6.3.A Sensitivity Data File Formats

6.3.A.1 Format of TSUNAMI-A sensitivity data file

The format of the TSUNAMI-A sensitivity data file produced by SAMS for cases with deterministic transport solutions is given in Table 6.3.A.1. The occurrence of each entry in the data file is followed by an identification of the data contained on each line of the file and the FORTRAN edit descriptor denoting the format of each line. A brief description of each line is also presented.

A sample of the TSUNAMI-A data file for the Flattop-25 sample problem is provided in Figure 6.3.A.1. Here, only two profiles out of the 130 computed are shown.

Table 6.3.A.1. Format specification for TSUNAMI-A sensitivity data file

Occurrence	Data	Format	Description
Once at beginning of file.	title	a80	Title extracted from transport calculation
	number of neutron groups	i10	Number of neutron groups in calculation
	total number of profiles, text descriptor, number of total profiles that are region integrated	i10, a35, i10	Total number of sensitivity profiles in data file, separated by a text descriptor, then the number of profiles that contain region-integrated data
	k_{eff}	f10.6	Value of k_{eff} from the forward transport calculation
	'energy boundaries:'	a	Text
	energy boundary data	5es14.6 (repeats until all data is printed)	Values of boundaries of energy groups. Begins with upper value for highest energy group and ends with lower value of lowest energy group.
Repeats for each profile.	isotope name, sensitivity reaction name, nuclide ID, MT number, Zone number or negative of material number, zone volume	a12, 1x, a15, 3i12, es14.6	Provides data identifying the sensitivity data that follows. Note, if sensitivity data is region-integrated, zone number and zone volume are both 0. If data is integrated over all zones containing the same material, the material number is given in place of the zone number as a negative number.
	Energy integrated sensitivity coefficient, sum of absolute value of group-wise sensitivities, sum of the group-wise sensitivities with opposite sign as energy integrated value (osc)	3es14.6	Energy-integrated sensitivity coefficients for this profile.
	group-wise sensitivity coefficients	5es14.6 (repeats until all data is printed)	Energy-dependent sensitivity coefficients. Begins with highest energy group.
Once at end of file.			Block of file verification information.

```
flattop-25
       238   number of neutron groups
       130   number of sensitivity profiles          30 are region integrated
  1.002969    k-eff from the forward case
energy boundaries:
  2.000000E+07  1.733300E+07  1.568300E+07  1.455000E+07  1.384000E+07
  1.284000E+07  1.000000E+07  8.187300E+06  6.434000E+06  4.800000E+06
  4.304000E+06  3.000000E+06  2.479000E+06  2.354000E+06  1.850000E+06
  1.500000E+06  1.400000E+06  1.356000E+06  1.317000E+06  1.250000E+06
  1.200000E+06  1.100000E+06  1.010000E+06  9.200000E+05  9.000000E+05
  8.750000E+05  8.611000E+05  8.200000E+05  7.500000E+05  6.790000E+05
  6.700000E+05  6.000000E+05  5.730000E+05  5.500000E+05  4.995200E+05
  4.700000E+05  4.400000E+05  4.200000E+05  4.000000E+05  3.300000E+05
  2.700000E+05  2.000000E+05  1.500000E+05  1.283000E+05  1.000000E+05
  8.500000E+04  8.200000E+04  7.500000E+04  7.300000E+04  6.000000E+04
  5.200000E+04  5.000000E+04  4.500000E+04  3.000000E+04  2.500000E+04
  1.700000E+04  1.300000E+04  9.500000E+03  8.030000E+03  6.000000E+03
  3.900000E+03  3.740000E+03  3.000000E+03  2.580000E+03  2.290000E+03
  2.200000E+03  1.800000E+03  1.550000E+03  1.500000E+03  1.150000E+03
  9.500000E+02  6.830000E+02  6.700000E+02  5.500000E+02  3.050000E+02
  2.850000E+02  2.400000E+02  2.100000E+02  2.075000E+02  1.925000E+02
  1.860000E+02  1.220000E+02  1.190000E+02  1.150000E+02  1.080000E+02
  1.000000E+02  9.000000E+01  8.200000E+01  8.000000E+01  7.600000E+01
  7.200000E+01  6.750000E+01  6.500000E+01  6.100000E+01  5.900000E+01
  5.340000E+01  5.200000E+01  5.060000E+01  4.920000E+01  4.830000E+01
  4.700000E+01  4.520000E+01  4.400000E+01  4.240000E+01  4.100000E+01
  3.960000E+01  3.910000E+01  3.800000E+01  3.700000E+01  3.550000E+01
  3.460000E+01  3.375000E+01  3.325000E+01  3.175000E+01  3.125000E+01
  3.000000E+01  2.750000E+01  2.500000E+01  2.250000E+01  2.100000E+01
  2.000000E+01  1.900000E+01  1.850000E+01  1.700000E+01  1.600000E+01
  1.509990E+01  1.440000E+01  1.375000E+01  1.290000E+01  1.190000E+01
  1.150000E+01  1.000000E+01  9.099990E+00  8.099990E+00  7.150000E+00
  7.000000E+00  6.750000E+00  6.500000E+00  6.250000E+00  6.000000E+00
  5.400000E+00  5.000000E+00  4.750000E+00  4.000000E+00  3.730000E+00
  3.500000E+00  3.150000E+00  3.049990E+00  3.000000E+00  2.969990E+00
  2.870000E+00  2.770000E+00  2.669990E+00  2.570000E+00  2.469990E+00
  2.379990E+00  2.299990E+00  2.209990E+00  2.120000E+00  2.000000E+00
  1.940000E+00  1.860000E+00  1.770000E+00  1.679990E+00  1.589990E+00
  1.500000E+00  1.450000E+00  1.400000E+00  1.349990E+00  1.299990E+00
  1.250000E+00  1.224990E+00  1.200000E+00  1.174990E+00  1.150000E+00
  1.139990E+00  1.129990E+00  1.120000E+00  1.110000E+00  1.099990E+00
  1.089990E+00  1.080000E+00  1.070000E+00  1.059990E+00  1.049990E+00
  1.040000E+00  1.030000E+00  1.020000E+00  1.009990E+00  1.000000E+00
  9.750000E-01  9.500000E-01  9.250000E-01  9.000000E-01  8.500000E-01
  8.000000E-01  7.500000E-01  7.000000E-01  6.500000E-01  6.250000E-01
  6.000000E-01  5.500000E-01  5.000000E-01  4.500000E-01  4.000000E-01
  3.750000E-01  3.500000E-01  3.250000E-01  3.000000E-01  2.750000E-01
  2.500000E-01  2.250000E-01  2.000000E-01  1.750000E-01  1.500000E-01
```

Figure 6.3.A.1. Truncated sensitivity data file for Flattop-25 sample problem.

```
  1.250000E-01  1.000000E-01  9.000000E-02  8.000000E-02  7.000000E-02
  6.000000E-02  5.000000E-02  4.000000E-02  3.000000E-02  2.530000E-02
  1.000000E-02  7.500000E-03  5.000000E-03  4.000000E-03  3.000000E-03
  2.500000E-03  2.000000E-03  1.500000E-03  1.200000E-03  1.000000E-03
  7.500000E-04  5.000000E-04  1.000000E-04  1.000000E-05
u-234       total                 92234          1          0  0.000000E+00
  4.717915E-03  4.975886E-03 -1.289843E-04
  2.506892E-08  1.674526E-07  3.009241E-07  3.212515E-07  8.004773E-07
  9.602059E-06  2.767762E-05  8.282738E-05  2.095243E-04  1.240423E-04
  6.019243E-04  4.044642E-04  1.135071E-04  5.606487E-04  4.757248E-04
  1.462671E-04  6.761932E-05  6.289243E-05  1.095966E-04  8.561461E-05
  1.773753E-04  1.640000E-04  1.761175E-04  4.353814E-05  5.616768E-05
  3.283979E-05  1.005176E-04  1.825428E-04  1.823796E-04  2.225234E-05
  1.648190E-04  5.830123E-05  4.848578E-05  1.014302E-04  5.276815E-05
  4.675121E-05  2.661435E-05  2.271738E-05  5.878201E-05  3.053242E-05
  1.441957E-05 -3.866848E-06 -8.105675E-06 -1.524720E-05 -1.112164E-05
 -1.873898E-06 -5.969614E-06 -1.989077E-06 -1.326105E-05 -9.321207E-06
 -2.404530E-06 -6.309741E-06 -1.968570E-05 -7.035957E-06 -9.446309E-06
 -4.643517E-06 -3.590477E-06 -1.204560E-06 -1.496028E-06 -1.231667E-06
 -9.897018E-08 -3.797082E-07 -1.884879E-07 -1.238474E-07 -2.742831E-08
 -9.015365E-08 -4.731163E-08 -5.688008E-09 -9.784721E-08 -4.339968E-08
 -3.857598E-08 -1.788772E-09 -9.179912E-09 -1.942945E-08 -7.808444E-10
 -1.033952E-09 -2.787285E-10 -7.649368E-11  3.174200E-12 -2.032114E-09
 -2.519205E-09 -8.466172E-12 -1.782872E-11 -4.164121E-10 -1.019102E-10
 -8.554906E-11 -8.181892E-12 -1.271741E-11 -2.199571E-10 -1.012644E-12
 -2.525998E-11  3.873520E-12  3.246969E-12 -1.846717E-12  2.073834E-12
 -2.864914E-12 -2.834941E-13 -1.647038E-12 -7.822336E-11 -3.875318E-12
 -2.367591E-11 -2.433239E-13  4.302250E-13  1.328992E-12 -2.683548E-14
 -3.569867E-15 -1.056719E-12  2.327642E-13  2.141648E-12 -6.464708E-15
  2.102727E-13  4.061489E-13  4.297794E-12 -1.140715E-11 -2.485342E-11
  3.520045E-12 -1.312734E-12 -6.466205E-13  4.677226E-14  5.384058E-13
 -7.029536E-14 -3.172012E-13 -1.050521E-12 -1.448066E-12  8.609614E-14
 -9.503147E-14  1.224622E-13 -5.610401E-14  1.206730E-13 -1.808347E-13
  5.110267E-13 -2.647888E-14 -5.274697E-13 -1.360891E-13 -9.483789E-15
  1.745369E-13 -2.324100E-13 -1.631119E-14  8.369275E-14 -2.896774E-12
 -4.645450E-14 -1.014518E-12 -1.253069E-12 -1.224193E-13 -3.247751E-13
 -2.170010E-14  5.679165E-15 -5.495932E-15 -5.738207E-15 -2.640171E-14
 -4.723927E-14 -2.692265E-14 -2.470002E-14 -2.212313E-14 -1.887611E-14
 -1.473034E-14 -1.451047E-14 -1.414891E-14  2.318902E-14  4.465008E-15
 -7.884706E-15 -1.256517E-14 -1.036473E-14 -9.936883E-15 -9.776219E-15
 -4.800508E-15 -4.391959E-15 -3.279705E-15  5.435813E-15 -6.187775E-15
 -1.940775E-15 -5.997969E-16 -3.333506E-16 -4.412221E-17 -4.046016E-16
 -3.825563E-17 -2.586768E-17 -1.933342E-17 -1.012773E-17 -5.796910E-18
 -1.903947E-18 -1.731421E-18 -2.378372E-19 -2.074179E-18 -7.863836E-19
 -1.446345E-18  1.001051E-18  5.654388E-18  7.607361E-18 -3.840432E-16
 -6.762651E-16 -7.569632E-16 -7.992030E-16 -1.579348E-15 -1.638912E-15
 -1.614449E-15 -1.524987E-15 -1.454677E-15 -2.958432E-16 -2.370000E-16
  2.145063E-16 -1.680721E-15 -3.103977E-15 -2.352000E-15  1.009233E-16
  1.583744E-17  4.777954E-18  5.125365E-19 -1.385105E-18 -7.333829E-19
  9.783341E-19  1.885422E-20  1.280582E-22 -1.217866E-22  6.410866E-23
```

Figure 6.3.A.1. Truncated sensitivity data file for Flattop-25 sample problem. (continued)

```
 -2.958369E-24 -1.558733E-25 -5.544137E-26 -1.831995E-26 -5.448893E-27
 -1.415088E-27 -3.110222E-28 -5.522761E-29 -5.429459E-30 -1.728100E-30
 -2.514164E-32  0.000000E+00  0.000000E+00  0.000000E+00  0.000000E+00
  0.000000E+00  0.000000E+00  0.000000E+00  0.000000E+00  0.000000E+00
  0.000000E+00  0.000000E+00  0.000000E+00
u-234       scatter              92234          1          0  0.000000E+00
  8.032846E-04  8.241044E-04 -1.041006E-05
 -3.248099E-09 -2.849794E-09  3.761279E-09  4.894583E-09  8.374101E-09
 -3.099800E-09 -7.458623E-07 -7.683340E-06  6.521506E-06  7.401795E-06
  3.981803E-05  3.092353E-05  9.673315E-06  5.444300E-05  4.968639E-05
  2.118375E-05  1.138184E-05  1.134012E-05  2.083885E-05  1.703296E-05
  3.708780E-05  3.574228E-05  3.382708E-05  7.202870E-06  8.988859E-06
  4.995195E-06  1.446466E-05  2.424787E-05  2.765288E-05  3.825457E-06
  3.116989E-05  1.317151E-05  1.199450E-05  2.762489E-05  1.707364E-05
  1.844534E-05  1.263098E-05  1.257121E-05  4.478947E-05  4.142602E-05
  4.409844E-05  2.870006E-05  1.012683E-05  1.152729E-05  4.782801E-06
  1.259705E-06  1.793371E-06  2.483675E-07  1.496686E-06  1.706688E-07
  1.686857E-07  9.490054E-08 -7.954430E-07 -4.688914E-07 -2.309356E-07
 -2.471537E-07 -1.786610E-07 -2.395761E-08 -3.666843E-09  1.724470E-08
 -3.073805E-09 -2.746581E-09  1.909088E-09 -1.216879E-08  1.541106E-09
  3.070286E-09 -1.714544E-09  2.222325E-09  4.704197E-09 -5.869767E-10
 -2.023745E-09 -1.670404E-10 -3.456028E-10  4.846314E-10  1.168348E-10
  9.827623E-12 -5.473694E-11  1.402322E-11  2.383711E-11  2.450650E-10
  3.568164E-10 -7.159047E-12 -1.503380E-11  6.139393E-11  3.348865E-12
  1.628715E-10 -4.819499E-12 -9.202975E-12  8.831698E-12  3.135675E-13
 -1.961365E-11  3.846148E-12  2.808294E-12 -1.477353E-12  1.857857E-12
 -2.155043E-12 -1.789186E-13 -4.133771E-13  3.033233E-12  4.904576E-14
  3.694654E-14 -6.397666E-14  4.128331E-13  1.060395E-12  1.458698E-15
  5.731954E-15 -7.811219E-13  2.242784E-13  1.751843E-12 -3.146954E-15
  1.844389E-13  3.293311E-13  3.467402E-12  2.026690E-12  5.768864E-12
  2.955440E-12 -8.597300E-13  5.334737E-14  1.100362E-13  4.331466E-13
 -4.817834E-14 -2.394196E-13 -7.884115E-13 -1.120566E-12  8.127751E-14
 -5.460604E-14  1.006648E-13 -3.436737E-14  9.646284E-14 -1.382066E-13
  4.648416E-13  5.996957E-15 -3.646852E-13  6.023955E-14 -4.109659E-15
  1.203473E-13 -1.351654E-13 -3.330587E-15  8.844682E-14 -1.428401E-13
  6.663312E-13 -1.568665E-14  1.282612E-14  1.681431E-14 -8.390950E-14
  1.250912E-14  5.585417E-15  3.200709E-16 -4.288993E-16 -4.661462E-15
 -1.315587E-14 -2.131794E-15 -1.135026E-16  6.150330E-16  1.873476E-16
  2.704163E-16 -8.424184E-17 -2.454189E-15  1.342258E-14  3.898874E-15
  1.177619E-16 -8.072667E-16  3.713938E-16  3.286023E-16 -2.195845E-17
  3.692910E-17 -8.551075E-18  2.126361E-16  4.077162E-15 -1.879803E-15
 -5.420138E-16  5.678537E-18  6.148490E-17  1.547221E-16 -1.861868E-16
 -1.463798E-17 -9.869435E-18 -7.532523E-18 -3.710468E-18 -2.008824E-18
 -3.941254E-19 -4.338395E-19  1.982443E-19 -6.647317E-19 -6.961168E-21
 -1.060476E-19  1.532491E-18  4.815554E-18  8.072217E-18  1.094195E-16
  6.851480E-18 -8.567528E-18 -1.375315E-17  2.677723E-17  9.881978E-18
  8.154495E-18  1.038738E-18 -1.150521E-17 -2.328087E-18 -1.094495E-18
  5.286105E-16 -2.343353E-16 -7.924307E-16 -5.631898E-16  3.676678E-17
  5.447929E-18  1.550351E-18  1.795543E-19 -3.911335E-19 -2.070213E-19
```

Figure 6.3.A.1. Truncated sensitivity data file for Flattop-25 sample problem. (continued)

```
  2.666570E-19  5.006574E-21  6.432183E-23 -1.883732E-23  1.634739E-23
 -7.540091E-26 -3.531102E-27 -1.165437E-27 -3.541294E-28 -9.582782E-29
 -2.220252E-29 -4.245368E-30 -6.290953E-31 -5.169058E-32 -1.116416E-32
 -2.558539E-36  0.000000E+00  0.000000E+00  0.000000E+00  0.000000E+00
  0.000000E+00  0.000000E+00  0.000000E+00  0.000000E+00  0.000000E+00
  0.000000E+00  0.000000E+00  0.000000E+00

...

file verification information
 code system:    scale
 version:    6.2
 program:  sams
   creation date:  01_apr_2016
   library:  /home/c53/scale_freeze/Linux_x86_64-release/bin/scale
   migration code:  sams
   version:  6.2.0
 jobname:  c53
 machine name:  node23
 date of file creation:  01_apr_2016
time of file creation:  17:22:50.45
 filename:  tsunami-1d4.sdf
 chi sensitivities are constrained
```

Figure 6.3.A.1. Truncated sensitivity data file for Flattop-25 sample problem. (continued)

6.3.A.2 Format of TSUNAMI-B sensitivity data file

The format of the TSUNAMI-B sensitivity data file produced by SAMS for cases with Monte Carlo transport solutions is given in Table 6.3.A.2. The occurrence of each entry in the data file is followed by an identification of the data contained on each line of the file and the FORTRAN edit descriptor denoting the format of each line. A brief description of each line is also presented.

A sample of the TSUNAMI-B data file for the LEU-COMP-THERM-009 case 10 sample problem is provided in Figure 6.3.A.2. Here, only two profiles out of the 3389 computed are shown.

Table 6.3.A.2. Format specification for TSUNAMI-B sensitivity data file

Occurrence	Data	Format	Description
Once at beginning of file.	title	a80	Title extracted from transport calculation
	number of neutron groups	i10	Number of neutron groups in calculation
	total number of profiles, text descriptor, number of total profiles that are region integrated	i10, a35, i10	Total number of sensitivity profiles in data file, separated by a text descriptor, then the number of profiles that contain region-integrated data
	k_{eff} '+/-' σ	f10.6, 1x, a, 1x, f10.6	Value of k_{eff} from the forward transport calculation and its standard deviation
	'energy boundaries:'	a	Text
	energy boundary data	5es14.6 (repeats until all data is printed)	Values of boundaries of energy groups. Begins with upper value for highest energy group and ends with lower value of lowest energy group.
Repeats for each profile.	isotope name, sensitivity reaction name, nuclide ID, MT number	a12, 1x, a15, 2i12	Provides data identifying the sensitivity data that follows. Note, if sensitivity data is region-integrated, zone number and zone volume are both 0. If data is integrated over all zones containing the same material, the material number is given in place of the zone number as a negative number.
	Unit number, number of the region within the unit, unit comments	2i7, a50	
	Zone number or negative of material number, zone volume, number of times unit is referenced in the problem, **MatId**	2es14.6, 2i7	Note, if sensitivity data is region-integrated, zone number and zone volume are both 0. If data is integrated over all zones containing the same material, the material number is given in place of the zone number as a negative number.

Table 6.3.A.2. Format specification for TSUNAMI-B sensitivity data file (continued)

Occurrence	Data	Format	Description
	energy integrated sensitivity coefficient, standard deviation for energy integrated sensitivity coefficient, sum of absolute value of group-wise sensitivities, sum of the group-wise sensitivities with opposite sign as energy integrated value (osc), standard deviation for osc.	5es14.6	Energy-integrated sensitivity coefficients and their standard deviations for this profile.
	group-wise sensitivity coefficients	5es14.6 (repeats until all data is printed)	Energy-dependent sensitivity coefficients. Begins with highest energy group.
	standard deviation in group-wise sensitivity coefficients	5es14.6 (repeats until all data is printed)	Standard deviation for energy-dependent sensitivity coefficients. Begins with highest energy group.
Once at end of file.			Block of file verification information.

```
sample 3 - tsunami-3d
       238   number of neutron groups
      3389   number of sensitivity profiles         291 are region integrated
  1.004674 +/-   0.000543 k-eff from the forward case
energy boundaries:
  2.000000E+07  1.733300E+07  1.568300E+07  1.455000E+07  1.384000E+07
  1.284000E+07  1.000000E+07  8.187300E+06  6.434000E+06  4.800000E+06
  4.304000E+06  3.000000E+06  2.479000E+06  2.354000E+06  1.850000E+06
  1.500000E+06  1.400000E+06  1.356000E+06  1.317000E+06  1.250000E+06
  1.200000E+06  1.100000E+06  1.010000E+06  9.200000E+05  9.000000E+05
  8.750000E+05  8.611000E+05  8.200000E+05  7.500000E+05  6.790000E+05
  6.700000E+05  6.000000E+05  5.730000E+05  5.500000E+05  4.995200E+05
  4.700000E+05  4.400000E+05  4.200000E+05  4.000000E+05  3.300000E+05
  2.700000E+05  2.000000E+05  1.500000E+05  1.283000E+05  1.000000E+05
  8.500000E+04  8.200000E+04  7.500000E+04  7.300000E+04  6.000000E+04
  5.200000E+04  5.000000E+04  4.500000E+04  3.000000E+04  2.500000E+04
  1.700000E+04  1.300000E+04  9.500000E+03  8.030000E+03  6.000000E+03
  3.900000E+03  3.740000E+03  3.000000E+03  2.580000E+03  2.290000E+03
  2.200000E+03  1.800000E+03  1.550000E+03  1.500000E+03  1.150000E+03
  9.500000E+02  6.830000E+02  6.700000E+02  5.500000E+02  3.050000E+02
  2.850000E+02  2.400000E+02  2.100000E+02  2.075000E+02  1.925000E+02
  1.860000E+02  1.220000E+02  1.190000E+02  1.150000E+02  1.080000E+02
  1.000000E+02  9.000000E+01  8.200000E+01  8.000000E+01  7.600000E+01
  7.200000E+01  6.750000E+01  6.500000E+01  6.100000E+01  5.900000E+01
  5.340000E+01  5.200000E+01  5.060000E+01  4.920000E+01  4.830000E+01
  4.700000E+01  4.520000E+01  4.400000E+01  4.240000E+01  4.100000E+01
  3.960000E+01  3.910000E+01  3.800000E+01  3.700000E+01  3.550000E+01
  3.460000E+01  3.375000E+01  3.325000E+01  3.175000E+01  3.125000E+01
  3.000000E+01  2.750000E+01  2.500000E+01  2.250000E+01  2.100000E+01
  2.000000E+01  1.900000E+01  1.850000E+01  1.700000E+01  1.600000E+01
  1.509990E+01  1.440000E+01  1.375000E+01  1.290000E+01  1.190000E+01
  1.150000E+01  1.000000E+01  9.099990E+00  8.099990E+00  7.150000E+00
  7.000000E+00  6.750000E+00  6.500000E+00  6.250000E+00  6.000000E+00
  5.400000E+00  5.000000E+00  4.750000E+00  4.000000E+00  3.730000E+00
  3.500000E+00  3.150000E+00  3.049990E+00  3.000000E+00  2.969990E+00
  2.870000E+00  2.770000E+00  2.669990E+00  2.570000E+00  2.469990E+00
  2.379990E+00  2.299990E+00  2.209990E+00  2.120000E+00  2.000000E+00
  1.940000E+00  1.860000E+00  1.770000E+00  1.679990E+00  1.589990E+00
  1.500000E+00  1.450000E+00  1.400000E+00  1.349990E+00  1.299990E+00
  1.250000E+00  1.224990E+00  1.200000E+00  1.174990E+00  1.150000E+00
  1.139990E+00  1.129990E+00  1.120000E+00  1.110000E+00  1.099990E+00
  1.089990E+00  1.080000E+00  1.070000E+00  1.059990E+00  1.049990E+00
  1.040000E+00  1.030000E+00  1.020000E+00  1.009990E+00  1.000000E+00
  9.750000E-01  9.500000E-01  9.250000E-01  9.000000E-01  8.500000E-01
  8.000000E-01  7.500000E-01  7.000000E-01  6.500000E-01  6.250000E-01
  6.000000E-01  5.500000E-01  5.000000E-01  4.500000E-01  4.000000E-01
  3.750000E-01  3.500000E-01  3.250000E-01  3.000000E-01  2.750000E-01
  2.500000E-01  2.250000E-01  2.000000E-01  1.750000E-01  1.500000E-01
  1.250000E-01  1.000000E-01  9.000000E-02  8.000000E-02  7.000000E-02
  6.000000E-02  5.000000E-02  4.000000E-02  3.000000E-02  2.530000E-02
```

Figure 6.3.A.2. Truncated sensitivity data file for LEU-COMP-THERM-009 sample problem.

```
  1.000000E-02  7.500000E-03  5.000000E-03  4.000000E-03  3.000000E-03
  2.500000E-03  2.000000E-03  1.500000E-03  1.200000E-03  1.000000E-03
  7.500000E-04  5.000000E-04  1.000000E-04  1.000000E-05
h-1          total                  1001           1
      0      0
  0.000000E+00  0.000000E+00      0      0
  5.878199E-01  1.080812E-02  6.393673E-01 -2.577372E-02  6.213759E-03
  0.000000E+00  5.495367E-07  2.331587E-06  3.300773E-06  1.013678E-05
  1.664451E-04  6.565088E-04  2.936479E-03  1.086949E-02  6.494953E-03
  3.153059E-02  2.792794E-02  8.750866E-03  3.526685E-02  2.959999E-02
  9.882265E-03  4.334542E-03  3.162922E-03  5.604319E-03  5.096612E-03
  9.352559E-03  6.455556E-03  6.329793E-03  2.219300E-03  3.147784E-03
  1.846754E-03  5.699152E-03  1.105599E-02  1.187824E-02  1.369476E-03
  1.163906E-02  4.560338E-03  4.090504E-03  9.433514E-03  4.478346E-03
  3.184407E-03  1.346294E-03  2.053422E-03  1.053713E-02  1.140274E-02
  1.608992E-02  1.374175E-02  6.013477E-03  9.138809E-03  5.250737E-03
  1.183478E-03  2.853132E-03  8.610512E-04  5.268028E-03  3.930706E-03
  1.126351E-03  3.129538E-03  9.236847E-03  3.594958E-03  8.088362E-03
  6.009586E-03  6.688602E-03  3.495383E-03  5.765521E-03  8.388449E-03
  7.368939E-04  4.127158E-03  2.704750E-03  1.835688E-03  7.008772E-04
  3.511407E-03  2.453974E-03  6.089740E-04  4.814587E-03  2.868577E-03
  5.284937E-03  2.875470E-04  4.140647E-03  9.981738E-03  1.164813E-03
  2.291818E-03  2.495308E-03  2.124530E-04  9.511635E-04  5.255117E-04
  7.128428E-03  4.241791E-04  4.854808E-04  1.006414E-03  1.796904E-03
  1.660348E-03  6.851843E-04  3.984874E-04  7.034940E-04  5.358846E-04
  1.050901E-03  3.317304E-04  7.389811E-04  1.406010E-04  6.820000E-04
  1.101282E-03  4.862233E-04  6.513879E-04  3.097945E-04  2.935911E-04
  6.771809E-04  1.280746E-03  7.355201E-04  1.169403E-03  6.720975E-04
  2.362427E-04  6.381695E-04  3.898248E-04  6.170204E-04  5.175026E-04
  3.620459E-04  2.299800E-04  7.884422E-04  2.636381E-04  6.499650E-04
  1.500763E-03  1.643672E-03  2.051421E-03  8.798907E-04  8.456801E-04
  8.233886E-04  4.289658E-04  1.624594E-03  8.639144E-04  2.045707E-04
  1.167873E-03  4.272030E-04  1.133354E-03  1.883793E-03  6.082309E-04
 -3.184982E-04  1.643061E-03  1.570067E-03  2.113940E-03  2.854535E-04
  5.201036E-04  4.741151E-04  5.402900E-04  5.840588E-04  1.450502E-03
  1.341676E-03  7.172654E-04  2.380048E-03  1.226849E-03  8.828276E-04
  1.603862E-03  4.655939E-04  2.244715E-04  1.612430E-04  5.069606E-04
  4.950527E-04  5.691839E-04  5.735686E-04  6.123026E-04  5.276913E-04
  4.411023E-04  5.995673E-04  4.464893E-04  8.972538E-04  4.808735E-04
  5.433926E-04  6.923829E-04  8.862597E-04  9.481183E-04  1.097237E-03
  6.662853E-04  7.941514E-04  9.267192E-04  9.465431E-04  1.350355E-03
  7.133665E-04  7.386729E-04  9.478894E-04  1.290858E-03  5.925235E-04
  7.198542E-04  8.246520E-04  1.024889E-03  1.260913E-03  1.611722E-03
  1.951751E-03  2.132400E-03  2.164822E-03  2.202685E-03  2.180256E-03
  2.151288E-03  1.960147E-03  1.642508E-03  1.331129E-03  2.219066E-03
  1.389834E-03  1.133856E-03  8.478845E-04  1.412585E-03  1.256246E-03
  1.073678E-03  1.132597E-03  8.625521E-04  4.983772E-04  5.043924E-04
  1.238305E-03  9.734085E-04  9.374273E-04  7.145087E-04  4.779918E-04
  4.910213E-04  5.642105E-04  7.554480E-04  8.415005E-04  1.107943E-03
  1.292846E-03  1.298630E-03  1.487261E-03  1.447523E-03  2.061059E-03
```

Figure 6.3.A.2. Truncated sensitivity data file for LEU-COMP-THERM-009 sample problem. (continued)

```
 2.543669E-03  5.434130E-04 -3.014440E-04 -8.338618E-05 -1.259993E-03
-1.049059E-03 -1.516055E-03 -4.246086E-03 -2.081466E-03 -9.899241E-03
-1.549410E-03 -1.532964E-03 -4.959768E-04 -4.645005E-04 -2.443465E-04
-1.921544E-04 -1.851809E-04 -9.943808E-05 -6.213754E-05 -6.412054E-05
-5.667409E-05 -6.599494E-05 -5.596935E-06
 0.000000E+00  2.166669E-07  4.563308E-07  5.797961E-07  1.052589E-06
 5.227409E-06  1.635907E-05  5.783163E-05  1.976880E-04  1.499190E-04
 7.129798E-04  6.959004E-04  2.559563E-04  9.831456E-04  9.627497E-04
 3.887061E-04  1.964393E-04  1.556215E-04  2.896371E-04  2.635342E-04
 4.911421E-04  4.089036E-04  4.619491E-04  1.526265E-04  1.964699E-04
 1.289384E-04  3.598922E-04  6.532525E-04  6.485064E-04  1.182854E-04
 6.882841E-04  3.167550E-04  2.880876E-04  6.021766E-04  3.712318E-04
 3.285352E-04  2.205750E-04  2.868595E-04  1.144578E-03  1.210874E-03
 1.630829E-03  1.478332E-03  8.691904E-04  1.300316E-03  8.875954E-04
 2.513224E-04  5.308395E-04  2.038769E-04  1.063601E-03  8.168670E-04
 2.744386E-04  6.274111E-04  1.948515E-03  9.865712E-04  1.823839E-03
 1.338510E-03  1.511362E-03  9.038528E-04  1.457087E-03  1.918360E-03
 2.801742E-04  1.096586E-03  7.956968E-04  6.608086E-04  2.723390E-04
 1.036666E-03  8.100112E-04  2.349632E-04  1.322213E-03  1.016259E-03
 1.612241E-03  1.628674E-04  1.053085E-03  2.383641E-03  3.969473E-04
 8.650431E-04  7.030079E-04  1.137526E-04  4.473213E-04  2.406486E-04
 1.745300E-03  1.777857E-04  2.259530E-04  3.595638E-04  4.174393E-04
 5.449888E-04  4.941223E-04  1.791767E-04  3.092047E-04  3.136610E-04
 3.682297E-04  2.325259E-04  3.616855E-04  2.189339E-04  5.192921E-04
 1.676002E-04  1.898789E-04  1.855957E-04  1.451389E-04  1.871217E-04
 2.472929E-04  1.716087E-04  2.387386E-04  2.055161E-04  2.282567E-04
 1.131949E-04  1.944377E-04  1.879942E-04  2.618990E-04  1.819375E-04
 1.802619E-04  1.265510E-04  2.860560E-04  1.303750E-04  2.620363E-04
 4.822369E-04  5.053777E-04  5.572759E-04  3.782100E-04  2.943088E-04
 3.092838E-04  1.883722E-04  4.454995E-04  3.535025E-04  3.330253E-04
 2.591977E-04  2.743464E-04  3.634571E-04  4.285595E-04  2.064984E-04
 6.655956E-04  4.948453E-04  5.874258E-04  5.804186E-04  1.536659E-04
 2.232270E-04  2.315359E-04  2.424440E-04  2.484870E-04  5.424511E-04
 4.148698E-04  2.984723E-04  8.109708E-04  3.782729E-04  3.508202E-04
 5.266942E-04  1.997956E-04  1.284097E-04  9.413755E-05  2.183365E-04
 2.207723E-04  2.293038E-04  2.357776E-04  2.480385E-04  2.314636E-04
 2.201457E-04  2.483637E-04  2.551705E-04  3.358805E-04  2.013221E-04
 2.605793E-04  2.935817E-04  3.074188E-04  3.212076E-04  3.372974E-04
 2.217707E-04  2.272350E-04  2.315085E-04  2.365833E-04  2.435013E-04
 1.491903E-04  1.504862E-04  1.526581E-04  1.494485E-04  7.853944E-05
 7.694254E-05  7.521152E-05  7.139824E-05  6.321032E-05  5.386979E-05
 4.227381E-05  3.244781E-05  2.600470E-05  2.441022E-05  2.685967E-05
 3.485016E-05  4.518938E-05  5.804115E-05  7.003531E-05  1.491623E-04
 1.711490E-04  1.797697E-04  1.924294E-04  3.367520E-04  3.626060E-04
 3.876486E-04  4.127060E-04  4.406396E-04  2.723181E-04  2.809896E-04
 5.027895E-04  5.409453E-04  5.750452E-04  5.933219E-04  3.346886E-04
 3.073575E-04  2.671577E-04  2.257729E-04  2.317883E-04  2.815263E-04
 3.724861E-04  4.884778E-04  6.219380E-04  8.232623E-04  1.116475E-03
 1.587840E-03  1.081433E-03  1.278081E-03  1.529288E-03  1.839648E-03
```

Figure 6.3.A.2. Truncated sensitivity data file for LEU-COMP-THERM-009 sample problem. (continued)

```
  2.160035E-03  2.473668E-03  2.749914E-03  1.747805E-03  2.894034E-03
  7.595401E-04  5.846859E-04  2.217471E-04  1.914071E-04  9.697134E-05
  8.595824E-05  7.688035E-05  4.872943E-05  3.432014E-05  3.488024E-05
  3.196222E-05  3.258262E-05  8.777834E-06
h-1          scatter                1001          1
      0      0
  0.000000E+00  0.000000E+00      0      0
  6.303991E-01  1.077414E-02  6.400794E-01 -4.840258E-03  4.481088E-03
  0.000000E+00  5.495671E-07  2.331707E-06  3.300919E-06  1.013723E-05
  1.664523E-04  6.565364E-04  2.936591E-03  1.086989E-02  6.495210E-03
  3.153197E-02  2.792903E-02  8.751186E-03  3.526826E-02  2.960132E-02
  9.882722E-03  4.334749E-03  3.163091E-03  5.604652E-03  5.096891E-03
  9.353111E-03  6.456018E-03  6.330305E-03  2.219428E-03  3.147952E-03
  1.846853E-03  5.699483E-03  1.105662E-02  1.187883E-02  1.369554E-03
  1.163969E-02  4.560593E-03  4.090726E-03  9.434017E-03  4.478649E-03
  3.184690E-03  1.346479E-03  2.053654E-03  1.053816E-02  1.140387E-02
  1.609164E-02  1.374353E-02  6.014523E-03  9.140635E-03  5.252031E-03
  1.183774E-03  2.853883E-03  8.612880E-04  5.269829E-03  3.932118E-03
  1.126754E-03  3.130657E-03  9.241730E-03  3.597525E-03  8.094637E-03
  6.014777E-03  6.695679E-03  3.499683E-03  5.774016E-03  8.403651E-03
  7.385747E-04  4.136535E-03  2.711805E-03  1.841652E-03  7.029597E-04
  3.522480E-03  2.462885E-03  6.110088E-04  4.832324E-03  2.882767E-03
  5.312621E-03  2.893077E-04  4.159580E-03  1.005115E-02  1.174187E-03
  2.317001E-03  2.516301E-03  2.144128E-04  9.637796E-04  5.314553E-04
  7.209417E-03  4.294930E-04  4.929678E-04  1.020469E-03  1.814332E-03
  1.685521E-03  7.086673E-04  4.049238E-04  7.171356E-04  5.502240E-04
  1.068964E-03  3.422397E-04  7.575767E-04  1.504152E-04  7.128682E-04
  1.109028E-03  4.950626E-04  6.602400E-04  3.159006E-04  3.027021E-04
  6.905827E-04  1.289303E-03  7.485397E-04  1.180639E-03  6.848187E-04
  2.409294E-04  6.485939E-04  3.999771E-04  6.329166E-04  5.275019E-04
  3.719266E-04  2.359282E-04  8.071988E-04  2.701662E-04  6.670883E-04
  1.538525E-03  1.686220E-03  2.100862E-03  9.130201E-04  8.704552E-04
  8.502701E-04  4.430830E-04  1.668918E-03  8.980936E-04  2.380146E-04
  1.193211E-03  4.546899E-04  1.172791E-03  1.934487E-03  6.293361E-04
 -2.253867E-04  1.710919E-03  1.658688E-03  2.209494E-03  3.032127E-04
  5.505222E-04  5.065812E-04  5.746219E-04  6.207397E-04  1.548970E-03
  1.416268E-03  7.683847E-04  2.563113E-03  1.305293E-03  9.570906E-04
  1.731522E-03  5.057083E-04  2.453513E-04  1.747015E-04  5.527029E-04
  5.433562E-04  6.206639E-04  6.277530E-04  6.703657E-04  5.820032E-04
  4.925180E-04  6.610006E-04  5.118483E-04  9.913894E-04  5.309230E-04
  6.149273E-04  7.776549E-04  9.787851E-04  1.048909E-03  1.207425E-03
  7.316338E-04  8.631854E-04  9.992484E-04  1.022619E-03  1.430072E-03
  7.546633E-04  7.810938E-04  9.917767E-04  1.334629E-03  6.098780E-04
  7.364101E-04  8.410845E-04  1.040464E-03  1.274770E-03  1.623622E-03
  1.961246E-03  2.139706E-03  2.170640E-03  2.208168E-03  2.186356E-03
  2.159295E-03  1.970835E-03  1.656340E-03  1.347787E-03  2.268713E-03
  1.446472E-03  1.195007E-03  9.137678E-04  1.554992E-03  1.416406E-03
  1.250617E-03  1.333341E-03  1.084074E-03  6.208760E-04  6.374314E-04
  1.520393E-03  1.303509E-03  1.300696E-03  1.122529E-03  6.883067E-04
  6.974777E-04  7.486881E-04  9.267605E-04  1.016119E-03  1.337179E-03
```

Figure 6.3.A.2. Truncated sensitivity data file for LEU-COMP-THERM-009 sample problem. (continued)

```
 1.601901E-03  1.714987E-03  2.065219E-03  2.269599E-03  3.267892E-03
 4.496744E-03  1.651763E-03  1.099488E-03  1.646667E-03  8.793735E-04
 1.613625E-03  1.724868E-03 -3.355957E-04 -3.661996E-05 -2.678600E-03
-4.340224E-04 -5.189590E-04 -1.363285E-04 -1.360189E-04 -9.593642E-05
-5.709878E-05 -6.221425E-05 -3.386675E-05 -2.253157E-05 -2.094053E-05
-1.934127E-05 -2.462690E-05 -2.170317E-06
 0.000000E+00  2.166573E-07  4.563122E-07  5.797737E-07  1.052550E-06
 5.227220E-06  1.635858E-05  5.783009E-05  1.976834E-04  1.499162E-04
 7.129665E-04  6.958902E-04  2.559530E-04  9.831330E-04  9.627389E-04
 3.887023E-04  1.964374E-04  1.556201E-04  2.896345E-04  2.635319E-04
 4.911378E-04  4.089002E-04  4.619455E-04  1.526254E-04  1.964684E-04
 1.289375E-04  3.598896E-04  6.532479E-04  6.485019E-04  1.182846E-04
 6.882796E-04  3.167530E-04  2.880858E-04  6.021730E-04  3.712296E-04
 3.285334E-04  2.205738E-04  2.868579E-04  1.144571E-03  1.210866E-03
 1.630818E-03  1.478321E-03  8.691841E-04  1.300305E-03  8.875877E-04
 2.513203E-04  5.308349E-04  2.038752E-04  1.063591E-03  8.168587E-04
 2.744358E-04  6.274046E-04  1.948488E-03  9.865571E-04  1.823805E-03
 1.338482E-03  1.511324E-03  9.038291E-04  1.457042E-03  1.918277E-03
 2.801630E-04  1.096534E-03  7.956573E-04  6.607744E-04  2.723250E-04
 1.036605E-03  8.099615E-04  2.349491E-04  1.322119E-03  1.016182E-03
 1.612093E-03  1.628536E-04  1.052985E-03  2.383268E-03  3.968910E-04
 8.649064E-04  7.028914E-04  1.137342E-04  4.472456E-04  2.406079E-04
 1.744864E-03  1.777447E-04  2.259000E-04  3.594763E-04  4.173333E-04
 5.448412E-04  4.939820E-04  1.791260E-04  3.091145E-04  3.135670E-04
 3.681154E-04  2.324528E-04  3.615673E-04  2.188618E-04  5.191086E-04
 1.675413E-04  1.898112E-04  1.855286E-04  1.450861E-04  1.870526E-04
 2.471996E-04  1.715434E-04  2.386457E-04  2.054351E-04  2.281650E-04
 1.131494E-04  1.943583E-04  1.879164E-04  2.617881E-04  1.818599E-04
 1.801841E-04  1.264961E-04  2.859284E-04  1.303168E-04  2.619164E-04
 4.820038E-04  5.051208E-04  5.569755E-04  3.780011E-04  2.941432E-04
 3.091053E-04  1.882628E-04  4.452257E-04  3.532799E-04  3.328100E-04
 2.590273E-04  2.741619E-04  3.632040E-04  4.282485E-04  2.063481E-04
 6.650581E-04  4.944312E-04  5.869004E-04  5.798635E-04  1.535210E-04
 2.230120E-04  2.313091E-04  2.422020E-04  2.482344E-04  5.418594E-04
 4.144033E-04  2.981307E-04  8.099135E-04  3.777744E-04  3.503435E-04
 5.259281E-04  1.995055E-04  1.282225E-04  9.399701E-05  2.180021E-04
 2.204282E-04  2.289391E-04  2.353957E-04  2.476291E-04  2.310753E-04
 2.197705E-04  2.479305E-04  2.547174E-04  3.352607E-04  2.009506E-04
 2.600849E-04  2.930110E-04  3.068041E-04  3.205445E-04  3.365811E-04
 2.213007E-04  2.267429E-04  2.309969E-04  2.360546E-04  2.429477E-04
 1.488554E-04  1.501431E-04  1.523043E-04  1.490992E-04  7.836059E-05
 7.676734E-05  7.504028E-05  7.123577E-05  6.306674E-05  5.374799E-05
 4.217917E-05  3.237631E-05  2.594829E-05  2.435751E-05  2.680074E-05
 3.477155E-05  4.508479E-05  5.790404E-05  6.986748E-05  1.487892E-04
 1.707188E-04  1.793168E-04  1.919402E-04  3.358301E-04  3.615817E-04
 3.865266E-04  4.114530E-04  4.392739E-04  2.714958E-04  2.801094E-04
 5.011157E-04  5.390380E-04  5.729596E-04  5.910309E-04  3.334616E-04
 3.061873E-04  2.661426E-04  2.248651E-04  2.308670E-04  2.803224E-04
 3.708528E-04  4.862559E-04  6.188882E-04  8.189344E-04  1.110189E-03
```

Figure 6.3.A.2. Truncated sensitivity data file for LEU-COMP-THERM-009 sample problem. (continued)

```
  1.577516E-03  1.075698E-03  1.270736E-03  1.520277E-03  1.828479E-03
  2.146210E-03  2.457027E-03  2.729725E-03  1.737714E-03  2.854629E-03
  7.541633E-04  5.796042E-04  2.197686E-04  1.895209E-04  9.598149E-05
  8.502876E-05  7.599381E-05  4.814730E-05  3.389918E-05  3.443490E-05
  3.153711E-05  3.212018E-05  8.655023E-06

…

file verification information
 code system:    scale
 version:    6.2
 program:  sams
   creation date:  01_apr_2016
   library:  /home/c53/scale_freeze/Linux_x86_64-release/bin/scale
   migration code:  sams
   version:  6.2.0
 jobname:  c53
 machine name:  node23
 date of file creation:  01_apr_2016
 time of file creation:  17:34:23.02
 filename:  tsunami-3d3.sdf
 chi sensitivities are constrained
```

Figure 6.3.A.2. Truncated sensitivity data file for LEU-COMP-THERM-009 sample problem. (continued)