)
001636          GO TO 136
001637       49 CONTINUE
001637          IF(K.EQ.2) GO TO 135
001641          RB=RKB
001643          PB=PKB
001644          UB=UKB
001646          VB=VKB
001647          EB=EKB
001651          GO TO 136
001651      135 CONTINUE
001651          RB=R2(ID,J,K-1)
001657          PB=P2(ID,J,K-1)
001663          UB=U2(ID,J,K-1)
001667          VB=V2(ID,J,K-1)
001673          EB=E2(ID,J,K-1)
001677      136 CONTINUE
001677          TB=PB/RB
001701          HB=EB+TB
001703          IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.JS.AND.K.EQ.KSM) GO TO 51
001721          GO TO 52
001721       51 RT=R2(ID+1,2,K+1)
001725          PT=P2(ID+1,2,K+1)
001730          UT=U2(ID+1,2,K+1)
001733          VT=V2(ID+1,2,K+1)
001736          ET=E2(ID+1,2,K+1)
001741          GO TO 53
001742       52 CONTINUE
001742          RT=R2(ID,J,K+1)
001750          PT=P2(ID,J,K+1)
001754          UT=U2(ID,J,K+1)
001760          VT=V2(ID,J,K+1)
001764          ET=E2(ID,J,K+1)
001770       53 CONTINUE
001770          TT=PT/RT
001772          HT=ET+TT
001774          IF((ID.EQ.3.OR.ID.EQ.5).AND.J.EQ.2.AND.(K.EQ.2.OR.K.EQ.KS))GOTO
002016          GO TO 17
002017       16 CONTINUE
002017          QB=SQRT(UB*UB+VB*VB)
002024          THB=THM-ATAN(YUXLE(IDL102))+ATAN(VB/UB)
002035          UB=QB*COS(THB)
002041          VB=QB*SIN(THB)
002044       18 QT=SQRT(UT*UT+VT*VT)
002051          THT=THM-ATAN(YLXLE(IDL102))+ATAN(VT/UT)
002062          UT=QT*COS(THT)
002066          VT=QT*SIN(THT)
002071       17 CONTINUE
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002071          IF(COEFTH.EQ.0.0) GO TO 123
002072          IF(ID.NE.3.AND.ID.NE.5) GO TO 123
002102          IF(J.NE.2.AND.J.NE.JS) GO TO 123
002111          IF(K.GT.3.AND.K.LT.KSM) GO TO 123
002121          THC=ATAN(VC/UC)
002125          IF(K.EQ.KSM) GO TO 124
002127          QB=SQRT(UB*UB+VB*VB)
002134          THB=(1.0-COEFTH)*ATAN(VB/UB)+COEFTH*THC
002144          UB=QB*COS(THB)
002147          VB=QB*SIN(THB)
002152          IF(K.EQ.3) GO TO 123
002154      124 QT=SQRT(UT*UT+VT*VT)
002161          THT=(1.0-COEFTH)*ATAN(VT/UT)+COEFTH*THC
002171          UT=QT*COS(THT)
002174          VT=QT*SIN(THT)
002177      123 CONTINUE
002177          FF1X=(RR*UR-RL*UL)*R2DX
002204          FF2X=(RR*UR*HR-RL*UL*HL)*R2DX
002212          FF3X=(RR*UR*UR+PR-RL*UL*UL-PL)*R2DX
002221          FF4X=(RR*UR*VR-RL*UL*VL)*R2DX
002227          GG1N=(RT*VT-RB*VB)*R2DN
002233          GG2N=(RT*VT*HT-RB*VB*HB)*R2DN
002242          GG3N=(RT*VT*UT-RB*VB*UB)*R2DN
002250          GG4N=(RT*VT*VT-RB*VB*VB+PT-PB)*R2DN
002257          GO TO (201,202,203,204,205,206,207) ID
002272      201 C1=1.0
002274          C2=CS/SS
002276          GO TO 211
002276      202 C1=1.0
002300          C2=CS/SS
002302          GO TO 212
002302      203 C1=1.0
002304          C2=CS
002305          GO TO 213
002306      204 C1=CS/C4
002310          C2=CS/SS
002312          GO TO 212
002312      205 C1=CS/CR
002314          C2=CS
002315          GO TO 213
002315      206 C1=CS/CR
002317          C2=CS/SR
002321          GO TO 212
002321      207 C1=CS/CR
002323          C2=CS/SR
002325          GO TO 210
002325      210 EE1P=EE1C-DT  *(C1*(1.0-X)*FF1X+C2*GG1N)+Z*EE1D
002337          EE2P=EE2C-DT  *(C1*(1.0-X)*FF2X+C2*GG2N)+Z*EE2D
002351          EE3P=EE3C-DT  *(C1*(1.0-X)*FF3X+C2*GG3N)+Z*EE3D
002363          EE4P=EE4C-DT  *(C1*(1.0-X)*FF4X+C2*GG4N)+Z*EE4D
002375          GO TO 220
002375      211 EE1P=EE1C-DT  *(C1*X*FF1X+C2*GG1N)+Z*EE1D
002406          EE2P=EE2C-DT  *(C1*X*FF2X+C2*GG2N)+Z*EE2D
002417          EE3P=EE3C-DT  *(C1*X*FF3X+C2*GG3N)+Z*EE3D
002430          EE4P=EE4C-DT  *(C1*X*FF4X+C2*GG4N)+Z*EE4D
002441          GO TO 220
002441      212 EE1P=EE1C-DT  *(C1*FF1X+C2*GG1N)+Z*EE1D
002452          EE2P=EE2C-DT  *(C1*FF2X+C2*GG2N)+Z*EE2D
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002462              EE3P=EE3C-DT    *(C1*FF3X+C2*GG3N)+Z*EE3D
002472              EE4P=EE4C-DT    *(C1*FF4X+C2*GG4N)+Z*EE4D
002502              GO TO 220
002502          213 EE1N=(RT-RB)*R2DN
002505              EE2N=(RT*ET-RB*EB)*R2DN
002511              EE3N=(RT*UT-RB*UB)*R2DN
002515              EE4N=(RT*VT-RB*VB)*R2DN
002521              FF1N=(RT*UT-RB*UB)*R2DN
002525              FF2N=(RT*UT*HT-RB*UB*HB)*R2DN
002533              FF3N=(RT*UT*UT+PT-RB*UB*UB-PB)*R2DN
002542              FF4N=(RT*UT*VT-RB*UB*VB)*R2DN

002550              IF(J.EG.2) GO TO 95
002552              DSUC=DSU(IDL102,J,3)
002554              DSLC=DSL(IDL102,J,3)
002556              DSXU=(DSU(IDL102,J+1,3)-DSU(IDL102,J-1,3))*R2DX
002564              DSXL=(DSL(IDL102,J+1,3)-DSL(IDL102,J-1,3))*R2DX
002570              DSTU=(DSUC-0.5*(DSU(IDL102,J,1)+DSU(IDL102,J,2)))*RDT
002576              DSTL=(DSLC-0.5*(DSL(IDL102,J,1)+DSL(IDL102,J,2)))*RDT
002605              YT=YY*(-DSTU)+(1.0-YY)*(DSTL)
002612              IF(J.EG.JS.AND.IDELTA.EQ.0.AND.(ISLTE.EQ.1          ))GO TO 83
002625              YX=YY*((YU(IDL102,J+1)-YU(IDL102,J-1))*R2DX-DSXU)+(1.0-YY)*
                   1  ((YL(IDL102,J+1)-YL(IDL102,J-1))*R2DX+DSXL)
002645              GO TO 84
002646           83 YX=YXM*CEE/ESS
002651           84 CONTINUE
002651              YN=YU(IDL102,J)-DSUC-YL(IDL102,J)-DSLC
002661              GO TO 96
002661           95 YT=0.0
002662              YN=YU(IDL102,2)-YL(IDL102,2)
002665              YUX=YUXLE(IDL102)*CEE/ESS
002667              YLX=YLXLE(IDL102)*CEE/ESS
002671              YX=YY*YUX+(1.0-YY)*YLX
002675              IF(K.EG.2.OR.K.EQ.KS) YX=YXM*CEE/ESS
002707           96 CONTINUE
002707              CQ=C2/ESS
002711              EE1P=EE1C-DT    *(C1*FF1X+(CQ*GG1N-(C1*YX*FF1N+YT*EE1N))/YN)+Z*EE
002727              EE2P=EE2C-DT    *(C1*FF2X+(CQ*GG2N-(C1*YX*FF2N+YT*EE2N))/YN)+Z*EE
002745              EE3P=EE3C-DT    *(C1*FF3X+(CQ*GG3N-(C1*YX*FF3N+YT*EE3N))/YN)+Z*EE
002763              EE4P=EE4C-DT    *(C1*FF4X+(CQ*GG4N-(C1*YX*FF4N+YT*EE4N))/YN)+Z*EE
003001              GO TO 220

003001          220 CONTINUE
003001              RP=EE1P
003003              EP=EE2P/RP
003004              UP=EE3P/RP
003006              VP=EE4P/RP
003007              Q2=0.5*(UP*UP+VP*VP-OMR(IDL102)**2)
003015              TP=GAML1*(EP-Q2)
003020              PP=RP*TP
003021              IF((ID.EG.3.OR.ID.EQ.5).AND.J.EQ.JS) GO TO 15
003034              RJL(K)=R2(ID,J,K)
003041              PJL(K)=P2(ID,J,K)
003046              UJL(K)=U2(ID,J,K)
003052              VJL(K)=V2(ID,J,K)
003056              EJL(K)=E2(ID,J,K)
003062           15 CONTINUE
003062              RKB=R2(ID,J,K)
```

```
003070              PKB=P2(ID,J,K)
003074              UKB=U2(ID,J,K)
003100              VKB=V2(ID,J,K)
003104              EKB=E2(ID,J,K)
003110              GO TO 223
003110       222 PP=PC
003112              RP=RC
003113              UP=UC
003115              VP=VC
003116              EP=EC
003120       223 CONTINUE
003120              P2(ID,J,K)=PP
003126              R2(ID,J,K)=RP
003132              E2(ID,J,K)=EP
003136              U2(ID,J,K)=UP
003142              V2(ID,J,K)=VP


003146       190 CONTINUE
003150       180 CONTINUE
003152       170 CONTINUE
003155              RETURN
003155              END
```

```
                    SUBROUTINE HOBDRY(IABC)
000003              DIMENSION    R2(7,13,13),P2(7,13,13),U2(7,13,13),V2(7,13,13),
                   2 E2(7,13,13),
                   3 DSU(2,13,3),DSL(2,13,3),YU(2,13),YL(2,13),JI(7),JF(7)
                   4 ,YUXLE(2),YLXLE(2),OMR(2)
                   5 ,Y5(33),X5(4,33),XQ3(4)
                   6 ,PDAI(2),PDAIU(2),PDAIL(2)
                   7 ,DRAGU(2),DRAGL(2)
                   8 ,DSU1(2),DSL1(2)
                   9 ,P3(5,9,13),R3(5,9,13),U3(5,9,13),V3(5,9,13)
                   9 ,PM(5,9,13),RM(5,9,13),UM(5,9,13),VM(5,9,13)
                   9 ,P4(9,13),R4(9,13),U4(9,13),V4(9,13)
                   9 ,P5(9,13),R5(9,13),U5(9,13),V5(9,13)
                   9 ,P32(9,2),R32(9,2),U32(9,2),V32(9,2),
                   9  PM2(9,2),RM2(9,2),UM2(9,2),VM2(9,2),
                   9  P3S(9,2),R3S(9,2),U3S(9,2),V3S(9,2),
                   9  PMS(9,2),RMS(9,2),UMS(9,2),VMS(9,2)
                   9 ,IX(9),IT(9,2)
000003              COMMON R2,P2,U2,V2,E2
000003              COMMON/A/GAMMA,GAML1
000003              COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000003              COMMON/B1/ IBLEQ
000003              COMMON/B2/ IDEBUG
000003              COMMON/C/DSU,DSL
000003              COMMON/D/ ID,J,KJ,IDS,K
000003              COMMON/E/ JI,JF,JS,KS
000003              COMMON/F/YU,YL
000003              COMMON/G/ DX,RDX,R2DX,RDX2
000003              COMMON/H/DN,RDN,R2DN,RDN2
000003              COMMON/I/DT,RDT,R2DT,RDT2,DTO2
000003              COMMON/J/ES1,ES2,CE1,CE2,CS,CR,SS,SR,RADLE1,RADLE2,C4
000003              COMMON/K/ ISTART
000003              COMMON/M/ XMU,IDELTA
000003              COMMON/N/ ITIME,NNN,NTIME
000003              COMMON/N1/ MMM,MTIME
000003              COMMON/N2/ NOBL,MOBL,ITIMEI
000003              COMMON/N3/ IPHI,IPSI
000003              COMMON/O/ PDAI,PDAIU,PDAIL
000003              COMMON/P1/ P3,R3,U3,V3,P4,R4,U4,V4,P5,R5,U5,V5,PM,RM,UM,VM
000003              COMMON/P2/ P32,R32,U32,V32,PM2,RM2,UM2,VM2
000003              COMMON/P3/ P3S,R3S,U3S,V3S,PMS,RMS,UMS,VMS
000003              COMMON/Q/JSM,JSP,KSM,KSP
000003              COMMON/T/LELADE
000003              COMMON/U/ YUXLE,YLXLE
000003              COMMON/V/ JV
000003              COMMON/W/Y5,X5,XQ3
000003              COMMON/X/EN,KAY
000003              COMMON/Y/ DSU1,DSL1
000003              COMMON/Z/DRAGU,DRAGL
000003              COMMON/ZA/ REYCR
000003              COMMON/ZC/ISLLE,ISLTE
000003              IGE(IPS)=INT(1000.999999999*FLOAT((MOBL-NOBL)*IPS)/FLOAT(MOBL)
                   1 1000
000017              IDEL(IPS)=-((MOBL-NOBL)*IPS-IGE(IPS)*MOBL)*MMM/NOBL
000033              IFE(IPH)=INT(1000.0+FLOAT((MOBL-NOBL)*IPH)/FLOAT(NOBL))-1000
000046              IDEM(IPH)=-(-(MOBL-NOBL)*IPH+IFE(IPH)*NOBL)*MMM/NOBL
000062              IF(ITER.EQ.2) GO TO 83
```

```
000064            IF(NTIME.EG.0) IPHI=IPHI+1
000067            IF(NTIME.EG.0) IPSI=IPSI+1
000072            IF(IPHI.EQ.NOBL) IPHI=0
000075            IF(IPSI.EQ.NOBL) IPSI=0
000100         83 CONTINUE
000100            FLNTIT=FLOAT(NTIME)-0.5*FLOAT(2-ITER)
000105            FLMTIT=FLOAT(NTIME)-0.5*FLOAT(2-ITER)
            C1 AA COMPUTE VERTICAL BOUNDARIES (4,JS,K), (5,1,K)   - - - - - - - - -
000112            IF(IBLEO.FG.0) GO TO 1117
000113            IF(NOBL.EQ.NOBL) GO TO 1007
000115            IDELT1=IDEL(IPSI+1)
000120            IDELT2=IDEL(IPSI  )
000123            IDELT3=IDEL(IPSI-1)
000126            GO TO 1008
000126       1007 IDELT1=0
000127            IDELT2=0
000130            IDELT3=0
000131       1008 CONTINUE
000131            IDEMT1=IDEM(IPHI-1)
000135            IDEMT2=IDEM(IPHI  )
000140            IDEMT3=IDEM(IPHI+1)
000143            IX(1)=ITIME-MMM
000145            IX(2)=ITIME-(MMM-(NNN-MMM))
000147            IX(3)=ITIME-(NNN-MMM)
000152            IX(4)=ITIME-IDELT1
000154            IX(5)=ITIME-IDELT2
000156            IX(6)=ITIME-IDELT3
000160            IX(7)=ITIME-IDEMT1
000162            IX(8)=ITIME-IDEMT2
000164            IX(9)=ITIME-IDEMT3
000166            DO 1006 I=1,9
000167       1006 IF((IX(I)+NNN).EQ.ITIME) IX(I)=ITIME
000175            J=0
000176            ICOUNT=0
000177       1005 ISAVE=9999
000200            DO 1110 I=1,9
000202            IF(IX(I).GE.ISAVE) GO TO 1110
000205            ITX=I
000206            ISAVE=IX(I)
000207       1110 CONTINUE
000211            J=J+1
000213            IT(J,1)=ISAVE
000215            IT(J,2)=ITX
000216            IX(ITX)=9999
000220            IF(J.LT.9) GO TO 1005
000222            IF(ITER.EQ.1) ITAPE=1
000225            IF(ITER.EQ.2) ITAPE=2
000230            ITAPEX=ITAPE
000232            III=1
000233            DO 1114 JJ=1,9
000234            I1=IT(JJ,1)
000236            I2=IT(JJ,2)
000237            IF(I1.EQ.ITIME) GO TO 1020
000241            I1FL=0
000242            IF(J.EQ.1) GO TO 1111
000244            IF(I1.EQ.IT(JJ-1,1)) I1FL=1
000247       1111 CONTINUE
000247            IF(I1.GT.ITIMEI) GO TO 1116
```

```
000253            GO TO 1118
000253      1116 CONTINUE
000253            I1=I1-NNN
000255            IF(ICOUNT.EQ.0) III=1
000257            ITAPEX=ITAPEX+2
000261            ICOUNT=ICOUNT+1
000262      1118 CONTINUE
000262            IF(I1FL.EQ.0) GO TO 1112
000263            BACKSPACE ITAPEX
000265            GO TO 1113
000266      1112 CONTINUE
000266            IIM=I1-1
000270            IF(IIM.LT.III) GO TO 1113
000272            DO 1025 M9=III,IIM
000273      1025 READ((ITAPEX) DUM3
000304      1113 CONTINUE
000304            READ(ITAPEX) ITIMEP,(P3(1,I2,J),R3(1,I2,J),U3(1,I2,J),V3(1,I2,
           1                          P3(2,I2,J),R3(2,I2,J),U3(2,I2,J),V3(2,I2,
           1                          P3(3,I2,J),R3(3,I2,J),U3(3,I2,J),V3(3,I2,
           1                          P3(4,I2,J),R3(4,I2,J),U3(4,I2,J),V3(4,I2,
           1                          P3(5,I2,J),R3(5,I2,J),U3(5,I2,J),V3(5,I2,
           1                          PM(1,I2,J),RM(1,I2,J),UM(1,I2,J),VM(1,I2,
           1                          PM(2,I2,J),RM(2,I2,J),UM(2,I2,J),VM(2,I2,
           1                          PM(3,I2,J),RM(3,I2,J),UM(3,I2,J),VM(3,I2,
           1                          PM(4,I2,J),RM(4,I2,J),UM(4,I2,J),VM(4,I2,
           1                          PM(5,I2,J),RM(5,I2,J),UM(5,I2,J),VM(5,I2,
           1 J=2, JS),              (P4(I2,K),R4(I2,K),U4(I2,K),V4(I2,K),
           1                          P5(I2,K),R5(I2,K),U5(I2,K),V5(I2,K),K=2,KS
           1 ,(P32(I2,I),R32(I2,I),U32(I2,I),V32(I2,I),
           1    PP2(I2,I),RM2(I2,I),UM2(I2,I),VM2(I2,I),
           1    P3S(I2,I),R3S(I2,I),U3S(I2,I),V3S(I2,I),
           1    PMS(I2,I),RMS(I2,I),UMS(I2,I),VMS(I2,I),I=1,2)
000633            GO TO 1115
000635      1020 ITIMEP=ITIME
000637            DO 1030 IDC=1,5
000640            IDP=IDC
000641            IF(IDC.EQ.3) IDP=4
000644            IF(IDC.GT.3) IDP=IDC+2
000650            DO 1030 J=2,JS
000652            P3(IDC,I2,J)=P2(IDP,J,3)
000661            R3(IDC,I2,J)=R2(IDP,J,3)
000670            U3(IDC,I2,J)=U2(IDP,J,3)
000677            V3(IDC,I2,J)=V2(IDP,J,3)
000705            PM(IDC,I2,J)=P2(IDP,J,KSM)
000715            RM(IDC,I2,J)=R2(IDP,J,KSM)
000725            UM(IDC,I2,J)=U2(IDP,J,KSM)
000735            VM(IDC,I2,J)=V2(IDP,J,KSM)
000745      1030 CONTINUE
000751            DO 1031 K=2,KS
000752            P4(I2,K)=P2(4,JV,K)
000760            R4(I2,K)=R2(4,JV,K)
000766            U4(I2,K)=U2(4,JV,K)
000774            V4(I2,K)=V2(4,JV,K)
001002            P5(I2,K)=P2(5,2,K)
001006            R5(I2,K)=R2(5,2,K)
001012            U5(I2,K)=U2(5,2,K)
001016            V5(I2,K)=V2(5,2,K)
001022      1031 CONTINUE
```

```
001024          P32(12,1)=P2(3,2,3)
001026          R32(12,1)=R2(3,2,3)
001027          U32(12,1)=L2(3,2,3)
001031          V32(12,1)=V2(3,2,3)
001032          P32(12,2)=P2(5,2,3)
001034          R32(12,2)=R2(5,2,3)
001035          U32(12,2)=L2(5,2,3)
001037          V32(12,2)=V2(5,2,3)
001040          P12(12,1)=P2(3,2,KSM)
001044          R12(12,1)=R2(3,2,KSM)
001047          U12(12,1)=L2(3,2,KSM)
001052          V12(12,1)=V2(3,2,KSM)
001055          P12(12,2)=P2(5,2,KSM)
001060          R12(12,2)=R2(5,2,KSM)
001063          U12(12,2)=L2(5,2,KSM)
001066          V12(12,2)=V2(5,2,KSM)
001071          P3S(12,1)=P2(3,JS,3)
001074          R3S(12,1)=R2(3,JS,3)
001076          U3S(12,1)=L2(3,JS,3)
001101          V3S(12,1)=V2(3,JS,3)
001103          P3S(12,2)=P2(5,JS,3)
001106          R3S(12,2)=R2(5,JS,3)
001110          U3S(12,2)=L2(5,JS,3)
001113          V3S(12,2)=V2(5,JS,3)
001115          P1S(12,1)=P2(3,JS,KSM)
001122          R1S(12,1)=R2(3,JS,KSM)
001126          U1S(12,1)=L2(3,JS,KSM)
001132          V1S(12,1)=V2(3,JS,KSM)
001136          P1S(12,2)=P2(5,JS,KSM)
001142          R1S(12,2)=R2(5,JS,KSM)
001146          U1S(12,2)=L2(5,JS,KSM)
001152          V1S(12,2)=V2(5,JS,KSM)
001156     1115 CONTINUE
001156          IF(IDEBUG.GT.0.AND.IDEBUG.LT.10) WRITE(6,190) ITIME,ITIMEP,I1,I
               1 ,ICOUNT,NNN,III,IIM
001212      190 FORMAT(/5X,42HITIME,ITIMEP,I1,ITER,ICOUNT,NNN,III,IIM = ,8I5/)
001212          IF(I1FL.EQ.1) GO TO 1114
001214          III=IIM+2
001216     1114 CONTINUE
001220          ITA=ITIME-ITIMEI-1
001223          IF(ITER.EQ.2) GO TO 1120
001225          REWIND 1
001227          REWIND 3
001231          IF(ITIME.EQ.ITIMEI+1) GO TO 1122
001234          DO 1121 I=1,ITA
001236     1121 READ(3) DUM5
001247     1122 GO TO 1123
001250     1120 CONTINUE
001250          REWIND 2
001252          REWIND 4
001254          IF(ITIME.EQ.ITIMEI+1) GO TO 1123
001257          DO 1125 I=1,ITA
001261     1125 READ(4) DUM5
001272     1123 CONTINUE
001272     1117 CONTINUE
001272          IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 250
001300          IF(IABC.GT.2) GO TO 612
001303      250 CONTINUE
```

```
001303          DOMR=OMR(2)-OMR(1)
001305          YU1C=YU(1,JS)
001310          YL1C=YL(1,JS)
001312          YL2C=YL(2,2)
001313          YU2C=YU(2,2)
001315          YL2M=YL(2,1)
001316          YU2M=YU(2,1)
001320          IF(IELEQ.EQ.0) GO TO 1010
001321          IKP=0
001322          KFI=2
001323       81 KFL=KS
001325          IF(IKP.EQ.2) KFI=3
001330          IF(IKP.EQ.0) KFL=KSM
001333          DO 94 K=KFI,KFL
001335          KK=IKP*(KS-2)+K
001341          Y5(KK)=YL1C+DN*FLOAT(K-2)*ES2/ES1+DOMR*DT*FLMTIT+FLOAT(IPSI+IKP
                1 *ES2/ES1*(YU2C-YL2C)
001362          X5(1,KK)=P5(7+IKP, K)
001370          X5(2,KK)=R5(7+IKP, K)
001374          X5(3,KK)=U5(7+IKP, K)
001377          X5(4,KK)=V5(7+IKP, K)
001403       94 CONTINUE
001405          KSS=2*(KS-2)+KS
001410          IKP=IKP+1
001411          IF(IKP.LT.3) GO TO 81
001413          GO TO 1011
001414     1010 CONTINUE
001414          DO 610 K=2,KSP
001416          Y5(K)=YL1C+DN*FLOAT(K-2)*ES2/ES1+DOMR*DT*FLNTIT
001427          IF(K.EQ.KSP) GO TO 300
001431          X5(1,K)=P2(5,2,K)
001435          X5(2,K)=R2(5,2,K)
001441          X5(3,K)=U2(5,2,K)
001445          X5(4,K)=V2(5,2,K)
001451          GO TO 610
001451      300 X5(1,K)=P2(5,2,3)
001454          X5(2,K)=R2(5,2,3)
001457          X5(3,K)=U2(5,2,3)
001461          X5(4,K)=V2(5,2,3)
001463      610 CONTINUE
001466          KSS=KS
001467     1011 CONTINUE
001467          DO 615 K=2,KS
001471          Y4=YL1C    +DN*FLOAT(K-2)
001475          IF(IELEQ.NE.0) GO TO 1012
001476          IF(              Y4.LT.Y5(2)) Y4=Y4+1,
001503          IF(              Y4.GT.Y5(KS)) Y4=Y4-1,
001510     1012 CONTINUE
001510          DO 620 KK=2,KSS
001512          YR=Y4
001514          YR1=Y5(KK)
001515          YR2=Y5(KK+1)
001517          IF(YR.LT.YR2       .AND.YR.GE.YR1    ) GO TO 622
001527      620 CONTINUE
001531          MARK=1
001532          GO TO 120
001533      622 CONTINUE
001533          DO 625 I=1,4
```

```
001535              X)1=X5(I,KK)
001540              X)2=X5(I,KK+1)
001542              CALL FAT(YR,YR1,YR2,XQ1,XQ2,XQA)
001546          625 XQ3(I)=XQA
001553              P2(4,JS,K)=XQ3(1)
001560              R2(4,IS,K)=XQ3(2)
001564              U2(4,IS,K)=XQ3(3)
001570              V2(4,IS,K)=XQ3(4)+DOMR
001575          615 E2(4,JS,K)=XQ3(1)/XQ3(2)/GAML1+0.5*(XQ3(3)**2+(XQ3(4)+DOMR)**2-
                  1 OMR(1)**2)

001613              IF(IBLEQ.EG.0) GO TO 1013
001614              IKP=0
001615              KFI=2
001616           85 KFL=KS
001620              IF(IKP.EG.2) KFI=3
001623              IF(IKP.EG.0) KFL=KSM
001626              DO 91 K=KFI,KFL
001630              KK=IKP*(KS-2)+K
001634              Y5(KK)=YL1C+DN*FLOAT(K -2)+FLOAT(IPHI+IKP-1)*(YU1C-YL1C)
001647              X5(1,KK)=P4(4+IKP, K)
001655              X5(2,KK)=R4(4+IKP, K)
001661              X5(3,KK)=U4(4+IKP, K)
001664              X5(4,KK)=V4(4+IKP, K)
001670           91 CONTINUE
001672              KII=2
001673              KSS=2*(KS-2)+KS
001676              IKP=IKP+1
001677              IF(IKP.LT.3) GO TO 85
001701              GO TO 1014
001702         1013 CONTINUE
001702              DO 640 K=1,KSP
001704              Y5(K)=YL1C    +DN*FLOAT(K-2)
001711              IF(K.EG.1) GO TO 311
001712              IF(K.EG.KSP) GO TO 310
001714              X5(1,K)=P2(4,JV,K)
001721              X5(2,K)=R2(4,JV,K)
001727              X5(3,K)=U2(4,JV,K)
001734              X5(4,K)=V2(4,JV,K)
001742              GO TO 640
001742          310 X5(1,K)=P2(4,JV,3)
001747              X5(2,K)=R2(4,JV,3)
001752              X5(3,K)=L2(4,JV,3)
001756              X5(4,K)=V2(4,JV,3)
001761              GO TO 640
001761          311 X5(1,K)=P2(4,JV,KSM)
001770              X5(2,K)=R2(4,JV,KSM)
001775              X5(3,K)=U2(4,JV,KSM)
002002              X5(4,K)=V2(4,JV,KSM)
002007          640 CONTINUE
002012              KII=1
002013              KSS=KS
002014         1014 CONTINUE
002014              TY=YU2M-YL2M
002016              DO 645 K=2,KS
002020              Y4=YL1C+ES2/ES1*(DN*FLOAT(K-2)*TY*(YL2M-YL2C))+DOMR*DT*FLNTIT
002035              IF(K.EG.2.CR.K.EQ.KS) Y4=YL1C+ES2/ES1*DN*FLOAT(K-2)+(0.5*(YL2M+
                  1 YU2M-1.0)-YL2C)+DOMR*DT*FLNTIT
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002063              IF(IELEO.NE.0) GO TO 1015
002064              IF(                     Y4.LT.Y5(2)) Y4=Y4+    ES2/ES1
002072              IF(                     Y4.GT.Y5(KS)) Y4=Y4-    ES2/ES1
002100      1015 CONTINUE
002100              DO 627 KK=KII,KSS
002102              YR=Y4
002104              YR1=Y5(KK)
002105              YR2=Y5(KK+1)
002107              IF(YR.LT.YR2     .AND.YR.GE.YR1     ) GO TO 628
002117       627 CONTINUE
002121              MARK=2
002122              GO TO 120
002123       628 CONTINUE
002123              DO 624 I=1,4
002125              XQ1=X5(I,KK)
002130              XQ2=X5(I,KK+1)
002132              CALL FAT(YR,YR1,YR2,XQ1,XQ2,XQA)
002136       624 XQ3(I)=XQA

002143              P2(5,1,K)=XQ3(1)
002146              R2(5,1,K)=XQ3(2)
002151              U2(5,1,K)=XQ3(3)
002154              V2(5,1,K)=XQ3(4)-DOMR
002160       645 E2(5,1,K)=XQ3(1)/XQ3(2)/GAML1+0.5*(XQ3(3)**2+(XQ3(4)-DOMR)**2-
                 1 OMR(2)**2)
002176       612 CONTINUE
      C1 ZZ COMPUTE VERTICAL BOUNDARIES (4,JS,K), (5,1,K)  - - - - - - - -
      C2 AA COMPUTE TEMPORARY VERTICAL BOUNDARIES (3,JSP,K), (5,JSP,K) . .
002176              IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 399
002204              IF(IABC.GE.3) GO TO 64
002206       399 CONTINUE
002206              IDL102=1
002207              XR=CE1/FLOAT(JS-2)
002213              DO 505 K=2,KS
002214              DO 510 J=3,JS
002215              Y5(J)=C4*FLOAT(J-2)/FLOAT(JS-2)
002222              X5(1,J)=P2(4,J,K)
002230              X5(2,J)=R2(4,J,K)
002235              X5(3,J)=U2(4,J,K)
002242              X5(4,J)=V2(4,J,K)
002247       510 CONTINUE
002251              DO 520 JJ=3,JSM
002252              J=JSM-JJ+3
002255              X4JP=Y5(J+1)
002257              X4J=Y5(J)
002260              IF(XR.LT.X4JP.AND.XR.GE.X4J) GO TO 522
002271       520 CONTINUE
002273              MARK=3
002274              GO TO 120
002275       522 XR1=X4J
002277              XR2=X4JP
002300              DO 525 I=1,4
002302              XQ1=X5(I,J)
002305              XQ2=X5(I,J+1)
002307              CALL FAT(XR,XR1,XR2,XQ1,XQ2,XYZ)
002313              XQ3(I)=XYZ
002315       525 CONTINUE
002320              P2(3,JSP,K)=XQ3(1)
```

```
002325          R2(3, ISP,K)=XQ3(2)
002331          U2(3, ISP,K)=XQ3(3)
002335          V2(3, ISP,K)=XQ3(4)
002341          E2(3, ISP,K)=XQ3(1)/XQ3(2)/GAML1+0.5*(XQ3(3)**2+XQ3(4)**2-
               1 DMR(IDL102)**2)
002356      505 CONTINUE
002360       64 CONTINUE
002360          IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 65
002366          IF(IABC.LE.1) GO TO 62
002370       65 CONTINUE
002370          DO 605 K=2,KS
002372          DO 605 J=2,JS
002373          P2(5, ISP,K)=P2(6,3,K)
002402          R2(5, ISP,K)=R2(6,3,K)
002405          U2(5, ISP,K)=U2(6,3,K)
002410          V2(5, ISP,K)=V2(6,3,K)
002413      605 E2(5, ISP,K)=E2(6,3,K)
002422       62 CONTINUE
002422          IF(ISLTE.EQ.0) GO TO 526
002423          DO 519 ID=3,5,2
002425          IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 541
002433          IF((ID.EQ.3.AND.IABC.GE.3).OR.(ID.EQ.5.AND.IABC.LE.1)) GO TO 51
002451      541 CONTINUE
002451          IDL102=(ID-1)/2
002454          YL1P=YL(IDL102,JSP)
002457          YU1P=YU(IDL102,JSP)
002461          YL1C=YL(IDL102,JS)
002463          YU1C=YU(IDL102,JS)
002465          DO 527 K=2,KSP
002467          Y5(K)=YL1C+DN*FLOAT(K-2)
002474          IF(K.EQ.KSP) GO TO 528
002475          X5(1,K)=P2(ID,JSP,K)
002503          X5(2,K)=R2(ID,JSP,K)
002511          X5(3,K)=U2(ID,JSP,K)
002516          X5(4,K)=V2(ID,JSP,K)
002523          GO TO 527
002524      528 X5(1,K)=P2(ID,JSP,3)
002531          X5(2,K)=R2(ID,JSP,3)
002535          X5(3,K)=U2(ID,JSP,3)
002540          X5(4,K)=V2(ID,JSP,3)
002543      527 CONTINUE
002546          TY=YU1P-YL1P
002550          DO 520 K=2,KS
002551          Y4=YL1P+DN*FLOAT(K-2)*TY
002556          IF(Y4.LT.YL1C) Y4=Y4+1.0
002563          IF(Y4.GT.YL1C) Y4=Y4-1.0
002570          DO 530 KK=2,KS
002572          YR=Y4
002574          YR1=Y5(KK)
002575          YR2=Y5(KK+1)
002577          IF(YR.LT.YR2.AND.YR.GE.YR1) GO TO 531
002607      530 CONTINUE
002611          MARK=4
002612          GO TO 120
002613      531 CONTINUE
002613          DO 532 I=1,4
002615          XQ1=X5(I,KK)
002620          XQ2=X5(I,KK+1)
```

```
002622                 CALL FAT(YR,YR1,YR2,XQ1,XQ2,XQA)
002626         532 XQ3(I)=XQA
002633             P2(ID,JSP,K)=XQ3(1)
002640             R2(ID,JSP,K)=XQ3(2)
002644             U2(ID,JSP,K)=XQ3(3)
002650             V2(ID,JSP,K)=XQ3(4)
002654             E2(ID,JSP,K)=XQ3(1)/XQ3(2)/GAML1+0.5*(XQ3(3)**2+XQ3(4)**2-
                  1 DMR(IDL102)**2)
002672         529 CONTINUE
002675         519 CONTINUE
002677         526 CONTINUE
           C2 ZZ COMPUTE TEMPORARY VERTICAL BOUNDARIES (3,JSP,K), (5,JSP,K) . .
002677             GO TO 136
002700         120 CONTINUE
002700             WRITE(6,124) MARK
002706         124 FORMAT(/1X,6HMARK =,1I3)
002706             WRITE(6,121)
002712         121 FORMAT(/5X,37HSOMETHING IS WRONG WITH INTERPOLATION/)
002712             CALL EXIT
002713         136 CONTINUE

           C3 AA COMPUTE PERMANENT HORIZONTAL BOUNDARIES (ID,J,1), (ID,J,KSP) -
002713             DO 100 ID=1,IDS
002716             J1=JI(ID)
002720             J2=JF(ID)
002721             IDL102=1
002722             IF(ID.GT.4) IDL102=2
002725          11 DO 13 J=J1,J2
002727             IF((ID.EQ.3.OR.ID.EQ.5).AND.J.NE.2) GO TO 21
002741             IF(ID.NE.3.AND.ID.NE.5) GO TO 12
002750             DO 7 II=1,3
002751             DSU(IDL102,J,II)=0.0
002756           7 DSL(IDL102,J,II)=0.0
002763          12 CONTINUE
           C3 AB ALL BIT (3,J,1), (3,J,KSP), (5,J,1), (5,J,KSP) . . . . . . . .
002763             IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 398
002771             IF((IABC.NE.0.AND.ID.LE.2).OR.(IABC.NE.2.AND.ID.EQ
                  1 .4).OR.(IABC.NE.4.AND.ID.GE.6).OR.(IABC.LE.1.AND.ID.EQ.5).OR.
                  1 (IABC.GE.2.AND.ID.EQ.3).OR.(IABC.EQ.4.AND.ID.EQ.5)) GO TO 13
003044         398 CONTINUE
003044             IF(IBLEQ.EQ.0) GO TO 1016
003045             IF(ID.EQ.3.OR.ID.EQ.5) GO TO 1004
003055             IDC=ID
003056             IF(ID.EQ.4) IDC=3
003061             IF(ID.GE.6) IDC=ID-2
003065             P2(ID,J,1)=PM(IDC,3,J)
003073             R2(ID,J,1)=RM(IDC,3,J)
003100             U2(ID,J,1)=UM(IDC,3,J)
003105             V2(ID,J,1)=VM(IDC,3,J)
003112             E2(ID,J,1)=PM(IDC,3,J)/RM(IDC,3,J)/GAML1+0.5*(UM(IDC,3,J)**2+
                  1 VM(IDC,3,J)**2-DMR(IDL102)**2)
003133             IREG=2
003134             IF(ID.GT.4) IREG=1
003140             P2(ID,J,KSP)=P3(IDC,IREG,J)
003151             R2(ID,J,KSP)=R3(IDC,IREG,J)
003161             U2(ID,J,KSP)=U3(IDC,IREG,J)
003172             V2(ID,J,KSP)=V3(IDC,IREG,J)
003202             E2(ID,J,KSP)=P3(IDC,IREG,J)/R3(IDC,IREG,J)/GAML1+0.5*
```

```
                    1 (U3(IDC,IREG,J)**2+V3(IDC,IREG,J)**2-OMR(IDL102)**2)
003225                GO TO 1003
003226        1004 CONTINUE
003226             I2P=2
003227             I21=3
003230             IF(IDL102.EQ.2) I2P=1
003233             P2(ID,J,1)=PM2(I2P,IDL102)
003240             R2(ID,J,1)=RM2(I2P,IDL102)
003244             U2(ID,J,1)=UM2(I2P,IDL102)
003247             V2(ID,J,1)=VM2(I2P,IDL102)
003253             E2(ID,J,1)=PM2(I2P,IDL102)/RM2(I2P,IDL102)/GAML1+0.5*
                    1 (UM2(I2P,IDL102)**2+VM2(I2P,IDL102)**2-OMR(IDL102)**2)
003271             P2(ID,J,KSP)=P32(I21,IDL102)
003300             R2(ID,J,KSP)=R32(I21,IDL102)
003307             U2(ID,J,KSP)=U32(I21,IDL102)
003316             V2(ID,J,KSP)=V32(I21,IDL102)
003325             E2(ID,J,KSP)=P32(I21,IDL102)/R32(I21,IDL102)/GAML1+0.5*
                    1 (U32(I21,IDL102)**2+V32(I21,IDL102)**2-OMR(IDL102)**2)
003345        1003 CONTINUE
003345             GO TO 13
003346        1016 CONTINUE
003346             R2(ID,J,1)=R2(ID,J,KSM)
003355             P2(ID,J,1)=P2(ID,J,KSM)
003361             U2(ID,J,1)=U2(ID,J,KSM)
003365             V2(ID,J,1)=V2(ID,J,KSM)
003371             E2(ID,J,1)=E2(ID,J,KSM)

003375             R2(ID,J,KSP)=R2(ID,J,3)
003402             P2(ID,J,KSP)=P2(ID,J,3)
003406             U2(ID,J,KSP)=U2(ID,J,3)
003412             V2(ID,J,KSP)=V2(ID,J,3)
003416             E2(ID,J,KSP)=E2(ID,J,3)
       C3 ZB ALL BUT (3,J,1), (5,J,KSP), (5,J,1), (5,J,KSP) . . . . . . .
003422          13 CONTINUE
003425             IF(ID.EQ.3.OR.ID.EQ.5) GO TO 21
003434             GO TO 30
       C3 AC FOR (3,J,1), (3,J,KSP), (5,J,1), (5,J,KSP) . . . . . . . . .
003434          21 CONTINUE
003434             GO TO (23,24)IDL102
003442          23 ES=ES1
003444             CE=CE1
003445             GO TO 40
003446          24 ES=ES2
003450             CE=CE2
003451          40 CONTINUE
003451             IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 397
003457             IF((IABC.LE.1.AND.ID.EQ.5).OR.(IABC.GE.2.AND.ID.EQ
                    1 .3).OR.(IABC.EQ.4.AND.ID.EQ.5)) GO TO 100
003505         397 CONTINUE
003505          22 CONTINUE
       C3 AD LEADING EDGE POINTS DRAG AND DELSTAR / / / / / / / / / / / /
003505             IF(IDELTA.EQ.0) GO TO 110
003506             KSM2=KS-2
003510             DO 122 K=2,KS,KSM2
003512             RC=R2(ID,2,K)
003516             UC=U2(ID,2,K)
003521             REY=0.5*CE/CE1*RC*UC*DX/XMU
003527             XMACH=0.0
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003530                EIM=0.0
003531                PX=0.0
003532                AA=1.72
003533                BB=0.5
003535                HAPE=2.59
003536                DSH=0.5*CE/ES*AA*REY**(-BB)*DX
003547                TAU=ES/CE*(RC*UC*UC/HAPE+(1.0+(2.0-XMACH**2)/HAPE)*(P2(ID,3,K)-
                     1 P2(ID,2,K))/4.0)*DSH
003571                DDRAG=(CE/CE1)*TAU*DX*0.5
003575                DRAG=DDRAG
003576                IF(K.EQ.KS) GO TO 130
003600                DRAGL(IDL1C2)=DRAG
003602                GO TO 122
003603           130  DRAGU(IDL1C2)=DRAG
           C3 ZD LEADING EDGE POINTS DRAG AND DELSTAR / / / / / / / / / / / / / /
003605           122  CONTINUE
           C3 AE NON-LEADING EDGE POINTS DRAG AND DELSTAR * * * * * * * * * * * *
003610                DO 140 K=2,KS,KSM2
003611                IF(K.EQ.KS) GO TO 141
003613                DS=DSL(IDL102,2,3)
003615                DRAG=DRAGL(IDL102)
003616                GO TO 142
003617           141  DS=DSU(IDL102,2,3)
003621                DRAG=DRAGU(IDL102)
003623           142  CONTINUE
003623                J2M=J2-1
003625                DO 150 J=3,J2
003627                RC=R2(ID,J,K)
003634                UC=U2(ID,J,K)
003641                PC=P2(ID,J,K)
003645                UL=U2(ID,J-1,K)
003651                IF(J.NE.J2) GO TO 382
003653                PX=(PC-P2(ID,J-1,K))*RDX
003661                UR=2.0*UC-UL
003664                GO TO 384
003665           382  CONTINUE
003665                PX=(P2(ID,J+1,K)-P2(ID,J-1,K))*R2DX
003677                UR=U2(ID,J+1,K)
003702           384  CONTINUE
003702                XMACH=UC/SQRT(GAMMA*PC/RC)
003710                IF(J.GT.J2M) GO TO 500
003714                IREY=0
003714           500  CONTINUE
003714                REY=(CE/CE1)*RC*UC*FLOAT(J-2)*DX/XMU
003725                IF(J.LE.J2M.AND.REY.GT.REYCR) IREY=1
003741                CALL AADE(RC,UC,UL,UR,DX,J,PX,REY,IREY,AA,BB,HAPE)
003755                DSX=(CE/ES)*AA*REY**(-BB)
003766                DS=DS+DSX*DX
003770                TAU=(ES/CE)*(RC*UC*UC*DSX/HAPE-DS*((2.0-XMACH**2)/HAPE+1.0)*PX)
004004                DDRAG=(CE/CE1)*TAU*DX
004007                IF(J.EQ.J2) DDRAG=DDRAG*0.5
004014                DRAG=DRAG+DDRAG
004016                IF(K.EQ.KS)GO TO 151
004020                DSL(IDL1C2,J,3)=DS
004023                GO TO 152
004024           151  DSU(IDL1C2,J,3)=DS
004027           152  CONTINUE
004027           150  CONTINUE
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004032              IF(K.EG.KS) GO TO 200
004034              DRAGL(IDL102)=DRAG
004036              GO TO 210
004036          200 DRAGU(IDL102)=DRAG
004040          210 CONTINUE
            C3 ZE NON-LEADING EDGE POINTS DRAG AND DELSTAR * * * * * * * * * * * *
004040          140 CONTINUE
004043              GO TO 220
004043          110 CONTINUE
004043              DRAGU(IDL102)=0.0
004045              DRAGL(IDL102)=0.0
004046              DO 219 J=3,J2
004047              DSU(IDL102,J,3)=0.0
004051              DSL(IDL102,J,3)=0.0
004053          219 CONTINUE
004055          220 CONTINUE
004055              DO 70 J=3,J2
004057              IF(ITIME.NE.NNN) GO TO 70
004060           60 DSU(IDL102,J,2)=DSU(IDL102,J,3)
004065              DSU(IDL102,J,1)=DSU(IDL102,J,2)
004067              DSL(IDL102,J,2)=DSL(IDL102,J,3)
004071              DSL(IDL102,J,1)=DSL(IDL102,J,2)
004073           70 CONTINUE
004076              DSU(IDL102,JSP,1)=DSU(IDL102,JS,1)
004102              DSU(IDL102,JSP,2)=DSU(IDL102,JS,2)
004105              DSU(IDL102,JSP,3)=DSU(IDL102,JS,3)
004111              DSL(IDL102,JSP,1)=DSL(IDL102,JS,1)
004114              DSL(IDL102,JSP,2)=DSL(IDL102,JS,2)
004120              DSL(IDL102,JSP,3)=DSL(IDL102,JS,3)
004123              IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 251
004131              IF((IABC.NE.0.AND.ID.EQ.3).OR.(IABC.NE.2.AND.ID.EQ.5)) GO TO 38
004145          251 CONTINUE
004145              DSU1(IDL102)=DSU(IDL102,JSP,3)
004150              DSL1(IDL102)=DSL(IDL102,JSP,3)
004152          380 CONTINUE

            C3 AF NON-LEADING EDGE HORIZONTAL BOUNDARIES = = = = = = = = = = = = =
004152              JSQ=JS
004154              IF(IDELTA.EQ.0) JSQ=JSM
004156              DO 80 J=3,JSQ
004160              JP1=J+1
004162              JM1=J-1
004163              YUC=YU(IDL102,J)
004165              YLC=YL(IDL102,J)
004170              YUR=YU(IDL102,JP1)
004172              YLR=YL(IDL102,JP1)
004174              YUL=YU(IDL102,JM1)
004177              YLL=YL(IDL102,JM1)
004201              DSUC=DSU(IDL102,J,3)
004203              DSLC=DSL(IDL102,J,3)
004205              DSUR=DSU(IDL102,JP1,3)
004207              DSLR=DSL(IDL102,JP1,3)
004211              DSUL=DSU(IDL102,JM1,3)
004214              DSLL=DSL(IDL102,JM1,3)
004216              DSUA=DSU(IDL102,J,1)
004220              DSLA=DSL(IDL102,J,1)
004222              DSUB=DSU(IDL102,J,2)
004224              DSLB=DSL(IDL102,J,2)
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004226          YUDC=YUC-DSUC
004230          YLDC=YLC+DSLC
004232          YUDR=YUR-DSUR
004234          YLDR=YLR+DSLR
004236          YUDL=YUL-DSUL
004240          YLDL=YLL+DSLL

004242          YXUC=(YUR-YUL)*R2DX
004245          YXLC=(YLR-YLL)*R2DX
004247          YXXUC=(YUR-2.0*YUC+YUL)*R2DX
004254          YXXLC=(YLR-2.0*YLC+YLL)*R2DX
004260          DSXUC=(DSUR-DSUL)*R2DX
004263          DSXLC=(DSLR-DSLL)*R2DX
004266          DSXUA=(DSU(IDL102,J+1,1)-DSU(IDL102,J-1,1))*R2DX
004273          DSXLA=(DSL(IDL102,J+1,1)-DSL(IDL102,J-1,1))*R2DX
004300          DSXUB=(DSU(IDL102,J+1,2)-DSU(IDL102,J-1,2))*R2DX
004304          DSXLB=(DSL(IDL102,J+1,2)-DSL(IDL102,J-1,2))*R2DX
004310          DSXXUC=(DSUR-2.0*DSUC+DSUL)*R2DX
004314          DSXXLC=(DSLR-2.0*DSLC+DSLL)*R2DX
004321          IF(ITER.EQ.1) GO TO 43
004323          DSXTUC=(DSXUC-4.0*DSXUB+3.0*DSXUA)*R2DT
004332          DSXTLC=(DSXLC-4.0*DSXLB+3.0*DSXLA)*R2DT
004340          DSTTUC=(DSUC-2.0*DSUB+DSUA)*RDT2
004345          DSTTLC=(DSLC-2.0*DSLB+DSLA)*RDT2

004351          DSTUC=(DSUC-DSUA)*R2DT
004354          DSTLC=(DSLC-DSLA)*R2DT
004356          GO TO 42
004357       43 DSXTUC=(DSXUC-4.0*DSXUB+1.5*(DSXUA+DSXUB))*RDT
004367          DSXTLC=(DSXLC-4.0*DSXLB+1.5*(DSXLA+DSXLB))*RDT
004376          DSTTUC=(DSUC-2.0*DSUB+0.5*(DSUA+DSUB))*0.25*RDT2
004406          DSTTLC=(DSLC-2.0*DSLB+0.5*(DSLA+DSLB))*0.25*RDT2

004416          DSTUC=(DSUC-0.5*(DSUA+DSUB))*RDT
004423          DSTLC=(DSLC-0.5*(DSLA+DSLB))*RDT
004430       42 CONTINUE
004430          YXUDC=(YXUC-DSXUC)
004432          YXLDC=(YXLC+DSXLC)
004434          YXXUDC=(YXXUC-DSXXUC)
004436          YXXLDC=(YXXLC+DSXXLC)
004440          YXTUDC=(-DSXTUC)
004442          YXTLDC=(DSXTLC)
004443          YTXUDC=YXTUDC
004445          YTXLDC=YXTLDC
004446          YTTUDC=(-DSTTUC)
004450          YTTLDC=(DSTTLC)
004451          YN=YUC-DSUC-YLC-DSLC
004455          RUC=R2(ID,J,KS)
004463          RLC=R2(ID,J, 2)
004465          UUC=U2(ID,J,KS)
004472          ULC=U2(ID,J, 2)
004474          VUC=V2(ID,J,KS)
004501          VLC=V2(ID,J, 2)
004503          CEE=CE1
004505          ESS=ES1
004506          IF(ID.EQ.5) CEE=CE2
004511          IF(ID.EQ.5) ESS=ES2
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004514          THETU=ATAN(ESS/CEE*(YUR-DSUR-YUL+DSUL)*R2DX)
004525          QRU2=JUC**2+VUC**2
004527          VDSU=-DSTUC*ESS/CE1
004532          TAU=ESS/CEE*YXUDC
004534          TBU=1.0+TAU**2
004536          TCU=VDSU*TAU
004540          TDU=TCU/TBU
004542          UUC=-TDU+SQRT(TDU**2+(QRU2-VDSU**2)/TBU)
004551          VUC=TAU*UUC+VDSU
004554          U2(ID,J,KS)=UUC
004561          V2(ID,J,KS)=VUC

004565          THETL=ATAN(ESS/CEE*(YLR+DSLR-YLL-DSLL)*R2DX)
004576          QRL2=JLC**2+VLC**2
004600          VDSL=DSTLC*ESS/CE1
004603          TAL=ESS/CEE*YXLDC
004605          TBL=1.0+TAL**2
004607          TCL=VDSL*TAL
004611          TDL=TCL/TBL
004613          ULC=-TDL+SQRT(TDL**2+(QRL2-VDSL**2)/TBL)
004622          VLC=TAL*ULC+VDSL
004625          U2(ID,J, 2)=ULC
004630          V2(ID,J, 2)=VLC
004633          PXUC=(P2(ID,J+1,KS)-P2(ID,J-1,KS))*R2DX
004644          PXLC=(P2(ID,J+1, 2)-P2(ID,J-1, 2))*R2DX
004650          TRM=CEE*CEE/(ESS*ESS)
004652          TRB=CEE/CE1
004654          PUN=Y1/( TRM     +YXUDC**2)*(YXUDC*PXUC-     RUC*(UUC*(YXXUDC*UUC+
               1 (YTXJDC+           YXTUDC)*TRB)+     YTTUDC *TRB**2))
004672          PLN=Y1/( TRM     +YXLDC**2)*(YXLDC*PXLC-     RLC*(ULC*(YXXLDC*ULC+
               1 (YTXLDC+           YXTLDC)*TRB)+     YTTLDC*TRB**2))
004710          PC=P2(ID,J,KS )+2.0*DN*PUN
004716          PC=P2(ID,J,KSN)+2.0*DN*PUN

004725          UUX=(J2(ID,J+1,KS)-U2(ID,J-1,KS))*R2DX
004733          TERAU=-SIN(THETU)/CEE
004737          TERBU=1.0/(ESS*((YU(IDL102,J)-DSU(IDL102,J,3))
               1 -(YL(IDL102,J)+DSL(IDL102,J,3)))*COS(THETU))
004755          PUNO=TERAU*PXUC+TERBU*PUN
004760          UUNO=-PJNO/(UUC*RUC)
004763          UUN=(JUNC-TERAU*UUX)/TERBU
004767          VC=VUC+V2(ID,J,KSM)-V2(ID,J,KSM-1)
004777          UC=U2(ID,J,KS )+UUN*2.0*DN
005005          UC=J2(ID,J,KSM)+UUN*2.0*DN
005013          RC=R2(ID,J,KS )*(PC/P2(ID,J,KS ))**(1.0/GAMMA)
005025          RC=R2(ID,J,KSN)*(PC/P2(ID,J,KSM))**(1.0/GAMMA)
005037          GO TO 666
005040          HYPU=SQRT((2.0*DX*CEE)**2+(ESS*(YUDR-YUDL))**2)
***NP *********************************
005051          TER1U=-ESS/CEE*(YUDR-YUDL)/HYPU
005055          TER2U=-ESS/CEE*YXUDC/(YUDC-YLDC)*(YUDR-YUDL)/HYPU
005065          TER3U=CEE/(ESS*(YUDC-YLDC))*(2.0*DX/HYPU)
005074          PUP=(P2(ID,J+1,KS)-P2(ID,J-1,KS))*R2DX*TER1U+PUN*(TER2U+TER3U)
005113          RUP=RUC/P2(ID,J,KS)/GAMMA*PUP
005120          RUN=(RLP-(R2(ID,J+1,KS)-R2(ID,J-1,KS))*R2DX*TER1U)/(TER2U+TER3U
005133          RC=R2(ID,J,KSM)+2.0*RUN*DN
005142      666 CONTINUE
```

```
005142          TC=PC/RC
005144          EC=TC/GAML1+0.5*(UC*UC+VC*VC-OMR(IDL102)**2)

005153          P2(ID,J,KSF)=PC
005161          R2(ID,J,KSF)=RC
005165          U2(ID,J,KSF)=UC
005171          V2(ID,J,KSF)=VC
005175          E2(ID,J,KSF)=EC

005201          PC=P2(ID,J,2)-2.0*DN*PLN
005206          PC=P2(ID,J,3)-2.0*DN*PLN

005214          ULX=(U2(ID,J+1, 2)-U2(ID,J-1, 2))*R2DX
005223          TERAL=-SIN(THETL)/CEE
005226          TERBL=1.0/(ESS*((YU(IDL102,J)-DSU(IDL102,J,3))
                1  -(YL(IDL102,J)+DSL(IDL102,J,3)))*COS(THETL))
005244          PLNO=TERAL*PXLC+TERBL*PLN
005247          ULNO=-PLNO/(ULC*RLC)
005252          ULN=(ULNC-TERAL*ULX)/TERBL
005256          VC=VLC+V2(ID,J,  3)-V2(ID,J,     4)
005262          UC=U2(ID,J,  2)-ULN*2.0*DN
005267          UC=U2(ID,J,  3)-ULN*2.0*DN
005274          RC=R2(ID,J,  2)*(PC/P2(ID,J,  2))**(1.0/GAMMA)
005306          RC=R2(ID,J,  3)*(PC/P2(ID,J,  3))**(1.0/GAMMA)
005317          GO TO 667
005320          HYPL=SQRT((2.0*DX*CEE)**2+(ESS*(YLDR-YLDL))**2)
***NP *********************************
005331          TER1L=-ESS/CEE*(YLDR-YLDL)/HYPL
005335          TER2L=-ESS/CEE*YXLDC/(YUDC-YLDC)*(YLDR-YLDL)/HYPL
005345          TER3L=CEE/(ESS*(YUDC-YLDC))*(2.0*DX/HYPL)
005354          PLP=(P2(ID,J+1, 2)-P2(ID,J-1, 2))*R2DX*TER1L+PLN*(TER2L+TER3L)
005367          RLP=RLC/P2(ID,J, 2)/GAMMA*PLP
005374          RLN=(RLP-(R2(ID,J+1, 2)-R2(ID,J-1, 2))*R2DX*TER1L)/(TER2L+TER3L
005406          RC=R2(ID,J,  3)-2.0*RLN*DN
005413     667 CONTINUE

005413          TC=PC/RC
005415          EC=TC/GAML1+0.5*(UC*UC+VC*VC-OMR(IDL102)**2)

005424          P2(ID,J,1)=PC
005430          R2(ID,J,1)=RC
005432          U2(ID,J,1)=UC
005435          V2(ID,J,1)=VC
005437          E2(ID,J,1)=EC
           C3 ZF NON-LEADING EDGE HORIZONTAL BOUNDARIES = = = = = = = = = = = = =
005442      80 CONTINUE
005445          IF(IDELTA.EQ.1) GO TO 30
005447          IF(IBLEO.EG.0) GO TO 1040
005450          I2P=2
005451          I2I=3
005452          IF(IDL102.EQ.2) I2P=1
005455          P2(ID,JS,1)=PMS(I2P,IDL102)
005462          R2(ID,JS,1)=RMS(I2P,IDL102)
005466          U2(ID,JS,1)=UMS(I2P,IDL102)
005471          V2(ID,JS,1)=VMS(I2P,IDL102)
005475          E2(ID,JS,  1)=PMS(I2P,IDL102)/RMS(I2P,IDL102)/GAML1+0.5*
                1  (UMS(I2P,IDL102)**2+VMS(I2P,IDL102)**2-OMR(IDL102)**2)
```

```
005513          P2(ID,JS,KSP)=P3S(I21,IDL102)
005522          R2(ID,JS,KSP)=R3S(I21,IDL102)
005531          U2(ID,JS,KSP)=U3S(I21,IDL102)
005540          V2(ID,JS,KSP)=V3S(I21,IDL102)
005547          E2(ID,JS,KSP)=P3S(I21,IDL102)/R3S(I21,IDL102)/GAML1+0.5*
              1 (U3S(I2P,IDL102)**2+V3S(I2P,IDL102)**2-OMR(IDL102)**2)
005567          GO TO 30
005570     1040 CONTIUE
005570          P2(ID,JS,1)=P2(ID,JS,KSM)
005577          R2(ID,JS,1)=R2(ID,JS,KSM)
005603          U2(ID,JS,1)=U2(ID,JS,KSM)
005607          V2(ID,JS,1)=V2(ID,JS,KSM)
005613          E2(ID,JS,1)=E2(ID,JS,KSM)
005617          P2(ID,JS,KSP)=P2(ID,JS,3)
005624          R2(ID,JS,KSP)=R2(ID,JS,3)
005630          U2(ID,JS,KSP)=U2(ID,JS,3)
005634          V2(ID,JS,KSP)=V2(ID,JS,3)
005640          E2(ID,JS,KSP)=E2(ID,JS,3)
005644       30 CONTIUE
          C3 ZC FOR (3,J,1), (3,J,KSP), (5,J,1), (5,J,KSP) , , , , , , , , , ,
005644      100 CONTIUE

005647          PDAIL(1)=0.0
005650          PDAIL(2)=0.0
005651          PDAIU(1)=0.0
005652          PDAIU(2)=0.0
005653          DO 309 ID=3,5,2
005654          IF(ITIME.NE.NNN.OR.IDELTA.EQ.0) GO TO 396
005662          IF((IABC.LE.1.AND.ID.EQ.5).OR.(IABC.GE.2.AND.ID.EQ
              1 .3).OR.(IABC.EQ.4.AND.ID.EQ.5)) GO TO 309
005710      396 CONTIUE
005710          IDL102=(ID-1)/2
005713          ESS=ES1
005714          CEE=CE1
005716          IF(IDL102.EQ.2) ESS=ES2
005721          IF(IDL102.EQ.2) CEE=CE2
005724          KSM2=KS-2
005726          DO 307 K=2,KS,KSM2
005727          DO 307 J=2,JSM
005730          PR=P2(ID,J+1,K)
005735          PL=P2(ID,J,K)
005742          PC=(PR+PL)*0.5
005745          IF(K.EQ.KS) GO TO 308
005747          AR=YL(IDL102,J+1)
005752          AL=YL(IDL102,J)
005754          DA=-(AR-AL)
005756          PDA=PC*DA*ESS/CEE
005761          PDAIL(IDL102)=PDAIL(IDL102)+PDA
005763          GO TO 312
005764      308 AR=YU(IDL102,J+1)
005767          AL=YU(IDL102,J)
005771          DA=AR-AL
005773          PDA=PC*DA*ESS/CEE
005777          PDAIU(IDL102)=PDAIU(IDL102)+PDA
006001      312 CONTIUE
006001      307 CONTIUE
006006          PDAI(IDL102)=PDAIL(IDL102)+PDAIU(IDL102)
006011      309 CONTIUE
```

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       C3 ZZ COMPUTE PERMANENT HORIZONTAL BOUNDARIES (ID,J,1), (ID,J,KSP) -
006013      31 RETURN
006014         END
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                    SUBROUTINE VEBRY1(IABC)
000003              DIMENSION    R1(7,13,13),P1(7,13,13),U1(7,13,13),V1(7,13,13),
                  1 E1(7,13,13),R2(7,13,13),P2(7,13,13),U2(7,13,13),V2(7,13,13),
                  2 E2(7,13,13),THETAL(2),THETAU(2),
                  3 DSU(2,13,3),DSL(2,13,3),YU(2,13),YL(2,13),JI(7),JF(7)
                  4 ,YUXLE(2),YLXLE(2),OMR(2)
                  6 ,PDAI(2),PDAIU(2),PDAIL(2)
                  7 ,DRAGU(2),DRAGL(2)
000003              COMMON R2,P2,U2,V2,E2
000003              COMMON/A/GAMMA,GAML1
000003              COMMON/B/OMP,NBLADE,NONDIM,ITER,PHI
000003              COMMON/C/DSU,DSL
000003              COMMON/D/ ID,J,KJ,IDS,K
000003              COMMON/E/ JI,JF,JS,KS
000003              COMMON/F/YU,YL
000003              COMMON/G/ DX,RDX,R2DX,RDX2
000003              COMMON/H/DN,RDN,R2DN,RDN2
000003              COMMON/I/DT,RDT,R2DT,RDT2,DTO2
000003              COMMON/J/ES1,ES2,CE1,CE2,CS,CR,SS,SR,RADLE1,RADLE2,C4
000003              COMMON/K/ ISTART
000003              COMMON/L/RII,UII,EII,PII,VII
000003              COMMON/N/ ITIME,NNN,NTIME
000003              COMMON/O/ PDAI,PDAIU,PDAIL
000003              COMMON/P/R1,P1,U1,V1,E1
000003              COMMON/Q/JSM,JSP,KSM,KSP
000003              COMMON/S/ THETAL,THETAU
000003              COMMON/U/ YUXLE,YLXLE
000003              COMMON/Z/DRAGU,DRAGL
000003              COMMON/ZE/ SPAIH,SRUAI,SRUVAI,SRU2PP
000003              COMMON/ZC/ PAIH2,RUAI1,RUVAI1,RU2PPE,NT
000003              COMMON/ZE/IDATA
000003              DX1=1.0/FLOAT(JS-2)
000007              DX7=1.0/FLOAT(JS-2)
000012              KSO2P1=KS/2+1
         C4 AA COMPUTE VERTICAL BOUNDARIES (1,2,K), (1,JS,K), (2,1,K), (2,JS,K
000015              DO 90 K=1,KSP

000016              P2(1,2,K)=1.0
000021              R2(1,2,K)=RII
000024              U2(1,2,K)=UII
000027              V2(1,2,K)=VII
000032              E2(1,2,K)=EII

000035              P2(1,JS,K)=P2(2,2,K)
000043              R2(1,JS,K)=R2(2,2,K)
000047              U2(1,JS,K)=U2(2,2,K)
000052              V2(1,JS,K)=V2(2,2,K)
000055              E2(1,JS,K)=E2(2,2,K)

000060              FRX=-DX/ALOG(1.0-DX)
000065              PC=P2(2,2,K)*(1.0-FRX)+P2(1,JSM,K)*FRX
000074              RC=R2(2,2,K)*(1.0-FRX)+R2(1,JSM,K)*FRX
000103              UC=U2(2,2,K)*(1.0-FRX)+U2(1,JSM,K)*FRX
000112              VC=V2(2,2,K)*(1.0-FRX)+V2(1,JSM,K)*FRX
000122              TC=PC/RC
000124              EC=TC/GAML1+0.5*(UC*UC+VC*VC-OMR(1)**2)
```

```
000133          P2(2,1,K)=PC
000135          R2(2,1,K)=RC
000137          U2(2,1,K)=UC
000141          V2(2,1,K)=VC
000143          E2(2,1,K)=EC

000145          P2(2,JS,K)=P2(3,2,K)
000151          R2(2,JS,K)=R2(3,2,K)
000154          U2(2,JS,K)=U2(3,2,K)
000157          V2(2,JS,K)=V2(3,2,K)
000162          E2(2,JS,K)=E2(3,2,K)

000165          P2(3,1,K)=P2(2,JSM,K)
000171          R2(3,1,K)=R2(2,JSM,K)
000174          U2(3,1,K)=U2(2,JSM,K)
000200          V2(3,1,K)=V2(2,JSM,K)
000204          E2(3,1,K)=E2(2,JSM,K)

        C4 ZZ COMPUTE VERTICAL BOUNDARIES (1,2,K), (1,JS,K), (2,1,K), (2,JS,K
000210     90 CONTINUE

000214     12 DO 190 K=1,KSP
        C5 AA COMPUTE VERTICAL BOUNDARIES (6,JSP,K), (7,2,K) . . . . . . . . .
000216          FRX=-DX/ALOG(1.0-DX7)
000223          PC=P2(6,JS,K)*(1.0-FRX)+P2(7,3,K)*FRX
000235          RC=R2(6,JS,K)*(1.0-FRX)+R2(7,3,K)*FRX
000244          UC=U2(6,JS,K)*(1.0-FRX)+U2(7,3,K)*FRX
000253          VC=V2(6,JS,K)*(1.0-FRX)+V2(7,3,K)*FRX
000262          TC=PC/RC
000264          EC=TC/GAML1+0.5*(UC*UC+VC*VC-OMR(2)**2)

000273          P2(6,JSP,K)=PC
000277          R2(6,JSP,K)=RC
000301          U2(6,JSP,K)=UC
000304          V2(6,JSP,K)=VC
000307          E2(6,JSP,K)=EC

000312          P2(7,2,K)=P2(6,JS,K)
000315          R2(7,2,K)=R2(6,JS,K)
000321          U2(7,2,K)=U2(6,JS,K)
000325          V2(7,2,K)=V2(6,JS,K)
000331          E2(7,2,K)=E2(6,JS,K)
        C5 ZZ COMPUTE VERTICAL BOUNDARIES (6,JSP,K), (7,2,K) . . . . . . . . .
000335    190 CONTINUE

        C6 AA COMPUTE DOWNSTREAM INFINITY * * * * * * * * * * * * * * * * * * *
000341          RUVAI=0.0
000342          RUAI=0.0
000343          JSO2P1=JS/2+1
000345          DO 265 K=2,KS
000347          RC=R2(4,JSO2P1,K)
000354          UC=U2(4,JSO2P1,K)
000360          VC=V2(4,JSO2P1,K)
000365          DRU=RC*UC*DN
000367          IF(K.EQ.2.OR.K.EQ.KS) DRU=0.5*DRU
000377          DRUV=DRU*VC
000401          RUVAI=RUVAI+DRUV
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000403    .266 RUAI=RUAI+DRU
000407         PAIHL=0.0
000410         PAIHU=0.0
000411         KSM2=KS-2
000413         DO 273 K=2,KS,KSM2
000414         DO 274 J=2,JS
000415         PC=P2(5,J,K)
000422         DPA=PC*DX
000424         IF(J.EG.2.OR.J.EQ.JS) DPA=0.5*DPA
000434         IF(K.EG.KS) GO TO 277
000436         PAIHL=PAIHL+DPA
000440         GO TO 284
000441     277 PAIHU=PAIHU+DPA
000443     284 CONTINUE
000443     274 CONTINUE
000446     273 CONTINUE
000450         PAIHD=PAIHL-PAIHU
000452         NT=2*(ITIME-NNN)-1+ITER
000456         IF(ISTART.NE.0) GO TO 100
000457         PAIH2=SPAIH
000460         RUAI1=SRUAI
000462         RUVAI1=SRUVAI
000463         RU2PPE=SRU2PP
000465     100 CONTINUE
000465         SPAIH=PAIH2
000467         SRUAI=RUAI1
000470         SRUVAI=RUVAI1
000472         SRU2PP=RU2PPE
000473         FLNT=FLOAT(NT)
000475         RUVAI1=(FLOAT(NT-1)*RUVAI1+RUVAI)/FLNT
000501         RUAI1=(FLOAT(NT-1)*RUAI1+RUAI)/FLNT
000506         PAIH2=(FLOAT(NT-1)*PAIH2+PAIHD)/FLNT
000513         RUVAI2=(ES2/ES1)*(RUVAI1+(OMR(1)-OMR(2))*RUAI1)
000520         RUE=RII*UII
000522         DRAGT1=DRAGU(1)+DRAGL(1)
000524         DRAGT2=DRAGU(2)+DRAGL(2)
000526         RU2PPP=(RII*UII*UII+PII-(DRAGT1-PDAI(1))/FLOAT(KS-2))*ES2/ES1-
               1 (DRAGT2-PDAI(2))/FLOAT(KS-2)
000544         RU2PPE=(FLOAT(NT-1)*RU2PPE+RU2PPP)/FLNT
000551         VRO1=RUVAI1/RUAI1
000553         EII=PII/RII/GAML1+(UII*UII+VII*VII-OMR(1)**2)*0.5
000562         HR1=EII+PII/RII
000565         HR2=HR1+(VRO1+OMR(1))*(OMR(1)-OMR(2))
000572         RUHE=RUE*HR2
000573         HE=RUHE/RUE
000574         VE=(PAIH2*CE2/ES2+RUVAI2)/RUE
000601         GAMP1=GAMMA+1.
000603         TR3=HE+0.5*(OMR(2)**2-VE*VE)
000610         TR2=1.0-2.0*(RUE/RU2PPE)**2*TR3
000615         ROOT=SQRT(1.0+GAMP1*GAML1*TR2)
000623         TR1=RU2PPE/GAMP1
000625         PE=TR1*(1.0+ROOT)
000630         PA=TR1*(1.0-ROOT)
000633         IF(PA.GT.PE) PE=PA
000636         RU2E=RU2PPE-PE
000640         UE=RU2E/RUE
000642         RE=RUE/UE
000643         EE=HE-PE/RE
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```
000646              DO 173 K=1,KSP
000647              P2(7, JS,K)=PE
000654              R2(7, JS,K)=RE
000660              U2(7, JS,K)=UE
000665              V2(7, JS,K)=VE
000671              E2(7, JS,K)=EE
          C6 ZZ COMPUTE DOWNSTREAM INFINITY * * * * * * * * * * * * * * * * * * * *
000675         173 CONTINUE

000677              RETURN
000700              END
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                      SUBROUTINE VEBRY2(IABC)
000003                DIMENSION     R1(7,13,13),P1(7,13,13),U1(7,13,13),V1(7,13,13),
                    1 E1(7,13,13),R2(7,13,13),P2(7,13,13),U2(7,13,13),V2(7,13,13),
                    2 E2(7,13,13),THETAL(2),THETAU(2),
                    3 DSU(2,13,3),DSL(2,13,3),YU(2,13),YL(2,13),JI(7),JF(7)
                    4 ,YUXLE(2),YLXLE(2),OMR(2)
                    5 ,Y5(33),X5(4,33),XQ3(4)
                    6 ,PDAI(2),PDAIU(2),PDAIL(2)
                    7 ,DRAGU(2),DRAGL(2)
                    8 ,DSU1(2),DSL1(2)
                    9 ,P3(5,9,13),R3(5,9,13),U3(5,9,13),V3(5,9,13)
                    9 ,PM(5,9,13),RM(5,9,13),UM(5,9,13),VM(5,9,13)
                    9 ,P4(9,13),R4(9,13),U4(9,13),V4(9,13)
                    9 ,P5(9,13),R5(9,13),U5(9,13),V5(9,13)
000003                COMMON R2,P2,U2,V2,E2
000003                COMMON/A/GAMMA,GAML1
000003                COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000003                COMMON/B1/ IBLEQ
000003                COMMON/C/DSU,DSL
000003                COMMON/D/ ID,J,KJ,IDS,K
000003                COMMON/E/ JI,JF,JS,KS
000003                COMMON/F/YU,YL
000003                COMMON/G/ DX,RDX,R2DX,RDX2
000003                COMMON/H/DN,RDN,R2DN,RDN2
000003                COMMON/I/DT,RDT,R2DT,RDT2,DTO2
000003                COMMON/J/ES1,ES2,CE1,CE2,CS,CR,SS,SR,RADLE1,RADLE2,C4
000003                COMMON/K/ ISTART
000003                COMMON/L/RII,UII,EII,PII,VII
000003                COMMON/M/ XMU,IDELTA
000003                COMMON/N/ ITIME,NNN,NTIME
000003                COMMON/O/ PDAI,PDAIU,PDAIL
000003                COMMON/P/R1,P1,U1,V1,E1
000003                COMMON/P1/ P3,R3,U3,V3,P4,R4,U4,V4,P5,R5,U5,V5,PM,RM,UM,VM
000003                COMMON/Q/JSM,JSP,KSM,KSP
000003                COMMON/S/ THETAL,THETAU
000003                COMMON/T/ LBLADE
000003                COMMON/U/ YUXLE,YLXLE
000003                COMMON/V/ JV
000003                COMMON/W/Y5,X5,XQ3
000003                COMMON/Y/ DSU1,DSL1
000003                COMMON/Z/ DRAGU,DRAGL
000003                COMMON/ZD/ISLLE,ISLTE
000003                REAL LRUDN,LRUHDN,LRU2DN,LVOUDN
000003                DOMR=OMR(2)-OMR(1)
000005                DX1=1.0/FLOAT(JS-2)
000011                DX7=1.0/FLOAT(JS-2)
000014                ID=3
000015                IDL102=(ID-1)/2
000017                YL1C=YL(IDL102,2)
000021                YU1C=YU(IDL102,2)
000022                YL1P=YL(IDL102,1)
000024                YU1P=YU(IDL102,1)
000025                DO 227 K=1,KSP
000027                Y5(K)=YL1C+DN*FLOAT(K-2)
000034                IF(K.EQ.1) GO TO 222
000035                IF(K.EQ.KSP) GO TO 228
000037                X5(1,K)=P2(ID,1,K)
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000043              X5(2,K)=R2(ID,1,K)
000050              X5(3,K)=U2(ID,1,K)
000054              X5(4,K)=V2(ID,1,K)
000061              GO TO 227
000061          228 IF(IBLEQ.EQ.0) GO TO 10
000062              X5(1,K)=P3(2,3,JSM)
000070              X5(2,K)=R3(2,3,JSM)
000074              X5(3,K)=U3(2,3,JSM)
000101              X5(4,K)=V3(2,3,JSM)
000105              GO TO 227
000105           10 CONTINUE
000105              X5(1,K)=P2(ID,1,3)
000111              X5(2,K)=R2(ID,1,3)
000113              X5(3,K)=U2(ID,1,3)
000116              X5(4,K)=V2(ID,1,3)
000120              GO TO 227
000120          222 IF(IBLEQ.EQ.0) GO TO 12
000121              X5(1,K)=P3(2,2,JSM)
000127              X5(2,K)=R3(2,2,JSM)
000133              X5(3,K)=U3(2,2,JSM)
000140              X5(4,K)=V3(2,2,JSM)
000144              GO TO 227
000144           12 CONTINUE
000144              X5(1,K)=P2(ID,1,KSM)
000152              X5(2,K)=R2(ID,1,KSM)
000156              X5(3,K)=U2(ID,1,KSM)
000162              X5(4,K)=V2(ID,1,KSM)
000166          227 CONTINUE
000171              TY=YU1P-YL1P
000173              DO 229 K=2,KS
000174              Y4=YL1P+DN*FLOAT(K-2)*TY
000201              IF(K.EQ.2.OR.K.EQ.KS) Y4=0.5*(YL1P+YU1P-1.0)+DN*FLOAT(K-2)
000220              IF(IBLEQ.NE.0) GO TO 30
000221              IF(Y4.LT.YL1C) Y4=Y4+1.0
000226              IF(Y4.GT.YU1C) Y4=Y4-1.0
000233              GO TO 29
000234           30 CONTINUE
000234              IF(Y4.LT.(YL1C-DN)) Y4=YL1C-DN
000241              IF(Y4.GT.(YL1C+DN)) Y4=YL1C+DN
000246           29 CONTINUE
000246              DO 230 KK=1,KS
000250              YR=Y4
000252              YR1=Y5(KK)
000253              YR2=Y5(KK+1)
000255              IF(YR.LT.YR2.AND.YR.GE.YR1) GO TO 231
000265          230 CONTINUE
000267              MARK=5
000270              GO TO 120
000271          231 CONTINUE
000271              DO 232 I=1,4
000273              XQ1=X5(I,KK)
000276              XQ2=X5(I,KK+1)
000300              CALL FAT(YR,YR1,YR2,XQ1,XQ2,XQA)
000304          232 XQ3(I)=XQA
000311              P2(ID,1,K)=XQ3(1)
000315              R2(ID,1,K)=XQ3(2)
000320              U2(ID,1,K)=XQ3(3)
000323              V2(ID,1,K)=XQ3(4)
```

```
000326          E2(ID,  1,K)=XQ3(1)/XQ3(2)/GAML1+0.5*(XQ3(3)**2+XQ3(4)**2-
              1 OMR(IDL102)**2)
000342      229 CONTINUE
000344      226 CONTINUE
          C7 AA COMPUTE VERTICAL BOUNDARIES (4,2,K), (6,2,K) - - - - - - - - - -
000344          DO 100 ID=4,6,2
          C     TO FIND KLP AND KUM
000346          KLP=2
000347          KUM=KS
000351          IDL102=(ID-2)/2
          C          IN THIS ROUTINE  IDL102=(ID-2)/2  FOR ID=4 AND 6
000353          IF(IDL102.EQ.2) GO TO 60
000354          CEE=CE1
000356          ESS=ES2
000357          GO TO 62
000360       60 CEE=CE2
000362          ESS=ES2
000363       62 CONTINUE
000363          THETAL(IDL102)=ATAN(ESS/CEE*(YL(IDL102,JSP)-YL(IDL102,JSM))*R2I
000376          THETAU(IDL102)=ATAN(ESS/CEE*(YU(IDL102,JSP)-YU(IDL102,JSM))*R2I
000410          DSLF=DSL(IDL102,JS,3)
000413          IF(DSLF.EQ.0.0) GO TO 81
000414          DO 80 K=2,KS
000416          YY1=DJ*FLOAT(K-2)
000421          IF(YY1.GT.DSLF) KLP=K
000425          IF(YY1.GT.DSLF) GO TO 81
000430       80 CONTINUE
000432       81 CONTINUE
000432          DSUF=DSU(IDL102,JS,3)
000435          IF(DSUF.EQ.0.0) GO TO 71
000436          DO 70 KKK=2,KS
000437          K=KS+2-KKK
000441          YY1=DJ*FLOAT(KS-K)
000444          IF(YY1.GT.DSUF) KUM=K
000447          IF(YY1.GT.DSUF) GO TO 71
000452       70 CONTINUE
000454       71 CONTINUE

000454          DELTAL=FLOAT(KLP-2)*DN
000460          DELTAU=FLOAT(KS-KUM)*DN
000462          IF(DELTAL+DELTAU.EQ.0.0) GO TO 111
000464          DO 105 K=1,KSP
000466          YY=FLOAT(K-2)
000470          Y5(K)=DSLF+YY*(1.0-DSUF-DSLF)*DN
000476          X5(1,K)=F2(ID-1,JS,K)
000504          X5(2,K)=R2(ID-1,JS,K)
000512          X5(3,K)=U2(ID-1,JS,K)
000517          X5(4,K)=V2(ID-1,JS,K)
000524      105 CONTINUE
000527          DO 110 K=KLP,KUM
000531          YR=FLOAT(K-2)*DN
000534          DO 115 KK=2,KS
000536          KKP=KK+1
000540          RA=Y5(KK)
000541          RU=Y5(KKP)
000543          IF(YR.LT.RB.AND.YR.GE.RA) GO TO 116
000554      115 CONTINUE
000556          MARK=0
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000557              GO TO 120
000557          116 CONTINUE
000557              DO 125 I=1,4
000561              Q1=X5(I,KK)
000564              Q2=X5(I,KKP)
000566              CALL FAT(YR,RA,RB,Q1,Q2,XYZ)
000572          125 XQ3(I)=XYZ
000577              P2(ID,2,K)=XQ3(1)
000603              R2(ID,2,K)=XQ3(2)
000606              U2(ID,2,K)=XQ3(3)
000611              V2(ID,2,K)=XQ3(4)
000614              E2(ID,2,K)=XQ3(1)/XQ3(2)/GAML1+0.5*(XQ3(3)*XQ3(3)+XG3(4)*XQ3(4)
                   1 OMR(IDL102)**2)
000630          110 CONTINUE
000632              RDSL=R2(ID-1,JS,2)
000636              UDSL=U2(ID-1,JS,2)
000640              RDL=R2(ID,2,KLP)
000644              UDL=U2(ID,2,KLP)
000647              RDSU=R2(ID-1,JS,KS)
000654              UDSU=U2(ID-1,JS,KS)
000660              RDU=R2(ID,2,KUM)
000663              UDU=U2(ID,2,KUM)
000666              EDSL=E2(ID-1,JS,2)
000670              EDSU=E2(ID-1,JS,KS)
000675              EDL=E2(ID,2,KLP)
000700              EDU=E2(ID,2,KUM)

000704              VDL=V2(ID,2,KLP)
000707              VDU=V2(ID,2,KUM)
000713              VDSL=V2(ID-1,JS, 2)
000716              VDSU=V2(ID-1,JS,KS)
000722              VOUDL=VDL/UDL
000724              VOUDU=VDU/UDU
000726              VOUDSL=VDSL/UDSL
000730              VOUDSU=VDSU/UDSU
000732              RUDSL=RDSL*UDSL
000734              RUDU=RDU*UDU
000736              RUDL=RDL*UDL
000740              RUDSU=RDSU*UDSU
000742              DDL=DELTAL-DSLF
000744              DDU=DELTAU-DSUF
000746              SDELTA=DELTAU+DELTAL
000747              SDS=DSUF+DSLF
000750              PDSU=P2(ID-1,JS,KS)
000756              PDSL=P2(ID-1,JS,2)
000760              PDU=P2(ID,2,KUM)
000764              PDL=P2(ID,2,KLP)
000767              HDSU=EDSU+PDSU/RDSU
000772              HDSL=EDSL+PDSL/RDSL
000775              HDU=EDU+PDU/RDU
001000              HDL=EDL+PDL/RDL
001003              RJHDSL=RUDSL*HDSL
001005              RUHDL=RUDL*HDL
001007              RJHDSU=RUDSU*HDSU
001011              RJHDU=RUDU*HDU
001013              RJ2DSL=RUDSL*UDSL+PDSL
001016              RJ2DL=RUDL*UDL+PDL
001021              RJ2DSU=RUDSU*UDSU+PDSU
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001024          RJ2DU=RUDU*UDU+PDU
001027          VOUTE=TAN(0.5*(THETAU( IDL102 )+THETAL( IDL102 )))
001035          AH4=.5*((RUHDSL+RUHDL)*(DELTAL-DSLF)+(RUHDU+RUHDSU)*(DELTAU-DSU
001047          AU4=.5*((RU2DSL+RU2DL)*(DELTAL-DSLF)+(RU2DU+RU2DSU)*(DELTAU-DSU
001062          A4=0.5*((RUDSL+RUDL)*(DELTAL-DSLF)+(RUDSU+RUDU)*(DELTAU=DSUF))
001074          A3=0.5*(RUDL*DELTAL+RUDU*DELTAU)
001101          L=1
001102      129 IF(A3-A4) 130,134,136
001106      136 L=L+1
001110          IF(2*(L-1).GT.(KUM-KLP)) GO TO 253
001114          GO TO 254
001114      253 WRITE(6,255) ID,L,KLP,KUM,DSLF,DSUF,DELTAL,DELTAU
001140      255 FORMAT(/5X,36HSOMETHING IS WRONG WITH DISPLACEMENT/,
               1 5X,37HID, L,KLP,KUM,DSLF,DSUF,DELTAL,DELTAU,/4X,2I3,2I4,4E13,5
001140          CALL EXIT
001141      254 IF(L.EQ.1) GO TO 257
001144          RUDU=RUDUM
001146          RUDL=RUDLP
001147          RJHDU=RUHDUM
001151          RUHDL=RUHDLP
001152          RU2DU=RU2DUM
001154          RJ2DL=RU2DLP
001155      257 CONTINUE

001155          PDLP=P2(ID,2,KLP+L)
001162          RDLP=R2(ID,2,KLP+L)
001165          UDLP=U2(ID,2,KLP+L)
001170          VDLP=V2(ID,2,KLP+L)
001173          EDLP=E2(ID,2,KLP+L)
001176          PDUM=P2(ID,2,KUM-L)
001201          RDUM=R2(ID,2,KUM-L)
001204          UDUM=U2(ID,2,KUM-L)
001207          VDUM=V2(ID,2,KUM-L)
001212          EDUM=E2(ID,2,KUM-L)
001215          RJDLP=RDLP*UDLP
001217          RJDUM=RDUM*UDUM
001221          RJHDUM=RUDUM*(EDUM+PDUM/RDUM)
001225          RJHDLP=RUDLP*(EDLP+PDLP/RDLP)
001231          RU2DLP=RUDLP*UDLP+PDLP
001234          RU2DUM=RUDUM*UDUM+PDUM

001236          A4=A4+0.5*(RUDL+RUDLP+RUDU+RUDUM)*DN
001245          AH4=AH4+0.5*(RUHDL+RUHDLP+RUHDU+RUHDUM)*DN
001254          AU4=AU4+0.5*(RU2DL+RU2DLP+RU2DU+RU2DUM)*DN
001263          DELTAL=DELTAL+DN
001265          DELTAU=DELTAU+DN
001266          A3=0.5*(DELTAL*RUDLP+DELTAU*RUDUM)
001272          IF(A3-A4) 140,134,136
            C   GO TO 129
001275      130 CONTINUE
            C   ALLOW RUTE TO BE NON-ZERO
001275          IF(SDELTA.EQ.0.0.AND.SDS.EQ.0.0) GO TO 134
001303          IF(SDELTA.EQ.0.0.AND.SDS.NE.0.0) GO TO 138
001311          DRAGT=DRAGU(IDL102)+DRAGL(IDL102)
001314          RUTE=(RUDSL*DDL+RUDSU*DDU-RUDL*DSLF-RUDU*DSUF)/SDELTA
001325          RUHTE=(RUHDSL*DDL+RUHDSU*DDU-RUHDL*DSLF-RUHDU*DSUF)/SDELTA
001335          RU2TE=(RU2DSL*DDL+RU2DSU*DDU-RU2DL*DSLF=RU2DU*DSUF
               1 +(PDSL+PDSU)*SDS-DRAGT)/SDELTA
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001352        139 CONTINUE
001352            CALL  ISOLV(RUTE,RUHTE,RU2TE,VOUTE,PTE)
001356            RU2TE=RU2TE-PTE
001360            UTE=RU2TE/RUTE
001362            RTE=RITE/UTE
001363            VTE=VOUTE*UTE
001365            HTE=RUHTE/RUTE
001366            ETE=HTE-PTE/RTE
001371            GO TO 131

001372        138 WRITE(6,162) SDELTA,SDS
001402        162 FORMAT(///10X,8HSDELTA =,E15,8,8H   SDS =,E15.8/)
001402            CALL EXIT
001403        134 IF(SDS.EG.0.0) GO TO 133
001405            UTE=0.0
001406            VTE=0.0
001407            DRAGT=DRAGU(IDL102)+DRAGL(IDL102)
001411            PTE=(RU2DSL*DDL+RU2DSU*DDU-RU2DL*DSLF-RU2DU*DSUF
                 1 +(PDSL+PDSU)*SDS-DRAGT)/SDELTA
001427            HTE=(HDSU*DSLF+HDSL*DSUF)/SDS
001433            RTE=GAMMA/GAML1*PTE/HTE
001437            ETE=HTE-PTE/RTE
001441            GO TO 131
001442        133 RUTE=0,5*( RUDSU+ RUDSL)
001445            RU2TE=0.5*(RU2DSU+RU2DSL)
001451            RUHTE=0.5*(RUHDSU+RUHDSL)
001454            GO TO 139
001455        131 CONTINUE
001455            U2(ID,2,2)=UTE
001457            V2(ID,2,2)=VTE
001461            P2(ID,2,2)=PTE
001462            R2(ID,2,2)=RTE
001464            E2(ID,2,2)=ETE
001465            U2(ID,2,KS)=UTE
001471            V2(ID,2,KS)=VTE
001474            P2(ID,2,KS)=PTE
001477            R2(ID,2,KS)=RTE
001502            E2(ID,2,KS)=ETE
001505            IF(L.EG.1) GO TO 145

            C
001507        140 FRU=(2.0*A4-DN*(RUDLP+RUDUM))/(RUDU*DELTAU+RUDL*DELTAL)
001521            FRUH=(2.0*AH4-DN*(RUHDLP+RUHDUM))/(RUHDU*DELTAU+RUHDL*DELTAL)
001532            FRU2=(2.0*AU4-DN*(RU2DLP    +RU2DUM    ))/((RU2DU    +PTE)*
                 1 DELTAU+(RU2DL    +PTE)*DELTAL)
001546            RUDLM=RUDL*FRU
001550            RUHDLM=RUHDL*FRUH
001552            RU2DLM=RU2DL*FRU2
001554            RUDUP=RUDU*FRU
001556            RUHDUP=RUHDU*FRUH
001560            RU2DUP=RU2DU*FRU2
001562            RVDLM=V2(ID,2,KLP+L-1)*R2(ID,2,KLP+L-1)
001571            RVDUP=V2(ID,2,KUM-L+1)*R2(ID,2,KUM-L+1)
001577            VDULM=RVDLM/RUDLM
001601            VDUUP=RVDUF/RUDUP
001603            KLPP=KLP+L-1
001605            KLPPM2=KLPP-2
001607            LRUDN=(RUDLM-RUTE)/DN/FLOAT(KLPPM2)
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001612            LRUHDN=(RUHDLM-RUHTE)/DN/FLOAT(KLPPM2)
001616            LRU2DN=(RU2DLM-PTE)/DN/FLOAT(KLPPM2)
001622            LVOUDN=(VOULM-VOUTE)/DN/FLOAT(KLPPM2)
001626            KJMP=KUM-L+1
001630            KSMKU=KS-KUMP
001632            URUDN=(RUDUP-RUTE)/DN/FLOAT(KSMKU)
001636            URUHDN=(RUHDUP-RUHTE)/DN/FLOAT(KSMKU)
001642            URU2DN=(RU2DUP-PTE)/DN/FLOAT(KSMKU)
001646            UVOUDN=(VOLUP-VOUTE)/DN/FLOAT(KS-KUMP)
         C
001653        142 KLPP=KLP+L
001655            KLPPM2=KLPP-2
001657            LRUDN=(RUDL-RUTE)/DN/FLOAT(KLPPM2)
001663            LRUHDN=(RUHDL-RUHTE)/DN/FLOAT(KLPPM2)
001667            LRU2DN=(RU2DL-PTE)/DN/FLOAT(KLPPM2)
001673            LVOUDN=(VOUDL-VOUTE)/DN/FLOAT(KLPPM2)
001677            KUMP=KUM-L
001701            KSMKU=KS-KUMP
001702            URUDN=(RUDU-RUTE)/DN/FLOAT(KSMKU)
001706            URUHDN=(RUHDU-RUHTE)/DN/FLOAT(KSMKU)
001712            UVOUDN=(VOUDU-VOUTE)/DN/FLOAT(KSMKU)
001716            URU2DN=(RU2DU-PTE)/DN/FLOAT(KSMKU)
001722            GO TO 195

001722        195 CONTINUE
001722            KLPPM1=KLPP-1
001724            DO 200 K=3,KLPPM1
001726            RUP=RUTE+LRUDN*DN*FLOAT(K-2)
001733            RUHP=RUHTE+LRUHDN*DN*FLOAT(K-2)
001741            RU2P=RU2TE+LRU2DN*DN*FLOAT(K-2)
001746            VOUP=VOUTE+LVOUDN*DN*FLOAT(K-2)
001753            IF(RUP.LE.0.0) GO TO 198
001755            CALL ISOLV(RUP,RUHP,RU2P,VOUP,PP)
001760            UP=(RU2P-PP)/RUP
001763            RP=RUP/UP
001764            VP=VOUP*UP
001766            HP=RUHP/RUP
001767            EP=HP-PP/RP
001772            GO TO 199
001773        198 UP=0.0
001774            VP=0.0
001775            PP=RU2P
001776            H2A=E2(ID,2,KLPP)+P2(ID,2,KLPP)/R2(ID,2,KLPP)
002006            H2B=E2(ID,2,2)+P2(ID,2,2)/R2(ID,2,2)
002011            HP=FLOAT(K-2)/FLOAT(KLPP-2)*(H2A-H2B)+H2B
002021            RP=GAMMA/GAML1*PP/HP
002025            EP=HP-PP/RP
002027        199 CONTINUE
002027            U2(ID,2,K)=UP
002033            V2(ID,2,K)=VP
002036            P2(ID,2,K)=PP
002041            R2(ID,2,K)=RP
002044            E2(ID,2,K)=EP
002047        200 CONTINUE
002052            DO 210 K=KUMP,KSM
002054            RUP=RUTE+URUDN*DN*FLOAT(KS-K)
002061            RUHP=RUHTE+URUHDN*DN*FLOAT(KS-K)
002066            RU2P=RU2TE+URU2DN*DN*FLOAT(KS-K)
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002073          VOUP=VOUTE+UVOUDN*DN*FLOAT(KS-K)
002100          IF(RUP.EC.0.0) GO TO 208
002101          CALL DSOLV(RUP,RUHP,RU2P,VOUP,PP)
002105          UP=(RU2P-PF)/RUP
002110          RP=RUP/UP
002111          VP=VOUP*UP
002113          HP=RU1P/RUP
002114          EP=HP-PP/RP
002117          GO TO 209
002120      208 UP=0.0
002121          VP=0.0
002122          PP=RU2P
002123          H2C=E2(ID,2,KUMP)+P2(ID,2,KUMP)/R2(ID,2,KUMP)
002133          H2D=E2(ID,2,KS)+P2(ID,2,KS)/R2(ID,2,KS)
002142          HP=FLOAT(KS-K)/FLOAT(KS-KUMP)*(H2C-H2D)+H2D
002153          RP=GAMMA/GAML1*PP/HP
002157          EP=HP-PP/RP
002161      209 CONTINUE
002161          U2(ID,2,K)=UP
002165          V2(ID,2,K)=VP
002170          P2(ID,2,K)=PP
002173          R2(ID,2,K)=RP
002176          E2(ID,2,K)=EP
002201      210 CONTINUE

002204      145 GO TO 100
002205      111 DO 112 K=2,KS
002207          U2(ID,2,K)=U2(ID-1,JS,K)
002216          V2(ID,2,K)=V2(ID-1,JS,K)
002222          P2(ID,2,K)=P2(ID-1,JS,K)
002226          R2(ID,2,K)=R2(ID-1,JS,K)
002232      112 E2(ID,2,K)=E2(ID-1,JS,K)
          C7 ZZ COMPUTE VERTICAL BOUNDARIES (4,2,K), (6,2,K) -- -- -- -- -- -- --
002240      100 CONTINUE

002242          GO TO 122
002243      120 CONTINUE
002243          WRITE(6,124) MARK
002251      124 FORMAT(/1X,6HMARK =,1I3)
002251          WRITE(6,121)
002255      121 FORMAT(/5X,37HSOMETHING IS WRONG WITH INTERPOLATION/)
002255          CALL EXIT
002256      122 CONTINUE
          C8 AA COMPUTE VERTICAL BOUNDARIES (3,JSP,K), (5,JSP,K) / / / / / / /
002256          DO 260 ID=3,5,2
002261          IDL102=(ID-1)/2
002263          IF(ITIME.EQ.NNN) GO TO 262
002264          DSUC=DSU(IDL102,JS,3)
002267          DSLC=DSL(IDL102,JS,3)
002271          GO TO 261
002272      262 DSUC=DSU1(IDL102)
002274          DSLC=DSL1(IDL102)
002276      261 CONTINUE
002276          DELTC=(DSLC+DSUC)/(FLOAT(KS-2)*(1.0-(DSLC+DSUC)))
002305          DRAGT=DRAGL(IDL102)+DRAGU(IDL102)
002307          DDRAG=DRAGT/FLOAT(KS-2)
002312          RU2I=0.0
002313          RUI=0.0
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002314              RJHI=J.0
002315              DO 640 K=2,KS
002316              PC=P2(ID,JSP,K)
002323              RC=R2(ID,JSP,K)
002330              UC=U2(ID,JSP,K)
002335              VC=V2(ID,JSP,K)
002341              EC=E2(ID,JSP,K)
002345              DRU=RC*UC
002347              DRU2=DRU*UC+PC+DDRAG
002352              DRUH=DRU*(EC+PC/RC)
002356              VOUC=VC/UC
002360              CALL OSOLV(DRU,DRUH,DRU2,VOUC,PC)
002364              UC=(DRU2-PC)/DRU
002367              RC=DRU/UC
002370              VC=UC*VOUC
002372              HC=DRUH/DRU
002373              EC=HC-PC/RC
002376              P2(ID,JSP,K)=PC
002403              R2(ID,JSP,K)=RC
002406              U2(ID,JSP,K)=UC
002412              V2(ID,JSP,K)=VC
002416              E2(ID,JSP,K)=EC
002422              IF(K.NE.2.AND.K.NE.KS) GO TO 630
002432              DRU=DRU*0.5
002433              DRU2=DRU2*0.5
002434              DRUH=DRUH*0.5
002435          630 RJI=RUI+DRU
002437              RJ2I=RU2I+DRU2
002441              RJHI=RUHI+DRUH
002443          640 CONTINUE
002446              DELRU=DELTC*RUI*DN
002450              DELRU2=DELTC*RU2I*DN
002452              DELRUH=DELTC*RUHI*DN
002454              DO 650 K=2,KS
002455              PC=P2(ID,JSP,K)
002462              RC=R2(ID,JSP,K)
002467              UC=U2(ID,JSP,K)
002474              VC=V2(ID,JSP,K)
002500              VOUC=VC/UC
002502              EC=E2(ID,JSP,K)
002507              RUC=RC*UC
002511              RU2C=RUC*UC+PC
002513              RUHC=RUC*(EC+PC/RC)
002517              RUC=RUC+DELRU
002521              RU2C=RU2C+DELRU2
002523              RUHC=RUHC+DELRUH
002525              CALL OSOLV(RUC,RUHC,RU2C,VOUC,PC)
002530              RU2C=RU2C-PC
002532              UC=RU2C/RUC
002534              RC=RUC/UC
002535              VC=VOUC*UC
002537              HC=RUHC/RUC
002540              EC=HC-PC/RC
002543              P2(ID,JSP,K)=PC
002550              R2(ID,JSP,K)=RC
002553              U2(ID,JSP,K)=UC
002557              V2(ID,JSP,K)=VC
002563              E2(ID,JSP,K)=EC
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002567          650 CONTINUE
          C8 ZZ COMPUTE VERTICAL BOUNDARIES (3,JSP,K), (5,JSP,K) / / / / / /
          C8 AB TANGEITIZE LE AND INVISCID TE . . . . . . . . . . . . . . .
002572              JSM2=IS-2
002574              KSM2=KS-2
002575              ESS=ES1
002577              CEE=CE1
002600              IF(ID.GT.4) ESS=ES2
002604              IF(ID.GT.4) CEE=CE2
002607              YXM=0.5*(YLXLE(IDL102)+YLXLE(IDL102))
002613              THM=ATAN(YXM)
002615              YXN=0.5*((YL(IDL102,JS)+DSL(IDL102,JS,3)+YU(IDL102,JS)-DSU(IDL1
                   1 JS,3)-1.0)-(YL(IDL102,JSM)+DSL(IDL102,JSM,3)-YU(IDL102,JSM)-
                   2 DSU(IDL102,JSM,3)-1.0))*RDX*ESS/CEE
002643              THN=ATAN(YXN)
002645              DO 50 J=2,JS,JSM2
002647              DO 50 K=2,KS,KSM2
002650              IF(J.EQ.JS) GO TO 52
002652              IF(K.EQ.KS) GO TO 54
002654              YXS=YLXLE(IDL102)
002656              GO TO 56
002656          54 YXS=YUXLE(IDL102)
002660              GO TO 56
002661          52 IF(IDELTA.EQ.1) GO TO 50
002663              IF(K.EQ.KS) GO TO 58
002665              YXS=(YL(IDL102,J  )-YL(IDL102,J-1))*RDX*ESS/CEE
002675              GO TO 56
002676          58 YXS=(YU(IDL102,J  )-YU(IDL102,J-1))*RDX*ESS/CEE
002706          56 UC=U2(ID,J,K)
002714              VC=V2(ID,J,K)
002720              QC2=UC*UC+VC*VC
002722              VOU2=YXS*YXS
002724              UC=SQRT(QC2/(1.0+VOU2))
002731              VC=UC*YXS
002733              U2(ID,J,K)=UC
002740              V2(ID,J,K)=VC
002744              IF(J.EQ.2) GO TO 40
002746              U2(ID+1,2,K)=SQRT(QC2)*COS(THN)
002757              V2(ID+1,2,K)=SQRT(QC2)*SIN(THN)
002767              GO TO 50
002770          40 U2(ID-1,JS,K)=SQRT(QC2)*COS(THM)
003003              V2(ID-1,JS,K)=SQRT(QC2)*SIN(THM)
003015              IF(ID.EQ.5) V2(4,JS,K)=V2(4,JS,K)+DOMR
003025          50 CONTINUE
          C8 ZB TANGEITIZE LE AND INVISCID TE . . . . . . . . . . . . . . . . .
003032          260 CONTINUE
          C9 AA ASSIGN SUPER VIRTUAL GRID POINT VALUES (FOR PRINT ONLY) = = =
003034              P2(3,JSP,KSP)=P2(3,JSP,  3)
003043              R2(3,JSP,KSP)=R2(3,JSP,  3)
003047              U2(3,JSP,KSP)=U2(3,JSP,  3)
003053              V2(3,JSP,KSP)=V2(3,JSP,  3)
003057              E2(3,JSP,KSP)=E2(3,JSP,  3)
003063              P2(3,JSP,  1)=P2(3,JSP,KSM)
003067              R2(3,JSP,  1)=R2(3,JSP,KSM)
003072              U2(3,JSP,  1)=U2(3,JSP,KSM)
003076              V2(3,JSP,  1)=V2(3,JSP,KSM)
003102              E2(3,JSP,  1)=E2(3,JSP,KSM)
003106              P2(4,2,KSP)=P2(4,2,  3)
```

```
003112          R2(4,2,KSP)=R2(4,2,   3)
003115          U2(4,2,KSP)=U2(4,2,   3)
003120          V2(4,2,KSP)=V2(4,2,   3)
003123          E2(4,2,KSP)=E2(4,2,   3)
003126          P2(4,2,   1)=P2(4,2,KSM)
003131          R2(4,2,   1)=R2(4,2,KSM)
003134          U2(4,2,   1)=U2(4,2,KSM)
003137          V2(4,2,   1)=V2(4,2,KSM)
003142          E2(4,2,   1)=E2(4,2,KSM)
003145          P2(4,JS,KSP)=P2(4,JS,   3)
003153          R2(4,JS,KSP)=R2(4,JS,   3)
003157          U2(4,JS,KSP)=U2(4,JS,   3)
003163          V2(4,JS,KSP)=V2(4,JS,   3)
003167          E2(4,JS,KSP)=E2(4,JS,   3)
003173          P2(4,JS,   1)=P2(4,JS,KSM)
003176          R2(4,JS,   1)=R2(4,JS,KSM)
003202          U2(4,JS,   1)=U2(4,JS,KSM)
003206          V2(4,JS,   1)=V2(4,JS,KSM)
003212          E2(4,JS,   1)=E2(4,JS,KSM)
003216          P2(5,1,KSP)=P2(5,1,   3)
003222          R2(5,1,KSP)=R2(5,1,   3)
003225          U2(5,1,KSP)=U2(5,1,   3)
003230          V2(5,1,KSP)=V2(5,1,   3)
003233          E2(5,1,KSP)=E2(5,1,   3)
003236          P2(5,1,   1)=P2(5,1,KSM)
003241          R2(5,1,   1)=R2(5,1,KSM)
003244          U2(5,1,   1)=U2(5,1,KSM)
003247          V2(5,1,   1)=V2(5,1,KSM)
003252          E2(5,1,   1)=E2(5,1,KSM)
003255          P2(5,JSP,KSP)=P2(5,JSP,   3)
003262          R2(5,JSP,KSP)=R2(5,JSP,   3)
003266          U2(5,JSP,KSP)=U2(5,JSP,   3)
003272          V2(5,JSP,KSP)=V2(5,JSP,   3)
003276          E2(5,JSP,KSP)=E2(5,JSP,   3)
003302          P2(5,JSP,   1)=P2(5,JSP,KSM)
003305          R2(5,JSP,   1)=R2(5,JSP,KSM)
003311          U2(5,JSP,   1)=U2(5,JSP,KSM)
003315          V2(5,JSP,   1)=V2(5,JSP,KSM)
003321          E2(5,JSP,   1)=E2(5,JSP,KSM)
003325          P2(6,2,KSP)=P2(6,2,   3)
003331          R2(6,2,KSP)=R2(6,2,   3)
003334          U2(6,2,KSP)=U2(6,2,   3)
003337          V2(6,2,KSP)=V2(6,2,   3)
003342          E2(6,2,KSP)=E2(6,2,   3)
003345          P2(6,2,   1)=P2(6,2,KSM)
003350          R2(6,2,   1)=R2(6,2,KSM)
003353          U2(6,2,   1)=U2(6,2,KSM)
003356          V2(6,2,   1)=V2(6,2,KSM)
003361          E2(6,2,   1)=E2(6,2,KSM)
        C9 ZZ ASSIGN SUPER VIRTUAL GRID POINT VALUES (FOR PRINT ONLY)  = = =
003364          RETURN
003364          END
```

```
                    SUBROUTINE QSOLV(RU,RUH,RU2,VOU,P)
000010              DIMENSION OMR(2)
000010              COMMON/A/ GAMMA,GAML1
000010              COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000010              COMMON/D/ ID,J,KJ,IDS,K
000010              IDL102=1
000010              IF(ID.GT.4) IDL102=2
000014              IF(RU.EQ.0.0) GO TO 53
000015              H=RUH/RU
000016              A=RU2*(1.0-(GAML1)*VOU**2)
000021              B=(GAMMA+1.0)*(1.0-(GAML1/(GAMMA+1.0))*VOU**2)
000030              C=RU2**2*(1.0+VOU**2)-2.0*RU**2*(H+0.5*OMR(IDL102)**2)
000042              IDL102=(ID-1)/2
000044              IF(B.EQ.0.0) GO TO 55
000046              IF(A.EQ.0.0) GO TO 56
000047              IF(GAML1*B*C/A**2.LT.-1.0) GO TO 60
000054              P1=A/B*(1.0-SQRT(1.0+GAML1*B*C/A**2))
000065              P2=A/B*(1.0+SQRT(1.0+GAML1*B*C/A**2))
000077              P=P1
000104              IF(P2.GT.P1) P=P2
000107              GO TO 133
000110           55 P=-GAML1*C/(2.0*A)
000114              GO TO 133
000114           56 P=SQRT(GAML1*C/B)
000124              GO TO 133
000124           53 P=RU2
000125          133 IF(P.LE.0.0) GO TO 70
000127              RETURN
000127           60 CONTINUE
000127              WRITE(6,200) ID,J,K,RU,RUH,RU2,VOU,A,B,C
000157          200 FORMAT(/5X,31HNEGATIVE SQRT IN P CALCULATION,,
                   1 2X,29HID,J,K,RU,RUH,RU2,VOU,A,B,C =,/5X,3I3,7E13.5)
000157              CALL EXIT
000160           70 CONTINUE
000160              WRITE(6,201) ID,J,K,RU,RUH,RU2,VOU,A,B,C,P
000215          201 FORMAT(/5X,21HP IS NEGATIVE OR ZERO,
                   1 2X,31HID,J,K,RU,RUH,RU2,VOU,A,B,,PP =,/5X,3I3,8E13.5)
000215              CALL EXIT
000216              END
```

```
              SUBROUTINE AABB(RC,UC,UL,UR,DX,J,PX,REY,IREY,AA,BB,HAPE)
000017        COMMON/X/EN,KAY
000017        COMMON/ZA/ REYCR
000017        IF(REY.GT.REYCR.AND.IREY.EQ.1) GO TO 160
000030        EMM=(UR-UL)/UC*0.5*FLOAT(J-2)
000035        IF(EMM.LT.-0.999) WRITE(6,192)J,UL,UC,UR,EMM
000062    192 FORMAT( 1X,15HJ,UL,UC,UR,EMM-,1I3,4E13.5 )
000062        IF(EMM.LT.-0.999) EMM=-0.999
000065        BETA=2.0*EMM/(1.0+EMM)
000070        IF(BETA.LT.-.1988) GO TO 170
000073        FMIFE2=.575+.402748*(BETA+.1988)-.658360*(BETA+.1988)**.78556
000104        EMF=3.283123+4.562992*BETA-SQRT(4.29783922+25.967906*BETA+
             1 21.87624*BETA**2)
000120        GO TO 180
000124    170 FMIFE2=.575+.402748*(BETA+.1988)+.658360*(-(BETA+.1988))**.785
000136        EMF=2.376+SQRT(-(BETA+.1988))
000144    180 CONTINUE
000144        BB=0.5
000145        AA=0.5*EMF*SQRT(2.0/(EMM+1.0))
000155        HAPE=EMF/FMIFE2
000160        GO TO 190
000164    160 ENN=EN-KAY*PX/(SQRT(1.0+(KAY*PX)**2))
000176        HAPE=(2.0+ENN)/ENN
000201        BB=0.2
000203        AA=0.8/(ENN+1.0)*(0.027*(1.0+ENN)*(2.0+ENN)/ENN)**0.8
000220    190 RETURN
000221        END
```

```
            SUBROUTINE FAT(R,R1,R2,    Q1,Q2,    Q)
000011      RAT = (R-R1)/(R2-R1)
000013      Q=Q1+RAT*(Q2-Q1)
000017      RETURN
000017      END
```

```
            SUBROUTINE AVERAG (R1,P1,U1,V1,R2,P2,U2,V2,RA,PA,UA,VA,HA)
000020      DIMENSION OMR(2)
000020      COMMON/B/ OHR,NBLADE,NONDIM,ITER,PHI
000020      COMMON/A/ GAMMA,GAML1
000020      COMMON/D/ ID,J,KJ,IDS,K
000020      IDL102=1
000020      IF(ID.GT.4) IDL102=2
000024      GR=GAMMA/GAML1
000026      H1=GR*P1/R1+0.5*(U1*U1+V1*V1-OMR(IDL102)**2)
000035      H2=GR*P2/R2+0.5*(U2*U2+V2*V2-OMR(IDL102)**2)
000046      RU1=R1*U1
000047      RU2=R2*U2
000051      RUV1=RU1*V1
000053      RUV2=RU2*V2
000055      RUH1=RU1*H1
000057      RUH2=RU2*H2
000060      RU21=RU1*U1+P1
000062      RU22=RU2*U2+P2
000065      RUA=0.5*(RU1+RU2)
000067      RUVA=0.5*(RUV1+RUV2)
000073      RUHA=0.5*(RUH1+RUH2)
000076      RU2A=0.5*(RU21+RU22)
000102      HA=RUHA/RUA
000104      VA=RUVA/RUA
000106      CALL PSOLV(HA,VA,RUA,RU2A,PA)
000112      UA=(RU2A-PA)/RUA
000115      RA=RUA/UA
000120      RETURN
000120      END
```

```
            SUBROUTINE PSOLV(H,V,RU,RU2,P)
000010      DIMENSION OMR(2)
000010      COMMON/A/ GAMMA,GAML1
000010      COMMON/B/OMR,NBLADE,NONDIM,ITER,PHI
000010      COMMON/D/ ID,J,KJ,IDS,K
000010      IDL102=1
000010      IF(ID.GT.4) IDL102=2
000014      IF(RU.EQ.0.0) GO TO 53
000015      GAMP1=GAMMA+1.
000017      A=H+0.5*(OMR(IDL102)**2-V*V)
000024      B=1.0-2.0*(RU/RU2)**2*A
000030      C=1.0+GAMP1*GAML1*B
000034      IF(C.LT..0)GO TO 60
000036      ROOT=SQRT(C)
000037      D=RU2/GAMP1
000044      P=D*(1.+ROOT)
000047      PA=D*(1.-ROOT)
000052      IF(PA.GT.P) P=PA
000055      GO TO 133
000056   53 P=RU2
000057  133 RETURN
000060   60 CONTINUE
000060      WRITE(6,200) ID,J,K,H,V,RU,RU2,A,B,C
000110  200 FORMAT(/5X,31HNEGATIVE SQRT IN P CALCULATION,,
           1 2X,29HID,J,K,H,V,RU,RU2,A,B,C =,/5X,3I3,7E13.5)
000110      CALL EXIT
000111      END
```

APPENDIX II

SAMPLE OUTPUT

U N S T E A D Y   C O M P R E S S O R

```
ITAPEI    =    0
ITAPEO    =    0
IPUNO     =    0

IDIM      =    1
NONDIM    =    0
IDATA     =    0

IPRT      =    1
IDEBUG    =    1
ITBUG     =    0
IDELTA    =    0
NBLADE    =    0
LBLADE    =    1

IBLEQ     =    1

IPI       =    2
ID,J,K-A  =    1      3      2
ID,J,K-B  =    3      2      2
ID,J,K-C  =    3      7      2
ID,J,K-D  =    5      2      2
ID,J,K-E  =    5      7      2
ID,J,K-6  =    7     12      7
ID,J-C1   =    2      7
ID,J-C2   =    6      7

IDS       =    7

IDP(7)    =    1      1      1      1      1      1      1
```

JI(1)	=	3	JF(1)	=	11
JI(2)	=	2	JF(2)	=	11
JI(3)	=	2	JF(3)	=	12
JI(4)	=	3	JF(4)	=	11
JI(5)	=	2	JF(5)	=	12
JI(6)	=	3	JF(6)	=	12
JI(7)	=	3	JF(7)	=	11

```
JS        =   12                      KS        =   12

ISLLE     =    0                      ISLTE     =    1

COEFTH    = 5.00000000E-01

NOBL      =   10                      MOBL      =   10

CE1       = 7.07107000E-02            ES1       = 1.00000000E-01
RADLE1    = 0.
YUXLE(1)  =-1.98522162E+00            YLXLE(1)  =-1.00000000E+00

YU(1, 2)  = 1.00000000E+00            YL(1, 2)  = 0.
YU(1, 3)  = 3.66590000E-01            YL(1, 3)  =-7.07110000E-02
YU(1, 4)  = 7.47114000E-01            YL(1, 4)  =-1.41421000E-01
YU(1, 5)  = 5.41570000E-01            YL(1, 5)  =-2.12132000E-01
```

$YU(1, 6) = 5.49960000E-01$ $YL(1, 6) = -2.82843000E-01$
$YU(1, 7) = 4.72282000E-01$ $YL(1, 7) = -3.535530C0E-01$
$YU(1, 8) = 4.08538000E-01$ $YL(1, 8) = -4.24264000E-01$
$YU(1, 9) = 3.58727000E-01$ $YL(1, 9) = -4.94975000E-01$
$YU(1,10) = 3.22849000E-01$ $YL(1,10) = -5.65685000E-01$
$YU(1,11) = 3.009905000E-01$ $YL(1,11) = -6.363960000E-01$
$YU(1,12) = 2.92893000E-01$ $YL(1,12) = -7.07107000E-01$

$CE2 = 7.07107000E-02$ $ES2 = 1.00000000E-01$
$RADLE2 = 0.$
$YUXLE(2) = 6.77938830E-01$ $YLXLE(2) = 1.32266117E+00$

$YU(2, 2) = 1.00000000E+00$ $YL(2, 2) = 0.$
$YU(2, 3) = 1.05021500E+00$ $YL(2, 3) = 9.12070000E-02$
$YU(2, 4) = 1.10498400E+00$ $YL(2, 4) = 1.77858000E-01$
$YU(2, 5) = 1.16430800E+00$ $YL(2, 5) = 2.59956000E-01$
$YU(2, 6) = 1.22818700E+00$ $YL(2, 6) = 3.37498000E-01$
$YU(2, 7) = 1.29662000E+00$ $YL(2, 7) = 4.10486000E-01$
$YU(2, 8) = 1.36960800E+00$ $YL(2, 8) = 4.78920000E-01$
$YU(2, 9) = 1.44715100E+00$ $YL(2, 9) = 5.42798000E-01$
$YU(2,10) = 1.52724800E+00$ $YL(2,10) = 6.02122000E-01$
$YU(2,11) = 1.61590000E+00$ $YL(2,11) = 6.568902000E-01$
$YU(2,12) = 1.70710700E+00$ $YL(2,12) = 7.07107000E-01$

$JV \ (IN) = 11$ $JV = 11$

$C4 = 7.07107000E-02$

```
        OMR(1)    = 0.                        OMR(2)    =-3.18647000E+02
        PI        = 1.00000000E+05            TI        = 3.00000000E+02
        UI        = 1.59323500E+02            VOUI      =-1.00000000E+00
        WM        = 2.90000000E+01            GAMMA     = 1.40000000E+00

        REYCR     = 6.00000000E+05
        XMU       = 2.00000000E-05
        EN        = 7.00000000E+00            KAY       = 1.00000000E+00

        PHI       = 1.00000000E-01


        ISTART    =      0
        ITIME     =      0                    IPT       =      1
        NTIME     =      0                    NPT       =      1
                            MTIME      =      0
        IPHI      =      0                    IPSI      =      0

        TIME      = 0.
        UZ        = 0.

        SPAIH     = 0.                        SRUAI     = 0.
        SRUVAI    = 0.                        SRU2PP    = 0.

        PI(REF)   = 1.00000000E+05            AI(REF)   = 3.46641381E+02
        TR(REF)   = 4.20000000E+02            XMUR(REF) = 2.03988052E+01


           P                  T                   U                   V/U

        1.00000000E+05     3.00000000E+02     1.59323500E+02     -1.00000000E+00


        ITIMEF    =     81
```

```
                    ITIME = 80   TIME =   0.              ID =  1  J =  2  X =

  K        Y              P              RHO            U              V              E.

  1  -1.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  2   0.             1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  3   1.00000E-01    1.10000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  4   2.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  5   3.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  6   4.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  7   5.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  8   6.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  9   7.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 10   8.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 11   9.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 12   1.00000E+00    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 13   1.10000E+00    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697


                    ITIME = 80   TIME =   0.              ID =  1  J =  3  X =

  K        Y              P              RHO            U              V              E

  1  -1.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  2   0.             1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  3   1.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  4   2.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  5   3.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  6   4.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  7   5.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  8   6.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  9   7.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 10   8.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 11   9.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 12   1.00000E+00    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 13   1.10000E+00    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697


                    ITIME = 80   TIME =   0.              ID =  1  J =  4  X =

  K        Y              P              RHO            U              V              E

  1  -1.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  2   0.             1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  3   1.00000E-01    1.10000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  4   2.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  5   3.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  6   4.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  7   5.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  8   6.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
  9   7.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 10   8.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 11   9.00000E-01    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 12   1.00000E+00    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
 13   1.10000E+00    1.00000E+00    1.40000E+00    4.59621E-01   -4.59621E-01    1.99697
```

ID = 1 J = 5 X = -1.20397E+00   MDOT = 6.43469E-01

	V	E	T	H	M	CP
-01	-4.59621E-01	1.99697E+00	7.14296E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14296E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.

ID = 1 J = 6 X = -9.16291E-01   MDOT = 6.43469E-01

	V	E	T	H	M	CP
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.

ID = 1 J = 7 X = -6.93147E-01   MDOT = 6.43469E-01

	V	E	T	H	M	CP
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.
-01	-4.59621E-01	1.99697E+00	7.14286E-01	2.71125E+00	6.50002E-01	0.

ID = 1 J = 8 X = -5.10826E-01   MDOT = 6.43469E-01

	V	E	T	H	M	CP

2.46468E-01	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-0.	
-1.46469E-01	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-01	1.99...
-4.64685E-02	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-01	1.996975
5.35315E-02	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-01	1.996975
1.53531E-01	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-01	1.996975
2.53531E-01	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-01	1.996975
3.53531E-01	1.00000E+00	1.40000E+00	4.59621E-01	-4.59621E-01	1.996975

DL102	DRAGU	DRAGL	PDAIU	PDAIL	PDAI
1	0,	0.	-1.00000E+00	1.00000E+00	0,

J	DSU	DSL
2	0,	0.
3	0,	0.
4	0,	0.
5	0,	0.
6	0,	0.
7	0,	0.
8	0,	0.
9	0,	0.
10	0,	0.
11	0,	0.
12	0,	0.
13	0,	0.

3	1.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.574...
4	2.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
5	3.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
6	4.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
7	5.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
8	6.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
9	7.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
10	8.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
11	9.00000E-01	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
12	1.00000E+00	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
13	1.10000E+00	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446

ITIME = 80   TIME =   0.   ID = 7   J = 12   X =

K	Y	P	RHO	U	V	E
1	-1.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
2	0.	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
3	1.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
4	2.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
5	3.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
6	4.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
7	5.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
8	6.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
9	7.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
10	8.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
11	9.00000E-01	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
12	1.00000E+00	1.00000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57446
13	1.10000E+00	1.10000E+00	1.40000E+00	4.59621E-01	4.59621E-01	1.57445

SPAIH = 0.   SRUAI = 0.   SRUVAI= 0.   SRU

PAIH2 = 0.   RUAI1 = 6.43469E-01   RUVAI1=-2.95751E-01   RU2

NT   =   1

PDAI(1) =   0.   PDAI(2) =   0.   PAIH(1) =   0.

1.

..29575E+00

PAIH(2) =   0.