Generation of .LEF File

- Do the following in the directory where your standard cells(hw5) are located
- The following are the files to be copied
- cp /sw/CDS/TANNER/stream.map
- Create a sub-directory in the present directory and name it as “tech”
- cp /sw/CDS/TANNER/tech/*.* to the tech directory

Unfortunately the abstract view created in Virtuoso does not include some important information required by Silicon Ensemble, so this intermediate step helps in moving the design between programs.

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, then re-import the GDS file in Abstract Generator.

Next slide explains " Exporting to GDS format"

Checklist:

You should be having "stream.map" and "/tech/tech.dpux" before you go to the next slide

Exporting to GDS Format

- To export to GDS format from ICFB:
- Go to the **CIW**.
- Click on *File -> Export -> Stream…*
- In the **Virtuoso Stream Out** form, enter the following information:

  Run Directory: .(just a dot meaning current directory)

  Library Name: <your standard_cells library name>

  Top Cell Name: (leave blank)

  View Name: layout

  Output File: <example : “STD.gds”>
- Then, click on the **User-Defined Data** button. A new form, the **Stream-Out User-Defined Data** form will appear.

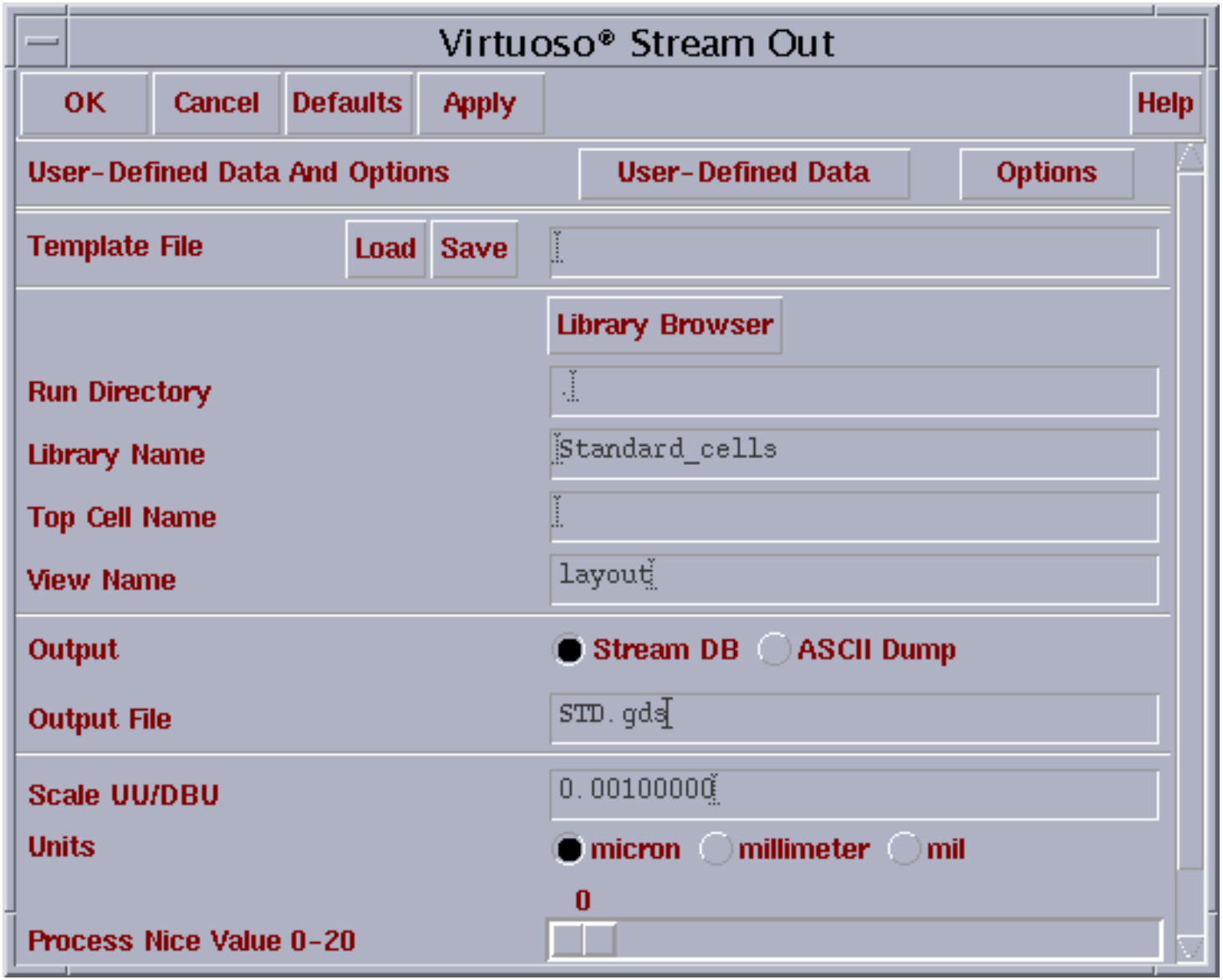

Virtuoso® Stream Out
OK
Cancel
Defaults
Apply
Help
User-Defined Data And Options
User-Defined Data
Options
Template File
Load
Save
Library Browser
Run Directory
.
Library Name
Standard_cells
Top Cell Name
View Name
layout
Output
Stream DB
ASCII Dump
Output File
STD.gds
Scale UU/DBU
0.0010000
Units
micron
millimeter
mil
0
Process Nice Value 0-20

Figure 1

Exporting to GDS Format

- In the **Stream Out User-Defined Data** form, enter "**stream.map**" for the Layer Map Table. Then, click on **OK**.
- 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, we are going to use the same Layer Map file.
- Refer to Fig : 2 (next slide) for the **Stream Out User-Defined Data** form.

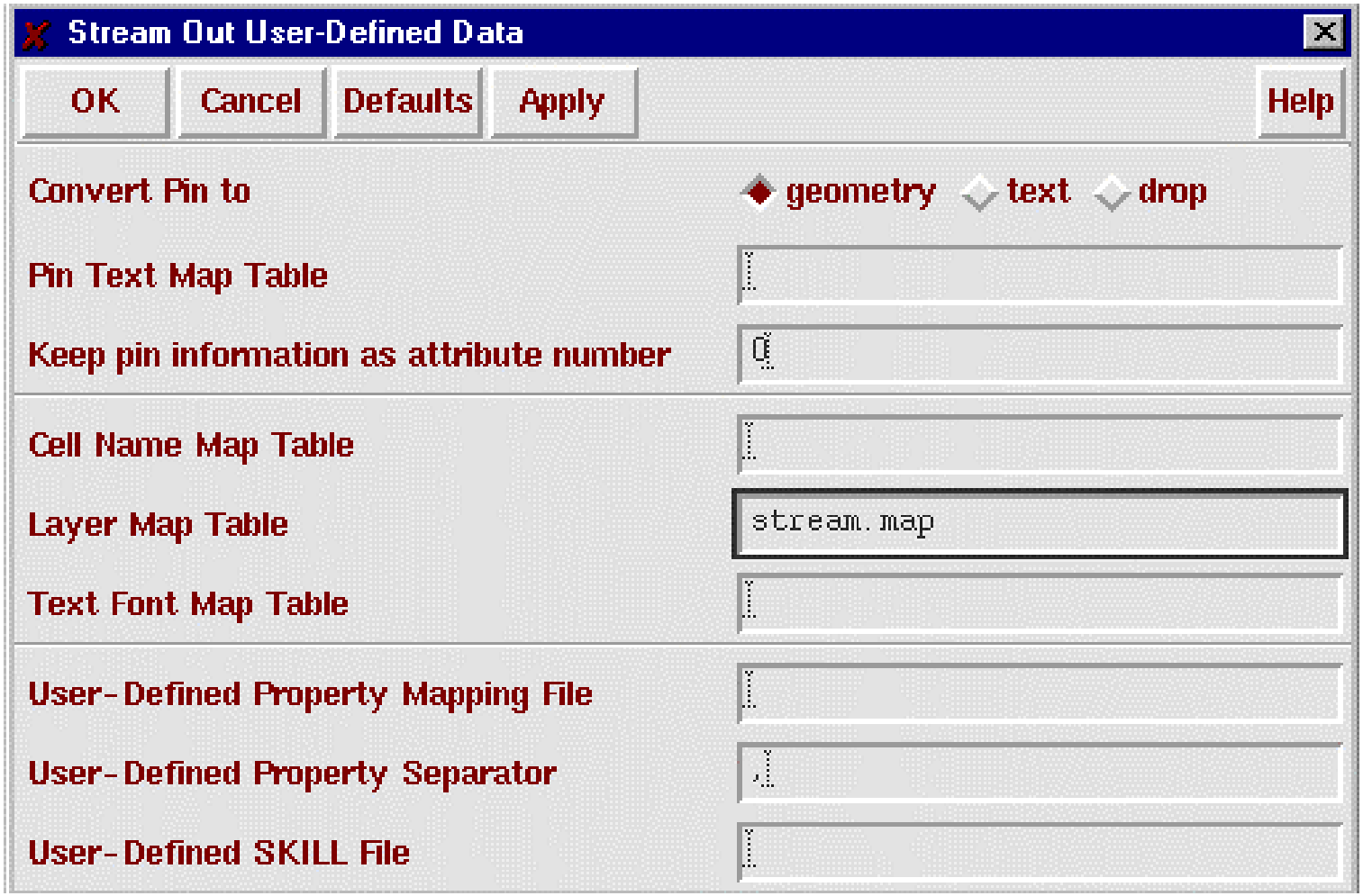


Figure 2 : Stream Out User-defined data

Exporting to GDS Format

- Now, back in the **Virtuoso Stream Out** Form (Figure 1), click on the **Options** button. A new form, the **Stream Out Options** form will appear (Figure 3).
- In the **Stream Out Options** form, select "**No Merge**" for the "Convert PCells to Geometry" field. This flattens out any parametric cells in the cell library (For the I/O Pad Cells). Then, click on **OK**.
- Click on **OK** in the **Virtuoso Stream Out** form. A *GDS* file (STD.*gds)* containing the standard cell library will be generated.

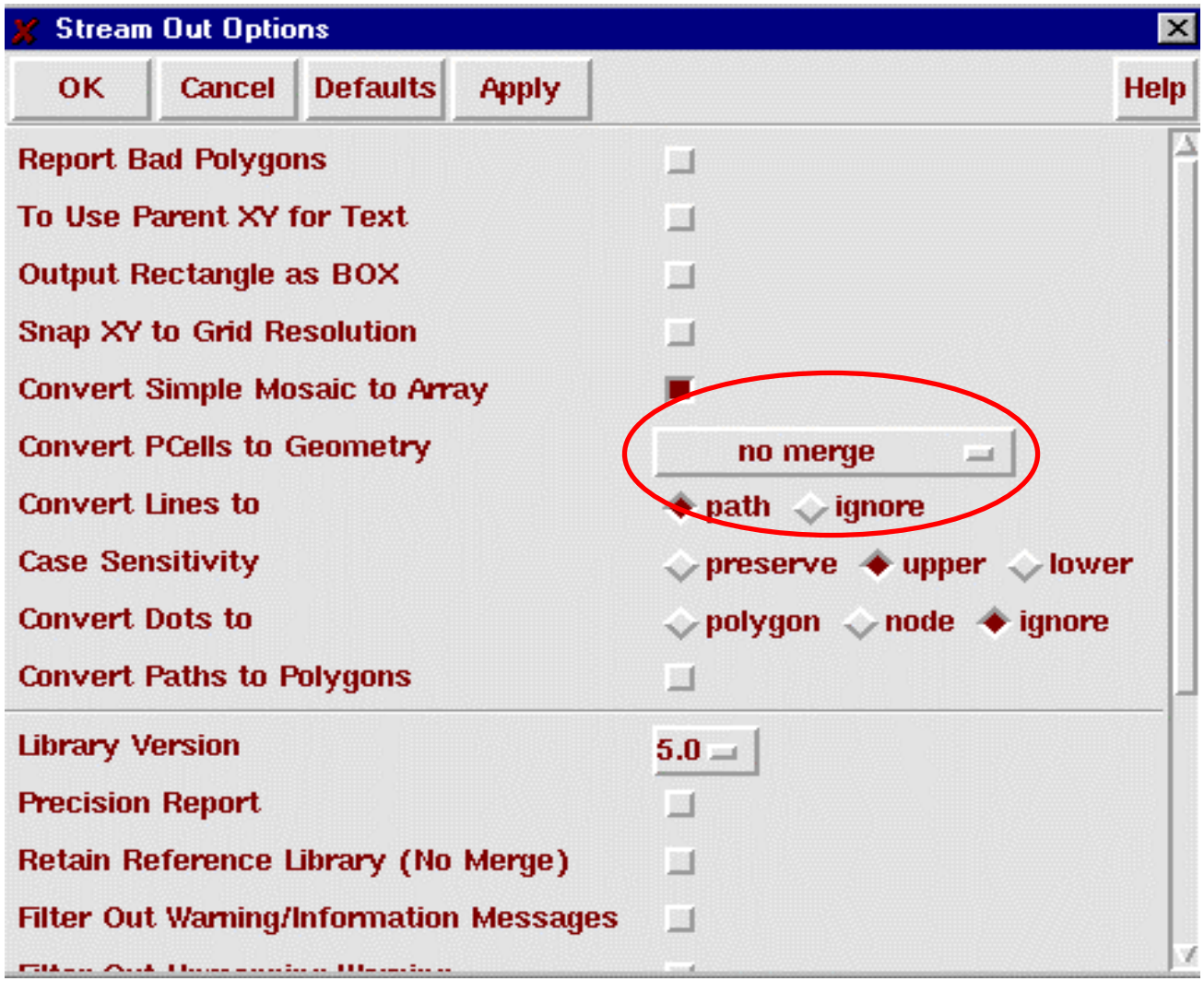


Figure 3: Stream Out Options Form

Using Abstract Generator to create LEF file

- To start up Abstract Generator:
- Go to the directory where your standard cells are located and type :

  abstract –tech ./tech &
- This will bring up the abstract generator screen. First, we need to import the *GDS* file containing our standard cell layouts, that we exported from ICFB previously.

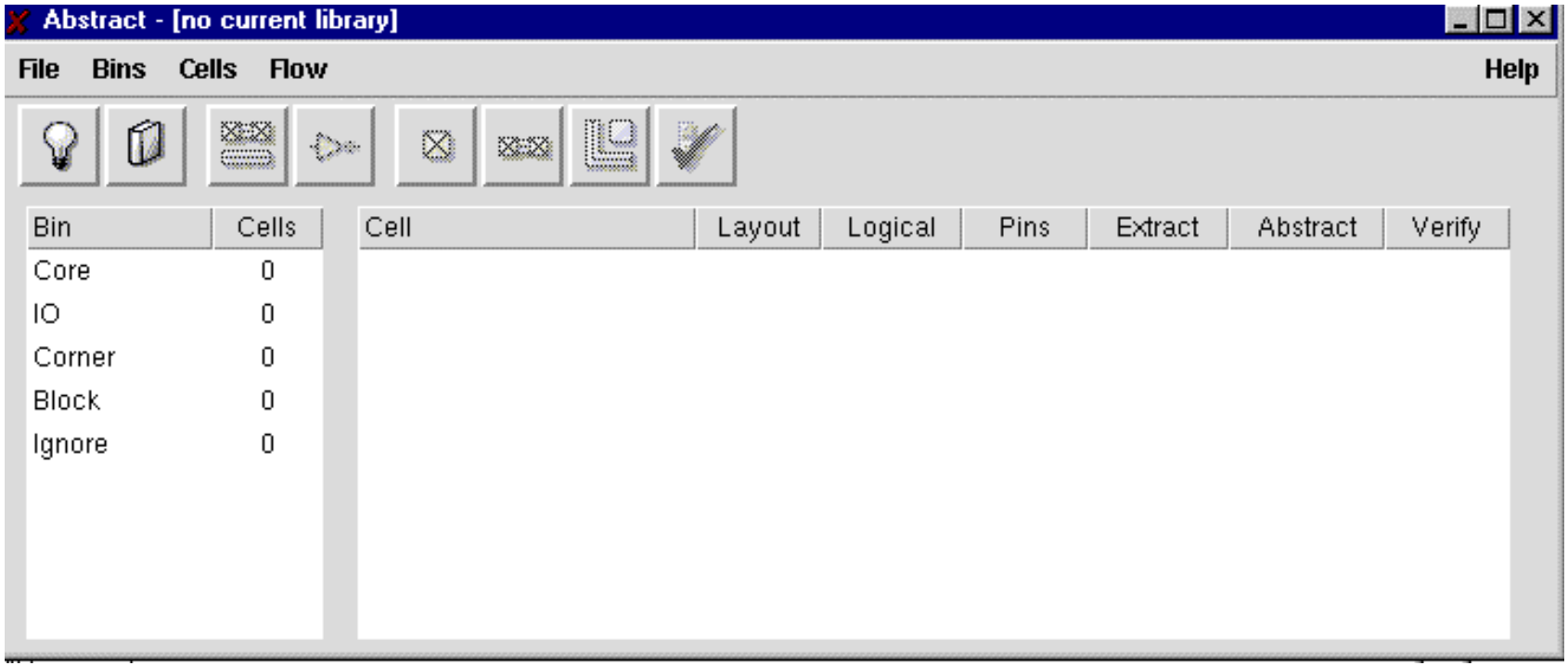


Figure 4: Abstract Generator's Main Window

Importing GDS

- In the main window, click on *File* -> *Technology*…
- After a few moments, the **Technology File Editor** should appear. Click on **Library path** on the left column, then give "**some library name**" and **"Path"** on the top row. (refer Figure 5, next slide)

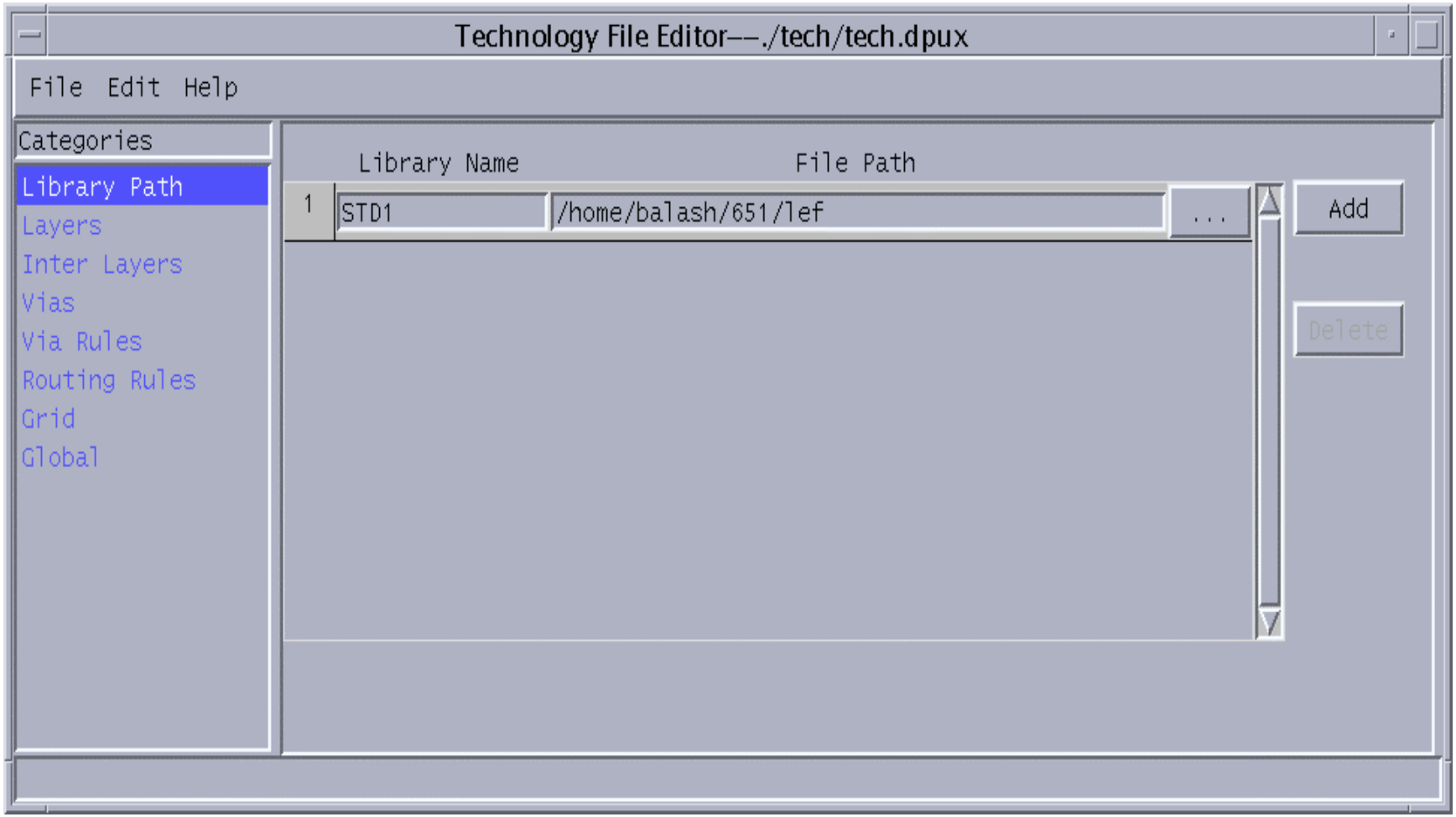


Figure 5: Abstract Generator's tech

- Click on **Layers** on the left column, then click on **Mapping** on the top row. (refer Figure 6, next slide)

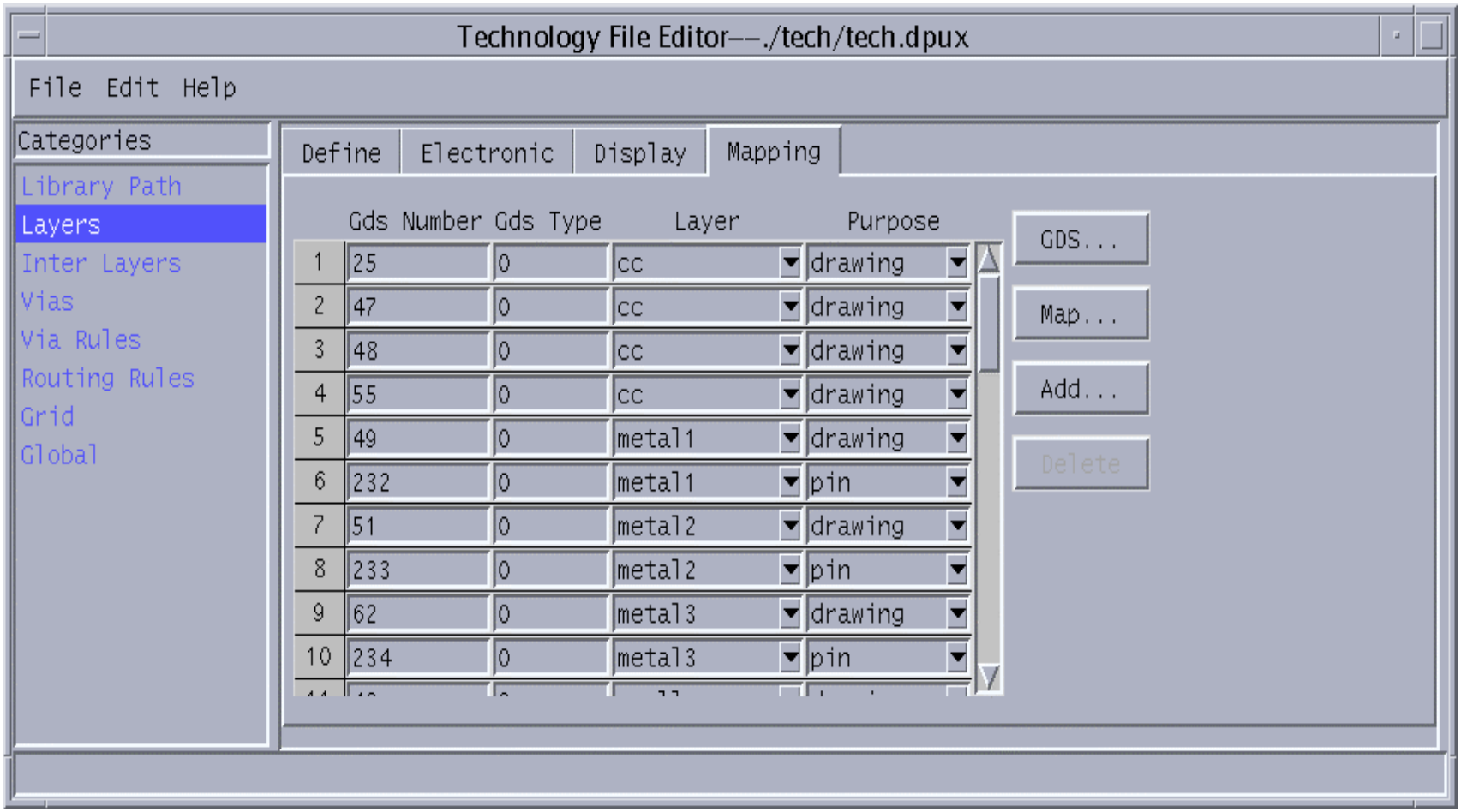

Technology File Editor--./tech/tech.dpux
File Edit Help
Categories
Library Path
Layers
Inter Layers
Vias
Via Rules
Routing Rules
Grid
Global
Define
Electronic
Display
Mapping
Gds Number
Gds Type
Layer
Purpose
1 25 0 cc drawing
2 47 0 cc drawing
3 48 0 cc drawing
4 55 0 cc drawing
5 49 0 metal1 drawing
6 232 0 metal1 pin
7 51 0 metal2 drawing
8 233 0 metal2 pin
9 62 0 metal3 drawing
10 234 0 metal3 pin
GDS...
Map...
Add...
Delete

Figure 6

Importing GDS

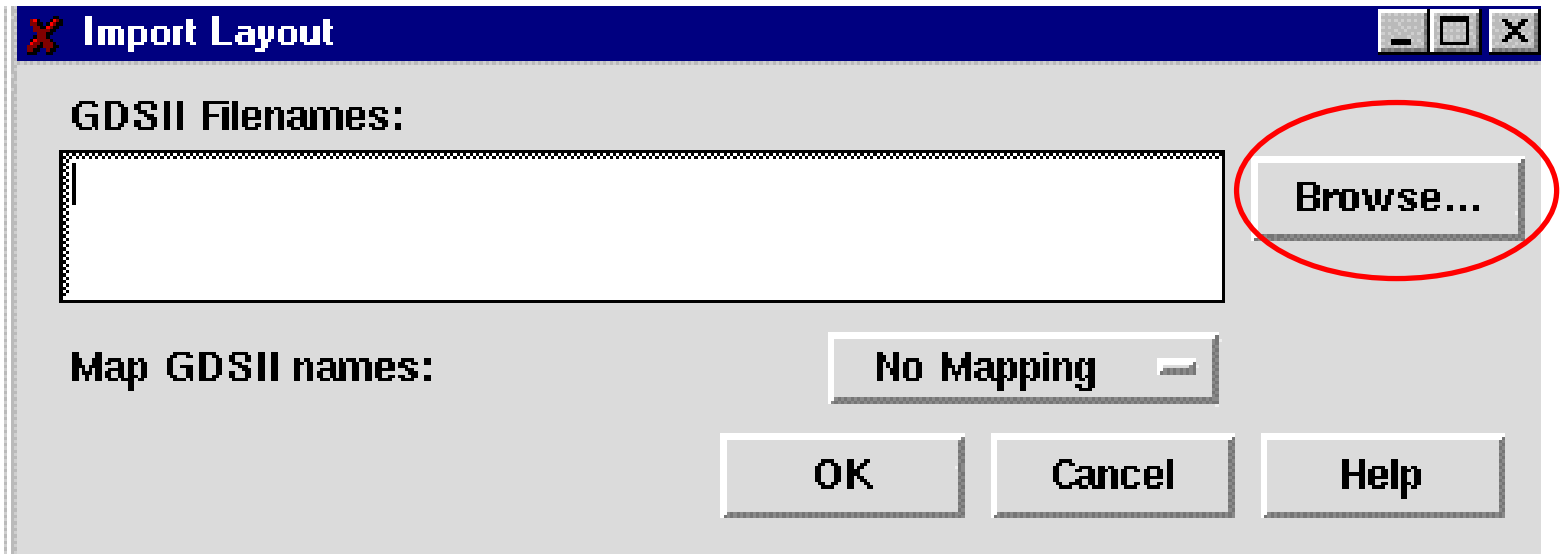
- You should see all the numbers which means already the stream.map had been loaded
- Click File -> Save and then Close the window

Importing GDS

- In the main window, click on *File* -> *Library*.
- If you have more than one design library, you will have to choose a design library to be your current working library.
- You should see the figure 4 again with no changes

Importing GDS

- Click on *File -> Import -> Stream(GDSII)*
- The **Import** form will appear (you may have to resize it after it appears).



Importing GDS

- Click on the **Browse** button. A browse form will appear (Figure 7, next slide)
- The GDS file we are looking for is STD.*gds*.
- Navigate through the browser to get to that file.
- Double-click on the file STD.*gds*.
- Back in the **Import** window, click on **OK**.

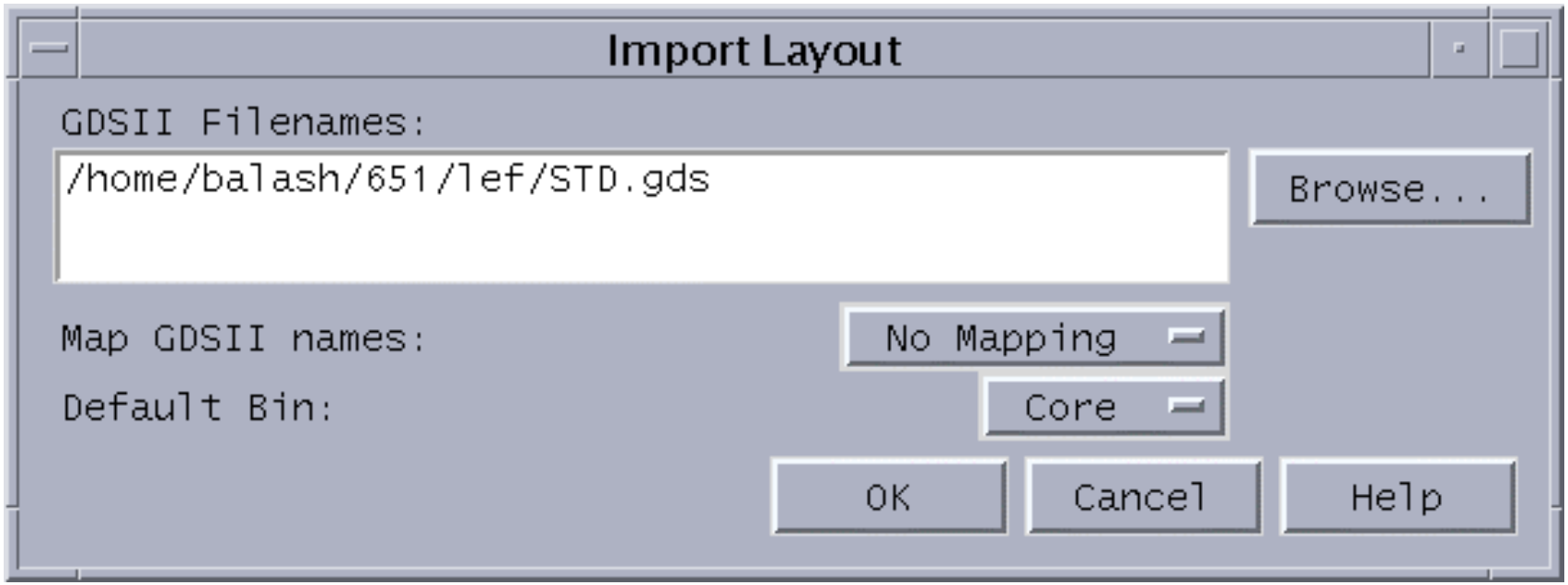


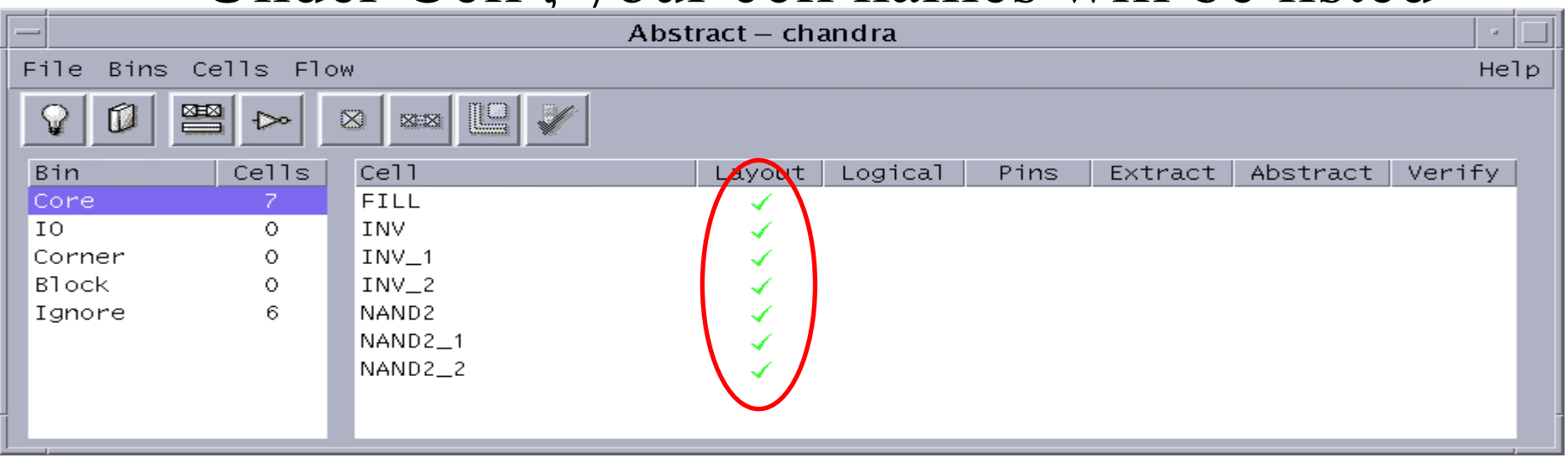
Figure 7: Browse Import Layout File Form

Importing GDS

- After a few moments, the standard cell layouts contained in *std.gds* will be imported into abstract generator. Notice that the **Core** bin now has “number of cells you have got “.

Viewing Cell Layout

- In the main window, click on the **Core** bin once. You should see that beside each cell, there is a green tick mark in the **Layout** column. This means there is a valid layout view for each cell.
- Under Cell , your cell names will be listed



Abstract Generation - Overview

- 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* step merges metal blocks under the same net into one single net – we will not be using this function since we want our pins to be specifically 3x3 lambda sized pins. It also changes any *metal.pin* layer into *metal.net.*

Abstract Generation - Overview

- 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.
- An *LEF* file will then be generated, using the *Abstract* view of the standard cells.

Abstract Generation – Pins Step

- Since all the standard cells are alike, we can process them all at once.
- Select all the cells.
- Click on *Flow -> Pins*. The **Pins** form will appear.
- Enter the fields as shown in Figure 8 . The next slide after that will explain what the entries mean.

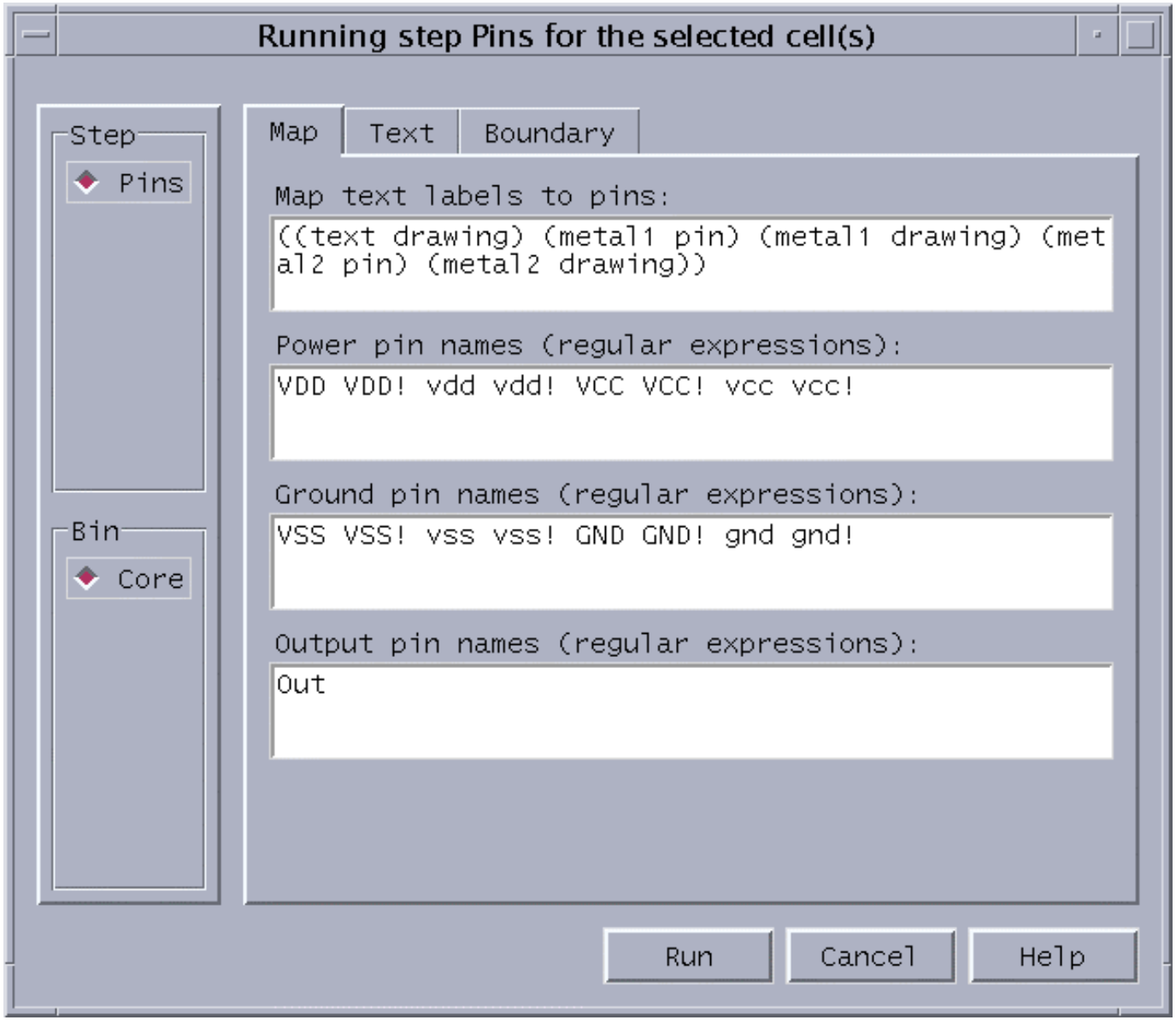


Figure 8: Pins Form (Map Tab)

Abstract Generation – Pins Step

- Map Text Label to Pins: Notice we have entered "**((text drawing) (metal1 pin) (metal1 drawing) (metal 2 pin) (metal 2 drawing))** " for this field.
- This tells Abgen to map any text in *text.drawing* to *metal1.pin* shapes if there are any *metal1.pin* shapes overlapping the text.
- If there aren't any *metal1.pin* shapes overlapping the text, then map the text to any overlapping *metal1.drawing* shapes.
- This works for us because all our text labels are either located over *metal1.pin* shapes (for our regular pins), or over *metal1.drawing* shapes (for our vdd/gnd pins).

Abstract Generation – Pins Step

- We have entered "**Out**" for the output pin names. In case of Inverter output pin named is "Out". List the Output pin names that you have in your standard cell

- In the exported LEF file, these pins will have "output" as their direction.

Abstract Generation – Pins Step

- The *Pins* step also generates Place-and-Route Boundaries (PR Boundaries) for each cell.
- Click on the **Boundary** tab. The **Pins** form will change to that of figure 9 (next slide).
- Choose "**always**" for the **Create Boundary** field.
- Fill in the values for "Adjust Boundary By" according to that shown in figure 9.

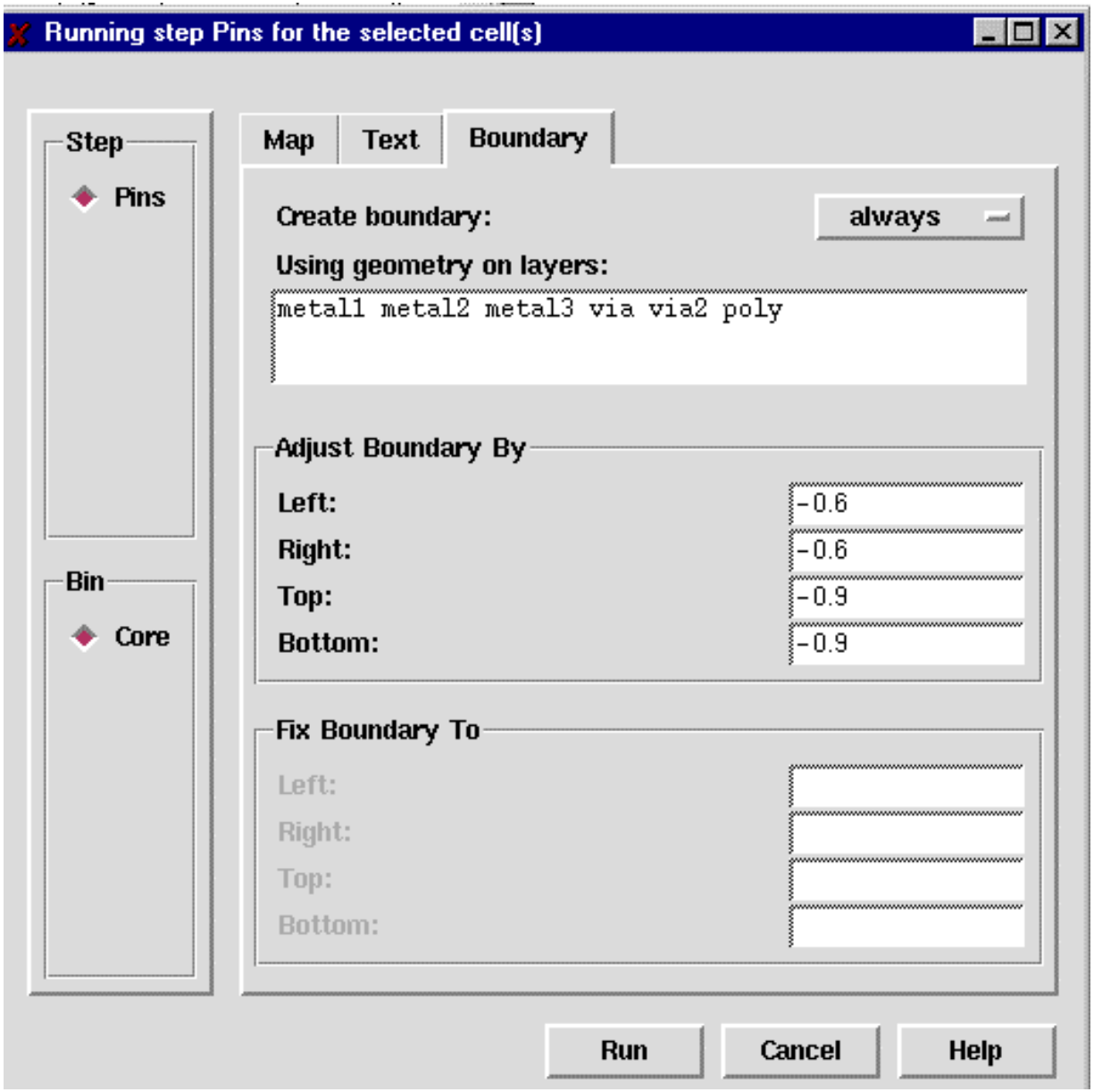
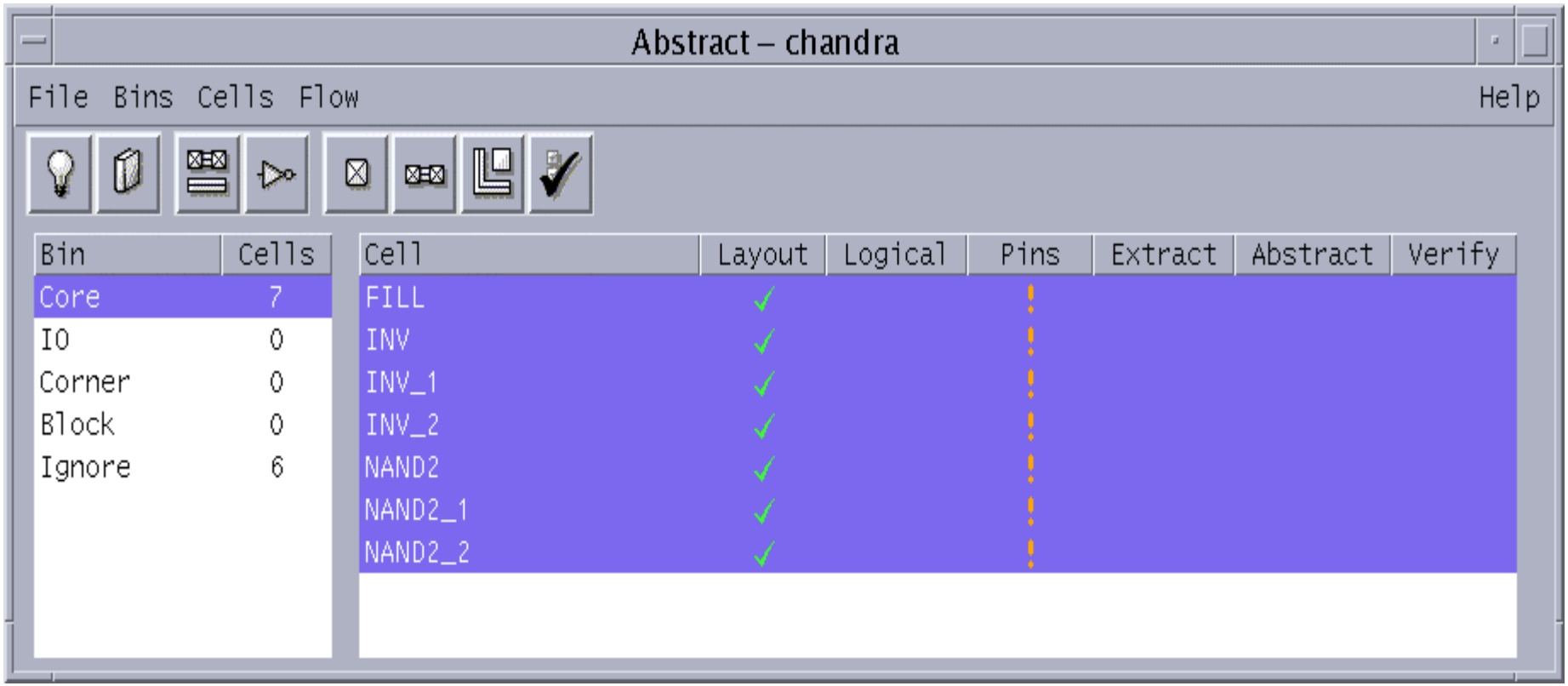


Figure 9: Pins Form (Boundary Tab)

Abstract Generation – Pins Step

- Now, click on **Run**. Abgen will take a few moments to generate *Pins* views for the selected standard cells.
- After Abgen is done, you will see an exclamation mark beside each selected cell, in the **Pins** column. An exclamation mark means that there was a warning (not an error) in the generation of that view.
- To see what the warning was, click on a standard cell (e.g. click on *any cell*). Then, click on *Cells -> Report.*


Abstract – chandra
File Bins Cells Flow Help
Bin Cells
Core 7
IO 0
Corner 0
Block 0
Ignore 6
Cell Layout Logical Pins Extract Abstract Verify
FILL
INV
INV_1
INV_2
NAND2
NAND2_1
NAND2_2

Abstract Generation – Extract Step

- In the main window, select all the standard cells
- Click on *Flow -> Extract*. The *Extract* form will appear.
- Click once on the **Extract Signal Nets** box to **de-select** it.
- Then, click on the **Power** tab to bring up the Power Net menu. Click once on the **Extract Power Nets** box to **de-select** it.
- Click on **Run**. This will run *Extract* on all the cells.
- To view the *Extract* view of a cell, select that cell, then click on *Cells -> Edit -> Extract*.

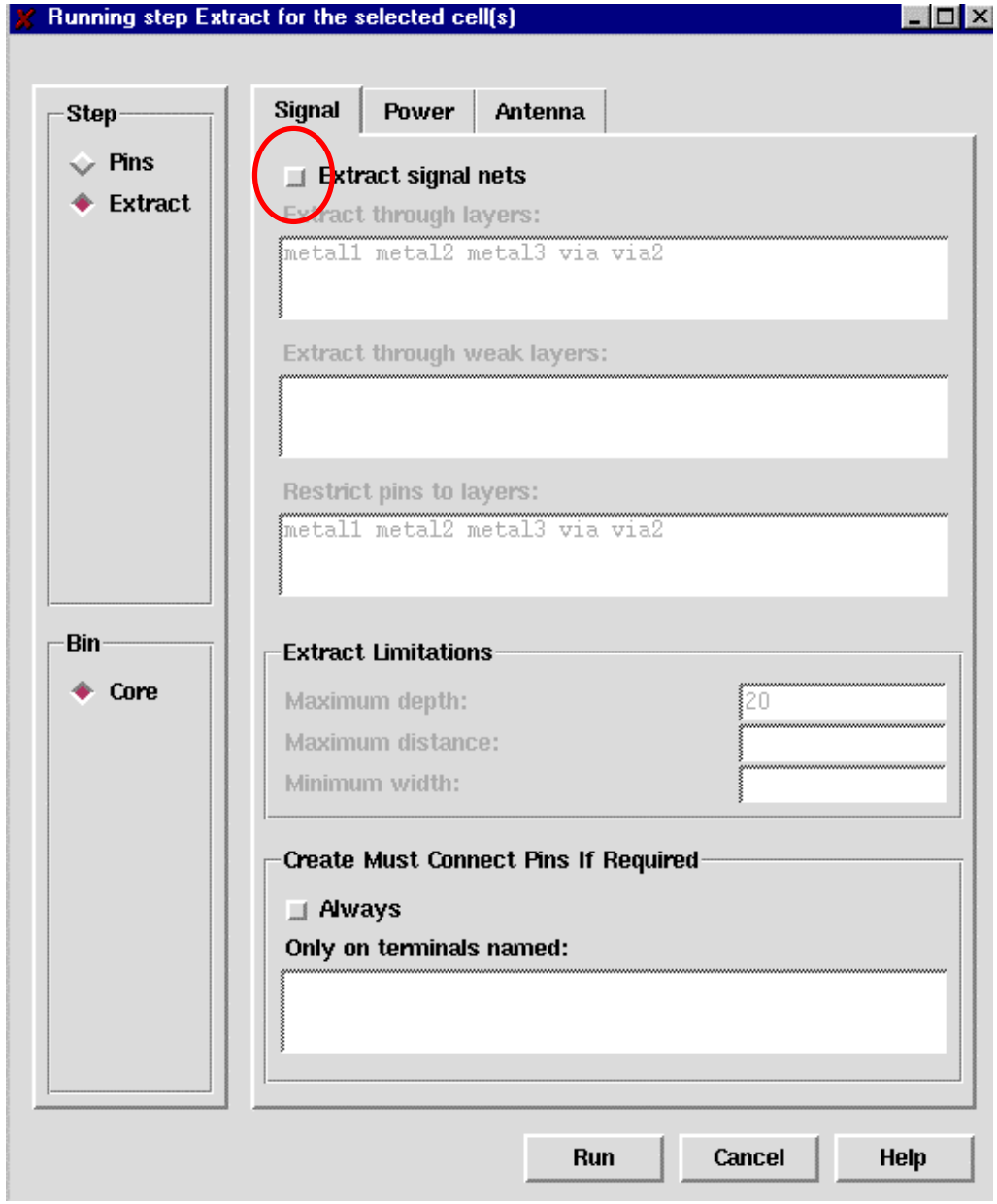


Figure 10: Extract Form (Signal Tab)

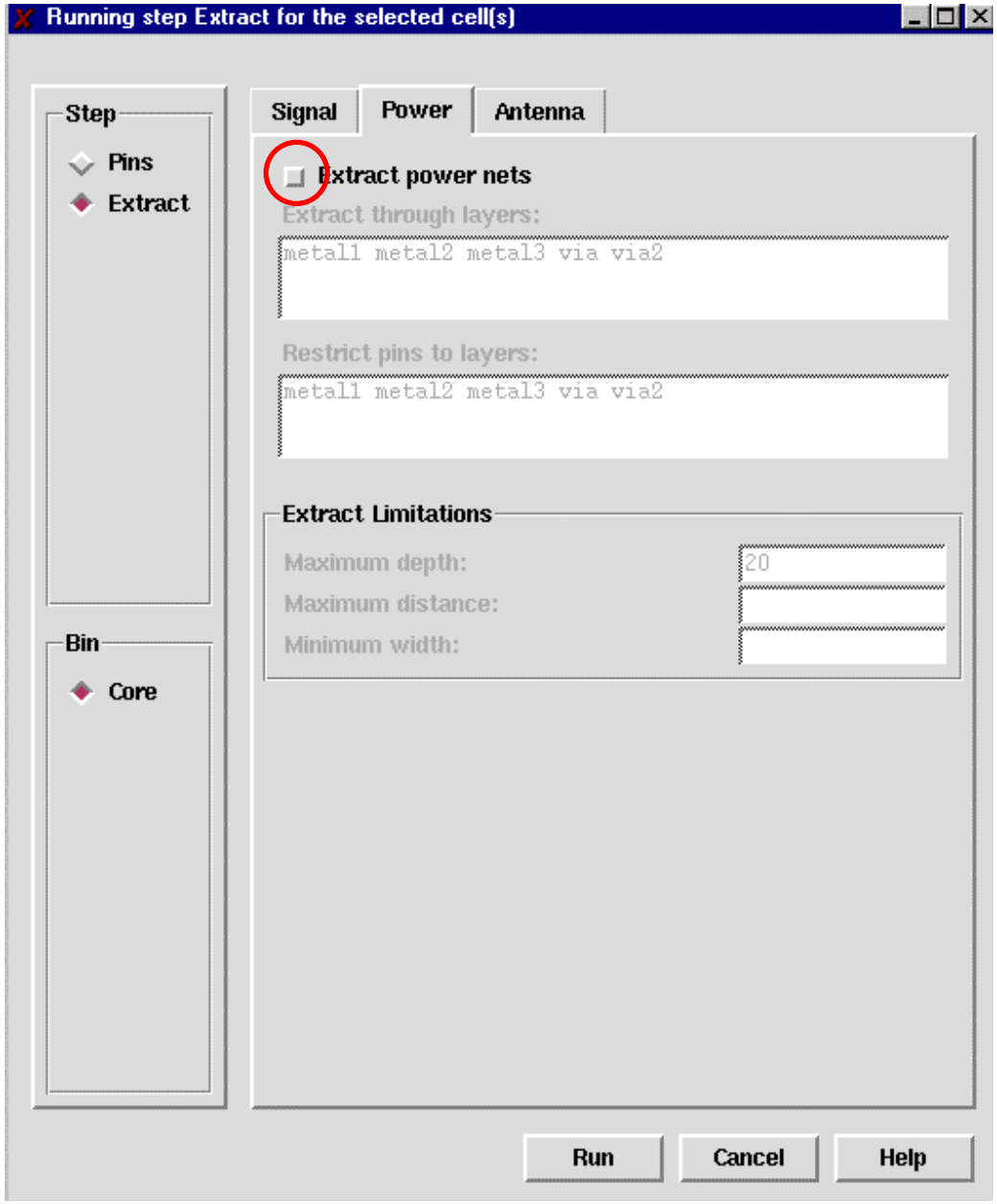
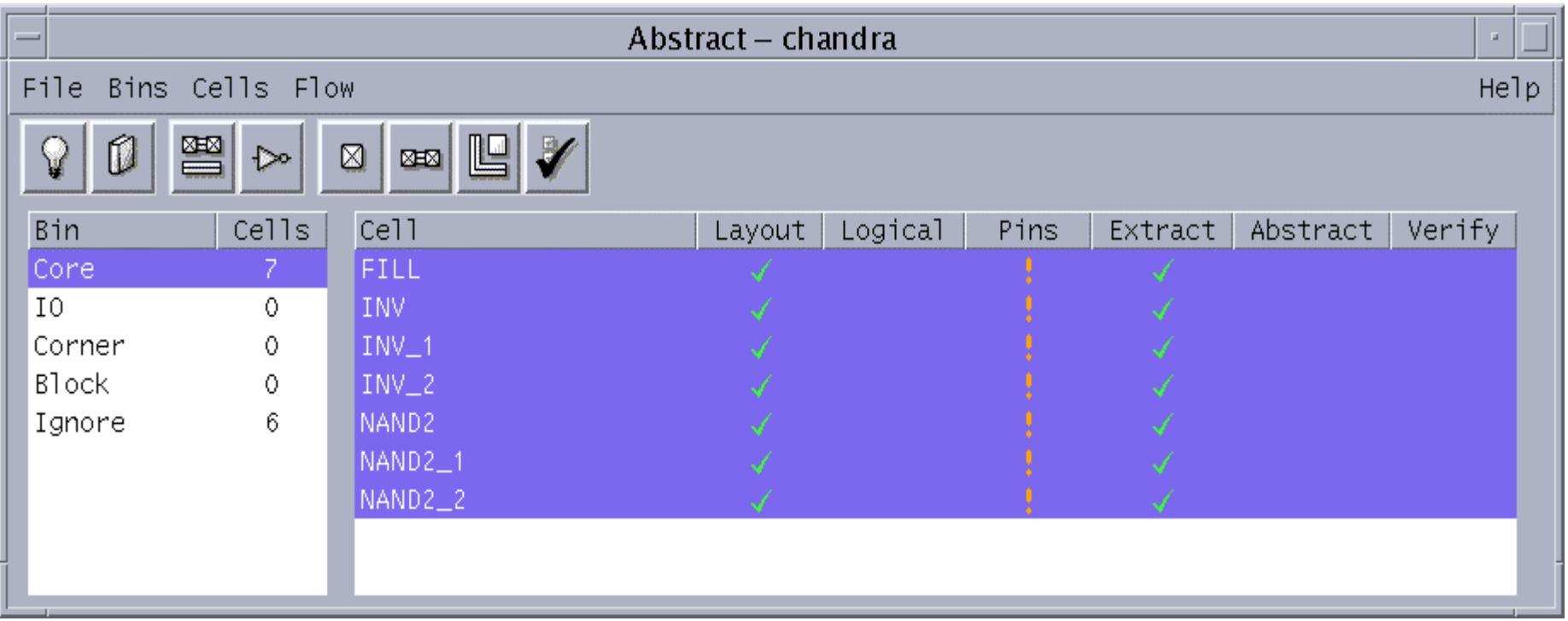


Figure 11: Extract Form (Power Tab)


Abstract – chandra
File Bins Cells Flow Help
Bin Cells
Core 7
IO 0
Corner 0
Block 0
Ignore 6
Cell Layout Logical Pins Extract Abstract Verify
FILL
INV
INV_1
INV_2
NAND2
NAND2_1
NAND2_2

Abstract Generation – Abstract Step

- In the main window, select all the standard cells – *FILL, INV,INV_1,INV_2, NAND2, NAND2_1,NAND2_2 (given as example here)*
- Under the **Blockage** tab, make sure that "**metal1 metal2 metal3 via via2**" is entered for the "Create detailed blockages on layers" field.
- Under the **Site** tab, enter "**core**" for the site name.
- Click on **Run**. This will generate abstracts for the aforementioned cells.

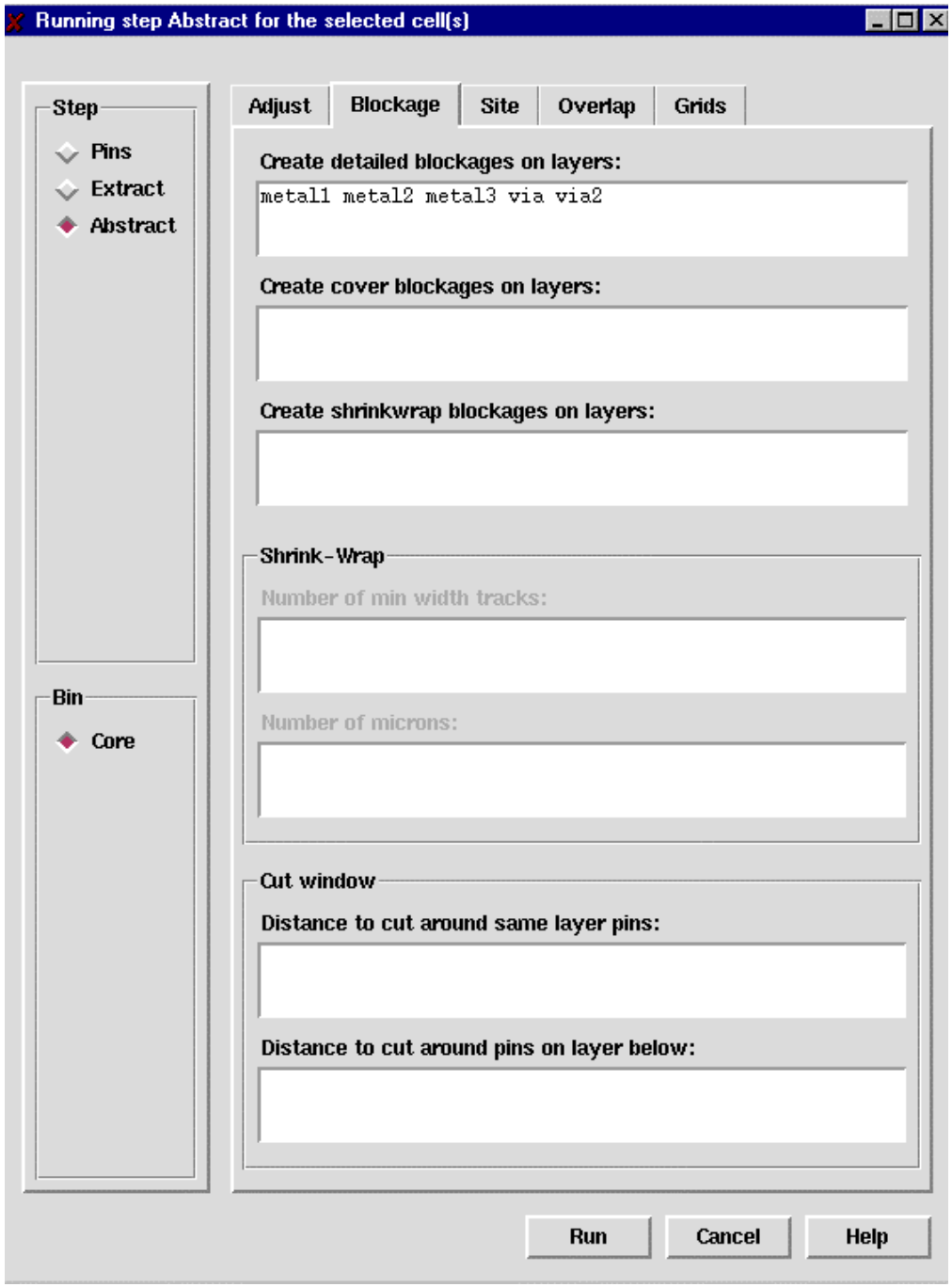
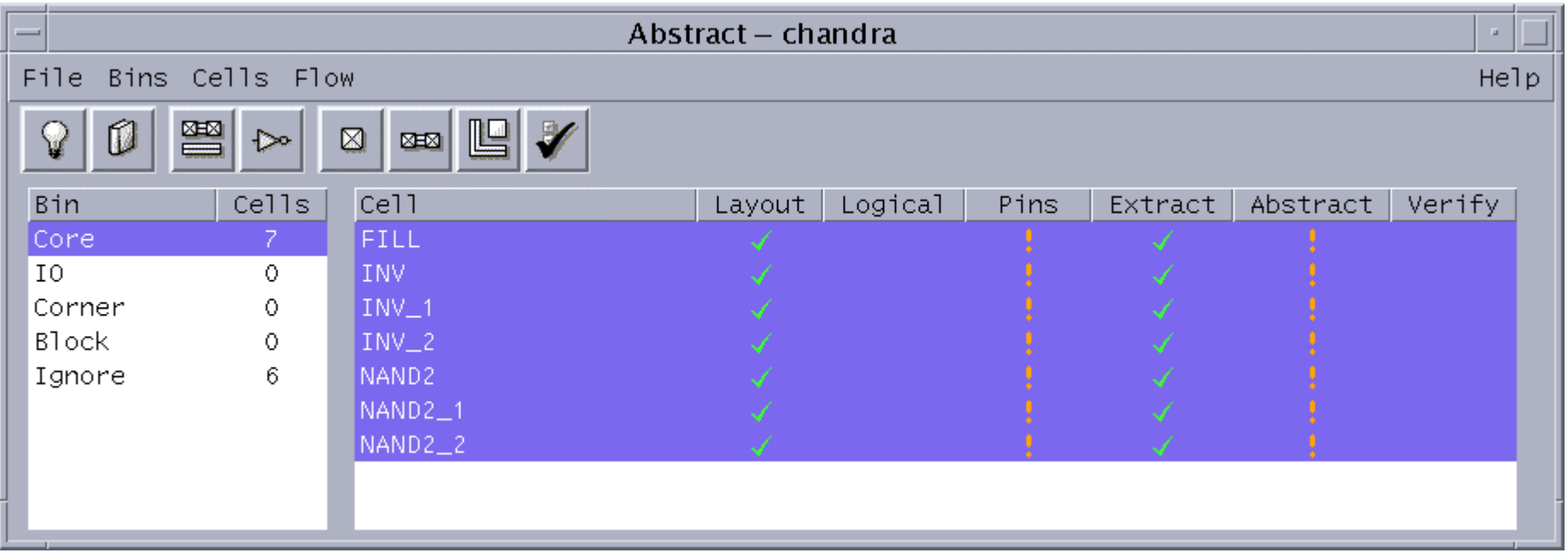


Figure 12: Abstract Form (Blockage Tab)

Figure 13: Abstract Form (Site Tab)

Abstract Generation – Abstract Step

- Notice that there are exclamation marks in the **Abstract** column of the cells, in the main window.
- Select a cell (e.g. *INV*), then click on *Cells -> Report*.
- The report for the *Abstract* step warns us that the **vdd** and **gnd** terminals have no pins on the Metal1-Metal2 routing grid.
- The warning can be safely ignored.


Abstract – chandra
File Bins Cells Flow Help
Bin Cells
Core 7
IO 0
Corner 0
Block 0
Ignore 6
Cell Layout Logical Pins Extract Abstract Verify
FILL
INV
INV_1
INV_2
NAND2
NAND2_1
NAND2_2

Abstract Generation – Verify Step

- In the main window, select all the standard cells
- Click on **Run**.
- Check out the next picture for results

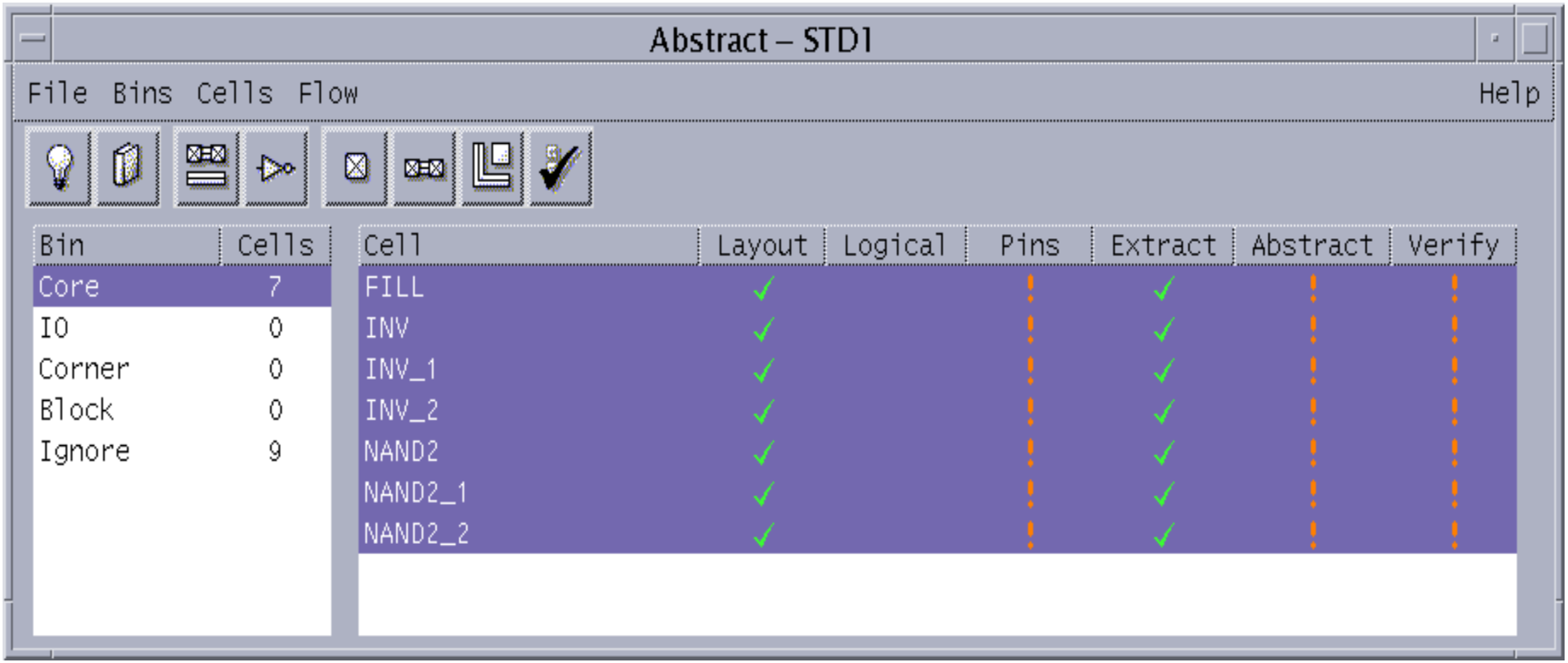


Figure 14: Verify Form

A Note about Warnings

- Warnings do not equal errors!
- Whenever you encounter a warning (or even an ‘info’ line), check its validity, and compare it with what you know about the standard cells.
- If the warning is something that you know about, and you know that it is okay, then you can safely ignore the warning.
- Of course if there is genuine concern about the warning you should go back to your previous steps and fix whatever is causing the warning before proceeding.

Cell Orientation

- All the cells in the **core** bin should have abstract views by now.
- Select all the standard cells (exclude the Pad cells).
- Click on *Cells -> Cell Properties*
- Change property **symmetry** to **X**, then click on **Apply** (refer figure 32, next slide).
- Click on **OK** to close the form.
- Having a symmetry of X means the cells can only be flipped about the X-axis.

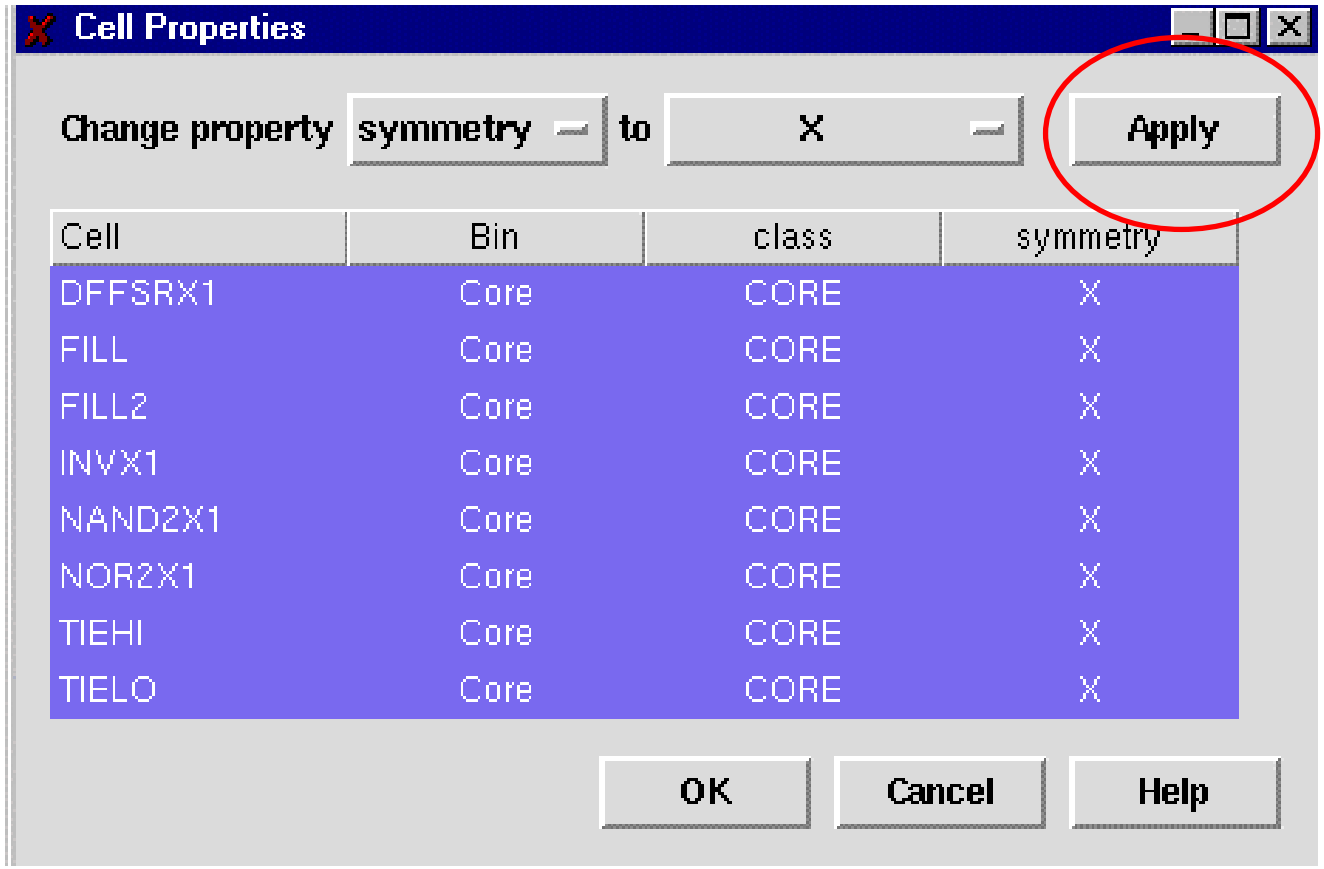


Figure 15: Cell Properties Form

Extracting to LEF Format

- In the main window, click on *File -> Export -> LEF*.
- The **Export LEF** form will appear.
- Click on the **Browse** button, and save the LEF file as ‘abstract.*lef*’ .(Any name)
- Set “LEF Units “ to be 100.
- Click on **OK** in the **Export LEF** form.

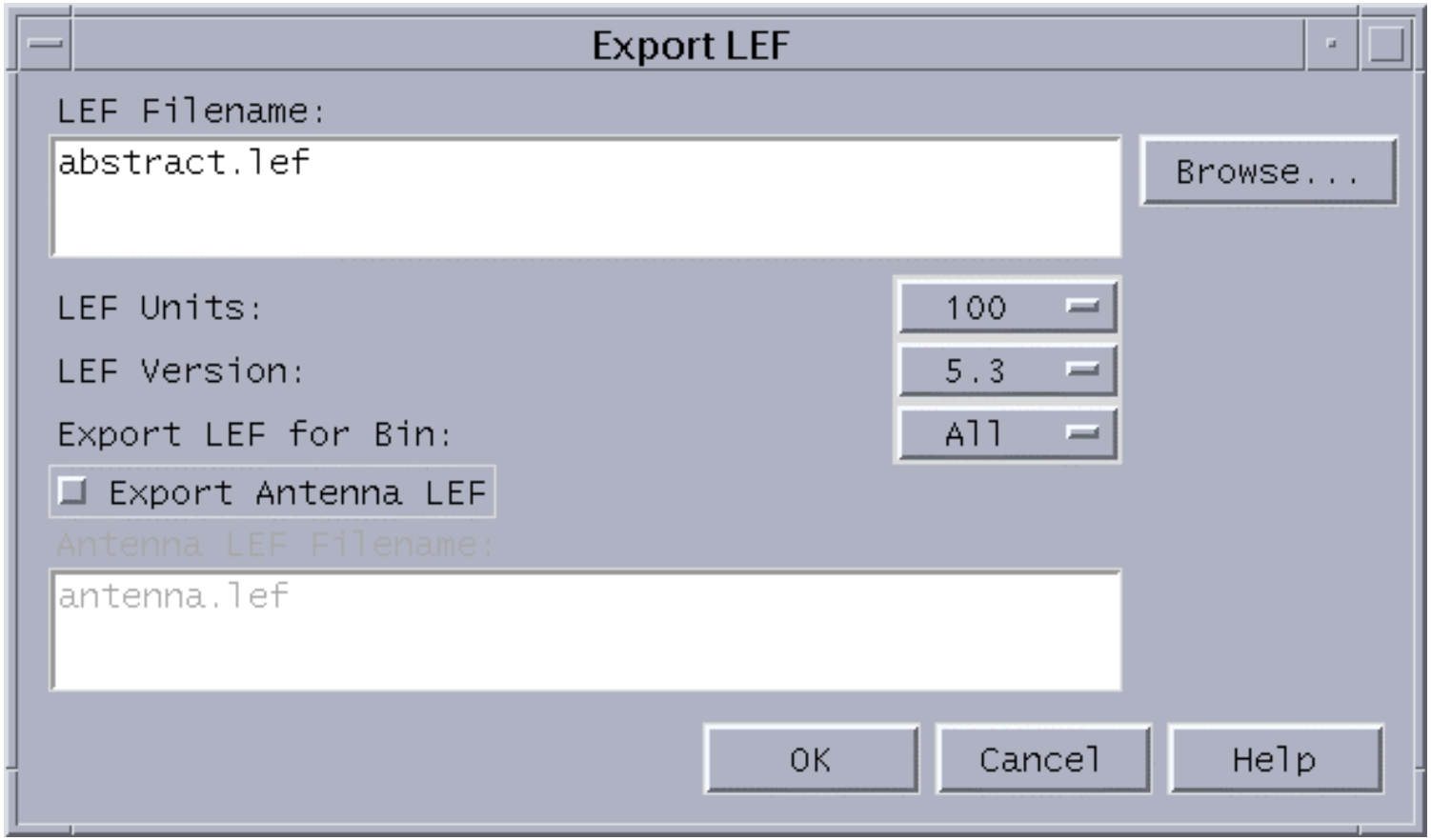


Figure 16: Export LEF Form

Modify the following in LEF file

- Pico “abstract.lef”
- Scroll down till you see the following and change its value from 18.00 to 24.00 (Check out next slide)

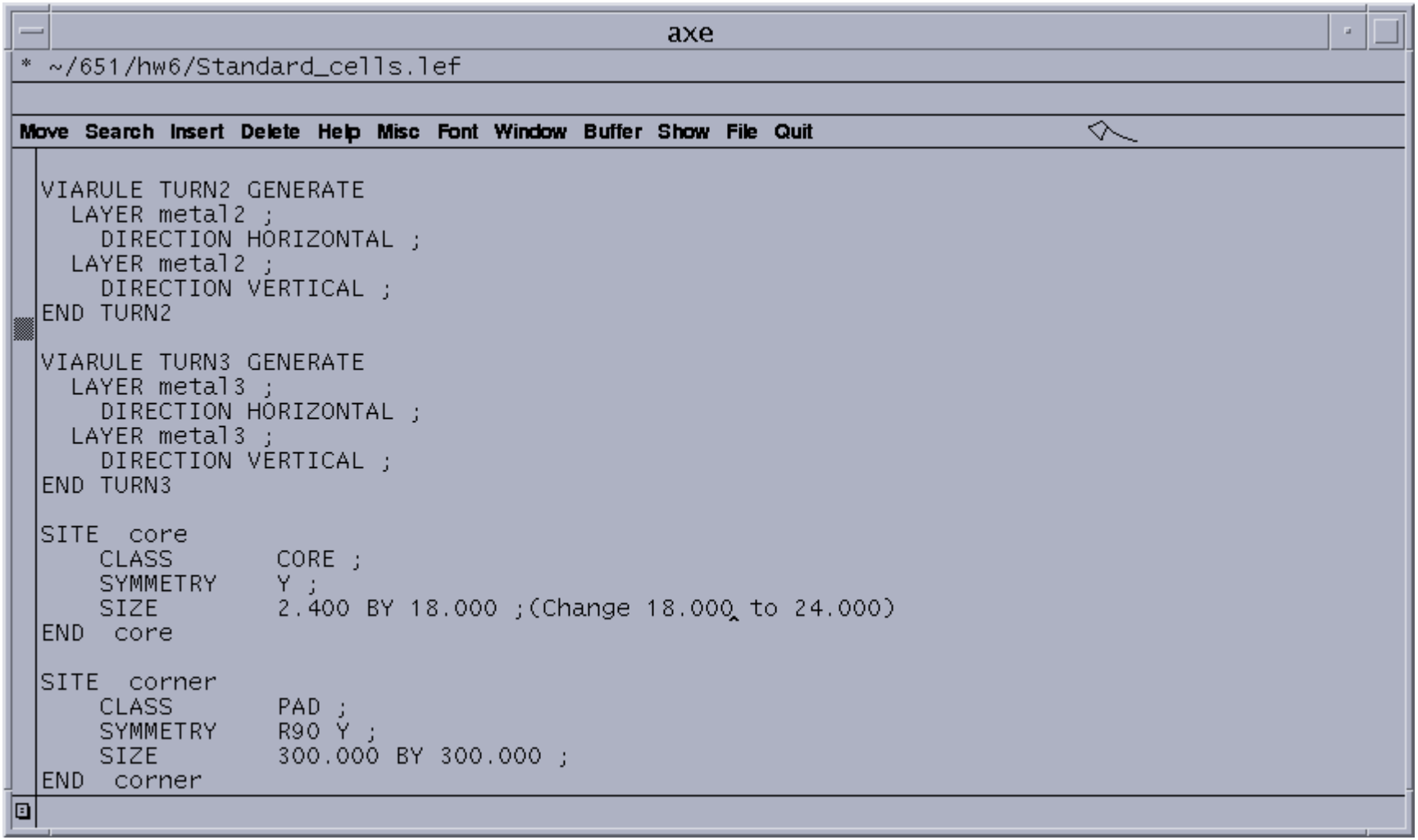


Figure 17: Change in the LEF file