```
PRE-CONCEPTUAL DESIGN OF THE Z-LLE ACCELERATOR
!
!    Following Mazarakis, Kim, and colleagues, the design assumes LTD-modul
!
!    The design presented below is a single-line model of the machine.
!
!
!
TIME-STEP          0.1E-9
RESOLUTION-TIME    0.1E-9
END-TIME           1.0E-6
NUMBER-PRINTS      1
EXECUTE-CYCLES     ALL
ECHO               YES
GRIDS              NO
MAX-POINTS         3001
DETAIL-PRINTS      FULL
!
BRANCH
!
!
!
!   *********   20 LTD modules   ***************************************************
!
!    We begin with a model of 20 LTD modules, connected in parallel.
!
!    We assume each LTD module consists of 10 LTD cavities, connected in series.
!
!    We assume each cavity includes 20 LTD bricks, in parallel.
!
!    Each brick is assumed to have a 40-nF capacitance and a 160-nH inductance.
!
!    We use for this calculation the RLC-circuit model of an LTD system that was
!    developed by Mazarakis and colleagues.
!
!
!
!    We assume an LTD-system capacitance of 1.6 uF:
!
RCG  1.00E12    1.60E-6
!
!
!
!    We assume each LTD cavity is charged to +/-100 kV:
!
INITIAL    VC1    2.00E6
!
!
!
!    We assume the series resistance of the LTD system is 7.50 milliohms,
!    and the series inductance is 4.00 nH:
!
RLS   7.50E-3      4.00E-9
!
!
!
!    We assume the shunt resistance due to the cores is 5.00 ohms:
!
RCG    5.00         1.0E-12
!
!
!
!   ********   4 monolithic radial-transmission-line impedance transformers   ********
!
!    We assume 4 radial transmission-line-impedance transformers in parallel, and that
!    they start at a radius of 4.5 meters.
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!
!    We also assume that at this radius, the impedance of the transformer system is
!    0.0605 ohms, the impedance at the system output is 0.120 ohms, and that the
!    transformer system has an exponential impedance profile:
!
TRL EXP  46.3E-9  0.0605  0.0852
!
UFO VIN
$VTRIN
UFO IIN
$ITRIN
UFO PIN
$PTRIN
UFO EIN
$ETRIN
!
RCG    32.21         1.0E-12
!
TRL EXP  46.3E-9  0.0852  0.1200
!
UFO VOUT
$VTROUT
UFO IOUT
$ITROUT
UFO POUT
$PTROUT
UFO EOUT
$ETROUT
!
RCG    44.20         1.0E-12
!
!
!
!   *************************  Water flares  ******************************
!
TRL LIN 5.96E-9  0.1200  0.3594
!
UFO VOUT
$VWF
UFO IOUT
$IWF
UFO POUT
$PWF
UFO EOUT
$EWF
!
!
!
!   ************************  Insulator stack  ******************************
!
RLS  1.0E-12    0.78E-9
!
UFO VOUT
$VSTACK
UFO IOUT
$ISTACK
UFO POUT
$PSTACK
UFO EOUT
$ESTACK
!
!
!
!   **************************  Vacuum flares  ******************************
!
RLS  1.0E-12    1.20E-9
```

```
!
UFO VOUT
$VVF
UFO IOUT
$IVF
UFO POUT
$PVF
UFO EOUT
$EVF
!
!
!
!   ****************************   MITLs   ********************************
!
RLS  1.0E-12    4.67E-9
!
UFO VOUT
$VMITLS
UFO IOUT
$IMITLS
UFO POUT
$PMITLS
UFO EOUT
$EMITLS
!
!
!
!   *****  Z-flow current loss immediately upstream of the convolute  ******
!
!   We assume the MITL system has a Z-flow impedance of 0.60 ohms:
!
RCG     0.0001      1.00E-12
VARIABLE R1      POS-MODEL
!  TSW   CURSW   TOPEN  ZFLOW  GSWMIN  GSWMAX  CBFLAG
   2E-9   1E2    2E-9   0.60   0.0001   10000     0
!
UFO IR1
$IZFLOSS
UFO R1
$RLOSS
!
!
!
!   ****************************  Convolute  ****************************
!
RLS  1.0e-12        1.30E-9
!
!
!
!   *******************  Inner-MITL and pinch at t = 0  *******************
!
RLS         0       4.60E-9
!
UFO VOUT
$VRWLOAD
!
!
!
!   ***************  Electrode-wall resistance  ****************************
!
RLS 0.0 0.0
VAR  R2  R2WALL
!
!  tstart   cyl_length_inner   cyl_length_outer   cyl_r_inner  cyl_r_outer
!
   1.1e-7       0.006               0.0085           0.0024      0.0054
```

```
!
! disk_upper_r_inner  disk_upper_r_outer  disk_lower_r_inner  disk_lower_r_outer
!
        0.0024               0.060              0.0024               0.060
!
UFO R2
$RWALL
!
!
!
!    *********   Time-dependent z-pinch model   ****************************
!
!   We assume a 5-mm initial radius, a 7.5-mm length, and a 10:1 convergence ratio.
!
!          INITIAL R     LENGTH   TOTAL MASS    FINAL R
CYLFOIL      0.0024      0.0075     77.0e-6     0.00024
!
!
!
UFO FRAD
$RADIUS
!
UFO FVEL
$VELOCITY
!
UFO FKE
$KINETIC
!
!
!
UFO VIN
$VLOAD
!
UFO IIN
$ILOAD
!
UFO EIN
$ELOAD
!
UFO PIN
$PLOAD
!
UFO L2
$LLOAD
!
!
!
UFO R2
$RLINER
!
UFO VR2
$VLINER
!
UFO PR2
$PLINER
!
!
!
!   ********   Tie it all back to ground   *******************************
!
!
RCG  1.0E-12  1.0E-12
!
!
```