ITER Profile Database

Standard list of variables and file format

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Contents:

Introduction:

The ITER Profile Database is implemented in a Central File Storage System (CFSS) located on a computer at the ITER San Diego co-center.

The CFSS stores well documented discharges that are publicly accessible through *ftp* by the fusion community.

Typical information for a given device like position of the measuring chords, level of accuracy for various measurements will be collected in a special file in the CFSS and will also figure in the future releases of this document (itself stored on the server).

A discharge documentation is composed of:

* A data description sheet which is a text file containing general information about the responsible scientist who produced the data, the analysis code and miscellaneous other information.

* 0D description file containing the global parameters of the discharge selected at some relevant time slices corresponding to the various phases of the discharge.

*1D description files containing the time evolution of scalar quantities as a function of time.

*2D description files containing the radial profiles of quantities as a function of time and additional information about the plasma geometry.

This document establishes what set of variables are provided for each description file together with the definition of these variables and the standard format in which they are provided.

Once the discharge documentation is sent to the central server, it is stored as follow:

* the directory */pub/profile_data* contains a list of directories corresponding to Tokamaks from which discharges are available.

* inside the Tokamak directory is a list of directories corresponding to a particular discharge themselves containing the description sheet, 0D, 1D and 2D description file for that discharge.

* the directory */pub/profile_data* also contains a text file composed of all the 0D description files of all the discharge located on the server. It could be used for searching discharges on the server.

This document describes, for each of the description files, the list of relevant plasma paramaters they contain together with the file format in which they are provided.

Definition of local transport quantities:

The primary role of the profile database is to supply profile data allowing the derivation of local transport coefficients and their comparison with predictions from transport models. It is assumed that the transport models will focus on thermal electron and main thermal ion transport. Therefore, the database seeks to provide the radial profiles as a function of time of all the relevant terms needed in the conservation equations for these two species.

Throughout this document the following definition are adopted:

The radial coordinate is the normalized toroidal flux defined as follow:

$\rho = \sqrt{\frac{\phi}{\phi_a}}$ where ϕ is the total toroidal flux enclosed by the given magnetic surface and ϕ_a is the total toroidal flux encl;osed by the plasma separatrix (see 1D signal # 29: PHIA). ρ goes from 0 in the center to 1 at the separatrix.

We note <.> the surface average operator defined by $\left\langle \overline{B} \,.\, \overline{\nabla} A \right\rangle = 0$ whatever A(R,Z), V(ρ) the volume enclosed by the surface of label ρ , S(ρ) the surface surface.

The particle and energy conservation equations can be written:

$$\frac{\partial}{\partial t} n_\alpha + \frac{1}{V'} \frac{\partial}{\partial \rho} V' \langle |\nabla \rho| \rangle \tilde{\Gamma}_\alpha = S_\alpha$$

$$\frac{\partial}{\partial t} W_\alpha + \frac{1}{V'} \frac{\partial}{\partial \rho} V' [-n_\alpha \chi_\alpha \langle |\nabla \rho|^2 \rangle \frac{\partial}{\partial \rho} T_\alpha + \langle |\nabla \rho| \rangle \frac{3}{2} \tilde{\Gamma}_\alpha T_\alpha] = CMP + Q_\alpha$$

The compressional term CMP is theory dependent and needs to be specified for each model.
For instance Bragiinski: $CMP = -n_\alpha k T_\alpha < \nabla v_\alpha >$ with $\tilde{\Gamma}_\alpha = n_\alpha v_\alpha$
Plasma surface: $S(\rho) = V'(\rho) \langle |\nabla \rho| \rangle$.

where α stands for either thermal electrons are main thermal ions.

Quantity:	Corresponding signal number and name in this manual:
ϕ_a	29. PHIA
n_α	9. NE, 38. NM1, 42. NM2, 42b. NM3, 46. NIMP
T_α	1. TE, 5. TI
$\frac{\partial}{\partial t} n_\alpha$	60. DNER

$\frac{¶}{¶t} W_a$	58. DWER, 59. DWIR
S(ρ)	72. SURF
Quantity:	Corresponding signal number and name in this manual:
$\langle \vert \nabla r \vert \rangle$ (*)	73. GRHO1
$\langle \vert \nabla r \vert^2 \rangle$ (*)	74. GRHO2
c_a	36. CHIE, 37. CHII (Note that the definition of c_a does not include the <| ρ |2>)

(*) ρ is dimensionless and the gradient is with respect to the (R,Z) coordinates so these quantities are in m^{-1} and m^{-2} respectively.

I) Data description sheet

This file contains all the information users need to known about the discharge or the way the data has been obtained but that doesn't appear either in this manual or in the 0D, 1D or 2D files detailed in the next chapters.
This text file should contain the following fields:

Tokamak:
Pulse number:
Contact person:
Institution:
Date of shot:
Analysis code(s)([1]):
Run number:
Date of analysis:
Assumption made for analysis([2]):
Shot description, purpose of the experiment:
Publication([3]):
Additional information:

Data providers should feel free to add in this file any information they think might be relevant to the use of this data.

([1]):This should list all codes used in the data analysis. For instance EFIT for equilibrium, PENCIL for NBI deposition profile, ONETWO for transport, etc ....

([2]): For instance "flat Zeff was assumed" or "It was asumed that Te = Ti" etc ...

([3]):Reference for papers where this discharge has been published (when available).

II) OD description file: global parameters

II-a) Standard list of global plasma variables:

It is expected that for each discharge sent to the CFSS one or several relevant time slices will be selected at which time the following global data - were relevant - will be provided. These time slices are used to summarize the discharge and help users locate specific regimes in the database. However, they are not necessarilly the same time slices as used in the 2D files described below (indeed 2D Ufiles may contains hundreds of time slices whereas for the 0D file only a few time slices will in general be sufficient).
Additional definitions are given at the end of this chapter for quantities used to define parameters figuring in this standard list.

General

1. **TOK**: This variable designates which tokamak has supplied the data. For example: ASDEX, D3D, JET, JFT2M, PBXM... (10 ASCII characters).

2. **UPDATE**: The date of the most recent update for any variable listed in the database. The format is YYMMDD (Year-Month-Day).

3. **DATE**: The date the shot was taken. The format is YYMMDD.

4. **SHOT**: The shot from which the data are taken.

5. **TIME**: Time during the shot at which the data are taken in seconds.

6. **AUXHEAT**: Type of auxiliary heating. Possible values are:

NONE	:	No Auxiliary heating
NB	:	Neutral Beam Injection
IC	:	Ion Cyclotron Resonance Heating
EC	:	Electron Cyclotron Resonance Heating
NBIC	:	Combined NBI + ICRH
LH	:	Lower hybrid
IBW	:	Ion Bernstein Waves.

7. **PHASE**: The phase of the discharge at TIME. Possible values are:

OHM	:	Ohmic
L	:	L-mode
LHLHL	:	H-mode with frequent L-H transitions

H	:	ELM-free H-mode
HSELM	:	H-mode with small ELMs
HGELM	:	H-mode with large ELMs
HGELMH	:	H-mode with high frequency large ELMs
VH	:	VH-mode
PEP	:	PEP mode

8. STATE Description of the plasma state for the present time slice:

STEADY	:	All global paramaters are in steady state
TRANS	:	At least one parameter is evolving

Plasma composition

9. PGASA: Mass number of the plasma working gas. Possible values are: 1 (Hydrogen), 2 Deuterium), 3 (^3H_e) or 4 (^4H_e).

10. PGASZ: Charge number of the plasma working gas. Possible values are: 1 (Hydrogen or Deuterium) or 2 (Helium).

11. BGASA: Mass number of the neutral beam gas. Possible values are: 1 (Hydrogen), 2 (Deuterium), 3 (^3H_e) or 4 (^4H_e).

12. BGASZ: Charge number of the neutral beam gas. Possible values are: 1 (Hydrogen or Deuterium) or 2 (Helium).

13. BGASA2: Mass number of the second neutral beam gas (JET only). Possible values are: 1 (Hydrogen), 2 (Deuterium), 3(^3H_e) or 4 (^4H_e).

14. BGASZ2: Charge number of the second neutral beam gas (JET only). Possible values are: 1 (Hydrogen or Deuterium) or 2 (Helium).

15. PIMPA: Mass number of the plasma main impurity. Possible values are: 8 (Beryllium), 10 (Boron), 12 (C), etc ...

16. PIMPZ: Charge number of the plasma main impurity. Possible values are: 4 (Beryllium), 5 (Boron), 6(C), etc ...

17. PELLET: Pellet material if a pellet(s) has been injected. Possible values are:

NONE	:	No pellets
H	:	Hydrogen pellet(s)
D	:	Deuterium pellet(s)
LI	:	Lithium pellet(s)

If at least one pellet is injected, a pellet table in a separate file must be provided for additional details.
A pellet table format is as follow:

Time in s	Size in 10*19 particles	Speed in km/s	Composition
10.3	145	1.2	LI

Geometry

18. RGEO: The plasma geometrical major radius in meters, from an MHD equilibrium fit, defined as the average of the minimum and the maximum radial extent of the plasma at the elevation of the magnetic axis.
Normal level of accuracy is ASDEX (± 0.5%), D3D (± 0.6%) JET (± 1%), JFT2M (± 0.75%), PBXM (± 0.65%), PDX (± 0.75%).

19. RMAG: The major radius of the magnetic axis in meters from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX).
Normal level of accuracy is ASDEX (± 0.5%), D3D (± 1%), JET (± 2%), JFT2M (±2%), PBXM (± 1%), PDX (± 4%).

20. AMIN: The horizontal plasma minor radius in meters from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX).
Normal level of accuracy is ASDEX (± 1%), D3D (± 0.5%), JET (± 3%), JFT2M (± 3%), PBXM (± 3%), PDX (± 3%).

21. SEPLIM: The minimum distance between the separatrix flux surface and either the vessel wall or limiters in meters from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX).
Normal level of accuracy is ASDEX (± 1 cm), D3D (± 0.5 cm), JET (± 1 cm), JFT2M (± 1 cm), PBXM (± 0.5 cm), PDX (± 1 cm).

22. XPLIM: The minimum distance between the X-point and either the vessel walls or limiters in meters from an MHD equilibrium fit. The value is positive if X-point is inside either the vessel wall or limiters.
Normal level of accuracy is ASDEX (Na), D3D (± 3 cm), JET (± 5 cm), JFT2M (± 3 cm), PBXM (± 5 cm), PDX (± 5 cm).

23. KAPPA: The plasma elongation determined from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX). Normal level of accuracy is ASDEX (± 1%), D3D (± 1%), JET (± 5%), JFT2M (± 10%), PBXM (± 10%), PDX (κ = 1 for all records, ± 10%).

24. DELTA: The triangularity of the plasma boundary from an MHD equilibrium fit. Normal level of accuracy is ASDEX (Na), D3D (± 10%), JET (± 10%), JFT2M (± 10%), PBXM (± 25%), PDX (Na).

25. INDENT: Indentation of the plasma determined from an MHD equilibrium fit. Normal level of accuracy is ASDEX (Na), D3D (Na), JET (Na), JFT2M (Na), PBXM (± 15%), PDX (Na).

26. AREA: Area of plasma cross section in m^2 determined from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX). Normal level of accuracy is ASDEX (± 3%), D3D (± 3%), JET (± 6%), JFT2M (± 5%), PBXM (± 10%), PDX (± 5%).

27. VOL: The plasmas volume in m^3 determined from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX). Normal level of accuracy is ASDEX (± 3%), D3D (± 3%), JET (± 6%), JFT2M (± 5%), PBXM (± 10%), PDX (± 5%).

28. CONFIG: The plasma configuration. Possible values are: SN for single null, DN for double null, IW for inner wall or TOP, BOT, OUT, IN for a limiter.

ASDEX: DN if vertical shift ΔZ is less than 5 mm, otherwise SN.
D3D: DN if two nulls and the separatrix flux surface are inside the divertor tiles and on the same flux surface within 0.25 cm.
JET: Determined by operation session leader.
JFT2M: DN if two nulls are inside the limiter.
PBXM: Only DN
PDX: Only SN

29. IGRADB: Indicates when CONFIG = SN whether the ion B-drift is towards (1) or pointing away from (-1) the X-point.

Machine condition

30. WALMAT: The material of the vessel wall. Possible values are: SS for stainless steel, IN for inconel, IN/C for Inconel with carbon, or CSS for (partly) Carbon on stainless steel.

31. DIVMAT: The material of the divertor tiles. Possible values are: SS for stainless steel, C or CC for carbon, TI1 or TI2 for titanium, BE for beryllium or C/BE for carbon at the top and beryllium at the bottom.

32. LIMMAT: The material of the limiters. Possible values are: BE for beryllium or C for carbon.

33. EVAP: The evaporated material used to cover the inside of the vessel. Possible values are: BOROA (B_2H_6 + CH_4 + H_2) or BOROB (B_2H_6 + H_2) BOROC (B_2D_6 + He) for boron, CARB or CARBH (CH_4 + D_2) for carbon, TI for titanium, BE for beryllium or NONE for no evaporation.

Magnetics

34. BT: The vacuum toroidal magnetic field in Tesla at RGEO determined from the TF coil current. Negative values for JET indicate operation with reversed toroidal field.
Normal level of accuracy is ± 1% for all machines.

35. IP: The plasma current in amperes determined from an external Rogowski loop with vessel current subtraction. Normally negative values for JET. Positive values for JET indicate operation with reversed current.
Normal level of accuracy is ASDEX (± 2%), D3D (± 1%), JET (± 1%), JFT2M (± 1%), PBXM (± 1%), PDX (± 1%).

36. VSURF: The loop voltage at the plasma boundary in volts.
Normal level of accuracy is ASDEX (± 5%), D3D (Na), JET (± 5%), JFT2M (± 5%), PBXM (± 50%), PDX (± 10%).

37. Q95: The plasma safety factor from an MHD equilibrium fit evaluated at the flux surface that encloses 95% of the total poloidal flux. For ASDEX $Q95 = q_{cyl} (1 + (AMIN / RGEO)^2 (1 + 0.5\, BEILI2^2))$ with $q_{cyl} = 10^7 (BT / IP) (AMIN^2 / RGEO) (1 + KAPPA^2) / 2$.
Normal level of accuracy is ASDEX (± 15%), D3D (± 3%), JET (± 10%), JFT2M (± 10%) PBXM (± 10%), PDX (± 10%).

38. BEPMHD: Poloidal beta computed from the MHD equilibrium fit. For ASDEX BEPMHD equals BEIMHD.
Normal level of accuracy is ASDEX (± 15%), D3D (± .05), JET (Na), JFT2M (± 15%), PBXM (± 20%), PDX (± 20%).

39. BETMHD: Toroidal beta computed from the MHD equilibrium fit.

Normal level of accuracy is ASDEX (± 18%), D3D (± 0.05 / β_ρ), JET (± 12%), JFT2M (± 15%), PBXM (± 20%), PDX (± 20%).

40. BEPDIA: Corrected poloidal diamagnetic beta for ASDEX from diamagnetic coils averaged over the 3 ohmic points in the database, (± 15%). D3D, JET, JFT2M, PBXM, PDX: Na.

Densities

41. NEL: Central line average electron density in m^{-3} from interferometer.
For JET NEL has been approximated by
ohmic: NEL ♠ exp {2.931 + 0.873 log (NEV) + 0.064 log (NEØ)}
H-mode: NEL ♠ exp {3.745 + 0.825 log (NEV) + 0.092 log (NEØ)}
if no measurement is available. The variable NELFORM indicates if NEL is measured or approximated.
Normal level of accuracy is ASDEX (± 2%), D3D (± 2 x 10^{18} m^{-3}), JET (± 8%), JFT2M (± 2%), PBXM (± 5%), PDX (± 5%).

42. DNELDT: The time rate of change of NEL in m^{-3} / s.
Normal level of accuracy is similar to NEL.

Impurities

43. ZEFF: Line average plasma effective charge determined from visible bremsstrahlung.
Normal level of accuracy is ASDEX (± 10%), D3D (± 20%).
JET (± 30%). JFT2M, PBXM, PDX: Na.

44. PRAD: Total radiated power in watts as measured by Bolometer.
Normal level of accuracy is ASDEX (± 20%), D3D (± 15%), JET (± 10-15%), JFT2M (± 10 - 20%), PBXM (± < 25%), PDX (Na).

Input powers

45. POHM: Total ohmic power in watts.
ASDEX: Determined from max {0, VSURF ∞ IP}, (Ohmic: ± 5% H: ± 50%).
D3D: Calculated using $CB_{10}I_p^2RGEO^2 / (W_T n_e)$. B_{10} is the central visible bremsstrahlung signal. When n_e is determined from the radial (vertical) CO_2 chord, C is equal to 1.03 ∞ 10^{-19} (9.92 ∞ 10^{-20}) (± 15%).
JET: Corrected for inductance effects (± 20%).

JFT2M:	Calculated as VSURF ∞ IP (± 10%).
PBXM:	Calculated as VSURF ∞ IP (± 50%).
PDX:	Calculated using VSURF and IP corrected for inductance effects (± 20%).

46. ENBI: Neutral beam energy weighted by power in volts. This quantity is calculated from E_iP_i / P_i where E_i is the beam energy for source i and P_i is the beam power for source i. For ASDEX the primary energy component is given.
Normal level of accuracy is ASDEX (± 0.2 KV), D3D (± 10%), JET (± 12%), JFT2M (± 5%), PBXM (± 15%), PDX (± 15%).

47. PINJ: The injected neutral beam power with beam of (BGASA, BGASZ) that passes into the torus in watts. Zero if no beams are on. Notice total injected neutral beam power is PINJ + PINJ2.
Normal level of accuracy is ASDEX (± 10%), D3D (± 10%), JET (± 6%), JFT2M (± 5%), PBXM (± 5%), PDX (± 10%).

48. BSOURCE: The power fractions injected by neutral beam e.g. P_1 = 80%, P_2 = 10% and P_3 = 10% then BSOURCE = 801010.

49. PINJ2: The injected neutral beam power from a second source with beam of (BGASA2, BGASZ2) in watts (JET only). Zero if no beams of second source are on.
Normal level of accuracy is JET (± 6%). ASDEX, D3D, JFT2M, PBXM, PDX: Na.

50. BSOURCE2: The power fractions injected by neutral beam with the second source (JET only). For 89-90 data the possibilities for BSOURCE and BSOURCE2 are 781606 for 80kV D, 652114 for 140kV D, 990000 for ^3H_e or ^4H_e beams.

51. COCTR: Fraction of beam power co-injected as compared to the total beam power injected.

52. PNBI: Total injected neutral beam power minus shine through in watts. Zero if no beams are on.
Normal level of accuracy is ASDEX (± 10%), D3D (± 10%), JET (± 10%), JFT2M (< ± 10%), PBXM (± 10%), PDX (± 10%).

53. ECHFREQ: ECH frequency in Hz

54. ECHMODE: Mode of ECH waves, O is ordinary and X is extraordinary.

55. ECHLOC: Location of ECH launch, IN identifies waves launched from the high field side or inside of the vessel and OUT is from the low field side.

56. PECH: ECH power in watts coupled to the plasma. Zero if no ECH is applied. Normal level of accuracy is D3D (± 10%). ASDEX, JET, JFT2M, PBXM, PDX: Na.

57. ICFREQ: Frequency of ICRH waves in Hz.

58. ICSCHEME: ICRH heating scheme. Possible Values: HMIN for H minority, HE3MIN for ^{3}He minority or H2NDHARM for 2nd harmonic H heating respectively.

59. ICANTEN: Antenna phasing. Possible Values are DIPOLE or MONOPOLE.

60. PICRH: ICRH power in watts coupled to the plasma. Zero if no ICRH is applied. Normal level of accuracy is JET (± 10%). ASDEX, D3D, JFT2M, PBXM, PDX: Na.

61. LHFREQ: Frequency of LH waves in Hz.

62. LHNPAR: LH parallel mode number.

63. PLH: LH power in watts coupled to the plasma. Zero if no LH is applied.

64. IBWFREQ: Frequency of IBW in Hz.

65. PIBW: IBW power in watts coupled to the plasma. Zero if no IBW is applied.

Temperatures

66. TE0: The electron temperature at the magnetic axis in eV.

ASDEX: From 16 radial YAG measurements under the same profile assumptions as for TEV (± 10%).

D3D: Determined by a spline temperature profile fit to the Thomson scattering data (± 10%).

JET: From ECE temperature profile (± 10%).

JFT2M, PBXM, PDX: Na.

67. TI0: The ion temperature at the magnetic axis in eV.

D3D: Determined by a spline temperature profile fit to the charge exchange recombination data (± 10%).

JET: From Crystal X-ray diagnostic (±10%) or from charge exchange recombination spectroscopy (± 10%).

ASDEX, JFT2M, PBXM, PDX: Na.

Energies

68. WFANI: Estimate of fraction of perpendicular fast ion energy as compared to the total fast ion energy due to NBI.
If WFPER and WFPAR are available WFANI = WFPER / (WFPER + WFPAR). otherwise:

ASDEX: From regression analysis based on 176 FREYA runs: C $NEL^{0.04}$ $(NE0\ (ZEFF\text{-}1))^{0.045}$ / $ENBI^{0.14}$ for H beam and C'$NEL^{0.12}$ $(NE0(ZEFF\text{-}1))^{0.020}$ / $ENBI^{0.14}$ for D beam where C and C' are estimated constants depending on the target gas. Missing central densities are interpolated by regression of the available central densities in the database against IP, BT, NEL, NEV, EVAP and PINJ. If not measured, ZEFF is assumed to be 3 for EVAP = NONE, 2.5 for carbonised shots and 1.5 for boronised shots.

D3D: The fast ion anisotropy is calculated only from geometry; the angles of the beam center line are known relative to the geometric axis of the tokamak and from this the perpendicular and parallel components can be determined.

JET: $1.16 \infty 10^{-2}$ $NEL^{0.11}$ / $ENBI^{0.07}$.

Normal level of accuracy is ASDEX (± 7%), D3D (± 50%), JET (± 50%), JFT2M, PBXM, PDX: Co.

69. WFICRH: Estimate of the perpendicular fast ion energy content during ICRH heating in Joules. It is given by 4 / 3 (ΔWDIA - ΔWMHD), where ΔWDIA and ΔWMHD is the increase in energy due to ICRH. Zero if no ICRH. Normal level of accuracy is JET (± 50%). ASDEX, D3D, JFT2M, PBXM, PDX: N.a.

70. MEFF: Effective atomic mass in AMU.
= 0.5 (PGASA + 0.5 (BGASA + BGASA2)) if PINJ > 0 and PINJ2 > 0.
= 0.5 (PGASA + BGASA) if only PINJ > 0.
= PGASA otherwise
(A few ohmic observations from JET have PABS   3 kW. For these observations MEFF = PGASA).

71. ISEQ: Parameter scan identifier

Possible options for ASDEX are:

ISEQ	Explanation
NONE	No particular scan
G1	Comparison shots for Helium program
NE1	Density variation
HT1	Search for high confinement times
EF11	Search for long ELM-free periods
SP11	Spectroscopic investigations
HBE1	High beta investigations, T_i profile measurements
HBE2	High beta investigations, T_i profile measurements
HBE3	High beta investigations, T_i profile measurements
P1	PNBI scan
P2	PNBI scan
QC1P3	QCYL and PNBI scan
BT1	BT scan
BT2 P4	BT and PNBI scan
BT3	BT scan
BT4	BT scan
BT5	BT scan
BT6	BT scan
BT7	BT scan

Possible options for JFT2M are:

ISEQ	Explanation
NONE	No particular scan
AM1	AMIN scan with Ip = 0.22MA (same Q95)
IP1	1st Ip scan with Bt = 1.25T
IP2	2nd Ip scan (Hydrogen)
IP3	3rd Ip scan (Deuterium)
BS1	Scan of 801010 (CO or CTR) and 603010 (CO or CTR)
BT1	Bt scan with Ip = 0.16MA
BT2	Bt scan with Ip = 0.21MA
EB1	ENBI scan with BSOURCE = 603010
EB2	ENBI scan with BSOURCE = 801010
G1	Intense gas puff for comparison with H pellet H-mode

G2	Intense gas puff for comparison with D pellet H-mode
G3IP2	2nd Ip scan (Hydrogen) with intense gas puffing
G4IP3	3rd Ip scan (Deuterium) with intense gas puffing
IE1	IEML and PNBI scan looking for steady state H-mode region
P1	PNBI scan by CO or CTR with Ip = 0.25MA
P2	PNBI scan by CO + CTR with Ip = 0.24MA
P3IP4NE1	PNBI , IP and NEL scan in Hydrogen plasma
P4IP5NE2	PNBI , IP and NEL scan in Deuterium plasma
PE1	Hydrogen pellet into Hydrogen plasma
PE2	Deuterium pellet into Deuterium plasma
XP1	XPLIM scan with Ip = 0.24MA

No options available for D3D, JET, PBXM and PDX.

72. WTH: Estimated thermal plasma energy content in Joules.

ASDEX: WTH = WDIA - 1.5 ∞ WFANI ∞ WFFORM.
D3D: WTH = WMHD - WFFORM.
JET: WTH = WDIA - 1.5 (WFPER + WFICRH). If WFPER is missing WFPER is replaced by WFANI ∞ WFFORM.
JFT2M: WTH = WDIA / 3 + 2 ∞ WMHD / 3 - WFFORM.
PBXM: WTH = WMHD - 0.75 ∞ WFPER - 1.5 ∞ WFPAR.
PDX: WTH = WMHD - 0.75 ∞ WFPER - 1.5 ∞ WFPAR.
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

73. WTOT: Estimated total plasma energy content in Joules.

ASDEX: WTOT = WTH + WFFORM.
D3D: WTOT = WMHD
JET: WTOT = WTH + WFPER + WFPAR + WFICRH. If WFPER and WFPAR are missing they are replaced by WFFORM.
JFT2M: WTOT = WTH + WFFORM
PBXM: WTOT = WTH + WFPER + WFPAR
PDX: WTOT = WTH + WFPER + WFPAR
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

74. DWTOT: Time rate of change of WTOT in Joules / s .

75. PL: Estimated Loss Power not corrected for charge exchange and unconfined orbit losses in watts.

ASDEX: PL = POHM + PNBI - DWDIA / 3 - 2 ∞ DWMHD / 3
D3D: PL = POHM + PNBI + PECH - DWMHD
JET: PL = POHM + PNBI + PICRH - DWDIA
JFT2M: PL = POHM + PNBI - DWDIA
PBXM: PL = POHM + PNBI - DWMHD
PDX: PL = POHM + PNBI - DWMHD
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

76. PLTH: Estimated Loss Power corrected for charge exchange and unconfined orbit losses in Watts, i.e. PLTH = PL - PFLOSS.
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

77. TAUTOT: Estimated total energy confinement time (WTOT / PLTH) in seconds.
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

78. TAUTH: Estimated thermal energy confinement time (WTH / PLTH) in seconds.
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

The following quantities were used in the above list but not yet defined, they are not needed for the 0D description:

WFFORM: Total fast ion energy due to NBI in joules estimated from approximate formula. Zero if no NBI is applied.
ASDEX: From regression analysis based on 176 FREYA runs: $CF_T NEL^{-1.3}$ PINJ $ENBI^{0.75}$ $(WTOT\text{-}WFFORM)^{0.5}$ for H beam, and $C'F'_T$ $NEL^{-1.1}$ PINJ ENBI $(WTOT\text{-}WFFORM)^{0.8}$ for D beam, where C and C' are estimated constants depending on the target gas, and F_T and F'_T are estimated temperature effects. Missing temperature profiles are interpolated by regression of the available YAG temperature profiles in the database against IP, BT, NEL, NEV, EVAP and beam gas.
D3D:

$$\frac{0.55\, P_b\, \tau_{se}}{2}\left\{1+\frac{2}{3}\left(\frac{v_c}{v_b}\right)^2\left\{\frac{1}{2}\ell n\left[\frac{(v_b+v_c)^2}{v_b^2-v_b v_c+v_c^2}\right]-\sqrt{3}\left[\frac{\pi}{6}+\tan^{-1}\left(\frac{2v_b-v_c}{\sqrt{3}v_c}\right)\right]\right\}\right\}$$

The velocities v_c and v_b are determined from the critical energy and the beam energy respectively, and P_b is the injected neutral beam power. The quantity τ_{se} is the slowing down-time on electrons first defined by Spitzer, $\tau_{se} = 6.3 \times 10^2 \frac{A_b T_e^{3/2}}{Z_b^2 n_e \ell n \Lambda_e}$, where A_b and Z_b are the atomic mass and charge of the fast ions, T_e is the electron temperature in eV, n_e is the electron density in m^{-3}, and $\ln \Lambda_e \simeq 16$ is the Coulomb logarithm. If ion drag were negligible, the term in the brackets would be identically one. For DIII-D parameters, however, this term varies rapidly with temperature. To give better agreement with ONETWO results, the above formula is multiplied by 0.55.

JET: $0.16 \infty 10^{19}$ PINJ / NEV for SHOT 18760;
10^{19} (0.16 P_{80kV} + 0.3 P_{140kV} + 0.02 P_{He}) / NEV for SHOT > 18760.

JFT2M: WFPER + WFPAR.

PBXM: WFPER + WFPAR.

PDX: WFPER + WFPAR.

Normal level of accuracy is ASDEX (± 15%), D3D (± 50%), JET (± 50%), JFT2M, PBXM, PDX: Co.

PFLOSS: Amount of neutral beam power in watts that is lost from the plasma through charge exchange and unconfined orbits.

ASDEX: From fits to FREYA code results, (± 30%)

D3D: PABS exp (3.3 - IP / 10^6) / 100 (± 30%).

JET: PINJ exp (3.35 - 0.667 | IP | / 10^6 - 0.2 NEL / 10^{19}) / 100 (± 50%).

JFT2M: From fits to Monte Carlo code results (± 20%).

PBXM: From a fits to the TRANSP code results (± 20%).

PDX: From a fits to the TRANSP code results (± 30%).

II-b) OD file format and example:

The suggested format for the 0D description follows the guidelines for the file format adopted to the OD H mode global database which are reproduced below.

* Record length: 80 bytes
* Number of records per timeslice: 12
* Each record is divided into 7 fields of 10 bytes, followed by a blank space. (i.e. I10,1X)
*The start byte and contents of each field are show below.
*The first 12 records in the file show the name of the variable stored in each field.
* Missing values are represented as follow:

Missing character string: ????????
Missing Integer: -9999999
Missing Real: -9.999E-09

The table below shows the start byte and contents of each field in each physical record comprising a single logical record. The format of each field is also shown.

Record	Start byte						
	1	12	23	34	45	56	67
1	TOK A10,1X	UPDATE I10,1X	DATE I10,1X	SHOT I10,1X	TIME 1PE10.3,1X	AUXHEAT A10,1X	PHASE A10,1X
2	STATE A10,1X	PGASA I10,1X	PGASZ I10,1X	BGASA I10,1X	BGASZ I10,1X	BGASA2 I10,1X	BGASZ2 I10,1X
3	PIMPA I10,1X	PIMPZ I10,1X	PELLET A10,1X	RGEO 1PE10.3,1X	RMAG 1PE10.3,1X	AMIN 1PE10.3,1X	SEPLIM 1PE10.3,1X
4	XPLIM 1PE10.3,1X	KAPPA 1PE10.3,1X	DELTA 1PE10.3,1X	INDENT 1PE10.3,1X	AREA 1PE10.3,1X	VOL 1PE10.3,1X	CONFIG A10,1X
5	IGRADB I10,1X	WALMAT A10,1X	DIVMAT A10,1X	LIMMAT A10,1X	EVAP A10,1X	BT 1PE10.3,1X	IP 1PE10.3,1X
6	VSURF 1PE10.3,1X	Q95 1PE10.3,1X	BEPMHD 1PE10.3,1X	BETMHD 1PE10.3,1X	BEPDIA 1PE10.3,1X	NEL 1PE10.3,1X	DNELDT 1PE10.3,1X
7	ZEFF 1PE10.3,1X	PRAD 1PE10.3,1X	POHM 1PE10.3,1X	ENBI 1PE10.3,1X	PINJ 1PE10.3,1X	BSOURCE I10,1X	PINJ2 1PE10.3,1X
8	BSOURCE2 I10,1X	COCTR 1PE10.3,1X	PNBI 1PE10.3,1X	ECHFREQ 1PE10.3,1X	ECHMODE 1PE10.3,1X	ECHLOC A10,1X	PECH 1PE10.3,1X
9	ICFREQ 1PE10.3,1X	ICSCHEME A10,1X	ICANTEN A10,1X	PICRH 1PE10.3,1X	LHFREQ 1PE10.3,1X	LHNPAR 1PE10.3,1X	PLH 1PE10.3,1X
10	IBWFREQ 1PE10.3,1X	PIBW 1PE10.3,1X	TEO 1PE10.3,1X	TIO 1PE10.3,1X	WFANI 1PE10.3,1X	WFICRH 1PE10.3,1X	MEFF 1PE10.3,1X
11	ISEQ A10,1X	WTH 1PE10.3,1X	WTOT 1PE10.3,1X	DWTOT 1PE10.3,1X	PL 1PE10.3,1X	PLTH 1PE10.3,1X	TAUTOT 1PE10.3,1X
12	TAUTH 1PE10.3,1X						

1X: One blank space (ASCII code 32).
A10: 10 ASCII characters.
I10: Integer using up to 10 characters.
1PE10.3: Floating point number occupying at most 10 characters. Format: ±#.###E±##

Example of 0D description file:

TOK	**UPDATE**	**DATE**	**SHOT**	**TIME**	**AUXHEAT**	**PHASE**
STATE	**PGASA**	**PGASZ**	**BGASA**	**BGASZ**	**BGASA2**	**BGASZ2**
PIMPA	**PIMPZ**	**PELLET**	**RGEO**	**RMAG**	**AMIN**	**SEPLIM**
XPLIM	**KAPPA**	**DELTA**	**INDENT**	**AREA**	**VOL**	**CONFIG**
IGRADB	**WALMAT**	**DIVMAT**	**LIMMAT**	**EVAP**	**BT**	**IP**
VSURF	**Q95**	**BEPMHD**	**BETMHD**	**BEPDIA**	**NEL**	**DNELDT**
ZEFF	**PRAD**	**POHM**	**ENBI**	**PINJ**	**BSOURCE**	**PINJ2**
BSOURCE2	**COCTR**	**PNBI**	**ECHFREQ**	**ECHMODE**	**ECHLOC**	**PECH**
ICFREQ	**ICSCHEME**	**ICANTEN**	**PICRH**	**LHFREQ**	**LHNPAR**	**PLH**
IBWFREQ	**PIBW**	**TEO**	**TI0**	**WFANI**	**WFICRH**	**MEFF**
ISEQ	**WTH**	**WTOT**	**DWTOT**	**PL**	**PLTH**	**TAUTOT**
TAUTH						
ASDEX	**920417**	**820622**	**5980**	**9.600E-01**	**NONE**	**OHM**
STEADY	**2**	**1**	**-9999999**	**-9999999**	**-9999999**	**-9999999**
12	**6**	**NONE**	**1.668**	**1.706**	**3.840E-01**	**2.083E-01**
-9.999E-09	**1.042**	**-9.999E-09**	**-9.999E-09**	**.4827**	**5.058E+00**	**DN**
-9999999	**SS**	**TI2**	**????????**	**NONE**	**2.204E+00**	**2.939E+05**
1.073E+00	**3.740E+00**	**4.181E-01**	**1.895E-03**	**4.116E-01**	**2.916E+19**	**5.493E+18**
-9.999E-09	**-9.999E-09**	**3.154E+05**	**-9.999E-09**	**-9.999E-09**	**-9999999**	**-9.999E-09**
-9999999	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**	**????????**	**-9.999E-09**
-9.999E-09	**????????**	**????????**	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**
-9.999E-09	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**	**-9.999E-09**	**2.000E+00**
NONE	**2.795E+04**	**2.795E+04**	**-9.999E-09**	**3.154E+05**	**3.154E+05**	**8.862E-02**
8.862E-02						

III) 1D description file: time traces

III-a) Minimum data set required for simulations:

1. **IP**: The plasma current in amperes determined from an external Rogowski loop with vessel current subtraction. Normally negative values for JET. Positive values for JET indicate operation with reversed current. Normal level of accuracy is ASDEX (± 2%), D3D (± 1%), JET (± 1%), JFT2M (± 1%), PBXM (± 1%), PDX (± 1%).

2. **BT**: The vacuum toroidal magnetic field in Tesla at RGEO determined from the TF coil current. Negative values for JET indicate operation with reversed toroidal field. Normal level of accuracy is ± 1% for all machines.

3. **AMIN**: The horizontal plasma minor radius in meters from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX). Normal level of accuracy is ASDEX (± 1%), D3D (± 0.5%), JET (± 3%), JFT2M (± 3%), PBXM (± 3%), PDX (± 3%).

4. **RGEO**: The plasma geometrical major radius in meters, from an MHD equilibrium fit, defined as the average of the minimum and the maximum radial extent of the plasma. Normal level of accuracy is ASDEX (± 0.5%), D3D (± 0.6%) JET (± 1%), JFT2M (± 0.75%), PBXM (± 0.65%), PDX (± 0.75%).

5. **KAPPA**: The plasma elongation determined from an MHD equilibrium fit or a formula based on a number of equilibria (ASDEX). Normal level of accuracy is ASDEX (± 1%), D3D (± 1%), JET (± 5%), JFT2M (± 10%), PBXM (± 10%), PDX ($\kappa = 1$ for all records, ± 10%).

6. **DELTA**: The triangularity of the plasma boundary from an MHD equilibrium fit. Normal level of accuracy is ASDEX (Na), D3D (± 10%), JET (± 10%), JFT2M (± 10%), PBXM (± 25%), PDX (Na).

7. **INDENT**: Indentation of the plasma determined from an MHD equilibrium fit. Normal level of accuracy is ASDEX (Na), D3D (Na), JET (Na), JFT2M (Na), PBXM (± 15%), PDX (Na).

8. **PNBI**: Total injected neutral beam power minus shine through in watts. Zero if no beams are on.

Normal level of accuracy is ASDEX (± 10%), D3D (± 10%), JET (± 10%), JFT2M (< ± 10%), PBXM (± 10%), PDX (± 10%).

9. PECH: ECH power in watts coupled to the plasma. Zero if no ECH is applied. Normal level of accuracy is D3D (± 10%). ASDEX, JET, JFT2M, PBXM, PDX: Na.

10. PICRH: ICRH power in watts coupled to the plasma. Zero if no ICRH is applied. Normal level of accuracy is JET (± 10%). ASDEX, D3D, JFT2M, PBXM, PDX: Na.

11. PLH: LH power in watts coupled to the plasma. Zero if no LH is applied.

12. PIBW: IBW power in watts coupled to the plasma. Zero if no IBW is apllied.

13. PFLOSS: Amount of neutral beam power in watts that is lost from the plasma through charge exchange and unconfined orbits.

ASDEX:	From fits to FREYA code results, (± 30%)
D3D:	PABS exp (3.3 - IP / 10^6) / 100 (± 30%).
JET:	PINJ exp (3.35 - 0.667 | IP | / 10^6 - 0.2 NEL / 10^{19}) / 100 (± 50%).
JFT2M:	From fits to Monte Carlo code results (± 20%).
PBXM:	From a fits to the TRANSP code results (± 20%).
PDX:	From a fits to the TRANSP code results (± 30%).

14. PRAD: Total radiated power in watts as measured by Bolometer. Normal level of accuracy is ASDEX (± 20%), D3D (± 15%), JET (± 10-15%), JFT2M (± 10 - 20%), PBXM (± < 25%), PDX (Na).

15. ZEFF: Line average plasma effective charge determined from visible bremsstrahlung. Normal level of accuracy is ASDEX (± 10%), D3D (± 20%). JET (± 30%). JFT2M, PBXM, PDX: Na.

16. NEL: Central line average electron density in m^{-3} from interferometer. For JET NEL has been approximated by

ohmic: NEL ♠ exp {2.931 + 0.873 log (NEV) + 0.064 log (NEØ)}

H-mode: NEL ♠ exp {3.745 + 0.825 log (NEV) + 0.092 log (NEØ)}

if no measurement is available. The variable NELFORM indicates if NEL is measured or approximated. Normal level of accuracy is ASDEX (± 2%), D3D (± 2 x 10^{18} m^{-3}), JET (± 8%), JFT2M (± 2%), PBXM (± 5%), PDX (± 5%).

III-b) Very useful additional information:

17. VSURF: The loop voltage at the plasma boundary in volts.
Normal level of accuracy is ASDEX (± 5%), D3D (Na), JET (± 5%), JFT2M (± 5%), PBXM (± 50%), PDX (± 10%).

18. VLOOP Measured loop voltage at the coil location in volts.

19. LI Internal plasma inductance:

$$li = \frac{2}{m_0^2 I_p^2 R_{geo}} \int B_p^2 dV$$

20. NMAIN0: Central main ion density in m-3.

21. THNT: Total thermal neutron yield in s-1.

22. WTH: Estimated thermal plasma energy content in Joules.

ASDEX: WTH = WDIA - 1.5 ∞ WFANI ∞ WFFORM.
D3D: WTH = WMHD - WFFORM.
JET: WTH = WDIA - 1.5 (WFPER + WFICRH). If WFPER is missing WFPER is replaced by WFANI ∞ WFFORM.
JFT2M: WTH = WDIA / 3 + 2 ∞ WMHD / 3 - WFFORM.
PBXM: WTH = WMHD - 0.75 ∞ WFPER - 1.5 ∞ WFPAR.
PDX: WTH = WMHD - 0.75 ∞ WFPER - 1.5 ∞ WFPAR.
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

23. WTOT: Estimated total plasma energy content in Joules.

ASDEX: WTOT = WTH + WFFORM.
D3D: WTOT = WMHD
JET: WTOT = WTH + WFPER + WFPAR + WFICRH.
If WFPER and WFPAR are missing they are replaced by WFFORM.
JFT2M: WTOT = WTH + WFFORM
PBXM: WTOT = WTH + WFPER + WFPAR
PDX: WTOT = WTH + WFPER + WFPAR
ASDEX, D3D, JET, JFT2M, PBXM, PDX: Co.

24. TE0: The electron temperature at the magnetic axis in eV.

ASDEX: From 16 radial YAG measurements under the same profile assumptions as for TEV (± 10%).
D3D: Determined by a spline temperature profile fit to the Thomson scattering data (± 10%).

JET: From ECE temperature profile (± 10%).
JFT2M, PBXM, PDX: Na.

25. TI0: The ion temperature at the magnetic axis in eV.
D3D: Determined by a spline temperature profile fit to the charge exchange recombination data (± 10%).
JET: From Crystal X-ray diagnostic (±10%) or from charge exchange recombination spectroscopy (± 10%).
ASDEX, JFT2M, PBXM, PDX: Na.

26. Q95: The plasma safety factor from an MHD equilibrium fit evaluated at the flux surface that encloses 95% of the total poloidal flux. For ASDEX $Q95 = q_{cyl} (1 + (AMIN / RGEO)^2 (1 + 0.5\ BEILI2^2))$ with $q_{cyl} = 10^7 (BT / IP) (AMIN^2 / RGEO) (1 + KAPPA^2) / 2$.
Normal level of accuracy is ASDEX (± 15%), D3D (± 3%), JET (± 10%), JFT2M (± 10%) PBXM (± 10%), PDX (± 10%).

27. POHM: Total ohmic power in watts.
ASDEX: Determined from max {0, VSURF ∞ IP}, (Ohmic: ± 5% H: ± 50%).
D3D: Calculated using $CB_{10}I_p{}^2RGEO^2 / (W_Tn_e)$. B_{10} is the central visible bremsstrahlung signal. When n_e is determined from the radial (vertical) CO_2 chord, C is equal to $1.03 \infty 10^{-19}$ ($9.92 \infty 10^{-20}$) (± 15%).
JET: Corrected for inductance effects (± 20%).
JFT2M: Calculated as VSURF ∞ IP (± 10%).
PBXM: Calculated as VSURF ∞ IP (± 50%).
PDX: Calculated using VSURF and IP corrected for inductance effects (± 20%).

28. IBOOT: Estimated total bootstrap current (in A).

29. PHIA Total toroidal flux in Weber enclosed by the plasma separatrix.

30. PFUSION Total fusion power due to DT reactions in W.

IV) 2D description: radial profiles

Note that all radial profile should be given using the square root of the normalized toroidal flux as the radial label ρ.

IV-a) Minimum data set required for simulations:

1. **TE**: Fitted electron temperature profile in eV.

2. **TEEB**: Error bars on the fitted electron temperature profile in eV.
TEEB is added to TE for the upper limit.
TEEB is subtracted from TE for the lower limit.
Provided on the same radial positions as TE.

3. **TEXP**: Measured electron temperature profile in eV.

4. **TEXPEB**: Error bars on the measured electron temperature profile in eV.
TEXPEB is added to TEXP for the upper limit.
TEXPEB is subtracted from TEXP for the lower limit.
Provided on the same radial positions as TEXP.

5. **TI**: Fitted ion temperature profile in eV.

6. **TIEB**: Error bars on the fitted ion temperature profile in eV.
TIEB is added to TI for the upper limit.
TIEB is subtracted from TI for the lower limit.
Provided on the same radial positions as TI.

7. **TIXP**: Measured ion temperature profile in eV.

8. **TIXPEB**: Error bars on the measured ion temperature profile in eV.
TIXPEB is added to TIXP for the upper limit.
TIXPEB is subtracted from TIXP for the lower limit.
Provided on the same radial positions as TIXP.

9. **NE**: Fitted electron density profile in m-3.

10. **NEEB**: Error bars on the fitted electron density profile in m-3.
NEEB is added to NE for the upper limit.
NEEB is subtracted from NE for the lower limit.
Provided on the same radial positions as NE.

11. NEXP: Measured electron density profile in m-3.

12. NEXPEB: Error bars on the measured electron density profile in m-3.
NEXPEB is added to NEXP for the upper limit.
NEXPEB is subtracted from NEXP for the lower limit.
Provided on the same radial positions as NEXP.

13. QNBIE: Power deposition profile on thermal electrons by beams in W / m-3.
14. QICRHE: Power deposition profile on thermal electrons by icrh in W / m-3.
15. QECHE: Power deposition profile on thermal electrons by ECH in W / m-3.
16. QLHE: Power deposition profile on thermal electrons by LH in W / m-3.
17. QIBWE: Power deposition profile on thermal electrons by IBW in W / m-3.

18. QNBII: Power deposition profile on thermal ions by beams in W / m-3.
(includes the thermalization power of fast ions)
19. QICRHI: Power deposition profile on thermal ions by icrh in W / m-3.
20. QECHI: Power deposition profile on thermal ions by ECH in W / m-3.
21. QLHI: Power deposition profile on thermal ions by LH in W / m-3.
22. QIBWI: Power deposition profile on thermal ions by IBW in W / m-3.

23. SNBIE: Source of thermal electrons from beams in s-1 m-3.

24. SNBII: Source of thermal ions from beams due to thermalization of beams particle and include charge exchange processes, in s-1 m-3.

25. CURNBI: Current drive profile by beams in A m-2.
26. CURICRH: Current drive profile by ICRH in A m-2.
27. CURECH: Current drive profile by ECH in A m-2.
28. CURLH: Current drive profile by LH in A m-2.

29. NFAST: Non thermal ion density profile in m-3.

30. QRAD: Total radiated power density in W m-3.

31. IOTAVAC: Stellarator vacuum rotational transform.
Omitted for Tokamaks.

IV-b) Very useful additional information :

32. ZEFFR: Plasma effective charge radial profile.

33. ZEFFREB: Error bars on plasma effective charge radial profile.
ZEFFREB added to ZEFFR for upper limit.

ZEFFREB subtracted from ZEFFR for lower limit.
Provided on the same radial positions as ZEFFR.

34. Q: Safety factor profile.

35. QEB: Error bars on safety factor profile.
QEB added to Q for upper limit.
QEB subtracted from Q for lower limit.
Provided on the same radial positions as Q.

36. CHIE: Estimated thermal electrons heat diffusivity in m2 s-1.

37. CHII: Estimated thermal ions heat diffusivity in m2 s-1.

38. NM1: Main ion density profile in m-3.

39. NM1EB: Error bars on main ion density profile in m-3.

40. NM1XP: Measured main ion density profile in m-3.

41. NM1XPEB: Error bars on measured main ion density profile in m-3.

42. NM2: Secondary main ion density profile in m-3.
For instance helium injection into deuterium plasma.

43. NM2EB: Error bars on secondary main ion density profile in m-3.

44. NM2XP: Measured secondary main ion density profile in m-3.

45. NM2XPEB: Error bars on measured secondary main ion density profile in m-3.

42b. NM3: Third main ion density profile in m-3.
For instance helium injection into deuterium plasma.

43b. NM3EB: Error bars on third main ion density profile in m-3.

44b. NM3XP: Measured third main ion density profile in m-3.

45b. NM3XPEB: Error bars on measured third main ion density profile in m-3.

46. NIMP: Main impurity density profile in m-3.

47. NIMPEB: Error bars on main impurity density profile in m-3.

48. NIMPXP: Measured main impurity density profile in m-3.

49. NIMPXPEB: Error bars on measured main impurity density profile in m-3.

50. QOHM: Ohmic power density in W m-3.

51. QEI: Equipartition power density from electrons to ions in W m-3.

52. CURTOT: Total current density in A m-2.

53. CURTOTEB: Error bars on total current density in A m-2.
CURTOTEB is added to CURTOT for upper limit.
CURTOTEB is subtracted from CURTOT for lower limit.
Provided on same radial positions as CURTOT.

54. VROT: Fitted toroidal angular speed in rad. s-1.

55. VROTEB: Error bars on fitted toroidal angular speed in rad. s-1.
VROTEB is added to VROT for upper limit.
VROTEB is subtracted from VROT for lower limit.
Provided on same radial positions as VROT.

56. VROTXP: Measured toroidal angular speed in rad. s-1.

57. VROTXPEB: Error bars on measured toroidal angular speed in rad. s-1.
VROTXPEB is added to VROTXP for upper limit.
VROTXPEB is subtracted from VROTXP for lower limit.
Provided on same radial positions as VROTXP.

58. DWER Term $\frac{\partial}{\partial t} W_e(\rho, t)$ of the energy conservation equation in W/m^3.

59. DWIR Term $\frac{\partial}{\partial t} W_i(\rho, t)$ of the energy conservation equation in W/m^3 where i is the main thermal ion.

60. DNER Term $\frac{\partial}{\partial t} n_e(\rho, t)$ of the electron particles conservation equation in $m^{-3}\ s^{-1}$.

61. SWALL Main thermal ion particle source term due to ionisation of recycling wall neutrals in $m^{-3}\ s^{-1}$.

62. QWALLE Thermal electrons heat loss due to the ionisation of wall neutrals in $W.m^{-3}$.

63. QWALLI Main thermal ion heat loss due to ionisation and charge exchange with wall neutrals in $W.m^{-3}$.

$$(= \langle s v \rangle_{ChargeExchange}\ n_0 n_i (\frac{3}{2} T_i - E_0) + \langle s v \rangle_{Ionisation}\ n_0 n_e E_0)$$

64. QFUSE Electron heating density due to fusion DT reaction in $W.m^{-3}$.

65. QFUSI Main thermal ion heating density due to DT fusion reaction in $W.m^{-3}$. Includes the thermalization power ($\frac{3}{2} S_{source\ thermal\ a} T_i$) when $Helium^4$ is the mail thermal ion.

66. BPOL Surface averaged poloidal magnetic field in Tesla.

<u>IV-c) Required geometry information:</u>

Should also be given as a function of the radial label ρ: square root of the normalized toroidal flux.

67. RMAJOR: The geometrical major radius in meters, from an MHD equilibrium fit, defined as the average of the minimum and the maximum radial extent of the magnetic surface at the elevation of the magnetic axis.
Normal level of accuracy is ASDEX (± 0.5%), D3D (± 0.6%) JET (± 1%), JFT2M (± 0.75%), PBXM (± 0.65%), PDX (± 0.75%).

68. RMINOR: Geometric minor radius of the magnetic surface at the elevation of the magnetic axis in m .

69. VOLUME: Volume enclosed by the magnetic surface in m3.

70. KAPPAR: Average elongation of the magnetic surface.

71. DELTAR: Averaged triangularity of the magnetic surface.

72. INDENTR: Averaged indentation of the magnetic surface.

73. SURF: Surface area of the magnetic surface in m2.

74. GRHO1: Geometric quantity: $\left\langle |\nabla r| \right\rangle$ where ρ is the surface label in m^{-1}.

75. GRHO2: Geometric quantity: $\left\langle |\nabla r|^2 \right\rangle$ where ρ is the surface label in m^{-2}.

<u>IV-d) Alternative format for Experimental Data:</u>

The file format for 2D profiles implies that a fixed radial vector in RHO space be used for each time point given in the time vector. However, experimental data are often measured on a grid (typically the major radius) which does not correspond to a fixed grid when translated in RHO space. In such cases it is not possible to project the measurement grid onto a fixed RHO grid for each time point without significant loss of information. To remedy this problem, an additional level of indirection is introduced: an index is used to label each radial measurement as a function of time, a separate 2D file gives the RHO coordinate for each index as a function as time.

The process can be schematically represented as follow:

<u>Standard 2D format:</u>

RHO vector (rho1, rho2, ... rhoN)
TIME vector: (t1, t2, ... , tM)
DATA vector: (data(rho1,t1),...,data(rhoN,t1), ..., data(rhoN, tM)

<u>Index format:</u>

Data file:

INDEX vector (0, 1, ... N)
TIME vector: (t1, t2, ... , tM)
DATA vector: (data(0,t1),...,data(0,t1), ..., data(N, tM)

RHO file:

INDEX vector (i1, i2, ... iN)
TIME vector: (t1, t2, ... , tM)
RHO vector: (rho(i1,t1),...,rho(iN,t1), ..., rho(iN, tM)

This special format is to be used ***only*** for:

* measured quantities that would loose significant information if projected onto a fixed RHO grid as a function of time,

* the following 2D signals:**TEXP, TEXPEB**, **TIXP, TIXPEB, NEXP, NEXPEB, NM1XP, NM1XPEB, NM2XP, NM2XPEB**, **NM3XP, NM3XPEB, NIMPXP, NIMPXPEB, VROTXP, VROTXPEB**. (i.e. experimental measurements and their corresponding error bars)

* The signal name for the RHO vector of the RHO file should be the name of the signal withg 'RHO' at the beginning.

For instance, experimental data points for TE would have the signal name: TEXP and will be followed by a file with singal name: 'RHOTEXP'

V) File naming convention and 1D and 2D file description format and naming convention

The 1D and 2D description files are themselves composed of a list of files, one for each of the variables listed above.

• The format for the variable files is ASCII UFILE as developed at PPPL by D. McCune. (see relevant files on the server in /pub/profile_data/server)

• 2D UFILEs should be provided as a function of the square root of the normalized toroidal flux (from 0 at the center to 1 at the edge).

The first independent variable should be the radial vector followed by the time vector:

```
RHO                            ;-INDEPENDENT VARIABLE LABEL: X-
TIME           SECONDS   ;-INDEPENDENT VARIABLE LABEL: Y-
TE                              ;-DEPENDENT VARIABLE LABEL-
```

For index file (see VI.d) the vectors are:

```
INDEX                          ;-INDEPENDENT VARIABLE LABEL: X-
TIME           SECONDS   ;-INDEPENDENT VARIABLE LABEL: Y-
TEXP                           ;-DEPENDENT VARIABLE LABEL-
```

and a separate set:

```
INDEX                          ;-INDEPENDENT VARIABLE LABEL: X-
TIME           SECONDS   ;-INDEPENDENT VARIABLE LABEL: Y-
RHOTEXP                     ;-DEPENDENT VARIABLE LABEL-
```

The radial vector RHO must be sorted in increasing order of the normalized toroidal flux. In order words, it should increase monotonically from the minimum value (closest to the axis) to its maximum value (closest to the edge or even beyond the separatrix if available).
Of course the data vector (containing the dependent variable) should be consistent with the order in which the radial vector is given. Similarly, the INDEX vector should contain integers in increasing order starting from 0.

• The field '-DEPENDENT VARIABLE LABEL-' should contain only the name of the variable as it appears in this manual.

For instance:

```
QNBII                          ;-DEPENDENT VARIABLE LABEL-
```

•Software information for reading and writing UFILEs and various software for extracting and retrieving the data are provided, whenever available, in: */pub/profile_data/software.*

•The various files are assembled together in two single files - one regrouping all 1D Ufiles the other regrouping all 2D Ufiles. UFILEs are separated by two lines of at list 10 '*' (ASCII code 42) as follow:

```
--- UFILE 1 -----
***********************************************
***********************************************
--- UFILE 2 -----
***********************************************
***********************************************
--- UFILE 3 -----
```

The file containing the separatrix information should be grouped with the 2D UFILEs.

•The discharge description sheet (plain ASCII text) is called:

tok_#####_com.dat

The file containing the 0D data is called:

tok_#####_0d.dat

The file grouping all 1D files is called:

tok_#####_1d.dat

The file grouping all 2D files is called:

tok_#####_2d.dat

The optional files containing all measured experimental data (see section IV. d) using indexes:
tok_#####_2dexp.dat

where *tok* is the name of the Tokamak and ##### is the pulse number.

• On the file server, the data corresponding to the tokamak *tok* , shot number ##### appears in the directory: */pub/profile_data/tok/#####* which contains:

tok_#####_com.dat
tok_#####_0d.dat
tok_#####_1d.dat
tok_#####_2d.dat

• All 0D data form all discharges figuring on the server are also grouped together in a file called *tokamak_0d.dat* figuring in the directory: */pub/profile_data.*

VI)Sending data to the server: step by step description:

Suggested steps to follow to send data to the server:

1)Check on the server in the directory */pub/profile_data/software* for any software that might already exist to extract the data on your system.

2)Fill in the 0D data in the format described in chapter II and name the file: *tok_#####_od.dat*.

3)Find in your local DataBase the available time traces corresponding to the signal list in chapter III. Translate each signal into a 1D UFILEs where the name figuring in the manual is used in the UFILE variable description field.

4)Find in your local DataBase the available radial profiles as a function of time corresponding to the signal list in chapter IV. Translate each signal into a 2D UFILEs where the name figuring in the manual is used in the UFILE variable description field, the radial coordinate is the square root of the normalized toroidal flux (radial vector before time vector).

5)Run the appropriate software to produce the equilibrium files in the format prescribed in chapters IV-c and IV-d.

6)Combine all 1D UFILEs into one file called *tok_#####_1d.dat* by separating each UFILE by two lines of at least 10 '*'

7)Combine all 2D UFILEs and the separatrix file into one file called *tok_#####_2d.dat* by separating each UFILE by two lines of at least 10 '*'

8)Create the data description sheet as detailed in chapter I and name the file:
tok_#####_com.dat.
(*/pub/profile_data/documents* contains a template of this file.)

9)Send by ftp any software you have developed in */pub/profile_data.transfer* ([1])so that other can benefit from this software.

10)Send by ftp all 4 files: *tok_#####_0d.dat* , *tok_#####_1d.dat* , *tok_#####_2d.dat* , *tok_#####_com.dat* in the directory: */pub/profile_data.transfer* ([1])

11)Send an Email to bouched@iterus.org to inform the San Diego JWS that data as been sent to the server and that it needs to be moved to the relevant read only directories on the server.

([1])The directory */pub/profile_data.transfer* is the only one where you have writting permission. */pub/profile_data* and sub-directories are read only to protect the integrity of the data.