Chapter 4

Input File

4.0.1 Summary of Input File

		11	21	31	41	51	61	71
NAME CARD								
00	Control	IRST1	IRST2	IPEST	NCYCLE	NSKIPR	NSKIPL	IMOVIE
01	Dimensions	NX	NZ	ALX	ALZ	ISYM	CCON	IDATA
02	Time step	DTMINS	DTMAXS	DTFAC	LRSWTCH	IDENS	IPRES	IFUNC
03	Numerical	XLIM	ZLIM	XLIM2	FFAC	NDIV	ICIRC	ISVD
04	Surf. Ave.	ISURF	NPSI	NSKIPSF	TFMULT	ALPHAR	BETAR	ITRMOD
05	Limiter	I	XLIMA(I)	ZLIMA(I)	XLIMA(I+1)	ZLIMA(I+1)	XLIMA(I+2)	ZLIM(I+2)
06	Divertor	IDIV	PSIRAT	X1SEP	X2SEP	Z1SEP	Z2SEP	NSEPMAX
07	Impurities	IIMP	ILTE	IMPBND	IMPPEL	AMGAS	ZGAS	NTHE
08	Obs. pairs	J	XOBS(2J-1)	ZOBS(2J-1)	XOBS(2J)	ZOBS(2J)	NPLOTOBS	
09	Ext. coils	N	XCOIL(N)	ZCOIL(N)	IGROUPC(N)	ATURNSC(N)	RSCOILS(N)	AINDC(N)
10	Int. coils	M	XWIRE(M)	ZWIRE(M)	IGROUPW(M)	ATURNSW(M)	RSWIRES(M)	CWICS(M)
11	ACOEF	ICO	NCO	ACOEF(ICO)	...(ICO+1)	...	...	...(ICO+4)
12	Tranport	TEVV	DCGS	QSAW	ZEFF	IALPHA	IBALSW	ISAW
13	Init. cond-1	ALPHAG	ALPHAP	NEQMAX	XPLAS	ZPLAS	GZERO	QZERO
14	Init. cond-2	ISTART	XZERIC	AXIC	ZZERIC	BZIC		
15	Coil groups	IGROUP	GCUR(1)	...	...	...	...	GCUR(6)
16	Plasma curr.	-	PCUR(1)	...	...	...	...	PCUR(6)
17	Plasma press.	-	PPRES(1)	...	...	...	...	PPRES(6)
18	Timing	-	TPRO(1)	...	...	...	...	TPRO(6)
19	Feedback-1	L	NRFB(L)	NFEEDO(L)	FBFAC(L)	FBCON(L)	IDELAY(L)	FBFACI(L)
20	Feedback-2	L	TFBONS(L)	TFBOFS(L)	FBFAC1(L)	FBFACD(L)	IPEXT(L)	
21	Contour plot	ICPLET	ICPLGF	ICPLWF	ICPLPR	ICPLBV	ICPLUV	ICPLXP
22	Vector plot	IVPLBP	IVPLVI	IVPLFR	IVPLJP	IVPLVC	IVPLVT	-
23	Aux. heat	-	BEAMP(1)	...	...	...	...	BEAMP(6)
24	Density	-	RNORM(1)	...	...	...	...	RNORM(6)
25	Dep. prof.	ABEAM	DBEAM	NEBEAM	EBEAMKEV	AMBEAM	FRACPAR	IBOOTST
26	Anom. trans.	-	FBCHIA(1)	...	...	...	...	FBCHIA(6)
27	Tor. field	-	GZEROV(1)	...	...	...	...	GZEROV(6)
28	Loop volt.	-	VLOOPV(1)	...	...	...	...	VLOOPV(6)
29	PEST output	-	TPEST(1)	...	...	...	...	TPEST(6)
30	Mag. Axis(x)	-	XMAGO(1)	...	...	...	...	XMAGO(6)
31	Mag. Axis(z)	-	ZMAGO(1)	...	...	...	...	ZMAGO(6)
32	Divertor	N	XLPLATE(N)	ZLPLATE(N)	XRPLATE(N)	ZRPLATE(N)	FPLATE(N,1)	FPLATE(N,2)
33	Coil grp-2	IGROUP	RESGS( )					
34	TEVV(t)	-	TEVVO(1)	...	...	...	...	TEVVO(6)
35	FFAC(t)	-	FFACO(1)	...	...	...	...	FFACO(6)
36	ZEFF(t)	-	ZEFFV(1)	...	...	...	...	ZEFFV(6)
37	Volt group	IGROUP	GVOLT(1)	...	...	...	...	GVOLT(6)
38	LHDEP	ILHCD	VILIM	FREQLH	AION	ZION	CPROF	IFK

39	Ext. coil-2	N	DXCOIL(N)	DZCOIL(N)	FCU(N)	FSS(N)	TEMPC(N)	CCICS(N)
40	Noplot	NOPLOT(1)	. . .	. . .	. . .	. . .	. . .	NOPLOT(7)
41	Ripple	IRIPPL	NTFCOIL	RIPMAX	RTFCOIL	NPITCH	RIPMULT	IRIPMOD
42	Major rad.	-	RZERV(1)	. . .	. . .	. . .	. . .	RZERV(6)
43	Minor rad.	-	AZERV(1)	. . .	. . .	. . .	. . .	AZERV(6)
44	Ellipticity	-	EZERV(1)	. . .	. . .	. . .	. . .	EZERV(6)
45	Triangularity	-	DZERV(1)	. . .	. . .	. . .	. . .	DZERV(6)
46	LH heating	-	PLHAMP(1)	. . .	. . .	. . .	. . .	PLHAMP(6)
47	Dens. exp-1	-	ALPHARV(1)	. . .	. . .	. . .	. . .	ALPHARV(6)
48	Dens. exp-2	-	BETARV(1)	. . .	. . .	. . .	. . .	BETARV(6)
49	Multipole	N	MULTN(N)	ROMULT(N)	IGROUPM(N)	ATURNSM(N)		
50	CD	-	FRACPAR(1)	. . .	. . .	. . .	. . .	FRACPAR(6)
51	alh	-	A(1)	. . .	. . .	. . .	. . .	A(6)
52	dlh	-	D(1)	. . .	. . .	. . .	. . .	D(6)
53	a1lh	-	A1(1)	. . .	. . .	. . .	. . .	A1(6)
54	a2lh	-	A2(1)	. . .	. . .	. . .	. . .	A2(6)
55	ac	-	AC(1)	. . .	. . .	. . .	. . .	AC(6)
56	dc	-	DC(1)	. . .	. . .	. . .	. . .	DC(6)
57	ac1	-	AC1(1)	. . .	. . .	. . .	. . .	AC1(6)
58	ac2	-	AC2(1)	. . .	. . .	. . .	. . .	AC2(6)
59	ICRH	-	PICRH(1)	. . .	. . .	. . .	. . .	PICRH(6)
60	Halo Temp	-	TH(1)	. . .	. . .	. . .	. . .	TH(6)
61	Halo Width	-	AH(1)	. . .	. . .	. . .	. . .	AH(6)
62	X-Shape point	-	XCON0(1)	. . .	. . .	. . .	. . .	XCON0(6)
63	Z-Shape point	-	ZCON0(1)	. . .	. . .	. . .	. . .	ZCON0(6)
64	Fast Wave J	-	FWCD(1)	. . .	. . .	. . .	. . .	FWCD(6)
65	ICRH power profile		A(1)	. . .	. . .	. . .	. . .	A(6)
66	ICRH power profile		D(1)	. . .	. . .	. . .	. . .	D(6)
67	ICRH power profile		A1(1)	. . .	. . .	. . .	. . .	A1(6)
68	ICRH power profile		A2(1)	. . .	. . .	. . .	. . .	A2(6)
69	ICRH current profile		A(1)	. . .	. . .	. . .	. . .	A(6)
70	ICRH current profile		D(1)	. . .	. . .	. . .	. . .	D(6)
71	ICRH current profile		A1(1)	. . .	. . .	. . .	. . .	A1(6)
72	ICRH current profile		A2(1)	. . .	. . .	. . .	. . .	A2(6)
73	He conf. time	-	HEACT(1)	. . .	. . .	. . .	. . .	HEACT(6)
74	UFILE output	-	TUFILE(1)	. . .	. . .	. . .	. . .	TUFILE(6)
75	Sawtooth time	-	SAWTIME(1)	. . .	. . .	. . .	. . .	SAWTIME(6)
76	Anom. ion trans.	-	FBCHIIA(1)	. . .	. . .	. . .	. . .	FBCHIIA(6)
77	acoef(123)	-	qadd(1)	. . .	. . .	. . .	. . .	qadd(6)
78	acoef(3003)	-	fhmodei(1)	. . .	. . .	. . .	. . .	fhmodei(6)
79	acoef(3011)	-	pwidthc(1)	. . .	. . .	. . .	. . .	pwidthc(6)
80	acoef(3006)	-	chiped(1)	. . .	. . .	. . .	. . .	chiped(6)
81	acoef(3102)	-	tped(1)	. . .	. . .	. . .	. . .	tped(6)
82	impurity fraction	imptype	frac(1)	. . .	. . .	. . .	. . .	frac(6)
83	acoef(3012)	-	nflag(1)	. . .	. . .	. . .	. . .	nflag(6)
84	acoef(3013)	-	expn1(1)	. . .	. . .	. . .	. . .	expn1(6)
85	acoef(3014)	-	expn2(1)	. . .	. . .	. . .	. . .	expn2(6)
86	acoef(3004)	-	firitb(1)	. . .	. . .	. . .	. . .	firitb(6)
87	acoef(3005)	-	secitb(1)	. . .	. . .	. . .	. . .	secitb(6)
88	acoef(881)	-	fracno(1)	. . .	. . .	. . .	. . .	fracno(6)
89	acoef(889)	-	newden(1)	. . .	. . .	. . .	. . .	newden(6)
90	ECRH Power (MW)		PECRH(1)	. . .	. . .	. . .	. . .	PECRH(6)
91	ECCD Toroidal Current (MA)		ECCD(1)	. . .	. . .	. . .	. . .	ECCD(6)
92	Sh. Par. a (ECCD H&CD)		AECD(1)	. . .	. . .	. . .	. . .	AECD(6)
93	Sh. Par. d (ECCD H&CD)		DECD(1)	. . .	. . .	. . .	. . .	DECD(6)
94	Sh. Par. a1 (ECCD H&CD)		A1ECD(1)	. . .	. . .	. . .	. . .	A1ECD(6)
95	Sh. Par. a2 (ECCD H&CD)		A2ECD(1)	. . .	. . .	. . .	. . .	A2ECD(6)
99								

4.0.2 Detailed Description of Input Cards

Card 00 - Control

11	21	31	41	51	61	71
IRST1	IRST2	IPEST	NCYCLE	NSKIPR	NSKIPL	IMOVIE

IRST1	= 0.0	Start run beginning at time t=TPRO(ISTART)
	= 1.0	Restart run which reads the file SPRSINA. A restart job normally requires only 3 input cards: title, type 00, and type 99. Cards which specify the evolution of parameters in time can also be included in a restart job. However, only the fields corresponding to future time points should be changed.
	= 2.0	Start run which reads initial equilibrium from the file EQFLINA
IRST2	= 0.0	Don't write a restart file
	= 1.0	Do write a restart file. Restart files are updated every NSKIPL cycles and at the times specified on the type 29 card and at the end of the run.
IPEST	= 0.0	Don't write PEST file
	= 1.0	Do write PEST files EQDSKA and EQDSKASCI at times specified on type 29 cards and at the end of the run. These files can then be read by J-SOLVER code with IFUNC2=4. (Note: also writes GEQDSK file compatible with EFIT output.
NCYCLE		Last cycle to be computed. If NCYCLE=0, only the initial equilibrium is computed. Use NCYCLE=-1 to check dimensionless gain for original TSC control model as described in section (**??**).
NSKIPR		Number of cycles between print cycles and between times when profile information is plotted
NSKIPL		Number of cycles between plot cycles. Restart files are also written every NSKIPL cycles.
IMOVIE	= 0.0	Regular graphics
	= 1.0	b/w movie with plasma currents plotted
	= 3.0	Color movie with plasma currents plotted

= 6.0	Color movie of poloidal flux contours and plasma current with fixed flux increments. For this option, the data statement in the subroutine CPLOT must be changed: PSISMAL-(minimum value) PSINCR-(increment) YMAX & YMIN at end of CPLOT (now PCUR(12))
= 7.0	Color movie of heat flux distribution on the divertor plate
= 8.0	Special disruption plots
= 10.	Writes special movie.cdf file for AVS postprocessing. Note that tmovie and dtmovie are input via the acoef(33) and acoef(34). Also note that min and max range for the major radius plots are given by acoef(42) and acoef(43).

Note : All jobs write a equilibrium file EQFLOUA upon termination. A start job with IRST1=2 can have ISYM=0 (type 01 card) even if the job which created the equilibrium file had ISYM=1, as long as the zone *size* (dimension of grid spacing) is the same.

Card 01 - Dimensions

11	21	31	41	51	61	71
NX	NZ	ALX	ALZ	ISYM	CCON	IDATA

NX		Number of zone vertices in the x direction,(NX-1) zones. Must have NX$\leq$ PNX-2 (see param.i) (46)
NZ		Number of zone vertices in the z direction,(NZ-1) zones. This should be an odd number if ISYM = 0. Must have NZ$\leq$ PNZ-2 (see param.i) (16)
ALX		Major radius of outside computational grid boundary in meters (3.0)
ALZ		One half the height of the computational grid boundary in meters (1.0)
ISYM	= 0.0	No symmetry about the midplane
	= 1.0	Symmetry about the midplane
CCON		Major radius of inside computational grid boundary (meters)
IDATA	= 0.0	Regular run
	= 1.0	Reads from PBX data tape file ENINA
	= 2.0	Reads from TFTR data tape file ENINA
	= 3.0	Reads from D-III-D data tape file ENINA
	= 4.0	Reads from PBX-M data tape file ENINA
	= 5.0	Reads from PBX-M data tape file ENINA (New format)
	= 6.0	FEDTSC
	= 7.0	TCV - Hofmann control algorithm
	= 8.0	ASDEX-U
	= 9.0	Reads from NSTX netCDF file nstx_magnetics.nc
	= 10.	Reads from MAST file mast_magnetics.nc

Note : A problem with ISYM=0 and NZ=NZ0 will have the same zone size as a problem with ISYM=1 and NZ=(NZ0-1)/2 +1.

Card 02 - Time step and switches

11	21	31	41	51	61	71
DTMINS	DTMAXS	DTFAC	LRSWTCH	IDENS	IPRES	IFUNC

DTMINS — Minimum time step allowed (μsec). Initial time step is 2*DTMINS (0.001)

DTMAXS — Maximum time step allowed (μsec) (1.0)

DTFAC — Time step safety factor. The time step used is the maximum value that is theoretically stable multiplied by DTFAC with the additional constraint that δt increase by at most 20% every 10 cycles and be less than DTMAXS (0.5)

LRSWTCH = 0.0 Normal run

= N.0 Special test run for coils without plasma where coil currents in group N are initialized to :

CCOILS(N)=SGN[ZCOIL(N)]*ACOEF(12)/RSWIRES(N)

To use this option TEVV must be positive, turn off all feedback and set IRST=0.0

IDENS = 0.0 Regular calculation of density transport Particle diffusion and pinch coefficients are input via acoef(851) and (852). Particle source terms provided by Neutral Beams [cards 25 and 23] and the source function acoef(871-876). The boundary conditions are provided by acoef(881) and the type 24 cards.

= 1.0 Forces the density to have profile given by

$$R(\Psi,t) = \mathrm{UDSD} * \mathrm{RNORM(t)} * \left\{ \left[1 - \left(\frac{\Psi - \Psi_{min}}{\Psi_{lim} - \Psi_{min}} \right)^{\mathrm{BETAR}} \right]^{\mathrm{ALPHAR}} + r_{edge} \right\} \tag{4.1}$$

where ALPHAR and BETAR are input on type 04 or type 47,48 cards. The edge density r_{edge} is input via acoef(881)

IPRES = 0.0 Regular calculation of energy transport

= 1.0 Forces the pressure to equal one of the following analytical forms :

For IFUNC=1,3,4,5 :

$$\begin{aligned} P(\Psi,t) &= P0(t)\left[\frac{\Psi_{lim}-\Psi}{\Psi_{lim}-\Psi_{min}}\right]^{\mathrm{ALPHAP}} && (4.2)\\ &+ \mathrm{ACOEF}(110)*\left(\frac{\mathrm{ALPHAP}}{\mathrm{ALPHAP}+1}\right)*\left[\frac{\Psi_{lim}-\Psi}{\Psi_{lim}-\Psi_{min}}\right]^{\mathrm{ALPHA+1}} && (4.3)\end{aligned}$$

For IFUNC=2

$$\frac{dP}{d\Psi} = P0\left[\frac{e^{-(\mathrm{ALPHAP})\hat{\Psi}} - e^{-(\mathrm{ALPHAP})}}{e^{-(\mathrm{ALPHAP})}-1}\right]. \qquad (4.4)$$

where $\hat{\Psi} = (\Psi - \Psi_{min})/(\Psi_{lim} - \Psi_{min})$ and ALPHAP is input on type 13 card. P0(t) is determined by card type 17. The ratio of electron to ion pressure is given by ACOEF(2). Pressure equilibration time is given by EQRATE,ACOEF(4).

IFUNC — Switch to choose the functional forms to use for pressure and toroidal field functions as described above and on type 13 card.

- = 1.0 tokamak profiles (Princeton)
- = 2.0 tokamak profiles (ORNL)
- = 3.0 RFP profiles (LANL)
- = 4.0 spheromak profiles (Princeton)
- = 5.0 "ohmic" profiles stationary on resistive time scale
- = 6.0 Calls special subroutine **splinfit**
- = 7.0 prescribed $< J.B >$ profile

Card 03 - Numerical

11	21	31	41	51	61	71
XLIM	ZLIM	XLIM2	FFAC	NDIV	ICIRC	ISVD

XLIM		An internal boundary is defined inside the computational grid so that the plasma can only occupy the rectangular region defined by : XLIM $<$ X $<$ XLIM2 ,and $\mid$ Z $\mid<$ ZLIM. The region outside this is always treated as vacuum. (i.e. , no plasma can exist there)
ZLIM		See XLIM
XLIM2		See XLIM
FFAC		Factor by which Alfvén waves are artificially slowed down. Ion mass is increased by FFAC^2. The time steps for the fast wave and the Alfvén wave are proportional to this. If negative, uses the absolute value to initialize and adjusts FFAC according to ACOEF (801)-(805) to keep AMACH constant. (1.0)
NDIV		Number of sub-cycles in diffusion part of poloidal flux equation and in the fast wave equation. The time step for fast wave and resistive diffusion are inversely proportional to this, as discussed in section (**??**) (1.0)
ICIRC	= 0.0	Don't solve circuit equations for the external coils
	= 1.0	Do solve circuit equations for the external coils
ISVD	= 0.0	Don't perform SVD analysis to obtain x-point
	= 1.0	Do perform SVD analysis to obtain x-point

Card 04 - Surface Averaging

11	21	31	41	51	61	71
ISURF	NPSI	NSKIPSF	TFMULT	ALPHAR	BETAR	ITRMOD

ISURF	= 0.0	No surface averaging (default)
	= 1.0	Use surface averaged transport equations
NPSI		Number of PSI surfaces (Φ surfaces) for one-dimensional transport calculation (always must be NPSIT < NPSI)
NSKIPSF		Number of cycles skipped between each surface average calculation (20.)
TFMULT		Multiplier defining the toroidal flux domain used in surface average calculation. The initial NPSIT will be NPSI/TFMULT. NPSIT will increase as the plasma grows, but if NPSIT ever exceeds NPSI the program will terminate.
ALPHAR		Exponent for the prescribed density function (see type 02 card) Will be overwritten if type 47 card is included. (0.5)
BETAR		Exponent for the prescribed density function (see type 02 card). Will be overwritten if type 48 card is included. (2.0)
ITRMOD		Switch selecting transport model
	= 1.0	The neo-ALCATOR model, where

χ_e = ACOEF(35) $\times 10.^{19}/n_e$ (mks)
χ_i = ACOEF(37) $\times 10.^{19}/n_e$ (mks)
d = ACOEF(39)

If ACOEF(107) is greater than zero, these coefficients are enhanced according to the Kaye-Goldston formula

$$\mathrm{ACOEF(35)} = \sqrt{\mathrm{ACOEF(35)}^2 + \mathrm{CHIAUXS}}$$

where

$$\mathrm{CHIAUXS} = [(\mathrm{ACOEF(107)*NE(0)*300.})/\mathrm{I_p}]^2\mathrm{*PTOT}$$

where $\mathrm{I_p}$ is the plasma current in amps and PTOT is the total power in watts.

= 2.0 Coppi/Tang transport model

Need to input the following on type 11 cards :

ACOEF(121) - .08 ... Auxiliary heated transport coefficient
ACOEF(122) - .42 ... Ohmic heated transport coefficient
ACOEF(123) - 0.5 ... Constant in form factor
ACOEF(126) - 2.0 ... Ratio of χ_i to χ_e
For H-mode modeling, need to define ACOEF(3003) and ACOEF(3011). For ITB modeling, need to define ACOEF(3004)-ACOEF(3006). Also, if idens=0, need to define ACOEF(851) and ACOEF(875).

= 3.0 Coppi/Mazzucato/Gruber transport model (L.Sugiyama)

= 4.0 Coppi/Tang transport model (Englade)

= 5.0 Marion Turner transport model

= 6.0 GLF23 + neoclassical

= 7.0 GLF23 + Coppi/Tang transport model

= 8.0 GLF23 H-mode + Coppi/Tang+ neoclassical (see note below)

= 9.0 GLF23 H-mode + neo-Alcator + neoclassical (see note below)

= 10. MMM95 H-mode + Coppi/Tang + neoclassical (see note below)

= 11. MMM95 H-mode + Neo-Alcator + neoclassical (see note below)

= 12. calls special Kcoppi routine (C.Kessel)

Note that models 8.0-11.0 are H-mode models. ACOEF(3011) needs to be defined as the H-mode pedistal location. These models default to model 2.0 if there is no auxialliary heating. Also, for models 9. and 11., ACOEF(35)-(39) and ACOEF(73) must be defined

Card 05 - Limiter Points

11	21	31	41	51	61	71
I	XLIMA(I)	ZLIMA(I)	XLIMA(I+1)	ZLIMA(I+1)	XLIMA(I+2)	ZLIMA(I+2)

XLIMA(I) The x coordinate of limiter I. If XLIMA(I)=0 for any I, that field and the rest of the cards are ignored.

ZLIMA(I) The z coordinate of limiter I.

Up to 3 limiter points can be defined on each type 5 card. The minimum value of the poloidal flux amongst all limiter points, PSILIM, defines the plasma boundary PSI=PSILIM

Note : If ISYM=1 and ZLIMA(I)<0 for some I, this limiter point will be automatically discarded and the remaining points will be renumbered to be consecutive.

Card 06 - Divertor

11	21	31	41	51	61	71
IDIV	PSIRAT	X1SEP	X2SEP	Z1SEP	Z2SEP	NSEPMAX

IDIV	= 0.0	Code does not check for magnetic divertor
	= 1.0	Code will attempt to locate magnetic separatrix and use this as the limiter if the value of PSI at the separatrix is less than PSILIM from the limiter points.
PSIRAT		Actual value of PSI used to limit plasma from separatrix is PSILIM = PSIRAT*(PSISEP-PSIMIN)+PSIMIN where PSISEP is the actual poloidal flux at the separatrix and PSIMIN is the flux at the magnetic axis. The normal value is PSIRAT = 0.999. (However, may have to lower if writing EQDSKA files for JSOLVER)
X1SEP		The separatrix is only searched for in the region : X1SEP<X2SEP
X2SEP		See X1SEP
Z1SEP		The separatrix is only searched for in the region : Z1SEP< Z2SEP
Z2SEP		See Z1SEP
NSEPMAX		The maximum number of separatrices that will be searched for. (2.)

Card 07 - Impurities

11	21	31	41	51	61	71
IIMP	ILTE	IMPBND	IMPPEL	AMGAS	ZGAS	NTHE

IIMP	= 0.0	No impurity line radiation. ZEFF determined from card 12 (or 36)
	= 1.0	Impurity constant fraction of background density ... see acoef(854)-(861) and also Type 82 (for time dependence)
	= 2.0	Impurity transport for iimp .gt. 0, ZEFF determined from impurity concentration
ILTE	= 0.0	Local thermodynamic equilibrium assumed
	= 1.0	Local thermodyanmic equilibrium not assumed
IMPBND	= 0.0	non-flow boundary condition for impurities
	= 1.0	pedistal boundary condition for impurities
IMPPEL	= 0.0	impurity pellet is deuterium
	= 1.0	impurity pellet is oxygen(not available)
	= 2.0	impurity pellet is carbon(not available)
	= 3.0	impurity pellet is iron(not available)
	= 4.0	impurity pellet is beryllium(not available)
	= 5.0	impurity pellet is neon
	= 6.0	impurity pellet is krypton
	= 7.0	impurity pellet is argon
AMGAS		Mass of primary ion species in amu (1.0 for hydrogen, 2.0 for deuterium, etc) (1.0)
ZGAS		Charge of primary ion species (1.0 for hydrogen, 2.0 for helium, etc) (1.0)
NTHE		Number of theta zones used in contouring plasma for parallel impurity diffusion, and also in ballooning mode calculation (100.)

Note : For IIMP>0, at least one of the fractions acoef(854)-(861) must be greater than zero OR these fractions must be defined as a function of time on the type 82 card. For IIMP=2, these values are used to initialize the impurity transport calculation.

Card 08 - Observation Pairs

11	21	31	41	51	61	71
J	XOBS(2J-1)	ZOBS(2J-1)	XOBS(2J)	ZOBS(2J)	NPLOTOBS	

J	Number of observation pairs where poloidal flux difference is to be recorded (and plotted optionally), and possibly used for feedback control (type 19 cards)
XOBS(2J-1)	x coordinate of first point in pair
ZOBS(2J-1)	z coordinate of first point in pair
XOBS(2J)	x coordinate of second point in pair
ZOBS(2J)	z coordinate of second point in pair
NPLOTOBS = 0.0	Don't plot time histories
= 1.0	Do plot time history of fluxes and flux difference at observation pair

Note : If ISYM=1 and ZOBS(J)<0 for some J, this observation point will be automatically discarded and the remaining observation points will be renumbered to be consecutive. The values of NFEEDO on the type 19 cards will automatically be changed also to reflect this renumbering.

Card 09 - External Coils

11	21	31	41	51	61	71
N	XCOIL(N)	ZCOIL(N)	IGROUPC(N)	ATURNSC(N)	RSCOILS(N)	AINDC(N)

Each type 09 card defines the properties of a single coil *external* to the computational grid.

N	External coil number (this must be a unique identifying number between 1 and PNCOIL)
XCOIL(N)	The x coordinate of the center of the external coil. (Must be outside the computational grid)
ZCOIL(N)	The z coordinate of the center of the external coil. (Must lie outside the computational grid)
IGROUPC(N)	Group number of coil N. Refers to type 15 card with the same group number.
ATURNSC(N)	Number of turns for coil N. This is a positive or negative number, not necessarily an integer. The preprogrammed current for coil N will be the product of ATURNSC(N) and the current in IGROUPC(N) as specified by the appropriate type 15 card
RSCOILS(N)	Resistance of coil N (ohms). For multiturn coils, this is the one-turn equivalent resistance.
AINDC(N)	Self inductance of coil N, assuming a single turn. If a type 39 card is included, this will be overwritten with an inductance calculated from the geometry.

Note 1 : If ISYM=1 AND ZCOIL(N)<0 for some N, this coil will be automatically discarded and the remaining coils will be renumbered to be consecutive.

Note 2 : An external coil can belong to more than one coil group, both for the feedback systems and for the preprogrammed currents. To specify the second group, follow the type 09 card with another type 09 card of the form:

09 10NN. ATURN(N,1) ATURN(N,2)...ATURN(N,6)

This will cause coil N to also belong to coil group NN with variable number of turns ATURN(N,I) at time TPRO(I) as specified by the type 18 card. Up to four additional systems can be specified by using 10NN., 20NN.,30NN.,40NN., in the first field.

Card 10 - Internal Coils

11	21	31	41	51	61	71
M	XWIRE(M)	ZWIRE(M)	IGROUPW(M)	ATURNSW(M)	RSWIRES(M)	CWICS(M)

Each type 10 card defines the properties of a single coil *internal* to the computational grid, denoted a *wire*.

M	Wire number (this must be a unique identifying number between 1 and PNCOIL)
XWIRE(M)	The x coordinate of the center of the wire. (coordinate must lie inside the grid)
ZWIRE(M)	The z coordinate of the center of the wire. (coordinate must lie inside the grid)
IGROUPW(M)	The absolute value |IGROUPW(M)| is the group number. Refers to type 15 card with the same group number. If IGROUPW(M)<0, this is a switch indicating that the wire is to occupy four adjacent cells (rather than 1) and to have the relative number of turns in the four cell area weighted so that the current centroid will be at [XWIRE(M),ZWIRE(M)].
ATURNSW(M)	The number of turns for wire M. This is a positive or negative number, not necessarily an integer. The preprogrammed current for wire M will be the product of ATURNSW(M) and the current in IGROUPW(M) as specified by the appropriate type 15 card.
RSWIRES(M)	The resistance of wire M (ohms). If negative, resistance is major radius XWIRE(M) times the absolute value of RSWIRES(M). For a multiturn coil, this is a one turn equivalent resistance.
CWICS(M)	Initial induced current in wire M. (kA)

Note 1 : If ISYM=1 AND ZWIRE(M)<0 for some M, this wire will be automatically discarded and the remaining wires will be renumbered to be consecutive.

Note 2 : An internal coil can belong to more than one coil group for feedback systems. To specify the second group, follow the type 10 card with another type 10 card of the form:

10 10NN. ATURN(M,1) (M,2) (M,3) (M,4) (M,5) ATURN(M,6)

This will cause coil M to also belong to coil group NN with variable number of turns ATURN(M,I) at time TPRO(I) as specified by type 18 card. Up to four additional systems can be specified by using 10NN.,20NN.,30NN.,40NN., in the first field.

Note 3 : If IGROUPW(M)$<$0, three new coils will be generated and the parameter PNCOIL must be large enough to accommodate these.
Note 4 : At the end of a run, a special file is written out called NEWTYPE10. This has CWIS defined.

Note 5 : Resistivity of copper : $1.724 \times 10^{-8} \Omega \cdot \mathrm{m}$
Resistivity of Aluminum : $2.824 \times 10^{-8} \Omega \cdot \mathrm{m}$
Resistivity of 304 SS : $7.2 \times 10^{-7} \Omega \cdot \mathrm{m}$

Card 11 - ACOEF Array

11	21	31	41	51	61	71
ICO	NCO	ACOEF(ICO)	...(ICO+1)	...(ICO+2)	...(ICO+3)	ACOEF(ICO+4)

ICO	First index of ACOEF array specified on this card
NCO	The number of elements on this card. (1≤NCO≤5)
ACOEF(I)	The value of ACOEF(I). The following ACOEF array elements are presently defined (default values in parentheses):
ACOEF(1)	If 1.0,special run for PBX, if 2.0, special run for NSTX, if 3.0 special run for ASDEX-U. If 4.0 or 5.0, special for ITER(0.). Note that acoef(1997) has a special meaning for acoef(1)=4.
ACOEF(2)	Ratio of initial electron to total pressure (0.5)
(3)	Time interval over which feedback systems are turned on. (0.0)
(4)	Relaxation factor for pressure when IPRES=1 (100).
(5)	If 1.0, time history plots start new at restart time. (0.0)
(6)	Parallel diffusion multiplier for ISURF=0, IPRES=0 (10.)
(7)	Mix between Dufort Frankel and FTCS in flux diffusion (0.5)
(8)	Implicit parameter for surface averaged time advancement (1.0)
(9)	Numerical viscosity coefficient (40.)
(10)	Ratio of incompressible to compressible viscosity (0.5)
(11)	Proportionality constant in plasma current feedback (0.5)
(12)	Initial voltage in wires for LRSWTCH>0 (1.0)
(13)	IFLUX switch for poloidal flux boundary condition (see Eq. (**??**). The options are : 0.0 constant, 1.0 first order, 2.0 second order, 3.0 full integral, 4.0 Von-Hagenow's virtual casing method. (default is 4.0)
(14)	Maximum scale for SURFVOLT plot (10.0)
(15)	Minimum OH loop voltage (-100.0)
(16)	Maximum OH loop voltage (100.0)
(17)	ICUBE switch for cubic time point interpolation. IF ICUBE=0.0 linear interpolation is used and for ICUBE=1.0 cubic interpolation is used. (0.0)
(18)	Multiplier in front of PSIDOT on boundary (0.0)
(19)	Not used
(20)	Switch for UCOR (0.0)
(21)	Error criterion for AMACH (1.0)
(22)	Error criterion for EKIN (100.)

(23) EPSIMIN...convergence criterion on PSI for equilibrium(10^{-7})
(24) EZCURF...convergence criterion on Z for equilibrium(10^{-6})
(25) DELG...equilibrium parameter used for IFUNC=3 (1.0)
(26) GRPRFP...equilibrium parameter used for IFUNC=3 (1.0)
(27) BETAJ...equilibrium parameter used for IFUNC=3 (1.0)
(28) Bypass initial filament growth rate calculation if nonzero (0.0)
(29) Time in seconds at which calculation stops (1000.)
(30) IWAYNE...switch to write special disruption file and produce voltage plots at flux loops (0.0)
(31) TJPHI...time when to start writing (0.0)
(32) DTJPHI...time increment for writing (0.0)
(33) TMOVIE (0.0)
(34) DTMOVIE (0.0)
(35),(37),(39) Anomalous transport coefficients CHIE,CHII,D (1.0,1.0,0.2) note: These are multiplied by $10^{19}/n$, so the effective diffusion coefficient is $D = ACOEF(39) \times 10^{19}/n$ etc.
(36),(38) off-diagonal transport coefficients for CHIE,CHII (0.0,0.0)
(40) If 1.0, U not zeroed in vacuum (0.0)
(41) RESGAP...coefficient of resistivity for gap in conductors (0.5). Set to 0.0 for default value which is a very high resistance. The effect of the gap is to constrain zero net current in coil groups with IGROUP<0 on type 15 cards. If nonzero, that value will be used as the as the resistance across the gap. This value is overidden if type 33 card is supplied.
(42) Minimum x for profile plots (0.)
(43) Maximum x for profile plots (0.)
(44) IRFP...set to 1.0 for reversed field pinch (0.0)
(45) Number of zones to search over for x-point (2.0)
(46) Maximum for τ_e plot (sec) (2.0)
(47) Maximum power for problem with burn control (used to regulate heating) ($1. \times 10^{12}$)
(48),(49) The number of contours drawn in plasma and vacuum (20.,20.)
(50),(51) Relaxation factors for initial equilibrium calculation (0.5,0.5)
(52) Vacuum vessel poloidal inductance (0.0)
(53) Vacuum vessel poloidal resistance (0.0)
(54) Current feedback coefficient for burn control (0.0)
(55) Reflectivity coefficient for cyclotron radiation (0.9)
(56) HYPER heating multiplier (0.0)

(57) t-begin for HYPER (0.0)
(58) t-end for HYPER ($1. \times 10^6$)
(59) EPSHYP...convergence criteria in HYPER ($1. \times 10^{-6}$)
(60) NLOOPM...maximum iterations in HYPER (4000.)
(61) If nonzero, ZMAG time history plotted even for ISYM=1 (0.0)
(62) Ratio of toroidal to compressible viscosity (1.0)
(63) Affects LSAW for ISURF=0 (0.667)
(64) Hyperresistivity coefficient (0.0)
(65) Hyperresistivity fraction (0.1)
(66) Hyperresistivity exponent (4.0)
(67) Hyperresistivity iteration damping-factor (1.2)
(68) Hyperresistivity iteration safety factor (1.0)
(69) Crash-time for Porcelli Sawtooth Model (0.10)
(70) Relaxation for resistivity when LRSWTCH$\neq$0 ($1. \times 10^{-4}$)
(71) Maximum temperature for resistivity calculation ($1. \times 10^6$)
(72) Bypass writing input on plot file if ACOEF(72)>0 (0.0)
(73) fraction of ion neoclassical to use for electrons
(74) Special limiter adjustment switch (0.0)
(75) Number of cycles coil resistivity is enhanced to let perturbation in(0.0)
(76) Switch for setting FBFAC(I1) to FBFAC(I2) to zero after equilibrium calculation (0.0)
(77) I1 - see ACOEF(76) (0.0)
(78) I2 - see ACOEF(76) (0.0)
(79) IGONE = 0 for normal run, =1 if no closed flux surfaces (0.0)
(80) Group number of superimposed oscillation (0.0)
(81) Amplitude of oscillation (kA) (0.0)
(82) Period of oscillation (seconds) (0.0)
(83) 2nd group number (0.0)
(84) 2nd amplitude number (0.0)
(85) 3rd group number (0.0)
(86) 3rd amplitude number (0.0)
(87) 4th group number (0.0)
(88) 4th amplitude number (0.0)
(90) Drag terms in equation of motion (0.2)
(91) Drag terms in equation of motion (0.2)
(92) Drag terms in equation of motion (0.2)
(93) Confinement time for He-ash (1.0). This value is overidden if type 73 card is supplied.

(95) TDISRUPT…time at which disruption occurs and QSAW changes ($1. \times 10^6$)

(96) QSAW2…value of QSAW after disruption (2.0)

(97) Fraction of flux in plasma that halo extends beyond - a halo width. (overwritten if type 61 card is included) (0.0)

(98) Temperature of halo in eV (overwritten if type 60 card is included) (1.0)

(99) Switch used in halo temperature and resistivity calculation. If acoef(99) > 0, linearly interpolates temperature in halo region from thalo at psilim to tevv at psilim+phalo.

(101) IDTEST…see note below (0.0)

(102) VTEST…see note below (0.0)

Note : Program will terminate normally if :

IDTEST =	-1	AND	$I_p(a)$	$<$	VTEST
”	1	“	“	$>$	“
”	-2	“	Z_{MA}	$<$	“
”	2	“	”	$>$	”
”	-3	“	$\dot{I}_p(A/S)$	$<$	“
”	3	“	”	$>$	“
“	-4	“	$X_{MA}(m)$	$<$	“
“	4	“	”	$>$	“
“	-5	”	q_{95}	$<$	“
“	5	“	“	$>$	“
“	-6	“	κ	$<$	“
“	6	“	“	$<$	“
“	-7	“	δ	$<$	“
“	7	“	“	$>$	“
“	-8	“	$PTOT(MW)$	$<$	“
“	8	“	“	$>$	“
“	-9	“	CURR(1)(kA)	$<$	“
“	9	“	“	$>$	“

(103) Multiplier bootstrap current (1.0)

(104) ITEMP: If ITEMP=1, the temperature in the external coils will be calculated as a function of time. In this case, type 39 cards must be included to provide additional coil information. (0.0)

(106)	Multiplier of AJLH for lower hybrid (1.0)
(107)	Anomalous auxiliary heating transport coefficient (1.0)
(108)	not presently used
(109)	No trapped particles when ACOEF(109)=1.0 (0.0)
(110)	Coefficient in pressure function (0.0) (see type 02 card)
(111)	Feedback constant for plasma density when IDATA=1 (0.0)
(112)	Feedback constant for ZEFF when IDATA=1 (0.0)
(113)	relative fraction of tritium for alpha heating calculation (0.49)
(114)	Stored energy wanted for feedback on D-T mix(0.0)
(115)	Derivative gain for control of feedback on DT mix(0.0)
(120)	Fraction of ETA (LSAW) to use in sawtooth model for ISAW=1. Note: 0 gives maximum flattening, 1 gives no flattening.(0.5)
(121)	Auxiliary heated transport coefficient for ITR=2 (0.08)
(122)	Ohmic transport coefficient for ITR=2 (0.42)
(123)	Factor added to q_{cylin} for ITR=2 (0.5)
(124)	χ enhancement inside q=1 surface (for isaw=1) (2.0)
(125)	Feedback constant for χ when IDATA=1 (0.0)
(126)	Ratio of χ_i to χ_e (2.0) If negative, then ACOEF(126) is χ_i in m^2/sec (spatial constant)
(127)	Feedback coefficient for χ time derivative term (0.0)
(128)	Minimum value for FBCHI (IDATA=1) (0.5)
(129)	Maximum value for FBCHI (IDATA=1) (2.0)
(130)-(298)	Special coefficients for thyristor voltage source model

Special coefficients for current feedback:

Coils inside grid:

ACOEF(290) = 1.0 Lausanne feedback model
= 2.0 Standard PID-model

PID-model :

ACOEF(291)	NSTART : first coefficient for feedback
ACOEF(292)	NFB : total number of feedback systems
ACOEF(293)	NWPRINT : print cycle (coil currents and voltages)

Having specified NSTART and NFB, the subsequent coefficients have to be specified according to:

ACOEF(J)	IGROUPW:	NSTART	$<$	J	$<$	NSTART+NFB-1
	VGAINP:	NSTART+NFB	$<$	J	$<$	NSTART+2*NFB-1
	VGAIND:	NSTART+2*NFB	$<$	J	$<$	NSTART+3*NFB-1
	VGAINI:	NSTART+3*NFB	$<$	J	$<$	NSTART+4*NFB-1
	TFBON:	NSTART+4*NFB	$<$	J	$<$	NSTART+5*NFB-1
	TFBOFF:	NSTART+5*NFB	$<$	J	$<$	NSTART+6*NFB-1
	VOLTMAX:	NSTART+6*NFB	$<$	J	$<$	NSTART+7*NFB-1
	TRAMP:	NSTART+7*NFB	$<$	J	$<$	NSTART+8*NFB-1

where:

IGROUP :	coil group for feedback
VGAINP :	proportional feedback constants (V/A)
VGAIND :	differential (Vs/A)
VGAINI :	integral (V/As) [note: if negative, then used as a switch to enforce series connection]
TFBON :	time when feedback system is switched on (s)
TFBOFF :	time when feedback system is switched off (s)
VOLTMAX :	maximum voltage (V)(one turn equiv. voltage)
TRAMP :	ramp time (s)

<u>Coils outside grid :</u>

Feedback on external coil group currents is applied, if :

<u>ICIRC=1</u> and <u>ACOEF(294)>129</u>

ACOEF(294) NSTART : first coefficient for feedback

ACOEF(295) NFB : total number of coil groups for feedback

ACOEF(296) = 0.0 Use inductance matrix in voltage feedback model :

$$V_{FB}^{j} = \left[\beta_p^k(\Delta I^k) + \beta_d^k\left(\frac{d\Delta I^k}{dt}\right) + \beta_I^k\left(\int \Delta I^k dt\right)\right] \cdot M_{k,j}.$$

where β_p^k, β_d^k, β_I^k are the proportional and derivative and integral gains, ΔI is the difference between the actual current and the desire current and $M_{k,j}$ is the mutual inductance matrix

= 1.0 Standard PID-model :

$$V_{FB}^k = \left(\beta_p^k(\Delta I^k) + \beta_d^k\left(\frac{d\Delta I^k}{dt}\right) + \beta_I^k\left(\int \Delta I^k dt\right)\right)\cdot \delta_{k,j},$$

where $\delta_{k,j}$ is the identity matrix.

= 2.0	Special for ZT-H
= 3.0	Use the following voltage feedback model:

$$V_{FB}^k = \left(R_j I_j + \beta_p^k(\Delta I^k) + \beta_d^k\left(\frac{d\Delta I^k}{dt}\right) + \beta_I^k\left(\int \Delta I^k dt\right)\right)\cdot \delta_{k,j},$$

= 4.0	ASDEX upgrade
= 5.0	call missionc
= 6.0	call volt

ACOEF(J)	IGROUPC :	NSTART	<	J	<	NSTART+NFB-1
	GAINPEG :	NSTART+NFB	<	J	<	NSTART+2*NFB-1
	GAINDEG :	NSTART+2*NFB	<	J	<	NSTART+3*NFB-1
	GAINIEG :	NSTART+3*NFB	<	J	<	NSTART+4*NFB-1
	TONEG :	NSTART+4*NFB	<	J	<	NSTART+5*NFB-1
	TOFFEG :	NSTART+5*NFB	<	J	<	NSTART+6*NFB-1
	VMINEG :	NSTART+6*NFB	<	J	<	NSTART+7*NFB-1
	VMAXEG :	NSTART+7*NFB	<	J	<	NSTART+8*NFB-1

where:

IGROUPC :	external coil group for feedback
GAINPEG :	proportional feedback constants (V/A) (else:(mu/s))
GAINDEG :	differential (Vs/A) (else: (mu))
GAINIEG :	integral (V/As) (else: (mu/s**2)
TONEG :	time when feedback system is switched on (s)
TOFFEG :	time when feedback system is switched off (s)
VMINEG :	minimum voltage (kV)/turn
VMAXED :	maximum voltage (kV)/turn

The following information is used by the shape control subroutine **tcv1**, when IDATA=7 on card 01. The default values for ACOEF(300) to ACOEF(560) are all equal to zero.

(300) If ACOEF(307)=0, the number of plasma current elements is equal to 2*ACOEF(300)

(301)		If ACOEF(307)=0 AND ACOEF(319)=1, the plasma current elements cover the rectangular area defined by : ACOEF(302) $< x <$ ACOEF(302) ACOEF(303) $< z <$ ACOEF(304)
(302)		See (301)
(303)		See (301)
(304)		See (301)
(305)		Not used
(306)		Not used
(307)	= 0.0	fixed plasma current elements
	= 1.0	current elements are periodically adapted to the preprogrammed plasma shape
(308)		Overall shape control gain, expressed as a time constant (in seconds) for the action of the control algorithm
(309)	= 0.0	boundary points are specified in the ACOEF array
	= 1.0	boundary points are generated analytically using the variables RZERV, AZERV, EZERV, DZERV on type 42, 43, 44 and 45 cards
(310)		Not used
(311)		Shape control proportional feedback gain
(312)		Shape control derivative feedback gain
(313)		Not used
(314)		Not used
(315)		Exit time in seconds for program diagnostics
(316)		Feedback coefficient for plasma current control by acting on flux at reference point. Only used when ACOEF(318)=2.
(317)	= 1.0	TCV
	= 2.0	BPX
	= 3.0	SSAT
	= N.0	User supplied subroutine containing the information discussed in section (**??**). This information is required for the Hofmann control scheme.
(318)	= 0.0	Plasma current is feedback controlled by applying an OH moment. OH group currents are defined in ACOEF(401) through ACOEF(450). Feedback gain is ACOEF(332)
	= 1.0	Plasma current is feedback controlled by acting on the boundary flux. The gain is ACOEF(329) and the weight is preprogrammed (see ACOEF(2093) , ACOEF(2193) etc)

	= 2.0	Plasma current is feedback controlled by acting on flux at reference point. Trajectory of reference point is preprogrammed (see ACOEF(2091),ACOEF(2092),ACOEF(2191),ACOEF(2192), etc). The gain is ACOEF(316) and the weight is preprogrammed as under 1 above.
	= 3.0	Plasma current is not feedback controlled, but the total volt-sec at reference point (same reference point as under 2 above) is feedback controlled to follow a given time evolution, as defined in ACOEF(2095), ACOEF(2195), etc. Gain is ACOEF(333), weight is preprogrammed as under 1 above.
(319)		Ratio of maximum to minimum width of finite element matrix.
(320)		Vertical position control proportional feedback gain. If ACOEF(320)≠0 group currents for a radial field moment must be given in ACOEF(451), ACOEF(452), etc.
(321)		Not used
(322)		Ellipticity control proportional feedback gain. If ACOEF(322)≠0, group currents producing a quadrupole moment must be specified in ACOEF(501), ACOEF(502) etc. This is not recommended!
(323)		Ellipticity control derivative feedback gain. If ACOEF(323)≠0, group currents producing a quadrupole moment must be specified in ACOEF(501), ACOEF(502) etc. This is not recommended!
(324)		Control cycle time (in seconds). This is the time interval for applying the control algorithm
(325)	= 0.0	For plasma current to be calculated from flux loops using finite elements
	= 1.0	For the TSC plasma current to be used in shape subroutines.
(326)		Not used
(327)		Number of control cycles between successive element changes
(328)		If ACOEF(328)=1, the shape evolution between two given shapes can be modified by using the type 44 card. In this case FRAC=EZERW (see subroutine tcvshap).
(329)		Feedback gain for plasma current control by acting on the flux at the plasma boundary. Used when ACOEF(318)=1.
(330)	= 0.0	Measurements are taken from psi-matrix using the subroutine **grap**.
	= 1.0	Measurements are computed using the subroutines **gf** and **gradgf**.

(331)		Damping coefficient for control algorithm (normally = 0.5)
(332)		Feedback coefficient for plasma current control by applying an OH current moment (see ACOEF(401)...). Only used when ACOEF(318)=0.
(333)		Feedback coefficient for volt-sec preprogramming. Only used when ACOEF(318)=3.
(334)	= 0.0	Vessel currents are equal to sum of the wire currents
	= 1.0	Vessel currents are computed from time derivative of flux
(340)		Number of plasma shapes specified using the ACOEF array
(341)		If equal to 1, weight of the top boundary point is preprogrammed.
(342)		If equal to 1, weight of the bottom boundary point is preprogrammed.
(380)		Number of preprogrammed boundary points (should be approximately $2\times$(Number of poloidal field coil groups))
(401)-(450)		Group currents which produce a perfect OH field. Used only when ACOEF(318)=0. Currents should be scaled such that the sum of all OH currents is of the order 10 kA-turns
(451)-(500)		Group currents which produce a pure radial field. Only used when ACOEF(320)$\neq$0 or ACOEF(2096)$\neq$0. Currents should be scaled as above
(501)-(504)		sed for Halo Current feedback simulations if acoef(501) nonzero
(504)		applied electric field for CHI
(510)		factor for determining the regularization parameter for shape feedback (IPEXT=25 on type 20 card) with type 62,63 cards
(511)		Integral gain factor for shape feedback (IPEXT=25 on type 20 card) with type 62,63 cards
(512)		Time for starting up the shape feedback slowly (IPEXT=25 on type 20 card) with type 62,63 cards
(513)		Proportional gain factor for shape feedback (IPEXT=25 on type 20 card) with type 62,63 cards
(514)		Derivative gain factor for shape feedback (IPEXT=25 on type 20 card) with type 62,63 cards
(540)		Number of preprogrammed BSUBR=0 points
(560)		Number of preprogrammed BSUBZ=0 points

Note : Additional information for the Hofmann shape control algorithm is provided on ACOEF(2000)-ACOEF(3000)

(700) NSLHRT : number of cycles skipped between ray tracing in LSC (50.)

(701) NSLHPC : number of cycles skipped between power and current calls to LSC (10.). Note that NSLHPC < NSLHRT

Note : 700-705 also are used to define divertor plots
Note : 701-705 used in special summary plot routine if idiv .ne. 0
These coefficients are needed for IFFAC=1 (neg FFAC on type 03) to control automatic adjustment of FFAC.

(703) gcmin: possible min for group current plot, default 0.
(704) gcmax: possible max for group current plot, default 0.
(705) possible min for power plot, default 0.
(706) possible max for power plot, default 0.

(710) nplot – number of divertor blow-up plots (max 4)
(711) xmin(i),i=1,4
(712) xmax(i),i=1,4
(713) zmin(i),i=1,4
(714) zmax(i),i=1,4

(751) xmin for second summary plot
(752) xmax for second summary plot
(753) zmin for second summary plot
(754) zmax for second summary plot
(755) multiplier of nx and nz for points used in contour plot

(760) pellet run if 1.0
(761) VXPEL...initial R velocity of pellet (note...normally negative)
(762) VZPEL...initial Z velocity of pellet
(763) XPEL....initial R position of pellet
(764) ZPEL....initial Z position of pellet
(765) RADPEL..initial radius of pellet (assumed spherical)
(766) time pellet gets injected
(767) fraction of impurity in pellet (set 0.0 for pure H pellet)

(770) second pellet if 1.0
(771) VXPEL...initial R velocity of second pellet (note...normally negative)
(772) VZPEL...initial Z velocity of second pellet
(773) XPEL....initial R position of second pellet
(774) ZPEL....initial Z position of second pellet

(775) RADPEL..initial radius of second pellet (assumed spherical)
(776) time second pellet gets injected
(777) fraction of impurity in second pellet (set 0.0 for pure H pellet)

(778) time between subsequent pellets
(779) final time

(790)	= 0.0	original calculation of pellet density
	= 1.0	average pellet density source over trail
(791)	= 0.0	original calculation of density integration for plots
	= 1.0	start density integration at restart time

(792) fraction which volume extends for pellet backaveraging
(795) = 1.0 for runaway calculation
(801) maximum AMACH (0.005)
(802) minimum FFAC decrease (0.9)
(803) maximum FFAC increase (1.1)
(804) maximum FFAC (1000.)
(805) minimum FFAC (1.0)
(806) Boundary relaxation factor (1.0)

(809) Multiplier of pellet ablation rate (1.0)
(810) multiplies η (1.0)
(811) QLIM : plasma will be limited by surface where q$\geq$QLIM (0.0)
(815) in missionc
(816) reserved for density jet
(817) reserved for density jet
(818) reserved for density jet
(819) reserved for density jet
(820) reserved for density jet

These coefficients are needed for subroutine ITERATE

(821)	PHI2 (1.75) for	ITYPE=1	poloidal flux
(822)	SF (1.4)	“	
(823)	FACCONV ($1. \times 10^{-8}$)	“	
(824)	NIMAX (4000.)	“	

(831) PHI2 (1.85) for ITYPE=2 velocity stream function
(832) SF (1.4) "
(833) FACCONV ($1. \times 10^{-8}$) "
(834) NIMAX (2000.) "

(841) PHI2 (1.62) for ITYPE=3 velocity potential
(842) SF (1.38) "
(843) FACCONV ($1. \times 10^{-8}$) "
(844) NIMAX (4000.) "

(850) Initial voltage for equilibrium calculation (0.0)
(851) Particle diffusion coefficient (m^2/s) for IDENS=0 and ITRMOD=2. See also ACOEF(875) (0.0)
(852) Normalized pinch term (dimensionless). This is the exponential decay factor for the steady state particle radial density profile (0.0)
(853) Flux of impurities crossing outermost flux surface (#/s) (0.0)

NOTE Acoef(854)-(861) are for impurity fractions
These can also be input as time-dependent variables on Type 82

(854) Oxygen (0.0)
(855) Carbon (0.0)
(856) Iron (0.0)
(857) Berillium (0.0)
(858) Neon (0.0)
(859) Krypton (0.0)
(860) Argon (0.0)
(861) Tungston (0.0)
(869) VT : transfer voltage(kV) for ZTH circuit when IRFP=1 and ACOEF(296)=2; when $V_T \leq$ACOEF(860), OH power supply comes on. (0.0)
(870) α for Ohm's law (0.0) : $\vec{E} + \vec{v} \times \vec{B} = \eta \left(\vec{J} - \alpha \vec{B}/\mu_o \right)$
(871) Edge density source multiplier in $atoms/m^3$ for IDENS=0, ISURF=1
edge density source for IDENS=0., ACOEF(871-876)
$S = a_{871} \exp a_{872} (\frac{\Phi - \Phi_e}{\Phi_e})$
$D_\perp = a_{851} + a_{a875} \tilde{\Phi}^2$ for $\tilde{\Phi} \leq 0.75$
$D_\perp = a_{876}$ for $\tilde{\Phi} > 0.75$
(872) Edge density source exponential decay factor for IDENS=0, ISURF=1

(875) Quadratic term multiplier in particle diffusion coefficient for IDENS=0, ISURF=1
(876) Particle diffusion coefficient for $\phi > 0.75$ for IDENS=0, ISURF=1
(877) Multiplier of PBREM (1.0)
(880) T_{edge} (eV) for transport calculations. (0.0)

Note : The electron and ion edge temperatures are deterined as follows :

For ACOEF(880)=0.0 : $(T_{edge})_e$ = TEVV unless THALO is specified by ACOEF(98) or by the type 60 card, and WHALO is specified to be non-zero by ACOEF(97) or by the type 61. Then $(T_{edge})_e$ = THALO

For ACOEF(880)>0.0 : $(T_{edge})_e$ =ACOEF(880)

In all cases : $(T_{edge})_i$ = (ACOEF(882)-1.)$(T_{edge})_e$

(881) Fraction of n_o for edge density (0.1)
(882) Ratio of total pressure to electron pressure at edge (2.0)
(889) Ratio of n1 and n2 in density profile (acoef 3013 and 3014). It is now input on type 89
(890) Heat conduction multiplier (1.0)
(891) Heat conduction denominator used in temperature equilibration (100.)
(894) ratio of pressure on sep to axis for FRC stability calculation
(895) Let x-point and psimin exist in structure
(896) Set to 1.0 for velocity chopping
(897) convective multiplier(3./2.)
(901) equilibrium shape control parameter

1.0	only shape points are used
2.0	shape points + flux linkage (acoef(902)) at xplas,zplas
3.0	shape points, + x-point (r_x=acoef(903),z_x=acoef(904))
4.0	shape points + flux linkage + x-point

(905) specifies max number of coil group currents to calculate (actually set this equal to the total number of groups. To fix any coil current, set the desired value in gcur(2) and set the corresponding gcur(3) value to 1.0)
(906) is the relative error tolorance...[1.e-3]
(907) is the iteration number when shape feedback starts
(908) is the iteration number when type 19 feedback ends
(909) is the relaxation factor for equilibrium shape feedback

(910) is number of iterations between resetting sigmax and relaxation factors
(911) is number of iterations to full implementation of vsec constraint
(931) switch for writing ographa file (0.0)
(941-962) used in routine jpolo for calculating vessel forces for iwayne > 0
(950) special SPDD3D coding for DIII-D
(991) ACOEF(991-997) are used with the $< j.B >$ current profile equilibrium mode (IFUNC=7.0, on type 02 card)
$\frac{\langle \vec{j} \cdot \vec{B} \rangle}{\langle \vec{B} \cdot \nabla \phi \rangle} = a_{991}(1 - \hat{\psi}^{a_{992}})^{a_{993}} + (1 - a_{991}) \frac{a_{994}^2 \hat{\psi}^{a_{995}}(1-\hat{\psi})^{a_{996}}}{a_{994}^2 + (\hat{\psi} - a_{997})^2}$
(1997) special switch for acoef(1)=4 to revert to 1997 code version treatment of iter VV

The following is additional information for the Hofmann control scheme :

(2000)	Time when the first plasma shape is specified (seconds)
(2001-2030)	The x coordinates of the boundary points
(2031-2060)	The z coordinates of boundary points
(2061)	Weight of top boundary point
(2062)	Weight of bottom boundary point
(2071,2072,2073)	x, z, weight of first BR=0 point
(2074,2075,2076)	x, z, weight of the second BR=0 point
(2081,2082,2083)	x, z, weight of first BZ=0 point
(2084,2085,2086)	x, z, weight of second BZ=0 point
(2091,2092)	x, z for preprogrammed volt seconds
(2093)	Weight of flux control, used when ACOEF(318)=1, 2, or 3.
(2094)	D-matrix scaling factor
(2095)	Preprogrammed volt seconds, used when ACOEF(318)=3.
(2096)	Derivative gain for vertical position control. If ACOEF(2096)$\neq$0, group currents for a radial field moment must be given in ACOEF(451), ACOEF(452) etc.
(2100)-(2195)	Same as above for second plasma shape
(2200)-(2295)	Same as above for third plasma shape
(etc)	Continue in same fashion for all plasma shapes
(3001)	= 1.0 to write special UFILE data,=2.0 for 1d and 2D UFILES
(3003)	transport multiplier for Coppi/Tang for flux > acoef(3011) can be input as time-dependent on type 78
(3004)	first ITB coefficient: minimum flux fraction

(3005) second ITB coefficient: maximum flux fraction
(3006) third ITB coefficient: reduction multiplier can be input as time-dependent on type 80
(3007) feedback coefficient for Chi Multiplier (0.0)
(3008) second feedback coefficient for Chi Multiplier (1.0)
(3009) spatial relaxation factor for GLF23 (.01)
(3010) time relaxation factor for GLF23 (0.1)
(3011) flux fraction for Coppi/Tang to apply acoef(3003) multiplier. Also, H-mode pedistal location for transport models 8-10. The GLF23 and MMM95 models are only applied interior to this fraction. (.75) Can be input as time dependent using the type 79.

Note : In order to use the Hofmann control scheme, the additional information described in section (**??**) must be provided through a subroutine.

(3012) flag for setting exponents n1/n2 in density profile if >0 (0)
(3013) n1
(3014) n2
(3015) exponential factor in χ at the edge used in Coppi model (0)
(3101) hyper-conductivity coefficient to smooth temperature (0.008 to 0.020)
(3102) tped (temperature pedestal) for use with hyper-conductivity (also on time dependent card type 81)
(3208) switch to use EPED1 calculations if =1. NOTE: for density outside $(4-10)\times 10^{19}$ and current outside (7-10) MA the pedestal temperature is not accurate.
(4948) switch for using external diffusivity data if >0 (0)
(4950) time to start TRANSP coupling (10^8)
(4951) time step for TRANSP forward integration (0.0)
(4952)
(4953) # of grids for profiles written to plasma state
(4954) zimp
(4955) H fraction in thermal ion species to be outputted to PS (0.0) (note: acoef(113)= D fraction)
(4956) beam power for each NBI used by TRANSP/NUBEAM (0.0)
(4957) number of Newton iterations for GLF linearization (1)
(4958) step size for derivatives in Newton iteration for GLF (-1.0)
(4959) switch for SWIM if >0 (0=no)

(4960) switch for TRANSP coupling if >0 (0=no)
(4961) switch for writing plasma state if >0 (0=no)
(4962) switch for using TSC in beam heating/current drive (0=yes)
(4963) switch for using TSC in fast ion source (0)
(4964) switch for using TSC in fast wave heating/current drive (0)
(4965) switch for using TSC in lower hybrid heating/current drive (0)
(4966) switch for using TSC in ECH heating/current drive (0)
(4967) switch for using external beam data if >0 (0)
(4968) switch for using external lower hybrid data if >0 (0)
(4969) switch for using external fast wave data if >0 (0)
(4970) switch for using external electron density data if >0 (0)
(4971) fraction of RF power to electrons when using analytic internal algorithm (1.0)
(4972) switch for using external electron rotation data if >0 (0)
(4973) switch to allow stored energy control using NB power if >0 (0)
(4974) switch to allow stored energy control using RF power if >0 (0)
(4975) switch for nb internal model, standard 0 (0)
(4976) switch for icrf internal model, standard 0 (0)
(4977) switch for density profile (0)
(4978) switch for using external line radiated power if >0 (0)
(4979) switch for using external ECRH data if >0 (0)
(4980) stop if reading PS failed if 1 (0)
(4981) itport(1) in GLF (0)
(4982) itport(2) in GLF (1)
(4983) itport(3) in GLF (1)
(4984) itport(4) in GLF (0)
(4985) itport(5) in GLF (0)
(4986) angular velocity used in GLF (0.0)
angrotp(i)=acoef(4986)*(npsit-i)/npsit
(4987) alpha value for the "alpha-effect" in GLF (0.0)
(4988) switch for rotational stabilization in GLF (0=off)
(4989)
(4990)
(4991) if .gt.0; get pressure profile from trxpl
(4992) if .gt.0; get electron pressure profile from trxpl
(4993) if .gt.0; get density profile from trxpl

(4994) if .gt.0; get nubeam machine description and wall data from trxpl

Card 12 - Transport

11	21	31	41	51	61	71
TEVV	DCGS	QSAW	ZEFF	IALPHA	IBALSW	ISAW

TEVV		Temperature of the vacuum region for use in resistivity calculation. If TEVV is negative, (-TEVV) is used initially then TEVV is adjusted to give the maximum value which is numerically stable. If type 34 card is included, this overrides value specified here. (1.0)
DCGS		Reference number density in units of $10^{19}/\mathrm{m}^3$ The actual density for IDENS=1 is the product of DCGS and RNORM on type 24 card.
QSAW		The resistivity is enhanced in the center of the plasma if ISURF=1 and ISAW=1 and the local safety factor satisfies q<QSAW. (see acoef(120) and acoef(124)) (1.0)
ZEFF		The effective Z used in the resistivity calculation if iimp=0 on type 07. Can also be input as a time dependent function on type 36. (1.0)
IALPHA		Switch for α-particle heating. If IALPHA=1, the α-particle heating corresponding to a 50:50 D/T mixture is included in the energy equation. (0.0)
IBALSW		Switch for ballooning calculation (0.0)
	= 0.0	No ballooning calculation
	= 1.0	Ballooning calculation performed every NSKIPSF cycles on every flux surface. Results are presented as a stability plot at the end of the calculation. *WARNING :* may be expensive for time dependent calculations
	= 2.0	Same as 1.0, with the addition that the thermal conductivity is increased by a factor of 10 on all surfaces found to be unstable.
	= 3.0	Same as 2.0, except only surfaces in the SOL are checked.
ISAW		Switch for sawtooth model (1.0)
	= 1.0	old "Standard" sawtooth model (average in time, based on qsaw) Also, increases Chi and eta inside q=qsaw surface based on ACOEF(120) and (124)
	= 2.0	Kadomtsev Sawtooth at times specified on type 75 card
	= 3.0	Full Porcilli Model

Card 13 - Initial Conditions

11	21	31	41	51	61	71
ALPHAG	ALPHAP	NEQMAX	XPLAS	ZPLAS	GZERO	QZERO

ALPHAG The initial toroidal field is given by $g\nabla\phi$ where

For IFUNC =1:

$gg^{'}$ = [GP1*FF1(Ψ)+GP2*FF2(Ψ)]

where

$\mathrm{FF1}(\hat{\Psi}) = -\hat{\Psi}^{\mathrm{ALPHAG}}$
$\mathrm{FF2}(\hat{\Psi}) = -4.0\hat{\Psi}^{\mathrm{ALPHAG}}[1-\hat{\Psi}]$
$\hat{\Psi}$=$(\Psi_{lim} - \Psi)/(\Psi_{lim} - \Psi_{min})$

And GP1 and GP2 are determined so that the central q value is QZERO and the total plasma current is PCUR(ISTART).

For IFUNC=2:

$$\frac{1}{2}\frac{dg^2}{d\Psi} = (\mathrm{XPLAS}^2 * \mathrm{PO} * (1/\mathrm{BETAJ} - 1) * \left[\frac{e^{-(\mathrm{ALPHAG})\hat{\Psi}} - e^{-(\mathrm{ALPHAG})}}{e^{-(\mathrm{ALPHAG})} - 1}\right]$$

where $\hat{\Psi} = (\Psi - \Psi_{min})/(\Psi_{lim} - \Psi_{min})$, BETAJ=ACOEF(27), and PO above and in the pressure equation are initialized by the type 17 card, but are iterated (renormalized) so the total plasma current is PCUR(ISTART) and g=GZERO at $\Psi = \Psi_{lim}$.

For IFUNC=3:

if (DELG > 0) g=GZERO + (const) $\hat{\Psi}^{\mathrm{ALPHAG}}$
where (const) is chosen to make plasma current equal to PCUR(ISTART) (as specified on the type 16 card)
if (DELG < 0) g=GPRFP*(1+(DELG-1)$\hat{\Psi}^{\mathrm{ALPHAG}}$)

where DELG=ACOEF(25) and GRPFP=ACOEF(26) is iterated (renormalized) so the total plasma current is PCUR(ISTART)

For IFUNC=4:

$g^2 = \mathrm{GZERO}^2 + 2 * \mathrm{GP1} * \mathrm{FF1}(\Psi)$

and GP1 is determined so the total plasma current is GCUR(1)

For IFUNC=5:

$$-\frac{1}{2}\frac{dg^2}{d\Psi} = \frac{\mathrm{GP1}/2\pi\eta + (p^{'} + \langle J_{CD}\rangle)/\langle R^{-2}\rangle}{\langle B^2\rangle/\langle B_T^2\rangle}$$

ALPHAP	Pressure exponent for equilibrium calculation (see type 02 card)
NEQMAX	Maximum number of equilibrium iterations allows. Normal value is 200. If NEQMAX is negative, the absolute value is used and the error flag is skipped if convergence is not obtained in ABS(NEQMAX) iterations.
XPLAS	Initial guess for the x coordinate of the magnetic axis. This value is used as the nominal major radius in several calculations.
ZPLAS	Initial guess for the z coordinate of the magnetic axis. This value is used as the nominal vertical position in several calculations.
GZERO	Vacuum toroidal field given by GZERO $\nabla\phi$. This can be specified as a function of time on the type 27 card.
QZERO	Initial value of the safety factor at the magnetic axis for IFUNC=1

Card 14 - Initial Conditions 2

11	21	31	41	51
ISTART	XZERIC	AXIC	ZZERIC	BZIC

ISTART	This indicates at which time point TPRO(I) as specified on the type 18 card the calculation is to begin. The normal value is 1.
XZERIC	If this is nonzero, the initial equilibrium iteration will be initialized with the plasma current distributed over a rectangular region centered at XZERIC and ZZERIC and with half width AXIC and half height BZIC. If these variables are specified, then the initial plasma position XPLAS and ZPLAS on the type 13 card are overwritten.
AXIC	See above
ZZERIC	See above
BZIC	See above

Card 15 - Coil Group Current

11	21	31	41	51	61	71
IGROUP	GCUR(1)	GCUR(2)	GCUR(3)	GCUR(4)	GCUR(5)	GCUR(6)

IGROUP The group number used to identify the coil. It is specified on type 9 and 10 cards for the external and internal coils. If IGROUP<0, then ABS(IGROUP) is used and this coil group has zero net current constraint applied if ACOEF(41)>0. If RESGS(IGROUP) is non-zero, then this resistance is used for the group resistance.

GCUR(I) The programmed coil current (kA) for the coil group IGROUP at time TPRO(I). When using the Hofmann control scheme only the initial coil currents are needed.

Card 16 - Plasma Current

11	21	31	41	51	61	71
-	PCUR(1)	PCUR(2)	PCUR(3)	PCUR(4)	PCUR(5)	PCUR(6)

PCUR(I) The programmed plasma current (kA) at the time TPRO(I)

Card 17 - Plasma Pressure

11	21	31	41	51	61	71
-	PPRES(1)	PPRES(2)	PPRES(3)	PPRES(4)	PPRES(5)	PPRES(6)

PPRES(I) The programmed plasma pressure (mks) at the time TPRO(I). For IPRES=0, only the initial value is needed. For IPRES=1, all values are used.

Card 18 - Time

11	21	31	41	51	61	71
-	TPRO(1)	TPRO(2)	TPRO(3)	TPRO(4)	TPRO(5)	TPRO(6)

TPRO(I) Time (in seconds) corresponding to GCUR(I),PCUR(I), etc. The intermediate values are linearly interpolated for ICUBE=0, cubic interpolation is used for ICUBE=1 (set by ACOEF(17)). Note that while most time dependent quantities are interpolated between time points, auxiliary heating system powers specified on type 23 (Neutral Beam) and 46 (Lower Hybrid) cards come on abruptly at these times and stay at the fixed level during each time interval.

Card 19 - Feedback 1

11	21	31	41	51	61	71
L	NRFB(L)	NFEEDO(L)	FBFAC(L)	FBCON(L)	IDELAY(L)	FBFACI(L)

L	Number of feedback system
NRFB(L)	If NRFB(L)>0, indicates coil group number for feedback If NRFB(L)=0, indicates feedback on plasma current
NFEEDO(L)	Observation pair number (type 8) used in feedback system. This is ignored if IPEXT(L) > 3 (type 20).
FBFAC(L)	This is a proportionality factor between the coil group current and the desired flux difference. Units are (amps/weber/radian) For external coils, this current is changed instantaneously for ICIRC=0, or a voltage is applied through the circuit equations for ICIRC=1. For internal coils, a voltage is applied (proportional to the wire resistivity) so that the desired current will be obtained after the coil L/R time. If IPEXT(L)=4 on corresponding type 20 card, FBFAC(L) is the proportionality factor between coil group current desired and difference between plasma current and plasma current desired.
FBCON(L)	Flux offset, FBFAC(L) multiplies : (PSI1-PSI2-FBCON(L)*FAC)
IDELAY(L)	If this is greater than zero, a time delay of IDELAY(L) time steps is introduced into the calculations. Note that the parameter PDELAY must be greater than the maximum IDELAY(L).
FBFACI(L)	This is the time integral feedback proportionality term. It is the same as FBFAC(L) except it multiplies the time integral of the flux or current difference. May be superimposed with FBFAC.

Note : If the first field on the type 19 card is equal to 1000.0, this card defines time varying observation points for the feedback system defined by the preceding type 19 card. The format is similar to that of the type [15,16,17,18,23,24] cards:

11	21	31	41	51	61	71
1000.0	NFEEDV(1,L)	(2,L)	(3,L)	(4,L)	(5,L)	(6,L)

NFEEDV(I,L) Observation pair number (type 08) used in feedback system L at time point I (type 18). Multiple cards can be included to define more than 6 points

Card 20 - Feedback 2

11	21	31	41	51	61	71
L	TFBONS(L)	TFBOFS(L)	FBFAC1(L)	FBFACD(L)	IPEXT(L)	

L		Number of feedback system (same as that on corresponding type 19 card)
TFBONS(L)		Time when feedback system L is turned on (sec)
TFBOFS(L)		Time when feedback system L is turned off (sec)
FBFAC1(L)		If >0, factor multiplying FBCON is proportional to the (plasma current)/(final current)
FBFACD(L)		This is the time derivative feedback proportionality term. It is the same as FBFAC(L) and FBFACI(L) except it multiplies the time derivative of the flux or current difference. It may be superimposed with FBFAC and FBFACI
IPEXT(L)		Signifies which flux to used from the observation coils
	= 1.0	Total flux per radian
	= 2.0	Flux from coils only (not presently available)
	= 3.0	Flux from plasma only (not presently available)
	= 4.0	Feedback signal is proportional to plasma current minus preprogrammed value. For this option , FBFAC is dimensionless
	= 5.0	Feedback signal is proportional to (XMAG-XMAGO(t)). where XMAGO(t) is defined on type 30 card…see note 4
	= 6.0	Feedback signal is proportional to (ZMAG-ZMAGO(t)). where ZMAGO(t) is defined on type 31 card…see note 4
	= 7-10	Feedback is proportional to EPS1C-EPS4C
	= 10NN	Feedback is proportional to current in wire NN
	= 21-24	Special option for RFP, proportional to $\cos(\theta) - \cos(4\theta)$
	= 25	Special shape control using acoef(510) and cards 62-63

Note 1 : If TFBONS or TFBOFS are negative, then their absolute value refers to the cycle number for which the feedback is turned on or off.

Note 2 : If controlling plasma current by using IPEXT(L)=4, the automatic plasma current control should be turned off by setting ACOEF(11)=0.

Note 3 : If IPEXT(L) = 7,8,9,10, the switch ISVD must be set to 1.0 on type 03 card

Note 4 : Feedback signal multiplied by (I_p/1 MA) for IPEXT(5) or IPEXT(6)

Card 21 - Contour Plots

11	21	31	41	51	61	71
ICPLET	ICPLGF	ICPLWF	ICPLPR	ICPLBV	ICPLUV	ICPLXP

If any of these switches are set to 1.0, the following contour plots are produced every NSKIPL cycles.

ICPLET	Resistivity array ETAY
	If (IRFP=1) ETA*J
ICPLGF	Toroidal field function g
ICPLWF	Toroidal velocity W
	If (IRFP=1) ($\vec{J} \cdot \vec{B}/B^2$)
ICPLPR	Pressure p
ICPLBV	Curl of the velocity field B $\equiv \Delta^* A$
	If (IRFP=1) HYPER/J
ICPLUV	Divergence of velocity field U$\equiv \nabla^2\Omega$
	If (IRFP=1) (ETA*J+HYPER)/(ETA*J)
ICPLXP	Close-up of poloidal flux near x-point region

Card 22 - Vector Plots

11	21	31	41	51	61	71
IVPLBP	IVPLVI	IVPLFR	IVPLJP	IVPLVC	IVPLVT	-

If any of these switches are set to 1.0, the following vector plots are produced every NSKIPL cycles.

IVPLBP	Poloidal magnetic field
IVPLVI	Incompressible velocity field
IVPLFR	Forces
IVPLJP	Poloidal current
IVPLVC	Compressible velocity field
IVPLVT	Total velocity field

Card 23 - Neutral Beam

11	21	31	41	51	61	71
-	BEAMP(1)	BEAMP(2)	BEAMP(3)	BEAMP(4)	BEAMP(5)	BEAMP(6)

BEAMP(I) The amplitude of the neutral beam source (MW) at time TPRO(I). The deposition profile is given on the type 25 card.

Card 24 - Plasma Density

11	21	31	41	51	61	71
-	RNORM(1)	RNORM(2)	RNORM(3)	RNORM(4)	RNORM(5)	RNORM(6)

RNORM(I) The normalized central density for IDENS=1 at time TPRO(I). The actual density is RNORM(I)*DCGS.

Card 25 - Neutral Beam Deposition Profile

11	21	31	41	51	61	71
ABEAM	DBEAM	NEBEAM	EBEAMKEV	AMBEAM	FRACPAR	IBOOTST

ABEAM	This variable along with DBEAM and NEBEAM specify the spatial external heat source deposition profile which is multiplied by the beam amplitude parameter on the type 23 card. (0.25) The spatial form factor is FF=F1*F2/SUM F1=DBEAM$^2/[(\hat{\Psi} - \text{ABEAM})^2 + \text{DBEAM}^2]$ F2=(1-$\hat{\Psi}^2)^{\text{NEBEAM}}$ with $\hat{\Psi} = (\Psi - \Psi_{min})/(\Psi_{lim} - \Psi_{min})$ and SUM is the normalization factor.
DBEAM	See ABEAM above. (0.1)
NEBEAM	See ABEAM above. (1.0)
EBEAMKEV	Energy of the neutral beam ions in keV. (80.)
AMBEAM	Mass of the neutral beam particles in amu. (1.0)
FRACPAR	Fraction of beam particles which are oriented parallel to the plasma current (0.0). -1$<$ FRACPAR $<$ 1. This can be input as a function of time, TPRO(I), on the type 50 card.
IBOOTST	If IBOOTST$\neq$0, the bootstrap current is included in the calculation. If IBOOTST=1, the collisionless Hirshman model is used and if IBOOTST=2 the collisional Harris model is used

Card 26 - Anomalous Transport

11	21	31	41	51	61	71
-	FBCHIA(1)	FBCHIA(2)	FBCHIA(3)	FBCHIA(4)	FBCHIA(5)	FBCHIA(6)

FBCHIA(I) Factor by which thermal conductivity is enhanced at time TPRO(I)

Card 27 - Toroidal Field

11	21	31	41	51	61	71
-	GZEROV(1)	...(2)	...(3)	...(4)	...(5)	GZEROV(6)

GZEROV(I) Vacuum toroidal field function GZERO at time TPRO(I)

Card 28 - Loop Voltage

11	21	31	41	51	61	71
-	VLOOPV(1)	...(2)	...(3)	...(4)	...(5)	VLOOPV(6)

VLOOPV(I) Programmed loop voltage for OH system at time TPRO(I). In general, a loop voltage determined by feedback will be superimposed on VLOOPV(I). The "automatic" plasma current control feedback is proportional to ACOEF(11). The maximum and minimum loop voltages (sum of preprogrammed and feedback) are limited by ACOEF(15)(min) and ACOEF(16)(max). Currents in passive conductors are initialized when VLOOPV(ISTART)>0 and ACOEF(41)=0.

Card 29 - PEST Output

11	21	31	41	51	61	71
-	TPEST(1)	TPEST(2)	TPEST(3)	TPEST(4)	TPEST(5)	TPEST(6)

TPEST(I) The specified times at which PEST output is to be written onto file EQDSKA for IPEST=1. Plots and a restart file are also written at these times.

Cards 30 and 31 - Magnetic Axis

11	21	31	41	51	61	71
-	XMAGO(1)	XMAGO(2)	XMAGO(3)	XMAGO(4)	XMAGO(5)	XMAGO(6)
-	ZMAGO(1)	ZMAGO(2)	ZMAGO(3)	ZMAGO(4)	ZMAGO(5)	ZMAGO(6)

XMAGO(I) The x-magnetic axis position corresponding to time TPRO(I) for use in feedback system (type 19,20) with IPEXT=5

ZMAGO(I) The z-magnetic axis position corresponding to time TPRO(I) for use in feedback system (type 19,20) with IPEXT=6

Card 32 - Divertor Plate

11	21	31	41	51	61	71
N	XLPLATE(N)	ZL...(N)	XR...(N)	ZR...(N)	FPLATE(N,1)	FPLATE(N,2)

N	Number of divertor plate
XLPLATE(N)	The x-coordinate of leftmost side of divertor plate N.
ZLPLATE(N)	The z-coordinate of leftmost side of divertor plate N.
XRPLATE(N)	The x-coordinate of rightmost side of divertor plate N.
ZRPLATE(N)	The z-coordinate of rightmost side of divertor plate N.
FPLATE(N,1)	Fraction of charged particle heat flux deposited on divertor plate N. Outside strike point is 1, inside is 2
FPLATE(N,2)	See FPLATE(N,1)

The plate will be divided into PNSEG bins, and the heat flux in each bin will be calculated and plotted. One sided exponential distributions are used, based on midplane scrapeoff distance of 0.6 cm.

Note : The default divertor shape follows a straight line between the coordinates specified here. If this card is followed by additional type 32 cards with option 1000 in the second field, additional defining points are added. The individual PNSEG+1 x-z coordinates are input 3 per card as follows

Note : Acoef(700)-(704) must be defined for divertor plots

32	10000.	X(I)	Z(I)	X(I+1)	Z(I+1)	X(I+2)	Z(I+2)

Card 33 - Gap Resistance

11	21
IGROUP	RESGS(IGROUP)

IGROUP Group number of coil (same as type 15 card).

RESGS The resistance of gap in coil. This will override the gap resistance computed from ACOEF(41) when IGROUP is negative.

Card 34 - Vacuum Temperature

11	21	31	41	51	61	71
-	TEVVO(1)	TEVVO(2)	TEVVO(3)	TEVVO(4)	TEVVO(5)	TEVVO(6)

TEVVO(I) Vacuum temperature TEVV at time point I. This card overrides the value specified on type 12 card. This option is NOT recommended, rather set TEVV negative on the type 12 card and allow TSC to determine the value

Card 35 - Mass Enhancement

11	21	31	41	51	61	71
-	FFACO(1)	FFACO(2)	FFACO(3)	TEVVO(4)	FFACO(5)	FFACO(6)

FFACO(I) Mass enhancement FFAC at time point I. Inclusion of of this card will override the value specified on type 03 card.

Card 36 - Resistivity Enhancement

11	21	31	41	51	61	71
-	ZEFFV(1)	ZEFFV(2)	ZEFFV(3)	ZEFFV(4)	ZEFFV(5)	ZEFFV(6)

ZEFFV(I) Resistivity enhancement ZEFF at time point I. Inclusion of this card will override the value specified on type 12 card. Only used for IIMP=0 on type 07.

Card 37 - Voltage Group

11	21	31	41	51	61	71
IGROUP	GVOLT(1)	GVOLT(2)	GVOLT(3)	GVOLT(4)	GVOLT(5)	GVOLT(6)

GVOLT(I) The preprogrammed voltage (kV) for coil group IGROUP at time TPRO. This is the equivalent one turn voltage.

Card 38 - ILHCD

11	21	31	41	51	61	71
ILHCD	VILIM	FREQLH	AION	ZION	CPROF	IFK

ILHCD	= 0.0	No LHCD calculation and no hot plasma conductivity correction
	= 1.0	LHCD calculation and hot plasma conductivity contribution are included
VILIM		Lower velocity limit for the LHCD spectrum normalized to local thermal velocity. (typical value 2 to 3)
FREQLH		Frequency in GHz of the LH wave(3.7 for instance)
AION		Ratio of masses $\mathrm{m_i/M_p}$ for the dominant ion species (1 for hydrogen)
ZION		Atomic number of the dominant ion species
CPROF		Option to calculate the RF current profile
	= 0.0	RF current profile is calculated from the Fisch formula (depends on power)
	= 1.0	RF current profile is calculated independently of power, from cards 55-58 according to

$$\frac{d_c^2 r^{a_{c_1}} (1-r)^{a_{c_2}}}{(r-a_c)^2 + d_c^2}$$

IFK	= 1.0	Read data file TSCOUTA
	= 2.0	Call LSC(see acoef(700),(701),(106))

Card 39 - External Coils 2

11	21	31	41	51	61	71
ICO	DXCOIL	DZCOIL	FCU	FSS	TEMPC	CCICS

ICO	External coil number (same as on type 09 card)
DXCOIL	Radial thickness of coil in meters
DZCOIL	Vertical thickness of coil in meters
FCU	Fraction of coil volume which is copper (see note below)
FSS	Fraction of coil volume which is stainless steel
TEMPC	Initial temperature of coil in °K
CCICS	Initial induced current in coil (kA)

Note: If FCU(N)>1, the truncated integer refers to the alloy type, while the decimal fraction refers to the fraction

Note: For superconducting coils, set ITEMP=-1 (type 12), FSS=0, TEMPC=2., FCU=0, RSCOILS=1.e-12

0.000<FCU<0.999 OFHC Copper
1.000<FCU<1.999 AL25 (Glidcop)
2.000<FCU<2.999 Berylium Copper

Card 40 - Output Reduction

11	21	31	41	51	61	71
NOPLOT(1)	...(2)	...(3)	...(4)	...(5)	...(6)	NOPLOT(7)

Plots are suppressed if the following numbers are assigned to the NOPLOT array on type(40) cards.

NOPLOT	Description
1	Grid, coils and limiters
2	Switch and time step information
3	Filament growth rate model
4	Initial coil and wire information
5	Coil currents,cycle=#
6	Current and flux
7	Special for spheromak formation
8	Special x-point plot
9	Heat flux, plate # cycle #
10	Profile plots(eg: q-prof vs poloidal flux, etc.)
11	Surface profiles, cycle=#
12	Summary plot
13	Flux measurements of observation pairs
14	Special divertor plots
15	Group number current and voltage
16	Current groups
17	Group voltage
18	Group power
19	Group energy
20	Total power and energy
21	Coil temperature
22	Currents(kA)
23	Timing information
51	AMACH and EKIN vs time
52	IPLIM and ZMAG vs time, XMAG vs TIME and ZMAG
53	XMAG and CUR vs time
54	DELP.TPI and PMIN.TPI vs time
55	DIAMAG and SURFVOLT vs time
56	QZERO and QEDGE vs time
57	DT and BETA vs TIME

58	$\langle N \rangle$/NMUR vs time and 1/q nr/B
	Density and INT ENER vs time
59	LI/2 vs time and LI vs q
60	TAUE-KG and TAU(MS) vs time
61	TI(0) and TE/TE-AV vs time
62	CHIOHMS and HFLUX-MW vs time
63	RO and MINORRAD vs time
64	DELT-TRI and ELLIP vs time
65	XSEP and ZSEP vs time
66	RESV-SEC and VSEC-TOT vs time
67	LOOPV-OH and VSEC-OH vs time
68	PTOT(MW) and PSEPCAL vs time
	Power flow in system
	FFAC and TEVV vs time
	NPSIT and RESID vs time
69	Nullapole and dipole vs time
70	Quadrupole and hexapole vs time
71	Octapole and decapole vs time

Note : To cancel the suppression of a certain plot, restart the job and input a negative number (eg: -9)

Example:

10. 2. +23. -9. 15. 12. 7.

Card 41 - TF Ripple

11	21	31	41	51	61	71
IRIPPL	NTFCOIL	RIPMAX	RTFCOIL	NPITCH	RIPMULT	IRIPMOD

IRIPPLE	= 0.0	Does not calculate ripple losses
	= 1.0	Does calculate ripple losses. *WARNING* : may be expensive for time dependent calculation
NTFCOIL		Number of TF coils
RIPMAX		Ripple magnitude at radius of TF coil
RTFCOIL		Radius of TF coil
NPITCH		Number of pitch angles for integration
RIPMULT		Ripple multiplier
IRIPMOD	= 1.0	CIT 2.1 meter design (U. Christenson)
	= 2.0	TFTR model
	= 3.0	Model RIPMAX*(R/RTFCOIL)$^{\mathrm{NTFCOIL}}$

Card 42 - Major Radius

11	21	31	41	51	61	71
-	RZERV(1)	RZERV(2)	RZERV(3)	RZERV(4)	RZERV(5)	RZERV(6)

RZERV(I) The preprogrammed major radius at time TPRO(I) for use in the Hofmann plasma shape control algorithm.

Card 43 - Minor Radius

11	21	31	41	51	61	71
-	AZERV(1)	AZERV(2)	AZERV(3)	AZERV(4)	AZERV(5)	AZERV(6)

AZERV(I) The preprogrammed minor radius at time TPRO(I) f or use in the Hofmann plasma shape control algorithm.

Card 44 - Ellipticity

11	21	31	41	51	61	71
-	EZERV(1)	EZERV(2)	EZERV(3)	EZERV(4)	EZERV(5)	EZERV(6)

EZERV(I) The preprogrammed ellipticity at time TPRO(I) for use in the Hofmann plasma shape control algorithm.

Card 45 - Triangularity

11	21	31	41	51	61	71
-	DZERV(1)	DZERV(2)	DZERV(3)	DZERV(4)	DZERV(5)	DZERV(6)

DZERV(I) The preprogrammed triangularity at time TPRO(I) for use in the Hofmann plasma shape control algorithm.

Card 46 - Lower Hybrid Heating

11	21	31	41	51	61	71
-	PLHAMP(1)...(2)		...(3)	...(4)	...(5)	PLHAMP(6)

PLHAMP(I) The lower hybrid heating power (MW) at time TPRO(I)

Card 47 - Density Exponent 1

11	21	31	41	51	61	71
-	ALPHARV(1)	...(2)	...(3)	...(4)	...(5)	ALPHARV(6)

ALPHARV(I) The density exponent ALPHAR (see type 02 card) at time TPRO(I) (0.5). If included, this overwrites the value on the type 04 card.

Card 48 - Density Exponent 2

11	21	31	41	51	61	71
-	BETARV(1)	...(2)	...(3)	...(4)	...(5)	BETARV(6)

BETARV(I) The density exponent BETAR (see type 02 card) at time TPRO(I) (2.0). If included, this overwrites the value on the type 04 card.

Card 49 - Multipolar Moments

11	21	31	41	51	61	71
N	MULTN(N)	ROMULT(N)	IGROUPM(N)	ATURNSM(N)		

N		Multipole coil number (this must be a unique identifying number between 1 and PNCOIL
MULTN(N)		Multipole field type :
	= 0.0	Even nullapole
	= 1.0	Odd nullapole
	= 2.0	Even dipole
	= 3.0	Odd dipole
	= 4.0	Even quadrupole
	= 5.0	Odd quadrupole
	= 6.0	Even hexapole
	= 7.0	Odd hexapole
	= 8.0	Even Octapole
	= 9.0	Odd Octapole
	= 10.0	Even decapole
ROMULT(N)		Major radius about which multipole fields are expanded
IGROUPM(N)		Group number of multipole coil N. Refers to type 15 card with the same number.
ATURNSM(N)		Number of turns for multipole coil N. This is a positive or negative number, not necessarily an integer. The preprogrammed current for multipole coil N will be the product of ATURNSC(N) and the current in IGROUPC(N) as specified by the appropriate type 15 card.

Card 50 - Neutral Beam Fraction

11	21	31	41	51	61	71
-	FRACPAR(1)	...(2)	...(3)	...(4)	...(5)	FRACPAR(6)

FRACPAR(I) The fraction of neutral beams oriented tangentially at time TPRO(I). If included, this overwrites the value on the type 25 card.

Cards 51-54 Input Power Profile (LH)

11	21	31	41	51	61	71
-	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
-	D(1)	D(2)	D(3)	D(4)	D(5)	D(6)
-	A1(1)	A1(2)	A1(3)	A1(4)	A1(5)	A1(6)
-	A2(1)	A2(2)	A2(3)	A2(4)	A2(5)	A2(6)

The above cards specify the input power profile for lower hybrid waves at time TPRO according to

$$S_{LH}(\hat{\Psi}) = \frac{d^2 \hat{\Psi}^{a_1} (1 - \hat{\Psi})^{a_2}}{(\hat{\Psi} - a)^2 + d^2}, \tag{4.5}$$

where $\hat{\Psi} = (\Psi - \Psi_{min})/(\Psi_{lim} - \Psi_{min})$. Normalization is such that the total power in MW is given on the type 46 card.

Cards 55-58 Current Profile (LH)

11	21	31	41	51	61	71
-	AC(1)	AC(2)	AC(3)	AC(4)	AC(5)	AC(6)
-	DC(1)	DC(2)	DC(3)	DC(4)	DC(5)	DC(6)
-	AC1(1)	AC1(2)	AC1(3)	AC1(4)	AC1(5)	AC1(6)
-	AC2(1)	AC2(2)	AC2(3)	AC2(4)	AC2(5)	AC2(6)

The above cards specify the current profile for lower hybrid waves evolving independently in time from the power according to

$$J_{LH}(\hat{\Psi}) = \frac{d_c^2 \hat{\Psi}^{a_{c1}} (1 - \hat{\Psi})^{a_{c2}}}{(\hat{\Psi} - a_c)^2 + d_c^2}. \tag{4.6}$$

Linear interpolation is used between different time values. Normalization is such that the total current is given by the Fisch formula. This resulting total current can be adjusted with ACOEF(106).

Card 59 - ICRH Power

11	21	31	41	51	61	71
-	PICRH(1)	...(2)	...(3)	...(4)	...(5)	PICRH(6)

PICRH(I) The amplitude of the ICRH source(MW) at time TPRO(I). The deposition profile for electron heating is given on the TYPE 65-68 cards.

Cards 60 and 61 - Halo Parameters

11	21	31	41	51	61	71
-	TH(1)	TH(2)	TH(3)	TH(4)	TH(5)	TH(6)
-	AH(1)	AH(2)	AH(3)	AH(4)	AH(5)	AH(6)

TH(I) The halo region temperature (in eV) corresponding to time TPRO(I)

AH(I) The halo region width (described as a fraction of the poloidal flux between the plasma edge and axis, $(\delta\psi_{halo} = AH(I)(\psi_{edge} - \psi_{axis}))$ corresponding to time TPRO(I)

Note 1 : Tedge must be set to zero, ACOEF(880)

Note 2 : these values override those specified in ACOEF(97) and ACOEF(98)

Note 3 : Either the type 97 or the AH parameter must be included for the temperature boundary condition to be applied.

Cards 62 and 63 - Control Points

11	21	31	41	51	61	71
-	XCON0(1)	XCON0(2)	XCON0(3)	XCON0(4)	XCON0(5)	XCON0(6)
-	ZCON0(1)	ZCON0(2)	ZCON0(3)	ZCON0(4)	ZCON0(5)	ZCON0(6)

XCON0(I) The x-shape point corresponding to time TPRO(I) for use in equilibrium iteration when acoef(901)>0 and shape control (IPEXT=25 on type 20 card)

ZCON0(I) The z-shape point corresponding to time TPRO(I) for use in equilibrium iteration when acoef(901)>0 and shape control (IPEXT=25 on type 20 card)

Card 64 - ICRH Fast Wave Current

11	21	31	41	51	61	71
-	FWCD(1)	…(2)	…(3)	…(4)	…(5)	FWCD(6)

FWCD(I) The total toroidal current(MA) driven by fast wave current drive at time TPRO(I). The deposition profile is given on the TYPE 69-72 cards.

Cards 65-68 Input Power Profile(ICRH)

11	21	31	41	51	61	71
-	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
-	D(1)	D(2)	D(3)	D(4)	D(5)	D(6)
-	A1(1)	A1(2)	A1(3)	A1(4)	A1(5)	A1(6)
-	A2(1)	A2(2)	A2(3)	A2(4)	A2(5)	A2(6)

The above cards specify the input power profile for electrons for ICRH heating. The power density from fast wave at time t is given by:

$$S_{ICRH}(\hat{\Psi}, t) = \alpha_N(t) \frac{d^2 \hat{\Psi}^{a_1} (1 - \hat{\Psi})^{a_2}}{(\hat{\Psi} - a)^2 + d^2}. \tag{4.7}$$

where $\hat{\Psi} = (\Psi - \Psi_{min})/(\Psi_{lim} - \Psi_{min})$. The normalization parameter $\alpha_N(t)$ is chosen such that the total power from fast waves in MW is given on the type 59 card.

Cards 69-72 Current Profile (FW)

11	21	31	41	51	61	71
-	A(1)	A(2)	A(3)	A(4)	A(5)	A(6)
-	D(1)	D(2)	D(3)	D(4)	D(5)	D(6)
-	A1(1)	A1(2)	A1(3)	A1(4)	A1(5)	A1(6)
-	A2(1)	A2(2)	A2(3)	A2(4)	A2(5)	A2(6)

The above cards specify the input current density profile for fast wave current drive. The current density from fast wave at time t is given by:

$$\vec{J_{FW}} = \alpha_N(t) f(\hat{\Psi}, t) \vec{B} \tag{4.8}$$

where

$$f(\hat{\Psi}, t) = \frac{d^2 \hat{\Psi}^{a_1} (1 - \hat{\Psi})^{a_2}}{(\hat{\Psi} - a)^2 + d^2}. \tag{4.9}$$

where $\hat{\Psi} = (\Psi - \Psi_{min})/(\Psi_{lim} - \Psi_{min})$. The normalization parameter $\alpha_N(t)$ is chosen such that the total current driven by fast waves in MA is given on the type 64 card.

Card 73 - He Confinement Time

11	21	31	41	51	61	71
-	HEACT(1)	...(2)	...(3)	...(4)	...(5)	HEACT(6)

HEACT(I) The He confinement time in seconds at time TPRO(I). This overrides the value given in ACOEF(93).

Card 74 - UFILE Output

11	21	31	41	51	61	71
-	TUFILE(1)	...(2)	...(3)	...(4)	...(5)	TUFILE(6)

TUFILE(I) Specified times at which UFILE output is to be written into file OGRAPH for ACOEF(3001)=1.

Card 75 - SAWTOOTH times

11	21	31	41	51	61	71
-	TUFILE(1)	...(2)	...(3)	...(4)	...(5)	TUFILE(6)

SAWTIME(I) Times (in seconds) for which sawtooth will occur for ISAW=2 on type 12

Card 76 - Anomalous Ion Transport for itrmod=13,14

11	21	31	41	51	61	71
-	FBCHIIA(1)	FBCHIIA(2)	FBCHIIA(3)	FBCHIIA(4)	FBCHIIA(5)	FBCHIIA(6)

FBCHIIA(I) Factor by which ion thermal conductivity (for itrmod=13,14) is enhanced at time TPRO(I)

Cards 77-89 new time-dependent variables (updated Dec-20-2010)

11	21	31	41	51	61	71
-	qadd(1)	qadd(2)	qadd(3)	qadd(4)	qadd(5)	qadd(6)
-	fhmodei(1)	fhmodei(2)	fhmodei(3)	fhmodei(4)	fhmodei(5)	fhmodei(6)
-	pwidthc(1)	pwidthc(2)	pwidthc(3)	pwidthc(4)	pwidthc(5)	pwidthc(6)
-	chiped(1)	chiped(2)	chiped(3)	chiped(4)	chiped(5)	chiped(6)
-	tped(1)	tped(2)	tped(3)	tped(4)	tped(5)	tped(6)
imptype	frac(1)	frac(2)	frac(3)	frac(4)	frac(5)	frac(6)
-	nflag(1)	nflag(2)	nflag(3)	nflag(4)	nflag(5)	nflag(6)
-	expn1(1)	expn1(2)	expn1(3)	expn1(4)	expn1(5)	expn1(6)
-	expn2(1)	expn2(2)	expn2(3)	expn2(4)	expn2(5)	expn2(6)
-	firitb(1)	firitb(2)	firitb(3)	firitb(4)	firitb(5)	firitb(6)
-	secitb(1)	secitb(2)	secitb(3)	secitb(4)	secitb(5)	secitb(6)
-	fracn0(1)	fracn0(2)	fracn0(3)	fracn0(4)	fracn0(5)	fracn0(6)
-	newden(1)	newden(2)	newden(3)	newden(4)	newden(5)	newden(6)

77 —— qadd(1) qadd(2) .... qadd(6) (default acoef(123))
78 —— fhmodei(1) fhmodei(2) .. fhmodei(6) (default acoef(3003))
79 —— pwidthc(1) pwidthc(2) .. pwidthc(6) (default acoef(3011))
80 —— chiped(1) chiped(2) .. chiped(6) (default acoef(3006))
81 —— tped(1) tped(2) .. tped(6) (default acoef(3102))
82 imptype frac(1) frac(2) .... frac(6) (default acoef(853+imptype)
83 —— nflag(1) nflag(2) .... nflag(6) (default acoef(3012))
84 —— expn1(1) expn1(2) .... expn1(6) (default acoef(3013))
85 —— expn2(1) expn2(2) .... expn2(6) (default acoef(3014))
86 —— firitb(1) firitb(2) .... firitb(6) (default acoef(3004))
87 —— secitb(1) secitb(2) .... secitb(6) (default acoef(3005))
88 —— fracn0(1) fracn0(2) .... fracn0(6) (default acoef(881))
89 —— newden(1) newden(2) .... newden(6) (default acoef(889))

Card 90 - ECRH Power (MW)

11	21	31	41	51	61	71
-	PECRH(1)	...(2)	...(3)	...(4)	...(5)	PECRH(6)

FWCD(I) ECRH Power (MW)

Card 91 - ECCD Toroidal Current (MA)

11	21	31	41	51	61	71
-	ECCD(1)	...(2)	...(3)	...(4)	...(5)	ECCD(6)

ECCD(I) ECCD Toroidal Current (MA)

Card 92 - First shape parameter a for ECCD heating AND CD

11	21	31	41	51	61	71
-	AECD(1)	...(2)	...(3)	...(4)	...(5)	AECD(6)

AECD(I) First shape parameter a for ECCD heating AND CD

Card 93 - Second shape parameter d for ECCD heating AND CD

11	21	31	41	51	61	71
-	DECD(1)	...(2)	...(3)	...(4)	...(5)	DECD(6)

DECD(I) Second shape parameter d for ECCD heating AND CD

Card 94 - Third shape parameter a1 for ECCD heating AND CD

11	21	31	41	51	61	71
-	A1ECD(1)	...(2)	...(3)	...(4)	...(5)	A1ECD(6)

A1ECD(I) Third shape parameter a1 for ECCD heating AND CD

Card 95 - Fourth shape parameter a2 for ECCD heating AND CD

11	21	31	41	51	61	71
-	A2ECD(1)	...(2)	...(3)	...(4)	...(5)	A2ECD(6)

A2ECD(I) Third shape parameter a2 for ECCD heating AND CD