Creating LEF File

Abstract Generation:

Export GDS:

Abstract generator comes as a part of the Silicon Ensemble package. As such, it cannot directly read ICFB library databases. We need to export the standard cell library to Stream (GDS) format and then re-import the GDS file in Abstract Generator. To export to GDS format from ICFB follow the instructions given below.

Go to "CIW" window and click ***File* -> *Export* -> *Stream.*** This opens the "Virtuoso Stream Out" window. Complete the form of "Virtuoso Stream Out" as shown in Fig1.

- Run Directory : .
- Library Name : cell (your library name)
- Top Cell Name : (leave blank)
- View Name: layout
- Output File: cell.gds (your .gds file)

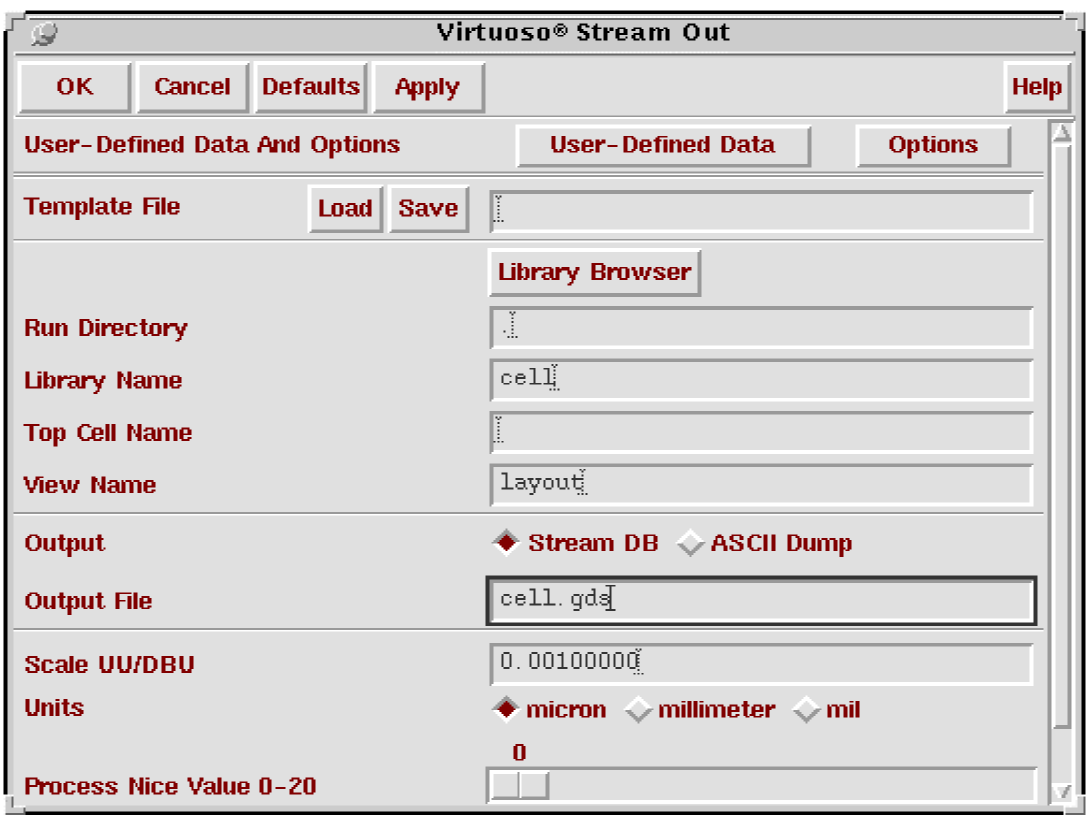

Fig1: Virtuoso Stream Out

In Fig 1 click ***User-Defined Data***. The "Stream Out User-Defined Data" form opens as shown in Fig 2.

In Fig 2 enter **stream.map** for the **Layer Map Table** field. Then click ***OK***.

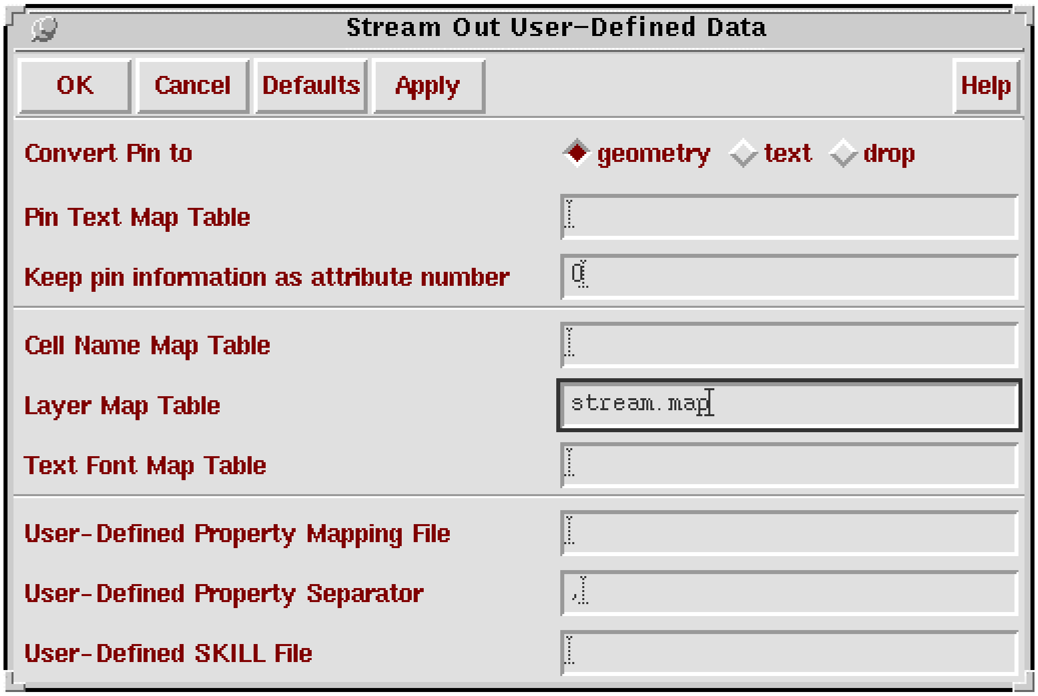

Fig2: Stream Out User-Defined Data

The text file stream.map tells ICFB which layers correspond to which GDS numbers. When we re-import the GDS file back into Abstract Generator, the tech file we are going to use has the same layer mappings.

Now back in the "Virtuoso Stream Out" form (Fig 1), click ***Options***. The "Stream Out Options" form opens as shown in Fig 3. In Fig3 select **Convert PCells to Geometry** field. This flattens out all parametric cells in the cell library (For the I/O Pad Cells). Change **Case Sensitivity** to **upper**. Then click ***OK***.

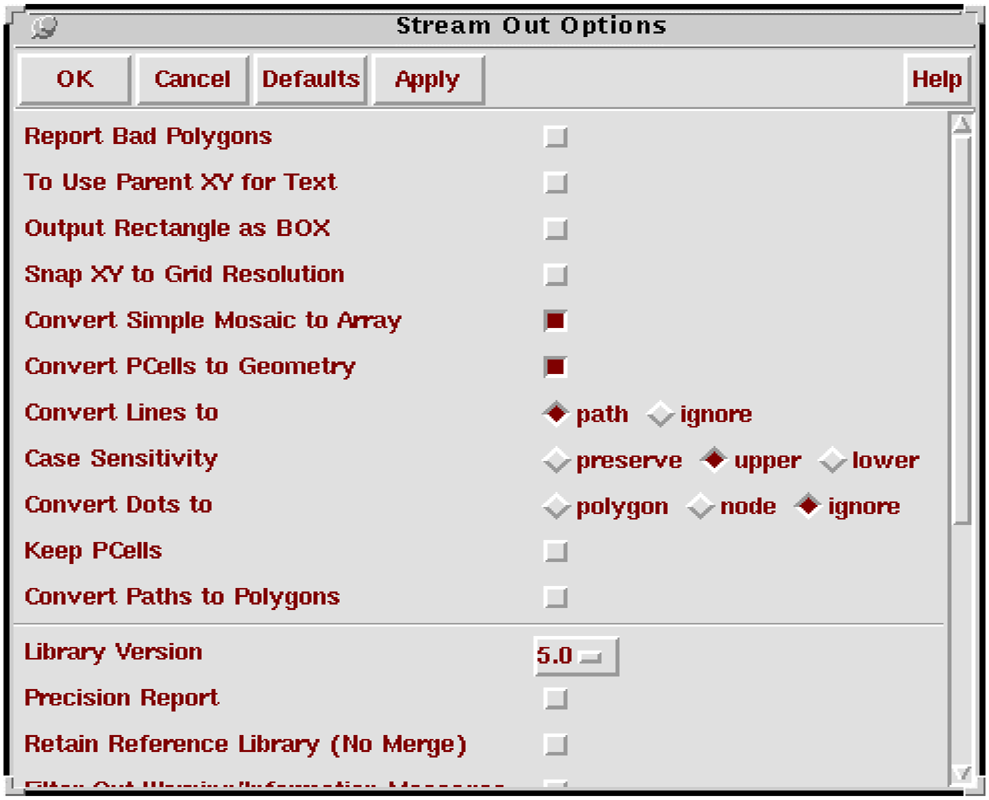

Fig3: Stream Out Options

Click ***OK*** in the “Virtuoso Stream Out” form. A “STRMOUT PopUp Message” appears showing some warnings as shown in Fig 4. You can ignore these warnings. In Fig 4 click ***OK***. Thus a GDS file containing the standard cell library will be generated.

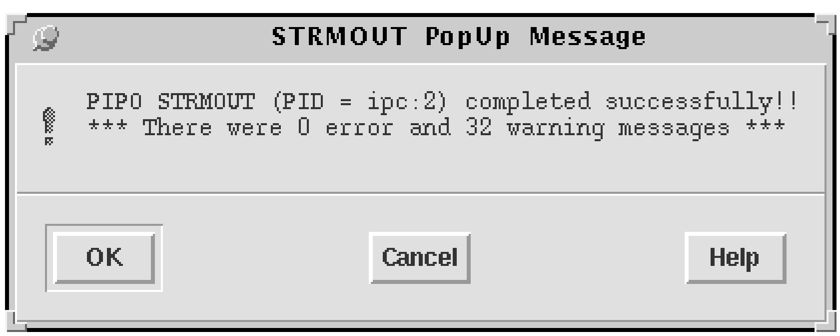

Fig 4: STRMOUT PopUp Message

Initialize Abstract Generator:

Start the Abstract Generator:
Go to your silicon ensemble directory and type the following command in the command prompt.

hostname.ece.pdx.edu >abstract -tech ./tech

The Abstract Generator window opens as shown in Fig 5.

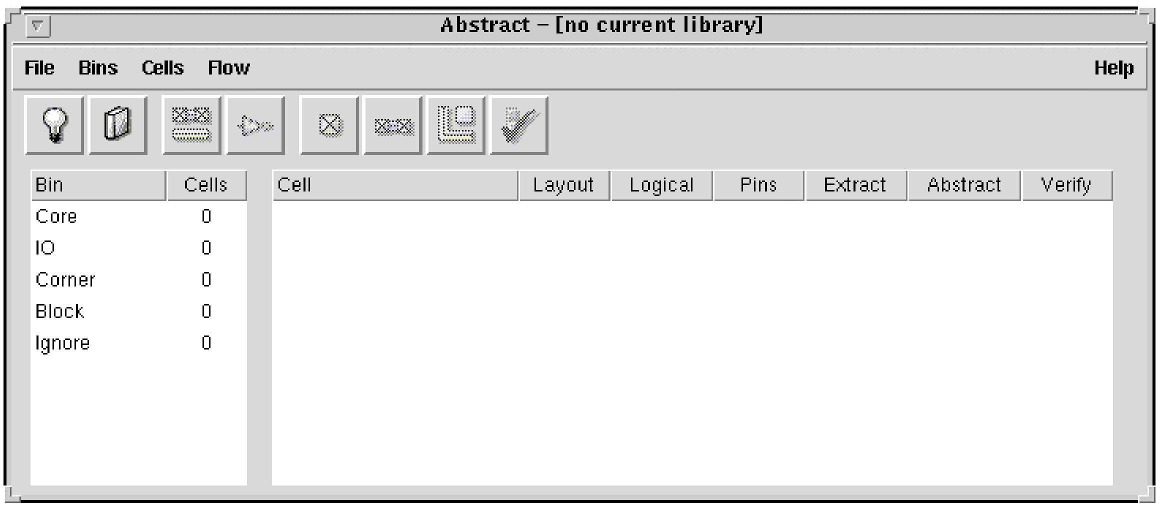

Fig 5: Abstract Generator

Mapping the library to a particular technology file:
In the Abstract Generator you will have to add your library to the technology file (tech.dpux). This can be done by following the instructions given below.

In Fig 5 click ***File -> Technology...*** to bring up the “Technology File Editor” window. Under ***Categories*** (on the left), click ***Library Path***. Click ***Add*** and replace *newLib1* with the name of your library (e.g. tut) and *newPath* with the path to your cadence library (e.g. /home/ece/siddhart/tut) as shown in Fig 6.

Important Point: MAKE ONE LIBRARY CONTAINING ALL STANDARD CELLS. The Silicon Ensemble abstract version of the cells will show up in ALL CAPS in Virtuoso, but the views will not be readable by Virtuoso. If your cells are named using ALL CAPS in Virtuoso, you will need to make a separate library directory for you abstract generator cells.

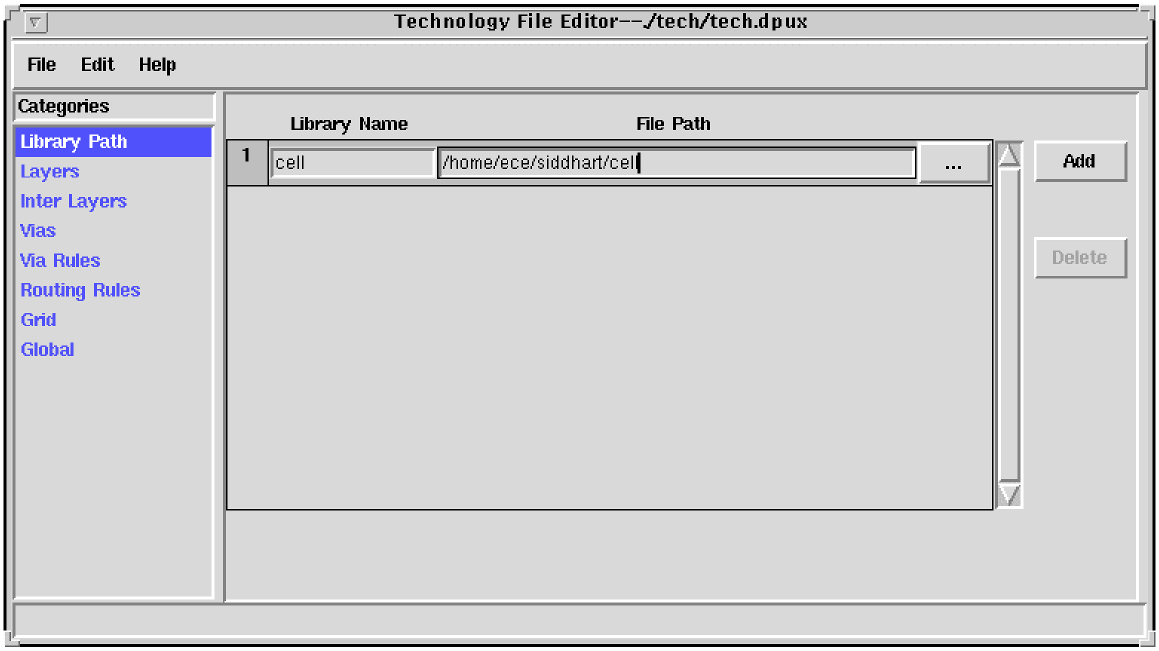

Fig 6: Technology File Editor – Library Path

In Fig 6 click ***Layers.*** Now Fig 6 appears as shown in Fig 7. In Fig 7 click ***Mapping.*** Now Fig 7 appears as shown in Fig 8.

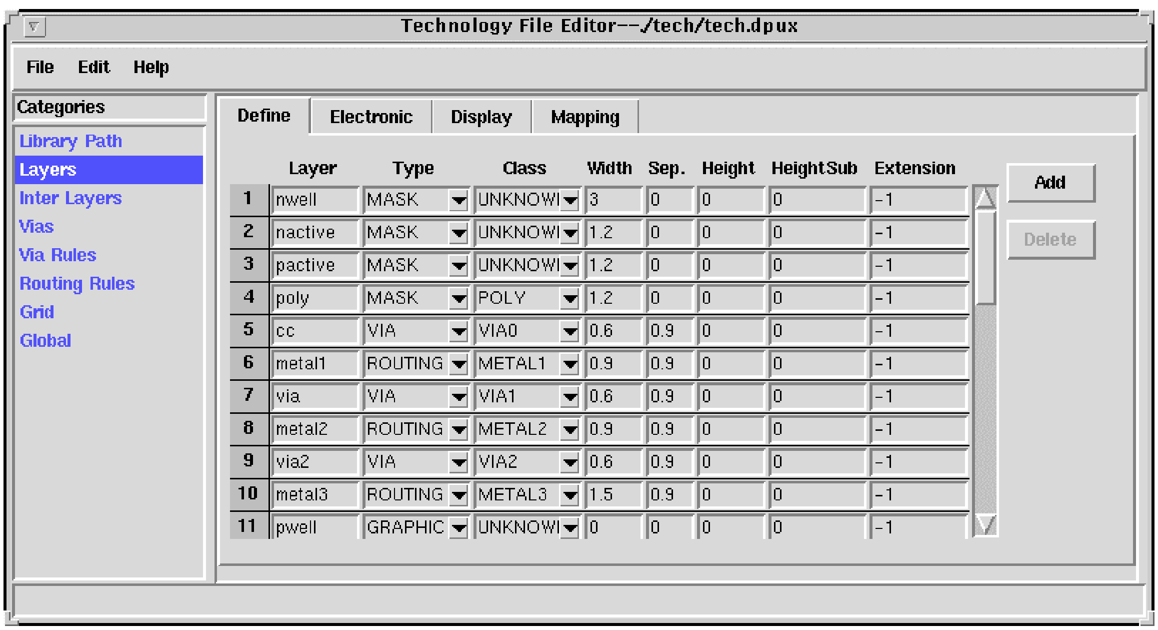

Fig 7: Technology File Editor - Layers

In Fig 8 click ***MAP***. A new window "Open" opens as shown in Fig 9. Then browse to get stream.map. Select stream.map and click ***Open***. In the "Technology File Editor" window click ***File -> Save*** and close the "Technology File Editor" window by clicking ***File -> Close***.

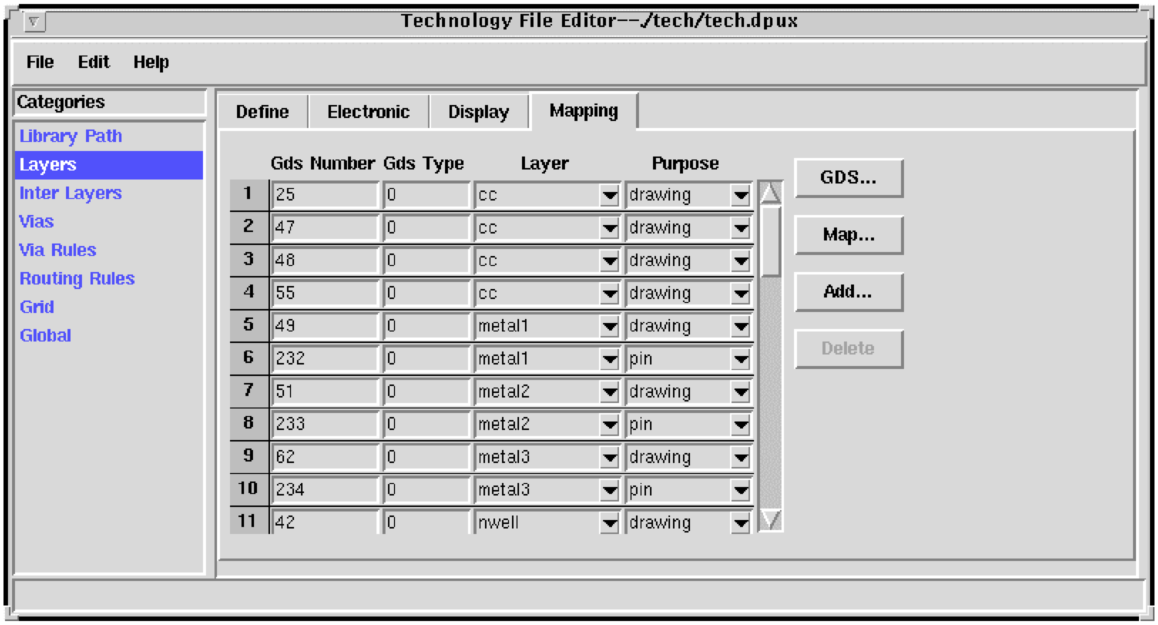

Fig 8: Technology File Editor - Mapping

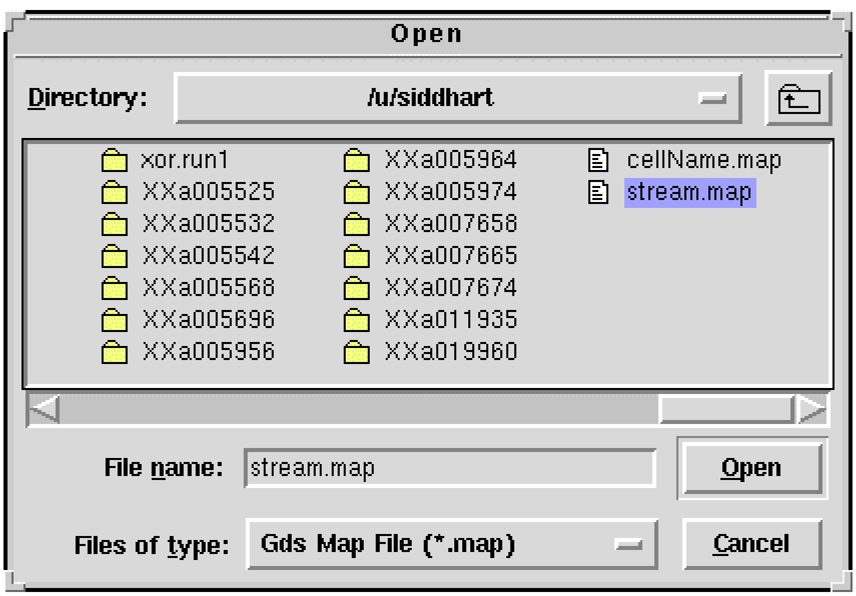

Fig 9: Browsing for stream.map

Using Abstract Generator:

Now we will be importing the GDS file exported earlier from Virtuoso. In the Abstract Generator window click ***File*** -> ***Library***. Since you have only one library at this point it should come up automatically. If you have more than one library you should select the library you want to open. After the library opens the name of the Abstract Generator window changes to "Abstract-your library name". In our case the name of the Abstract Generator window is "Abstract-tut".

In the "Abstract-tut" window click **File** -> ***Import*** -> ***Stream(GDS11)….***The "Import Layout" window opens as shown in Fig 10. Browse until you find the GDS file you exported earlier from Virtuoso. Then click ***OK***.

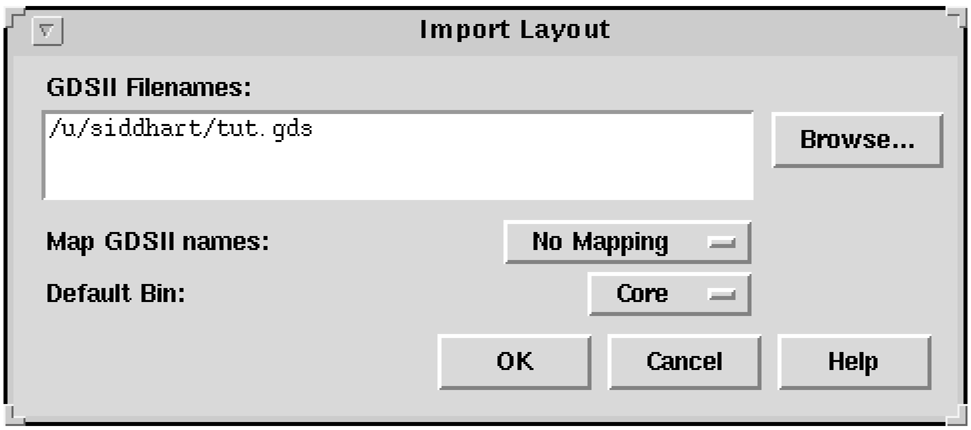

Fig 10: Import Layout

After a few moments the cells from your library will appear in the "Abstract-tut" window in Core Bin as shown in Fig 11.

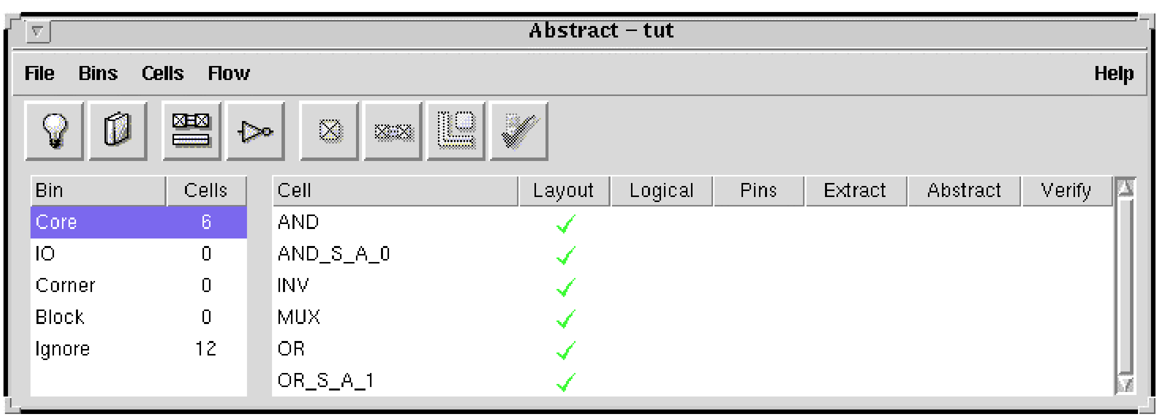

Fig 11: Abstract generator window after importing the gds file

At this point, if there are any cells that do not have a green tick next to them in the layout column, select them (Shift allows you to select groups, Control allows you to selector deselect one at a time...same as windows).When all the cells are selected click ***Cells*** -> ***Move***. The "Move Select Cells" form opens as shown in Fig 12. Select **Ignore** and click ***OK*** to move these cells to the Ignore bin.

Note: If there are cells without any valid views in the Core bin, you may not be able to export the library later.

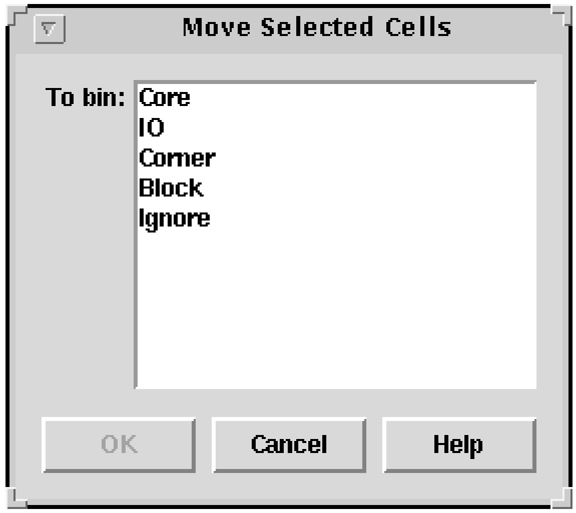

Fig 12: Move Selected Cells

There are three main steps in generating abstracts - generating the Pins view, the Extract view, and finally the Abstract view.

- The Pins step maps text labels to metal layers, designating certain metal blocks as pins (all pin information is lost during GDS export, so we need to re-instate that information).
- The Extract merges metal blocks under the same net into one single net
- The Abstract step copies the pin (net) information from the Extract step, and generated blockages for the metal and via layers (or any other layer that you specify). These blockages will tell the place-and-route tool (namely Silicon Ensemble) which parts of the standard cell to avoid routing over with certain layers.

The resulting Abstract view contains only net and blockage information, which will be exported into an LEF file and imported into Silicon Ensemble.

Pins Step:

In Fig 11 select all the cells and click ***Flow -> Pins***. The “Running step Pins for the selected cells(s)” form opens. Add all the output pins of all standard cells in the “Output pin names (regular expression)” as shown in Fig 13. Leave rest as default.

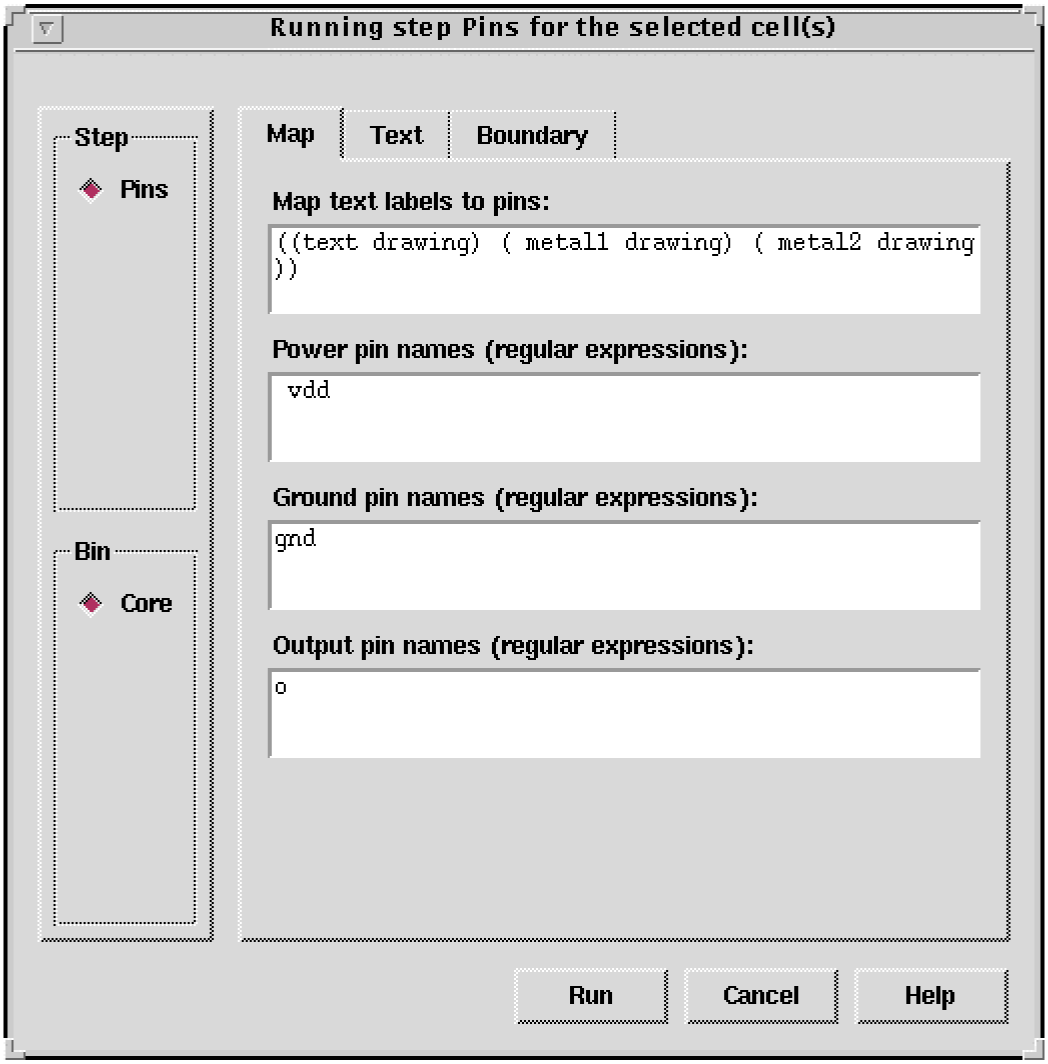

Fig 13: Pins Step - Map

In Fig 13 click ***Boundary*** tab. Now the “Running step Pins for the selected cell(s)” window appears as shown in Fig 14.

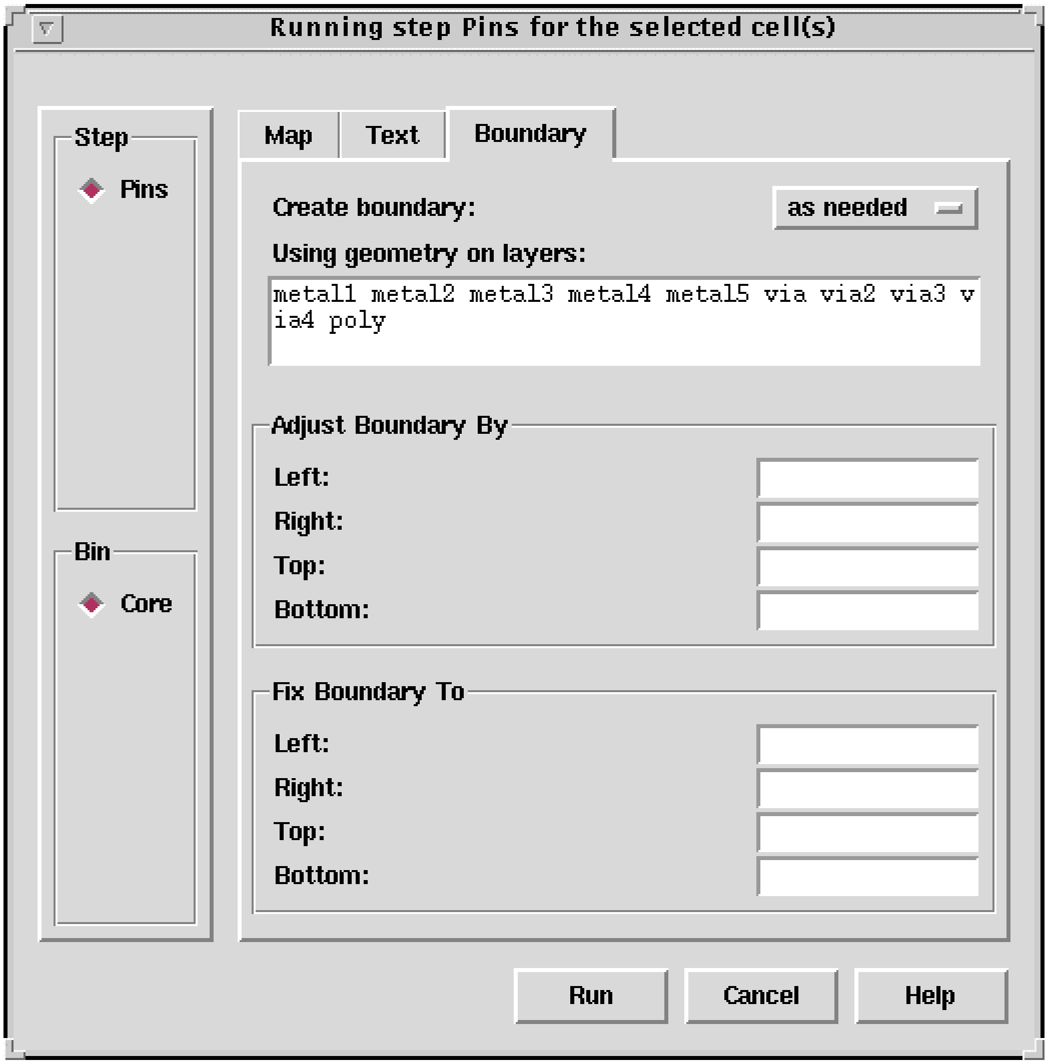

Fig 14: Pins Step - Boundary

In Fig 14 click ***Run***.

Now the "Abstract-tut" window appears as shown in Fig 15. For all the cells it should show a green tick in the Pins column. If it is shows ! sign there is some warning. If it shows a warning see the report.

To view the report click ***Cells*** -> ***report***.

If there are no warnings the Pins step is over.

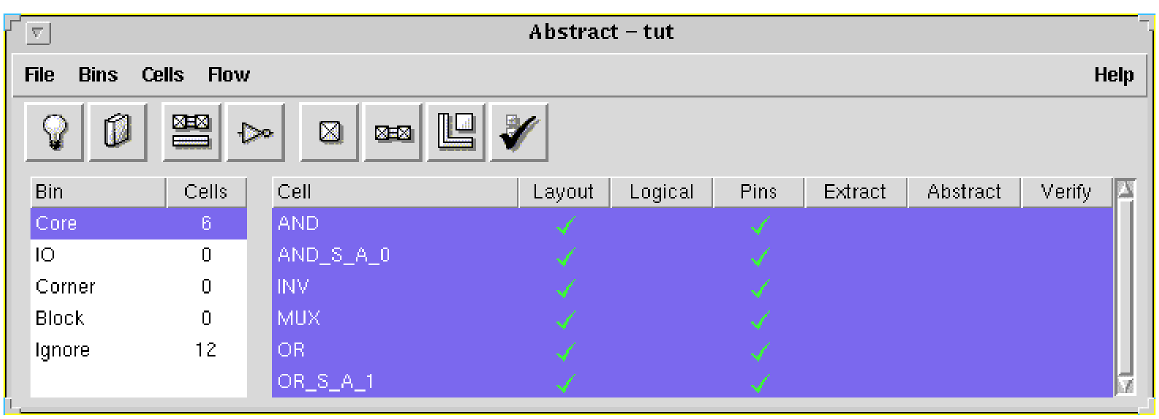

Fig 15: Abstract generator after Pins step

Extract Step:

In Fig 15 select all the cells in the "Abstract-tut" window and click ***Flow ->Extract.*** The "Running step Extract for the selected cell(s)" window opens as shown in Fig 16.

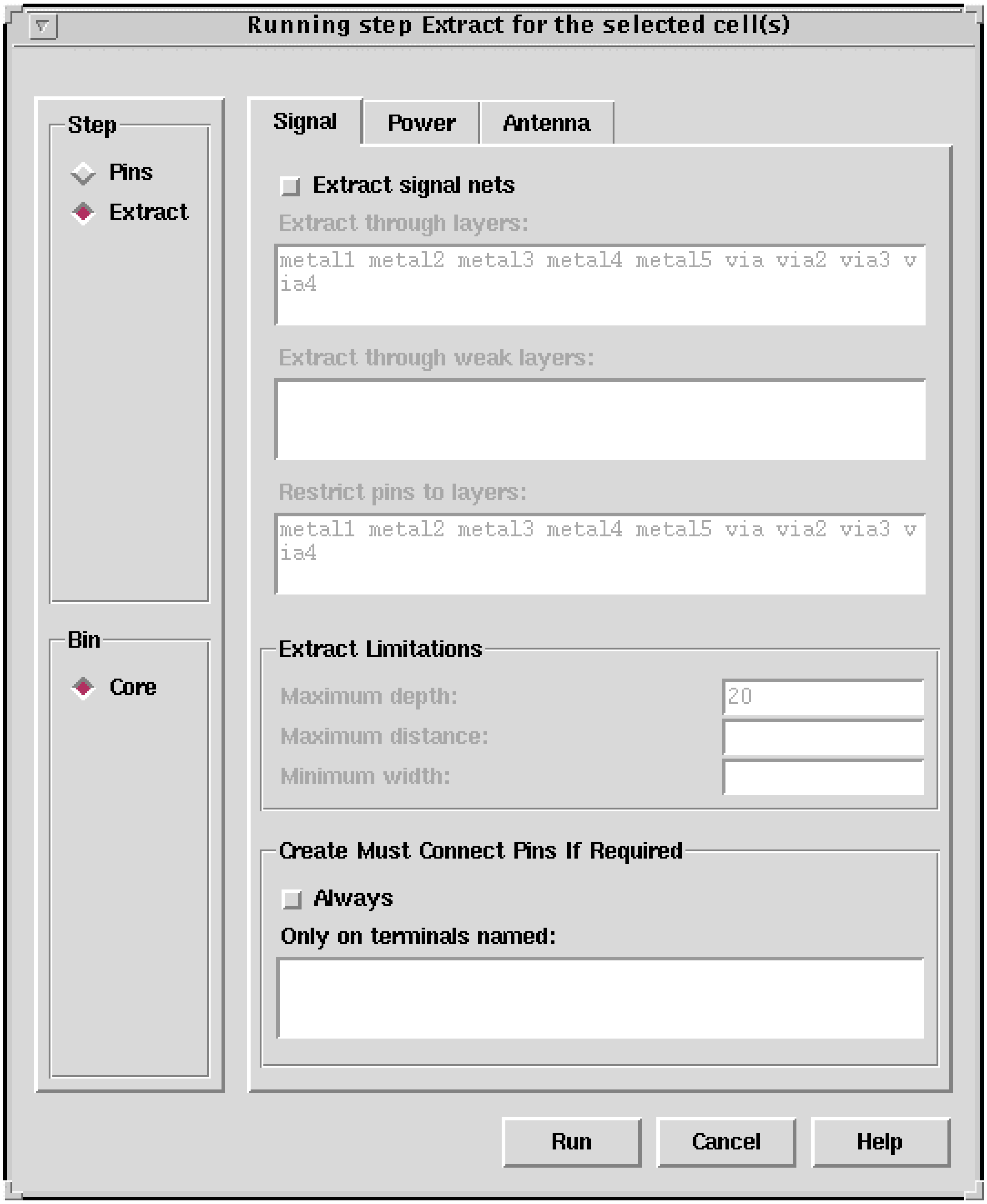

Fig 16: Extract step - Signal

In Fig 16 click on the **Power** tab and select **Extract Power Nets** as shown in Fig 17.

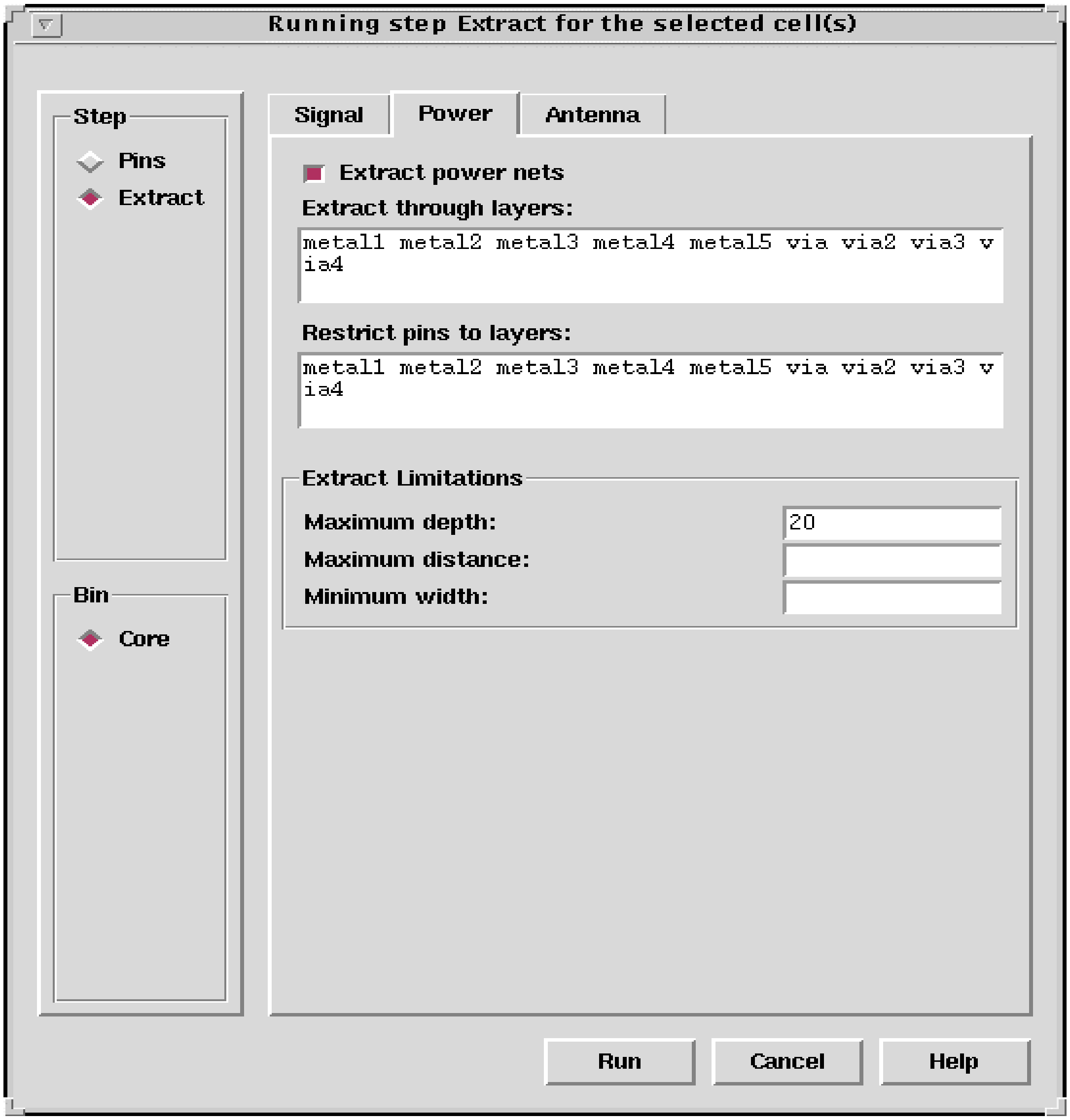

Fig17: Extract step - Power

Then click ***Run***. The “Abstract-tut” window should appear as shown in Fig 18. All the cells should have a green tick in the Extract column. If there are ! signs in the Extract column then there are some warnings. To see the warnings view the report by clicking ***Cell -> report.*** If there are no warnings then the Extract step is over.

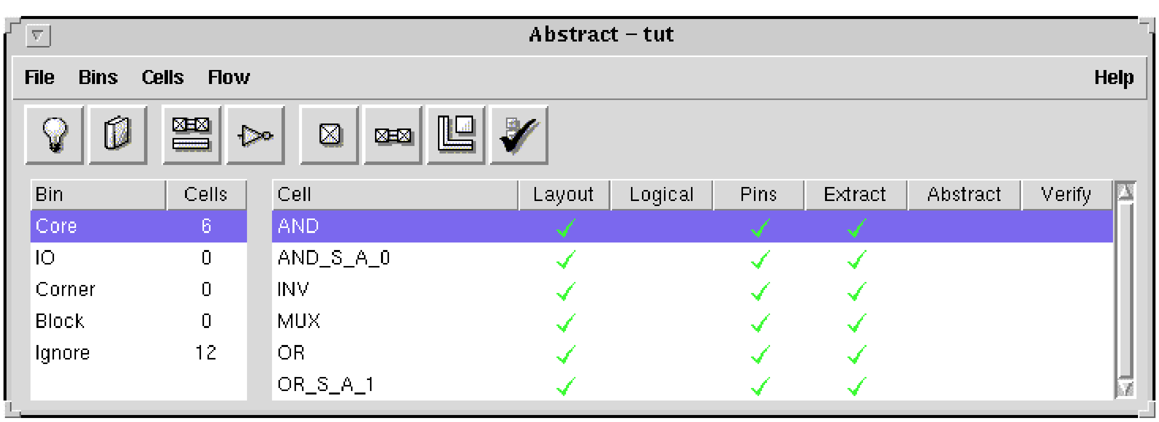

Fig 18: Abstract generator after Extract Step

Abstract Step:

Now select each cell one by one and follow the procedure given below.
After selecting the standard cell click ***Flow -> Abstract*** in Fig 18**.** The "Running step Abstract for the selected cell(s)" window opens as shown in Fig 19.

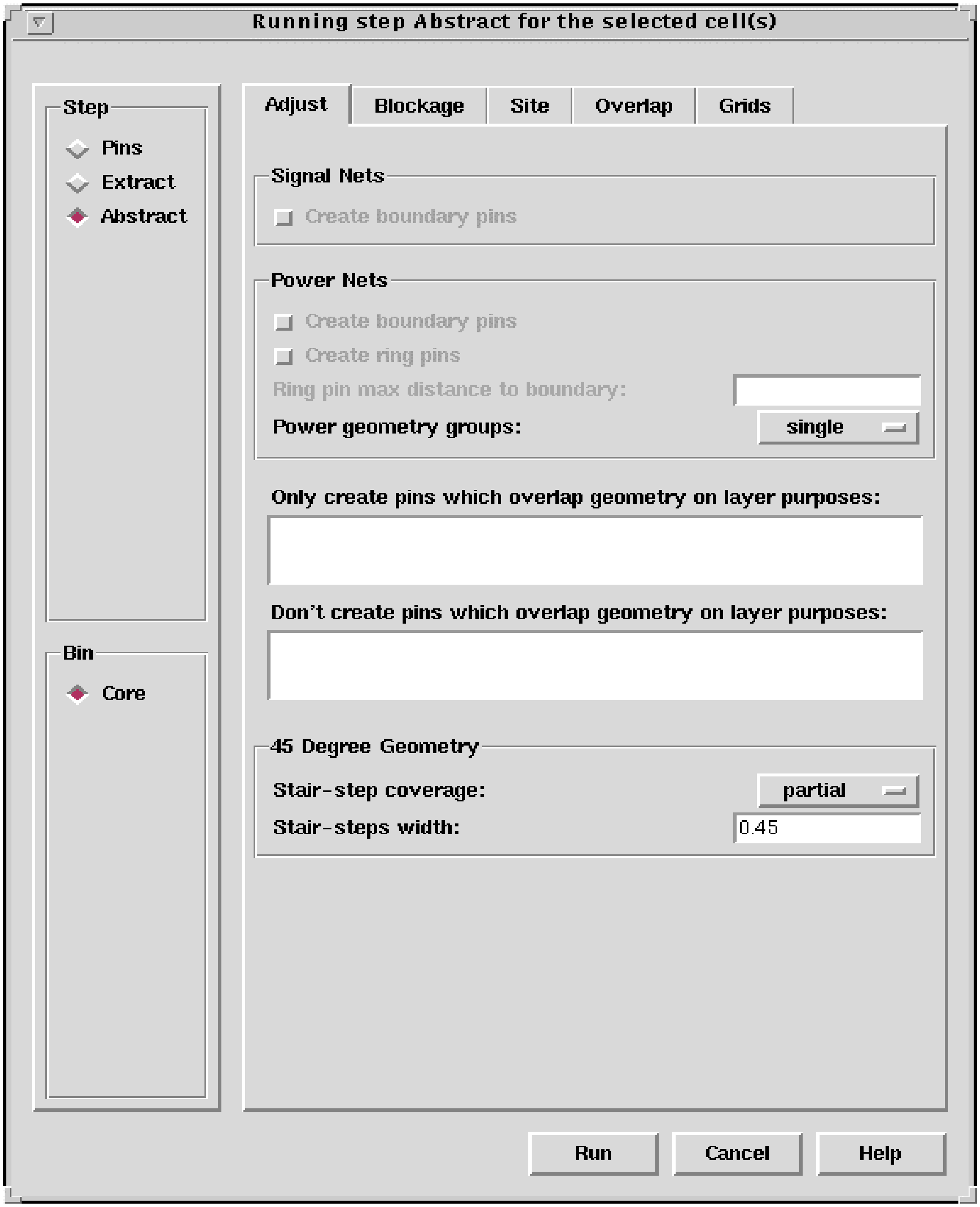

Fig 19: Abstract step - Adjust

In Fig 19 click on ***Site*** tab, enter *core* for the Site Name as shown in Fig 20.
Site core is used for cells inside the pad frame that are 18um high and multiple of 2.4um wide.
Site dbl_core is for cells 36um high and multiple of 2.4um wide.
Sites IO and corner describe components of the pad frame.

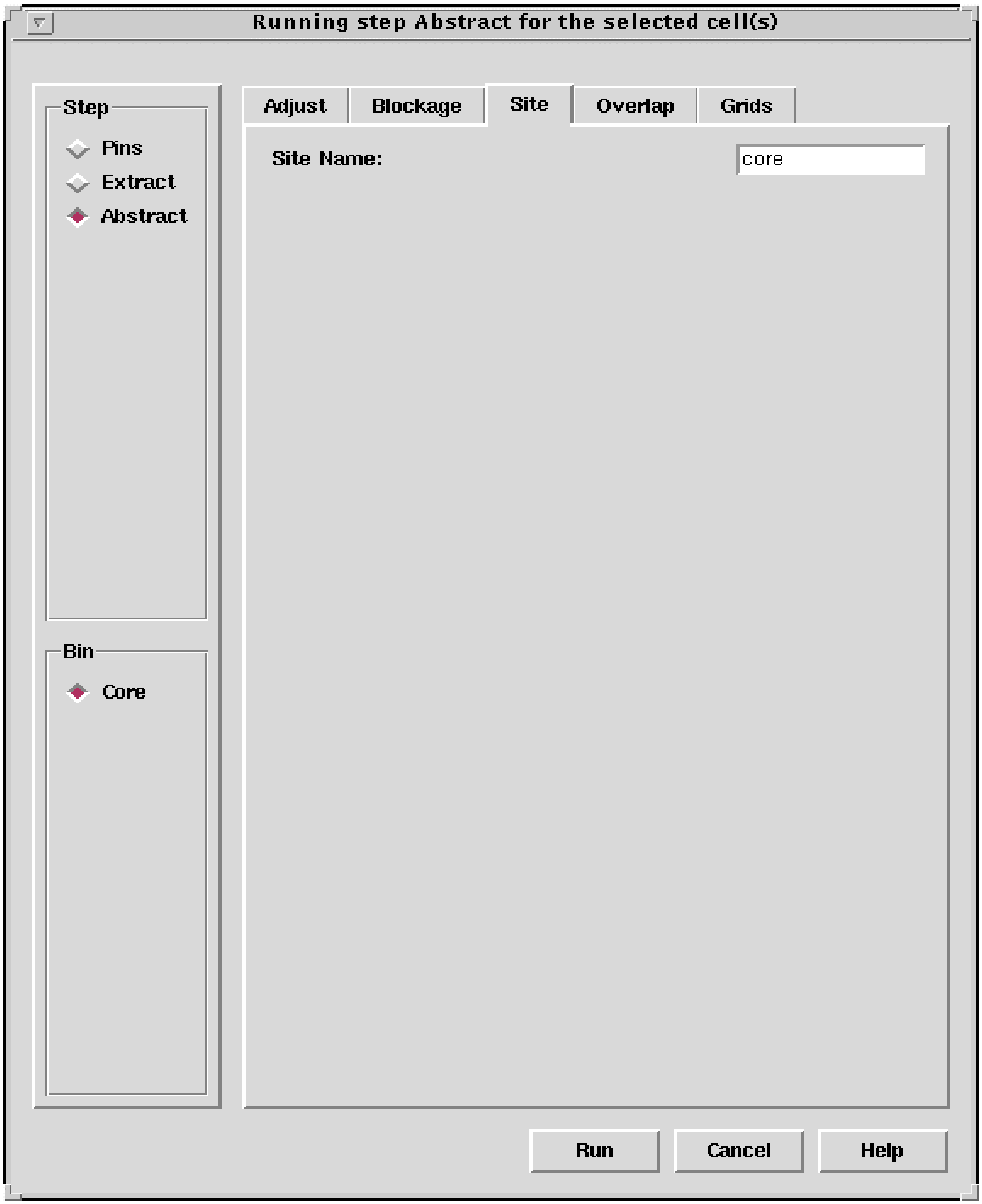

Fig 20: Abstract step - Site

In Fig 20 click on **Grids** tab fill the form as shown in Fig 21 (NOTE: All units in um).

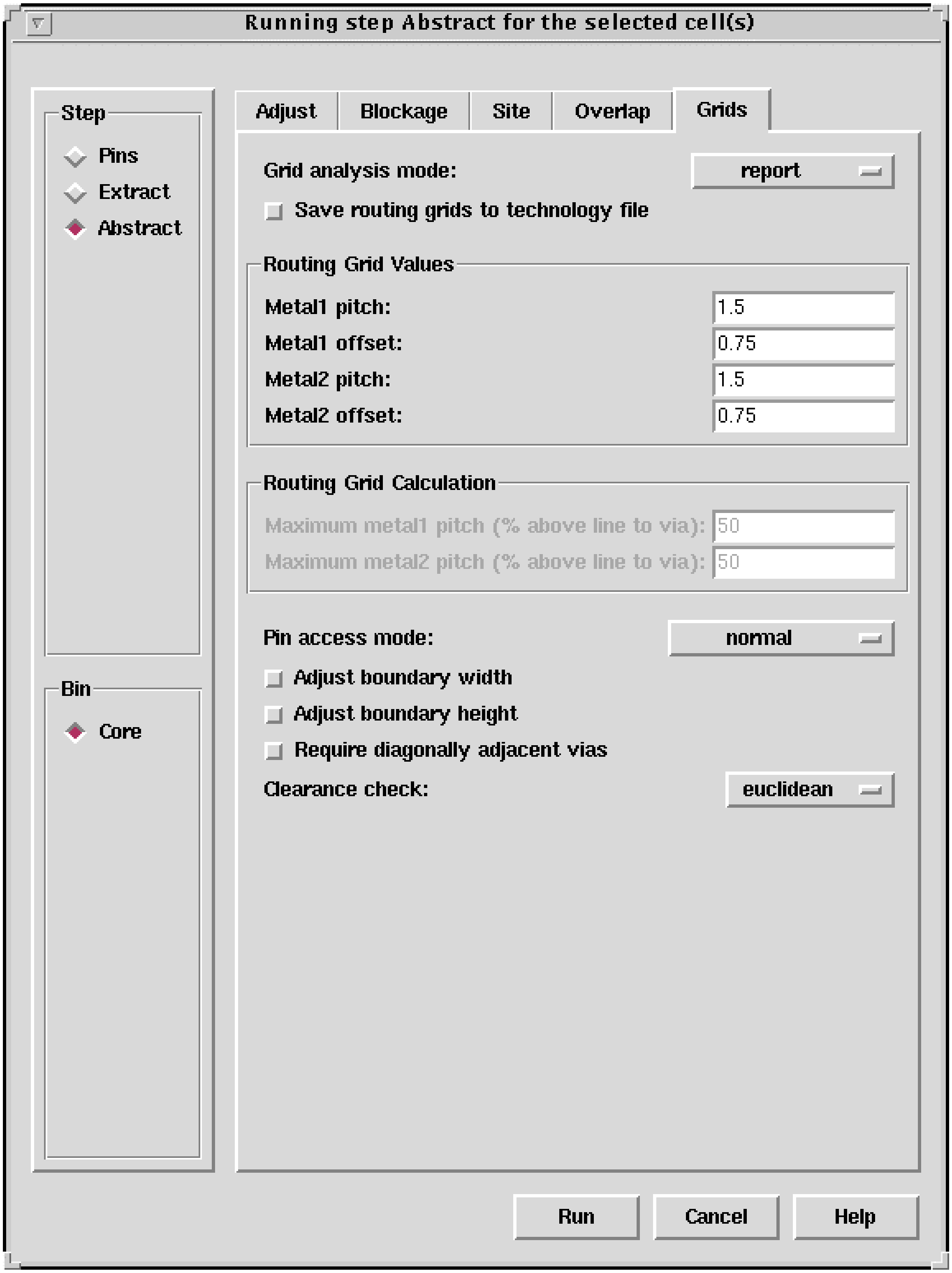

Fig 21: Abstract step - Grids

In Fig 21 click ***Run*** to generate the abstract view of standard cell. Repeat this procedure for all the standard cells. After the Abstract step is over for all the cells the "Abstract-tut" window appears as shown in Fig 22. For all the cells the Abstract column should will have a ! sign.

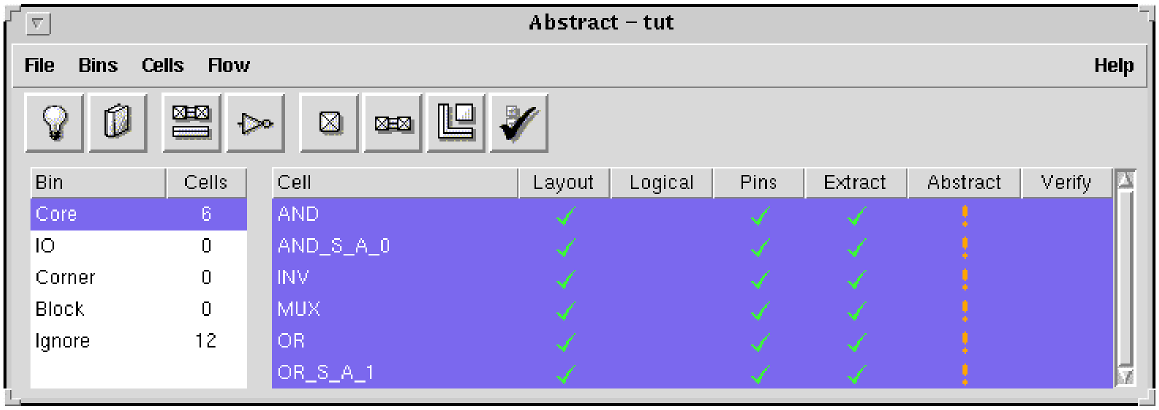

Fig 23: Abstract Generator after Abstract step

To view report click ***Cell** -> **report*** in "Abstract-tut" window.
The Report should be as shown in Fig 24.

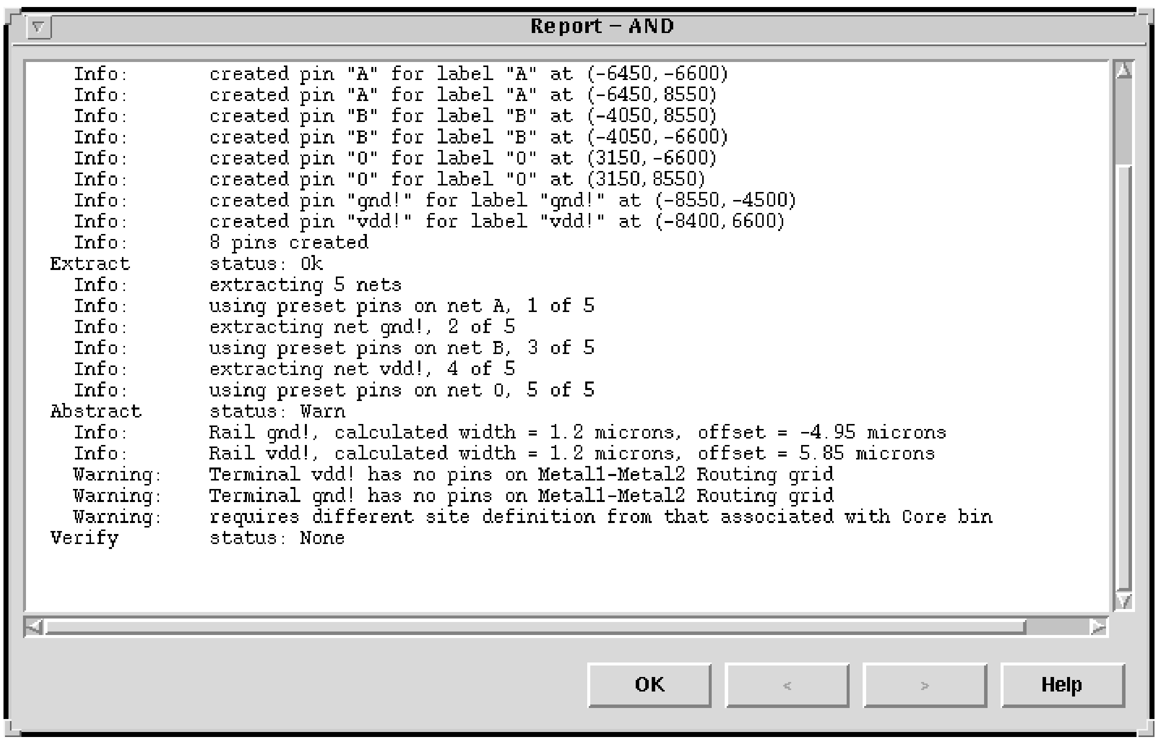

Fig 24: Final Report

NOTE: The warning under the Abstract step should state that vdd! and gnd! have no pins on the Matal1-Metal2 routing grid .These should be ignored. If there are warnings for the other pins, they should be taken care of by placing the pins on the intersection of metal1 and metal2 routing grids in the standard cell layout as shown below (Fig 25).

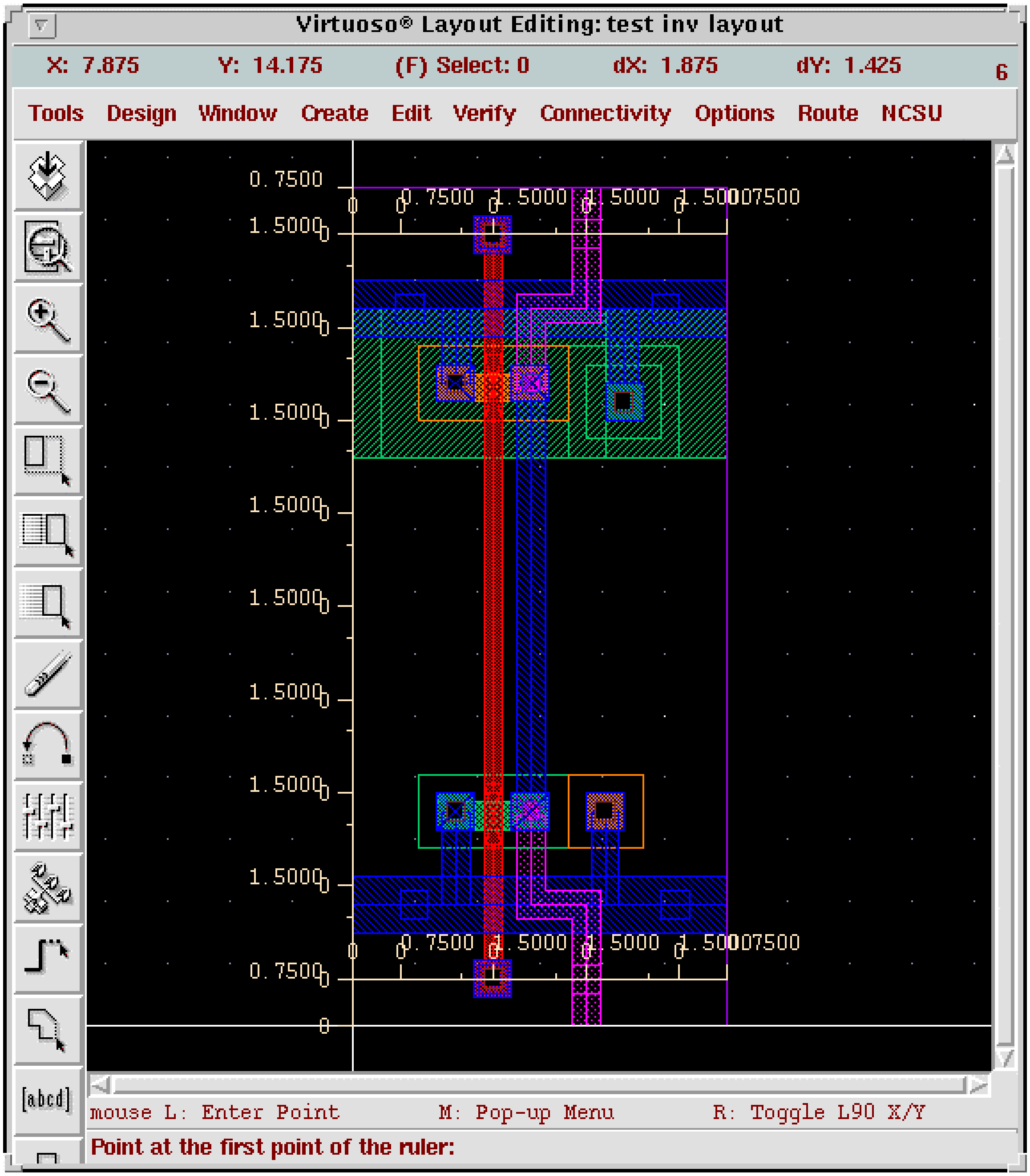

Fig 25: Layout showing routing grid rules

Cell Orientation:
In the "Abstract-tut" window select all the standard cells and click ***Cells -> Cell Properties***. A "Cell Properties" window opens as shown in Fig 26.
Change **class** to **symmetry** and **R0** to **X** and click ***Apply***.
Then click ***OK***.

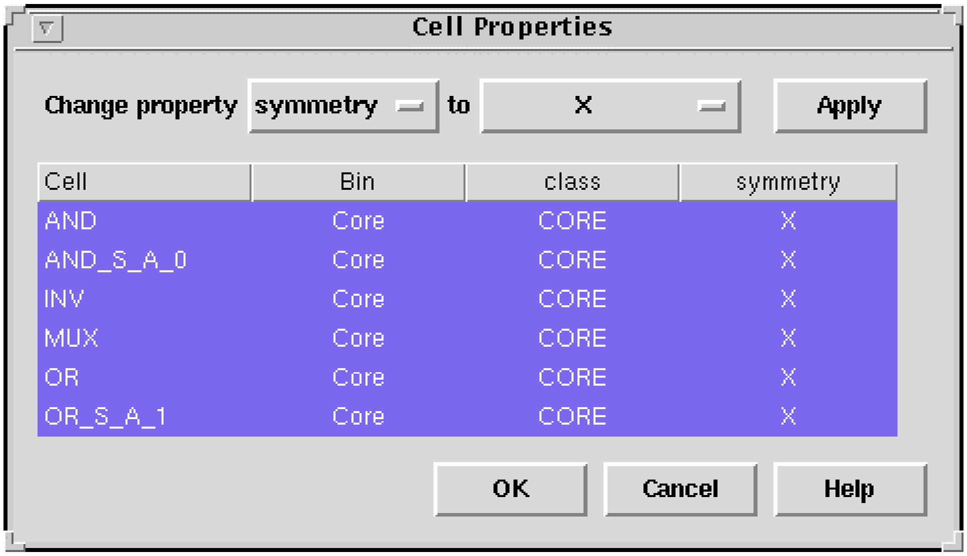

Fig 26: Cell Properties

LEF File:

There is one last step before exporting the LEF file. In the “Abstract-tut” window select ***File -> General Options.*** The “General Options” window opens as shown in Fig 27. In Fig 27 select **Silicon Ensemble** for **Target place and route system**, **1000** for **LEF units**, and **5.3** for **LEF version**. Click ***OK***.

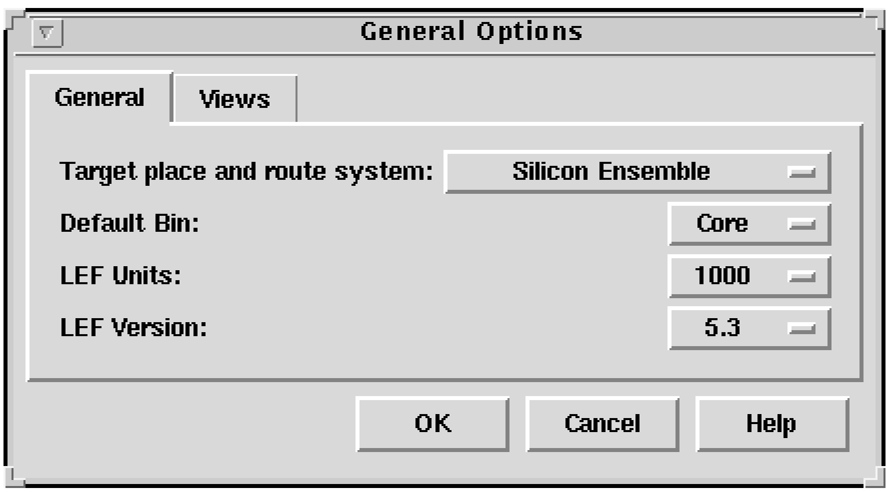

Fig 27: General Options

In the “Abstract-tut” window click ***File -> Export -> LEF*** to bring up the “Export LEF” form as shown in Fig 28.
Specify the location of where you wish to save the file.
Select **Core** for the **Export LEF for Bin** field and click ***OK***.
Close the “Abstract-tut” window.

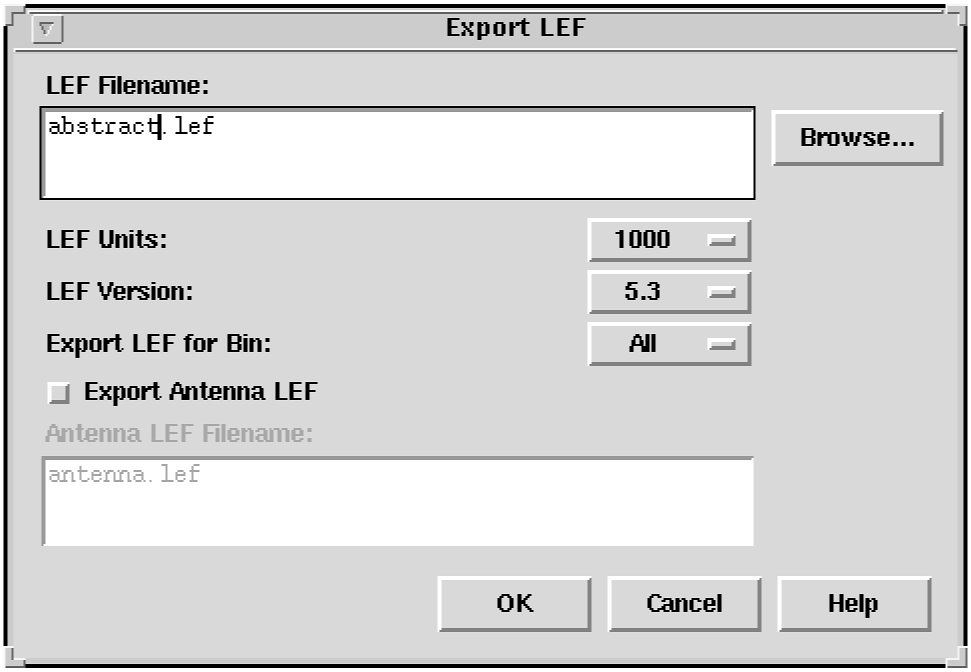

Fig 28: Export LEF

This is the end of creating the LEF File.

LEF CORRECTION

Go to your silicon ensemble directory and run the perl script lef_correction on your LEF file. Type this command .

hostname.ece.pdx.edu > *lef_corrections your_file_name.lef* > *new_file_name.lef*.

Reason for LEF file correction:

The abstract views created in the Abstract Generator renamed the cells to ALL CAPS. Because Cadence is case sensitive, you will need to go back and replace these capitalized names (in the LEF file exported from Abstract Generator) with the original, lower-case cell names used in Virtuoso.

Thus the LEF file has been created. Now you can proceed with any one of the following approaches.

1) Create a verilog netlist from the schematic (Tutorial 2).
2) Create DEF file from the schematic (Tutorial 3).