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**A Monte Carlo Model System
for Core Analysis and Design at
the Washington State University
Radiation**

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**A MONTE CARLO MODEL SYSTEM FOR CORE ANALYSIS
AND EPITHERMAL NEUTRON BEAM DESIGN
AT THE
WASHINGTON STATE UNIVERSITY RADIATION CENTER**

Thomas. D. Burns, Jr.

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ABSTRACT

The Monte Carlo Model System (MCMS) for the Washington State University (WSU) Radiation Center provides a means through which core criticality and power distributions can be calculated, as well as providing a method for neutron and photon transport necessary for BNCT epithermal neutron beam design. The computational code used in this Model System is MCNP4A. The geometric capability of this Monte Carlo code allows the WSU system to be modeled very accurately. A working knowledge of the MCNP4A neutron transport code increases the flexibility of the Model System and is recommended, however, the eigenvalue/power density problems can be run with little direct knowledge of MCNP4A. Neutron and photon particle transport require more experience with the MCNP4A code.

The Model System consists of two coupled subsystems; the Core Analysis and Source Plane Generator Model (CASP), and the BeamPort Shell Particle Transport Model (BSPT). The CASP Model incorporates the $S(\alpha, \beta)$ thermal treatment, and is run as a criticality problem yielding the system eigenvalue (k_{eff}), the core power distribution, and an implicit surface source for subsequent particle transport in the BSPT Model.

The BSPT Model uses the source plane generated by a CASP run to transport particles through the thermal column beamport. The user can create filter arrangements in the beamport and then calculate characteristics necessary for assessing the BNCT potential of the given filter arrangement. Examples of the characteristics to be calculated are: neutron fluxes, neutron currents, fast neutron KERMA's and gamma KERMA's.

The MCMS is a useful tool for the WSU system. Those unfamiliar with the MCNP4A code can use the MCMS transparently for core analysis, while more experienced users will find the particle transport capabilities very powerful for BNCT filter design.

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Appendix B - BSPT Model Surface and Cell Diagrams

CORE ANALYSIS AND SOURCE PLANE GENERATOR MODEL (CASP MODEL)

The following discussion of the Core Analysis and Source Plane Generator Model will present the model in a transparent fashion, for the users not familiar with MCNP4A. Points where a more in depth treatment would benefit the experienced MCNP4A user are included under the *Model Point* subheadings. Diagrams with the actual surface and cell designations for the grid model and grid elements are included in Appendix A. These will be useful to the experienced MCNP4A user if he desires to modify the model geometry. The user may also desire to change or add to the materials in the default model. The user should refer to the MCNP4A manual for a discussion on material designations, however, adjusting materials is discouraged for those without experience with MCNP4A.

There are three main steps in transparently constructing a core configuration. First, the core elements must be mapped into the core grid. Next, the control blade and transient rod heights must be set. Finally, the type and number of simulation particles to be run must be established.

1.1 Core Grid Mapping

The core model is a 9 x 7 grid of primarily 3 inch x 3 inch element locations. The four corner locations are slightly larger (4 inches x 4 inches) and are of fixed content. The remaining 59 element locations are not of fixed content and can be filled with any of the following elements:

1. Standard Fuel Element
2. FLIP Fuel Element
3. Graphite Reflector Block
4. Rotator Tube Element
5. Transient Rod Element

Each element location in the grid has a cell number which corresponds to its place in the grid. The first digit is the row number in which the cell is located while the second digit is the column number in which the cell is located. A plan view schematic of the Core Grid Model is shown in Figure 1.

Figure 1. - Plan View Schematic of Core Grid Model

There are three regions of the grid; Region 1 - the two rows above the first control blade spacer, Region 2 - the three rows between the first and second control blade spacers, Region 3 - the two rows below the second control blade spacer. Each of the non-corner cells in these three regions can be filled with any of the five aforementioned elements, or with water, by specifying the appropriate *element number* on the *fill* space of the cell definition card or filled with water by specifying the "1 -1.0" string in the *material number/material density* section of the cell definition card. The first digit of the *element number* is the Region that the cell is in and the second digit is a number 1-5 corresponding to the desired element (numbers 1-5 correspond to the above list of elements).

The following are two examples of typical *cell cards* in the CASP Model input. The first is an example of an element location in Region 2 that is filled with a standard fuel element. The second is an example of an element in any Region (the specific example is for element 64, which is in Region 3) that is filled with water.

Example 1.

Example 2.

Once the core grid has been mapped for the particular core configuration of interest, the next step is to set the heights of the four control blades. The next section will discuss how to set these heights.

Model Point

The element numbers actually correspond to universes which are infinite lattices of each of the different elements. The reason that there are 15 universes (element numbers) for the 5 elements is that the control blade spacers of the Core Grid Model put the three Regions out of phase. Thus, the 5 universe lattices that are in phase with the middle Region (Region 2) need to be translated up by the width of a control blade spacer (yielding 10 lattices) and translated down by the width of a control blade spacer (yielding 15 lattices).

If the user desires to add another element to the existing bank of core elements (1-5) there are five steps that should be followed. Define a unique set of surfaces to build the new element cells, build the unique set of new element cells in phase with the center Region (Region 2), group the cells into an infinite lattice and define this lattice as a universe, translate the lattice up (with the "like" "but" card) to be in phase with Region 1 and define this as a different universe, and finally translate the lattice down (with the "like" "but" card) to be in phase with Region 3 and define this again as a different universe.

It may appear that using this lattice/universe system introduces unnecessary complexity into the model, as opposed to simply defining each cell to be used in a given problem once and then translating it into the desired grid spaces individually without using the infinite lattice. The benefit to the lattice/universe system is that it makes subsequent core configuration changes much easier and more straightforward (especially for the transparent user). It is the opinion of the author that the initial complexity in setting up the lattice/universe system is more than offset by the benefit of smooth core configuration adjustments in future use of the MCMS Model.

1.2 Control Blade and Transient Rod Height Adjustment

There are four control blades (three Boral blades and one Stainless Steel blade) in the CASP Model and each of these can be set to independent heights. There is also a Transient Rod Core Element which contains three TRIGA fuel rods and one boron carbide control rod (see Appendix A). This Transient Rod Core Element can be placed in as many of the core grid element locations as the user desires, however, the height of all of the transient rods in the model are controlled by the same surface, thus they are not independent.

The schematic of the control blade locations and their cell numbers is shown in Figure 2.

Figure 2. - Control Blade Content and Location Schematic

The procedure for adjusting the rod heights is as follows. First, locate the section of the input file for the CASP Model where control blade/transient rod surfaces are defined, then change the numerical value on the surface card corresponding to the blade or rod that is to be adjusted. The numerical entries on the cards are in centimeters and can range in value from -19.05 to 42.00. The active fuel height ranges from -19.05 to 19.05, and the top of the core is at 42.365. The entry for a fully inserted blade or rod would be -19.05.

Model Point

The Transient Rod Element is defined once and then declared as a universe consisting of an infinite lattice, thus the height of the boron carbide rod in every Transient Rod Element (hence, any Transient Rod Element specified in the Core Grid Model) is controlled by the same surface.

If the user wanted to use more than one Transient Rod Element in a given core configuration, each having independent rod height control, then he would have to add additional core elements to the CASP Model. These new core elements would be identical to the existing Transient Rod Element, but with unique sets of surface and cell numbers. The process for adding a new core element is outlined in the ***Model Point*** discussion of section **1.1 Core Grid Mapping**.

1.3 Setting the Type and Number of Particles to Run

The MCMS can run both neutron only transport problems, and coupled neutron and photon transport problems. The default is to transport neutrons only. If the user desires to run a coupled neutron and photon problem he need only go to the ***mode*** card in the input file and uncomment it out.

To set the number of particles to be run the user must go to the ***kcode*** card in the CASP Model input file. The CASP Model runs 100 cycles, and the actual number that is input is the number of particles to run per cycle. The total number of particles to be run therefore, is $100 * (\text{Number Input by User})$. An example of the ***kcode*** card for a problem to be run for 250,000 total particles is given in Example 3.

Example 3.

Model Point

The *kcode* card can be modified any way that the user desires. The number of total cycles can be varied, and the number of inactive cycles can also be varied. The CASP Model has a SRCTP file which eliminates the need to skip a large number of cycles. If this file is not available for whatever reason, there is a KSRC card included (yet commented out) with an explicit set of source points. To use this card just uncomment it out.

The initial K_{eff} guess may need to be adjusted if core configurations that are either extremely supercritical or extremely subcritical have problems running.

The number of particles that a user should run depends upon the accuracy that he is looking for and the amount of computer time that he wants to spend. To help the user determine the appropriate number of particles to run, plots of **computer time vs. number of particles run**, **error in K_{eff} vs. number of particles run**, and **percent error in power density vs. number of particles run** are included for CASP Model runs of 25,000; 250,000; and 2,500,000 particles on a 100 MHz HP workstation. These plots are shown in Figures 3, 4, and 5, respectively. A good rule of thumb is that when increasing the number of particles from one run to the next, the user should expect to see the error drop by the square root of the ratio of particle increase.

Figure 3.

Figure 4.

Figure 5.

Model Point

The models that were run to generate these plots all used the same importance weighting field. The field that they used is the default on the input model. Importance weighting can have a significant effect on computer run time and tally statistics, thus if the user desires to modify the importance field these plots may no longer be valid.

1.4 Running the CASP Model

The procedure for running the CASP Model is simply the standard MCNP4A execution procedure. This discussion assumes that the user has the MCNP4A executable file and all of the associated data files properly loaded and compiled on their machine and that the code is running properly.

The flow of a CASP Model run is as follows:

1. The original CASP Model input file is WSUc. To generate a new core configuration, the user should open the WSUc file, make the desired modifications, then save the modified file under a new name. One logical convention is to label the configurations in an ascending numerical order (i.e. WSUc1, WSUc2, etc...), however, this is solely a matter of personal preference. Your input files must be in your MCNP4A working directory (the directory containing the MCNP4A XSDIR files or the directory with a link to these files).

2. Once the input configuration file is generated the user needs to invoke the MCNP4A program.

The command line for this is shown in the following example:

```
mcnp4a i="input file name" o="output file name"
```

The input file name is the name of the user modified CASP model file, and the output file name is chosen by the user and it is where the output from the run will be written. One convention for labeling output files is to use the input file name with an "o" appended, however, this is solely a matter of personal preference.

Sometimes, it is useful to plot the model geometry to confirm that the configuration model

is correct. MCNP4A has a very useful internal plotting routine, however, the user should consult the MCNP4A manual for further instructions on using this feature.

Finally, it is often desirable to run these models in the background. The UNIX "nohup" command is useful for this purpose. Recall that when using "nohup" command a dump for the standard output and standard error must be given with the "> 'dump file name'" string. An example of the command line for a background job is as follows:

```
nohup mcnp4a i="input file name" o="output file name" >"dump file name" &
```

3. The MCNP4A run produces the some default files with each run. A list of these files and a brief description are given below.

Files generated from all CASP Model runs:

runtp - The model run tape. This file is used for any continuation runs of a problem. It contains all of the information about the model run to which it corresponds. The *prdmp* card controls the generation of this file. Further discussion can be found in the MCNP4A manual.

srctp - This file contains criticality source distribution information. The default srctp file was written by the WSUc default core configuration. The code uses this file for its initial source distribution when running a criticality problem. When a new configuration is used it is recommended that two runs be performed; one with the old srctp file, which will generate a new srctp file (the new file will be named srctq and the user will need to remove the old srctp file and then change the srctq file to srctp), and then one with the new srctp file for better convergence.

Optionally generated files:

comout - This file is generated when the MCNP4A internal plotting routine is employed. It is generally not of any concern for the CASP Model user, however, if the user desires more information he should consult the MCNP4A manual.

wssa - This file is created by a CASP Model run using the Surface Source Generation option. The wssa file is used as the implicit particle source file for subsequent transport calculations in the BSPT Model.

1.5 Using the Surface Source Generation Option

The two subsystems of the MCMS, the CASP and the BSPT, are coupled together via the generated Surface Source. This Surface Source provides the particle source for transport calculations in the BSPT Model, and it is generated in a CASP Model criticality run. To enact the Surface Source Generation option in the CASP Model, the user must go to the *ssw* card in the input file and remove the comment character preceding the card. This will cause the wssa file containing all of the Surface Source information to be created. Instructions on how to use the Surface Source from the wssa file to transport particles in the beamport are given in the later sections discussing the BSPT Model.

Model Point

The model surface to which the Surface Source is written is number 1002. This is the delimiting surface at the beginning of the beamport (the opening edge of the conical region of the beamport). There are more model surfaces further out axially in the x-direction, and the Surface

Source can be written to any of these by simply replacing surface number 1002 by the new surface. If the user decides to change the surface to which the source is written in the CASP Model, he must also change the surface from which the source is read in the BSPT Model. The card where this change is made in the BSPT Model is the *ssr* card, and the new surface number will be the same as in the CASP Model because all overlapping cells and surfaces have the same cell and surface descriptor numbers in both the CASP and BSPT Models. It should be noted that the author feels that the default source surface is more than adequate and discourages the user from making modifications

Finally, the filter region of the CASP Model that overlaps the BSPT Model should match the BSPT Model. Normally these adjustments will entail little more than a change of material in previously defined cells or the translation of a pre-existing surface. For "first cut" scoping calculations, the default CASP Model Surface Source will be adequate for all but the most drastically modified BSPT filter models. However, when the final designs are being analyzed in detail, the Surface Source employed should have been generated from a CASP Model run which matches the BSPT Model being evaluated.

1.6 CASP Model Output

The CASP Model output is written to a file specified by the user in the command line when he begins a CASP Model run. This output file is in the standard MCNP4A format. Some adjustments in the MCNP4A output files can be made using the *prdmp* card. If the user is interested in information on what adjustments can be made and how to make them he should consult the MCNP4A manual.

The user will need to peruse the output file to get acquainted with the format, and after a few times should be able to find the tally information of interest. The eigenvalue information is simply a scalar value confidence interval, hence it requires no post processing for graphical displays. Conversely, the power density data is an array of values that requires a small amount of post processing for a meaningful graphical display. The method of post processing and the graphical routines employed are solely a matter of personal preference.

The author uses a combination of VI editor commands and some short customized fortran data manipulation codes to put the output data into a format readable by the GNUPLOT graphical display software. This method of post processing has been amenable to the needs of the author, however, it might not be right for the needs of each user. Therefore, the author makes no recommendation on the post processing and graphical display method.

An MCNP4A generated plot of the proposed core configuration for BNCT, and the subsequent GNUPLOT generated contour plot of the power density data are given in Figures 6 and 7.

Figure 6. - MCNP4A Generated Plot of BNCT Core Configuration

Figure 7. - GNUPLOT Generated Contour Plot of Core Power Distribution

BEAMPORT SHELL PARTICLE TRANSPORT MODEL (BSPT MODEL)

The use of the BSPT model requires a working knowledge of the MCNP4A code. Therefore the user will not be able to run the model transparently. The discussion here will concentrate on two areas; identifying the descriptor numbers of surfaces and cells to be modified when adding a new filter to the BSPT Model, and explaining the procedure used to run the model using a Surface Source generated in the CASP Model.

Diagrams with the actual surface and cell designations for the BSPT Model are included in Appendix B.

2.1 The Filter Regions

For the MCMS, the filter region is defined as the inner volume of the beamport where the graphite thermal column was housed. There is a base case Al/CF₂ filter arrangement in the default BSPT Model input file (WSUsh). The user cannot change the filter model in a transparent fashion. To make modifications to the filter region the user must be able to create MCNP4A surfaces and define MCNP4A cells.

There are ranges of surface and cell numbers that have been "earmarked" for use in defining the filter region model. The user is free to use any surface or cell number that is unique in his creation of a filter region model, however, it is the authors opinion that using the "earmarked" cells and surfaces will make the input file more clear.

The surfaces numbering **3000 - 4999** and the cells numbering **3000 - 4999** are the ranges "earmarked" for use in building filter region models. Some of these surfaces and cells have already been used in the creation of the default model, therefore the user needs to be careful not to

overdefine cells or surfaces when creating a new filter arrangement. Some adjustments to the default model can be very minor, encompassing only a change of materials in previously defined cells or the small translation of an existing surface. Other adjustments may not be so trivial. The user may desire to analyze a model which requires him to redefine the entire cell structure of the filter region. Although a redefinition is not a trivial matter, it should not pose any challenge to the experienced MCNP4A user.

As a final note, the user needs to be cognizant of how modifications to the filter region will affect the importance field of the overall model. The default model has an importance field that is optimized for the existing filter region model. If the user makes drastic modifications to the geometry of the filter region, then he should reset the entire importance field appropriately for the new model. Often the user can do this "by hand," however, if problems persist, the author recommends using the MCNP4A internal Weight Window Generation option. This feature of the transport code is discussed in the manual.

2.2 Running the BSPT Model

There are four steps the user must follow to run a BSPT Model using a Surface Source generated from a previous CASP Model.

1. The implicit Surface Source file generated in the CASP run is named wssa, however, the BSPT Model will look to read its Surface Source input from the file rssa. Thus, the user must rename the wssa file rssa.
2. The user must decide which type of particles to transport; neutrons only or coupled neutrons and photons. If the CASP Model run that generated the Surface Source was a neutron only prob-

lem, then the subsequent BSPT Model can transport only neutrons. If the Surface Source was generated from a coupled neutron and photon run, then the user can choose whether to run the BSPT Model in the neutron only or coupled neutron and photon mode. The default is to run in the neutron only mode. If the user desires to run in the coupled mode, two things must be done: uncomment out the *mode* card in the input file, and uncomment out all of the photon dose tally cards (*f62***) at the end of the input file.

3. The user needs to set the number of particles to be run. This is done by going to the *nps* card in the input file and setting the value there to the desired magnitude. The user gains nothing by setting this number higher than the number of particles ran in the CASP Model that generated the Surface Source.

4. Finally, the user must invoke the MCNP4A program by following the standard MCNP4A execution procedure. This procedure has been discussed previously in section 2.1 **Running the CASP Model**.

2.3 BSPT Model Output

The BSPT Model gives the following default output:

All runs

1. Average neutron flux (over a 15cm diameter disc) axially along the centerline of the thermal column for total, thermal (0-0.4eV), epithermal (0.4eV-10keV), and fast (10keV-20MeV) neutrons.

2. Neutron current (over a 15cm diameter disc) axially along the centerline of the thermal column for total, thermal (0-0.4eV), epithermal (0.4eV-10keV), and fast (10keV-20MeV) neutrons.

3. The total and three group dose rates in tissue at the beam exit in cGy/min.

Optionally generated by uncommenting out existing lines in the input file

4. A fine group energy breakdown of the neutron flux at the beam exit. The energy bins are as follows (in MeV); 1×10^{-7} , 2×10^{-7} , 3×10^{-7} , ..., 8, 9, 10. This output can be plotted as a flux per unit lethargy histogram. At least 10×10^6 particles need to be run to get good statistics with this tally.

5. Photon dose rate in tissue at the beam exit in rem/hr. This tally can only be used when running a coupled neutron and photon problem.

These five tallies have been provided in the default input file, however, the user is free to tally for any quantity that MCNP4A allows. The user should consult the MCNP4A manual for further instruction on how to modify the model to tally for non-default information which is of interest.

A GNUPLOT generated plot of the three group neutron fluxes vs. axial position along the beam centerline for the default WSUsh model is shown in Figure 8. Figure 9. gives a GNUPLOT generated flux per unit lethargy histogram for the default WSUsh model.

Figure 8. - Neutron Fluxes vs. Axial Beam Position

Figure 9. - Flux per Unit Lethargy Histogram

2.4 Validation of the Surface Source

The CASP Model and BSPT model have a common region where one model overlaps the other. In order to verify that the Surface Source was yielding the same results as the full criticality source, a comparison was made in this region between the flux output generated by the criticality source and the flux output generated by the Surface Source. The agreement between the criticality generated flux and the Surface Source generated flux was outstanding. Figures 10, 11, and 12 are plots (from a set of runs with a 68cm Al/CF2 filter, large Bi collimator model) of the criticality and Surface Source generated fluxes vs. axial beam position for thermal, epithermal and fast neutrons, respectively.

Figure 10. - Comparison of Criticality and Surface Source Generated Thermal Fluxes

Figure 11. - Comparison of Criticality and Surface Source Generated Epithermal Fluxes

Figure 12. - Comparison of Criticality and Surface Source Generated Fast Fluxes

Appendix A

CASP Model Surface and Cell Diagrams

This appendix includes the CASP Model default input deck and the following diagrams:

1. WSUc Model
2. Core Grid Model
3. Aluminum Cone / Lead Thermal Shield Model
4. Standard and FLIP Fuel Element Model
5. Transient Rod Element Model
6. Graphite Element Model
7. Rotator Tube Element Model

In the Surface and Cell Diagrams the following font convention is used:

1000 - designates a Surface number

1000 - designates a Cell number

MCNP4A - Washington State University Reactor Facility Beam Model

CELL CARDS

```

c
c
c *****
c ***** Main Core Grid Cells *****
c *****
c Fill Each Main Grid Cell With the Appropriate Element:
c
c      11,21,31 - Standard Fuel Element
c      12,22,32 - FLIP Fuel Element
c      13,23,33 - Reflector Block
c      14,24,34 - Rotator Tube Element
c      15,25,35 - Transient Rod Element
c
c ***** Region 1 - Use 11,12,13,14,15 *****
c      Row 1
12 0 2 -3 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
13 0 3 -4 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
14 0 4 -5 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
15 0 5 -6 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
16 0 6 -7 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
17 0 7 -8 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
18 0 8 -9 -11 12 -21 22 imp:n=1 imp:p=1 fill=13
c      Row 2
21 1 -1.0 1 -2 -12 121 -21 22 imp:n=1 imp:p=1 fill=
22 0 2 -3 -12 121 -21 22 imp:n=1 imp:p=1 fill=14
23 0 3 -4 -12 121 -21 22 imp:n=1 imp:p=1 fill=11
24 0 4 -5 -12 121 -21 22 imp:n=1 imp:p=1 fill=11
25 0 5 -6 -12 121 -21 22 imp:n=1 imp:p=1 fill=13
26 0 6 -7 -12 121 -21 22 imp:n=1 imp:p=1 fill=13
27 0 7 -8 -12 121 -21 22 imp:n=1 imp:p=1 fill=11
28 0 8 -9 -12 121 -21 22 imp:n=1 imp:p=1 fill=11
29 0 9 -10 -12 121 -21 22 imp:n=1 imp:p=1 fill=11
c
c ***** Region 2 - Use 21,22,23,24,25 *****
c      Row 3
31 1 -1.0 1 -2 -131 13 -21 22 imp:n=1 imp:p=1 fill=
32 0 2 -3 -131 13 -21 22 imp:n=1 imp:p=1 fill=24
33 0 3 -4 -131 13 -21 22 imp:n=1 imp:p=1 fill=21
34 0 4 -5 -131 13 -21 22 imp:n=1 imp:p=1 fill=22
35 0 5 -6 -131 13 -21 22 imp:n=1 imp:p=1 fill=22
36 0 6 -7 -131 13 -21 22 imp:n=1 imp:p=1 fill=22
37 0 7 -8 -131 13 -21 22 imp:n=1 imp:p=1 fill=22
38 0 8 -9 -131 13 -21 22 imp:n=1 imp:p=1 fill=21
39 0 9 -10 -131 13 -21 22 imp:n=1 imp:p=1 fill=21
c      Row 4
41 1 -1.0 1 -2 -13 14 -21 22 imp:n=1 imp:p 1 fill=
42 0 2 -3 -13 14 -21 22 imp:n=1 imp:p 1 fill=24
43 0 3 -4 -13 14 -21 22 imp:n=1 imp:p 1 fill=21
44 0 4 -5 -13 14 -21 22 imp:n=1 imp:p 1 fill=22
45 0 5 -6 -13 14 -21 22 imp:n=1 imp:p 1 fill=22
46 0 6 -7 -13 14 -21 22 imp:n=1 imp:p 1 fill=25
47 0 7 -8 -13 14 -21 22 imp:n=1 imp:p 1 fill=22
48 0 8 -9 -13 14 -21 22 imp:n=1 imp:p 1 fill=22
49 0 9 -10 -13 14 -21 22 imp:n=1 imp:p 1 fill=21
c      Row 5
51 1 -1.0 1 -2 -14 141 -21 22 imp:n=1 imp:p=1 fill=
52 0 2 -3 -14 141 -21 22 imp:n=1 imp:p=1 fill=24
53 0 3 -4 -14 141 -21 22 imp:n=1 imp:p=1 fill=21
54 0 4 -5 -14 141 -21 22 imp:n=1 imp:p=1 fill=22
55 0 5 -6 -14 141 -21 22 imp:n=1 imp:p=1 fill=22
56 0 6 -7 -14 141 -21 22 imp:n=1 imp:p=1 fill=22
57 0 7 -8 -14 141 -21 22 imp:n=1 imp:p=1 fill=22
58 0 8 -9 -14 141 -21 22 imp:n=1 imp:p=1 fill=21
59 0 9 -10 -14 141 -21 22 imp:n=1 imp:p=1 fill=21
c

```

c ***** Region 3- Use 31,32,33,34,35 *****

c Row 6

61	0	1	-2	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
62	0	2	-3	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
63	0	3	-4	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
64	0	4	-5	-151	15	-21	22	imp:n=1	imp:p=1	fill=31
65	0	5	-6	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
66	0	6	-7	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
67	0	7	-8	-151	15	-21	22	imp:n=1	imp:p=1	fill=31
68	0	8	-9	-151	15	-21	22	imp:n=1	imp:p=1	fill=31
69	0	9	-10	-151	15	-21	22	imp:n=1	imp:p=1	fill=31

c Row 7

72	0	2	-3	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
73	0	3	-4	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
74	0	4	-5	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
75	0	5	-6	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
76	0	6	-7	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
77	0	7	-8	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
78	0	8	-9	-15	16	-21	22	imp:n=1	imp:p=1	fill=33

c ***** Corner Grid Elements *****

c Row 1

11	2	0.06020	(31 -2 -33 12 -21 22)	(-927:928:931:-932)	imp:n=1	imp:p=1
711	1	-1.0	927 -928 -931 932 -21 22		imp:n=1	imp:p=1

c Row 7

19	2	0.06020	(9 -32 -33 12 -21 22)	(-929:930:931:-932)	imp:n=1	imp:p=1
719	1	-1.0	929 -930 -931 932 -21 22		imp:n=1	imp:p=1

c Row 7

71	2	0.06020	(31 -2 -15 34 -21 22)	(-927:928:933:-934)	imp:n=1	imp:p=1
771	1	-1.0	927 -928 -933 934 -21 22		imp:n=1	imp:p=1

c Row 7

79	2	0.06020	(9 -32 -15 34 -21 22)	(-929:930:933:-934)	imp:n=1	imp:p=1
779	1	-1.0	929 -930 -933 934 -21 22		imp:n=1	imp:p=1

c ***** Control Region Elements *****

c Guides

100	2	0.06020	1 -101 -121 131 -21 22	imp:n=1	imp:p=1
101	2	0.06020	101 -102 -121 111 -21 22	imp:n=1	imp:p=1
102	2	0.06020	101 -102 -112 131 -21 22	imp:n=1	imp:p=1
103	2	0.06020	102 -103 -121 131 -21 22	imp:n=1	imp:p=1
104	2	0.06020	103 -104 -121 111 -21 22	imp:n=1	imp:p=1
105	2	0.06020	103 -104 -112 131 -21 22	imp:n=1	imp:p=1
106	2	0.06020	104 -10 -121 131 -21 22	imp:n=1	imp:p=1

c Control Blades - Upper Region

107	2	0.06020	1 -101 -141 151 -21 22	imp:n=1	imp:p=1
108	2	0.06020	101 -102 -141 113 -21 22	imp:n=1	imp:p=1
109	2	0.06020	101 -102 -114 151 -21 22	imp:n=1	imp:p=1
110	2	0.06020	102 -103 -141 151 -21 22	imp:n=1	imp:p=1
111	2	0.06020	103 -104 -141 113 -21 22	imp:n=1	imp:p=1
112	2	0.06020	103 -104 -114 151 -21 22	imp:n=1	imp:p=1
113	2	0.06020	104 -10 -141 151 -21 22	imp:n=1	imp:p=1

201	5	0.08881	101 -102 -111 112 -21 201	imp:n=1	imp:p=1
202	5	0.08881	103 -104 -111 112 -21 202	imp:n=1	imp:p=1
203	3	0.08647	101 -102 -113 114 -21 203	imp:n=1	imp:p=1
204	5	0.08881	103 -104 -113 114 -21 204	imp:n=1	imp:p=1

c Control Blades - Lower Water Gap Region

211	1	-1.0	101 -102 -111 112 -201 22	imp:n=1	imp:p=1
212	1	-1.0	103 -104 -111 112 -202 22	imp:n=1	imp:p=1
213	1	-1.0	101 -102 -113 114 -203 22	imp:n=1	imp:p=1
214	1	-1.0	103 -104 -113 114 -204 22	imp:n=1	imp:p=1

c ***** Core Grid Lattices *****

c

```

c      Standard Element Lattices - Region 1,2,3
801  0   900 -901 902 -903 imp:n=1 imp:p=1 lat=1 u=21 fill=1
802  like 801 but      trcl=( 0  2.54  0)          u=11
803  like 801 but      trcl=( 0 -2.54  0)          u=31
c
c      FLIP Element Lattices - Region 1,2,3
804  like 801 but          u=22 fill=2
805  like 804 but      trcl=( 0  2.54  0)          u=12
806  like 804 but      trcl=( 0 -2.54  0)          u=32
c
c      Graphite Element Lattices - Region 1,2,3
807  like 801 but          u=23 fill=3
808  like 807 but      trcl=( 0  2.54  0)          u=13
809  like 807 but      trcl=( 0 -2.54  0)          u=33
c
c      Rotator Tube Lattices - Region 1,2,3
810  like 801 but          u=24 fill=4
811  like 810 but      trcl=( 0  2.54  0)          u=14
812  like 810 but      trcl=( 0 -2.54  0)          u=34
c
c      Transient Rod Element Lattices - Region 1,2,3
813  like 801 but          u=25 fill=5
814  like 813 but      trcl=( 0  2.54  0)          u=15
815  like 814 but      trcl=( 0 -2.54  0)          u=35
c
c      ***** Universe Element Cells *****
c
c      Standard Element
c
901  6  0.09344  -909 -905 +906      imp:n=1 imp:p=1 u=1
902  4  -1.6      -909  905 -904      imp:n=1 imp:p=1 u=1
903  4  -1.6      -909 -906 +907      imp:n=1 imp:p=1 u=1
904  8  0.09532  -910  904      imp:n=1 imp:p=1 u=1
905  3  0.08647  -910 -907  908      imp:n=1 imp:p=1 u=1
906  9  0.08293  -910 -908      imp:n=1 imp:p=1 u=1
907  3  0.08647   909 -910 -904 907 imp:n=1 imp:p=1 u=1
c
908  6  0.09344  -911 -905 +906      imp:n=1 imp:p=1 u=1
909  4  -1.6      -911  905 -904      imp:n=1 imp:p=1 u=1
910  4  -1.6      -911 -906 +907      imp:n=1 imp:p=1 u=1
911  8  0.09532  -912  904      imp:n=1 imp:p=1 u=1
912  3  0.08647  -912 -907  908      imp:n=1 imp:p=1 u=1
913  9  0.08293  -912 -908      imp:n=1 imp:p=1 u=1
914  3  0.08647   911 -912 -904 907 imp:n=1 imp:p=1 u=1
c
915  6  0.09344  -913 -905 +906      imp:n=1 imp:p=1 u=1
916  4  -1.6      -913  905 -904      imp:n=1 imp:p=1 u=1
917  4  -1.6      -913 -906 +907      imp:n=1 imp:p=1 u=1
918  8  0.09532  -914  904      imp:n=1 imp:p=1 u=1
919  3  0.08647  -914 -907  908      imp:n=1 imp:p=1 u=1
920  9  0.08293  -914 -908      imp:n=1 imp:p=1 u=1
921  3  0.08647   913 -914 -904 907 imp:n=1 imp:p=1 u=1
c
922  6  0.09344  -915 -905 +906      imp:n=1 imp:p=1 u=1
923  4  -1.6      -915  905 -904      imp:n=1 imp:p=1 u=1
924  4  -1.6      -915 -906 +907      imp:n=1 imp:p=1 u=1
925  8  0.09532  -916  904      imp:n=1 imp:p=1 u=1
926  3  0.08647  -916 -907  908      imp:n=1 imp:p=1 u=1
927  9  0.08293  -916 -908      imp:n=1 imp:p=1 u=1
928  3  0.08647   915 -916 -904 907 imp:n=1 imp:p=1 u=1
c
929  1  -1.0      910 912 914 916      imp:n=1 imp:p=1 u=1
c
c      FLIP Element
c
930  7  0.09016  -909 -905 +906      imp:n=1 imp:p=1 u=2

```

931	4	-1.6	-909	905	-904	imp:n=1	imp:p=1	u=2
932	4	-1.6	-909	-906	+907	imp:n=1	imp:p=1	u=2
933	8	0.09532	-910	904		imp:n=1	imp:p=1	u=2
934	3	0.08647	-910	-907	908	imp:n=1	imp:p=1	u=2
935	9	0.08293	-910	-908		imp:n=1	imp:p=1	u=2
936	3	0.08647	909	-910	-904 907	imp:n=1	imp:p=1	u=2

c

937	7	0.09016	-911	-905	+906	imp:n=1	imp:p=1	u=2
938	4	-1.6	-911	905	-904	imp:n=1	imp:p=1	u=2
939	4	-1.6	-911	-906	+907	imp:n=1	imp:p=1	u=2
940	8	0.09532	-912	904		imp:n=1	imp:p=1	u=2
941	3	0.08647	-912	-907	908	imp:n=1	imp:p=1	u=2
942	9	0.08293	-912	-908		imp:n=1	imp:p=1	u=2
943	3	0.08647	911	-912	-904 907	imp:n=1	imp:p=1	u=2

c

944	7	0.09016	-913	-905	+906	imp:n=1	imp:p=1	u=2
945	4	-1.6	-913	905	-904	imp:n=1	imp:p=1	u=2
946	4	-1.6	-913	-906	+907	imp:n=1	imp:p=1	u=2
947	8	0.09532	-914	904		imp:n=1	imp:p=1	u=2
948	3	0.08647	-914	-907	908	imp:n=1	imp:p=1	u=2
949	9	0.08293	-914	-908		imp:n=1	imp:p=1	u=2
950	3	0.08647	913	-914	-904 907	imp:n=1	imp:p=1	u=2

c

951	7	0.09016	-915	-905	+906	imp:n=1	imp:p=1	u=2
952	4	-1.6	-915	905	-904	imp:n=1	imp:p=1	u=2
953	4	-1.6	-915	-906	+907	imp:n=1	imp:p=1	u=2
954	8	0.09532	-916	904		imp:n=1	imp:p=1	u=2
955	3	0.08647	-916	-907	908	imp:n=1	imp:p=1	u=2
956	9	0.08293	-916	-908		imp:n=1	imp:p=1	u=2
957	3	0.08647	915	-916	-904 907	imp:n=1	imp:p=1	u=2

c

958	1	-1.0	910	912	914	916	imp:n=1	imp:p=1	u=2
-----	---	------	-----	-----	-----	-----	---------	---------	-----

c

c Graphite Reflector Element

c

959	4	-1.6	(917 -918 919 -920)	-904	908	imp:n=1	imp:p=1	u=3
960	2	0.06020	(-917:918:-919:920)	-904	908	imp:n=1	imp:p=1	u=3
961	8	0.09532	904			imp:n=1	imp:p=1	u=3
962	9	0.08293	-908			imp:n=1	imp:p=1	u=3

c

c Rotator Tube Element

c

963	2	0.06020	-924	923	921	imp:n=1	imp:p=1	u=4
964	1	-1.0	-923	921		imp:n=1	imp:p=1	u=4
965	2	0.06020	-924	-921	922	imp:n=1	imp:p=1	u=4
966	2	0.06020	-926	925	-922	imp:n=1	imp:p=1	u=4
967	1	-1.0	-925	-922		imp:n=1	imp:p=1	u=4

c

968	1	-1.0	926	-922		imp:n=1	imp:p=1	u=4
969	1	-1.0	924	922		imp:n=1	imp:p=1	u=4

c

c Transient Rod Element

c

970	2	0.04816	-936	935	907	imp:n=1	imp:p=1	u=5
971	10	0.13848	-935	205		imp:n=1	imp:p=1	u=5
972	1	-1.0	-935	-205	907	imp:n=1	imp:p=1	u=5
973	9	0.08293	-936	-907		imp:n=1	imp:p=1	u=5

c

974	7	0.09016	-911	-905	+906	imp:n=1	imp:p=1	u=5
975	4	-1.6	-911	905	-904	imp:n=1	imp:p=1	u=5
976	4	-1.6	-911	-906	+907	imp:n=1	imp:p=1	u=5
977	8	0.09532	-912	904		imp:n=1	imp:p=1	u=5
978	3	0.08647	-912	-907	908	imp:n=1	imp:p=1	u=5
979	9	0.08293	-912	-908		imp:n=1	imp:p=1	u=5
980	3	0.08647	911	-912	-904 907	imp:n=1	imp:p=1	u=5

c

```

981 7 0.09016 -913 -905 +906 imp:n=1 imp:p=1 u=5
982 4 -1.6 -913 905 -904 imp:n=1 imp:p=1 u=5
983 4 -1.6 -913 -906 +907 imp:n=1 imp:p=1 u=5
984 8 0.09532 -914 904 imp:n=1 imp:p=1 u=5
985 3 0.08647 -914 -907 908 imp:n=1 imp:p=1 u=5
986 9 0.08293 -914 -908 imp:n=1 imp:p=1 u=5
987 3 0.08647 913 -914 -904 907 imp:n=1 imp:p=1 u=5
C
988 7 0.09016 -909 -905 +906 imp:n=1 imp:p=1 u=5
989 4 -1.6 -909 905 -904 imp:n=1 imp:p=1 u=5
990 4 -1.6 -909 -906 +907 imp:n=1 imp:p=1 u=5
991 8 0.09532 -910 904 imp:n=1 imp:p=1 u=5
992 3 0.08647 -910 -907 908 imp:n=1 imp:p=1 u=5
993 9 0.08293 -910 -908 imp:n=1 imp:p=1 u=5
994 3 0.08647 909 -910 -904 907 imp:n=1 imp:p=1 u=5
C
995 1 -1.0 936 912 914 910 imp:n=1 imp:p=1 u=5
C
C *****
C ***** Beamport Cells *****
C *****
C ***** Core Side Water Region *****
C
1000 1 -1.0 31 -1 -12 15 -21 22 imp:n=1 imp:p=1
1001 1 -1.0 10 -32 -12 15 -21 22 imp:n=1 imp:p=1
C
1002 1 -1.0 2 -8 11 -33 -21 22 imp:n=1 imp:p=1
1003 1 -1.0 8 -9 11 -33 -21 22 imp:n=1 imp:p=1 $ Pb Box
C
1004 1 -1.0 2 -8 -16 34 -21 22 imp:n=1 imp:p=1
1005 1 -1.0 8 -9 -16 34 -21 22 imp:n=1 imp:p=1 $ Pb Box
C
C ***** Water Box Cells *****
C
1006 1 -1.0 (-31:32:33:-34:21:-22) (1001 -8 1005 -1006 1009 -1010) &
imp:n=1 imp:p=1
1007 1 -1.0 1001 -1002 1003 -1004 1007 -1008 (-1005:1006:-1009:1010) &
imp:n=0.25 imp:p=0.25
1008 1 -1.0 (5002:-5003:21:-22) 8 -1002 1005 -1006 1009 -1010 &
imp:n=1 imp:p=1
1009 1 -1.0 32 -1002 -33 34 -21 22 imp:n=1 imp:p=1
C
1010 1 -1.0 8 -1002 33 -5002 -21 22 imp:n=1 imp:p=1 $ Pb Box
1011 1 -1.0 8 -1002 -34 5003 -21 22 imp:n=1 imp:p=1 $ Pb Box
C
C ***** Aluminum Cone Grid & Lead Thermal Shield *****
C Aluminum Grid
1100 2 0.06020 1002 -1100 -1999 imp:n=2 imp:p=2
C
1101 2 0.06020 1100 -1102 -2000 -1103 1104 imp:n=2 imp:p=2
1102 2 0.06020 1100 -1102 -2000 -1105 1106 imp:n=2 imp:p=2
C
1103 2 0.06020 1100 -1102 -1107 1108 -1106 -2000 imp:n=2 imp:p=2
1104 2 0.06020 1100 -1102 -1107 1108 -1104 1105 imp:n=2 imp:p=2
1105 2 0.06020 1100 -1102 -1107 1108 1103 -2000 imp:n=2 imp:p=2
C
1106 2 0.06020 1100 -1102 -1109 1110 -1106 -2000 imp:n=2 imp:p=2
1107 2 0.06020 1100 -1102 -1109 1110 -1104 1105 imp:n=2 imp:p=2
1108 2 0.06020 1100 -1102 -1109 1110 1103 -2000 imp:n=2 imp:p=2
C Lead Thermal Shield
1109 11 0.03298 1100 -1101 -1106 1107 -2000 imp:n=2 imp:p=2
1110 11 0.03298 1100 -1101 -1104 1105 1107 -2000 imp:n=2 imp:p=2
1111 11 0.03298 1100 -1101 1103 1107 -2000 imp:n=2 imp:p=2
C
1112 11 0.03298 1100 -1101 -1108 1109 -1106 -2000 imp:n=2 imp:p=2

```

```

1113 11 0.03298 1100 -1101 -1108 1109 -1104 1105 imp:n=2 imp:p=2
1114 11 0.03298 1100 -1101 -1108 1109 1103 -2000 imp:n=2 imp:p=2
c
1115 11 0.03298 1100 -1101 -1106 -1110 -2000 imp:n=2 imp:p=2
1116 11 0.03298 1100 -1101 -1104 1105 -1110 -2000 imp:n=2 imp:p=2
1117 11 0.03298 1100 -1101 1103 -1110 -2000 imp:n=2 imp:p=2
c
Void Region
1118 0 1101 -1102 -1106 1107 -2000 5001 imp:n=2 imp:p=2 $ Rf
1119 0 1101 -1102 -1106 1107 -5001 imp:n=2 imp:p=2
1120 0 1101 -1102 -1104 1105 1107 -2000 5001 imp:n=2 imp:p=2 $ Rf
1121 0 1101 -1102 -1104 1105 1107 -5001 imp:n=2 imp:p=2
1122 0 1101 -1102 1103 1107 -2000 5001 imp:n=2 imp:p=2 $ Rf
1123 0 1101 -1102 1103 1107 -5001 imp:n=2 imp:p=2
c
1124 0 1101 -1102 -1108 1109 -1106 -2000 5001 imp:n=2 imp:p=2 $ Rf
1125 0 1101 -1102 -1108 1109 -1106 -5001 imp:n=2 imp:p=2
1126 0 1101 -1102 -1108 1109 -1104 1105 imp:n=2 imp:p=2
1127 0 1101 -1102 -1108 1109 1103 -2000 5001 imp:n=2 imp:p=2 $ Rf
1128 0 1101 -1102 -1108 1109 1103 -5001 imp:n=2 imp:p=2
c
1129 0 1101 -1102 -1106 -1110 -2000 5001 imp:n=2 imp:p=2 $ Rf
1130 0 1101 -1102 -1106 -1110 -5001 imp:n=2 imp:p=2
1131 0 1101 -1102 -1104 1105 -1110 -2000 5001 imp:n=2 imp:p=2 $ Rf
1132 0 1101 -1102 -1104 1105 -1110 -5001 imp:n=2 imp:p=2
1133 0 1101 -1102 1103 -1110 -2000 5001 imp:n=2 imp:p=2 $ Rf
1134 0 1101 -1102 1103 -1110 -5001 imp:n=2 imp:p=2
c
c ***** Conical Region Cells *****
c
2000 1 -1.0 1002 -3000 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=0.75 imp:p=0.75
2001 1 -1.0 1002 -3000 2024 -2025 2042 -2043 1999 imp:n=2 imp:p=2
2002 2 0.06020 1100 -3000 2000 -1999 imp:n=2 imp:p=2
c
c
2003 1 -1.0 3000 -2001 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=0.75 imp:p=0.75
2004 1 -1.0 3000 -2001 2024 -2025 2042 -2043 1999 imp:n=3 imp:p=3
2005 2 0.06020 3000 -2001 2000 -1999 imp:n=3 imp:p=3
c
c
2006 1 -1.0 2001 -2002 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=0.75 imp:p=0.75
2007 1 -1.0 2001 -2002 2024 -2025 2042 -2043 (-2014:2015:-2032:2033) &
      imp:n=3 imp:p=3
2008 2 0.06020 2001 -2002 2014 -2015 2032 -2033 2000 imp:n=3 imp:p=3
c
c ***** Boral Lined Region Cells *****
c
2100 12 0.07965 2002 -2003 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=3 imp:p=3
2101 12 0.07965 2002 -2003 2024 -2025 2042 -2043 (-2014:2015:-2032:2033) &
      imp:n=9 imp:p=9
2102 3 0.08647 2002 -2003 2014 -2015 2032 -2033 (-2012:2013:-2030:2031) &
      imp:n=9 imp:p=9
2103 5 0.08881 2002 -2003 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=9 imp:p=9
c
c ***** Inner Beam Cells *****
c
3000 0 1102 -3000 -2000 5001 imp:n=4 imp:p=4
3001 0 1102 -3000 -5001 imp:n=4 imp:p=4
c
3002 0 3000 -3001 -2000 5001 imp:n=6 imp:p=6
3003 0 3000 -3001 -5001 imp:n=6 imp:p=6
c

```



```

3004 0          3001 -3002 -2000 5001          imp:n=6 imp:p=6
3005 0          3001 -3002 -5001          imp:n=6 imp:p=6
C
3006 0          3002 -2002 -2000 5001          imp:n=6 imp:p=6
3007 0          3002 -2002 -5001          imp:n=6 imp:p=6
C
C      Filter Region of Inner Beam
C
4000 15  -3.97      2002 -3003 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=6 imp:p=6
4001 14  0.06970    2002 -3003 4002 -4003 4004 -4005
      imp:n=12 imp:p=12
C
4002 15  -3.97      3003 -3004 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=12 imp:p=12
4003 14  0.06970    3003 -3004 4002 -4003 4004 -4005
      imp:n=24 imp:p=24
C
4004 15  -3.97      3004 -3005 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=24 imp:p=24
4005 14  0.06970    3004 -3005 4002 -4003 4004 -4005
      imp:n=48 imp:p=48
C
4006 15  -3.97      3005 -2003 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=48 imp:p=48
4007 14  0.06970    3005 -2003 4002 -4003 4004 -4005
      imp:n=96 imp:p=96
C
C      ***** Outside World Void Region *****
C
5000 0          -1001:2003:-1003:1004:-1007:1008  imp:n=0 imp:p=0
C
C      *****
C      ***** Core Surface Cards *****
C      *****
C
C      Core Grid Definition Surfaces (X-Axis)
C
C      Main Grid
1      px      -34.29
2      px      -26.67
3      px      -19.05
4      px      -11.43
5      px      -3.81
6      px       3.81
7      px      11.43
8      px      19.05
9      px      26.67
10     px      34.29
C      Corner Elements
31     px      -36.83
32     px       36.83
C      Control Plates
101    px      -28.311
102    px       -1.26
103    px       1.26
104    px      28.311
C
C      Core Definition Surfaces (Y-Axis)
C
C      Main Grid
11     py      29.21
12     py      21.59
121    py      13.97
131    py      11.43

```



```

13  py    3.81
14  py   -3.81
141 py  -11.43
151 py  -13.97
15  py  -21.59
16  py  -29.21
c    Corner Elements
33  py   31.75
34  py  -31.75
c    Control Plates
111 py   13.716
112 py   11.684
113 py  -11.684
114 py  -13.716
c
c    Core Definition Surfaces (Z-Axis)
c
c    Main Grid
21  pz   42.365
22  pz  -48.715
c    Control Plates
201 pz   15.0      $ This surface controls the height of Plate 1 (Boral)
202 pz   15.0      $ This surface controls the height of Plate 2 (Boral)
203 pz   15.0      $ This surface controls the height of Plate 3 (SS)
204 pz   15.0      $ This surface controls the height of Plate 4 (Boral)
205 pz   15.0      $ This surface controls the Transient Rod height (B4C)
c
c    Element Universe Surface Cards
c
c    Standard and FLIP Elements
c
900 px  -3.8101
901 px   3.8101
c
902 py  -3.8101
903 py   3.8101
c
904 pz   27.76
905 pz   19.05
906 pz  -19.05
907 pz  -27.76
908 pz  -32.84
c
909 c/z  -1.905  1.905  1.74
910 c/z  -1.905  1.905  1.791
c
911 c/z   1.905  1.905  1.74
912 c/z   1.905  1.905  1.791
c
913 c/z  -1.905 -1.905  1.74
914 c/z  -1.905 -1.905  1.791
c
915 c/z   1.905 -1.905  1.74
916 c/z   1.905 -1.905  1.791
c
c    Graphite Reflector Elements
c
917 px  -3.65125
918 px   3.65125
c
919 py  -3.65125
920 py   3.65125
c
c    Rotator Tube Elements
c
921 pz  -36.015

```

922 pz -38.555

c

923 cz 3.683

924 cz 3.810

925 cz 2.540

926 cz 3.250

c

c Corner Grid Elements

c

927 px -35.125

928 px -28.375

929 px 28.375

930 px 35.125

c

931 py 30.045

932 py 23.295

933 py -23.295

934 py -30.045

c

c Transient Rod Elements

c

935 c/z 1.905 -1.905 1.7526

936 c/z 1.905 -1.905 1.8796

c

c

***** Beam Port Surface Cards *****

c

c Water Box Definition Surfaces

c

1001 px -51.83

1002 px 38.1

c

1003 py -121.92

1004 py 121.92

1005 py -62.00

1006 py 62.00

c

1007 pz -121.92

1008 pz 121.92

1009 pz -62.00

1010 pz 62.00

c

c Conical Region Surfaces

c

1999 kx -109.906 0.13069 1

2000 kx -106.156 0.13069 1

c

2001 px 101.60

2002 px 102.87

c

c Aluminum Face Grid

1100 px 39.37

1101 px 46.355

1102 px 59.69

c

1103 py 22.86

1104 py 20.32

1105 py -20.32

1106 py -22.32

c

1107 pz 22.86

1108 pz 20.32

1109 pz -20.32

1110 pz -22.86

c
c Leaded Region Surfaces

c
2003 px 139.70
c
2010 py -75.565
2011 py 75.565
2012 py -76.2
2013 py 76.2
2014 py -77.47
2015 py 77.47

c
2024 py -91.44
2025 py 91.44

c
2028 pz -75.565
2029 pz 75.565
2030 pz -76.2
2031 pz 76.2
2032 pz -77.47
2033 pz 77.47

c
2042 pz -91.44
2043 pz 91.44

c
c Inner Shell Region of the Beam Port Surfaces

c
3000 px 70
3001 px 80
3002 px 90

c
3003 px 110
3004 px 120
3005 px 130

c
4002 py -60.96
4003 py 60.96

c
4004 pz -60.96
4005 pz 60.96

c ***** Tally Segment Surface *****

c
5000 cx 7.5

c ***** Lead Box and Relector Surfaces *****

c
5001 kx -97.3 0.13069 1

c
5002 py 52.15
5003 py -52.15

c *****
c ***** CRITICALITY DATA CARDS *****
c *****

kcode 2500 1.1 5 100

c ksrc	-17.145	19.685	0	0	-9.525	15.875	0	13.335	19.685	0
c	20.955	15.875	0	32.385	19.685	0	-17.145	9.525	0	
c	-9.525	5.715	0	-1.905	9.525	0	5.715	5.715	0	
c	13.335	9.525	0	20.955	5.715	0	28.575	9.525	0	
c	-17.145	-1.905	0	-9.525	1.905	0	-1.905	-1.905	0	
c	5.715	1.905	0	13.335	-1.905	0	20.955	1.905	0	
c	28.575	-1.905	0	-17.145	-9.525	0	-9.525	-5.715	0	
c	-1.905	-9.525	0	5.715	-5.715	0	13.335	-9.525	0	
c	20.955	-5.715	0	32.385	-9.525	0	-9.525	-19.685	0	
c	17.145	-19.685	0	32.385	-19.685	0				

c	-17.145	19.685	12	-9.525	15.875	12	13.335	19.685	12
c	20.955	15.875	12	32.385	19.685	12	-17.145	9.525	12

c	-9.525	5.715	12	-1.905	9.525	12	5.715	5.715	12
c	13.335	9.525	12	20.955	5.715	12	28.575	9.525	12
c	-17.145	-1.905	12	-9.525	1.905	12	-1.905	-1.905	12
c	5.715	1.905	12	13.335	-1.905	12	20.955	1.905	12
c	28.575	-1.905	12	-17.145	-9.525	12	-9.525	-5.715	12
c	-1.905	-9.525	12	5.715	-5.715	12	13.335	-9.525	12
c	20.955	-5.715	12	32.385	-9.525	12	-9.525	-19.685	12
c	17.145	-19.685	12	32.385	-19.685	12			
c									
c	-17.145	19.685	-12	-9.525	15.875	-12	13.335	19.685	-12
c	20.955	15.875	-12	32.385	19.685	-12	-17.145	9.525	-12
c	-9.525	5.715	-12	-1.905	9.525	-12	5.715	5.715	-12
c	13.335	9.525	-12	20.955	5.715	-12	28.575	9.525	-12
c	-17.145	-1.905	-12	-9.525	1.905	-12	-1.905	-1.905	-12
c	5.715	1.905	-12	13.335	-1.905	-12	20.955	1.905	-12
c	28.575	-1.905	-12	-17.145	-9.525	-12	-9.525	-5.715	-12
c	-1.905	-9.525	-12	5.715	-5.715	-12	13.335	-9.525	-12
c	20.955	-5.715	-12	32.385	-9.525	-12	-9.525	-19.685	-12
c	17.145	-19.685	-12	32.385	-19.685	-12			

***** Mode Card *****

mode n p

***** Surface Source Write Card *****

ssw 1002

***** Print Dump Control Card *****

prdump j 100 j 2

***** MATERIAL CARDS *****

Water

m1 1001.50c 0.667

8016.50c 0.333

mt1 lwtr.07t

Aluminum

m2 13027.50c 1.0

304 Stainles Steel (WSU)

m3 26000.55c 0.730

24000.50c 0.191

28000.50c 0.075

6012.50c 0.004

Graphite (Carbon)

m4 6012.50c 1.0

mt4 grph.01t

Boral (from ARH-600, 35% B4C 65% Al)

m5 5010.50c 0.090

5011.56c 0.364

6012.50c 0.114

13027.50c 0.432

Standard Fuel Meat

m6 92235.53c 0.0027

92238.53c 0.0106

1001.53c 0.6129

40000.53c 0.3738

mt6 h/zr.01t

zr/h.01t

FLIP Fuel Meat

m7	92235.53c	0.0098
	92238.53c	0.0041
	1001.53c	0.6016
	40000.53c	0.3826
	68166.81c	0.0011
	68167.81c	0.0008
mt7	h/zr.01t	
	zr/h.01t	
c		
c	Top of Fuel Region (homogenized)	
m8	26000.55c	0.1364
	24000.50c	0.0357
	28000.50c	0.0141
	6012.50c	0.0007
	13027.50c	0.0322
	1001.50c	0.5207
	8016.50c	0.2602
mt8	lwtr.07t	
c		
c	Bottom of Fuel Region (homogenized)	
m9	26000.55c	0.0274
	24000.50c	0.0071
	28000.50c	0.0028
	6012.50c	0.0001
	13027.50c	0.3041
	1001.50c	0.4390
	8016.50c	0.2195
mt9	lwtr.07t	
c		
c	Boron Carbide (Transient Fuel Rod)	
m10	5010.50c	0.1583
	5011.56c	0.6417
	6012.50c	0.2000
c		
c	Lead	
m11	82000.50c	1.0
c		
c	Ordinary Concrete	
m12	1001.50c	0.18667
	8016.50c	0.52127
	26000.55c	0.00247
	6000.50c	0.04788
	14000.50c	0.07579
	12000.50c	0.00738
	13027.50c	0.00924
	20000.50c	0.14549
	11023.50c	0.00381
c		
c	Heavy Concrete	
m13	1001.50c	0.10078
	8016.50c	0.55034
	25055.50c	0.00025
	26000.55c	0.19460
	14000.50c	0.01960
	12000.50c	0.01714
	16032.50c	0.00114
	20000.50c	0.03238
	24000.50c	0.00023
	15031.50c	0.00013
	22000.50c	0.08318
	23000.50c	0.00023
c		
c	Al/Teflon	
m14	13027.50c	0.5185
	6012.50c	0.1555
	9019.50c	0.3111

3006.50c 0.0011
3007.55c 0.0137

C
C Aluminum Oxide (Al2O3)
m15 13027.50c -0.5292
8016.50c -0.4708

C
C Li(nat)-Poly
m17 1001.50c 0.5262
8016.50c 0.1007
6012.50c 0.2968
3006.50c 0.0725
3007.55c 0.0038

C
C Bismuth
m18 83209.50c 1.0

C ***** TALLY SPECIFICATION CARDS *****

C Neutron Flux Over a 7.5cm(radius) Disk Along the Beam's Axial Centerline
f2:n 1002 1100 1101 1102 3000 3001 3002 2002 3003 3004 3005
fm2:n 7.53e16

fs2 -5000
sd2 (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1)
fq2 f e
e2 4.14e-7 0.01 20

C

C Neutron Current Over a 7.5cm(radius) Disk Along the Beam's Axial Centerline
f1:n 1002 1100 1101 1102 3000 3001 3002 2002 3003 3004 3005
fm1:n 7.53e16

fs1 -5000
sd1 (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1)
fq1 f e
e1 4.14e-7 0.01 20

C

C ***** Power Density Tallies *****

C
f17:n 12 13 14 15 16 17 18
fm17 13152
sd17 1 1 1 1 1 1
f27:n 21 22 23 24 25 26 27 28 29
fm27 13152
sd27 1 1 1 1 1 1 1
f37:n 31 32 33 34 35 36 37 38 39
fm37 13152
sd37 1 1 1 1 1 1 1
f47:n 41 42 43 44 45 46 47 48 49
fm47 13152
sd47 1 1 1 1 1 1 1
f57:n 51 52 53 54 55 56 57 58 59
fm57 13152
sd57 1 1 1 1 1 1 1
f67:n 61 62 63 64 65 66 67 68 69
fm67 13152
sd67 1 1 1 1 1 1 1
f77:n 72 73 74 75 76 77 78
fm77 13152
sd77 1 1 1 1 1 1 1
C

Core Grid Model - Surface and Cell Diagram

Aluminum Cone / Lead Thermal Shield Model - Surface and Cell Diagram

Standard & FLIP Fuel Element Model - Surface and Cell Diagram

Transient Rod Element Model - Surface and Cell Diagram

Note: The elevation view is of the Transient Rod. The fuel rods in a Transient Rod Element are identical to those in the Standard and FLIP Elements, and a diagram of these can be found on the Standard and FLIP Element sheet. The table below matches the letters from the Standard and FLIP rod diagram with the cells in the three Transient Rod Element fuel rods.

	A	B	C	D	E	F	G
Upper Left TR Rod	991	989	994	988	990	992	993
Lower Left TR Rod	984	982	987	981	983	985	986
Upper Right TR Rod	977	975	980	974	976	978	979

Note: In the default model the 970 cell is filled with aluminum at 80% density. This approximates the porosity of the transient rod sheath region.

205

907

22

Graphite Element Model -Surface and Cell Diagram

Rotator Tube Element Model - Surface and Cell Diagram

Appendix B

BSPT Model Surface and Cell Diagrams

This appendix includes the BSPT Model default input deck and the following diagrams:

- 1. BSPT Model Surface Diagram**
- 2. BSPT Model Cell Diagram**

MCNP4A - Washington State University Reactor Facility Beam Model
CELL CARDS

***** Beamport Cells *****

***** Water Box Cells *****

1000 0 1001 -1002 1003 -1004 1007 -1008 imp:n=1 imp:p=1

***** Aluminum Cone Grid & Lead Thermal Shield *****

Aluminum Grid

1100 2 0.06020 1002 -1100 -1999 imp:n=2 imp:p=2

1101 2 0.06020 1100 -1102 -2000 -1103 1104 imp:n=2 imp:p=2

1102 2 0.06020 1100 -1102 -2000 -1105 1106 imp:n=2 imp:p=2

1103 2 0.06020 1100 -1102 -1107 1108 -1106 -2000 imp:n=2 imp:p=2

1104 2 0.06020 1100 -1102 -1107 1108 -1104 1105 imp:n=2 imp:p=2

1105 2 0.06020 1100 -1102 -1107 1108 1103 -2000 imp:n=2 imp:p=2

1106 2 0.06020 1100 -1102 -1109 1110 -1106 -2000 imp:n=2 imp:p=2

1107 2 0.06020 1100 -1102 -1109 1110 -1104 1105 imp:n=2 imp:p=2

1108 2 0.06020 1100 -1102 -1109 1110 1103 -2000 imp:n=2 imp:p=2

Lead Thermal Shield

1109 11 0.03298 1100 -1101 -1106 1107 -2000 imp:n=2 imp:p=2

1110 11 0.03298 1100 -1101 -1104 1105 1107 -2000 imp:n=2 imp:p=2

1111 11 0.03298 1100 -1101 1103 1107 -2000 imp:n=2 imp:p=2

1112 11 0.03298 1100 -1101 -1108 1109 -1106 -2000 imp:n=2 imp:p=2

1113 11 0.03298 1100 -1101 -1108 1109 -1104 1105 imp:n=2 imp:p=2

1114 11 0.03298 1100 -1101 -1108 1109 1103 -2000 imp:n=2 imp:p=2

1115 11 0.03298 1100 -1101 -1106 -1110 -2000 imp:n=2 imp:p=2

1116 11 0.03298 1100 -1101 -1104 1105 -1110 -2000 imp:n=2 imp:p=2

1117 11 0.03298 1100 -1101 1103 -1110 -2000 imp:n=2 imp:p=2

Void Region

1118 0 1101 -1102 -1106 1107 -2000 5001 imp:n=2 imp:p=2 \$Rf

1119 0 1101 -1102 -1106 1107 -5001 imp:n=2 imp:p=2

1120 0 1101 -1102 -1104 1105 1107 -2000 5001 imp:n=2 imp:p=2 \$Rf

1121 0 1101 -1102 -1104 1105 1107 -5001 imp:n=2 imp:p=2

1122 0 1101 -1102 1103 1107 -2000 5001 imp:n=2 imp:p=2 \$Rf

1123 0 1101 -1102 1103 1107 -5001 imp:n=2 imp:p=2

1124 0 1101 -1102 -1108 1109 -1106 -2000 5001 imp:n=2 imp:p=2 \$Rf

1125 0 1101 -1102 -1108 1109 -1106 -5001 imp:n=2 imp:p=2

1126 0 1101 -1102 -1108 1109 -1104 1105 imp:n=2 imp:p=2

1127 0 1101 -1102 -1108 1109 1103 -2000 5001 imp:n=2 imp:p=2 \$Rf

1128 0 1101 -1102 -1108 1109 1103 -5001 imp:n=2 imp:p=2

1129 0 1101 -1102 -1106 -1110 -2000 5001 imp:n=2 imp:p=2 \$Rf

1130 0 1101 -1102 -1106 -1110 -5001 imp:n=2 imp:p=2

1131 0 1101 -1102 -1104 1105 -1110 -2000 5001 imp:n=2 imp:p=2 \$Rf

1132 0 1101 -1102 -1104 1105 -1110 -5001 imp:n=2 imp:p=2

1133 0 1101 -1102 1103 -1110 -2000 5001 imp:n=2 imp:p=2 \$Rf

1134 0 1101 -1102 1103 -1110 -5001 imp:n=2 imp:p=2

***** Conical Region Cells *****

2000 1 -1.0 1002 -3000 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=0.75 imp:p=0.75

2001 1 -1.0 1002 -3000 2024 -2025 2042 -2043 1999 imp:n=2 imp:p=2

2002 2 0.06020 1100 -3000 2000 -1999 imp:n=2 imp:p=2


```

2003 1 -1.0 3000 -2001 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=0.75 imp:p=0.75
2004 1 -1.0 3000 -2001 2024 -2025 2042 -2043 1999 imp:n=3 imp:p=3
2005 2 0.06020 3000 -2001 2000 -1999 imp:n=3 imp:p=3
C
2006 1 -1.0 2001 -2002 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=0.75 imp:p=0.75
2007 1 -1.0 2001 -2002 2024 -2025 2042 -2043 (-2014:2015:-2032:2033) &
      imp:n=3 imp:p=3
2008 2 0.06020 2001 -2002 2014 -2015 2032 -2033 2000 imp:n=3 imp:p=3
C
C ***** Boral Lined Region Cells *****
C
2100 12 0.07965 2002 -2003 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=3 imp:p=3
2101 12 0.07965 2002 -2003 2024 -2025 2042 -2043 (-2014:2015:-2032:2033) &
      imp:n=9 imp:p=9
2102 3 0.08647 2002 -2003 2014 -2015 2032 -2033 (-2012:2013:-2030:2031) &
      imp:n=9 imp:p=9
2103 5 0.08881 2002 -2003 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=9 imp:p=9
C
C
2104 12 0.07965 2003 -2004 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=3 imp:p=3
2105 12 0.07965 2003 -2004 2024 -2025 2042 -2043 (-2018:2019:-2036:2037) &
      imp:n=9 imp:p=9
2106 3 0.08647 2003 -2004 2018 -2019 2036 -2037 (-2012:2013:-2030:2031) &
      imp:n=9 imp:p=9
2107 5 0.08881 2003 -2004 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=9 imp:p=9
C
C
2108 12 0.07965 2004 -3009 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=9 imp:p=9
2109 12 0.07965 2004 -3009 2024 -2025 2042 -2043 (-2018:2019:-2036:2037) &
      imp:n=60 imp:p=60
2110 3 0.08647 2004 -3009 2018 -2019 2036 -2037 (-2016:2017:-2034:2035) &
      imp:n=60 imp:p=60
2111 11 0.03298 2004 -3009 2016 -2017 2034 -2035 (-2012:2013:-2030:2031) &
      imp:n=60 imp:p=60
2112 5 0.08881 2004 -3009 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=60 imp:p=60
C
2113 12 0.07965 3009 -2005 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=48 imp:p=48
2114 12 0.07965 3009 -2005 2024 -2025 2042 -2043 (-2018:2019:-2036:2037) &
      imp:n=192 imp:p=192
2115 3 0.08647 3009 -2005 2018 -2019 2036 -2037 (-2016:2017:-2034:2035) &
      imp:n=192 imp:p=192
2116 11 0.03298 3009 -2005 2016 -2017 2034 -2035 (-2012:2013:-2030:2031) &
      imp:n=192 imp:p=192
2117 5 0.08881 3009 -2005 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=192 imp:p=192
C
C
2118 13 0.08050 2005 -2006 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=48 imp:p=48
2119 13 0.08050 2005 -2006 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
      imp:n=192 imp:p=192
2120 3 0.08647 2005 -2006 2022 -2023 2040 -2041 (-2016:2017:-2034:2035) &
      imp:n=192 imp:p=192
2121 11 0.03298 2005 -2006 2016 -2017 2034 -2035 (-2012:2013:-2030:2031) &
      imp:n=192 imp:p=192
2122 5 0.08881 2005 -2006 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &

```

imp:n=192 imp:p=192

C
C
2123 13 0.08050 2006 -3012 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=48 imp:p=48
2124 13 0.08050 2006 -3012 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=192 imp:p=192
2125 3 0.08647 2006 -3012 2022 -2023 2040 -2041 (-2020:2021:-2038:2039) &
imp:n=192 imp:p=192
2126 11 0.03298 2006 -3012 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
imp:n=192 imp:p=192
2127 5 0.08881 2006 -3012 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=192 imp:p=192

C
2128 13 0.08050 3012 -3015 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=96 imp:p=96
2129 13 0.08050 3012 -3015 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=384 imp:p=384
2130 3 0.08647 3012 -3015 2022 -2023 2040 -2041 (-2020:2021:-2038:2039) &
imp:n=384 imp:p=384
2131 11 0.03298 3012 -3015 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
imp:n=384 imp:p=384
2132 5 0.08881 3012 -3015 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=384 imp:p=384

C
2133 13 0.08050 3015 -2007 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=96 imp:p=96
2134 13 0.08050 3015 -2007 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=384 imp:p=384
2135 3 0.08647 3015 -2007 2022 -2023 2040 -2041 (-2020:2021:-2038:2039) &
imp:n=384 imp:p=384
2136 11 0.03298 3015 -2007 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
imp:n=384 imp:p=384
2137 5 0.08881 3015 -2007 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=384 imp:p=384

C
C
2138 13 0.08050 2007 -2008 1003 -1004 1007 -1008 (-2026:2027:-2044:2045) &
imp:n=96 imp:p=96
2139 3 0.08647 2007 -2008 2026 -2027 2044 -2045 (-2020:2021:-2038:2039) &
imp:n=384 imp:p=384
2140 11 0.03298 2007 -2008 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
imp:n=384 imp:p=384
2141 5 0.08881 2007 -2008 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=384 imp:p=384

C
C ***** End Region Cells *****

C
2142 13 0.08050 2008 -3017 1003 -1004 1007 -1008 (-2026:2027:-2044:2045) &
imp:n=96 imp:p=96
2143 3 0.08647 2008 -3017 2026 -2027 2044 -2045 (-2024:2025:-2042:2043) &
imp:n=384 imp:p=384
C
2144 13 0.08050 3017 -2009 1003 -1004 1007 -1008 (-2026:2027:-2044:2045) &
imp:n=96 imp:p=96
2145 3 0.08647 3017 -2009 2026 -2027 2044 -2045 (-2024:2025:-2042:2043) &
imp:n=96 imp:p=96

C
2146 13 0.08050 2009 -1011 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=24 imp:p=24

C
C ***** Inner Beam Cells *****

C
3000 0 1102 -3000 -2000 5001 imp:n=4 imp:p=4 \$Rf
3001 0 1102 -3000 -5001 imp:n=4 imp:p=4

C

3002	0		3000	-3001	-2000	5001				imp:n=6	imp:p=6	\$Rf
3003	0		3000	-3001	-5001					imp:n=6	imp:p=6	
C												
3004	0		3001	-3002	-2000	5001				imp:n=6	imp:p=6	\$Rf
3005	0		3001	-3002	-5001					imp:n=6	imp:p=6	
C												
3006	0		3002	-2002	-2000	5001				imp:n=6	imp:p=6	\$Rf
3007	0		3002	-2002	-5001					imp:n=6	imp:p=6	
C												
C												
C												
4000	15	-3.97	2002	-3003	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4001	14	0.06970	2002	-3003	4002	-4003	4004	-4005				
C												
4002	15	-3.97	3003	-3004	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4003	14	0.06970	3003	-3004	4002	-4003	4004	-4005				
C												
4004	15	-3.97	3004	-3005	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4005	14	0.06970	3004	-3005	4002	-4003	4004	-4005				
C												
4006	15	-3.97	3005	-3006	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4007	14	0.06970	3005	-3006	4002	-4003	4004	-4005				
C												
4008	15	-3.97	3006	-3007	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4009	14	0.06970	3006	-3007	4002	-4003	4004	-4005				
C												
4010	15	-3.97	3007	-3008	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4011	14	0.06970	3007	-3008	4002	-4003	4004	-4005				
C												
4012	15	-3.97	3008	-3009	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4013	14	0.06970	3008	-3009	4002	-4003	4004	-4005				
C												
4014	11	0.03298	3009	-3010	2010	-2011	2028	-2029	(-4002:4003:-4004:4005)	&		
4015	11	0.03298	3009	-3010	4002	-4003	4004	-4005				

```

4024 17 0.10351 3012 -3013 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
                                     imp:n=384 imp:p=384
4025 0 3012 -3013 4006 -4007 4008 -4009 4001 imp:n=576 imp:p=576
4026 17 0.10351 3012 -3013 4000 -4001 imp:n=1152 imp:p=1152
4027 0 3012 -3013 -4000 imp:n=2304 imp:p=2304
C
4028 17 0.10351 3013 -3014 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
                                     imp:n=384 imp:p=384
4029 0 3013 -3014 4006 -4007 4008 -4009 4001 imp:n=768 imp:p=768
4030 17 0.10351 3013 -3014 4000 -4001 imp:n=1536 imp:p=1536
4031 0 3013 -3014 -4000 imp:n=3072 imp:p=3072
C
4032 17 0.10351 3014 -3015 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
                                     imp:n=384 imp:p=384
4033 0 3014 -3015 4006 -4007 4008 -4009 4001 imp:n=1152 imp:p=1152
4034 17 0.10351 3014 -3015 4000 -4001 imp:n=2304 imp:p=2304
4035 0 3014 -3015 -4000 imp:n=4608 imp:p=4608
C
4036 17 0.10351 3015 -2008 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
                                     imp:n=384 imp:p=384
4037 0 3015 -2008 4006 -4007 4008 -4009 4001 imp:n=1536 imp:p=1536
4038 17 0.10351 3015 -2008 4000 -4001 imp:n=3072 imp:p=3072
4039 0 3015 -2008 -4000 imp:n=6144 imp:p=6144
C
C End Region
C
4040 17 0.10351 2008 -3016 2024 -2025 2042 -2043 (-4006:4007:-4008:4009) &
                                     imp:n=384 imp:p=384
4041 0 2008 -3016 4006 -4007 4008 -4009 5000 imp:n=1536 imp:p=1536
4042 0 2008 -3016 -5000 imp:n=6144 imp:p=6144
C
4043 17 0.10351 3016 -3017 2024 -2025 2042 -2043 (-4010:4011:-4012:4013) &
                                     imp:n=384 imp:p=384
4044 0 3016 -3017 4010 -4011 4012 -4013 5000 imp:n=1536 imp:p=1536
4045 0 3016 -3017 -5000 imp:n=6144 imp:p=6144
C
4046 17 0.10351 3017 -3018 2024 -2025 2042 -2043 (-4010:4011:-4012:4013) &
                                     imp:n=96 imp:p=96
4047 0 3017 -3018 4010 -4011 4012 -4013 5000 imp:n=384 imp:p=384
4048 0 3017 -3018 -5000 imp:n=1536 imp:p=1536
C
4049 17 0.10351 3018 -1011 2024 -2025 2042 -2043 (-4010:4011:-4012:4013) &
                                     imp:n=24 imp:p=24
4050 0 3018 -1011 4010 -4011 4012 -4013 5000 imp:n=96 imp:p=96
4051 0 3018 -1011 -5000 imp:n=384 imp:p=384
C
C ***** Outside World Void Region *****
C
5000 0 -1001:1011:-1003:1004:-1007:1008 imp:n=0 imp:p=0
C
C ***** Beam Port Surface Cards *****
C
C *****
C
C Water Box Definition Surfaces
C
1001 px 36
1002 px 38.1
C
1003 py -121.92
1004 py 121.92
C
1007 pz -121.92
1008 pz 121.92
C
1011 px 323.85

```

c
c Conical Region Surfaces
c
1999 kx -109.906 0.13069 1
2000 kx -106.156 0.13069 1
5001 kx -97.3 0.13069 1

c
2001 px 101.60
2002 px 102.87

c
c Aluminum Face Grid

1100 px 39.37
1101 px 46.355
1102 px 59.69

c
1103 py 22.86
1104 py 20.32
1105 py -20.32
1106 py -22.32

c
1107 pz 22.86
1108 pz 20.32
1109 pz -20.32
1110 pz -22.86

c
c Leaded Region Surfaces

c
2003 px 139.70
2004 px 140.97
2005 px 185.42
2006 px 186.69
2007 px 246.38
2008 px 247.65
2009 px 308.61

c
2010 py -75.565
2011 py 75.565
2012 py -76.2
2013 py 76.2
2014 py -77.47
2015 py 77.47
2016 py -78.74
2017 py 78.74
2018 py -80.01
2019 py 80.01
2020 py -81.28
2021 py 81.28
2022 py -82.55
2023 py 82.55
2024 py -91.44
2025 py 91.44
2026 py -92.71
2027 py 92.71

c
2028 pz -75.565
2029 pz 75.565
2030 pz -76.2
2031 pz 76.2
2032 pz -77.47
2033 pz 77.47
2034 pz -78.54
2035 pz 78.54
2036 pz -80.01
2037 pz 80.01
2038 pz -81.28
2039 pz 81.28

2040 pz -82.55
2041 pz 82.55
2042 pz -91.44
2043 pz 91.44
2044 pz -92.71
2045 pz 92.71

C

C Inner Shell Region of the Beam Port Surfaces

C

3000 px 70
3001 px 80
3002 px 90

C

3003 px 110
3004 px 120
3005 px 130
3006 px 140
3007 px 150
3008 px 160
3009 px 172.87
3010 px 178.87
3011 px 183.95
3012 px 195
3013 px 210
3014 px 220
3015 px 235

C

3016 px 252.73
3017 px 275
3018 px 300

C

C Filter Surfaces

C

4000 kx 259.78 0.3819 -1
4001 kx 269.44 0.3819 -1

C

4002 py -60.96
4003 py 60.96

C

4004 pz -60.96
4005 pz 60.96

C

4006 py -70.485
4007 py 70.485

C

4008 pz -70.485
4009 pz 70.485

C

4010 py -86.56
4011 py 86.56

C

4012 pz -86.56
4013 pz 86.56

C

C ***** Tally Segment Surface *****

C

5000 cx 7.5

C

C ***** Mode Card *****

C

C mode n p

C

C *****
C ***** SURFACE SOURCE READ CARDS *****
C *****

C

ssr old=1002 new=1002
nps 1800000

***** MATERIAL CARDS *****

Water

m1 1001.50c 0.667
8016.50c 0.333

Aluminum

m2 13027.50c 1.0

304 Stainles Steel (WSU)

m3 26000.55c 0.730
24000.50c 0.191
28000.50c 0.075
6012.50c 0.004

Graphite (Carbon)

m4 6012.50c 1.0

Boral (from ARH-600, 35% B4C 65% Al)

m5 5010.50c 0.090
5011.56c 0.364
6012.50c 0.114
13027.50c 0.432

Standard Fuel Meat

m6 92235.50c 0.0027
92238.50c 0.0106
1001.50c 0.6129
40000.50c 0.3738

FLIP Fuel Meat

m7 92235.50c 0.0098
92238.50c 0.0041
1001.50c 0.6016
40000.50c 0.3826
68166.81c 0.0011
68167.81c 0.0008

Top of Fuel Region (homogenized)

m8 26000.55c 0.1364
24000.50c 0.0357
28000.50c 0.0141
6012.50c 0.0007
13027.50c 0.0322
1001.50c 0.5207
8016.50c 0.2602

Bottom of Fuel Region (homogenized)

m9 26000.55c 0.0274
24000.50c 0.0071
28000.50c 0.0028
6012.50c 0.0001
13027.50c 0.3041
1001.50c 0.4390
8016.50c 0.2195

Boron Carbide (Transient Fuel Rod)

m10 5010.50c 0.1583
5011.56c 0.6417
6012.50c 0.2000

Lead

```

m11      82000.50c  1.0
c
c      Ordinary Concrete
m12      1001.50c   0.18667
          8016.50c   0.52127
          26000.55c  0.00247
          6000.50c   0.04788
          14000.50c  0.07579
          12000.50c  0.00738
          13027.50c  0.00924
          20000.50c  0.14549
          11023.50c  0.00381

```

```

c
c      Heavy Concrete
m13      1001.50c   0.10078
          8016.50c   0.55034
          25055.50c  0.00025
          26000.55c  0.19460
          14000.50c  0.01960
          12000.50c  0.01714
          16032.50c  0.00114
          20000.50c  0.03238
          24000.50c  0.00023
          15031.50c  0.00013
          22000.50c  0.08318
          23000.50c  0.00023

```

```

c
c      Al/Teflon
m14      13027.50c  0.5185
          3006.50c   0.0011
          3007.55c   0.0137
          6012.50c   0.1555
          9019.50c   0.3111

```

```

c
c      Aluminum Oxide (Al2O3)
m15      13027.50c  -0.5292
          8016.50c  -0.4708

```

```

c
c      Li(nat)-Poly
m17      1001.50c   0.5262
          8016.50c   0.1007
          6012.50c   0.2968
          3006.50c   0.0725
          3007.55c   0.0038

```

```

c
c      Bismuth
m18      83209.50c  1.0

```

```

c
c      ***** TALLY SPECIFICATION CARDS *****
c

```

```

c      Neutron Flux Over a 7.5cm(radius) Disk Along the Beam's Axial Centerline
f2:n      1002 1100 1101 1102 3000 3001 3002 2002 3003 3004 3005 3006 3007 3008 &
          3009 3010 3011 3012 3013 3014 3015 2008

```

```

fm2:n      7.53e16

```

```

fs2        -5000

```

```

sd2        (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1) &
          (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1) &
          (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1) &
          (176.71 1)  (176.71 1)  (176.71 1)  (176.71 1)

```

```

fq2        f e
e2          4.14e-7  0.01  20

```

```

c
c      Neutron Current Over a 7.5cm(radius) Disk Along the Beam's Axial Centerline
f1:n      1002 1100 1101 1102 3000 3001 3002 2002 3003 3004 3005 3006 3007 3008 &
          3009 3010 3011 3012 3013 3014 3015 2008
fm1:n      7.53e16

```



```

fs1 -5000
sd1 (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
    (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
    (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
    (176.71 1) (176.71 1) (176.71 1) (176.71 1)
fq1 f e
e1 4.14e-7 0.01 20
c
c Neutron Current Over the Al/Teflon Filter Inlet and Outlet Face (121.92x121
f11:n 2002 3009
fm11:n 7.53e16
fs11 -4002 4003 -4004 4005
sd11 (1 1 1 1 1) (1 1 1 1 1)
e11 4.14e-7 0.01 20
c
c Neutron Dose rates at the Beam Aperture Exit (cGy/min)
f22:n 2008
fm22:n 7.53e16
fs22 -5000
sd22 (176.71 1)
fq22 f e
e22 4.14e-7 0.01 20
de22 .10000E-10 .10000E-06 .41399E-06 .87642E-06 .18554E-05
    .50435E-05 .10677E-04 .37267E-04 .10130E-03 .21445E-03
    .45400E-03 .15846E-02 .33546E-02 .71017E-02 .15034E-01
    .21875E-01 .24176E-01 .26058E-01 .31828E-01 .40868E-01
    .67379E-01 .11109E+00 .18316E+00 .29720E+00 .36883E+00
    .49787E+00 .60810E+00 .74274E+00 .82085E+00 .10026E+01
    .13534E+01 .16530E+01 .19205E+01 .22313E+01 .23457E+01
    .23653E+01 .24660E+01 .27253E+01 .30119E+01 .36788E+01
    .49659E+01 .60653E+01 .74682E+01 .86071E+01 .10000E+02
    .12214E+02 .14191E+02 .17333E+02
c
df22 .1E-20 .1E-20 .1E-20 .35220E-12 .80570E-12
    .19660E-11 .46200E-11 .13090E-10 .39370E-10 .92580E-10
    .19550E-09 .55320E-09 .13820E-08 .29910E-08 .60670E-08
    .99720E-08 .12200E-07 .13230E-07 .14940E-07 .18060E-07
    .24380E-07 .34870E-07 .47760E-07 .63230E-07 .75370E-07
    .85630E-07 .96160E-07 .10530E-06 .11350E-06 .12100E-06
    .13730E-06 .15330E-06 .16570E-06 .17750E-06 .18470E-06
    .18700E-06 .18910E-06 .19470E-06 .20240E-06 .21340E-06
    .23410E-06 .25160E-06 .26400E-06 .27390E-06 .28080E-06
    .28700E-06 .29200E-06 .29390E-06
c
c Fine Energy Breakdown of Neutron Flux at Beam Exit Surface
c f12:n 2008
c fs12 -5000
c sd12 (176.71 1)
c fq12 e f
c e12 1e-7 2e-7 3e-7 4e-7 5e-7 6e-7 7e-7 8e-7 9e-7 &
c 1e-6 2e-6 3e-6 4e-6 5e-6 6e-6 7e-6 8e-6 9e-6 &
c 1e-5 2e-5 3e-5 4e-5 5e-5 6e-5 7e-5 8e-5 9e-5 &
c 1e-4 2e-4 3e-4 4e-4 5e-4 6e-4 7e-4 8e-4 9e-4 &
c 1e-3 2e-3 3e-3 4e-3 5e-3 6e-3 7e-3 8e-3 9e-3 &
c 1e-2 2e-2 3e-2 4e-2 5e-2 6e-2 7e-2 8e-2 9e-2 &
c 1e-1 2e-1 3e-1 4e-1 5e-1 6e-1 7e-1 8e-1 9e-1 &
c 1 2 3 4 5 6 7 8 9 &
c 1e+1 2e+1 3e+1 4e+1 5e+1 6e+1 7e+1 8e+1 9e+1 &
c
c Gamma Dose Rate (rem/hr) at Water Plug Surface
c f62:p 2008
c fs62 -5000
c fm62 7.53e16
c sd62 (176.71 1)
c Flux-to-Dose Conversion Factors for Photons
c de62 .01 .015 .02 .03 .04 .05 .06 .08 .1 .15 .2 .3 .4 &

```

[illegible]

The map displays the 1000 block of East 11th Street, with lots numbered 1001 through 2026. The street layout includes East 11th Street running horizontally across the top and bottom, and East 12th Street running horizontally across the middle. A diagonal line, likely representing a railroad or a major easement, runs from the bottom left towards the top right. The map is divided into several sections by vertical and horizontal lines, with lot numbers placed within these sections. Annotations include '1000' at the top center, '1001' at the bottom left, and '1002' at the bottom right. The map also shows various other lot numbers, such as 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1112, 1113, 1114, 1115, 1116, 1117, 1118, 1119, 1120, 1121, 1122, 1123, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, 1132, 1133, 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143, 1144, 1145, 1146, 1147, 1148, 1149, 1150, 1151, 1152, 1153, 1154, 1155, 1156, 1157, 1158, 1159, 1160, 1161, 1162, 1163, 1164, 1165, 1166, 1167, 1168, 1169, 1170, 1171, 1172, 1173, 1174, 1175, 1176, 1177, 1178, 1179, 1180, 1181, 1182, 1183, 1184, 1185, 1186, 1187, 1188, 1189, 1190, 1191, 1192, 1193, 1194, 1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1210, 1211, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1222, 1223, 1224, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1232, 1233, 1234, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1248, 1249, 1250, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, 1263, 1264, 1265, 1266, 1267, 1268, 1269, 1270, 1271, 1272, 1273, 1274, 1275, 1276, 1277, 1278, 1279, 1280, 1281, 1282, 1283, 1284, 1285, 1286, 1287, 1288, 1289, 1290, 1291, 1292, 1293, 1294, 1295, 1296, 1297, 1298, 1299, 1300, 1301, 1302, 1303, 1304, 1305, 1306, 1307, 1308, 1309, 1310, 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322, 1323, 1324, 1325, 1326, 1327, 1328, 1329, 1330, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341, 1342, 1343, 1344, 1345, 1346, 1347, 1348, 1349, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357, 1358, 1359, 1360, 1361, 1362, 1363, 1364, 1365, 1366, 1367, 1368, 1369, 1370, 1371, 1372, 1373, 1374, 1375, 1376, 1377, 1378, 1379, 1380, 1381, 1382, 1383, 1384, 1385, 1386, 1387, 1388, 1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397, 1398, 1399, 1400, 1401, 1402, 1403, 1404, 1405, 1406, 1407, 1408, 1409, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1417, 1418, 1419, 1420, 1421, 1422, 1423, 1424, 1425, 1426, 1427, 1428, 1429, 1430, 1431, 1432, 1433, 1434, 1435, 1436, 1437, 1438, 1439, 1440, 1441, 1442, 1443, 1444, 1445, 1446, 1447, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1484, 1485, 1486, 1487, 1488, 1489, 1490, 1491, 1492, 1493, 1494, 1495, 1496, 1497, 1498, 1499, 1500, 1501, 1502, 1503, 1504, 1505, 1506, 1507, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1517, 1518, 1519, 1520, 1521, 1522, 1523, 1524, 1525, 1526, 1527, 1528, 1529, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1544, 1545, 1546, 1547, 1548, 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556, 1557, 1558, 1559, 1560, 1561, 1562, 1563, 1564, 1565, 1566, 1567, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1575, 1576, 1577, 1578, 1579, 1580, 1581, 1582, 1583, 1584, 1585, 1586, 1587, 1588, 1589, 1590, 1591, 1592, 1593, 1594, 1595, 1596, 1597, 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1606, 1607, 1608, 1609, 1610, 1611, 1612, 1613, 1614, 1615, 1616, 1617, 1618, 1619, 1620, 1621, 1622, 1623, 1624, 1625, 1626, 1627, 1628, 1629, 1630, 1631, 1632, 1633, 1634, 1635, 1636, 1637, 1638, 1639, 1640, 1641, 1642, 1643, 1644, 1645, 1646, 1647, 1648, 1649, 1650, 1651, 1652, 1653, 1654, 1655, 1656, 1657, 1658, 1659, 1660, 1661, 1662, 1663, 1664, 1665, 1666, 1667, 1668, 1669, 1670, 1671, 1672, 1673, 1674, 1675, 1676, 1677, 1678, 1679, 1680, 1681, 1682, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1690, 1691, 1692, 1693, 1694, 1695, 1696, 1697, 1698, 1699, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1711, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, 1726, 1727, 1728, 1729, 1730, 1731, 1732, 1733, 1734, 1735, 1736, 1737, 1738, 1739, 17

BSPT Model - Cell Diagram

Appendix C

Combined Full Beam Model (CFB Model) Default Input File

This appendix includes the BSPT Model default input deck for the CFB Model.

This Model may be useful as a check for the final beam design. Also, it may be needed to generate a Surface Source at the beam exit for use in analyzing the design of a treatment room facility.

MCNP4A - Washington State University Reactor Facility Beam Model

CELL CARDS

 ***** Main Core Grid Cells *****

Fill Each Main Grid Cell With the Appropriate Element:

11,21,31 - Standard Fuel Element
 12,22,32 - FLIP Fuel Element
 13,23,33 - Reflector Block
 14,24,34 - Rotator Tube Element
 15,25,35 - Transient Rod Element

***** Region 1 - Use 11,12,13,14,15 *****

Row 1

12	0	2	-3	-11	12	-21	22	imp:n=1	imp:p=1	fill=13
13	0	3	-4	-11	12	-21	22	imp:n=1	imp:p=1	fill=13
14	0	4	-5	-11	12	-21	22	imp:n=1	imp:p=1	fill=13
15	0	5	-6	-11	12	-21	22	imp:n=1	imp:p=1	fill=13
16	0	6	-7	-11	12	-21	22	imp:n=1	imp:p=1	fill=13
17	0	7	-8	-11	12	-21	22	imp:n=1	imp:p=1	fill=13
18	0	8	-9	-11	12	-21	22	imp:n=1	imp:p=1	fill=13

Row 2

21	1	-1.0	1	-2	-12	121	-21	22	imp:n=1	imp:p=1	fill=
22	0	2	-3	-12	121	-21	22	imp:n=1	imp:p=1	fill=14	
23	0	3	-4	-12	121	-21	22	imp:n=1	imp:p=1	fill=11	
24	0	4	-5	-12	121	-21	22	imp:n=1	imp:p=1	fill=11	
25	0	5	-6	-12	121	-21	22	imp:n=1	imp:p=1	fill=13	
26	0	6	-7	-12	121	-21	22	imp:n=1	imp:p=1	fill=13	
27	0	7	-8	-12	121	-21	22	imp:n=1	imp:p=1	fill=11	
28	0	8	-9	-12	121	-21	22	imp:n=1	imp:p=1	fill=11	
29	0	9	-10	-12	121	-21	22	imp:n=1	imp:p=1	fill=11	

***** Region 2 - Use 21,22,23,24,25 *****

Row 3

31	1	-1.0	1	-2	-131	13	-21	22	imp:n=1	imp:p=1	fill=
32	0	2	-3	-131	13	-21	22	imp:n=1	imp:p=1	fill=24	
33	0	3	-4	-131	13	-21	22	imp:n=1	imp:p=1	fill=21	
34	0	4	-5	-131	13	-21	22	imp:n=1	imp:p=1	fill=22	
35	0	5	-6	-131	13	-21	22	imp:n=1	imp:p=1	fill=22	
36	0	6	-7	-131	13	-21	22	imp:n=1	imp:p=1	fill=22	
37	0	7	-8	-131	13	-21	22	imp:n=1	imp:p=1	fill=22	
38	0	8	-9	-131	13	-21	22	imp:n=1	imp:p=1	fill=21	
39	0	9	-10	-131	13	-21	22	imp:n=1	imp:p=1	fill=21	

Row 4

41	1	-1.0	1	-2	-13	14	-21	22	imp:n=1	imp:p 1	fill=
42	0	2	-3	-13	14	-21	22	imp:n=1	imp:p 1	fill=24	
43	0	3	-4	-13	14	-21	22	imp:n=1	imp:p 1	fill=21	
44	0	4	-5	-13	14	-21	22	imp:n=1	imp:p 1	fill=22	
45	0	5	-6	-13	14	-21	22	imp:n=1	imp:p 1	fill=22	
46	0	6	-7	-13	14	-21	22	imp:n=1	imp:p 1	fill=25	
47	0	7	-8	-13	14	-21	22	imp:n=1	imp:p 1	fill=22	
48	0	8	-9	-13	14	-21	22	imp:n=1	imp:p 1	fill=22	
49	0	9	-10	-13	14	-21	22	imp:n=1	imp:p 1	fill=21	

Row 5

51	1	-1.0	1	-2	-14	141	-21	22	imp:n=1	imp:p=1	fill=
52	0	2	-3	-14	141	-21	22	imp:n=1	imp:p=1	fill=24	
53	0	3	-4	-14	141	-21	22	imp:n=1	imp:p=1	fill=21	
54	0	4	-5	-14	141	-21	22	imp:n=1	imp:p=1	fill=22	
55	0	5	-6	-14	141	-21	22	imp:n=1	imp:p=1	fill=22	
56	0	6	-7	-14	141	-21	22	imp:n=1	imp:p=1	fill=22	
57	0	7	-8	-14	141	-21	22	imp:n=1	imp:p=1	fill=22	
58	0	8	-9	-14	141	-21	22	imp:n=1	imp:p=1	fill=21	
59	0	9	-10	-14	141	-21	22	imp:n=1	imp:p=1	fill=21	

c ***** Region 3- Use 31,32,33,34,35 *****

c Row 6

61	0	1	-2	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
62	0	2	-3	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
63	0	3	-4	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
64	0	4	-5	-151	15	-21	22	imp:n=1	imp:p=1	fill=31
65	0	5	-6	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
66	0	6	-7	-151	15	-21	22	imp:n=1	imp:p=1	fill=33
67	0	7	-8	-151	15	-21	22	imp:n=1	imp:p=1	fill=31
68	0	8	-9	-151	15	-21	22	imp:n=1	imp:p=1	fill=31
69	0	9	-10	-151	15	-21	22	imp:n=1	imp:p=1	fill=31

c Row 7

72	0	2	-3	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
73	0	3	-4	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
74	0	4	-5	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
75	0	5	-6	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
76	0	6	-7	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
77	0	7	-8	-15	16	-21	22	imp:n=1	imp:p=1	fill=33
78	0	8	-9	-15	16	-21	22	imp:n=1	imp:p=1	fill=33

c ***** Corner Grid Elements *****

c Row 1

11	2	0.06020	(31 -2 -33 12 -21 22)	(-927:928:931:-932)	imp:n=1	imp:p=1
711	1	-1.0	927 -928 -931 932 -21 22		imp:n=1	imp:p=1

c Row 7

19	2	0.06020	(9 -32 -33 12 -21 22)	(-929:930:931:-932)	imp:n=1	imp:p=1
719	1	-1.0	929 -930 -931 932 -21 22		imp:n=1	imp:p=1

c Row 7

71	2	0.06020	(31 -2 -15 34 -21 22)	(-927:928:933:-934)	imp:n=1	imp:p=1
771	1	-1.0	927 -928 -933 934 -21 22		imp:n=1	imp:p=1

c Row 7

79	2	0.06020	(9 -32 -15 34 -21 22)	(-929:930:933:-934)	imp:n=1	imp:p=1
779	1	-1.0	929 -930 -933 934 -21 22		imp:n=1	imp:p=1

c ***** Control Region Elements *****

c Guides

100	2	0.06020	1 -101 -121 131 -21 22	imp:n=1	imp:p=1
101	2	0.06020	101 -102 -121 111 -21 22	imp:n=1	imp:p=1
102	2	0.06020	101 -102 -112 131 -21 22	imp:n=1	imp:p=1
103	2	0.06020	102 -103 -121 131 -21 22	imp:n=1	imp:p=1
104	2	0.06020	103 -104 -121 111 -21 22	imp:n=1	imp:p=1
105	2	0.06020	103 -104 -112 131 -21 22	imp:n=1	imp:p=1
106	2	0.06020	104 -10 -121 131 -21 22	imp:n=1	imp:p=1

c Control Blades - Upper Region

107	2	0.06020	1 -101 -141 151 -21 22	imp:n=1	imp:p=1
108	2	0.06020	101 -102 -141 113 -21 22	imp:n=1	imp:p=1
109	2	0.06020	101 -102 -114 151 -21 22	imp:n=1	imp:p=1
110	2	0.06020	102 -103 -141 151 -21 22	imp:n=1	imp:p=1
111	2	0.06020	103 -104 -141 113 -21 22	imp:n=1	imp:p=1
112	2	0.06020	103 -104 -114 151 -21 22	imp:n=1	imp:p=1
113	2	0.06020	104 -10 -141 151 -21 22	imp:n=1	imp:p=1

c Control Blades - Lower Water Gap Region

201	5	0.08881	101 -102 -111 112 -21 201	imp:n=1	imp:p=1
202	5	0.08881	103 -104 -111 112 -21 202	imp:n=1	imp:p=1
203	3	0.08647	101 -102 -113 114 -21 203	imp:n=1	imp:p=1
204	5	0.08881	103 -104 -113 114 -21 204	imp:n=1	imp:p=1

211	1	-1.0	101 -102 -111 112 -201 22	imp:n=1	imp:p=1
212	1	-1.0	103 -104 -111 112 -202 22	imp:n=1	imp:p=1
213	1	-1.0	101 -102 -113 114 -203 22	imp:n=1	imp:p=1
214	1	-1.0	103 -104 -113 114 -204 22	imp:n=1	imp:p=1

c ***** Core Grid Lattices *****

c


```

c      Standard Element Lattices - Region 1,2,3
801  0   900 -901 902 -903 imp:n=1 imp:p=1 lat=1 u=21 fill=1
802  like 801 but   trcl=( 0  2.54  0)          u=11
803  like 801 but   trcl=( 0 -2.54  0)          u=31
c
c      FLIP Element Lattices - Region 1,2,3
804  like 801 but                               u=22 fill=2
805  like 804 but   trcl=( 0  2.54  0)          u=12
806  like 804 but   trcl=( 0 -2.54  0)          u=32
c
c      Graphite Element Lattices - Region 1,2,3
807  like 801 but                               u=23 fill=3
808  like 807 but   trcl=( 0  2.54  0)          u=13
809  like 807 but   trcl=( 0 -2.54  0)          u=33
c
c      Rotator Tube Lattices - Region 1,2,3
810  like 801 but                               u=24 fill=4
811  like 810 but   trcl=( 0  2.54  0)          u=14
812  like 810 but   trcl=( 0 -2.54  0)          u=34
c
c      Transient Rod Element Lattices - Region 1,2,3
813  like 801 but                               u=25 fill=5
814  like 813 but   trcl=( 0  2.54  0)          u=15
815  like 814 but   trcl=( 0 -2.54  0)          u=35
c
c      ***** Universe Element Cells *****
c
c      Standard Element
c
901  6   0.09344  -909 -905 +906      imp:n=1 imp:p=1 u=1
902  4   -1.6      -909  905 -904      imp:n=1 imp:p=1 u=1
903  4   -1.6      -909 -906 +907      imp:n=1 imp:p=1 u=1
904  8   0.09532  -910  904              imp:n=1 imp:p=1 u=1
905  3   0.08647  -910 -907  908      imp:n=1 imp:p=1 u=1
906  9   0.08293  -910 -908              imp:n=1 imp:p=1 u=1
907  3   0.08647   909 -910 -904 907  imp:n=1 imp:p=1 u=1
c
908  6   0.09344  -911 -905 +906      imp:n=1 imp:p=1 u=1
909  4   -1.6      -911  905 -904      imp:n=1 imp:p=1 u=1
910  4   -1.6      -911 -906 +907      imp:n=1 imp:p=1 u=1
911  8   0.09532  -912  904              imp:n=1 imp:p=1 u=1
912  3   0.08647  -912 -907  908      imp:n=1 imp:p=1 u=1
913  9   0.08293  -912 -908              imp:n=1 imp:p=1 u=1
914  3   0.08647   911 -912 -904 907  imp:n=1 imp:p=1 u=1
c
915  6   0.09344  -913 -905 +906      imp:n=1 imp:p=1 u=1
916  4   -1.6      -913  905 -904      imp:n=1 imp:p=1 u=1
917  4   -1.6      -913 -906 +907      imp:n=1 imp:p=1 u=1
918  8   0.09532  -914  904              imp:n=1 imp:p=1 u=1
919  3   0.08647  -914 -907  908      imp:n=1 imp:p=1 u=1
920  9   0.08293  -914 -908              imp:n=1 imp:p=1 u=1
921  3   0.08647   913 -914 -904 907  imp:n=1 imp:p=1 u=1
c
922  6   0.09344  -915 -905 +906      imp:n=1 imp:p=1 u=1
923  4   -1.6      -915  905 -904      imp:n=1 imp:p=1 u=1
924  4   -1.6      -915 -906 +907      imp:n=1 imp:p=1 u=1
925  8   0.09532  -916  904              imp:n=1 imp:p=1 u=1
926  3   0.08647  -916 -907  908      imp:n=1 imp:p=1 u=1
927  9   0.08293  -916 -908              imp:n=1 imp:p=1 u=1
928  3   0.08647   915 -916 -904 907  imp:n=1 imp:p=1 u=1
c
929  1   -1.0      910 912 914 916      imp:n=1 imp:p=1 u=1
c
c      FLIP Element
c
930  7   0.09016  -909 -905 +906      imp:n=1 imp:p=1 u=2

```

931	4	-1.6	-909	905	-904	imp:n=1	imp:p=1	u=2
932	4	-1.6	-909	-906	+907	imp:n=1	imp:p=1	u=2
933	8	0.09532	-910	904		imp:n=1	imp:p=1	u=2
934	3	0.08647	-910	-907	908	imp:n=1	imp:p=1	u=2
935	9	0.08293	-910	-908		imp:n=1	imp:p=1	u=2
936	3	0.08647	909	-910	-904 907	imp:n=1	imp:p=1	u=2

c

937	7	0.09016	-911	-905	+906	imp:n=1	imp:p=1	u=2
938	4	-1.6	-911	905	-904	imp:n=1	imp:p=1	u=2
939	4	-1.6	-911	-906	+907	imp:n=1	imp:p=1	u=2
940	8	0.09532	-912	904		imp:n=1	imp:p=1	u=2
941	3	0.08647	-912	-907	908	imp:n=1	imp:p=1	u=2
942	9	0.08293	-912	-908		imp:n=1	imp:p=1	u=2
943	3	0.08647	911	-912	-904 907	imp:n=1	imp:p=1	u=2

c

944	7	0.09016	-913	-905	+906	imp:n=1	imp:p=1	u=2
945	4	-1.6	-913	905	-904	imp:n=1	imp:p=1	u=2
946	4	-1.6	-913	-906	+907	imp:n=1	imp:p=1	u=2
947	8	0.09532	-914	904		imp:n=1	imp:p=1	u=2
948	3	0.08647	-914	-907	908	imp:n=1	imp:p=1	u=2
949	9	0.08293	-914	-908		imp:n=1	imp:p=1	u=2
950	3	0.08647	913	-914	-904 907	imp:n=1	imp:p=1	u=2

c

951	7	0.09016	-915	-905	+906	imp:n=1	imp:p=1	u=2
952	4	-1.6	-915	905	-904	imp:n=1	imp:p=1	u=2
953	4	-1.6	-915	-906	+907	imp:n=1	imp:p=1	u=2
954	8	0.09532	-916	904		imp:n=1	imp:p=1	u=2
955	3	0.08647	-916	-907	908	imp:n=1	imp:p=1	u=2
956	9	0.08293	-916	-908		imp:n=1	imp:p=1	u=2
957	3	0.08647	915	-916	-904 907	imp:n=1	imp:p=1	u=2

c

958	1	-1.0	910	912	914 916	imp:n=1	imp:p=1	u=2
-----	---	------	-----	-----	---------	---------	---------	-----

c

c Graphite Reflector Element

959	4	-1.6	(917 -918 919 -920)	-904 908	imp:n=1	imp:p=1	u=3
960	2	0.06020	(-917:918:-919:920)	-904 908	imp:n=1	imp:p=1	u=3
961	8	0.09532	904		imp:n=1	imp:p=1	u=3
962	9	0.08293	-908		imp:n=1	imp:p=1	u=3

c

c Rotator Tube Element

963	2	0.06020	-924 923 921	imp:n=1	imp:p=1	u=4
964	1	-1.0	-923 921	imp:n=1	imp:p=1	u=4
965	2	0.06020	-924 -921 922	imp:n=1	imp:p=1	u=4
966	2	0.06020	-926 925 -922	imp:n=1	imp:p=1	u=4
967	1	-1.0	-925 -922	imp:n=1	imp:p=1	u=4

c

968	1	-1.0	926 -922	imp:n=1	imp:p=1	u=4
969	1	-1.0	924 922	imp:n=1	imp:p=1	u=4

c

c Transient Rod Element

970	2	0.04816	-936 935 907	imp:n=1	imp:p=1	u=5
971	10	0.13848	-935 205	imp:n=1	imp:p=1	u=5
972	1	-1.0	-935 -205 907	imp:n=1	imp:p=1	u=5
973	9	0.08293	-936 -907	imp:n=1	imp:p=1	u=5

c

974	7	0.09016	-911 -905 +906	imp:n=1	imp:p=1	u=5
975	4	-1.6	-911 905 -904	imp:n=1	imp:p=1	u=5
976	4	-1.6	-911 -906 +907	imp:n=1	imp:p=1	u=5
977	8	0.09532	-912 904	imp:n=1	imp:p=1	u=5
978	3	0.08647	-912 -907 908	imp:n=1	imp:p=1	u=5
979	9	0.08293	-912 -908	imp:n=1	imp:p=1	u=5
980	3	0.08647	911 -912 -904 907	imp:n=1	imp:p=1	u=5

c

```

981 7 0.09016 -913 -905 +906 imp:n=1 imp:p=1 u=5
982 4 -1.6 -913 905 -904 imp:n=1 imp:p=1 u=5
983 4 -1.6 -913 -906 +907 imp:n=1 imp:p=1 u=5
984 8 0.09532 -914 904 imp:n=1 imp:p=1 u=5
985 3 0.08647 -914 -907 908 imp:n=1 imp:p=1 u=5
986 9 0.08293 -914 -908 imp:n=1 imp:p=1 u=5
987 3 0.08647 913 -914 -904 907 imp:n=1 imp:p=1 u=5
C
988 7 0.09016 -909 -905 +906 imp:n=1 imp:p=1 u=5
989 4 -1.6 -909 905 -904 imp:n=1 imp:p=1 u=5
990 4 -1.6 -909 -906 +907 imp:n=1 imp:p=1 u=5
991 8 0.09532 -910 904 imp:n=1 imp:p=1 u=5
992 3 0.08647 -910 -907 908 imp:n=1 imp:p=1 u=5
993 9 0.08293 -910 -908 imp:n=1 imp:p=1 u=5
994 3 0.08647 909 -910 -904 907 imp:n=1 imp:p=1 u=5
C
995 1 -1.0 936 912 914 910 imp:n=1 imp:p=1 u=5
C
C *****
C ***** Beamport Cells *****
C *****
C ***** Core Side Water Region *****
C
1000 1 -1.0 31 -1 -12 15 -21 22 imp:n=1 imp:p=1
1001 1 -1.0 10 -32 -12 15 -21 22 imp:n=1 imp:p=1
C
1002 1 -1.0 2 -8 11 -33 -21 22 imp:n=1 imp:p=1
1003 1 -1.0 8 -9 11 -33 -21 22 imp:n=1 imp:p=1 $ Pb Box
C
1004 1 -1.0 2 -8 -16 34 -21 22 imp:n=1 imp:p=1
1005 1 -1.0 8 -9 -16 34 -21 22 imp:n=1 imp:p=1 $ Pb Box
C
C ***** Water Box Cells *****
C
1006 1 -1.0 (-31:32:33:-34:21:-22) (1001 -8 1005 -1006 1009 -1010) &
imp:n=1 imp:p=1
1007 1 -1.0 1001 -1002 1003 -1004 1007 -1008 (-1005:1006:-1009:1010) &
imp:n=0.25 imp:p=0.25
1008 1 -1.0 (5002:-5003:21:-22) 8 -1002 1005 -1006 1009 -1010 &
imp:n=1 imp:p=1
1009 1 -1.0 32 -1002 -33 34 -21 22 imp:n=1 imp:p=1
C
1010 1 -1.0 8 -1002 33 -5002 -21 22 imp:n=1 imp:p=1 $ Pb Box
1011 1 -1.0 8 -1002 -34 5003 -21 22 imp:n=1 imp:p=1 $ Pb Box
C
C ***** Aluminum Cone Grid & Lead Thermal Shield *****
C Aluminum Grid
1100 2 0.06020 1002 -1100 -1999 imp:n=2 imp:p=2
C
1101 2 0.06020 1100 -1102 -2000 -1103 1104 imp:n=2 imp:p=2
1102 2 0.06020 1100 -1102 -2000 -1105 1106 imp:n=2 imp:p=2
C
1103 2 0.06020 1100 -1102 -1107 1108 -1106 -2000 imp:n=2 imp:p=2
1104 2 0.06020 1100 -1102 -1107 1108 -1104 1105 imp:n=2 imp:p=2
1105 2 0.06020 1100 -1102 -1107 1108 1103 -2000 imp:n=2 imp:p=2
C
1106 2 0.06020 1100 -1102 -1109 1110 -1106 -2000 imp:n=2 imp:p=2
1107 2 0.06020 1100 -1102 -1109 1110 -1104 1105 imp:n=2 imp:p=2
1108 2 0.06020 1100 -1102 -1109 1110 1103 -2000 imp:n=2 imp:p=2
C Lead Thermal Shield
1109 11 0.03298 1100 -1101 -1106 1107 -2000 imp:n=2 imp:p=2
1110 11 0.03298 1100 -1101 -1104 1105 1107 -2000 imp:n=2 imp:p=2
1111 11 0.03298 1100 -1101 1103 1107 -2000 imp:n=2 imp:p=2
C
1112 11 0.03298 1100 -1101 -1108 1109 -1106 -2000 imp:n=2 imp:p=2

```

```

1113 11 0.03298 1100 -1101 -1108 1109 -1104 1105 imp:n=2 imp:p=2
1114 11 0.03298 1100 -1101 -1108 1109 1103 -2000 imp:n=2 imp:p=2
c
1115 11 0.03298 1100 -1101 -1106 -1110 -2000 imp:n=2 imp:p=2
1116 11 0.03298 1100 -1101 -1104 1105 -1110 -2000 imp:n=2 imp:p=2
1117 11 0.03298 1100 -1101 1103 -1110 -2000 imp:n=2 imp:p=2
c Void Region
1118 0 1101 -1102 -1106 1107 -2000 5001 imp:n=2 imp:p=2 $Rf
1119 0 1101 -1102 -1106 1107 -5001 imp:n=2 imp:p=2
1120 0 1101 -1102 -1104 1105 1107 -2000 5001 imp:n=2 imp:p=2 $Rf
1121 0 1101 -1102 -1104 1105 1107 -5001 imp:n=2 imp:p=2
1122 0 1101 -1102 1103 1107 -2000 5001 imp:n=2 imp:p=2 $Rf
1123 0 1101 -1102 1103 1107 -5001 imp:n=2 imp:p=2
c
1124 0 1101 -1102 -1108 1109 -1106 -2000 5001 imp:n=2 imp:p=2 $Rf
1125 0 1101 -1102 -1108 1109 -1106 -5001 imp:n=2 imp:p=2
1126 0 1101 -1102 -1108 1109 -1104 1105 imp:n=2 imp:p=2
1127 0 1101 -1102 -1108 1109 1103 -2000 5001 imp:n=2 imp:p=2 $Rf
1128 0 1101 -1102 -1108 1109 1103 -5001 imp:n=2 imp:p=2
c
1129 0 1101 -1102 -1106 -1110 -2000 5001 imp:n=2 imp:p=2 $Rf
1130 0 1101 -1102 -1106 -1110 -5001 imp:n=2 imp:p=2
1131 0 1101 -1102 -1104 1105 -1110 -2000 5001 imp:n=2 imp:p=2 $Rf
1132 0 1101 -1102 -1104 1105 -1110 -5001 imp:n=2 imp:p=2
1133 0 1101 -1102 1103 -1110 -2000 5001 imp:n=2 imp:p=2 $Rf
1134 0 1101 -1102 1103 -1110 -5001 imp:n=2 imp:p=2
c
***** Conical Region Cells *****
c
2000 1 -1.0 1002 -3000 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=0.75 imp:p=0.75
2001 1 -1.0 1002 -3000 2024 -2025 2042 -2043 1999 imp:n=2 imp:p=2
2002 2 0.06020 1100 -3000 2000 -1999 imp:n=2 imp:p=2
c
c
2003 1 -1.0 3000 -2001 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=0.75 imp:p=0.75
2004 1 -1.0 3000 -2001 2024 -2025 2042 -2043 1999 imp:n=3 imp:p=3
2005 2 0.06020 3000 -2001 2000 -1999 imp:n=3 imp:p=3
c
c
2006 1 -1.0 2001 -2002 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=0.75 imp:p=0.75
2007 1 -1.0 2001 -2002 2024 -2025 2042 -2043 (-2014:2015:-2032:2033) &
imp:n=3 imp:p=3
2008 2 0.06020 2001 -2002 2014 -2015 2032 -2033 2000 imp:n=3 imp:p=3
c
c
***** Boral Lined Region Cells *****
c
2100 12 0.07965 2002 -2003 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=3 imp:p=3
2101 12 0.07965 2002 -2003 2024 -2025 2042 -2043 (-2014:2015:-2032:2033) &
imp:n=9 imp:p=9
2102 3 0.08647 2002 -2003 2014 -2015 2032 -2033 (-2012:2013:-2030:2031) &
imp:n=9 imp:p=9
2103 5 0.08881 2002 -2003 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=9 imp:p=9
c
c
2104 12 0.07965 2003 -2004 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=3 imp:p=3
2105 12 0.07965 2003 -2004 2024 -2025 2042 -2043 (-2018:2019:-2036:2037) &
imp:n=9 imp:p=9
2106 3 0.08647 2003 -2004 2018 -2019 2036 -2037 (-2012:2013:-2030:2031) &
imp:n=9 imp:p=9
2107 5 0.08881 2003 -2004 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &

```

imp:n=9 imp:p=9

C

C

2108 12 0.07965 2004 -3009 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=9 imp:p=9
2109 12 0.07965 2004 -3009 2024 -2025 2042 -2043 (-2018:2019:-2036:2037) &
imp:n=60 imp:p=60
2110 3 0.08647 2004 -3009 2018 -2019 2036 -2037 (-2016:2017:-2034:2035) &
imp:n=60 imp:p=60
2111 11 0.03298 2004 -3009 2016 -2017 2034 -2035 (-2012:2013:-2030:2031) &
imp:n=60 imp:p=60
2112 5 0.08881 2004 -3009 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=60 imp:p=60

C

2113 12 0.07965 3009 -2005 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=48 imp:p=48
2114 12 0.07965 3009 -2005 2024 -2025 2042 -2043 (-2018:2019:-2036:2037) &
imp:n=192 imp:p=192
2115 3 0.08647 3009 -2005 2018 -2019 2036 -2037 (-2016:2017:-2034:2035) &
imp:n=192 imp:p=192
2116 11 0.03298 3009 -2005 2016 -2017 2034 -2035 (-2012:2013:-2030:2031) &
imp:n=192 imp:p=192
2117 5 0.08881 3009 -2005 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=192 imp:p=192

C

C

2118 13 0.08050 2005 -2006 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=48 imp:p=48
2119 13 0.08050 2005 -2006 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=192 imp:p=192
2120 3 0.08647 2005 -2006 2022 -2023 2040 -2041 (-2016:2017:-2034:2035) &
imp:n=192 imp:p=192
2121 11 0.03298 2005 -2006 2016 -2017 2034 -2035 (-2012:2013:-2030:2031) &
imp:n=192 imp:p=192
2122 5 0.08881 2005 -2006 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=192 imp:p=192

C

C

2123 13 0.08050 2006 -3012 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=48 imp:p=48
2124 13 0.08050 2006 -3012 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=192 imp:p=192
2125 3 0.08647 2006 -3012 2022 -2023 2040 -2041 (-2020:2021:-2038:2039) &
imp:n=192 imp:p=192
2126 11 0.03298 2006 -3012 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
imp:n=192 imp:p=192
2127 5 0.08881 2006 -3012 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=192 imp:p=192

C

2128 13 0.08050 3012 -3015 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=96 imp:p=96
2129 13 0.08050 3012 -3015 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=384 imp:p=384
2130 3 0.08647 3012 -3015 2022 -2023 2040 -2041 (-2020:2021:-2038:2039) &
imp:n=384 imp:p=384
2131 11 0.03298 3012 -3015 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
imp:n=384 imp:p=384
2132 5 0.08881 3012 -3015 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
imp:n=384 imp:p=384

C

2133 13 0.08050 3015 -2007 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
imp:n=96 imp:p=96
2134 13 0.08050 3015 -2007 2024 -2025 2042 -2043 (-2022:2023:-2040:2041) &
imp:n=384 imp:p=384
2135 3 0.08647 3015 -2007 2022 -2023 2040 -2041 (-2020:2021:-2038:2039) &
imp:n=384 imp:p=384

```

2136 11 0.03298 3015 -2007 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
      imp:n=384 imp:p=384
2137 5 0.08881 3015 -2007 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=384 imp:p=384
c
c
2138 13 0.08050 2007 -2008 1003 -1004 1007 -1008 (-2026:2027:-2044:2045) &
      imp:n=96 imp:p=96
2139 3 0.08647 2007 -2008 2026 -2027 2044 -2045 (-2020:2021:-2038:2039) &
      imp:n=384 imp:p=384
2140 11 0.03298 2007 -2008 2020 -2021 2038 -2039 (-2012:2013:-2030:2031) &
      imp:n=384 imp:p=384
2141 5 0.08881 2007 -2008 2012 -2013 2030 -2031 (-2010:2011:-2028:2029) &
      imp:n=384 imp:p=384
c
c
      ***** End Region Cells *****
c
2142 13 0.08050 2008 -3017 1003 -1004 1007 -1008 (-2026:2027:-2044:2045) &
      imp:n=96 imp:p=96
2143 3 0.08647 2008 -3017 2026 -2027 2044 -2045 (-2024:2025:-2042:2043) &
      imp:n=384 imp:p=384
c
2144 13 0.08050 3017 -2009 1003 -1004 1007 -1008 (-2026:2027:-2044:2045) &
      imp:n=96 imp:p=96
2145 3 0.08647 3017 -2009 2026 -2027 2044 -2045 (-2024:2025:-2042:2043) &
      imp:n=96 imp:p=96
c
2146 13 0.08050 2009 -1011 1003 -1004 1007 -1008 (-2024:2025:-2042:2043) &
      imp:n=24 imp:p=24
c
c
      ***** Inner Beam Cells *****
c
3000 0 1102 -3000 -2000 5001 imp:n=4 imp:p=4 $Rf
3001 0 1102 -3000 -5001 imp:n=4 imp:p=4
c
3002 0 3000 -3001 -2000 5001 imp:n=6 imp:p=6 $Rf
3003 0 3000 -3001 -5001 imp:n=6 imp:p=6
c
3004 0 3001 -3002 -2000 5001 imp:n=6 imp:p=6 $Rf
3005 0 3001 -3002 -5001 imp:n=6 imp:p=6
c
3006 0 3002 -2002 -2000 5001 imp:n=6 imp:p=6 $Rf
3007 0 3002 -2002 -5001 imp:n=6 imp:p=6
c
c
      Filter Region of Inner Beam
c
4000 15 -3.97 2002 -3003 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=6 imp:p=6
4001 14 0.06970 2002 -3003 4002 -4003 4004 -4005
      imp:n=12 imp:p=12
c
4002 15 -3.97 3003 -3004 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=12 imp:p=12
4003 14 0.06970 3003 -3004 4002 -4003 4004 -4005
      imp:n=24 imp:p=24
c
4004 15 -3.97 3004 -3005 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=24 imp:p=24
4005 14 0.06970 3004 -3005 4002 -4003 4004 -4005
      imp:n=48 imp:p=48
c
4006 15 -3.97 3005 -3006 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=48 imp:p=48
4007 14 0.06970 3005 -3006 4002 -4003 4004 -4005
      imp:n=96 imp:p=96
c

```

```

4008 15 -3.97 3006 -3007 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=96 imp:p=96
4009 14 0.06970 3006 -3007 4002 -4003 4004 -4005
      imp:n=192 imp:p=192
C
4010 15 -3.97 3007 -3008 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=192 imp:p=192
4011 14 0.06970 3007 -3008 4002 -4003 4004 -4005
      imp:n=384 imp:p=384
C
4012 15 -3.97 3008 -3009 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=384 imp:p=384
4013 14 0.06970 3008 -3009 4002 -4003 4004 -4005
      imp:n=768 imp:p=768
C
4014 11 0.03298 3009 -3010 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=768 imp:p=768
4015 11 0.03298 3009 -3010 4002 -4003 4004 -4005
      imp:n=1536 imp:p=1536
C
C
C
4016 17 0.10351 3010 -3011 2010 -2011 2028 -2029 (-4002:4003:-4004:4005) &
      imp:n=768 imp:p=768
4017 17 0.10351 3010 -3011 4002 -4003 4004 -4005 4001 &
      imp:n=768 imp:p=768
4018 17 0.10351 3010 -3011 4000 -4001 imp:n=768 imp:p=768
4019 0 3010 -3011 -4000 imp:n=1536 imp:p=1536
C
4020 17 0.10351 3011 -3012 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
      imp:n=192 imp:p=192
4021 0 3011 -3012 4006 -4007 4008 -4009 4001 imp:n=384 imp:p=384
4022 17 0.10351 3011 -3012 4000 -4001 imp:n=768 imp:p=768
4023 0 3011 -3012 -4000 imp:n=1536 imp:p=1536
C
4024 17 0.10351 3012 -3013 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
      imp:n=384 imp:p=384
4025 0 3012 -3013 4006 -4007 4008 -4009 4001 imp:n=576 imp:p=576
4026 17 0.10351 3012 -3013 4000 -4001 imp:n=1152 imp:p=1152
4027 0 3012 -3013 -4000 imp:n=2304 imp:p=2304
C
4028 17 0.10351 3013 -3014 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
      imp:n=384 imp:p=384
4029 0 3013 -3014 4006 -4007 4008 -4009 4001 imp:n=768 imp:p=768
4030 17 0.10351 3013 -3014 4000 -4001 imp:n=1536 imp:p=1536
4031 0 3013 -3014 -4000 imp:n=3072 imp:p=3072
C
4032 17 0.10351 3014 -3015 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
      imp:n=384 imp:p=384
4033 0 3014 -3015 4006 -4007 4008 -4009 4001 imp:n=1152 imp:p=1152
4034 17 0.10351 3014 -3015 4000 -4001 imp:n=2304 imp:p=2304
4035 0 3014 -3015 -4000 imp:n=4608 imp:p=4608
C
4036 17 0.10351 3015 -2008 2010 -2011 2028 -2029 (-4006:4007:-4008:4009) &
      imp:n=384 imp:p=384
4037 0 3015 -2008 4006 -4007 4008 -4009 4001 imp:n=1536 imp:p=1536
4038 17 0.10351 3015 -2008 4000 -4001 imp:n=3072 imp:p=3072
4039 0 3015 -2008 -4000 imp:n=6144 imp:p=6144
C
C
C
      End Region
C
4040 17 0.10351 2008 -3016 2024 -2025 2042 -2043 (-4006:4007:-4008:4009) &
      imp:n=384 imp:p=384
4041 0 2008 -3016 4006 -4007 4008 -4009 5000 imp:n=1536 imp:p=1536
4042 0 2008 -3016 -5000 imp:n=6144 imp:p=6144
C

```



```

4043 17 0.10351 3016 -3017 2024 -2025 2042 -2043 (-4010:4011:-4012:4013) &
                                     imp:n=384 imp:p=384
4044 0          3016 -3017 4010 -4011 4012 -4013 5000 imp:n=1536 imp:p=1536
4045 0          3016 -3017 -5000                      imp:n=6144 imp:p=6144
C
4046 17 0.10351 3017 -3018 2024 -2025 2042 -2043 (-4010:4011:-4012:4013) &
                                     imp:n=96 imp:p=96
4047 0          3017 -3018 4010 -4011 4012 -4013 5000 imp:n=384 imp:p=384
4048 0          3017 -3018 -5000                      imp:n=1536 imp:p=1536
C
4049 17 0.10351 3018 -1011 2024 -2025 2042 -2043 (-4010:4011:-4012:4013) &
                                     imp:n=24 imp:p=24
4050 0          3018 -1011 4010 -4011 4012 -4013 5000 imp:n=96 imp:p=96
4051 0          3018 -1011 -5000                      imp:n=384 imp:p=384
C

```

```

C ***** Outside World Void Region *****
C
5000 0          -1001:1011:-1003:1004:-1007:1008    imp:n=0 imp:p=0
C

```

```

C *****
C ***** Core Surface Cards *****
C *****
C

```

Core Grid Definition Surfaces (X-Axis)

Main Grid

```

1  px -34.29
2  px -26.67
3  px -19.05
4  px -11.43
5  px -3.81
6  px 3.81
7  px 11.43
8  px 19.05
9  px 26.67
10 px 34.29

```

Corner Elements

```

31 px -36.83
32 px 36.83

```

Control Plates

```

101 px -28.311
102 px -1.26
103 px 1.26
104 px 28.311

```

Core Definition Surfaces (Y-Axis)

Main Grid

```

11 py 29.21
12 py 21.59
121 py 13.97
131 py 11.43
13 py 3.81
14 py -3.81
141 py -11.43
151 py -13.97
15 py -21.59
16 py -29.21

```

Corner Elements

```

33 py 31.75
34 py -31.75

```

Control Plates

```

111 py 13.716
112 py 11.684
113 py -11.684

```



```

114 py -13.716
c
c Core Definition Surfaces (Z-Axis)
c
c Main Grid
21 pz 42.365
22 pz -48.715
c Control Plates
201 pz 15.0 $ This surface controls the height of Plate 1 (Boral)
202 pz 15.0 $ This surface controls the height of Plate 2 (Boral)
203 pz 15.0 $ This surface controls the height of Plate 3 (SS)
204 pz 15.0 $ This surface controls the height of Plate 4 (Boral)
205 pz 15.0 $ This surface controls the Transient Rod height (B4C)
c
c Element Universe Surface Cards
c
c Standard and FLIP Elements
c
900 px -3.8101
901 px 3.8101
c
902 py -3.8101
903 py 3.8101
c
904 pz 27.76
905 pz 19.05
906 pz -19.05
907 pz -27.76
908 pz -32.84
c
909 c/z -1.905 1.905 1.74
910 c/z -1.905 1.905 1.791
c
911 c/z 1.905 1.905 1.74
912 c/z 1.905 1.905 1.791
c
913 c/z -1.905 -1.905 1.74
914 c/z -1.905 -1.905 1.791
c
915 c/z 1.905 -1.905 1.74
916 c/z 1.905 -1.905 1.791
c
c Graphite Reflector Elements
c
917 px -3.65125
918 px 3.65125
c
919 py -3.65125
920 py 3.65125
c
c Rotator Tube Elements
c
921 pz -36.015
922 pz -38.555
c
923 cz 3.683
924 cz 3.810
925 cz 2.540
926 cz 3.250
c
c Corner Grid Elements
c
927 px -35.125
928 px -28.375
929 px 28.375
930 px 35.125

```

```

c
931 py 30.045
932 py 23.295
933 py -23.295
934 py -30.045
c
c Transient Rod Elements
c
935 c/z 1.905 -1.905 1.7526
936 c/z 1.905 -1.905 1.8796
c
c ***** Lead Box and Relector Surfaces *****
c
5002 py 52.15
5003 py -52.15
c
c ***** Beam Port Surface Cards *****
c *****
c
c Water Box Definition Surfaces
c
1001 px -51.83
1002 px 38.1
c
1003 py -121.92
1004 py 121.92
1005 py -62.00
1006 py 62.00
c
1007 pz -121.92
1008 pz 121.92
1009 pz -62.00
1010 pz 62.00
c
1011 px 323.85
c
c Conical Region Surfaces
c
1999 kx -109.906 0.13069 1
2000 kx -106.156 0.13069 1
5001 kx -97.3 0.13069 1
c
2001 px 101.60
2002 px 102.87
c
c Aluminum Face Grid
1100 px 39.37
1101 px 46.355
1102 px 59.69
c
1103 py 22.86
1104 py 20.32
1105 py -20.32
1106 py -22.32
c
1107 pz 22.86
1108 pz 20.32
1109 pz -20.32
1110 pz -22.86
c
c Leaded Region Surfaces
c
2003 px 139.70
2004 px 140.97
2005 px 185.42

```

2006	px	186.69
2007	px	246.38
2008	px	247.65
2009	px	308.61

c

2010	py	-75.565
2011	py	75.565
2012	py	-76.2
2013	py	76.2
2014	py	-77.47
2015	py	77.47
2016	py	-78.74
2017	py	78.74
2018	py	-80.01
2019	py	80.01
2020	py	-81.28
2021	py	81.28
2022	py	-82.55
2023	py	82.55
2024	py	-91.44
2025	py	91.44
2026	py	-92.71
2027	py	92.71

c

2028	pz	-75.565
2029	pz	75.565
2030	pz	-76.2
2031	pz	76.2
2032	pz	-77.47
2033	pz	77.47
2034	pz	-78.54
2035	pz	78.54
2036	pz	-80.01
2037	pz	80.01
2038	pz	-81.28
2039	pz	81.28
2040	pz	-82.55
2041	pz	82.55
2042	pz	-91.44
2043	pz	91.44
2044	pz	-92.71
2045	pz	92.71

c

c Inner Shell Region of the Beam Port Surfaces

c

3000	px	70
3001	px	80
3002	px	90

c

3003	px	110
3004	px	120
3005	px	130
3006	px	140
3007	px	150
3008	px	160
3009	px	172.87
3010	px	178.87
3011	px	183.95
3012	px	195
3013	px	210
3014	px	220
3015	px	235

c

3016	px	252.73
3017	px	275
3018	px	300

```

c
c   Filter Surfaces
c
4000  kx    259.78      0.3819  -1
4001  kx    269.44      0.3819  -1
c
4002  py   -60.96
4003  py    60.96
c
4004  pz   -60.96
4005  pz    60.96
c
4006  py   -70.485
4007  py    70.485
c
4008  pz   -70.485
4009  pz    70.485
c
4010  py   -86.56
4011  py    86.56
c
4012  pz   -86.56
4013  pz    86.56
c
c   ***** Tally Segment Surface *****
c
5000  cx     7.5
c
c   ***** CRITICALITY DATA CARDS *****
c
kcode 2500  1.1  5  100
c  ksrc  -17.145  19.685  0      -9.525  15.875  0      13.335  19.685  0
c      20.955  15.875  0      32.385  19.685  0      -17.145  9.525  0
c      -9.525  5.715  0      -1.905  9.525  0      5.715  5.715  0
c      13.335  9.525  0      20.955  5.715  0      28.575  9.525  0
c      -17.145  -1.905  0      -9.525  1.905  0      -1.905  -1.905  0
c      5.715  1.905  0      13.335  -1.905  0      20.955  1.905  0
c      28.575  -1.905  0      -17.145  -9.525  0      -9.525  -5.715  0
c      -1.905  -9.525  0      5.715  -5.715  0      13.335  -9.525  0
c      20.955  -5.715  0      32.385  -9.525  0      -9.525  -19.685  0
c      17.145  -19.685  0      32.385  -19.685  0
c
c      -17.145  19.685  12      -9.525  15.875  12      13.335  19.685  12
c      20.955  15.875  12      32.385  19.685  12      -17.145  9.525  12
c      -9.525  5.715  12      -1.905  9.525  12      5.715  5.715  12
c      13.335  9.525  12      20.955  5.715  12      28.575  9.525  12
c      -17.145  -1.905  12      -9.525  1.905  12      -1.905  -1.905  12
c      5.715  1.905  12      13.335  -1.905  12      20.955  1.905  12
c      28.575  -1.905  12      -17.145  -9.525  12      -9.525  -5.715  12
c      -1.905  -9.525  12      5.715  -5.715  12      13.335  -9.525  12
c      20.955  -5.715  12      32.385  -9.525  12      -9.525  -19.685  12
c      17.145  -19.685  12      32.385  -19.685  12
c
c      -17.145  19.685  -12      -9.525  15.875  -12      13.335  19.685  -12
c      20.955  15.875  -12      32.385  19.685  -12      -17.145  9.525  -12
c      -9.525  5.715  -12      -1.905  9.525  -12      5.715  5.715  -12
c      13.335  9.525  -12      20.955  5.715  -12      28.575  9.525  -12
c      -17.145  -1.905  -12      -9.525  1.905  -12      -1.905  -1.905  -12
c      5.715  1.905  -12      13.335  -1.905  -12      20.955  1.905  -12
c      28.575  -1.905  -12      -17.145  -9.525  -12      -9.525  -5.715  -12
c      -1.905  -9.525  -12      5.715  -5.715  -12      13.335  -9.525  -12
c      20.955  -5.715  -12      32.385  -9.525  -12      -9.525  -19.685  -12
c      17.145  -19.685  -12      32.385  -19.685  -12
c
c   ***** Mode Card *****
c

```

```

c
c      mode n p
c
c      ***** Surface Source Write Card *****
c      ssw  2008
c
c      ***** Print Dump Control Card *****
c      prdmp j 100 j 2
c
c      ***** MATERIAL CARDS *****
c
c      Water
c      m1      1001.50c    0.667
c              8016.50c    0.333
c      mt1     lwtr.07t
c
c      Aluminum
c      m2      13027.50c   1.0
c
c      304 Stainles Steel (WSU)
c      m3      26000.55c   0.730
c              24000.50c   0.191
c              28000.50c   0.075
c              6012.50c    0.004
c
c      Graphite (Carbon)
c      m4      6012.50c    1.0
c      mt4     grph.01t
c
c      Boral (from ARH-600, 35% B4C 65% Al)
c      m5      5010.50c    0.090
c              5011.56c    0.364
c              6012.50c    0.114
c              13027.50c   0.432
c
c      Standard Fuel Meat
c      m6      92235.53c    0.0027
c              92238.53c    0.0106
c              1001.53c     0.6129
c              40000.53c    0.3738
c      mt6     h/zr.01t
c              zr/h.01t
c
c      FLIP Fuel Meat
c      m7      92235.53c    0.0098
c              92238.53c    0.0041
c              1001.53c     0.6016
c              40000.53c    0.3826
c              68166.81c    0.0011
c              68167.81c    0.0008
c      mt7     h/zr.01t
c              zr/h.01t
c
c      Top of Fuel Region (homogenized)
c      m8      26000.55c    0.1364
c              24000.50c    0.0357
c              28000.50c    0.0141
c              6012.50c     0.0007
c              13027.50c    0.0322
c              1001.50c     0.5207
c              8016.50c     0.2602
c      mt8     lwtr.07t
c
c      Bottom of Fuel Region (homogenized)
c      m9      26000.55c    0.0274

```

	24000.50c	0.0071
	28000.50c	0.0028
	6012.50c	0.0001
	13027.50c	0.3041
	1001.50c	0.4390
	8016.50c	0.2195
mt9	lwtr.07t	

c		
c	Boron Carbide (Transient Fuel Rod)	
m10	5010.50c	0.1583
	5011.56c	0.6417
	6012.50c	0.2000

c		
c	Lead	
m11	82000.50c	1.0
c		
c	Ordinary Concrete	
m12	1001.50c	0.18667
	8016.50c	0.52127
	26000.55c	0.00247
	6000.50c	0.04788
	14000.50c	0.07579
	12000.50c	0.00738
	13027.50c	0.00924
	20000.50c	0.14549
	11023.50c	0.00381

c		
c	Heavy Concrete	
m13	1001.50c	0.10078
	8016.50c	0.55034
	25055.50c	0.00025
	26000.55c	0.19460
	14000.50c	0.01960
	12000.50c	0.01714
	16032.50c	0.00114
	20000.50c	0.03238
	24000.50c	0.00023
	15031.50c	0.00013
	22000.50c	0.08318
	23000.50c	0.00023

c		
c	Al/Teflon	
m14	13027.50c	0.5185
	6012.50c	0.1555
	9019.50c	0.3111
	3006.50c	0.0011
	3007.55c	0.0137

c		
c	Aluminum Oxide (Al ₂ O ₃)	
m15	13027.50c	-0.5292
	8016.50c	-0.4708

c		
c	Li(nat)-Poly	
m17	1001.50c	0.5262
	8016.50c	0.1007
	6012.50c	0.2968
	3006.50c	0.0725
	3007.55c	0.0038

c		
c	Bismuth	
m18	83209.50c	1.0

***** TALLY SPECIFICATION CARDS *****

c		
c	Neutron Flux Over a 7.5cm(radius) Disk Along the Beam's Axial Centerline	
f2:n	1002 1100 1101 1102 3000 3001 3002 2002 3003 3004 3005 3006 3007 3008 &	

```

3009 3010 3011 3012 3013 3014 3015 2008
fm2:n 7.53e16
fs2 -5000
sd2 (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1)
fq2 f e
e2 4.14e-7 0.01 20
c
c Neutron Current Over a 7.5cm(radius) Disk Along the Beam's Axial Centerline
f1:n 1002 1100 1101 1102 3000 3001 3002 2002 3003 3004 3005 3006 3007 3008 &
3009 3010 3011 3012 3013 3014 3015 2008
fm1:n 7.53e16
fs1 -5000
sd1 (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) &
(176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1) (176.71 1)
fq1 f e
e1 4.14e-7 0.01 20
c
c Neutron Dose rates at the Beam Aperture Exit (cGy/min)
f22:n 2008
fm22:n 7.53e16
fs22 -5000
sd22 (176.71 1)
fq22 f e
e22 4.14e-7 0.01 20
de22 .10000E-10 .10000E-06 .41399E-06 .87642E-06 .18554E-05
.50435E-05 .10677E-04 .37267E-04 .10130E-03 .21445E-03
.45400E-03 .15846E-02 .33546E-02 .71017E-02 .15034E-01
.21875E-01 .24176E-01 .26058E-01 .31828E-01 .40868E-01
.67379E-01 .11109E+00 .18316E+00 .29720E+00 .36883E+00
.49787E+00 .60810E+00 .74274E+00 .82085E+00 .10026E+01
.13534E+01 .16530E+01 .19205E+01 .22313E+01 .23457E+01
.23653E+01 .24660E+01 .27253E+01 .30119E+01 .36788E+01
.49659E+01 .60653E+01 .74682E+01 .86071E+01 .10000E+02
.12214E+02 .14191E+02 .17333E+02
c
df22 .1E-20 .1E-20 .1E-20 .35220E-12 .80570E-12
.19660E-11 .46200E-11 .13090E-10 .39370E-10 .92580E-10
.19550E-09 .55320E-09 .13820E-08 .29910E-08 .60670E-08
.99720E-08 .12200E-07 .13230E-07 .14940E-07 .18060E-07
.24380E-07 .34870E-07 .47760E-07 .63230E-07 .75370E-07
.85630E-07 .96160E-07 .10530E-06 .11350E-06 .12100E-06
.13730E-06 .15330E-06 .16570E-06 .17750E-06 .18470E-06
.18700E-06 .18910E-06 .19470E-06 .20240E-06 .21340E-06
.23410E-06 .25160E-06 .26400E-06 .27390E-06 .28080E-06
.28700E-06 .29200E-06 .29390E-06
c
c Fine Energy Breakdown of Neutron Flux at Beam Exit Surface
c f12:n 2008
c fs12 -5000
c sd12 (176.71 1)
c fq12 e f
c e12 1e-7 2e-7 3e-7 4e-7 5e-7 6e-7 7e-7 8e-7 9e-7 &
c 1e-6 2e-6 3e-6 4e-6 5e-6 6e-6 7e-6 8e-6 9e-6 &
c 1e-5 2e-5 3e-5 4e-5 5e-5 6e-5 7e-5 8e-5 9e-5 &
c 1e-4 2e-4 3e-4 4e-4 5e-4 6e-4 7e-4 8e-4 9e-4 &
c 1e-3 2e-3 3e-3 4e-3 5e-3 6e-3 7e-3 8e-3 9e-3 &
c 1e-2 2e-2 3e-2 4e-2 5e-2 6e-2 7e-2 8e-2 9e-2 &
c 1e-1 2e-1 3e-1 4e-1 5e-1 6e-1 7e-1 8e-1 9e-1 &
c 1 2 3 4 5 6 7 8 9 &
c 1e+1 2e+1 3e+1 4e+1 5e+1 6e+1 7e+1 8e+1 9e+1 &
c

```

c Gamma Dose Rate (rem/hr) at Water Plug Surface

c f62:p 2008

c fs62 -5000

c fm62 7.53e16

c sd62 (176.71 1)

c Flux-to-Dose Conversion Factors for Photons

c de62 .01 .015 .02 .03 .04 .05 .06 .08 .1 .15 .2 .3 .4 &

c .5 .6 .8 1.0 1.5 2.0 3.0 4.0 5.0 6.0 8.0 10.0

c df62 2.78e-6 1.11e-6 5.88e-7 2.56e-7 1.56e-7 1.20e-7 1.11e-7 &

c 1.20e-7 1.47e-7 2.38e-7 3.45e-7 5.56e-7 7.69e-7 9.09e-7 &

c 1.14e-6 1.47e-6 1.79e-6 2.44e-6 3.03e-6 4.00e-6 4.76e-6 &

c 5.56e-6 6.25e-6 7.69e-6 9.09e-6

c fq62 f e

c

c

***** Power Density Tallies *****

c

f17:n 12 13 14 15 16 17 18

fm17 13152

sd17 1 1 1 1 1 1

f27:n 21 22 23 24 25 26 27 28 29

fm27 13152

sd27 1 1 1 1 1 1 1 1

f37:n 31 32 33 34 35 36 37 38 39

fm37 13152

sd37 1 1 1 1 1 1 1 1

f47:n 41 42 43 44 45 46 47 48 49

fm47 13152

sd47 1 1 1 1 1 1 1 1

f57:n 51 52 53 54 55 56 57 58 59

fm57 13152

sd57 1 1 1 1 1 1 1 1

f67:n 61 62 63 64 65 66 67 68 69

fm67 13152

sd67 1 1 1 1 1 1 1 1

f77:n 72 73 74 75 76 77 78

fm77 13152

sd77 1 1 1 1 1 1

c