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MCNP VISUAL EDITOR COMPUTER CODE MANUAL

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MASTER

1.0 INTRODUCTION

The Monte Carlo N-Particle (MCNP) computer code¹ is a particle transport code with powerful 3 dimensional geometry and source modeling capabilities that can be applied to reactor physics, shielding, criticality, environmental nuclear waste cleanup, medical imaging, and numerous other related areas.

Creating a MCNP input file with a line editor is both tedious and error prone as it entails arduous descriptions of geometry, tallies, sources, and optimization parameters. These input files may contain thousands of lines, and once the input file is created, substantial additional time is often required to plot and test the geometry and to correct any errors.

A graphical interface^{2,3,4} has been developed to assist the user in the creation of MCNP input files. This visual editor allows the user to interactively create an input file with the help of two or more dynamic cross sectional views of the model. A wide selection of menu options enables rapid input of information and immediate visualization of the geometry and other information being created.

The present executable for a SPARC-Sun^a workstation can be executed at Westinghouse Hanford Company under X-Windows^b with the command /p/mcnp/mcnped, where mcnped is a command file that executes the editor. The execution line at other sites will depend upon how the local environment is set up. The new user should practice with a few simple problems before trying to create an involved geometry. The example problem at the end of this document is a possibility for the 1st session. Additional exercises from class notes are given in Appendix A.

The following discussion summarizes how to use the graphical interface, where Figure 1 provides a quick summary of the menu buttons. The visual editor is constructed with user friendly menu buttons so this manual is primarily to help the new user get started and to provide some detail when specific questions arise. The discussion here assumes that the user has some familiarity with the MCNP geometry specification, as described in the MCNP manual.

2.0 BEGINNING AN INTERACTIVE EDITING SESSION

Once the Visual Editor screen has been activated by typing the execution line, such as /p/mcnp/mcnped, the main panel appears in the upper left hand portion of the screen and two (default) geometry plot areas in the lower portion of

^a Sun is a trademark of Sun Microsystems, Inc.

^b The X Window System is a trademark of the Massachusetts Institute of Technology.

the screen. Select "Begin" with the left mouse button from the main panel area to start the editing session. "Begin" initiates a search by the editor for a partial "inp" file in the local directory.

If a file named inp exists, it will be read into the editor. However, if an inpn file exists that has a later creation date than the inp file, a pop-up window will first appear asking the user if he wants to "Continue" to read in the inp file or if he wants to "Copy inpn to inp" and read this revised inp file into the editor.

If an inp file does not exist, this editing session is starting from scratch and the screen will instruct the user to enter the title card in a "Title Line" panel [followed by a return]. The editor will then read this inp file, consisting only of the title card, and prepare for the editing session.

After the inp file is read, some messages should appear in the white area to the right of the main panel -- these are typically warning messages indicating an incomplete inp file. At this point you are ready to start creating your geometry, or if you are starting from a partial inp file, to modify or add to your geometry. You can create a new input file, called "inpn", that represents the current status of the editing session by pressing the "Backup inp" on the main panel at any time. This not only creates the file "inpn" but creates an identical file called inpn"n", where "n" is incremented by one from the largest previously existing inpn"n-1". It is wise to do a "Backup inp" periodically in the editing session so you will have a current inpn file if something goes wrong, and so you will also have a number of inpn"n" files in case you should want to retrace your steps. An inpn file will also typically be created at a normal "Quit" of the editor, and hence represents the final product of the editing session.

Typically, you will select "Update plots" at this point before going to the next step, which is usually to create new surfaces. "Update plots" will not give a response if you are starting with just a title card, but select "Update plots" anyway to initialize the plots. You may also need to adjust some of the plot parameters, such as origin and basis, as discussed in a later section. The plot parameter defaults are set so that they are often satisfactory.

3.0 NEW SURFACE CREATION

To create a surface select "Surface Creation" with the left mouse button. The "New Surface Creation" panel will appear with the options to create "Planes", "Spheres", "Cylinders", "Cones", "Quadratics" and "Torus". Each of these are pull down menus which display an expanded sub-menu for that surface type as described in Figure 2. In the upper right corner of the panel is a toggle to select input surface dimensions in centimeters or inches, where the default is cm and this is recommended for most applications.

After selecting a surface type, enter the surface number (if the default number is not satisfactory) and enter the surface coefficients by mouse or by keyboard. If two or three digits of accuracy are sufficient, most of the surfaces can be created on one of the two geometry plots using the mouse: [Move the mouse to the approximate location of the desired new surface, and click the left mouse button (and drag it if more than one surface coefficient is involved as discussed in Figure 2). Coordinates for the surface are displayed in the "New Surface Creation" panel. If these coordinates are not at quite the desired location, adjust the mouse and repeat the process. You can read the coordinate locations for the mouse position just above the upper right hand corner of each plot.] Surface coefficients are entered by keyboard with a "return" after each entry, if more accuracy is needed. After you are satisfied with the surface location, register the surface by selecting the "Register" button. The surface will appear on the plot at the indicated coordinates on each plot, where the surface number can also be displayed by using the "surface" toggle button on each plot.

"Transformation number" and "Reflective Surface" are two other features on the "New Surface Creation" panel that need to be input, as applicable, prior to registering the surface. The transformation must be input [see Section 7.3] before you can use that transformation in the creation of a surface. The reflective surface boundary condition can be selected as on or off.

To exit the "New Surface Creation" panel press "Quit". After creating a number of surfaces, it is wise to press the "Backup inp" button to save an `inpn` and an `inpn.n` file that represents the current status of the `inp` file.

3.1 EDIT, CREATE, SCAN IN NEW SURFACE CREATION PANEL

The default of the "New Surface Creation" panel is to "CREATE" a surface as discussed in section 3.0 above. The "SCAN" option at the bottom of the panel can be selected to recall a surface, where you type the "Surface number" you want to recall. Then this surface will be recalled with the surface type and surface coefficients shown. Now you can either:

- modify the surface coefficients by selecting the "EDIT" option at the bottom of the panel and entering the changes you want to make in the surface coefficients. After you have made the changes, select "Register".
- create a similar surface (an editor "like-but" option) by selecting the "CREATE" option at the bottom of the panel. Then a new surface will be created with all attributes like the original one selected with "SCAN", except for the surface number and any changes you make. The editor will choose a new surface number although you can override this. "Register" this surface after you have completed the changes.
- delete the surface by selecting "Delete" at the top of the panel.

4.0 NEW CELL CREATION

After the appropriate surfaces have been created, that will be needed for the creation of one or more cells, select "Cell Creation" with the left mouse button. When you are using a color monitor, and are in the "color on" mode, cells of different materials will be filled with different colors and numbered in red. However, the default "color off" mode is usually preferable since the plots are generated much more rapidly in black and white.

4.1 DEFINING A CELL

Following are basic steps for defining a cell in the "New Cell Creation" panel:

1. The editor selects a new default problem cell number as you enter the panel or after you register a cell, but you can change this if you prefer another problem cell number.
2. Enter material number for the cell from the keyboard, or bring up the Material List panel with the Material Creation Button under Data Cards and click on the desired material -- this enters both the material and its default density on the New Cell Creation panel. Note: You need to first define the material in the Material Creation Button under the Data Cards Button (see Section 7.1).
3. Enter the material density from the keyboard [positive if atom density and negative if gram density] if different from the default, return.
4. Enter fill number and universe number for the cell -- see subsequent discussion.
5. Drag the mouse across each relevant surface on the plots, while holding down the left button, to select the bounding surfaces for a simple object [release the left button after crossing each individual surface]: those numbers should appear in the white area to the left of the "New Cell Creation" panel or else an error message that "drag failed", in which case you need to repeat the last mouse action. [Here these surfaces being entered by mouse are usually the convex perimeter of a simple object. If this object is not part of the cell, it will be cut out of the cell with the "cut" of step 7 -- the editor will cut it out by forming the appropriate union operations.]

6. Click the left mouse button inside the object to indicate the sense of the surfaces for the object. Note that some of the surface numbers in the white area will change sign.
7. Choose "Paste" with the left mouse button, or "Cut" if a region is being cut out of a portion of the cell being formed. The white area now shows the surfaces with senses (and unions if needed) of the partial cell card.
8. Repeat steps 5-7 for each "paste" or "cut" operation until the cell is completely defined. You can also enter "Not" "cell numbers" if appropriate.
9. "Register" the cell, and the white area will give the message "CELL REGISTERED". The plots will also be updated to show the new cell, where dashed lines will be replaced with solid lines along the portions of surfaces where valid cells are defined on each side of the surface.

[Note on step 5: Occasionally, when there are inconsistencies in the geometry, a surface will not appear or there will not be a response when the mouse is dragged across the surface. Do a "show" of this surface as described in Section 6.7. You may need to keep repeating this after each cell is registered until this inconsistency is removed.]

4.2 DISCUSSION OF CELL PASTE AND CUT OPERATIONS

The bounding surface description of the cell is defined through a series of "Paste" and "Cut" operations. The "Paste" operation allows a complex geometry to be created by pasting together simple convex objects such as parallelepipeds, spheres, cylinders, or more general shapes. The "Cut" operation allows the user to remove a piece from inside of the currently defined cell. For example; to create a cell inside of a sphere but outside of an inner cube, the first step is to define the outer spherical portion of the cell by crossing the spherical surface with the mouse. Then use the "Paste" operation, after specifying the sense inside of the sphere, with the mouse. Then remove the inner cube by crossing each of its six surfaces with the mouse and using the "Cut" operation after specifying the sense inside of the cube with the mouse.

The "Paste" operation typically creates a sequence of intersections, with the sense of the involved surfaces determined by the mouse location when the sense is entered. "Paste" allows the user to paste together a complex, even disjoint, cell from the simple objects. If the cell is partially formed with previous paste or cut operations, the new paste will introduce a union operation prior to the sequence of intersections. For most cells, only one paste operation is required -- usually prior to any cut operations.

The "Cut" operation typically creates a sequence of unions, with the sense of the involved surfaces determined by the reverse of that for the mouse location when the sense is entered. "Cut" allows the user to cut out simple objects one at a time. Typically the perimeter of the cell has been formed with "paste" operations before the "cut" operation, and the new cut will introduce an intersection operator prior to the sequence of unions. There is a special case in the creation of the "outside world" cell, or for cells on the outer portion of a universe, where "cut" may be the only operation. Then the cut produces a number of unions describing the cell as the region beyond.

4.3 SPECIAL SENSE CONSIDERATIONS

It is sometimes inconvenient to enter the sense for the full (x,y,z) point from only one of the plots. Assume, for example, that the sense is entered from the left plot with the horizontal being parallel to the x-axis and the vertical being parallel to the z-axis. Then the y value is a fixed constant value anywhere on this plot, corresponding to the y of the origin of this plot. This may not be the y you want for the sense computation. In this situation, after entering the sense on the left plot, you can move to the right plot and suppress x and z by toggling on the "Mouse Sense" of the "New Cell Creation" panel. Then pushing the left mouse button on this right hand plot will reset the value of y. This selection of (x,y,z) for the sense could even be done from three different plots, if necessary.

4.4 UNIVERSES, FILLS, AND TRANSFORMATIONS

The cell transformation number, universe number, and fill number should also be appropriately input.

As a general rule you need to use the following sequence in creating cells involving universes, fills, and transformations for a given universe number that fills a cell:

1. Create the cell first that the universe fills, but do not include its transformation; i.e., you will first create the universe at the origin. If the plots are too messy around the origin, you may need to use the "hide" option to hide some cells (and surfaces) on the plots -- see latter section on hide and show.
2. Create all the cells, one at a time, that are of this universe -- give each one this universe number. Remember that you do not include the outer bounding surfaces that are included on the cell with the fill=.
3. If a transformation is involved, return to the cell created in step 1 and modify it by including the appropriate transformation number -- see section 4.8 on Cell Edit, Create, Scan. Then your plots for this universe will shift to the appropriate location. If other cells are like this cell but have a different transformation, before modifying

this cell you should create cells like this cell but each with the appropriate transformation -- see section 4.8 on Cell Edit, Create, Scan. You must create all the transformations [see Section 7.3] prior to using them in the cells.

If you have a universe inside of a universe, you can use the following sequence:

- A. Create the cell first that the outer universe fills, but do not include its transformation.
- B. Do step 2 above for the cells of the outer universe that do not have a "fill=" referring to the inner universe, where the cell of step A contains the outer universe number on its "fill=".
- C. Do step 1 above for a cell of the outer universe that has a "fill=" referring to the inner universe.
- D. Do steps 2 and 3 above for the cells of the inner universe. Remember that any transformations of step 3 for the inner universe will be with respect to any transformations of the outer universe.
- E. Do step 3 above for the outer universe; i.e., assign transformations to the outer universe along with any "like but" cells.

4.5 OTHER CELL CREATION OPTIONS

The material number and density were briefly discussed under #2 of Section 4.1, where the creation of materials is covered in Section 7.1. The lattice type number shows up on the "New Cell Creation" panel, but is not yet operational. The user can also exclude portions from the cell by entering cell numbers to be excluded on the "Not_____" one at a time, separated by carriage returns.

4.6 UNDO

A useful feature of the "New Cell Creation" panel is the "Undo" button. This button allows the user to erase any mistakes prior to a register. Both drags and clicks can be "un-done" in reverse sequence one at a time.

4.7 REGISTER

"Register" is the final step in the cell making process. Once the cell is registered it is officially incorporated into the geometry. If the user is in a plot refresh mode the geometry plots will be updated immediately after register of the cell. After creating a number of cells, it is prudent to press the "Backup inp" button to save an inpn and an inpn"n" file that represents the current status of the inp file.

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4.8 EDIT, CREATE, SCAN IN NEW CELL CREATION PANEL

The default with the "New Cell Creation" panel is to "CREATE" a cell as discussed in section 4.0 to 4.7 above. The "SCAN" option at the bottom of the panel can be selected to recall a cell, where you type the "Cell number" you want to recall. Then this cell will be recalled with the surfaces (with senses and unions) shown at the top of the panel under "Description". Now you can either:

- modify the cell by selecting the "EDIT" option at the bottom of the panel and entering the changes you want to make. After you have made the changes, select "Register".
- make a similar cell (an editor "like-but" option) by selecting the "CREATE" option at the bottom of the panel. Then a new cell will be created with all attributes like the original one selected with "SCAN", except for the cell number and any changes you make -- such as a new transformation. The editor will choose a new cell number although you can override this. "Register" this cell after you have completed the changes.
- delete the cell by selecting "Delete" at the top of the panel.

4.9 CELL SPLITTING

Another feature of New Cell Creation is the "Register for cell splitting" button. This allows the user to divide a region equally into as many cells as he wishes. This is usually implemented by creating the region that is to be divided as a cell. At the point where one would normally "Register" the cell "Register for cell splitting" is selected instead. Once this button is selected, another panel comes up. It is in this panel that the user designates the number of splits (number of cells created), assumed to be n here, the region and the geometry type of the region.

Possible geometry types for the splitting include: box-in-box, where $n-1$ surfaces are inserted between the inner and outer box in each of the $-x$, $+x$, $-y$, $+y$, $-z$, and $+z$ directions with uniform spacing between the inserted surfaces in each of the directions; sphere-in-sphere where $n-1$ radial surfaces are inserted between the inner and outer spheres, where the inner sphere can have a radius of zero; slab, where a large parallelepiped region is divided with $n-1$ surfaces in either the x , y , or z direction as specified by the user; and cylinder-in-cylinder. For cylinder-in-cylinder, the inner and outer cylinders may be: (1) the same axial height [actually designated as "Cylinder" in the geometry type], and the cylindrical annulus can be divided either axially or radially -- in either case the inner cylinder radius can optionally be zero; or (2) the inner cylinder is completely inside the outer cylinder, and the region is divided into n cylinder-in-cylinder cells.

Once the split is registered the panel disappears, and the multiple cells that fill the original region appear in the geometry plots. The editor automatically creates the n new cells and all the surfaces that are needed.

4.10 CREATE A MULTI-BEND CYLINDRICAL DUCT

There is an option to create a multi-bend (90 degree bends) duct that may have a number of radial zones, where the same radial zones occur along each straight section of the duct. This is sometimes very useful since such streaming calculations usually require: (1) a number of thin radial regions near the central streaming portion of the duct for high importances in order to increase scattering collisions; and (2) a number of axial zones along the duct in order to increase importances along the duct from entrance (of particles from the source) to exit. This is a labor intensive geometry to describe with a line editor, but can be done quickly with the visual editor. However, the duct must be created in the sequence specified here as follows:

- Create surfaces, typically planes, that will bound the cells containing the duct. For example, if the duct goes through a concrete wall, these surfaces would eventually be used to describe the boundaries of the concrete cells through which the duct passes. One of these surfaces would be the surface normal to the duct at its entrance and another would be the surface normal to the duct at its exit. Also include at least one surface normal to the duct leg between any two bends. Additional surfaces can be created normal along each duct leg for splitting the duct cells axially (typically for axial importances), but all such surfaces must not be so close to a duct bend that they infringe upon the radial cells at the bend.
- Select "Cell Creation" and then select "Create Cylindrical Duct" under "Special Options". This will give a "Cylindrical Duct Creation" panel where you must specify the number of radial zones you want to use to describe the duct -- these radial zones will be used to describe the materials (such as central void, steel liner, concrete) and for radial importances. After you have specified this number of cylindrical zones, the panel will expand and ask for the outer radius of each zone, the material number of each radial zone, and the corresponding material density. Then enter the number of straight duct legs at the bottom of the panel. Now select "continue" and a panel will come up for the first duct leg. Note: all materials that are used must be defined first -- see Section 7.1.
- The first duct leg must be either the entrance or exit leg -- for our purposes here we will assume it is the entrance leg. Enter the axis of this leg (must presently be along x, y, or z), and enter the other two coordinate values for this axis. Then enter the number of axial splitting surfaces along this 1st leg of the duct that are normal to the axis of this leg. The entrance surface must be included, so this number

will be 1 if there are no axial splitting surfaces between the entrance and the first bend of the duct or it would be 2 if there is one splitting surface along this first leg of the duct, etc. Then enter these one or more surface numbers beginning from the entrance surface and proceeding with the other axial surface numbers in sequence along this leg of the duct. Then select "continue" and the panel for "Duct Leg 2" will appear.

- The panel for the 2nd duct leg appears just like that for the first duct leg. Now the axis of this duct leg must be perpendicular to the axis of first duct leg and the two coordinates entered for the location of this axis must be such that the axes of these two legs will exactly cross in the third dimension. Enter the number of axial splitting surfaces along this leg that are normal to this leg -- must be at least 1 -- and enter the surface numbers, continuing in sequence along the duct from entrance to exit. Select "continue" after you have described this leg of the duct. The panel for "Duct Leg 3" will appear.
- Continue to enter the information for each leg. The number of splitting surfaces for the last leg must include the surface number that is normal to the duct at its exit; i.e., the number of splitting surfaces must be at least one. When "continue" is selected after the last leg (it is permissible to have only 2 legs), the program will automatically create the surfaces and cells for the duct and the plots should be updated showing the duct. The above information must all be correct or your plots will show errors -- you should save the inp file just before using this special option so you can easily start again at the duct creation point.

The cells radially beyond the cells of the duct are complicated because of the duct bends. The visual editor will help you create these cells, provided you include no more than one bend within any of these cells. You simply create the outer boundary of one of these cells that contains a duct bend and select "paste" in the usual manner after specifying the sense for this outer boundary. Now you can cut out the duct within this cell by selecting "Cut Duct Bend" under the "Cut" with the right mouse button. You will get a message in the white area "Click in the outer cell of the bend to cut". That cell is specified with the left mouse button and the appropriate union operation to cut out this bend will appear. Then simply "register" the cell, and repeat for the other cells that contain the duct. If one of these cells contain a straight section, you can cross the outer surface of that leg and do the usual (default) cut.

4.11 CREATE A MULTI-BEND RECTANGULAR DUCT

This option is not yet operational, but will eventually be similar to the cylindrical duct option, except it will be used to describe a rectangular duct.

5.0. BACKUP INP

"Backup Inp" takes what is in memory and writes it out to the files inpn and the inpn"n", where the inpn"n" files are numbered according to the order they were created. In addition to frequently saving inpn files as backups in case something goes wrong, it is sometimes useful to have the inpn"n" files available to have a step-by-step trace of the creation of the final inpn. The inpn* files should be removed when they are no longer needed.

6.0 PLOTTING AND CHANGING PLOT PARAMETERS

6.1 UPDATE PLOTS

As it's name implies, the "Update plots" button is used to update the plots to the current status of the inpn file being created. In the "Refresh" mode, plot updates are done automatically, except at the beginning of an edit session.

When you change the basis, origin, or extent parameters for a plot, you need to "Update plots" before the new parameters are implemented in the plots.

6.2 BASIS

One of the advantages of multiple plots is the ability to view the same geometry with multiple cross sectional slices. This is especially helpful with complex three-dimensional geometries. The left plot in the Editor is automatically defaulted to an xz basis and the right to a xy basis. These can be changed two ways. A "Basis" pull down menu is available with the choices of xy, xz, yx, yz, zx, and zy, or the user can enter his choice by hand on the lines available. In order to enter a basis by hand the user must click on the line that is to be changed with the left mouse button and "return" after the change. After the new basis has been established, "Update plots" needs to be selected to generate the new plot.

6.3. ORIGIN

The origin of the two plots automatically defaults to 0,0,0. These coordinates are easily changed by entering the desired origin by hand. Simply click on the line with the left mouse button and return once the data for that line has been input. Once the new origin is ready to be implemented, select "Update plots".

Another way to adjust the origin involves setting the "ORIGIN" toggle switch to dark for the plot. Then the origin can be moved by clicking in the plot, where the click will locate the new center of the plot.

The boxes on the (x,y,z) input lines, under ORIGIN in each plot, enable the user to change an origin (x,y,or z) value for the plot with the mouse on the other plot. For example, click the y box for the left plot and then click the y value desired on the right plot, and y for the left plot will change to that value.

6.4 EXTENT

The extent of the plots automatically defaults to 100. This can easily be changed by clicking with the left mouse button on the appropriate lines, typing in desired extent and doing a carriage return. A faster method is to move the box on the "SCALE" right above the plot to select a scale factor for the extent between zero and 1,000.

6.5 LAST PLOT

The "Last" option enables the user to go back to prior parameters. For instance, if the extent has been doubled from 100 to 200 using the "SCALE", the user can select "Last" and the extent will return to 100. If more than one parameter change has been done "Last" will go backwards through the sequence. The parameters changed by "Multiplier", "Zoom" and "Basis" can all be recalled with "Last".

6.6 HARD COPY PRINT OF PLOTS

Before printing out a plot, two items must be set. The "COLOR" menu defaults to black and white. However, this can be changed for the actual printing by selecting which ever one is appropriate. The "Print" button menu for each plot contains the print command and an option to change printers. Make sure that if a color plot is being sent, it is being sent to a color printer.

Select the "Print" for the appropriate plot to obtain a hard copy.

6.7 HIDE AND SHOW FOR PLOTS

The ability to hide or show selected surfaces or cells on the plots is available in the "New Surface Creation" and "New Cell Creation" panels, respectively. For example, to hide some cells while in the "New Cell Creation" panel, select "List" from the upper right hand corner of this panel. Then a "Cell Description" panel appears. Place the mouse over the cell number you want to hide and press the left mouse button, and then select the "hide" option with the left mouse button. This cell will not appear on the plots -- more than one cell can be selected before selecting "hide". Now "quit" this sub-menu. Note: selecting the cell and then "show" will cause the cell to show up on the plots again.

6.8 ANNOTATE PLOTS

The "Annotate Plots" on the main menu panel brings up an "Annotate the Plots" panel, which allows you to put character strings on a plot. Select the "X" and "Y" coordinates for the location of the character string on the plot relative to the upper left hand corner -- usually select with the mouse. Type in the "Text" and select "Apply" for it to appear on the plot.

6.9 PLOT TOGGLES

Toggle buttons have two functions - on or off. When on they are outlined in black, when off they have a thin, gray outline. Turning them on or off involves a click with the left mouse button. All toggle buttons except "Zoom" are defaulted to on.

Surface

When the "Surface" toggle is turned on, surface numbers will appear on the plots next to their respective surface. If the toggle is turned off, surface numbers do not appear.

Cell

When the "Cell" toggle is turned on, cell numbers will appear inside their respective cells. If the toggle is turned off, cell numbers do not appear.

Refresh

"Refresh" is short for "constantly refresh". When "Refresh" is on the plots are constantly updated. For instance, if "Refresh" is turned off and a sphere is created the sphere will not appear on the plot until "Update plots" is selected. If "Refresh" is on and a spherical surface is created, it will appear on the plot once it is registered.

Zoom

The "Zoom" toggle enables the user to magnify a portion of the plot. When the "Zoom" toggle is on, the user needs only to cross a portion of the geometry with the mouse and that area will be magnified. This is useful for intricate work in small cells.

6.10 SURFACE AND CELL LABELS

Selecting the "Labels" button with the right mouse button will call a menu which lists 19 labels recognized by MCNP. These labels are: CEL, IMP:, RHO, DEN, VOL, FCL:, MAS, PWT, MAT, TMPn, WNNn:, EXT:p, PD, DXC:, U, LAT, FILL, and NONU. Those items with a ":" have a pullright menu to choose p, n, e. Items with n call a pop-up menu which allows the user to type in a number.

6.11 MULTIPLE PLOTS

Multiple Plot windows allow the user to view a geometry with up to ten different plots. These plots are saved and retrieved using the "Plot" button and menu. The left plot screen contains options for 0, 2, 4, 6, and 8. The right plot screen contains the remaining 1, 3, 5, 7, and 9.

Utilizing multiple plot screens is very simple. Once a geometry is created, all plots show that geometry. However, the parameters changed in a plot remain specific to that plot number (when coming into a new plot, all the parameters are set to default).

A simple example is to create a sphere in plot 0. Enter plot 2 and change the extent of the sphere to 200. Enter plot three and do a "Zoom". Now go back into plot 2 to find the sphere with an extent of 200.

7.0 DATA CARDS

The "Data Cards" menu contains five choices; Materials, Importances, Transformations, Source and Other. At the present time only Transformations and Materials are completely implemented.

7.1 MATERIALS

Two options appear under the Materials button, "Material Creation" and "List Materials". The "List Materials" option brings up a "Material List" panel that is useful during cell creation. Clicking on one of these materials during creation of a cell will select that material number for the cell and its corresponding default density.

The materials are actually created by choosing the "Materials Creation" button under the Materials button. This brings up two panels -- a "Material Card" panel and a "Generic Materials" panel. Prior to creating any materials, you must set the mode of the calculation with the Problem Mode button. For the discussion here, we will assume that the problem mode is neutron. Typically, one would first select the "List Standard Materials" button on the "Material Card" panel to bring in whatever materials are needed from this standard list. This brings up the "Standard Materials" panel, where the materials of interest can be selected by clicking with the left mouse button. Then use the "Add Selected Materials" option to create material cards for these standard materials. These materials will appear on the "Material Card" panel. Additional materials can be added at any later date from the standard materials by simply selecting more materials from the "Standard Materials" panel and clicking on "Add Selected Materials".

Caution: The standard materials compositions and densities have been selected from what is desired in a typical application. This requires a judgment in

most cases. A composition and density that may be perfectly acceptable in most applications, may be very unacceptable in a special application. Trace element activation or temperature, for example, may mean important differences. When using standard materials, the user should always carefully review the acceptability of these materials.

Selecting "Quit" on the "Standard Materials" panel will replace this panel with a "Generic Materials" panel. You can use this panel to build a material by specifying each isotope of the material and registering it. To do this, click on "Cross Section" in the "Generic Materials" panel. This brings up a table of the elements. Selecting an element with the left mouse button brings up the isotopes for that element in a panel to the right. Clicking on an isotope, brings up the cross section sets for that isotope where the default cross section set is darkened. If the default is not the one you want, choose the appropriate cross section set by clicking on it with the mouse. When you do this, that cross section set ID will appear under "isotope" in the "Generic Materials" panel. Enter the density for that isotope in the material being created in the adjacent "density" box. Repeat this for the other isotopes in the material. Some elements will have an elemental cross section set, denoted by 26000. for iron for example. After you have selected all of the isotopes for the material, enter the name you want the material called at the top of the "Material Card" panel and the total density of the material -- this total density will be the default used on cell cards with that material, but you can change this on each cell card if there are different densities of that material. Then select "Register Materials" to register the material. This process is repeated until all the desired materials have been created, although you can always come back in these panels and add materials.

Two other options in the "Generic Materials" panel are "Delete" and "Change". To delete a particular isotope, highlight the number by a click with the mouse. Once it is highlighted, select "Delete" and the isotope will disappear. Change works the same way. To change an isotope, highlight the number by a click with the mouse, select which isotope it is to be changed to and select "Change". To delete an entire material, name and isotope, highlight the name of the material in the "Material Card" panel and select delete.

7.2 IMPORTANCES (not yet operational)

7.3 TRANSFORMATIONS

The "Transformation Description" panel provides spaces to enter the elements of the transformation. A carriage return must be done after each element entered. When the correct coordinates have been entered, select "Register". This process may be repeated as many times as necessary for subsequent transformations. The number of the transformation is the number entered in either the "New Surface Creation" panel or the "New Cell Creation" panel, respectively, when the transformation is to be utilized.

7.4 SOURCE

A Menu to input the source cards has not yet been implemented, but an option to display randomly sampled source points on geometry plots from a source that is read in on the input file is available. This is utilized by selecting the source button under the data cards button, which produces a "Source Description" panel. "Refresh" the plot where you want to generate source points and turn the other plot off. Set the number of particles for which you want to sample source points (default 1,000). Also select how far from the plot plane source points will be plotted (default 100) -- for example, with the default of 100 and an (x,y) plot with z=0 for the plot, sampled (x,y) source points will be plotted when the sampled z value is greater than -100 but less than +100. Then select "plot" with the left mouse button. For each sampled (x,y,z) point, the visual editor will determine how far the sampled point is from the normal to the plot plane that passes through the (x,y,z) point and will plot the point if it is less than the distance specified.

7.5 OTHER (not yet operational)

Eventually the user will be able to input any data card in an efficient manner with a menu driven format.

8.0 HELP

A help package to give the user information at any point in the visual editor has not yet been implemented.

9.0 LIMITATIONS OF PRESENT VERSION OF VISUAL EDITOR

The present version of the visual editor has shortcomings that will eventually be corrected. Many of the data cards have not yet been implemented as discussed in Section 7.0. Lattices cannot be described in an interactive session, but the remainder of the geometry treatment is fairly general. There are certain limitations during the reading of an inp file, where the newly created inpn file has lost or modified some information as described in the remainder of this section.

9.1 READING AND WRITING CELL CARDS

The attempt is made to read the inp and write out the same information to the inpn file. There are some types of cell card structure, where the inpn file will be missing information that was in the original inp file. This includes:

- The "lat=1" or "lat=2" on a cell card will not be written to the inpn file for the cell. Any corresponding "fill= i:j k:l m:n + matrix" will also not be written to the inpn file.

- Transformations involving the "fill" card on a cell card are not written out, but the "fill=n" is written out unless it is a matrix as already mentioned.
- A "tcr1=n" on the cell card, with n a transformation number, will be written out ok, but "tcr1=()" on the cell card, with the numbers inside the brackets giving the transformation are not written out.
- The "#n", where n is a cell number, on a cell card will be written out to the inpn file, but the "#()" is not written out to the inpn file where surface numbers are inside the brackets.

In spite of the above limitations in the inpn file that is written, the visual editor can still be useful for working with such inpn files. As a general rule, it will read into the FORTRAN the above data ok and will give valid geometry plots, and can be used to plot source points. However, if you are going to use the resulting inpn file from an editing session, you must fix the above limitations in inpn with an editor.

9.2 DATA CARDS WRITTEN TO INPN FILE

Most of the data cards in the inpn file are read in as a data card and written right back out as a data card with no change of format. Exceptions are the material cards and the transformation cards, which are treated explicitly (you can also create them in an interactive session) with the visual editor. These will be written out ok, but may be in a different format than they were on the inpn file. The data cards that have an entry for each cell [IMP, VOL, PWT, FCL, PD, DXC, NONU, TMP, WWN] are not treated explicitly in the visual editor, but they are written out in a special format that uses a "\$" comment on each line to show the cell numbers involved for that line.

9.3 COMMENT CARDS AND "\$" COMMENT WRITTEN TO INPN FILE

Comment cards are read in from the inpn file and written out at the same relative location in the inpn file. The "\$" comment portion of a data card will be written out directly for all the data cards, except those data cards that have an entry for each cell -- these cards are written out in a special format that uses a "\$" comment on each line to show the cell numbers involved for that line. The "\$" comments from the inpn file for cell and surface cards are read into the visual editor, but only one "\$" comment will be written out for a cell or surface card; i.e., if there are more than one "\$" comments for a given cell or surface, only one will be written to the inpn file.

9.4 READING AN INPUT FILE WITH 1ST CARD BEING "MESSAGE"

The visual editor should read the inp file ok, but the inpn file written out will contain the "message" card on the first line and will not give the title card. Its recommended for inp files with "message" that the "message" card(s) be trimmed off before using the visual editor.

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Figure 1. MAIN PANEL AND PLOT CONTROLS SUMMARY

Quit	Exits the program
Begin	Starts the Visual Editor -- This button then changes to Reinitiate
Reinitiate	Menu: Contains the choices current, saved, or new *Current - takes what is in memory and writes it to inpn and inp *Saved - takes last inpn file and copies it to inp *New - starts over
Surface Creation	Opens the New Surface Creation panel
Cell Creation	Opens the New Cell Creation panel
Backup Inp	Takes what is in memory and writes it out to inpn and the inpn(number)
Update Plots	Updates the plots after a change has been made or when first starting the program
Data Cards	Menu: Access to the data cards that have currently been implemented -- materials, transformations, and source point plotting.
Update Plots	Update the plots
Color	Color On: Plot will be printed and displayed in color Color Off: Plot will be printed and displayed in black and white
Basis -- Plot Panels	Menu: select one of the six pre-set basis options, or type in desired basis
Labels -- Plot Panels	Menu: contains the choices CEL, INP:, RHO, DEN, VOL, FCL:, MAS, PWT, MAT, TMPn, WNNn:, EXT:, PD, DXC:, U, LAT, FILL, NONU *Those items with ":" have a pullright menu to choose p, n, e *Those items with n have a popup menu which allows the user to type in a number
Zoom -- Plot Panels	ON: By crossing a section of the plot with the mouse the user can zoom in on that particular section OFF: Nothing happens when a section is crossed
Last -- Plot Panels	Will go to the previous plot

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Plot -- Plot Panels	Menu: contains choices of 0,2,4,6,8 for the left plot or 1,3,5,7,9 for the right plot, to obtain up to 10 different plot views
SCALE -- Plot Panels	Enables the user to change the extent by moving the scale between 0 and 1,000 to ratio current extent
Print -- Plot Panels	Obtain hard copy of the plot with option to also designate the printer
Origin -- Plot Panels	Lines: type in desired origin -- or -- Click "Origin" and click left plot button on plot where you want the new center of the plot to be -- or -- Select one of the coordinates from the other plot by: first click in the box of the coordinate from the plot you want changed, and then click on the other plot what you want that coordinate value to be
Extent -- Plot Panels	Input desired extent coordinates on the lines provided - - or use SCALE above
Surface -- Plot Panels	ON: shows surface numbers on plots OFF: does not show surface numbers on plots
Cell -- Plot Panels	ON: shows cell numbers on plots OFF: does not show cell numbers on plots
Refresh -- Plot Panels	ON: constantly updates plot changes (except in edit) OFF: plot does not update unless "Update" is pushed

Figure 2. NEW SURFACE CREATION DATA ENTRIES

PLANES	p	Enter coordinates on lines given
	px	Click at desired location on the plot with the mouse or enter coordinates by hand
	py	Click at desired location on the plot with the mouse or enter coordinates by hand
	pz	Click at desired location on the plot with the mouse or enter coordinates by hand
SPHERES	so	Click to locate desired radius or enter coordinates by hand
	s	Click to locate center, drag from there for radius or enter coordinates by hand
	sx	Click to locate center, drag from there for radius or enter coordinates by hand
	sy	Click to locate center, drag from there for radius or enter coordinates by hand
	sz	Click to locate center, drag from there for radius or enter coordinates by hand
CYLINDERS	c/x	Click to locate center, drag from there for radius or enter coordinates by hand
	c/y	Click to locate center, drag from there for radius or enter coordinates by hand
	c/z	Click to locate center, drag from there for radius or enter coordinates by hand
	cx	Click to locate radius
	cy	Click to locate radius
	cz	Click to locate radius
CONES		All coordinates are entered by hand
QUADRATICS		All coordinates are entered by hand
TORUS		All coordinates are entered by hand

Example Problem

Objective: Following the steps below, the user will create a cross inside of a sphere (where the cross is bounded by the sphere in the 3rd dimension), where there is a smaller sphere inside of the cross, and define the outside world as beyond the outer sphere -- a simple example of unions. The final geometry consists of 10 surfaces and 4 cells.

Keep in mind: The basis of the left plot is xz and the basis of the right plot is xy (unless the user decides to change them). A drag involves holding down the left mouse button.

1. Select "Begin".
2. A "Title line" panel will appear. Type in your title and press enter.
3. Press "Update plots". Select "Surface Creation" which brings up the "New Surface Creation" panel.
4. Using the right mouse button, pull down the "Sphere" menu and select "so". Move mouse to one of the plots and click to locate sphere radius of approximately 99 (using mouse the location will not be exact). The location of the click will appear in the "New Surface Creation" panel for the radius. Once the desired radius is found, register the surface by pushing the "Register" button in the "New Surface Creation" panel and this surface should appear on the plots. Make a second sphere the same way as the first except with a radius of approximately 22. "Register" the second sphere once the correct coordinate has been located.
5. After the two spheres have been completed go back up into the surface panel, pull down the "Planes" menu, and select px. With the mouse, locate px planes at approximately -80, 80, -25 and 25. Be sure to register after each coordinate is located.
6. To finish the cross, pull down the "Plane" menu again and select py. With the mouse, locate py planes at approximately 80, -80, 25, and -25. Remember to register after each coordinate.
7. Now that all the surfaces of the cross and spheres are in place, "Quit" the "New Surface Creation" panel and select "Cell Creation" which brings up the "New Cell Creation" panel. You may want to select "Backup inp" to save the current status of your input file.
8. Drag the mouse over surface 1 (large sphere -- you may want to toggle "surface" to show surface numbers) on right-hand plot, click inside with the mouse to define the sense, select "Cut" and then "Register". This defines the outside world. To define the cross portion of the cross outside the inner sphere, the first step is to drag over surfaces 3, 9, 10, and 4, (the horizontal segment of the cross), click in the center of this rectangle for the sense of this object and select "Paste". Since this is not the final cell, it does not yet get registered. Instead, drag over surfaces 7, 5, 6, and 8 (the vertical segment of the cross), click in the center, select "Paste". Then drag over spherical surface 2, click in the center of surface 2 for the sense, select "Cut". Then

drag over spherical surface 1, click outside of surface 1 for the sense, and select "Cut" to bound the cross in the z direction with the sphere. Then "Register".

9. Cell number 3, inside the inner sphere, is created by dragging across surface 2 (small sphere), clicking in the middle, selecting "Paste" and then "Register". Finally, cell number 4, outside the cross and inside the outer sphere, is formed as follows. Drag the mouse across spherical surface 1, click for the sense inside of this sphere, and select "paste". Then drag the mouse across surfaces 3, 4, 9, and 10, click sense inside of these surfaces, and select "Cut" to cut out this portion of the cross. Drag the mouse across surfaces 5, 6, 7, and 8, click sense inside of these surfaces, and select "Cut" to cut out this portion of the cross. "Register" and the dashed lines should disappear, which indicates a valid geometry.
10. Select "quit" on the "New Cell Creation" panel and select "quit" on the main panel to leave the editor. Now look at your inpn file that was created representing the geometry. You may want to now copy the inpn file to inp, and execute again to demonstrate that the plots show the cross geometry OK.

APPENDIX A

VISUAL EDITOR NOTES

- 1) The visual editor was created to allow for the creation of MCNP input files through a visual interface. By using a visual editor, MCNP geometries can be created quickly and error free. With the visual editor even novice users can create complex MCNP geometries. The package has been used to create very complex geometries and has already saved hundreds of man hours. The log file for the visual editor shows that the editor has been used over 1,500 times in the past year.
- 2) The visual editor has been developed over the past 3 years and is still being developed. Problems are tracked via a current bug list. Any bugs are to be reported to Randy Schwarz (509)376-5977. To access the visual editor at Westinghouse Hanford:

/p/mcnp/mcnped

- 2) Current capabilities:

Almost all geometry functions except lattices are available.
Sophisticated scanning and editing functions are provided.
Sophisticated plotting functions are provided.
Source plotting is available.

- 3) Planned future capabilities:

Implementation of data cards (importances, source, tallies, etc.)

OVERVIEW OF THE VISUAL EDITOR

Upper left panel: Basic command functions

Top text panel: MCNP ERROR and WARNING messages.

Bottom text panel: User information

Two bottom plot windows: Plot and modify the geometries.

COMMAND SUMMARY:

BEGIN: Start the visual editor

QUIT: Exit the visual editor

HELP: Online help

REINITIATE: Restart the visual editor

SURFACE CREATION: Create/Scan/Modify surfaces

CELL CREATION: Create/Scan/Modify cells

BACKUP INP: Backup the current input file

DATA CARDS: Allow for creation of materials, transformations, etc. and viewing the source

UPDATE PLOTS: Redraw the plots, typically used only after selecting BEGIN

ANNOTATE PLOTS: Allow text to be inserted on a plot

COLOR: Turn color on/off

How to use this tutorial:

This tutorial is written to help new users understand how to use the visual editor. The exercises are expected to be performed in sequence, since each new scenario starts where the last scenario ended. Each exercise contains a sequence of steps, with each step describing the action taken and a description of what the action does. This tutorial teaches the new user how to use the visual editor by taking them through a series of example exercises.

Actions in these exercises will either indicate select, which means to select the button with the left mouse button, or menu which indicates that the user should select the button with the right mouse button which will bring up a menu. Then the menu option indicated in the action column should be selected.

Because there are times when numerous panels will be displayed simultaneously, the panel to which an action is directed will be indicated.

After each exercise, the user is directed to back up the input file. If the user gets lost, it is recommended that they retrieve the last file that was backed up by selecting REINITIATE-SAVED and start from this last saved position.

BASIC PLOTTING CAPABILITIES

This exercise demonstrates some of the basic plotting capabilities of the visual editor. For this exercise we will start with a input file that already exists and show how the visual editor can be used to make geometry plots of the file.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	mkdir vised	Make a temporary directory in your home workspace
2	cd vised	Change to the temporary directory
3	cp buss13a inp	Copy over sample input file for the visual editor. input file is the MCNP model for the BUSS cask. The visual editor always expects the input file to be called "inp." This geometry was NOT created by the visual editor.
4	/p/mcnp/mcnped	Run the Visual Editor
5	select BEGIN	Always start by selecting the BEGIN button.
6	select UPDATE PLOTS	The visual editor will not automatically generate the plots after initiation. Notice there are several dotted lines on the plot. These represent unused surfaces.
7	select SURFACE CREATION	Bring up the surface creation menu. Notice the menu is in CREATE mode.
8	menu HIDE; ALL	Will hide all unused surfaces and remove them from the plot.
9	surface creation panel: select QUIT	Remove the surface creation window.
10	right plot: select SCALE (press down left mouse button on the slider bar) and slide left to around 30	The scale is a slider bar that can be selected and moved. Once the mouse button is released, the plot is redrawn using the new scale factor. Notice the plot extents are changed to the value selected.
11	left plot: menu BASIS; YZ	Set the basis of the left plot to YZ.
12	left plot: select ORIGIN	The origin button allows the user to change the origin of the plot to where the user indicates.
13	left plot: move the mouse to the center of the port (about 0 -40, 36) and press the left mouse button	The x and y coordinates of the mouse within the plot are shown in upper right plot panel. Press the left mouse button at the indicated coordinates to change the origin of the plot.
14	left plot: select ZOOM	The zoom button allows the user to zoom in on any location in the plot by dragging the left mouse button from the upper left corner to the lower right corner of the region to zoom in on.
15	left plot: drag the left mouse button over the port (about 0 -65, 50 to 0 -20, 25)	This will zoom in on the port region of the plot. The resulting extents will not be equal which will cause the plot to be distorted.
16	left plot: select CELL	Will display the cell numbers on the left plot
17	left plot: menu CEL; DEN	Display the cell densities on the left plot.
18	left plot: menu DEN; IMP;; IMP:P	Display the photon importances on the left plot.
19	right plot: select the z origin	Each of the origin values has a box to the left that can be selected. Select the box next to the z coordinate which is the third box down below the ORIGIN button.

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20	left plot: select a point in the center of the port (around 0 -40, 36)	The z coordinate of the left plot will be set to the point selected. This allows an efficient way of changing a coordinate of one plot by selecting the desired coordinate off another plot.
21	right plot: select y origin	Select the box by the Y coordinate in the right plot.
22	left plot: select a point at the center of the port (around 0 -40, 36)	Change the Y coordinate of the right plot to the point selected.
23	right plot: select SURFACE	Display the surface numbers on the right plot.
24	left plot: select LAST	Show previous left plot view.
25	left plot: menu IMP:P; MAT	Show the material numbers.
26	left plot: menu PRINT; CHANGE PRINTER	Allows you to set the printer
27	lpr -Pmps3 out.ps	Define the printer to use, here "mps3" is the name of the printer. Your printer name will probably be different.
28	left plot: select PRINT	Print out the plot
29	select BACKUP INP	Back up the input file.

DISPLAYING CELL & SURFACE INFORMATION

The following example is a continuation of the last example. It will show how to display surface and cell information read in by the visual editor.

select: LEFT BUTTON

menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	left plot: menu PLOT 0: PLOT 2	Switch to an alternate plot, total of 10 plots are available (5 left plots, 5 right plots)
2	select SURFACE CREATION	Display the surface creation panel
3	surface creation panel: select LIST	Display a scrolling list of all of the surfaces. The surface list will also contain transformed surfaces. Scroll through the list to look at different surfaces.
4	surface list panel: select QUIT	Close the surface list panel.
5	surface creation panel: select SCAN	Change to SCAN mode. In scan mode the description of a surface can be retrieved by dragging the mouse across the surface in the plot window.
6	left plot: select SURFACE	Display the surface numbers on the left plot.
7	left plot: Drag the mouse across surface 14	By dragging the mouse across a surface in SCAN mode. The surface description is displayed in the surface creation panel. A cone surface should be displayed.
8	right plot: Drag the mouse across surface 75.	Display surface 75 which is an off axis cylinder (type C/Z).
9	surface creation panel: select QUIT	Close the surface creation panel.
10	select CELL CREATION	Display the cell creation panel.
11	cell creation panel: select LIST	Display a scrolling list of all of the cell descriptions. Scroll through the list to view the cell descriptions. Cell descriptions will be truncated if they are too long.
12	cell list panel: select QUIT	close the cell list panel.
13	cell creation panel: select SCAN	Change to SCAN mode. In scan mode the description of a cell can be retrieved by selecting the cell with the mouse.
15	left plot: select SURFACE	Will remove the display of the surface numbers on the left plot
16	left plot: select CELL	Will display the cell numbers on the left plot.
17	left plot: select SCALE, slide left to a value around 40.	Reset the extents on the left plot to enlarge the center region of the cask.
18	left plot: select cell 52	By selecting cell 52 in SCAN mode, the cell description is displayed in the cell creation panel.
19	left plot: select cell 72	Display description of cell 72. Notice the not cards.
20	left plot: select cell 7	Display description of cell 7. Notice the universe number.
21	cell creation panel: select QUIT	Close the cell creation panel.
22	select BACKUP INP	Back up the input file.

DISPLAYING DATA CARDS AND SOURCE

The following example is a continuation of the last example. It will show how to display materials, transformations, and plot the source. In step 11, no materials will be displayed if the "materials" sub directory has not been made and the library files "standrd.n" and "standrd.p" placed in this sub directory.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	right plot: menu PLOT 1; PLOT 3	Switch to an alternate plot, total of 10 plots are available (5 left plots, 5 right plots)
2	left plot: menu PLOT 2 PLOT 4	Switch to an alternate left plot.
3	menu DATA CARDS; SOURCE	Display a source plotting panel.
4	source panel: select PLOT	Plot out 1000 source particles. If any of the plot options are changed, the particles will need to be replotted.
5	source panel: select QUIT	Remove the source plotting panel.
6	menu DATA CARDS; TRANSFORMATION	Display the transformation scrolling list. Use the scroll bar to display the different transformations.
7	transformation panel: select QUIT	Remove the transformation panel.
8	menu DATA CARDS; MATERIALS; MATERIAL CREATION	Display the material creation panel. Notice that two materials are shown.
9	material panel: select material 1	Display material 1.
10	material panel: select material 2	Display material 2.
11	material panel: select LIST STANDARD MATERIALS	Display a scrolling list of standard material descriptions that can be used for creating material cards for the input file. Need to have the materials directory set up for this to work.
12	standard materials panel: select QUIT	Remove the standard materials panel.
13	Material Description: select CROSS SECTION	Show all available cross sections for creating materials. Cross section information is generated by reading the xsdir file.
14	element chart panel: select 94 PLUTONIUM	Show cross section files available for plutonium.
15	element chart panel: select QUIT	Remove the cross section list.
16	material card panel: select QUIT	Remove the material card list.

PRACTICE EXERCISES:

What is the coordinate for the bottom of the cask?
 What is the radius of the cask?
 What is the density of the source region?
 What cell number in the source region generates the most particles?
 What cell uses transformation 16?

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What is the cell number of the last cell created?
How many transformations are used in this problem?

CREATING A SIMPLE GEOMETRY

This exercise will show how to create a simple MCNP geometry consisting of a steel cask containing a spherical source region. The source region will be created using a universe and will use a transformation. Be very careful in following the directions or else the surface and cell numbers that are created will not match up with the ones which will be called out in these exercises.

CREATING A CELL

select: LEFT BUTTON

menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
2	rm inp	Exit the visual editor if you are in it. Remove the input file if it exists.
3	/p/mcnp/mcnped	Run the visual editor.
4	select BEGIN	Always start by selecting the BEGIN button.
5	enter title and press RETURN	The editor will ask you to enter a title card. Enter the title and press return.
6	left plot: select surface	Show the surface numbers on the left plot. The asterisk in front of the surface indicates that the surface is not part of the geometry yet because it hasn't been used in creating a cell.
7	select SURFACE CREATION	Bring up the surface creation menu.
8	surface creation: menu CYLINDER; CZ	Indicate you wish to create a CZ surface.
9	left plot: select a radius around 60 cm.	We will create the CZ surface using the mouse. move the mouse to the right plot and select a point at around x=60 cm. This will be the inside surface of the cask. NOTE: We could also enter the coordinates on the line instead of using the mouse.
10	surface creation: select REGISTER	By selecting register, the surface is created and will appear in both plots.
11	left plot: select a radius around 75 cm.	The surface creation panel will default the next surface to whatever the previous surface was, which is a CZ surface in this case. Use the mouse to create another surface at around x= 75 cm. This will be the outside surface of the cask.
12	surface creation: select REGISTER	Create the surface.
13	surface creation: menu PLANE; PZ	Indicate that you want to create a pz surface.
14	left plot: select an elevation around 50 cm.	Use the mouse to select the coordinate of the pz surface to around 50 cm. This will be used to define the inside upper cask surface.
15	surface creation: select REGISTER	Create the surface.
16	left plot: select an elevation around -50 cm.	Use the mouse to select a pz coordinate of around -50 cm. This will be used to define the inside lower cask surface.
17	surface creation: select REGISTER	Create the surface.
18	surface creation: select QUIT	Remove the surface creation window.
19	select CELL CREATION	Bring up the cell creation window.
20	left plot: drag across surface 1	We will now create a cell by dragging across all of the surfaces used by the cell. The cell will be a cylinder that represents the inside of the cask.
21	left plot: drag across surface 3	Select surface 3 to be part of the boundary of the cell.

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22	left plot: drag across surface 4	Select surface 4 to be part of the boundary of the cell.
23	left plot: select a point around the center of the plot (0, 0, 0).	With the surfaces selected, we will now ask the visual editor to determine the sense of the surfaces for the cell. This is done by selecting a point in the center of the cell to be created. The surfaces with their calculated senses will be displayed.
24	cell creation: select PASTE	Cells are created through a series of CUT and PASTE operations. By pasting this set of surfaces, we will "add" this region to the cell we are creating.
25	cell creation: select REGISTER	This will create cell 1 which is a cylinder representing the inside of the cask. Notice that the asterisks are removed from the surface numbers.
26	left plot: select CELL	Show the cell numbers.
27	select BACKUP INP	Back up the input file.

SPLITTING A CELL INTO SLICES FOR BIASING

The following example is a continuation of the last example. For thick shields, such as the shield region of the cask we are creating, it is sometimes necessary to divide the shield into a number of smaller regions to allow for importance splitting in the shield. The following steps will create the cask shield region and split it into three equal regions.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	cell creation: select QUIT	Remove the cell creation window.
2	select SURFACE CREATION	Bring up the surface creation window.
3	surface creation: menu PLANE; PZ	Indicate you want to create a PZ surface.
4	left plot: select an elevation around 70 cm.	Use the mouse to set the coordinate the surface to around 70 cm.
5	surface creation: select REGISTER	Create the surface.
6	left plot: select an elevation around -70 cm.	Set the z coordinate of the surface.
7	surface creation: select REGISTER	Create the surface.
8	surface creation: select QUIT	Remove the surface creation window.
9	select CELL CREATION	Bring up the cell creation window.
10	left plot: drag across surfaces 5,6,2	Select surfaces 5, 6, and 2 to be part of the cell. They will make up the outside surface of the cask.
11	left plot: select a point around the center of the plot (0, 0, 0)	Define the sense of the surfaces by clicking at a point inside all three surfaces for the cell being created.
12	left plot: select PASTE	Add this region to the cell being defined.
13	left plot: drag across surfaces 1,3,4	Select surfaces 1, 3, and 4 to be part of the cell.
14	left plot: select a point around the center of the plot (0, 0, 0).	Define the sense of the surfaces.
15	cell creation: select CUT	Cut out the inside cylindrical region from the from the region defined in step 12 to leave the cask region which will represent a cylinder inside a cylinder.
16	left plot: menu REGISTER; REGISTER FOR CELL SPLITTING	Since the cask region will be an effective shielding material, it needs to be split into a number of smaller regions for particle biasing. This option will allow this region to be split into a number of equal smaller regions for this purpose.
17	split window: change number of splits to 3.	The defaults is to split the cell into 5 regions. We will split the cell into 3 regions. Notice that all of the other options have already been set by the visual editor.
18	split window: select REGISTER	Create the cells. This will create cells 2, 3, and 4.
23	cell creation: select QUIT	Remove the cell creation window.
24	select BACKUP INP	Back up the input file

MODIFYING AND DELETING SURFACES

The following example is a continuation of the last example. Quite often it is necessary to modify a surface after it has been created. The following steps will demonstrate how surfaces can be modified or deleted.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	select SURFACE CREATION	Bring up the surface creation window.
2	left plot: select a radius of around 70	We now want to create a sphere that will contain the source. Use the mouse to create a sphere with a radius of about 70 cm. Notice that we do not need to indicate that we are creating a sphere because this is the default mode. Because you are selecting a radius, which is dependent on both the x and z values, you may have to press select several times until you get the correct radius.
3	surface creation: select REGISTER	Create the surface.
4	surface creation: change to SCAN mode	In order for this to work, the sphere has to fit inside the cylinder. The sphere we created will not work. We need to edit the surface to change it.
5	left plot: select the sphere by dragging across it.	Since we are in SCAN mode we can select the sphere by dragging across it.
6	surface creation: change to EDIT	We now want to edit the selected surface.
7	surface creation: change R to 45.0	We want to change the radius to 45 cm. We can either do this with the mouse or by hand. This time we are doing it by hand so we can set the exact value. Press return after entering the value.
8	surface creation: select REGISTER	Modify the surface.
9	left plot: select a radius around 30.	Set the radius of another sphere to 30 cm using the mouse.
10	surface creation: select REGISTER	Create the surface.
11	surface creation: select SCAN	We now want to delete this new surface that have created. This is done by scanning the surface and selecting the delete button.
12	select the 30 cm sphere by dragging across it.	Now that we are in SCAN mode we can select the surface by dragging across it.
13	surface creation: select DELETE	Delete the sphere that was just created.
14	surface creation: select QUIT	Remove the surface creation window.
15	select BACKUP INP	Back up the input file

MODIFYING AND DELETING CELLS

The following example is a continuation of the last example. Once a cell is created it sometimes needs to be modified or removed. The following exercise gives some examples of modifying and deleting cells.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	select CELL CREATION	Bring up the cell creation window.
2	cell creation: change mode to SCAN	We want to be in SCAN mode so that we can select cell 1 for editing. We will be editing cell 1 so that it is outside the sphere we just created.
3	right plot: select CELL	Show the cell numbers on the left plot.
4	left plot: select cell 1 with the mouse.	Select cell 1 by clicking the mouse near the origin of the plot (0, 0, 0)
5	cell creation: change to EDIT mode	Change the mode to edit so we can change cell 1.
6	left plot: drag across the sphere.	Select the sphere as part of cell 1.
7	left plot: select a point inside the sphere	Determine the sense of the sphere.
8	cell creation: select CUT	Modify the description of cell 1 be outside the sphere. Essentially "CUT" out the sphere from cell 1. Note that once a cut operation has been made, the surfaces with their senses and union operators will be displayed.
9	cell creation: select REGISTER	Create the modified cell. Notice the cell creation window is reset to CREATE mode.
10	cell creation: change to SCAN mode.	Change to SCAN mode to allow us to delete cell 3. We will change cell 3 so that it is two cells.
11	right plot: select cell 3.	Use the mouse to click on cell 3 which is the center cask cell.
12	cell creation: select DELETE	Delete cell 3.
13	cell creation: change to CREATE mode	Want to re-create cell 3, so need to be in CREATE mode.
14	left plot: drag across surfaces 11,12,8	Select surfaces 11, 12, and 8 to be part of the new cell. IF YOU HAVE PROBLEMS, SELECT CANCEL AND TRY AGAIN.
15	left plot: select a point between surfaces 11 and 12 and inside 8.	Determine the sense of these surfaces.
16	cell creation: select PASTE	Add this region to the cell being defined.
17	left plot: drag across surfaces 9,10,8	Select surfaces 9, 10, and 8 as part of the cell.
18	left plot: select a point between surfaces 10 and 9 and inside 8.	Determine the sense of the surfaces.
19	cell creation: select PASTE	Add this region to the cell. Note this creates a disjoint cell.
20	cell creation: select REGISTER	Create the cell.
21	cell creation: drag across surfaces 7,8,9,11	Select surfaces to make a "ring" cell.

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22	cell creation: select a point between 9 and 11, outside 7 and inside 8.	Determine the sense of the surfaces.
23	cell creation: select PASTE	Add this region to the cell being created.
24	cell creation: select REGISTER	Create the cell.
25	Select BACKUP INP	Back up the input file

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CREATING A UNIVERSE

A universe is used in MCNP to define a set of cells contained within the boundaries of cell that the universe fills. In this example we will make a simple universe of a sphere which will fill another larger sphere.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	Cell creation: drag across surface 13	We now want going to create the source cell which will be inside surface 13.
2	left plot: select a point inside the sphere.	Determine the sense of the surface.
3	cell creation: select PASTE	Add this region to the cell being created.
4	cell creation: set FILL NUMBER = 1	Set the fill to 1.
5	cell creation: select REGISTER	Create the cell. Notice the plot looks OK even though UNIVERSE 1 does not exist.
6	select SURFACE CREATION	Bring up the surface creation window.
7	surface creation: enter a radius of 10.0	Create a sphere with a radius of 10 cm, using keyboard entry. Hit return.
8	surface creation: select REGISTER	Create the surface.
9	surface creation: select QUIT	Remove the surface creation window.
10	left plot: drag across surface 14.	Select surface 14 for the cell description.
11	left plot: select a point inside 14.	Determine the sense of the sphere.
12	cell creation: select PASTE	Add the region to the cell.
13	cell creation: set UNIVERSE to 1	Define the universe as 1.
14	cell creation: set FILL to 0	Remove the fill indicator. The default is to NOT change the fill back to 0.
15	cell creation: select REGISTER	Create the cell. The smaller sphere is now defined as a universe filling the bigger sphere.
16	cell creation: drag across 14	Define a new cell will containing all space outside 14.
17	cell creation: select a point outside 14.	Determine the sense of the sphere.
18	cell creation: select PASTE	Add all the space outside 14 to the cell.
19	cell creation: select REGISTER	Create the cell. Notice that this cell was also created with a universe of 1 since the default is to not change the universe back to 0.
20	select BACKUP INP	Back up the input file.

USING TRANSFORMATIONS

MCNP uses transformations to transform the location and orientation of cells or groups of cells. We will use transformations in this example to transform the inner sphere inside the source.

select: LEFT BUTTON

menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	menu DATA CARDS; TRANSFORMATIONS	Bring up the transformation menu.
2	transformations: set X to -20	Set the X coordinate of the transformation.
3	transformations: set Y to 0	Set the Y coordinate of the transformation.
4	transformations: set Z to -20	Set the Z coordinate of the transformation.
5	transformations: select REGISTER	Create the transformation.
6	transformations: select QUIT	Remove the transformation window.
7	cell creation: select SCAN	Change to cell scan mode.
8	left plot: select cell	Toggle the cell button on the left plot so that cell numbers are displayed.
9	cell creation: select cell 8	Scan in cell 8 by selecting it with the mouse.
10	cell creation: change mode to EDIT	Edit cell 8.
11	cell creation: change transformation to 1	change the transformation from 0 to 1.
12	cell creation: select REGISTER	Register the modified cell. Notice that cell 9 is now undefined because surface 14 no longer exists. Need to change cell 9 so that it refers to cell 8 as #8.
13	cell creation: change mode to SCAN	Change to cell scan mode.
14	cell creation: select cell 9	Scan in cell 9 by selecting it with the mouse.
15	cell creation: change mode to edit	Edit cell 9.
16	cell creation: select CLEAR DESCRIPTION	Remove the description.
17	cell creation: enter 8 after the NOT	Go to the line after the NOT button, enter an 8, press return.
18	cell creation: select REGISTER	Register the modified cell.
19	select BACKUP INP	Back up the input file

CREATING THE OUTSIDE WORLD

To create the outside world it is necessary to cut out the geometry which will then leave the outside world.

select: LEFT BUTTON menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	cell creation: set universe to 0	The universe is not automatically set back to 0 when creating a new cell. Need to set it to 0.
2	left plot: drag across surfaces 6,5,2	Select surfaces 6, 5, and 2 to be part of the outside world.
3	left plot: select a point around the center of the plot (0,0,0).	Define the sense for the surfaces.
4	cell creation: select CUT	Do a CUT operation which will define all space outside the area you have selected.
5	cell creation: select REGISTER	Register the cell.

CREATING A MATERIAL

select: LEFT BUTTON

menu: RIGHT BUTTON

STEP	ACTION	DESCRIPTION
1	menu DATA CARDS; MATERIALS; MATERIAL CREATION	Bring up the material creation window.
2	material card: Enter material name of water	Define the material as water. Press return when done.
3	material card: Enter density of -1.0	Define the density as -1.0. Press return when done.
4	Generic materials: select CROSS SECTION	Bring up the list of cross sections
5	material: Toggle to neutron continues	Change to select continuous neutron cross sections.
6	material: enter a density of 2	Set the atom density of hydrogen to 2. Press return. Note that you do not need to select hydrogen because the material list defaults to hydrogen.
7	cross section: select OXYGEN	Show the available oxygen cross section tables.
8	cross section: select the ENDF5T cross section	Change from the selected cross section by selecting the endf5t cross section.
9	material: enter a density of 1.	set the atom density to 1.0.
10	material: select REGISTER MATERIAL	Create the material.
11	material: select QUIT	Remove the material windows.
12	cell creation: change mode to SCAN	Change to cell scan mode.
13	left plot: select cell 9	Scan in cell 9 by selecting it with the mouse.
14	cell creation: change mode to EDIT	Change the mode to edit.
15	cell creation: change material number to 1	Change the material number from 0 to 1.
16-	cell creation: select REGISTER	Register the modified cell.