# TOKEF:
# A Tokamak Input Generator
# for EFFI

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## Abstract

The EFFI code calculates Electromagnetic Fields, Forces and Inductances for ironless magnetic systems of arbitrary geometry. Since even modestly complex coil systems originate a long EFFI file, input generators are desirable. TOKEF is such a generator for coils belonging to Tokamak reactors (TF and PF coils).

## Zusammenfassung

TOKEF: Ein Tokamak Input Generator für EFFI.

Das EFFI-Programm berechnet elektromagnetische Felder, Kräfte und Induktivitäten für eisenlose Magnetsysteme willkürlicher Geometrie. Da bereits relativ einfache Spulensysteme zu länglicher Eingabe Veranlassung geben, sind Input Generatoren wünschenswert. TOKEF ist ein solcher Generator für Spulen in Tokamak Reaktoren (TF und PF Spulen).

## 1. Introduction

The computer code EFFI /1/ calculates Electromagnetic Field, Force and Inductance in coil systems of arbitrary geometry. Because of its great flexibility, it can be used in a very large field of applications. On the other hand, this very flexibility can be a serious handicap for the user, since inputting and checking the geometrical data can be a painstaking and time-consuming affair. It is hence almost a necessity to have a specific input generator for each kind of application. Following the code EIG /2/ to generate an input for fusion reactors of mirror type, we developped the code TOKEF (Tokamak with EFFI) for fusion reactors of Tokamak type.
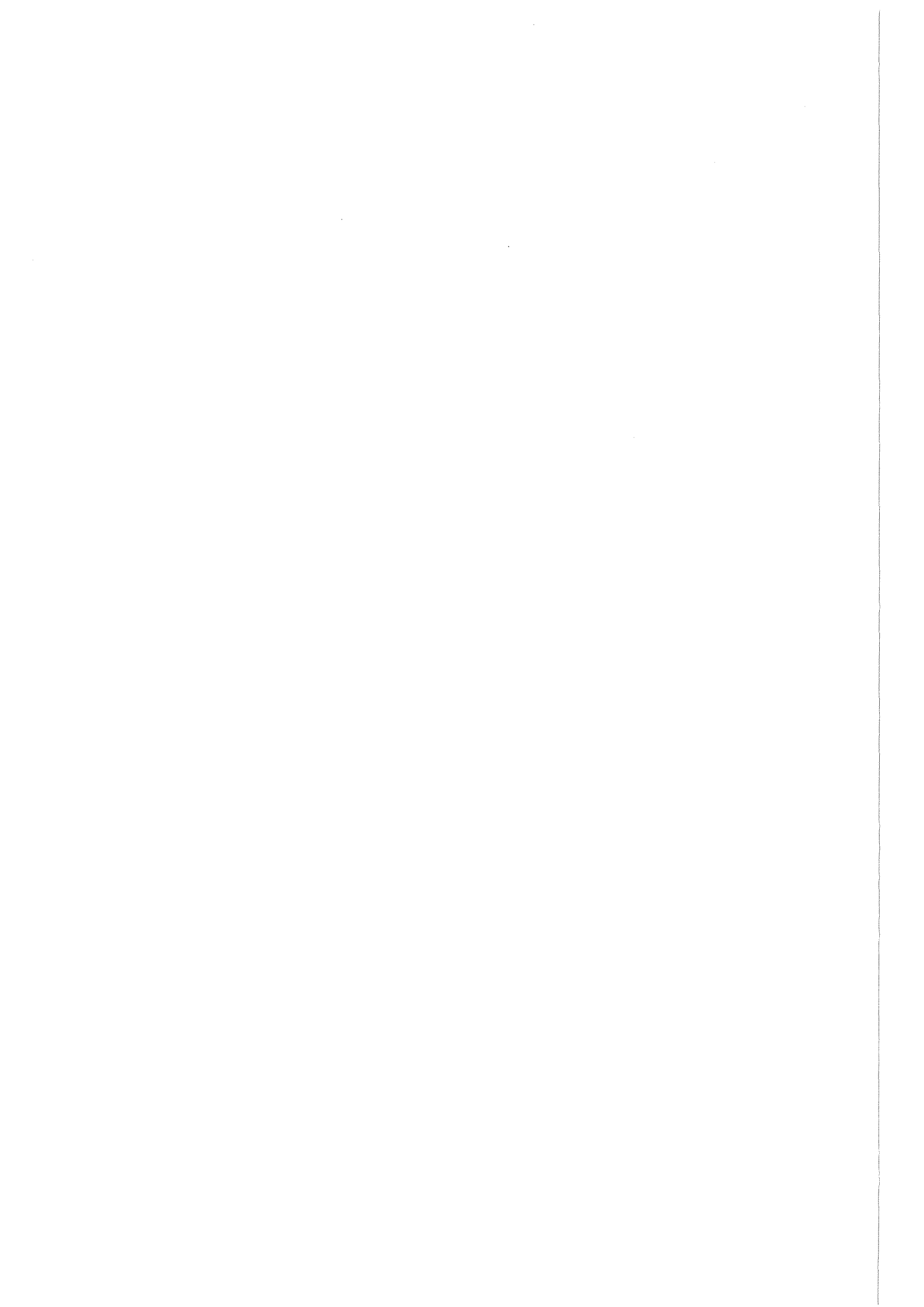
## 2. Structure of the input file

EFFI input consists of a title card, a units data set, a geometry data set and an output data set. Although the emphasis of TOKEF lays on the geometry data set, a complete input can be generated in a single run. The TOKEF input has the same structure as the EFFI input. The first (Title) and fourth (Output) data set have also the same syntax. The second (Units) and third (Geometry) data sets are generated by TOKEF from a specific input with different syntax.

Specific TOKEF input consists of one or more sections delimited by two cards: the first card contains a key-word beginning in the first column, and the last card contains the separator ***, beginning also in the first column. A section may consist of more subsections: a subsection is a set of cards, terminated by a card containing the separator ** beginning in the first columm. The specific TOKEF input is closed by the separator $$$, beginning in the first column.

Between the first and the last card, parameters are entered in the form

        key-word=value    key-word=value  etc.

on one or more cards and in a completely free form.

Only columns 1 through 72 are read in, to allow cards numeration. A pair "key-word=value" can not be stretched on two cards. One or more blanks are used as separator(s) between pairs.

The key-word must be a valid TOKEF key-word, as described in the following chapters; the value is either a literal or a numeric. Numerics can be represented in both fixed and floating form. The field width can go from 1 to 10 bytes for numerics and from 1 to 8 bytes for character strings. Valid numerics are e.g.

1.    1.E1    1.E+1    +10.E-01    .00001E+05

## 3. Entering the Title card

The Title card is the first physical record in the TOKEF input. The number of characters appearing in the EFFI heading depends on the EFFI implementation. TOKEF reads in 72 characters.

## 4. Generating the Units data set

This section is optional and can be completely skipped when all units and parameter values correspond to EFFI default values. If entered, the section must begin with the key-word UNITS. Keywords and values are the valid EFFI options. Since TOKEF automatically generates the EFFI separator $, this must not be put in in any case.

## 5. Generating the Coil Geometry data set

### 5.1 Types of coils and reference systems

Magnetic coils for fusion reactors of Tokamak types are:
1) D-shaped coils or solenoids to generate the toroidal field;
2) Solenoids to generate a poloidal field. From the point of view of the conductor elements in EFFI, D-shaped coils consist of ARC´s and possibly of GCE´s. Solenoids consist of LOOP´s.

To describe the position of these elements, we define two Cartesian reference systems: 1) a global x-y-z coordinates system, related to the whole reactor (Fig. 1); 2) a local r-s-t coordinates system, related to each single coil (Fig. 2, 3). The z global axis and the t local axis are coincident.
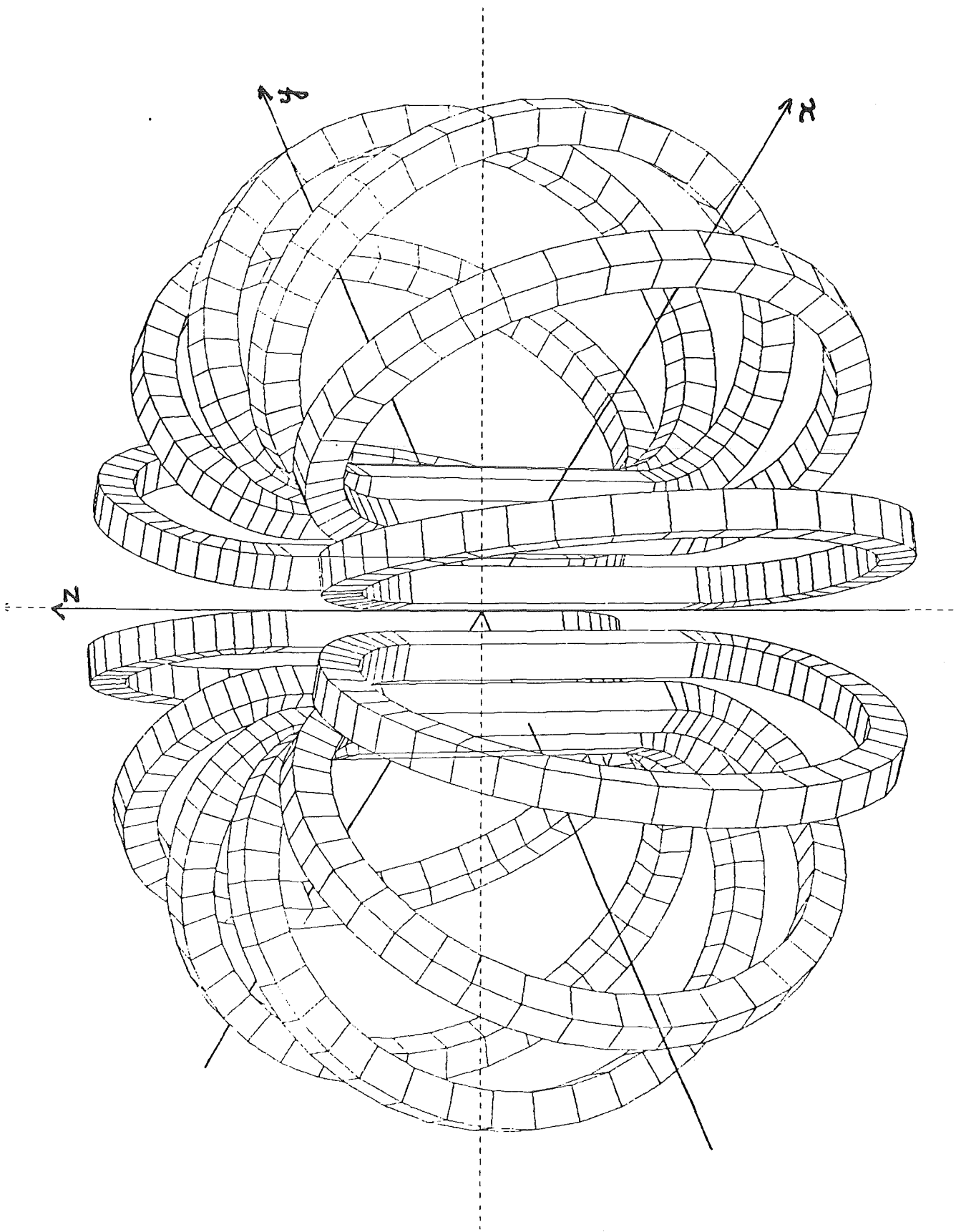
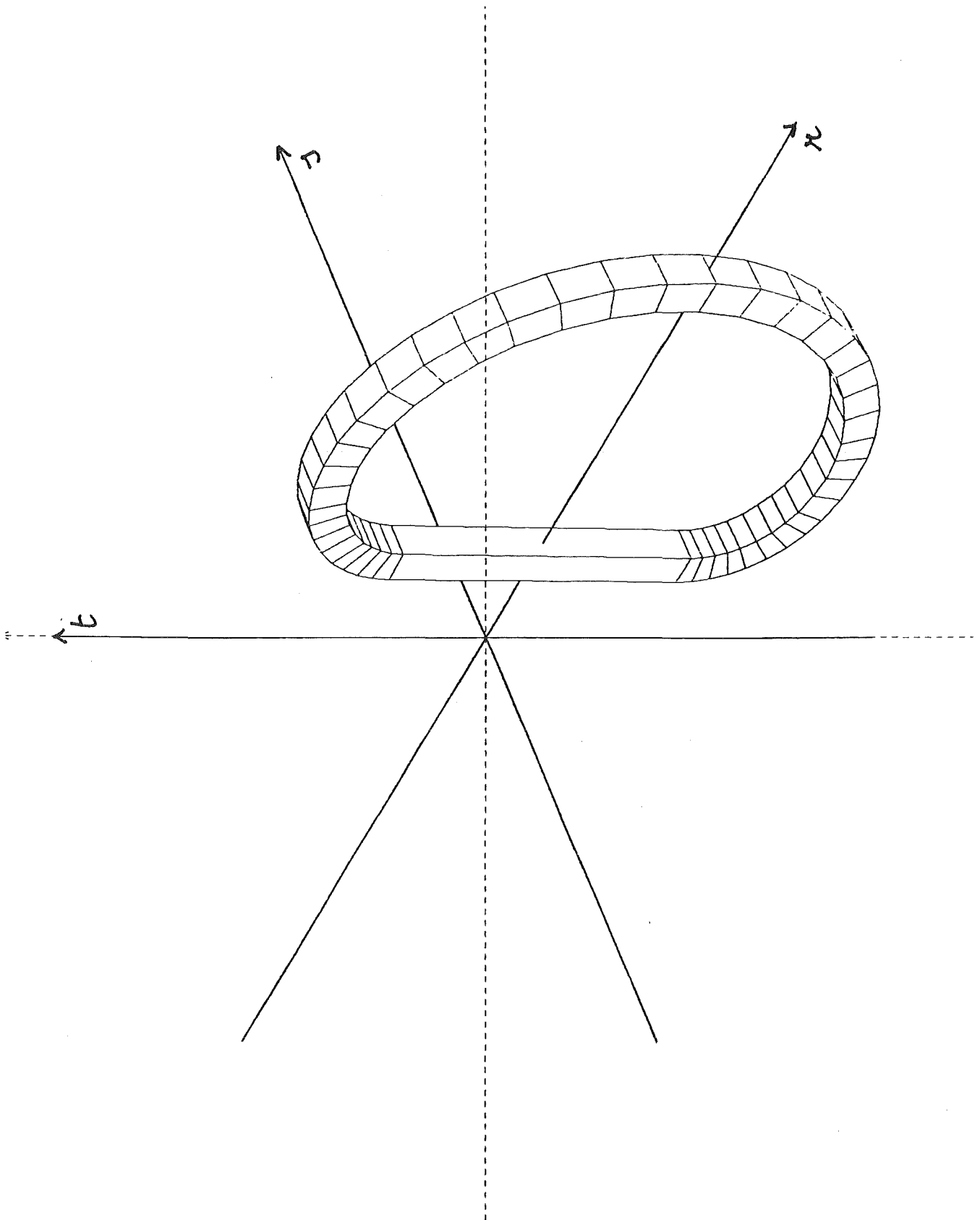Fig. 1: A Tokamak Reactor in the global coordinates system.

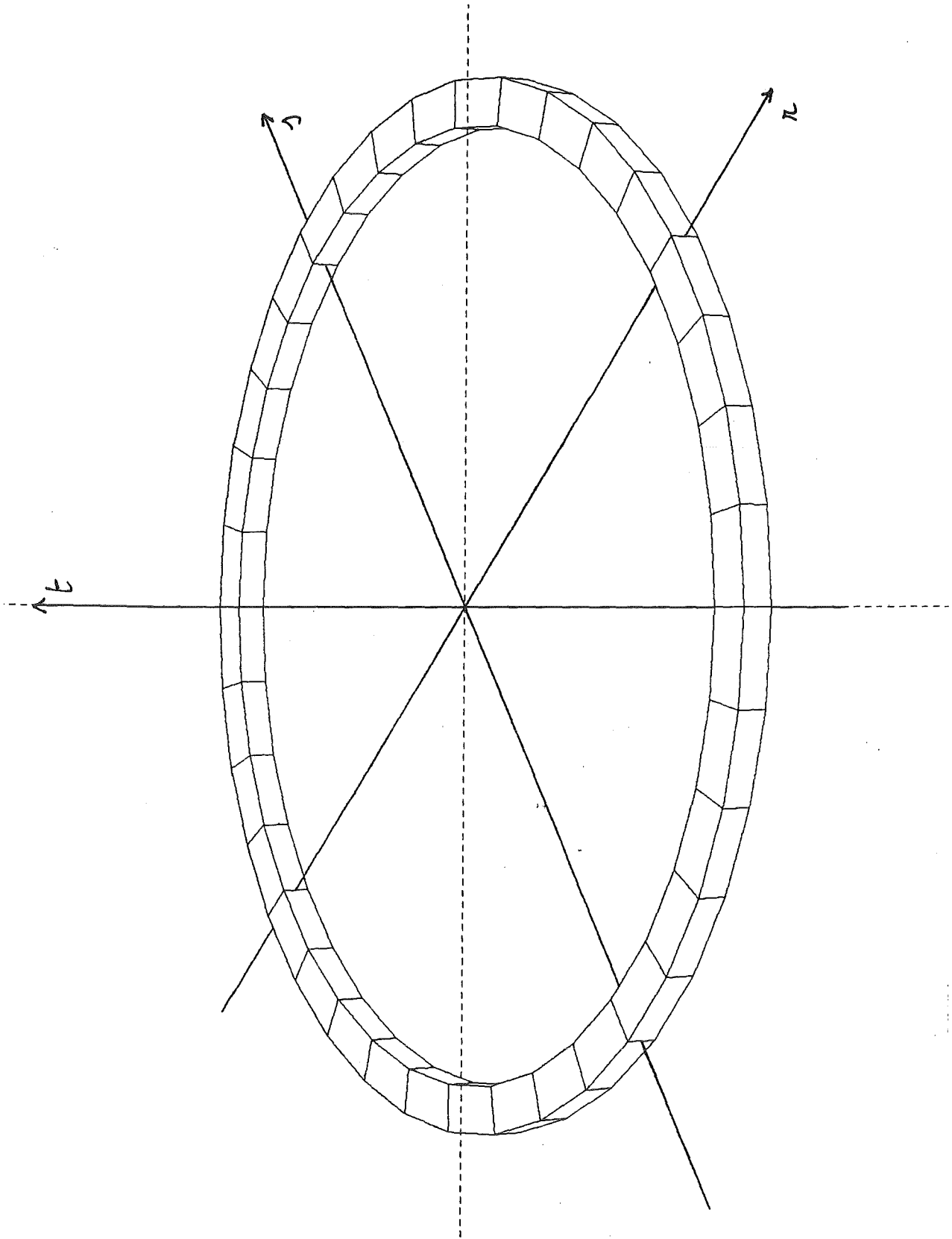Fig. 2.    A Torus Coil in the local coordinates system.

Fig. 3. A Poloidal Coil in the local coordinates system.

## 5.2  D-shaped coils

A D-shaped coil is defined by the following parameters: a geo-
metrical middle curve, a radial dimension, an axial dimension,
its position in the reactor global system and a current density.
Since the geometrical middle curve is usually shared by more
than one coil, it is useful to enter it in a separate section.

### 5.2.1  The geometrical middle curve

Geometrical middle curves are defined in sections beginning with
the key-word TCURVE and terminating by the separator ***. Each
section consists of two or more subsections. The first
subsection contains one necessary parameter, and two optional
parameters.

NAME:  name of the curve. This name, consisting of 1 to 8
characters, is needed to identify the curve in the coil defini-
tion.

TOLLEN: the tolerance allowed for lengths in the test for
tangency. Its default value, taken by the program if this
key-word is not given, is 0.001 m.

TOLLAN: the tolerance allowed for angles in the test for
tangency. Its default value, taken by the program if this
key-word is not given, is 0.01 radians.

The following subsection(s) define each a circular arc of the
middle curve. If the middle curve contains any straight
segments, they are automatically generated by TOKEF and need not
be entered. The arcs defined by two subsequent subsections must
be tangent to each other: during the check of the input, both
ARC's and GCE's are tested for tangency with their predecessor.

Each subsection contains four parameters:

R:      r-coordinate of the center
T:      t-coordinate of the center
RAD:    radius of the arc
ANG:    angle between the r-axis and the radius at the end of
        the arc.

The initial angle is not needed: for the first arc, its value is
zero; for the other arcs, its value is the value ANG of the pre-
decessor arc. For the top half of the curve, angles assume
values between $0^{\circ}$ amd $180^{\circ}$; for the bottom half, between $0^{\circ}$ and
$-180^{\circ}$ (Fig. 4). If the curve is symmetrical with respect to the
r-s plane (where t = 0), the bottom half needs not be entered;
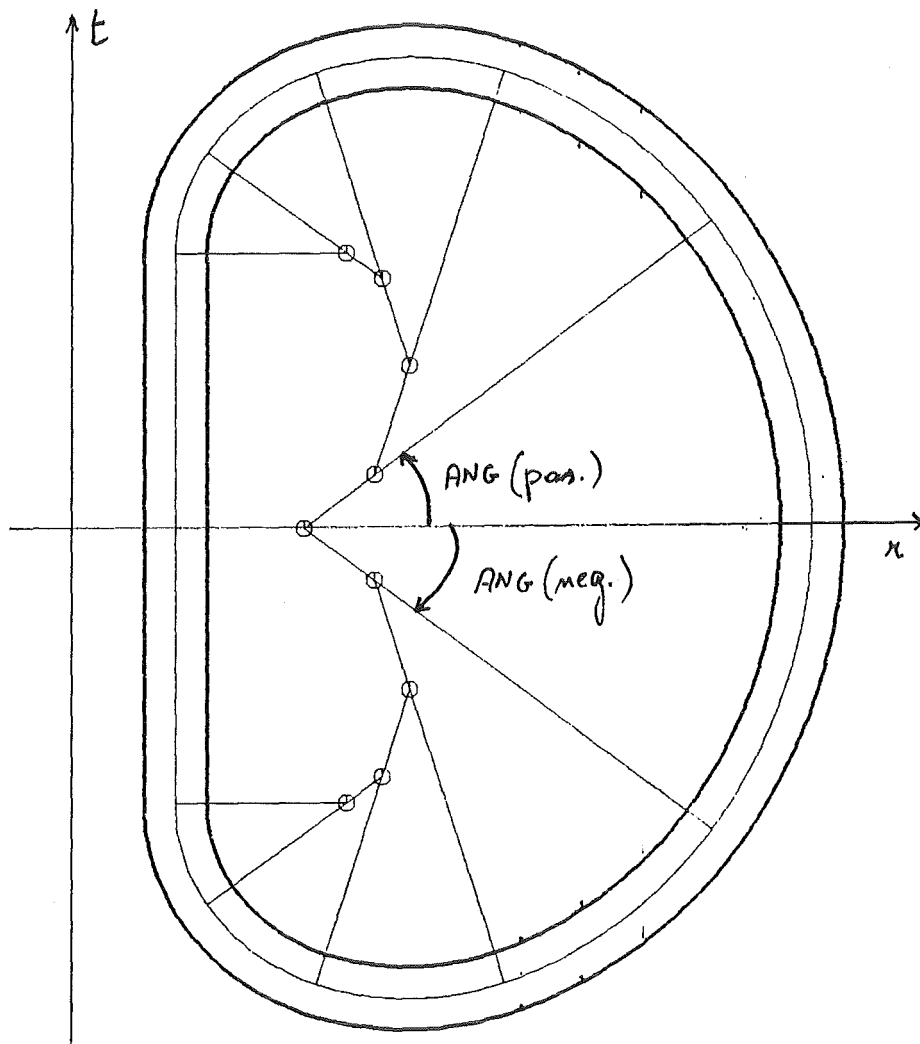TOKEF generates it automatically, if no negative angle is
present.



Fig. 4. Geometrical Middle Curve for a Torus Coil.

## 5.2.2   The coils

Each coil or group of coils (see parameter NUMC) is defined in a
section beginning with the key-word TCOIL and terminating with
the separator ***. It is possible to enter up to 20 parameters:
some of them are necessary, some are optional and some are
mutually exclusive.

### 5.2.2.1 Necessary parameters:

NAME:        Name of the coil, corresponding to the EFFI coil
             identification
CURVE:       Name of the geometrical middle curve, defined in a
             TCURVE section
DR:          Radial dimension
DA:          Axial dimension
CUR:         Current in Ampère
CURD:        Current density in requested units
             Either CUR or CURD must be entered, but not both.
ZAN:         Angle between the t-r symmetry plane of the coil and
             the global z-x plane. ZAN defines a single coil.
NUMC:        This parameter can be used instead of ZAN and the two
             are mutually exclusive. It defines the number of
             coils at equal angular distance around the global
             z-axis. The first generated coil has an angle ZAN of
             $0^o$ and the name NAME01; the angles of the following
             coils are multiples 360/NUMC for names NAME02,
             NAME03, etc.

### 5.2.2.2   Misaligned coils

In order to calculate cases of coil misalignment, TOKEF offers
the possibility of inputting displacements and rotations with
respect to the local coordinates system. Since the probability
of a  multiple rotation is small and the handling of the Euler's
angles one of the major source of troubles in calculating the
position of the coils, we limited the possiblity to a single

rotation. Thus, the parameters RAN, SAN and TAN are mutually exclusive.

Displacements are calculated in the local coordinates system before the rotation of the coil. The displacements are described by the following optional parameters:

RDIS: displacement in the local r-direction
SDIS: displacement in the local s-direction
TDIS: displacement in the local t-direction.

Rotations are also calculated in a local systsem, after optional displacements. The following parameters are needed:

RAN, SAX, TAX: the coil is rotated by an angle RAN around an r⁻-axis, parallel to the local r-axis; the coordinates of the point where the r⁻-axis intersects the s-t plane are SAX and TAX.

SAN, TAX, RAX: The coil is rotated by an angle SAN around a s⁻-axis, parallel to the local s-axis; the coordinates of the point where the s⁻-axis intersects the t-r plane are TAX and RAX.

TAN, RAX, SAX: the coil is rotated by an angle TAN about a t⁻-axis, parallel to the local t-axis: the coordinates of the point where the t⁻-axis intersects the r-s plane are RAX and SAX.

5.2.2.3  Coils with trapezoidal section
Since EFFI accepts only coils with rectangular section, coils with trapezoidal section must be simulated by a bundle of arcs and GCE⁻s. The parameters needed are:

DAI: axial thickness at inner coil surface
DAO: axial thickness at outer coil surface
DAI and DAO must be both present and are mutually exclusive with the parameter DA of the "normal" coil.
NDIV: number of requested divisions in the radial direction.

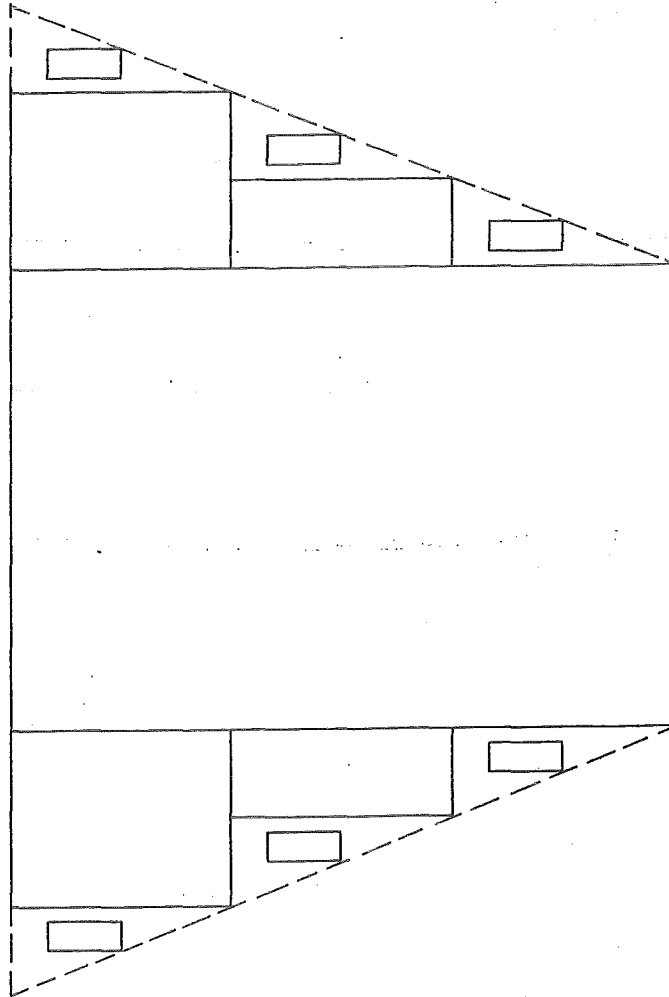Fig. 5. A Trapezoidal Coil, simulated through a coils bundle.

The Figure 5 shows a very "exaggerated" trapeze with NDIV = 3; it is divided into NDIVx4-1 rectangles. The small rectangles have the same centre of gravity as the corresponding triangles and the maximum possible area which does not exceed the triangle sides. The current density is multiplied by the ratio $area_{triangle}/area_{rectangle}$.

## 5.3 Coils for the poloidal field

These coils are represented by LOOP's. Since their geometrical curve is very simple, it is put in together with the other parameters in a section beginning with the key-word PCOIL and terminating by the separator ***.

### 5.3.1 Necessary parameters

NAME:       Name of the coil, corresponding to the EFFI coil
            identification
Z:          Distance between the r-s symmetry plane of the coil
            and the global x-y plane (where z = 0).
RAD:        Radius of the geometrical middle curve of the coil
DR:         Radial dimension
DA:         Axial dimension
CUR:        Current in Ampère
CURD:       Current density in requested units.
            CUR and CURD are mutually exclusive.

### 5.3.2 Optional parameters

SYM = YES   The program generates two equal coils symmetrical with
            respect to the global x-y plane (where z = 0). The
            coil names are NAME01 and NAME02.
BET:        Rotation around a local axis lying on the r-s
            symmetry plane of the coil.
ALF:        Angle between this axis and the x global axis. ALF is
            necessary if BET is present.
ADIS:       Displacement in the local r direction
SDIS:       Displacement in the local s direction
N.B. Coils are displaced <u>after</u> rotation, in the new local
system.

## 6. Entering the Output data set

After the ending separator $$$, the user may enter any valid
EFFI option specifying the type of output desired (EFFI User's
Manual, Sections 3.4.1 through 3.4.5).


## 7. Acknowledgements

I wish to acknowledge the helpful suggestions of F. Arendt and
Dr. W. Maurer.

## References

/1/   S.J. Sackett
      UCID 17621 "EFFI-a code for calculating the electromagnetic
      field, force and inductance in coil systems of arbitrary
      geometry", 1977.

/2/   B.M. Manes, W. Maurer
      "EIG - An Input Generator for EFFI"
      KfK 3672, Januar 1984

/3/   Operating System BS 3000-  FORTRAN 77-  Reference Manual.

/4/   OS/VS - DOS/VSE - VM/370 - Assembler Language - IBM:
      GC 33-4010-5

## Appendix

TOKEF is written in FORTRAN 77, as prescribed in ANS-FORTRAN X 3.9-1978 /3/, and in IBM Assembler /4/. It has about 2400 cards and has been implemented and tested on an IBM 370/3033 and on a Siemens 7890.

The used input/output Units are:

```
 5  For the input
 6  For the normal output
 2  For the error messages
 1  For the EFFI input data
10  Temporary I/O unit (unformatted)
11  Temporary I/O unit (unformatted)
12  Temporary I/O unit (unformatted)
```

The program structure is represented in Fig. 6. At the end of this appendix follows a somehow arbitrary input, which covers almost all TOKEF items, together with the generated EFFI input.

The contents of each single section of the program is briefly summarized here:

MAIN: Allocates dynamically the storage for the fields (see also rountine GETSTO). All variables containing the geometrical data of the coils are kept in storage, in order to allow a further implementation (e.g. the generation of special grids, or the overlapping of GCE elements for Force and Inductance calculation).

CONVLD: converts a 10-Bytes literal into a 4-Bytes decimal.

FRINP: reads in the input in the free format described in section 2.

FIRST: finds the first appearance of a given character in a literal string.

NAMEC: creates the names for a group of coils (see section 5.2.2.1).

PCOIL: calculates the geometrical data for the poloidal coils.

PREPCO: reads in and checks the data for the poloidal coils.

PRETCO: reads in and checks the data for the toroidal coils.

PRETCU: reads in and checks the data for the geometrical middle-curve(s).

ROTR: rotates a toroidal coil around an r-axis.

ROTS: rotates a toroidal coil around an s-axis.

ROTTZ: rotates a toroidal coil around a t-axis or around the global z-axis.

TCOER: prints error messages for the toroidal coils data.

TCOIL: calculates the geometrical data for the toroidal coils.

TCURVE: calculates the data for the geometrical middle-curve(s).

TRIAN: converts the triangles at the side of the trapezoidal coils in rectangles with the same centre of gravity.

UNITS: reads in the requested units.

A555: this Assembler routine generates the completion code 555 (IBM language).

GETSTO: this Assembler routines supplies storage for the dynamical allocation of fields.
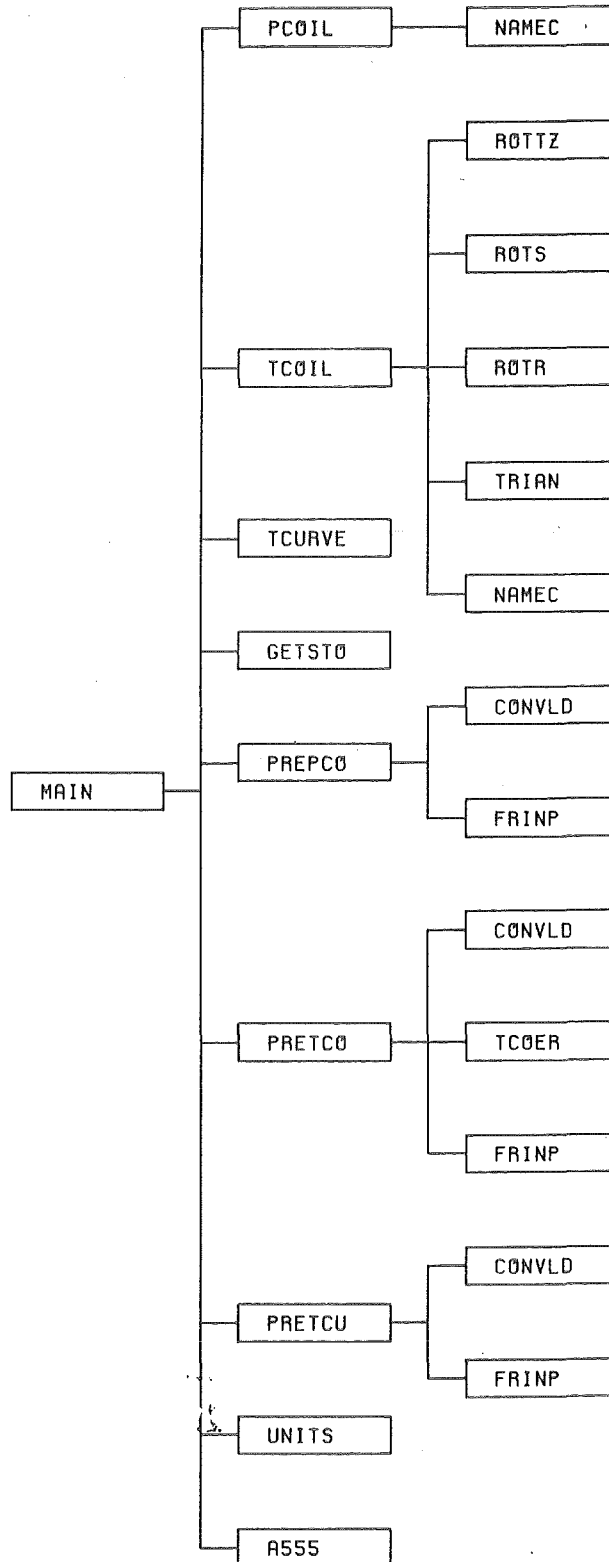
Fig. 6. Structure Tree for TOKEF Program.

```
         SAMPLE FOR TOKEF
     UNITS
     ANGLE=DEGREE     CURRENT=A/CM**2
     LENGTH=M
 ***
 PCOIL
 NAME=OH1     RAD=1.18   Z=.504 DR=.735    DA=.508 CUR=-5.6E6
 SYM=YES
 ***
 PCOIL
 NAME=OH41   RAD=3.10   Z=5.44     DR=.655    DA=0.655   CUR=-6.43E6
 ***
 TCURVE
 NAME=NC
 **
 RAD=5.04378      R=3.477126     T=0.          ANG=36.38
 **
 RAD=4.153099     R=4.19437      T=0.52893    ANG=72.03
 **
 RAD=3.005099     R=4.54895      T=1.62038    ANG=107.87
 **
 RAD=2.0881       R=4.26725      T=2.49315    ANG=144.29
 **
 RAD=1.64809      R=3.909999     T=2.75       ANG=180.
 **
 ***
 TCOIL
 NAME=TOR1      CURVE=NC   DR=.4662   DA=.7125   CURD=2390.     NUMC=2
 ***
 TCOIL
 NAME=TOR3      CURVE=NC   DR=.4662   DA=.7125   CURD=2390.     ZAN=30.
 ***
 TCOIL
 NAME=TOR4      CURVE=NC   DR=.4662   DA=.7125   CURD=2390.     ZAN=60.
 RAN=5.    SAX=0.    TAX=0.
 ***
 TCOIL
 NAME=TOR5      CURVE=NC   DR=.4662   DAI=.6   DAO=.8   CURD=2390.   ZAN=120.
 NDIV=4
 ***
 TCOIL
 NAME=TOR6      CURVE=NC   DR=.4662   DA=.7125   CURD=2390.     ZAN=150.
 RDIS=.1  SDIS=.2    TDIS=.3
 ***
 $$$
   XYZ
   -10.    20.    10.
   -10.    20.    20.
   0.    0    $
   XZY
   0.    10.    10.
   -10.    20.    10.
   0.    0    $
```

```
INPUT SAMPLE FOR TOKEF
ANGLE=DEGREE
CURRENT=A/CM**2
LENGTH=M
$
COIL=TOR11          $
ARC
   3.4771E+00  0.0           0.0
   5.0438E+00
   0.0         9.0000E+01    0.0          3.6380E+01
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   4.1944E+00  0.0           5.2893E-01
   4.1531E+00
   0.0         9.0000E+01    3.6380E+01   7.2030E+01
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   4.5489E+00  0.0           1.6204E+00
   3.0051E+00
   0.0         9.0000E+01    7.2030E+01   1.0787E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   4.2672E+00  0.0           2.4931E+00
   2.0881E+00
   0.0         9.0000E+01    1.0787E+02   1.4429E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   3.9100E+00  0.0           2.7500E+00
   1.6481E+00
   0.0         9.0000E+01    1.4429E+02   1.8000E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   3.9100E+00  0.0           -2.7500E+00
   1.6481E+00
   0.0         9.0000E+01    1.8000E+02   2.1571E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   4.2672E+00  0.0           -2.4931E+00
   2.0881E+00
   0.0         9.0000E+01    2.1571E+02   2.5213E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   4.5489E+00  0.0           -1.6204E+00
   3.0051E+00
   0.0         9.0000E+01    2.5213E+02   2.8797E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   4.1944E+00  0.0           -5.2893E-01
   4.1531E+00
   0.0         9.0000E+01    2.8797E+02   3.2362E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
ARC
   3.4771E+00  0.0           0.0
   5.0438E+00
   0.0         9.0000E+01    3.2362E+02   3.6000E+02
   7.1250E-01  4.6620E-01    2.3900E+03    $
```

```
GCE
   2.2619E+00  0.0          2.7500E+00
   2.2619E+00 -3.5625E-01   2.7500E+00
   2.0288E+00  0.0          2.7500E+00
   2.3900E+03
   2.2619E+00  0.0         -2.7500E+00
   2.2619E+00 -3.5625E-01  -2.7500E+00
   2.0288E+00  0.0         -2.7500E+00     $
COIL=TOR12          $
ARC
  -3.4771E+00  2.1835E-06   0.0
   5.0438E+00
   1.8000E+02  9.0000E+01   0.0          3.6380E+01
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -4.1944E+00  2.6339E-06   5.2893E-01
   4.1531E+00
   1.8000E+02  9.0000E+01   3.6380E+01   7.2030E+01
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -4.5489E+00  2.8565E-06   1.6204E+00
   3.0051E+00
   1.8000E+02  9.0000E+01   7.2030E+01   1.0787E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -4.2672E+00  2.6797E-06   2.4931E+00
   2.0881E+00
   1.8000E+02  9.0000E+01   1.0787E+02   1.4429E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -3.9100E+00  2.4553E-06   2.7500E+00
   1.6481E+00
   1.8000E+02  9.0000E+01   1.4429E+02   1.8000E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -3.9100E+00  2.4553E-06  -2.7500E+00
   1.6481E+00
   1.8000E+02  9.0000E+01   1.8000E+02   2.1571E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -4.2672E+00  2.6797E-06  -2.4931E+00
   2.0881E+00
   1.8000E+02  9.0000E+01   2.1571E+02   2.5213E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -4.5489E+00  2.8565E-06  -1.6204E+00
   3.0051E+00
   1.8000E+02  9.0000E+01   2.5213E+02   2.8797E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -4.1944E+00  2.6339E-06  -5.2893E-01
   4.1531E+00
   1.8000E+02  9.0000E+01   2.8797E+02   3.2362E+02
   7.1250E-01  4.6620E-01   2.3900E+03   $
ARC
  -3.4771E+00  2.1835E-06   0.0
```

```
   5.0438E+00
   1.8000E+02   9.0000E+01   3.2362E+02   3.6000E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
GCE
  -2.2619E+00   1.4204E-06   2.7500E+00
  -2.2619E+00   3.5625E-01   2.7500E+00
  -2.0288E+00   1.2740E-06   2.7500E+00
   2.3900E+03
  -2.2619E+00   1.4204E-06  -2.7500E+00
  -2.2619E+00   3.5625E-01  -2.7500E+00
  -2.0288E+00   1.2740E-06  -2.7500E+00    $
COIL=TOR3          $
ARC
   3.0113E+00   1.7386E+00   0.0
   5.0438E+00
   3.0000E+01   9.0000E+01   0.0          3.6380E+01
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.6324E+00   2.0972E+00   5.2893E-01
   4.1531E+00
   3.0000E+01   9.0000E+01   3.6380E+01   7.2030E+01
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.9395E+00   2.2745E+00   1.6204E+00
   3.0051E+00
   3.0000E+01   9.0000E+01   7.2030E+01   1.0787E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.6955E+00   2.1336E+00   2.4931E+00
   2.0881E+00
   3.0000E+01   9.0000E+01   1.0787E+02   1.4429E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.3862E+00   1.9550E+00   2.7500E+00
   1.6481E+00
   3.0000E+01   9.0000E+01   1.4429E+02   1.8000E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.3862E+00   1.9550E+00  -2.7500E+00
   1.6481E+00
   3.0000E+01   9.0000E+01   1.8000E+02   2.1571E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.6955E+00   2.1336E+00  -2.4931E+00
   2.0881E+00
   3.0000E+01   9.0000E+01   2.1571E+02   2.5213E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.9395E+00   2.2745E+00  -1.6204E+00
   3.0051E+00
   3.0000E+01   9.0000E+01   2.5213E+02   2.8797E+02
   7.1250E-01   4.6620E-01   2.3900E+03    $
ARC
   3.6324E+00   2.0972E+00  -5.2893E-01
   4.1531E+00
   3.0000E+01   9.0000E+01   2.8797E+02   3.2362E+02
```

```
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     3.0113E+00    1.7386E+00    0.0
     5.0438E+00
     3.0000E+01    9.0000E+01    3.2362E+02    3.6000E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
GCE
     1.9589E+00    1.1310E+00    2.7500E+00
     2.1370E+00    8.2243E-01    2.7500E+00
     1.7570E+00    1.0144E+00    2.7500E+00
     2.3900E+03
     1.9589E+00    1.1310E+00   -2.7500E+00
     2.1370E+00    8.2243E-01   -2.7500E+00
     1.7570E+00    1.0144E+00   -2.7500E+00     $
COIL=TOR4           $
ARC
     1.7386E+00    3.0113E+00    0.0
     5.0438E+00
     6.0000E+01    9.5000E+01    0.0           3.6380E+01
     7.1250E-01   .4.6620E-01    2.3900E+03     $
ARC
     2.1371E+00    3.6094E+00    5.2692E-01
     4.1531E+00
     6.0000E+01    9.5000E+01    3.6380E+01    7.2030E+01
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     2.3968E+00    3.8689E+00    1.6142E+00
     3.0051E+00
     6.0000E+01    9.5000E+01    7.2030E+01    1.0787E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     2.3218E+00    3.5869E+00    2.4837E+00
     2.0881E+00
     6.0000E+01    9.5000E+01    1.0787E+02    1.4429E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     2.1626E+00    3.2663E+00    2.7395E+00
     1.6481E+00
     6.0000E+01    9.5000E+01    1.4429E+02    1.8000E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     1.7474E+00    3.5060E+00   -2.7395E+00
     1.6481E+00
     6.0000E+01    9.5000E+01    1.8000E+02    2.1571E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     1.9454E+00    3.8042E+00   -2.4837E+00
     2.0881E+00
     6.0000E+01    9.5000E+01    2.1571E+02    2.5213E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
     2.1522E+00    4.0101E+00   -1.6142E+00
     3.0051E+00
     6.0000E+01    9.5000E+01    2.5213E+02    2.8797E+02
     7.1250E-01    4.6620E-01    2.3900E+03     $
ARC
```

```
  2.0573E+00  3.6555E+00  -5.2692E-01
  4.1531E+00
  6.0000E+01  9.5000E+01   2.8797E+02   3.2362E+02
  7.1250E-01  4.6620E-01   2.3900E+03    $
ARC
  1.7386E+00  3.0113E+00   0.0
  5.0438E+00
  6.0000E+01  9.5000E+01   3.2362E+02   3.6000E+02
  7.1250E-01  4.6620E-01   2.3900E+03    $
GCE
  1.3385E+00  1.8390E+00   2.7395E+00
  1.6459E+00  1.6616E+00   2.7085E+00
  1.2220E+00  1.6372E+00   2.7395E+00
  2.3900E+03
  9.2339E-01  2.0787E+00  -2.7395E+00
  1.2307E+00  1.9013E+00  -2.7706E+00
  8.0684E-01  1.8768E+00  -2.7395E+00    $
COIL=TOR5          $
ARC
 -1.7386E+00  3.0113E+00   0.0
  5.0438E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  6.0000E-01  4.6620E-01   2.3900E+03    $
ARC
 -2.0092E+00  2.8550E+00   0.0
  4.9855E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  2.5000E-02  1.1655E-01   2.3900E+03    $
ARC
 -2.0200E+00  2.8488E+00   0.0
  5.1021E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  5.0000E-02  1.1655E-01   2.3900E+03    $
ARC
 -2.0308E+00  2.8425E+00   0.0
  5.2186E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  7.5000E-02  1.1655E-01   2.3900E+03    $
ARC
 -1.4679E+00  3.1675E+00   0.0
  4.9855E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  2.5000E-02  1.1655E-01   2.3900E+03    $
ARC
 -1.:    :'00  3.1738E+00   0.0
  5.1021E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  5.0000E-02  1.1655E-01   2.3900E+03    $
ARC
 -1.4463E+00  3.1800E+00   0.0
  5.2186E+00
  1.2000E+02  9.0000E+01   0.0          3.6380E+01
  7.5000E-02  1.1655E-01   2.3900E+03    $
ARC
 -2.0381E+00  2.8384E+00   0.0
  4.8884E+00
```

```
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-2.0597E+00  2.8259E+00  0.0
 5.0049E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-2.0814E+00  2.8134E+00  0.0
 5.1215E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-2.1030E+00  2.8009E+00  0.0
 5.2380E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-1.4391E+00  3.1842E+00  0.0
 4.8884E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-1.4174E+00  3.1967E+00  0.0
 5.0049E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-1.3958E+00  3.2092E+00  0.0
 5.1215E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-1.3741E+00  3.2217E+00  0.0
 5.2380E+00
 1.2000E+02  9.0000E+01  0.0         3.6380E+01
 8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
-2.0972E+00  3.6324E+00  5.2893E-01
 4.1531E+00
 1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
 6.0000E-01  4.6620E-01  2.3900E+03   $
ARC
-2.3678E+00  3.4762E+00  5.2893E-01
 4.0948E+00
 1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
 2.5000E-02  1.1655E-01  2.3900E+03   $
ARC
-2.3786E+00  3.4699E+00  5.2893E-01
 4.2114E+00
 1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
 5.0000E-02  1.1655E-01  2.3900E+03   $
ARC
-2.3895E+00  3.4637E+00  5.2893E-01
 4.3279E+00
 1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
```

```
   7.5000E-02  1.1655E-01  2.3900E+03   $
ARC
  -1.8265E+00  3.7887E+00  5.2893E-01
   4.0948E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   2.5000E-02  1.1655E-01  2.3900E+03   $
ARC
  -1.8157E+00  3.7949E+00  5.2893E-01
   4.2114E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   5.0000E-02  1.1655E-01  2.3900E+03   $
ARC
  -1.8049E+00  3.8012E+00  5.2893E-01
   4.3279E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   7.5000E-02  1.1655E-01  2.3900E+03   $
ARC
  -2.3967E+00  3.4595E+00  5.2893E-01
   3.9977E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -2.4183E+00  3.4470E+00  5.2893E-01
   4.1142E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -2.4400E+00  3.4345E+00  5.2893E-01
   4.2308E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -2.4616E+00  3.4220E+00  5.2893E-01
   4.3473E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -1.7977E+00  3.8053E+00  5.2893E-01
   3.9977E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -1.7760E+00  3.8178E+00  5.2893E-01
   4.1142E+00
   1.    02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -1.7544E+00  3.8303E+00  5.2893E-01
   4.2308E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
  -1.7327E+00  3.8428E+00  5.2893E-01
   4.3473E+00
   1.2000E+02  9.0000E+01  3.6380E+01  7.2030E+01
   8.3333E-03  3.8850E-02  1.0755E+04   $
```

```
ARC
  -2.2745E+00   3.9395E+00   1.6204E+00
   3.0051E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   6.0000E-01   4.6620E-01   2.3900E+03    $
ARC
  -2.5451E+00   3.7833E+00   1.6204E+00
   2.9468E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   2.5000E-02   1.1655E-01   2.3900E+03    $
ARC
  -2.5559E+00   3.7770E+00   1.6204E+00
   3.0634E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   5.0000E-02   1.1655E-01   2.3900E+03    $
ARC
  -2.5668E+00   3.7708E+00   1.6204E+00
   3.1799E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   7.5000E-02   1.1655E-01   2.3900E+03    $
ARC
  -2.0038E+00   4.0958E+00   1.6204E+00
   2.9468E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   2.5000E-02   1.1655E-01   2.3900E+03    $
ARC
  -1.9930E+00   4.1020E+00   1.6204E+00
   3.0634E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   5.0000E-02   1.1655E-01   2.3900E+03    $
ARC
  -1.9822E+00   4.1083E+00   1.6204E+00
   3.1799E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   7.5000E-02   1.1655E-01   2.3900E+03    $
ARC
  -2.5740E+00   3.7666E+00   1.6204E+00
   2.8497E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.5956E+00   3.7541E+00   1.6204E+00
   2.9662E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.6173E+00   3.7416E+00   1.6204E+00
   3.0828E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.6389E+00   3.7291E+00   1.6204E+00
   3.1993E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
```

```
  -1.9750E+00   4.1124E+00   1.6204E+00
   2.8497E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
  -1.9533E+00   4.1249E+00   1.6204E+00
   2.9662E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
  -1.9317E+00   4.1374E+00   1.6204E+00
   3.0828E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
  -1.9100E+00   4.1499E+00   1.6204E+00
   3.1993E+00
   1.2000E+02   9.0000E+01   7.2030E+01   1.0787E+02
   8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
  -2.1336E+00   3.6955E+00   2.4931E+00
   2.0881E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   6.0000E-01   4.6620E-01   2.3900E+03   $
ARC
  -2.4043E+00   3.5393E+00   2.4931E+00
   2.0298E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   2.5000E-02   1.1655E-01   2.3900E+03   $
ARC
  -2.4151E+00   3.5330E+00   2.4931E+00
   2.1464E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   5.0000E-02   1.1655E-01   2.3900E+03   $
ARC
  -2.4259E+00   3.5268E+00   2.4931E+00
   2.2629E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   7.5000E-02   1.1655E-01   2.3900E+03   $
ARC
  -1.8630E+00   3.8518E+00   2.4931E+00
   2.0298E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   2.5000E-02   1.1655E-01   2.3900E+03   $
ARC
  -1.8522E+00   3.8580E+00   2.4931E+00
   2.1464E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   5.0000E-02   1.1655E-01   2.3900E+03   $
ARC
  -1.8413E+00   3.8643E+00   2.4931E+00
   2.2629E+00
   1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
   7.5000E-02   1.1655E-01   2.3900E+03   $
ARC
  -2.4331E+00   3.5226E+00   2.4931E+00
```

```
    1.9327E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -2.4548E+00   3.5101E+00   2.4931E+00
    2.0492E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -2.4764E+00   3.4976E+00   2.4931E+00
    2.1658E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -2.4981E+00   3.4851E+00   2.4931E+00
    2.2823E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -1.8341E+00   3.8685E+00   2.4931E+00
    1.9327E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -1.8125E+00   3.8810E+00   2.4931E+00
    2.0492E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -1.7908E+00   3.8935E+00   2.4931E+00
    2.1658E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -1.7692E+00   3.9060E+00   2.4931E+00
    2.2823E+00
    1.2000E+02   9.0000E+01   1.0787E+02   1.4429E+02
    8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
   -1.9550E+00   3.3862E+00   2.7500E+00
    1.6481E+00
    1.2000E+02   9.0000E+01   1.4429E+02   1.8000E+02
    6.0000E-01   4.6620E-01   2.3900E+03   $
ARC
   -2.2256E+00   3.2299E+00   2.7500E+00
    1.5898E+00
    1.2000E+02   9.0000E+01   1.4429E+02   1.8000E+02
    2.5000E-02   1.1655E-01   2.3900E+03   $
ARC
   -2.2365E+00   3.2237E+00   2.7500E+00
    1.7064E+00
    1.2000E+02   9.0000E+01   1.4429E+02   1.8000E+02
    5.0000E-02   1.1655E-01   2.3900E+03   $
ARC
   -2.2473E+00   3.2174E+00   2.7500E+00
    1.8229E+00
```

```
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      7.5000E-02  1.1655E-01  2.3900E+03   $
ARC
     -1.6844E+00  3.5424E+00  2.7500E+00
      1.5898E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      2.5000E-02  1.1655E-01  2.3900E+03   $
ARC
     -1.6735E+00  3.5487E+00  2.7500E+00
      1.7064E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      5.0000E-02  1.1655E-01  2.3900E+03   $
ARC
     -1.6627E+00  3.5549E+00  2.7500E+00
      1.8229E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      7.5000E-02  1.1655E-01  2.3900E+03   $
ARC
     -2.2545E+00  3.2132E+00  2.7500E+00
      1.4927E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -2.2761E+00  3.2007E+00  2.7500E+00
      1.6092E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -2.2978E+00  3.1882E+00  2.7500E+00
      1.7258E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -2.3194E+00  3.1757E+00  2.7500E+00
      1.8423E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -1.6555E+00  3.5591E+00  2.7500E+00
      1.4927E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -1.6338E+00  3.5716E+00  2.7500E+00
      1.(     :·00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -1.6122E+00  3.5841E+00  2.7500E+00
      1.7258E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
      8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
     -1.5905E+00  3.5966E+00  2.7500E+00
      1.8423E+00
      1.2000E+02  9.0000E+01  1.4429E+02  1.8000E+02
```

```
     8.3333E-03   3.8850E-02   1.0755E+04     $
ARC
   -1.9550E+00   3.3862E+00  -2.7500E+00
    1.6481E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    6.0000E-01   4.6620E-01   2.3900E+03     $
ARC
   -2.2256E+00   3.2299E+00  -2.7500E+00
    1.5898E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    2.5000E-02   1.1655E-01   2.3900E+03     $
ARC
   -2.2365E+00   3.2237E+00  -2.7500E+00
    1.7064E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    5.0000E-02   1.1655E-01   2.3900E+03     $
ARC
   -2.2473E+00   3.2174E+00  -2.7500E+00
    1.8229E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    7.5000E-02   1.1655E-01   2.3900E+03     $
ARC
   -1.6844E+00   3.5424E+00  -2.7500E+00
    1.5898E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    2.5000E-02   1.1655E-01   2.3900E+03     $
ARC
   -1.6735E+00   3.5487E+00  -2.7500E+00
    1.7064E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    5.0000E-02   1.1655E-01   2.3900E+03     $
ARC
   -1.6627E+00   3.5549E+00  -2.7500E+00
    1.8229E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    7.5000E-02   1.1655E-01   2.3900E+03     $
ARC
   -2.2545E+00   3.2132E+00  -2.7500E+00
    1.4927E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    8.3333E-03   3.8850E-02   1.0755E+04     $
ARC
   -2.2761E+00   3.2007E+00  -2.7500E+00
    1.6092E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    8.3333E-03   3.8850E-02   1.0755E+04     $
ARC
   -2.2978E+00   3.1882E+00  -2.7500E+00
    1.7258E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    8.3333E-03   3.8850E-02   1.0755E+04     $
ARC
   -2.3194E+00   3.1757E+00  -2.7500E+00
    1.8423E+00
    1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
    8.3333E-03   3.8850E-02   1.0755E+04     $
```

```
ARC
  -1.6555E+00   3.5591E+00  -2.7500E+00
   1.4927E+00
   1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.6338E+00   3.5716E+00  -2.7500E+00
   1.6092E+00
   1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.6122E+00   3.5841E+00  -2.7500E+00
   1.7258E+00
   1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.5905E+00   3.5966E+00  -2.7500E+00
   1.8423E+00
   1.2000E+02   9.0000E+01   1.8000E+02   2.1571E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.1336E+00   3.6955E+00  -2.4931E+00
   2.0881E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   6.0000E-01   4.6620E-01   2.3900E+03      $
ARC
  -2.4043E+00   3.5393E+00  -2.4931E+00
   2.0298E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   2.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.4151E+00   3.5330E+00  -2.4931E+00
   2.1464E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   5.0000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.4259E+00   3.5268E+00  -2.4931E+00
   2.2629E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   7.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.8630E+00   3.8518E+00  -2.4931E+00
   2.0298E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   2.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.8522E+00   3.8580E+00  -2.4931E+00
   2.1464E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   5.0000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.8413E+00   3.8643E+00  -2.4931E+00
   2.2629E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   7.5000E-02   1.1655E-01   2.3900E+03      $
ARC
```

```
  -2.4331E+00   3.5226E+00  -2.4931E+00
   1.9327E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.4548E+00   3.5101E+00  -2.4931E+00
   2.0492E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.4764E+00   3.4976E+00  -2.4931E+00
   2.1658E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.4981E+00   3.4851E+00  -2.4931E+00
   2.2823E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -1.8341E+00   3.8685E+00  -2.4931E+00
   1.9327E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -1.8125E+00   3.8810E+00  -2.4931E+00
   2.0492E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -1.7908E+00   3.8935E+00  -2.4931E+00
   2.1658E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -1.7692E+00   3.9060E+00  -2.4931E+00
   2.2823E+00
   1.2000E+02   9.0000E+01   2.1571E+02   2.5213E+02
   8.3333E-03   3.8850E-02   1.0755E+04    $
ARC
  -2.2745E+00   3.9395E+00  -1.6204E+00
   3.0051E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   6.0000E-01   4.6620E-01   2.3900E+03    $
ARC
  -2.5451E+00   3.7833E+00  -1.6204E+00
   2.9468E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   2.5000E-02   1.1655E-01   2.3900E+03    $
ARC
  -2.5559E+00   3.7770E+00  -1.6204E+00
   3.0634E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   5.0000E-02   1.1655E-01   2.3900E+03    $
ARC
  -2.5668E+00   3.7708E+00  -1.6204E+00
```

```
   3.1799E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   7.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.0038E+00   4.0958E+00  -1.6204E+00
   2.9468E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   2.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.9930E+00   4.1020E+00  -1.6204E+00
   3.0634E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   5.0000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.9822E+00   4.1083E+00  -1.6204E+00
   3.1799E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   7.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.5740E+00   3.7666E+00  -1.6204E+00
   2.8497E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.5956E+00   3.7541E+00  -1.6204E+00
   2.9662E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.6173E+00   3.7416E+00  -1.6204E+00
   3.0828E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.6389E+00   3.7291E+00  -1.6204E+00
   3.1993E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.9750E+00   4.1124E+00  -1.6204E+00
   2.8497E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.9533E+00   4.1249E+00  -1.6204E+00
   2.9662E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.9317E+00   4.1374E+00  -1.6204E+00
   3.0828E+00
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -1.9100E+00   4.1499E+00  -1.6204E+00
   3.1993E+00
```

```
   1.2000E+02   9.0000E+01   2.5213E+02   2.8797E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.0972E+00   3.6324E+00  -5.2893E-01
   4.1531E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   6.0000E-01   4.6620E-01   2.3900E+03      $
ARC
  -2.3678E+00   3.4762E+00  -5.2893E-01
   4.0948E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   2.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.3786E+00   3.4699E+00  -5.2893E-01
   4.2114E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   5.0000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.3895E+00   3.4637E+00  -5.2893E-01
   4.3279E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   7.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.8265E+00   3.7887E+00  -5.2893E-01
   4.0948E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   2.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.8157E+00   3.7949E+00  -5.2893E-01
   4.2114E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   5.0000E-02   1.1655E-01   2.3900E+03      $
ARC
  -1.8049E+00   3.8012E+00  -5.2893E-01
   4.3279E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   7.5000E-02   1.1655E-01   2.3900E+03      $
ARC
  -2.3967E+00   3.4595E+00  -5.2893E-01
   3.9977E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.4183E+00   3.4470E+00  -5.2893E-01
   4.?    ?00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.4400E+00   3.4345E+00  -5.2893E-01
   4.2308E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
   8.3333E-03   3.8850E-02   1.0755E+04      $
ARC
  -2.4616E+00   3.4220E+00  -5.2893E-01
   4.3473E+00
   1.2000E+02   9.0000E+01   2.8797E+02   3.2362E+02
```

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    8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
   -1.7977E+00  3.8053E+00 -5.2893E-01
    3.9977E+00
    1.2000E+02  9.0000E+01  2.8797E+02  3.2362E+02
    8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
   -1.7760E+00  3.8178E+00 -5.2893E-01
    4.1142E+00
    1.2000E+02  9.0000E+01  2.8797E+02  3.2362E+02
    8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
   -1.7544E+00  3.8303E+00 -5.2893E-01
    4.2308E+00
    1.2000E+02  9.0000E+01  2.8797E+02  3.2362E+02
    8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
   -1.7327E+00  3.8428E+00 -5.2893E-01
    4.3473E+00
    1.2000E+02  9.0000E+01  2.8797E+02  3.2362E+02
    8.3333E-03  3.8850E-02  1.0755E+04   $
ARC
   -1.7386E+00  3.0113E+00  0.0
    5.0438E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    6.0000E-01  4.6620E-01  2.3900E+03   $
ARC
   -2.0092E+00  2.8550E+00  0.0
    4.9855E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    2.5000E-02  1.1655E-01  2.3900E+03   $
ARC
   -2.0200E+00  2.8488E+00  0.0
    5.1021E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    5.0000E-02  1.1655E-01  2.3900E+03   $
ARC
   -2.0308E+00  2.8425E+00  0.0
    5.2186E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    7.5000E-02  1.1655E-01  2.3900E+03   $
ARC
   -1.4679E+00  3.1675E+00  0.0
    4.9855E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    2.5000E-02  1.1655E-01  2.3900E+03   $
ARC
   -1.4571E+00  3.1738E+00  0.0
    5.1021E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    5.0000E-02  1.1655E-01  2.3900E+03   $
ARC
   -1.4463E+00  3.1800E+00  0.0
    5.2186E+00
    1.2000E+02  9.0000E+01  3.2362E+02  3.6000E+02
    7.5000E-02  1.1655E-01  2.3900E+03   $
```

```
ARC
 -2.0381E+00   2.8384E+00   0.0
  4.8884E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -2.0597E+00   2.8259E+00   0.0
  5.0049E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -2.0814E+00   2.8134E+00   0.0
  5.1215E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -2.1030E+00   2.8009E+00   0.0
  5.2380E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -1.4391E+00   3.1842E+00   0.0
  4.8884E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -1.4174E+00   3.1967E+00   0.0
  5.0049E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -1.3958E+00   3.2092E+00   0.0
  5.1215E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
ARC
 -1.3741E+00   3.2217E+00   0.0
  5.2380E+00
  1.2000E+02   9.0000E+01   3.2362E+02   3.6000E+02
  8.3333E-03   3.8850E-02   1.0755E+04   $
GCE
 -1.1310E+00   1.9589E+00   2.7500E+00
 -8.7115E-01   2.1089E+00   2.7500E+00
 -1.0144E+00   1.7570E+00   2.7500E+00
  2.3900E+03
 -1.1310E+00   1.9589E+00  -2.7500E+00
 -8.7115E-01   2.1089E+00  -2.7500E+00
 -1.0144E+00   1.7570E+00  -2.7500E+00   $
GCE
 -1.4307E+00   1.8531E+00   2.7500E+00
 -1.4199E+00   1.8593E+00   2.7500E+00
 -1.4016E+00   1.8026E+00   2.7500E+00
  2.3900E+03
 -1.4307E+00   1.8531E+00  -2.7500E+00
 -1.4199E+00   1.8593E+00  -2.7500E+00
 -1.4016E+00   1.8026E+00  -2.7500E+00   $
```

```
GCE
 -1.3833E+00   1.7459E+00   2.7500E+00
 -1.3616E+00   1.7584E+00   2.7500E+00
 -1.3541E+00   1.6954E+00   2.7500E+00
  2.3900E+03
 -1.3833E+00   1.7459E+00  -2.7500E+00
 -1.3616E+00   1.7584E+00  -2.7500E+00
 -1.3541E+00   1.6954E+00  -2.7500E+00      $
GCE
 -1.3358E+00   1.6387E+00   2.7500E+00
 -1.3033E+00   1.6575E+00   2.7500E+00
 -1.3067E+00   1.5883E+00   2.7500E+00
  2.3900E+03
 -1.3358E+00   1.6387E+00  -2.7500E+00
 -1.3033E+00   1.6575E+00  -2.7500E+00
 -1.3067E+00   1.5883E+00  -2.7500E+00      $
GCE
 -8.8946E-01   2.1656E+00   2.7500E+00
 -8.7863E-01   2.1718E+00   2.7500E+00
 -8.6032E-01   2.1151E+00   2.7500E+00
  2.3900E+03
 -8.8946E-01   2.1656E+00  -2.7500E+00
 -8.7863E-01   2.1718E+00  -2.7500E+00
 -8.6032E-01   2.1151E+00  -2.7500E+00      $
GCE
 -8.2036E-01   2.0709E+00   2.7500E+00
 -7.9871E-01   2.0834E+00   2.7500E+00
 -7.9122E-01   2.0204E+00   2.7500E+00
  2.3900E+03
 -8.2036E-01   2.0709E+00  -2.7500E+00
 -7.9871E-01   2.0834E+00  -2.7500E+00
 -7.9122E-01   2.0204E+00  -2.7500E+00      $
GCE
 -7.5126E-01   1.9762E+00   2.7500E+00
 -7.1878E-01   1.9950E+00   2.7500E+00
 -7.2212E-01   1.9258E+00   2.7500E+00
  2.3900E+03
 -7.5126E-01   1.9762E+00  -2.7500E+00
 -7.1878E-01   1.9950E+00  -2.7500E+00
 -7.2212E-01   1.9258E+00  -2.7500E+00      $
GCE
 -1.5082E+00   1.9205E+00   2.7500E+00
 -1.5045E+00   1.9226E+00   2.7500E+00
 -1.4984E+00   1.9037E+00   2.7500E+00
  1.0755E+04
 -1.5082E+00   1.9205E+00  -2.7500E+00
 -1.5045E+00   1.9226E+00  -2.7500E+00
 -1.4984E+00   1.9037E+00  -2.7500E+00      $
GCE
 -1.4715E+00   1.8071E+00   2.7500E+00
 -1.4679E+00   1.8092E+00   2.7500E+00
 -1.4618E+00   1.7903E+00   2.7500E+00
  1.0755E+04
 -1.4715E+00   1.8071E+00  -2.7500E+00
 -1.4679E+00   1.8092E+00  -2.7500E+00
 -1.4618E+00   1.7903E+00  -2.7500E+00      $
```

```
GCE
 -1.4349E+00   1.6937E+00   2.7500E+00
 -1.4313E+00   1.6957E+00   2.7500E+00
 -1.4252E+00   1.6768E+00   2.7500E+00
  1.0755E+04
 -1.4349E+00   1.6937E+00  -2.7500E+00
 -1.4313E+00   1.6957E+00  -2.7500E+00
 -1.4252E+00   1.6768E+00  -2.7500E+00       $
GCE
 -1.3983E+00   1.5802E+00   2.7500E+00
 -1.3947E+00   1.5823E+00   2.7500E+00
 -1.3886E+00   1.5634E+00   2.7500E+00
  1.0755E+04
 -1.3983E+00   1.5802E+00  -2.7500E+00
 -1.3947E+00   1.5823E+00  -2.7500E+00
 -1.3886E+00   1.5634E+00  -2.7500E+00       $
GCE
 -9.0915E-01   2.2664E+00   2.7500E+00
 -9.0554E-01   2.2685E+00   2.7500E+00
 -8.9944E-01   2.2495E+00   2.7500E+00
  1.0755E+04
 -9.0915E-01   2.2664E+00  -2.7500E+00
 -9.0554E-01   2.2685E+00  -2.7500E+00
 -8.9944E-01   2.2495E+00  -2.7500E+00       $
GCE
 -8.2923E-01   2.1779E+00   2.7500E+00
 -8.2562E-01   2.1800E+00   2.7500E+00
 -8.1952E-01   2.1611E+00   2.7500E+00
  1.0755E+04
 -8.2923E-01   2.1779E+00  -2.7500E+00
 -8.2562E-01   2.1800E+00  -2.7500E+00
 -8.1952E-01   2.1611E+00  -2.7500E+00       $
GCE
 -7.4930E-01   2.0895E+00   2.7500E+00
 -7.4569E-01   2.0916E+00   2.7500E+00
 -7.3959E-01   2.0727E+00   2.7500E+00
  1.0755E+04
 -7.4930E-01   2.0895E+00  -2.7500E+00
 -7.4569E-01   2.0916E+00  -2.7500E+00
 -7.3959E-01   2.0727E+00  -2.7500E+00       $
GCE
 -6.6938E-01   2.0011E+00   2.7500E+00
 -6.6577E-01   2.0031E+00   2.7500E+00
 -6.5966E-01   1.9842E+00   2.7500E+00
  1.        +04
 -6.6938E-01   2.0011E+00  -2.7500E+00
 -6.6577E-01   2.0031E+00  -2.7500E+00
 -6.5966E-01   1.9842E+00  -2.7500E+00       $
COIL=TOR6         $
ARC
 -3.1979E+00   1.6154E+00   3.0000E-01
  5.0438E+00
  1.5000E+02   9.0000E+01   0.0          3.6380E+01
  7.1250E-01   4.6620E-01   2.3900E+03   $
ARC
 -3.8190E+00   1.9740E+00   8.2893E-01
```

```
     4.1531E+00
     1.5000E+02    9.0000E+01    3.6380E+01    7.2030E+01
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -4.1261E+00    2.1513E+00    1.9204E+00
     3.0051E+00
     1.5000E+02    9.0000E+01    7.2030E+01    1.0787E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -3.8821E+00    2.0104E+00    2.7931E+00
     2.0881E+00
     1.5000E+02    9.0000E+01    1.0787E+02    1.4429E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -3.5728E+00    1.8318E+00    3.0500E+00
     1.6481E+00
     1.5000E+02    9.0000E+01    1.4429E+02    1.8000E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -3.5728E+00    1.8318E+00   -2.4500E+00
     1.6481E+00
     1.5000E+02    9.0000E+01    1.8000E+02    2.1571E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -3.8821E+00    2.0104E+00   -2.1931E+00
     2.0881E+00
     1.5000E+02    9.0000E+01    2.1571E+02    2.5213E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -4.1261E+00    2.1513E+00   -1.3204E+00
     3.0051E+00
     1.5000E+02    9.0000E+01    2.5213E+02    2.8797E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -3.8190E+00    1.9740E+00   -2.2893E-01
     4.1531E+00
     1.5000E+02    9.0000E+01    2.8797E+02    3.2362E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
ARC
    -3.1979E+00    1.6154E+00    3.0000E-01
     5.0438E+00
     1.5000E+02    9.0000E+01    3.2362E+02    3.6000E+02
     7.1250E-01    4.6620E-01    2.3900E+03       $
GCE
    -2.1455E+00    1.0077E+00    3.0500E+00
    -1.9673E+00    1.3163E+00    3.0500E+00
    -1.9436E+00    8.9120E-01    3.0500E+00
     2.3900E+03
    -2.1455E+00    1.0077E+00   -2.4500E+00
    -1.9673E+00    1.3163E+00   -2.4500E+00
    -1.9436E+00    8.9120E-01   -2.4500E+00       $
COIL=OH11            $
LOOP
     0.0           0.0           5.0400E-01
     1.1800E+00
     0.0           0.0
```

```
    5.0800E-01    7.3500E-01   -1.4998E+03    $
COIL=OH12         $
LOOP
    0.0           0.0          -5.0400E-01
    1.1800E+00
    0.0           0.0
    5.0800E-01    7.3500E-01   -1.4998E+03    $
COIL=OH41         $
LOOP
    0.0           0.0           5.4400E+00
    3.1000E+00
    0.0           0.0
    6.5500E-01    6.5500E-01   -1.4987E+03    $
    $
XYZ
  -10.     20.    10.
  -10.     20.    20.
   0.    0     $
XZY
    0.     10.    10.
  -10.     20.    10.
   0.    0     $
    $
```