Hercules™ VUE
User Guide

Version B-2008.09-SP4, October 2011

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Preface

This preface includes the following sections:

- What's New in This Release
- About This Guide
- Customer Support

What's New in This Release

Information about new features, enhancements, and changes, along with known problems and limitations and resolved Synopsys Technical Action Requests (STARs), is available in the *Hercules Release Notes* in SolvNet.

To see the *Hercules Release Notes*,

1. Go to the Download Center on SolvNet located at the following address:

   https://solvnet.synopsys.com/DownloadCenter

   If prompted, enter your user name and password. If you do not have a Synopsys user name and password, follow the instructions to register with SolvNet.
2. Select Hercules, and then select a release in the list that appears.

About This Guide

The *Hercules VUE User Guide* assists the designer in analyzing and debugging with VUE.

This preface provides information about the Synopsys documentation conventions, contacting Customer Support, and accessing SolvNet.

Audience

This user guide is designed to enhance both beginning and advanced users' knowledge of VUE tool. This guide includes information about the VUE GUI, communication with layout and schematic tools, and how to analyze errors.

Related Publications

For additional information about Hercules, see Documentation on the Web, which is available through SolvNet at the following address:

https://solvnet.synopsys.com/DocsOnWeb

In addition, the documentation is installed with the Hercules software and is available through the Hercules VUE Help menu.

Conventions

The following conventions are used in Synopsys documentation.

Convention	Description
`Courier`	Indicates command syntax.
`Courier italic`	Indicates a user-defined value in Synopsys syntax, such as *`object_name`*. (A user-defined value that is not Synopsys syntax, such as a user-defined value in a Verilog or VHDL statement, is indicated by regular text font italic.)
`Courier bold`	Indicates user input—text you type verbatim—in Synopsys syntax and examples. (User input that is not Synopsys syntax, such as a user name or password you enter in a GUI, is indicated by regular text font bold.)
[ ]	Denotes optional parameters, such as *`pin1 [pin2 ... pinN]`*
|	Indicates a choice among alternatives, such as `low | medium | high` (This example indicates that you can enter one of three possible values for an option: low, medium, or high.)
_	Connects terms that are read as a single term by the system, such as `set_annotated_delay`
Control-c	Indicates a keyboard combination, such as holding down the Control key and pressing c.
\	Indicates a continuation of a command line.
/	Indicates levels of directory structure.
Edit > Copy	Indicates a path to a menu command, such as opening the Edit menu and choosing Copy.

Customer Support

Customer support is available through SolvNet online customer support and through contacting the Synopsys Technical Support Center.

Accessing SolvNet

SolvNet includes an electronic knowledge base of technical articles and answers to frequently asked questions about Synopsys tools. SolvNet also gives you access to a wide range of Synopsys online services including software downloads, documentation on the Web, and “Enter a Call to the Support Center.”

To access SolvNet, go to the SolvNet Web page at the following address:

https://solvnet.synopsys.com

If prompted, enter your user name and password. If you do not have a Synopsys user name and password, follow the instructions to register with SolvNet.

If you need help using SolvNet, click HELP in the top-right menu bar or in the footer.

Contacting the Synopsys Technical Support Center

If you have problems, questions, or suggestions, you can contact the Synopsys Technical Support Center in the following ways:

- Open a call to your local support center from the Web by going to https://solvnet.synopsys.com, entering your user name and password and then clicking “Enter a Call to the Support Center.”
- Send an e-mail message to your local support center.
  - E-mail support_center@synopsys.com from within North America.
  - Find other local support center e-mail addresses at http://www.synopsys.com/Support/GlobalSupportCenters/Pages
- Telephone your local support center.
  - Call (800) 245-8005 from within the continental United States.
  - Call (650) 584-4200 from Canada.
  - Find other local support center telephone numbers at http://www.synopsys.com/Support/GlobalSupportCenters/Pages

1

Introduction to VUE

This chapter provides an introduction to VUE usage, including runset requirements, available command-line options, and general VUE setup options.

Introduction

VUE is a flow-based graphical tool that guides you through the entire physical verification flow. Within one interface, you can configure and execute a verification run, easily load the results, review a run summary, and debug the design by highlighting errors, nets, and devices within most layout editor and schematic capture tools.

VUE Setup

Required Files

A number of files are required to run VUE and to connect with different interfaces. The installation package contains all of the required files and does not require any setup beyond running the Synopsys Common Installer.

Note:
The Hercules and VUE versions must be the same to ensure compatibility.

The following VUE files must be installed in the HERCULES_HOME_DIR install directory.

VUE File	Description
$HERCULES_HOME_DIR/bin/systype/vue	VUE binary
$HERCULES_HOME_DIR/etc/VUE/*	VUE command files
$HERCULES_HOME_DIR/etc/tcl-u/CosmosVue.tcl	Tcl code for Cosmos connection
$HERCULES_HOME_DIR/etc/tcl-u/IcwbVue.tcl	Tcl code for IC WorkBench connection
$HERCULES_HOME_DIR/lib-u/systype/VUE/*	VUE connection filter files

Runset Requirements

There is only one requirement, which can be set in one of two ways to ensure that all data required by VUE is generated.

- To generate VUE data, either use the CREATE_VUE_OUTPUT option in the runset:

```
OPTIONS {
   CREATE_VUE_OUTPUT = TRUE
}
```

  Or, set the -vue command-line option.

- Set the output format of the runset to Milkyway™, GDSII, or OASIS.

VUE Execution

VUE can be started in two ways:

- On the shell command line
- Within the layout editor

For information on starting VUE from within a layout editor, see Chapter 3, “Running Hercules Within VUE.”

VUE Command-Line Arguments

VUE has several command-line arguments that control commonly used VUE commands. They are:

```
vue [-usage | -h | -help] [-V] [-Version] [-cmdPrint] \
  [-iconic] [-lay layTool] [-sch schTool] \
  [-load block.vue] [-replay fileName] \
  [-replayOutput fileName] [-gdsOutput fileName] \
  [-layArgs argName argValue]
```

Argument	Description
-usage | -h | -help	Display usage message and exit.
-V	Print product version.
-Version	Print product and library version.
-cmdPrint	Toggle the command print-out.
-iconic	Start VUE iconified.
-lay *layTool*	Layout tool on which to connect during startup. Supports Astro, IC Compiler, CosmosLE, Enterprise, IC WorkBench EV Plus, and Virtuoso.
-sch *schTool*	Schematic tool on which to connect during startup. Supports Composer and CosmosSE.
-load *block*.vue	Auto-load the information found in the *block*.vue file. By default, no data file is loaded on VUE startup.
-replay *fileName*	Input replay file. By default, no replay file is loaded.
-replayOutput *fileName*	Output replay file. Default is vue.timestamp.
-gdsOutput *fileName*	Output GDSII file.
-layArgs	Sets layout editor specific arguments required for connection on the command line, if needed. For more information on allowable options for each layout tool, see Chapter 2, “VUE Communications Interface Guide.”

The -geometry *WIDTHxHEIGHT +XOFF+YOFF* command-line argument is a general argument used to specify the window size and location of VUE during startup.

WIDTH, HEIGHT, XOFF, and YOFF are numbers measured in either pixels or characters, depending on the application.

XOFF and YOFF can be positive or negative values to specify the distance of the window from the left (+) or right (-) and top (+) or bottom (-) edges of the screen, respectively. Both offsets are measured from the edge of the screen to the corresponding edge of the window.

Offsets must be given as pairs. That is, in order to specify either XOFF or YOFF both must be present. Windows can be placed in the four corners of the screen using the following specifications:

```
+0+0  for the upper left hand corner
-0+0  for the upper right hand corner
-0-0  for the lower right hand corner
+0-0  for the lower left hand corner
```

Here are some examples for setting the VUE size and location:

```
vue -geometry 200x500-0-0 &
vue -geometry 200x500+0+0 &
vue -geometry 500x500-100+100 &
```

Bind Key Setting

The bind key setting allows you to specify, or bind which keys are used to view the next or previous DRC error in VUE. This capability is enabled as follows:

- Load the error output data from Hercules into VUE. Click the first error in the Violations pane. VUE zooms to that error location in the layout editor.
- Fix the error in the layout editor.
- Press the next violation designated bind key to enable VUE to zoom to the next error in the layout editor.

The Virtuoso and Laker layout interfaces support bind keys. Set your own bind keys in Virtuoso by following these steps:

- Create or modify the bind key setting file, `myBindKey.il`, as shown below:

```
hiSetBindKey(window, key_or_combination, function)
hiSetBindKey("Layout","Ctrl<Key>Down", "vueDrcNextViolation()")
hiSetBindKey("Layout","Ctrl<Key>Up", "vueDrcPrevViolation()")
```

Modify only the `key_or_combination` portion of the file. Do not modify the window, function, or command portions of the file. In this case, press Ctrl+Down Arrow key to instruct VUE to select the next DRC violation listed in the VUE Violations pane. Press Ctrl+Up Arrow key to instruct VUE to select the previous DRC violation.

- Launch Virtuoso and load the bind key skill file.
- Launch VUE and load the results. After you select a cell from the VUE Layout Cell pane, use your own bind key in Virtuoso to track the DRC violations.

Set your own bind keys in Laker by following these steps:

- Create or modify the bind key setting file, `myBindKey.key`, as shown below:

```
{
key_or_combination window function TCL_name / TCL_procedure
Ctrl<Key>Down * f.tcl LakerFilter  HERCULES::VUEDrcNextViolation
Ctrl<Key>Up * f.tcl LakerFilter  HERCULES::VUEDrcPrevViolation
}
```

  Modify only the `key_or_combination` portion of the file. Do not modify the window, function, and command portions of the file. In this case, press Ctrl+Down Arrow key to instruct VUE to select the next DRC violation listed in the VUE Violations pane. Press Ctrl+Up Arrow key to instruct VUE to select the previous DRC violation.

- Create a .tcl file, for example, `vueBindKey.tcl`, as shown below:

```
gtSetBindKey -windowType lakerDsgWnd -file ./myBindKey.key
```

- Launch Laker and source the .tcl file. For example, source `./vueBindKey.tcl`.
- Launch VUE and load the results. After you select a cell from the VUE Layout Cell pane, use your own bind key in Laker to track the DRC violations.

VUE Menu Overview

File Menu

The File menu contains several commonly used administrative options. You can:

- Load a VUE preference file.
- Save custom VUE preferences.
- Load a VUE replay file.
- Save or purge the DRC/Extraction error status while viewing errors.

- Close the current project.
- Exit VUE.

File Menu Option	Description
Save Preferences	Creates a VUE preference file (default is .vuerc) file in the directory you specify. The .vuerc file allows you to save your VUE configuration for use in other VUE sessions. See **Saving User Preferences** for more information.
Load Preferences	Loads a valid VUE preference file. All current settings will be overwritten.
Load Replay File	Allows you to load a previously made replay file. This is useful for data-dependent project settings.
Save DRC/ Extraction Error Status	These options allow you to save the error status of DRC/ Extractions errors. The status file names are set in the DRC/ Extraction options window. See (DRC/Extraction) for more information on error types. Note: The error status remains only until Hercules is rerun.
Purge Fixed Errors	Purging Fixed Errors reverts an error check status from Fixed to Error.
Purge Ignored Errors	Purging Ignored Errors reverts an error check status from Ignored to Error.
Close	Unloads all run data from VUE, removing any necessary tabs. The Execution and Load Tabs remain.
Exit	Unloads all run data and VUE shuts down.

Saving User Preferences

File > Save Preferences creates a VUE preference file in the directory you specify. The default VUE preference file is .vuerc file is automatically loaded when VUE is started if it is located in the following directories:

- Current working directory
- User's home directory
- Product Install directory ($HERCULES_HOME_DIR)

The .vuerc file located in the install directory sets up VUE in the default mode.

Note:
Settings in the .vuerc file take precedence over any settings in the runset.

The preference file does not save any data-dependent VUE options. See the section on loading a VUE replay file for more information. The options you can customize and save in the .vuerc file are:

Options: General

- Setting of Edit-in-Place for DRC
- Setting of Edit-in-Place for LVS
- Control of Zoom Factor

Options: DRC/Extraction

- Use Comment field for error check name
- Status Options (showing Error, Fixed, Ignored)
- Window List Option (Arranging by Blocks/Checks or Checks/Blocks)
- Traversal Options

Toolbar

- DRC/Extraction
- Check Hilite color/fill
- Marker Hilite color/fill
- LVS
- Net Hilite color/fill
- Device Hilite color/fill

Execution tab

- All fields in the execution tab configure menu
- Block
- Library/format
- Explode list
- Edtext file
- Output block
- Output library/output format

- Group file directory
- Run_details directory
- #dp/#threads
- Host list
- Select rule/unselect rule
- Select Window/Cell only mode
- Schematic netlist/format
- Equivalence file
- Compare directory
- Extraction only (on or off)
- Compare only (on or off)
- Auto Load Results (on or off)

DRC/Extraction tab

- Highlight (individual violations, all violations in selected check, all violations in selected block)
- Show Text Open/Short Details

LVS tab

- Highlight multiple objects

Loading a VUE Replay File

Choosing File > Load Replay file allows you to load in a VUE replay file once VUE has already started. This is useful for data-dependent project settings such as highlight layer filtering, DRC error filtering, and so on.

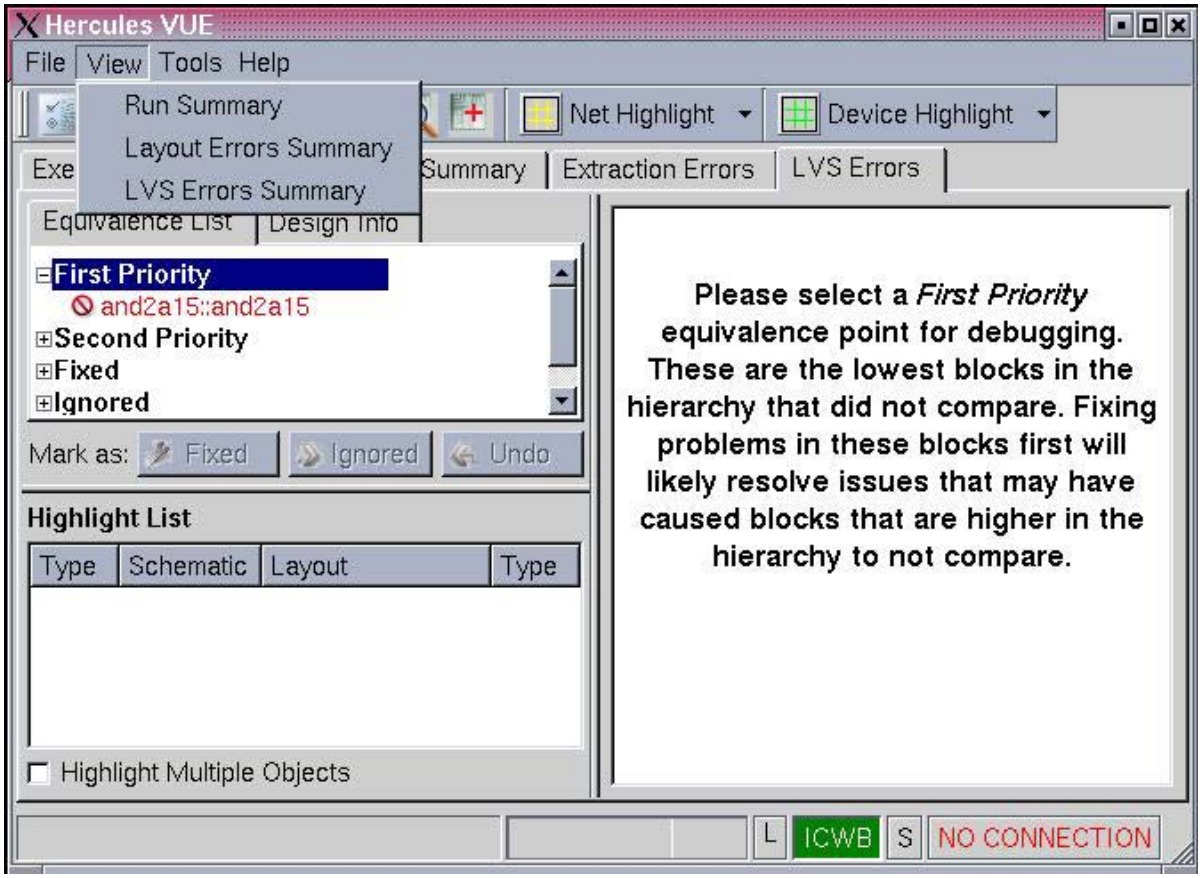
All commands in the replay file will be run. It is recommended that you remove unnecessary commands in the replay file to reduce confusion.

VUE does not load the replay file to which it is writing.

View Menu

The View menu allows you to view Run Summary, Layout Errors, and LVS Errors Summaries.

Figure 1-1 View Menu



Tools Menu

The Tools menu allows you to change viewing options or set the layout and schematic connections. Instructions for setting up the connection to layout and schematic tools are discussed earlier in this chapter. For details on the Communication Window, see Chapter 2, “VUE Communications Interface Guide.”

Options Window

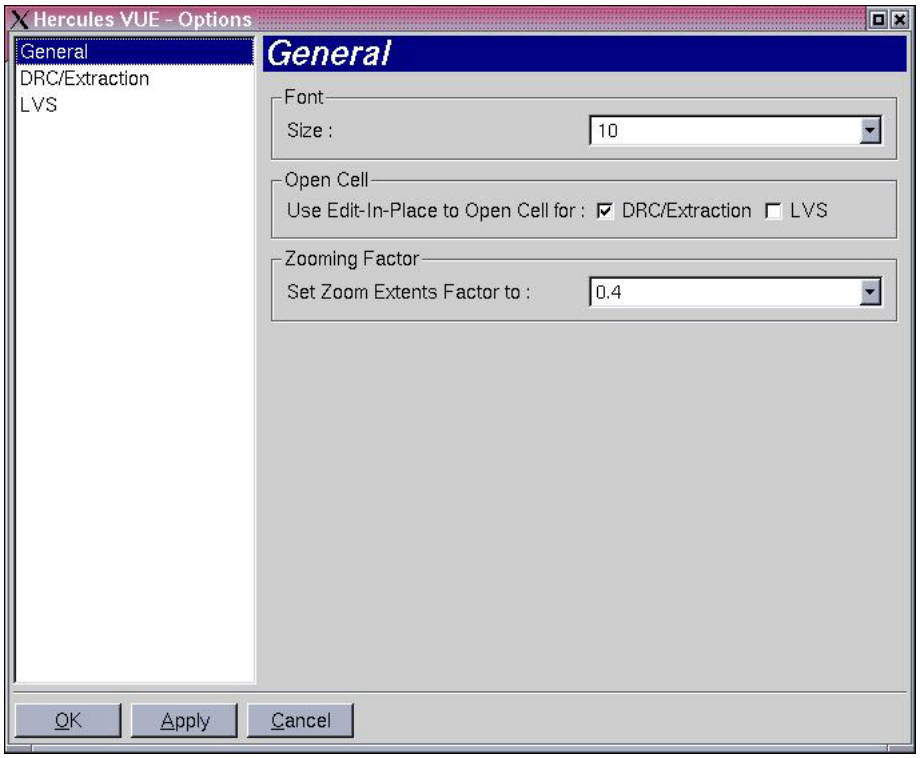
The Options window allows you to set how VUE displays errors or highlights objects.

General View

- Font. Controls the font of all text displayed by VUE

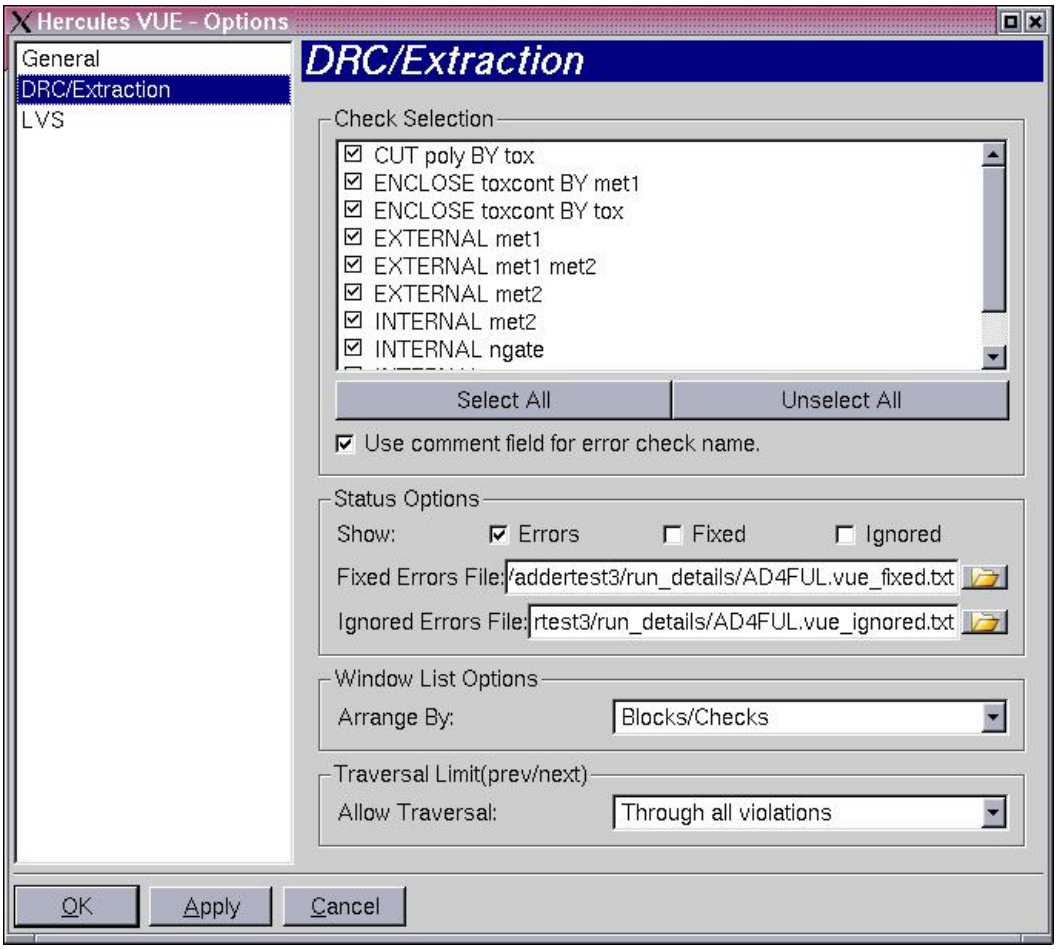
- Open Cell. Controls whether cells are opened in Edit-In-Place mode for DRC and LVS errors. The Edit-In-Place mode opens a cell within the context of its parent. If this option is disabled, VUE opens only the cell.
- Zooming Factor. Controls how close VUE zooms into the error highlights. The closer the zoom value is to one, the closer VUE zooms to the error. The default value is 0.8.

Figure 1-2 Options Window General



DRC/Extraction View

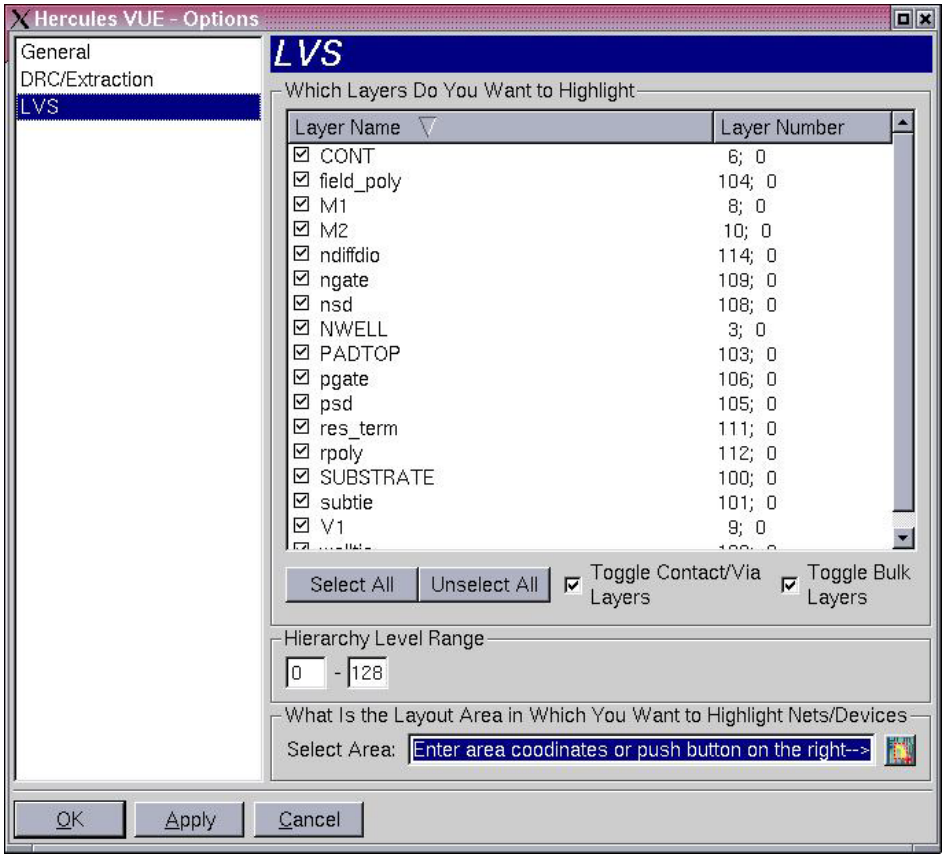
Figure 1-3 Options Window DRC/Extraction



- Check Selection. Controls the types of errors that are displayed in the Extraction Errors tab. Select Use comment field for error check name to deselect this option and replace the comment with the actual command from the runset.
- Status Options. Controls which Error Status types are displayed in the Extraction error tab. It defaults to show only errors. You can also set the Text file names for Fixed and Ignored errors.
- Window List Options. You can choose how to organize the error output in VUE. The Checks/Blocks option rearranges the window to put the Error Check Field to the left of the Layout Block field. The default is Blocks/Checks.
- Traversal Limit(prev/next). Controls traversal through all violations (default) within the selected block or check when using the Prev and Next buttons.

LVS View

Figure 1-4 Options Window LVS



- Which Layers Do You Want to Highlight. Controls which layers of a net are highlighted. This is useful when you want to view the routing layer of a net to see some connections better. All of the layers in the final connect data base are listed here.
- Toggle Contact/Via Layers to help speed up highlighting on large nets. Well ties are not considered a contact/via layer.
- Toggle Bulk Layers turns on or off the bulk layers in the highlight list. A layer is determined to be bulk if it is used as such in a device extraction command.
- Hierarchy Level Range is used to limit the net highlight to a specific range of hierarchical levels. This can improve highlighting time.
- Select Area. Enter lower-left and upper-right coordinates of a region in which to highlight. Alternately, you can define the region in the layout editor by using the button to the right of the entry field.

VUE Help Menu

The VUE Help menu provides quick access to the product documentation.

The Help menu uses the install directory (HERCULES_HOME_DIR) environment variable to locate the documentation.

Select Help to view the documentation as either HTML or a PDF file. From the Help menu, you can access this user guide, other user guides, the reference manual, and tutorial.

VUE Main Toolbar

The main toolbar provides more options with which you can change the existing viewing capabilities.

Figure 1-5 VUE Main Toolbar

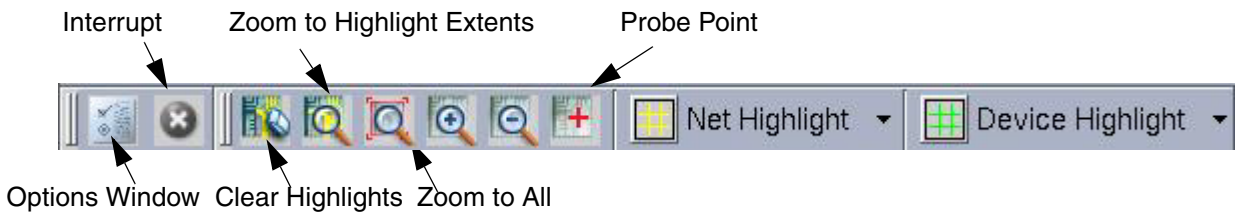
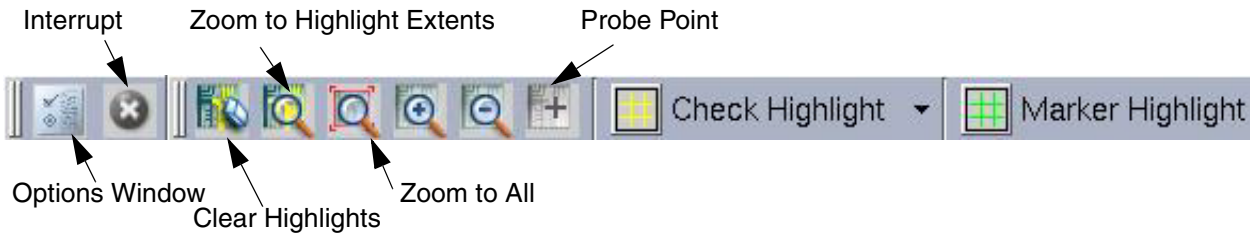


Figure 1-6 VUE DRC Toolbar



Option	Description
Options Window	Opens up the VUE Options window.
Interrupt	Stops current highlighting.
Clear Highlights	Removes all the highlights that VUE draws in the layout.
Zoom to Highlight Extents	Zooms to fit the extents of the highlighted items.

Option	Description
Options Window	Opens up the VUE Options window.
Zoom to All	Zooms to fit the entire open block within the layout window.
Zoom In	Zoom in by a factor of 0.5.
Zoom Out	Zoom out by a factor of 2.
Probe Point	Used for LVS errors. Not available for Extraction/DRC Errors tab. For more details, see “LVS Errors” on page 3-39.
Check Highlight	Change the Color/Fill for highlighting primary DRC Errors if currently in DRC/Extraction Errors tab. The error must be re-highlighted to update Color/Fill.
Marker Highlight	Change the Color/Fill for highlighting secondary DRC Errors if currently in DRC/Extraction Errors tab. The error must be re-highlighted to update Color/Fill.
Net Highlight	Change the Color/Fill for highlighting nets if currently in LVS Errors Tab. The net must be re-highlighted to update Color/Fill.
Device Highlight	Change the Color/Fill for highlighting devices if currently in LVS Errors tab. The device must be re-highlighted to update Color/Fill.

2

VUE Communications Interface Guide

This chapter provides basic information on how to interface with layout and schematic tools.

Introduction

VUE supports interfaces to several layout and schematic capture tools. These interfaces allow VUE to display error information, highlight nets, shorts and devices, and to cross-probe.

The supported layout interfaces are:

- Synopsys® CosmosLE™
- Synopsys Enterprise
- Synopsys IC WorkBench EV Plus
- Synopsys Astro™
- Synopsys IC Compiler™
- Cadence® Virtuoso® Layout Editor (formerly Composer)
- Springsoft Laker™

The supported schematic interfaces are:

- Synopsys CosmosSE™
- Cadence Virtuoso Schematic Editor

Graphical User Interface

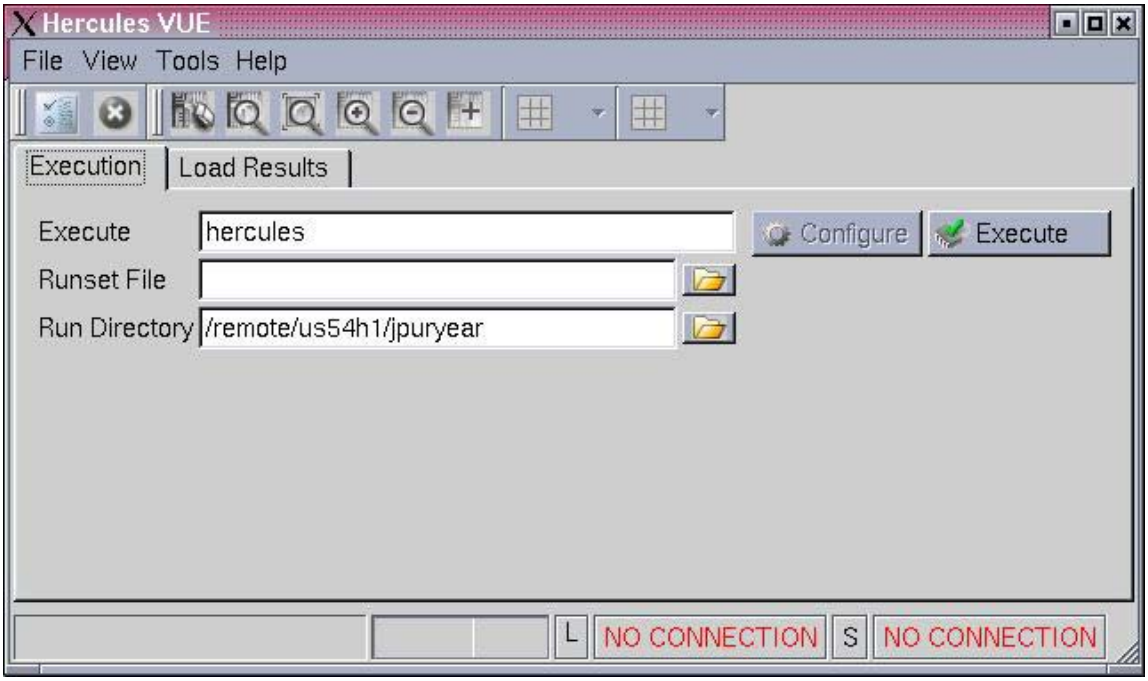
Information about the communications interface is shown in two sections of the GUI.

Main VUE GUI

The lower right corner of the main VUE GUI shows the communication status of the layout and schematic connections. The names of the connected layout and schematic tools are displayed. At startup, there are no connections.

Start VUE from the working directory in which Hercules is executed. Once started, the corresponding interface window displays.

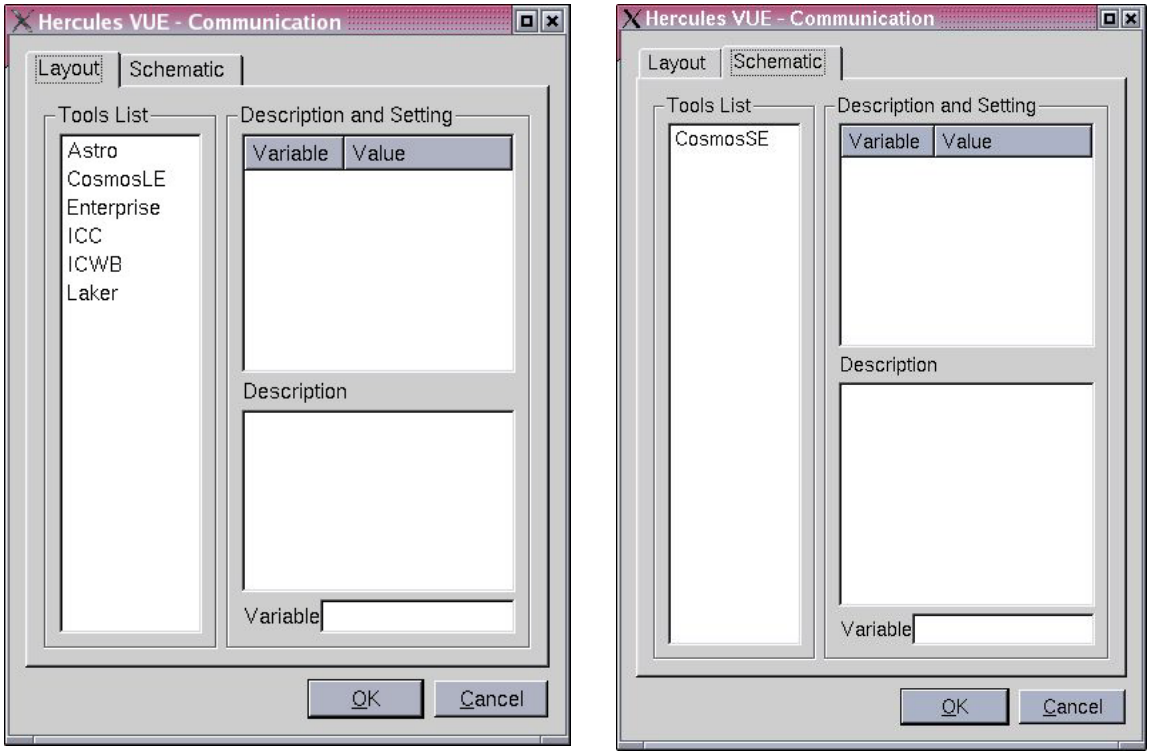
Figure 2-1 The Interface Window



Communications GUI

The Communications GUI is started from Tools > Communication. This window allows you to connect to different layout and schematic tools and to change interface-specific parameters. Figure 2-2 shows supported schematic and layout tools.

Figure 2-2 Schematic and Layout Tools Lists



Cosmos

Setup

There are three ways to start and connect to VUE from a Cosmos session. They are:

- Start VUE from within Cosmos.
- Start VUE from the command line and connect via the VUE command-line options.
- Start VUE from the command line and select CosmosLE/SE from the communication Window within VUE.

Note:
VUE works only with version 2004.09-eng2 and later versions of Cosmos.

Starting VUE within Cosmos

To Start VUE from within Cosmos, Click Verification > Hercules VUE from the Layout or Schematic window. VUE automatically connects to the Cosmos session from which you start.

Command-line Options

You can start VUE from a UNIX command line and connect to a version of Cosmos that is already running.

Use the command-line options:	To connect to an existing:
vue -lay cosmosle	CosmosLE session
vue -lay cosmosle -sch cosmosse	CosmosLE and CosmosSE session
vue -lay cosmosle -layArgs ProcessId *number*	Choose a particular CosmosLE session from which to connect.

If VUE has a problem connecting, a Communications window appears at startup. A description of the problem is written to the shell.

Communications Window

You can start VUE from a UNIX command line and connect to a version of Cosmos that is already running.

1. Select Tools > Communication to display the Communications dialog box.
2. Select the CosmosLE entry to connect to CosmosLE.
3. To connect to the schematic editor in Cosmos, select the Schematic tab in the Communications window and select CosmosSE.

Communicating with Other Cosmos Sessions

To communicate with another Cosmos session, open the Communications dialog box and select the appropriate tool from the list on the left. Then select the Process ID (PID) variable in the right column. Type the PID of the session to which you would like to connect in the Variable field and click OK.

There are two ways to find the PID of the Cosmos session. First, if the tool was started in Tcl mode, type pid in the command window. This returns the PID of this Cosmos session. If Cosmos is not started in Tcl mode, you can find it from the shell by using the UNIX utility top in your shell. Look for Cosmos.bin.

Note: The Cosmos sessions must run on the same Aserver.

Limitations

If you do not start VUE from the menu entry in Cosmos, and you attempt to connect to a version of Cosmos using the command-line option or the Communications GUI, VUE connects to the first version of Cosmos (based on your UNIX user ID) that you started on the machine where you are running VUE.

To connect to a different session on startup, you can use the -layArgs VUE command-line option to set the Process Id when you start VUE.

```
vue -lay cosmosle -layArgs ProcessId number
```

IC WorkBench EV Plus

Setup

VUE communicates with IC WorkBench EV Plus (ICWBEV Plus) through a socket or port connection. This socket must be opened by ICWBEV Plus. You can open the communication socket with environment variables, manually on ICWBEV Plus startup, or within the ICWBEV Plus session. The socket can be any number between 0-65535 that is not already being used. The UNIX netstat command shows which port numbers are available.

Environment Variables

ICWBEV Plus uses the environment variable:

```
ICWBEV_USER=HERCULES
```

If this is started before IC WorkBench EV Plus is started, there is an additional button in the toolbar section:

This button opens a communication socket, starts VUE, and sets up communication to ICWBEV Plus. No further setup is needed.

ICWBEV Plus Command Line

To open a socket on the command line, start ICWBEV Plus using the following command-line argument:

```
%icwbev -socket number
```

Within ICWBEV Plus

To open a socket once ICWBEV Plus has already been started, type the following within the ICWBEV Plus command window:

```
user_socket open 0
```

This command returns a number. This is the open socket that ICWBEV Plus established.

VUE Command-line Options

You can start ICWBEV Plus and VUE from the UNIX command prompt, and then connect directly to that existing ICWBEV Plus session using the following commands:

```
vue -lay icwbev -layArgs Port <number> Host <hostname>
```

The hostname variable specifies the machine name on which you want to display ICWBEV Plus and VUE. It is not necessary to change this variable if you are running and displaying on the same machine. If you are displaying the GUI on a different machine, you must set this variable.

Communications Window

You can start VUE from a UNIX command line and connect to a version of ICWBEV Plus that is already running:

- Select Tools > Communication to display the Communications dialog box.
- Select the ICWBEV Plus entry.

Enter the values for the variables directly into the variables field in the Communications window.

- Select Port then enter the socket value and click OK.
- Select Hostname then enter the hostname (or IP) and click OK.

Note:
The hostname variable specifies the machine name on which you want to display ICWBEV Plus and VUE. It is not necessary to change this variable if you are running and displaying on the same machine. If you are displaying the GUI on a different machine, you must set this variable.

Communicating with IC WorkBench EV Plus Sessions

If you would like VUE to communicate with another IC WorkBench EV Plus session, open the Communications dialog box and select ICWBEV Plus from the list on the left. Then set the hostname and port variables and click OK.

Astro

Setup

VUE connects to Astro through the VUE command-line options or the Communications Window. VUE cannot be started from within Astro.

Note:
VUE works with all versions of Astro.

Command-line Options

If Astro is running on the host from which you started VUE, you can connect directly using the VUE command-line options:

Use the command-line options:	To connect to an existing:
vue -lay astro	Astro session
vue -lay astro -layArgs ProcessId <number>	Astro session if there are multiple sessions running on the same host.

Communications Window

If Astro is running, you can start VUE and connect to Astro via the Communications window. You need to specify the PID to connect to the correct version of Astro.

VUE and Astro need to be running on the same platform when using the tools together via the communications link. For example, if Astro is running on a 64 bit AMD machine, VUE should also run on an AMD.64 machine.

Limitations

Astro supports only three fill styles: solid, rectangle, and blank.

IC Compiler

Setup

To use VUE within IC Compiler, set the following variables before invoking IC Compiler in your terminal or your .cshrc file:

$HERCULES_HOME_DIR. Variable used to get the IC Compiler specific tcl files to create menus within IC Compiler.

$path (should have Hercules executable paths). Variable used to get the VUE executable when you open Hercules VUE from the IC Compiler Verification menu.

Example:

```
"setenv $HERCULES_HOME_DIR/global/apps3/hercules_2008.09"
```

```
set path =(/global/apps3/hercules_2008.09/bin/AMD.64 $path)
```

If the two variables are set properly when you invoke IC Compiler, the files required to open Hercules VUE are loaded automatically in IC Compiler.

Note:

VUE loses communication with IC Compiler if IC Compiler is launched in the background and VUE is also launched in the background using the `-gui &` command-line option from the icc_shell. The solution is to either make the icc_shell return to the foreground, or not invoke the icc_shell in the background.

Laker

Setup

To use VUE with the Springsoft Laker tool:

- Make sure that $HERCULES_HOME_DIR is set properly.
- Invoke Laker with the startup tcl-file.

  ```
  %>laker -play $HERCULES_HOME_DIR/etc/tcl-u/LakerVue.tcl
  ```

- Connect VUE and Laker.
  - Select Laker from the tool list in the VUE Communications Window and connect it to port 9189.
  - Or, open a design window within Laker and click Hercules > Start Hercules VUE.

Virtuoso Layout Editor and Virtuoso Schematic Editor

Version

The VUE Virtuoso Layout Editor and Virtuoso Schematic Editor interfaces were developed in SKILL v6.10 and tested with Cadence ICFB v5.0.

Setup

To use VUE with the Cadence tools, you must first load the SkillVueMenu.il file. It is loaded here:

```
"$HERCULES_HOME_DIR/etc/VUE/SkillVueMenu.il"
```

You can load the SkillVueMenu.il file automatically by executing the following command in the Command Interface Window.

```
load(strcat( getShellEnvVar("HERCULES_HOME_DIR") "/etc/VUE/

SkillVueMenu.il") )
```

Add this statement to the .cdsinit file so that the SkillVueMenu.il file is loaded automatically every time you start the Cadence environment.

Loading this file adds a Hercules menu to all new Virtuoso Layout Editor and Virtuoso Schematic Editor Schematic windows. This menu contains the following menu commands:

Run Hercules	Allows the user to set PIPO streamout options and run Hercules.
Run VUE	Starts VUE and establishes a connection between the tool or window from which it was started.
Set to Hercules VUE Layout Window or Set to Hercules VUE Schematic Window	Associates the layout or schematic window (Virtuoso Layout Editor or Virtuoso Schematic Editor) with VUE for communications.
VUE Setup	Allows user control over how VUE highlights within Virtuoso. You can select between y0-y9 or hilite0 -hilite9
Clear VUE Highlights	Clears any highlights that VUE created.

Launching Hercules and IC Validator VUE Simultaneously From Virtuoso

To launch Hercules and IC Validator simultaneously from Virtuoso:

- Set $HERCULES_HOME_DIR and $ICV_HOME_DIR to their corresponding paths so the VUE binary is invoked correctly with each version.
- Load the skill file for IC Validator with SkillVueMenuHF.il file:

  load(strcat(getShellEnvVar("ICV_HOME_DIR") "/etc/VUE/SkillVueMenuHF.il")
- Load the skill file for Hercules with SkillVueMenu.il file:

  load(strcat(getShellEnvVar("HERCULES_HOME_DIR") "/etc/VUE/SkillVueMenu.il"))

When you open a cell view, you will see IC Validator and Hercules menu items. Select the corresponding Run VUE items to invoke IC Validator and Hercules VUE.

Note:

If you want to debug a cell using DRC and LVS simultaneously, set the Edit-In-Place mode to On (Off) for both DRC/Extraction and LVS. By default, DRC/Extraction does not use Edit-In-Place, while LVS does. If you do not apply the same Edit-In-Place setting, the highlight might be in the wrong place.

VUE Display Resources File (DRF)

VUE uses the Virtuoso tool's definition for the y0-y9 system layers by default for highlighting. VUE reads the definitions found on startup and limits the color/fill choices for highlights within VUE. Hililte0-hilite9 can be used by selecting the appropriate box from the VUE setup pull-down menu within Virtuoso. This is useful if you use VirtuosoXL, which uses y0-y9 for other purposes.

The Hercules tool packages a default display resource file (drf) which can be merged with the Virtuoso tool's existing display resource file to provide a set of simple color/fill combinations if the existing Virtuoso definitions are not sufficient to clearly highlight all of the error data from VUE. The drf file is found here:

$HERCULES_HOME_DIR/etc/VUE/*vue_display.drf*

The following methods can be used to merge the VUE drf file with existing display information:

- Place the *vue_display.drf* file in a location automatically loaded by Virtuoso (in order of loading by Virtuoso)
- A local display resource file you specify using the drfPath variable in your .cdsenv file. The syntax is:

  ```
  graphic drfPath string "path/display.drf"
  Note: .cdsenv can only have one graphic drfPath statement
  ```

- Personal display resource file (must be named *display.drf*)

  ~/display.drf

- The current directory (must be named *display.drf*)

  ~/display.drf

- Merge the drf file in the DRF merge editor using CIW > tools > merge DRF editor.

Auto-Populating VUE Layout and Schematic Fields, Respectively

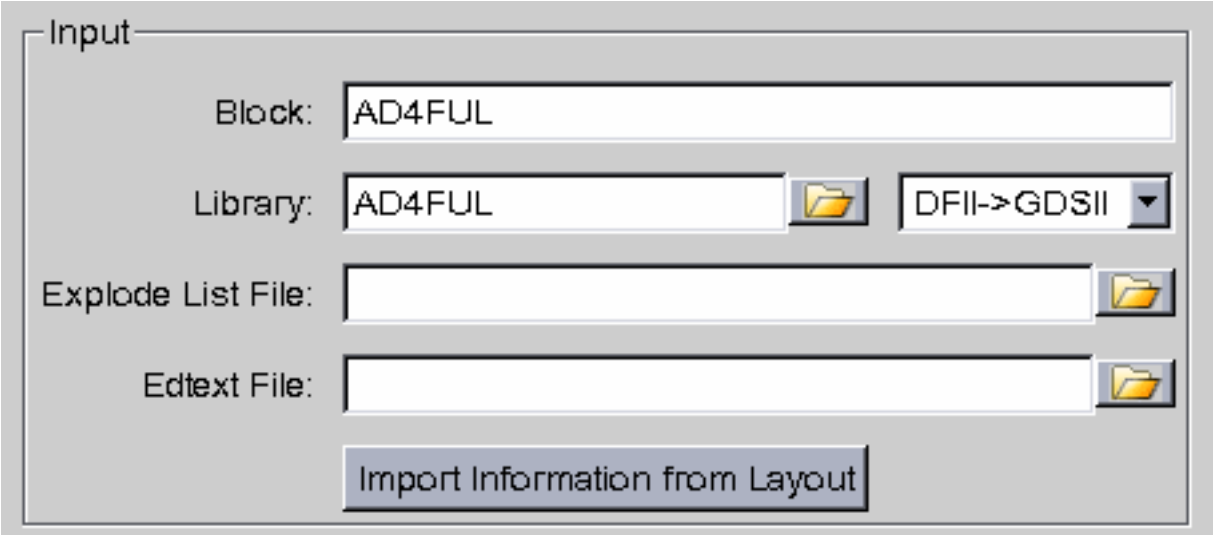
Auto-populating input fields occurs when the information is provided within the Hercules runset.ev file Header section or when both the Layout and Schematic are connected. In Figure 2-3 only the Layout is connected.

Figure 2-3 Layout Connected

Click the Import Information from Layout button shown in Figure 2-4.

Note:
If the schematic is not connected, auto-population cannot take place. Therefore, you must use the Import Information from Layout button.

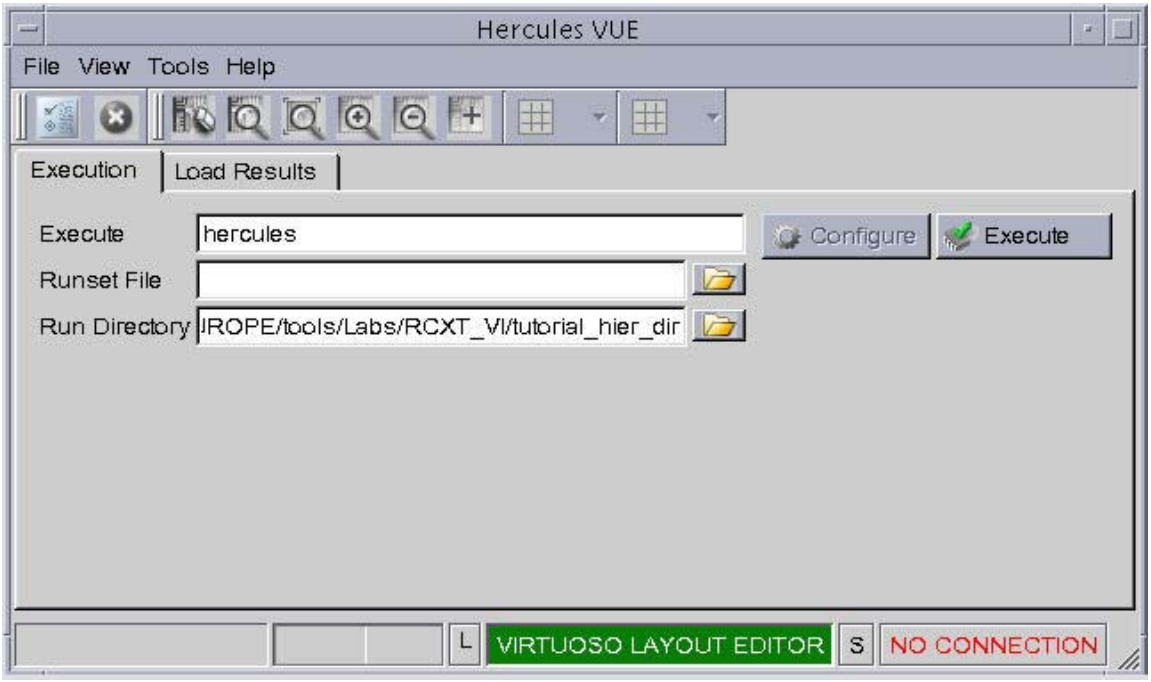
Figure 2-4 Import Information from Layout



The recommended sequence for connecting VUE to Virtuoso is presented in the following procedures.

Run VUE from the Virtuoso Hercules tab by selecting Run VUE.

Figure 2-5 Hercules VUE

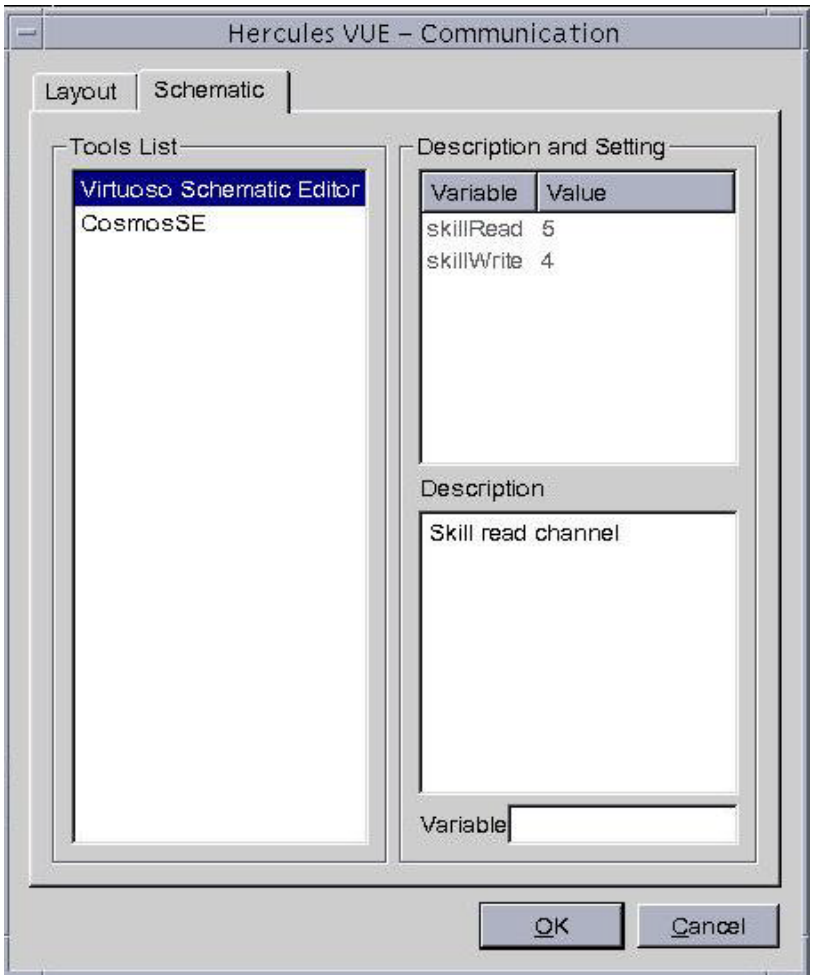


Select Communication to connect to Virtuoso Composer. See Figure 2-6 on page 2-13.

Figure 2-6 Communication

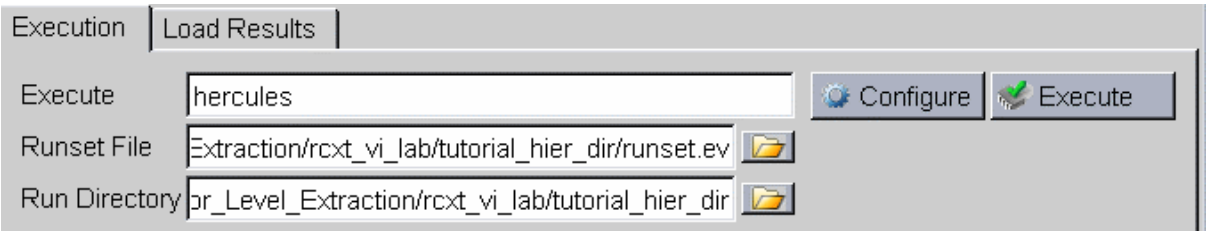
Select Virtuoso Schematic Editor and click OK.

Figure 2-7 Virtuoso Schematic Editor



Fill in the Runset File field and click Configure. See Figure 2-8 on page 2-14.

Figure 2-8 Runset File Field



Database input fields should be auto-populated. Figure 2-9 shows the general setup for Layout. Figure 2-10 shows the general setup for Schematic.

Note:

If you click Configure before the Schematic has been connected, the database input fields are not auto-populated with active database information. If you click Reload Runset, the GUI is refreshed allowing respective fields to auto-populate.

Figure 2-9 Auto-Populating Setup for Layout

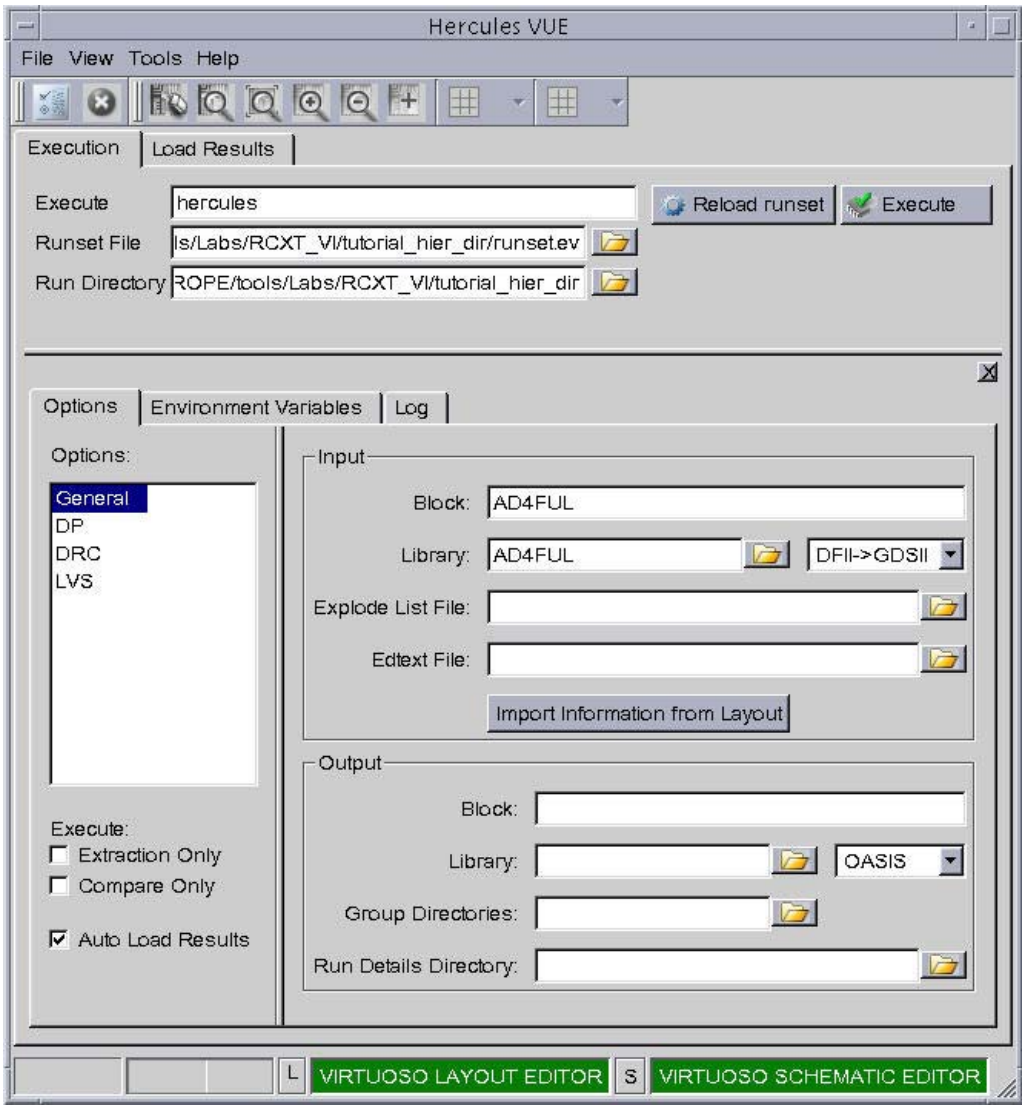
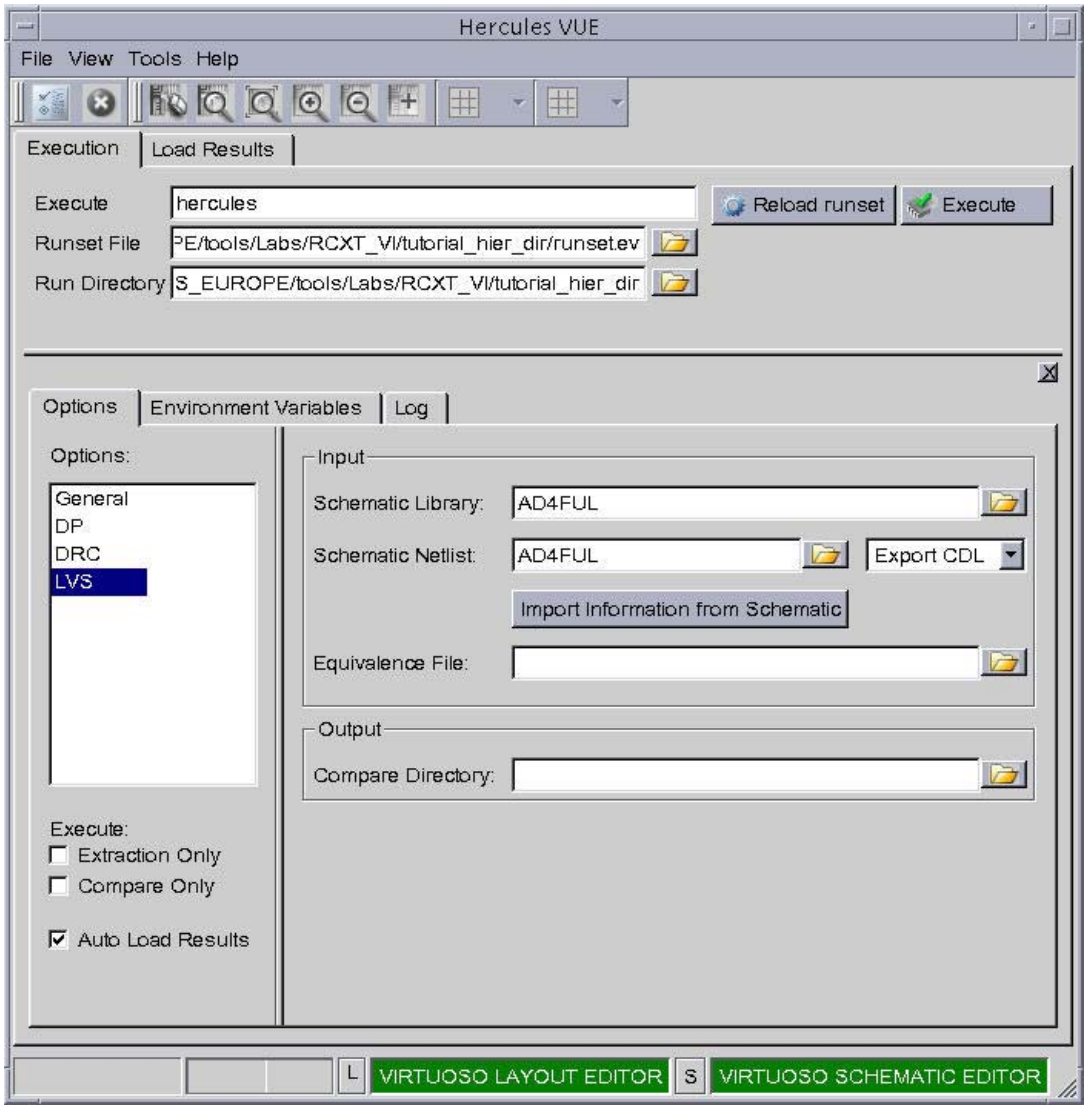


Figure 2-10 Auto-Populating for Schematic



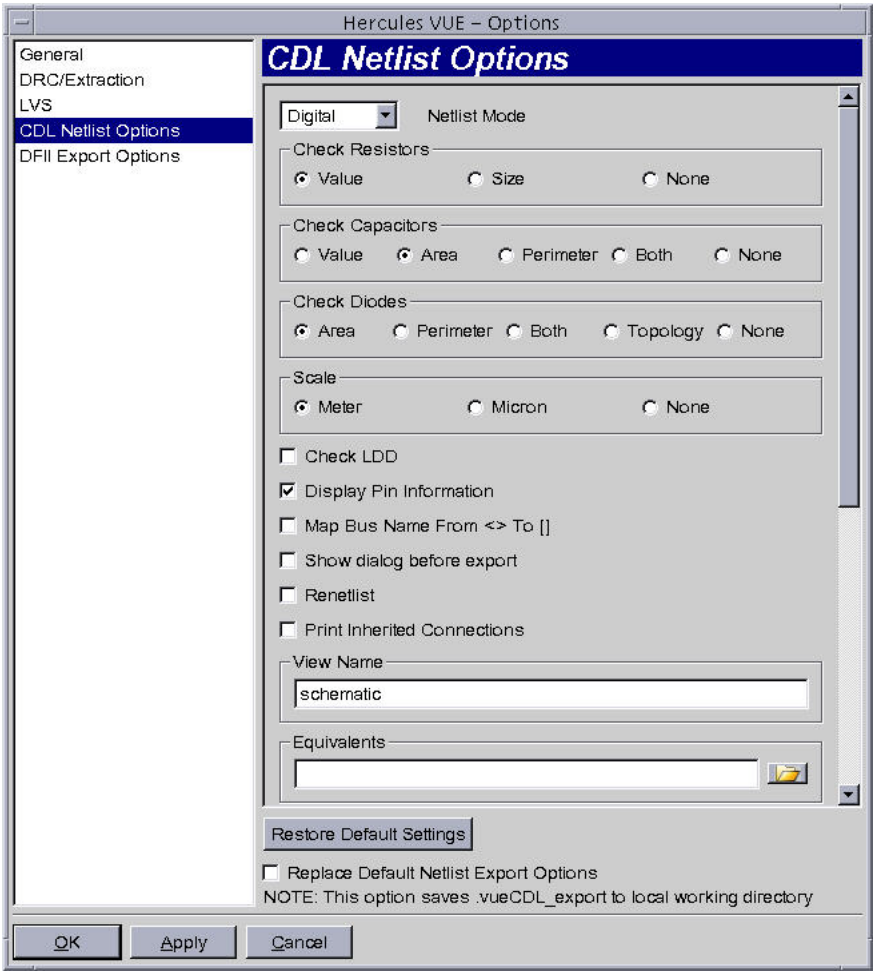
Exporting CDL Netlist Capabilities and Usage Within VUE

Select Options to access the CDL Netlist Export Options. See Figure 2-11 on page 2-17.

Figure 2-11 CDL Netlist

The CDL Netlist Options sections cover the full range of selectable options that are provided within the Cadence Virtuoso Export CDL. Upon Hercules execution, these options are written to the Cadence formatted si.env input template file. The options are then used by si.env for processing in the user's working directory.

Figure 2-12 CDL Netlist Options



The Restore Default Settings button restores the default settings packaged within Hercules.

The Replace Default Netlist Export Options check box allows you to override the default settings packaged within Hercules. Check this box and click OK or Apply to see a new .vueCDL_export file in the working directory.

To ensure that your defaults are loaded for every run, make sure the .vueCDL_export file resides within the directory from which VUE was launched.

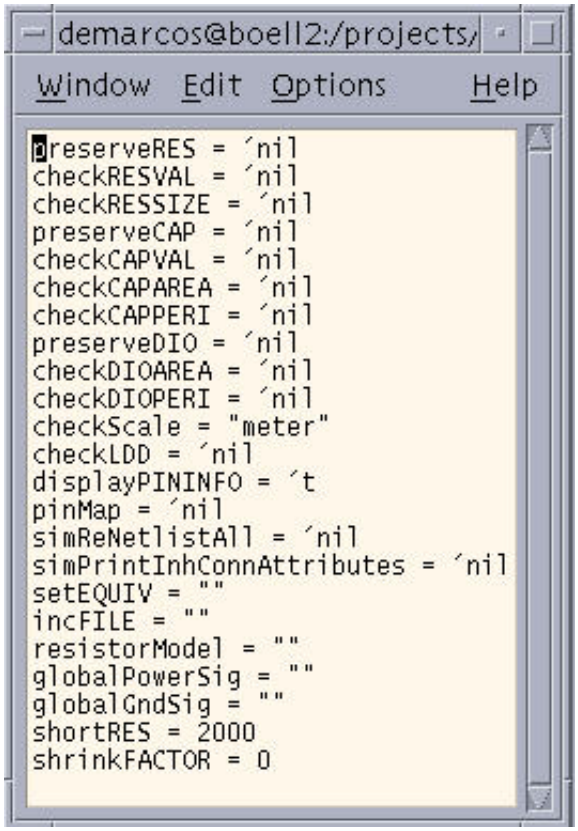
Figure 2-13 Restore Default Settings

Note:

If you have previously saved defaults to the .vueCDL_export file and wish to restore the factory defaults settings, you must either check the Replace Default Netlist Export Options box and click OK or Apply, or remove the .vueCDL_export file from the working directory.

Figure 2-14 shows an example of the .vueCDL_export file. This file can be changed manually and is automatically loaded with VUE.

Figure 2-14 .vueCDL_export File



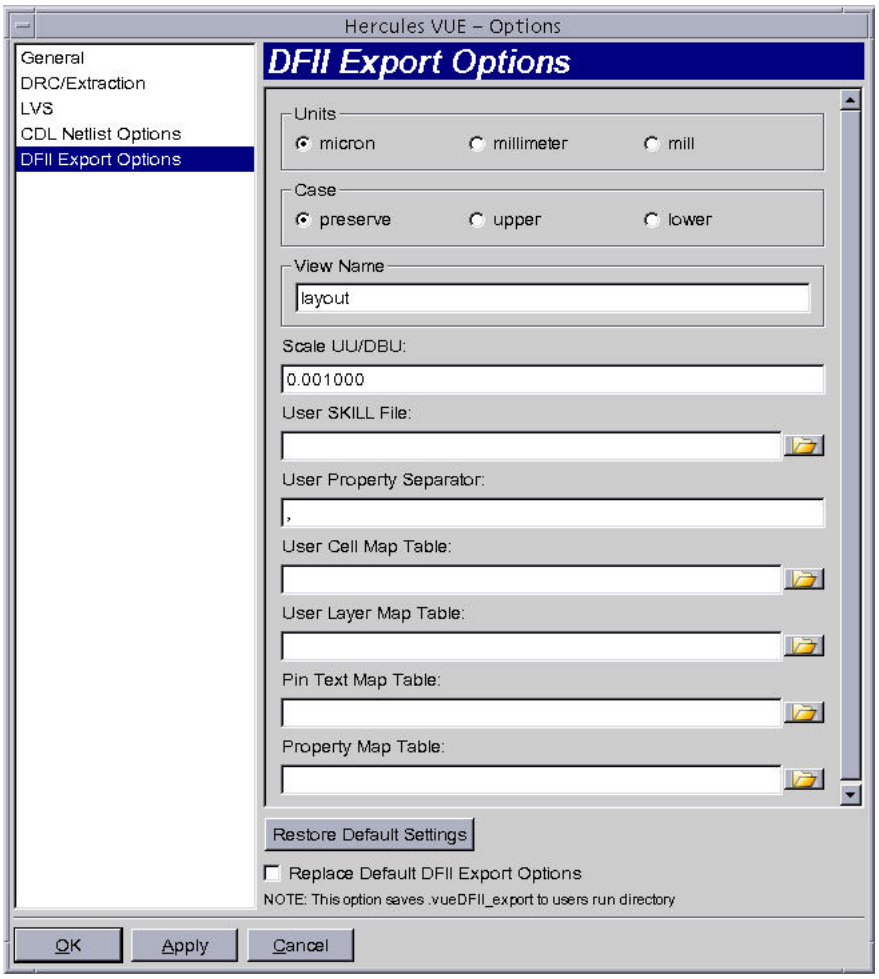
Exporting DFII Capabilities and Usage Within VUE

Select Options to access the DFII Export Options.

Figure 2-15 DFII Export Options

The DFII Export Options section covers the majority of selectable options that are provided within the Cadence Virtuoso Export stream. See Figure 2-16 on page 2-20.

Figure 2-16 DFII Netlist Options



The Replace Default Netlist Export Options check box allows you to override the default settings packaged within Hercules. Check this box and click OK or Apply to see a new .vueCDL_export file in the working directory.

To ensure that your defaults are loaded for every run, make sure the .vueDFII_export file resides within the directory from which VUE was launched.

Figure 2-17 Restore Default Settings

Note:

If you have previously saved defaults to the .vueDFII_export file and wish to restore the factory defaults settings, you must either check the Replace Default DFII Export Options box and click OK or Apply, or remove the .vueDFII_export file from the working directory.

Figure 2-18 shows an example of the .vueDFII_export file. This file can be changed manually and is automatically loaded with VUE.

Figure 2-18 .vueDFII_export File

```
demarcos@boell2:/projects/pvregress/HERCU
Window  Edit  Options                    Help

streamOutKeys = list(nil
    'runDir                          "."
    'libName                         "AD4FUL"
    'primaryCell                     "AD4FUL"
    'outFile                         "AD4FUL.gds"
    'compression                     "gzip"
    'hierDepth                       32
    'convertToGeo                    nil
    'maxVertices                     200
    'refLib                          nil
    'libVersion                      "5.0"
    'checkPolygon                    nil
    'snapToGrid                      nil
    'simMosaicToArray                t
    'textCaseSensitivity             "preserve"
    'lineToZeroPath                  "path"
    'convertDot                      "ignore"
    'rectToBox                       nil
    'convertPathToPoly               nil
    'keepPcell                       nil
    'replaceBusBitChar               nil
    'useParentXYforText              nil
    'reportPrecision                 nil
    'runQuiet                        nil
    'comprehensiveLog                nil
    'ignorePcellEvalFail             nil
    'errFile                         "PIPO.LOG"
    'NOUnmappingLayerWarning                 nil
    'techFileChoice                  nil
    'pcellSuffix                     "DbId"
    'respectGDSIILimits              nil
    'dumpPcellInfo                   nil
    'genListHier                     nil
    'textFontTable                   ""
    'convertPin                      "geometry"
    'pinInfo                         0
    'rodDir                          ""
    'refLibList                      ""
    'scale                           0.001000
    'units                           "micron"
    'caseSensitivity                 "preserve"
    'cellMapTable                    ""
    'layerTable                      "Layer_65nm.map"
    'pinTextMapTable                 ""
    'propMapTable                    ""
    'propSeparator                   "."
    'userSkillFile                   ""
    'viewName                        "layout"
```

Note:

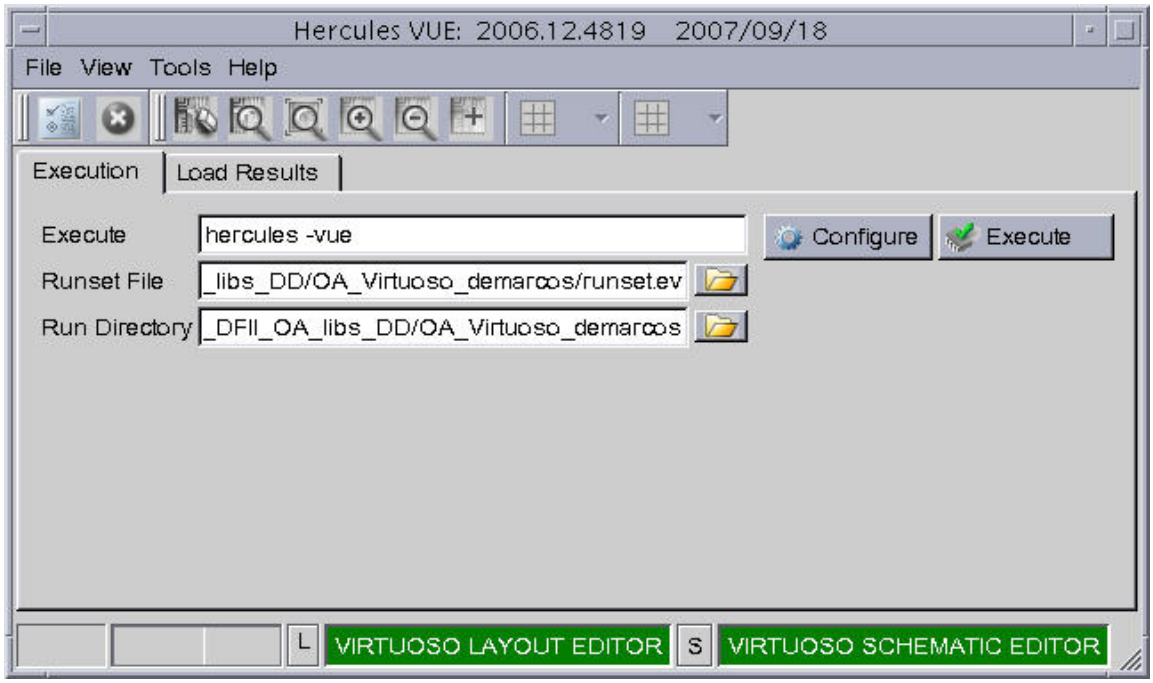
The .vueDFII_export is prepackaged with Hercules to provide factory defaults. This file is located in the following directory:

```
UNIX% $HERCULES_HOME_DIR/etc/VUE/
```

Using the Hercules OpenAccess Reader With VUE

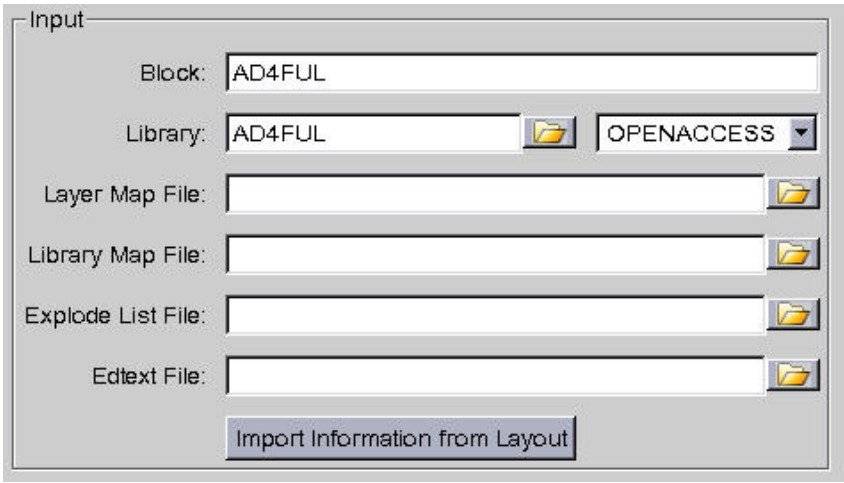
Hercules supports the reading of OpenAccess databases using VUE. See Figure 2-19.

Figure 2-19 OpenAccess Direct Read Using VUE



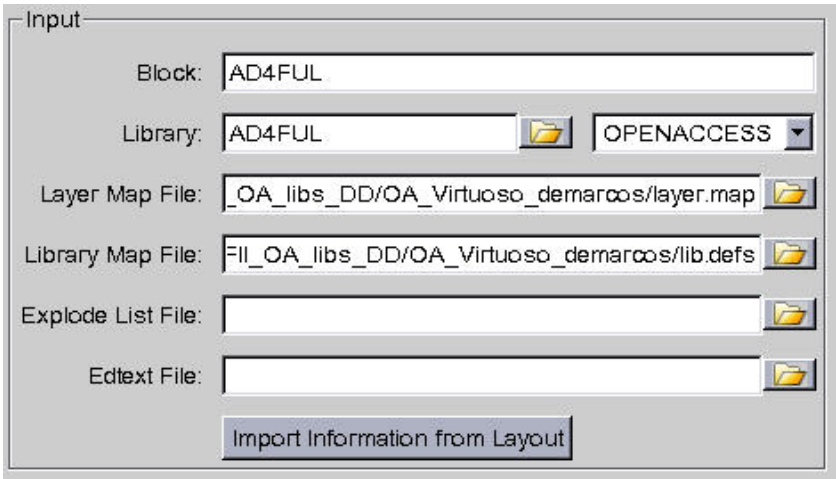
Once VUE is started, the runset is loaded, and communication is established between VUE and the Virtuoso Schematic and Layout windows, click Configure.

Figure 2-20 Completing Form Fields



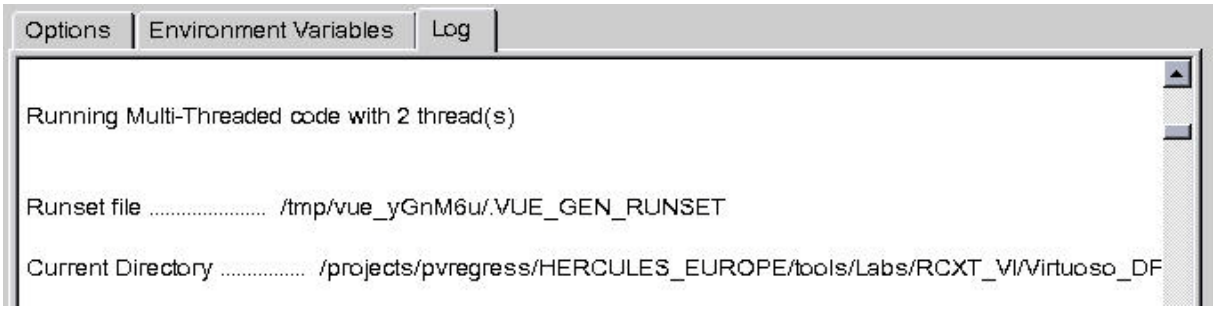
If the library format does not automatically select OPENACCESS, use the Import information from Layout button to populate the fields.

Figure 2-21 Completing Form Fields Using Import Information from Layout



The Layer Map File and Library Map File fields are required for this flow to function. You must either provide the locations to these files within the runset (mentioned above), or manually insert them using the associated browse buttons.

Figure 2-22 Runset in Log File



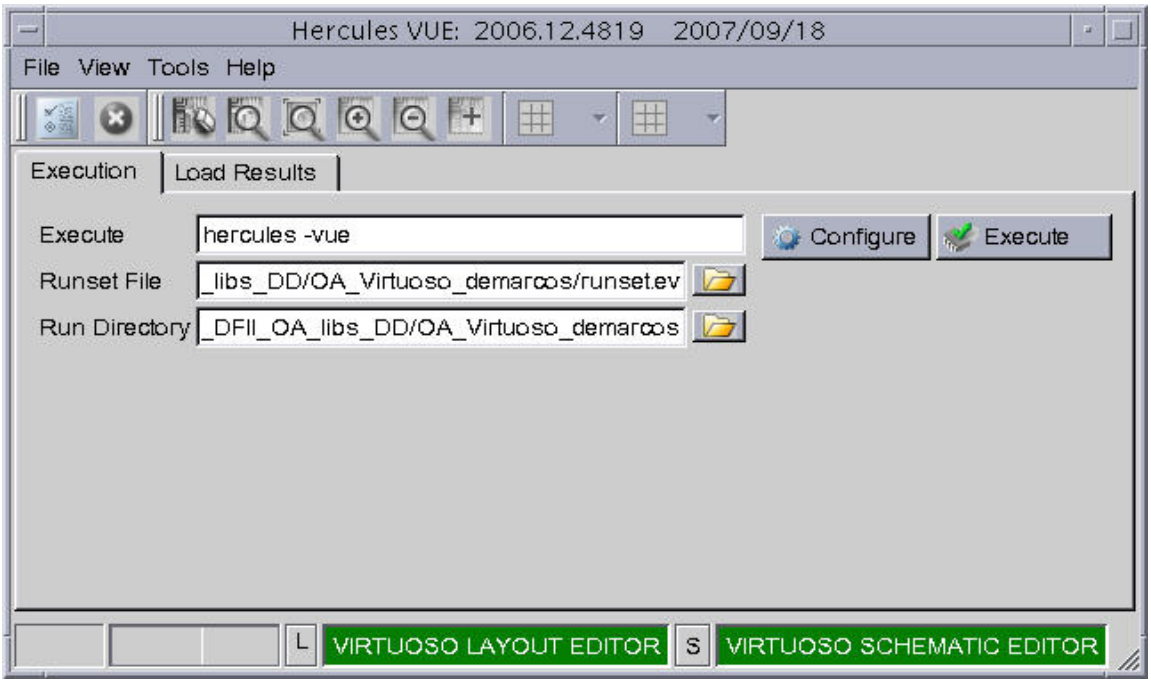
Once setup is complete, click the Execute button to start the verification run. Upon execution, Hercules generates a temporary runset. This runset is located in the log file (see Figure 2-22).

For additional information on the OpenAccess options, see the OPENACCESS_OPTIONS section in the Detailed Options chapter in the *Hercules Reference Manual*.

Exporting OpenAccess Capabilities and Usage Within VUE

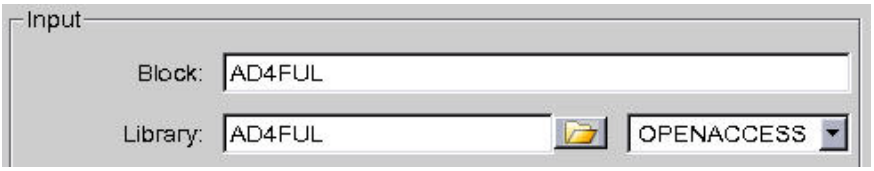
Select Options to access the DFII Export Options. See Figure 2-23 on page 2-24

Figure 2-23 OpenAccess Export



Once VUE is started, the runset is loaded, and communication is established between VUE and the Virtuoso Schematic and Layout windows, click Configure.

Figure 2-24 Completing Form Fields Library Format

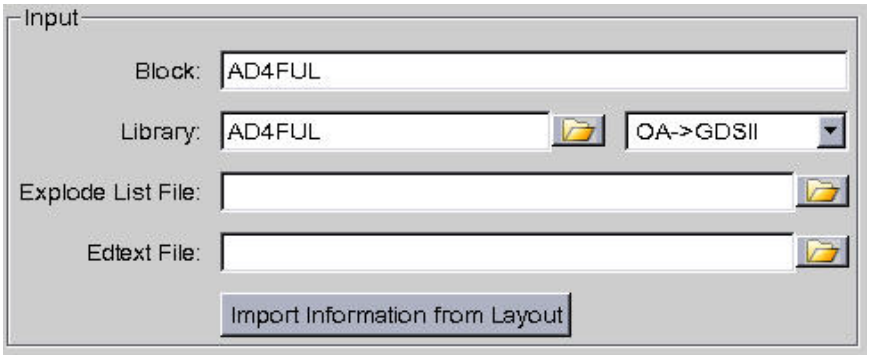


The default behavior of VUE in the OpenAccess flow is to automatically set the library format to OPENACCESS when connected to an active layout window reading from OpenAccess.

Figure 2-25 OA > GDSII Selection

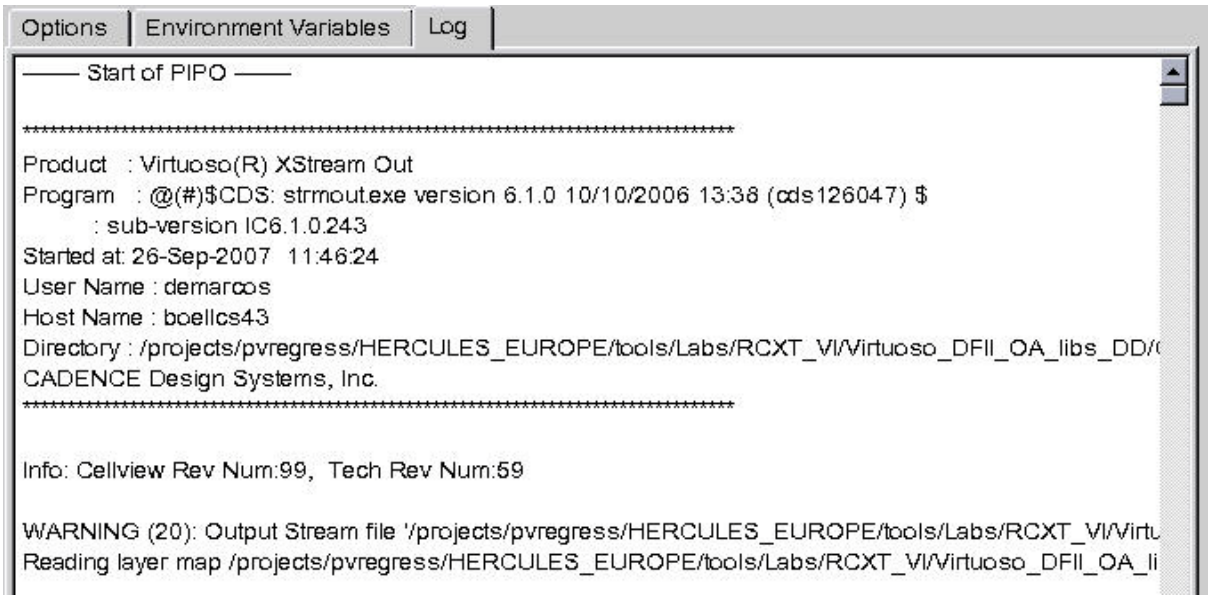
If the desired output is GDSII rather than OPENACCESS, you are required to manually select OA > GDSII from the library format pull-down menu.

Figure 2-26 OA > GDSII Requirements



The Layer Map File and Library Map File fields are not required for this flow to function.

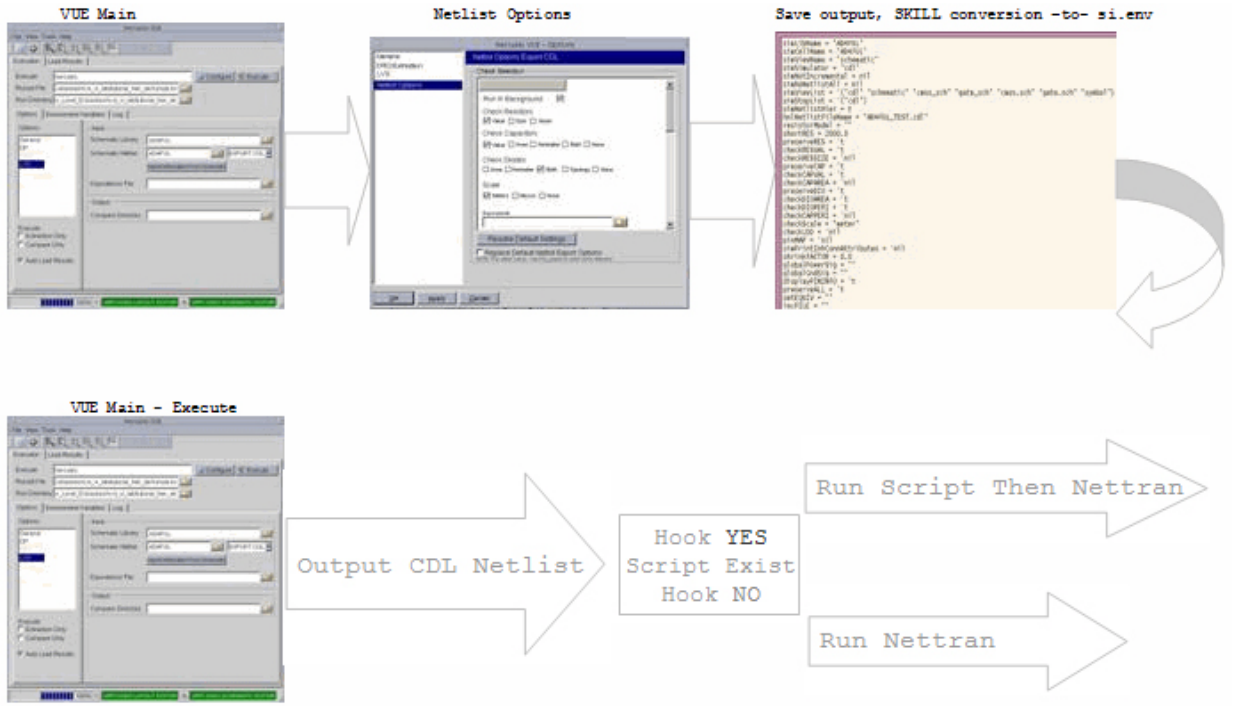
Figure 2-27 Streamout Process in Log File



Once setup is complete, click the Execute button to start the verification run. Information about the streamout process using Cadence XStream is located in the log file (see Figure 2-27).

Injecting User Scripts to Post-Process CDL Netlists Within the Hercules Run Stream

Figure 2-28 Hook Script



Flows that require CDL netlists to be post-processed benefit from the Hercules Netlist Hook script. One of the reasons CDL netlists might need to be post-processed is that inherent CDL format limitations do not allow 3-terminal resistors. VUE offers the possibility to engage these scripts within the Hercules netlisting flow. The benefit of this engagement allows you to streamline your physical verification process so that external processes can be handled in a single step to maintain flow integrity.

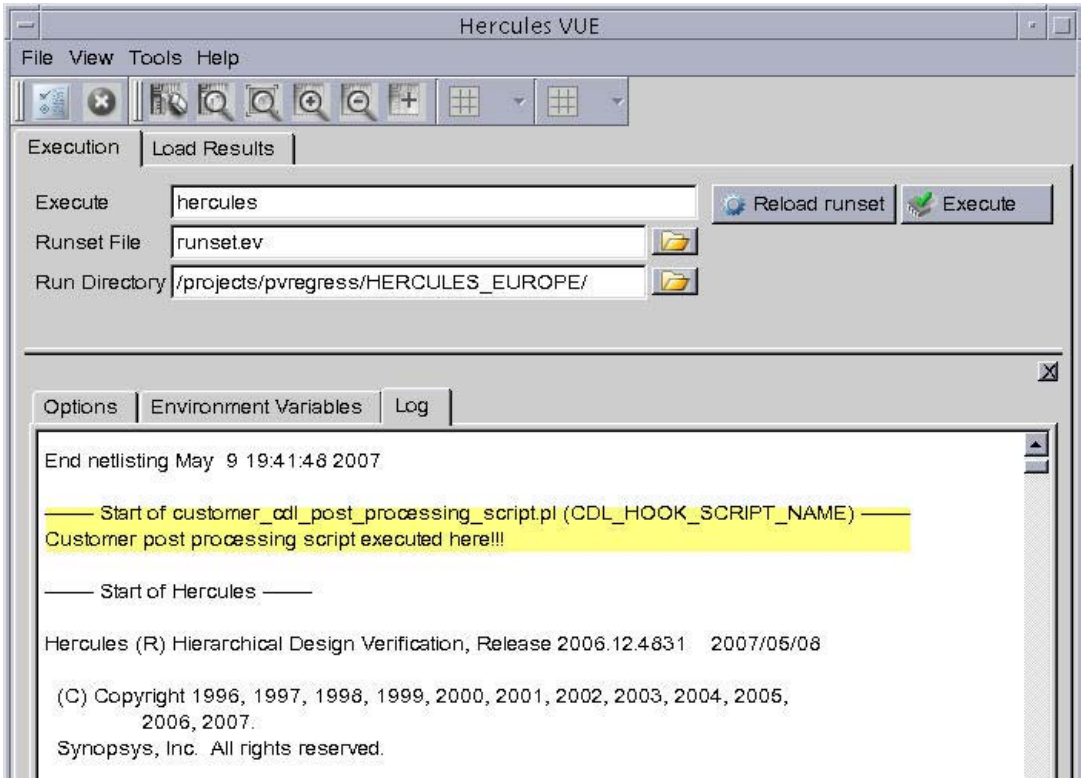
To engage the Hercules Netlist Hook script, execute the following command:

```
UNIX% setenv CDL_HOOK_SCRIPT_NAME \
customer_cdl_post_processing_script.pl
```

The *customer_cdl_post_processing_script.pl* can be any name you choose.

Click Execute to observe where the user scripts are engaged within the flow. See the highlighted section in Figure 2-29.

Figure 2-29 Hook Script Details



Note:
Ensure that the required environmental variable to engage this capability is set prior to launching *icfb* Virtuoso and VUE.

Note:
The output post-processed CDL file name generated from the user scripts must be the same name as the input for proper NetTran execution.

Note:
This flow does not influence NetTran or any NetTran settings.

Note:
The end user is responsible for any scripts used within this flow and any effects these scripts might cause.

Limitations

VUE must be started from the menu entry in Virtuoso Layout Editor or Virtuoso Schematic Editor. VUE cannot connect to these tools if it is started directly from a UNIX command prompt.

Note:

Traversing between Virtuoso and Virtuoso XL layout tools may deregister the Hercules Skill filter files, causing the Hercules menu to disappear. Furthermore, some third party Skill files might inadvertently deregister Hercules menus upon loading.

Reload the Hercules Skill files in the former case, and ensure that the Skill loading sequence in the latter case does not invoke a conflict.

Note:

Filters are de-registered because of another vendor's Skill files or because of switching between Virtuoso and XL. You might need to reload the filter.

3

Running Hercules Within VUE

This chapter explains how to run VUE and view and analyze errors.

Executing Hercules from VUE

The Execution tab allows you to execute Hercules from the interface. The runset file name (with path, if not current working directory) must be entered to start Hercules successfully. After you have selected the runset, click the Configure button to extend the Execute window.

On startup, there are three entry fields in VUE.

- Execute. Controls what is executed and defaults to Hercules. This field is used to add Hercules command-line options that are not controllable from the configure menu. It is also used to execute a script instead of calling Hercules directly.
- Runset File. Defines the runset that is executed.
- Run Directory. Specifies the directory in which Hercules is run. This defaults to the current working directory.

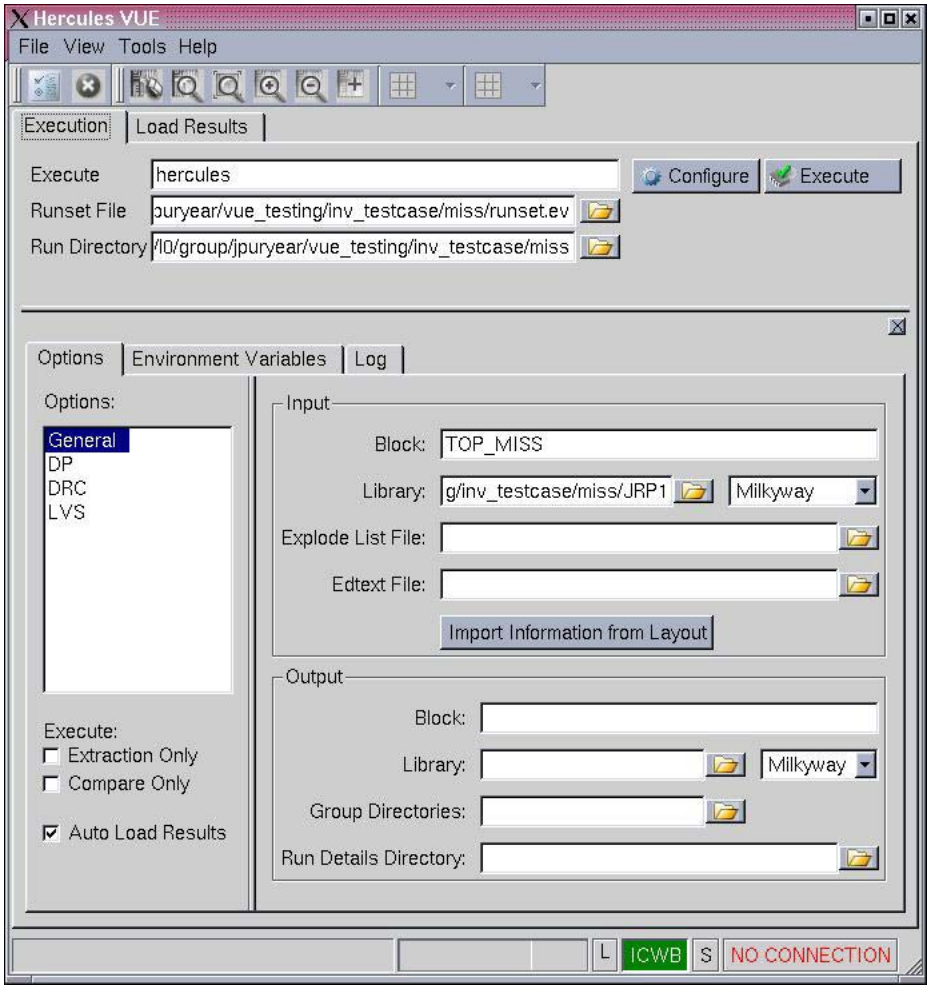
After you have selected the runset, click the Configure button to control more Hercules run options. Any header options defined in the runset are automatically populated in the appropriate fields when the configure button is pressed.

The execute button starts the Hercules run as currently configured within VUE. A log window opens in VUE to help track the run.

There are four categories of options that can be controlled: General, DP, DRC, and LVS.

- General options control the basic input and output of a Hercules run, such as block, library name, library format, and so on.

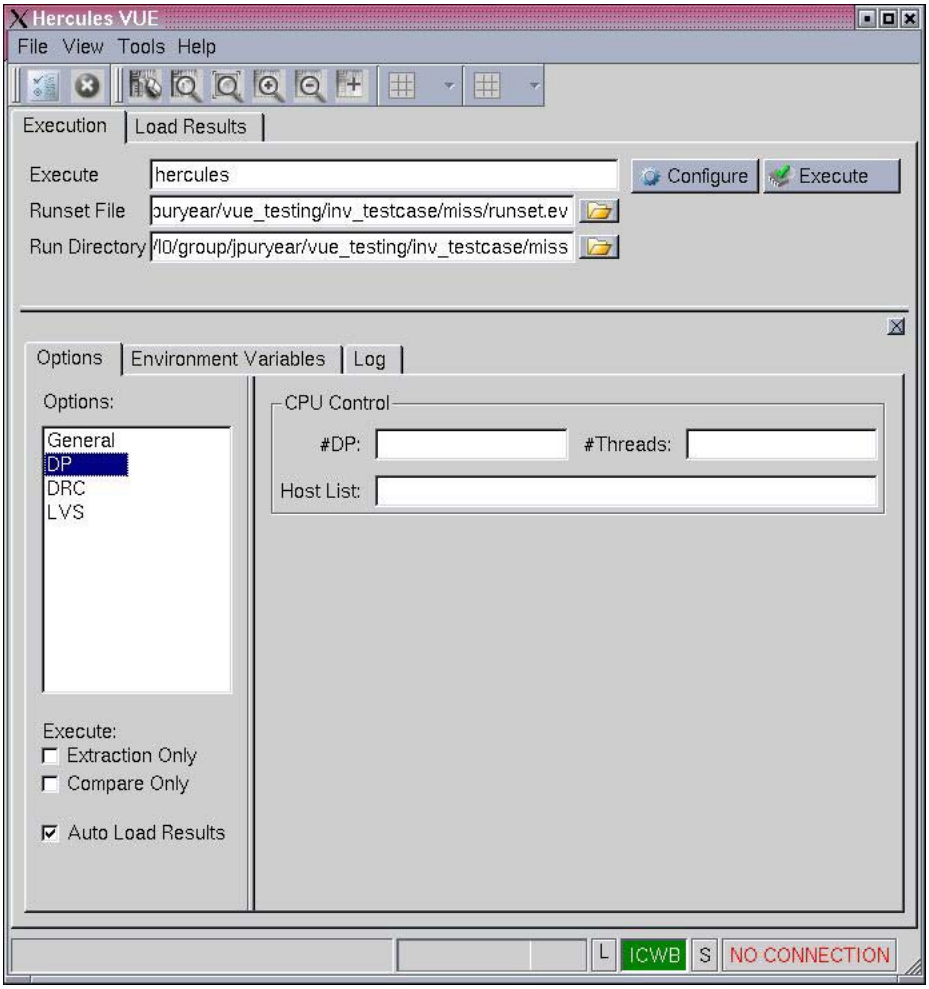
Figure 3-1 Execute Tab with General Options



When you click the Import information from layout button, VUE loads the Block, Library, and format information in the input pane.

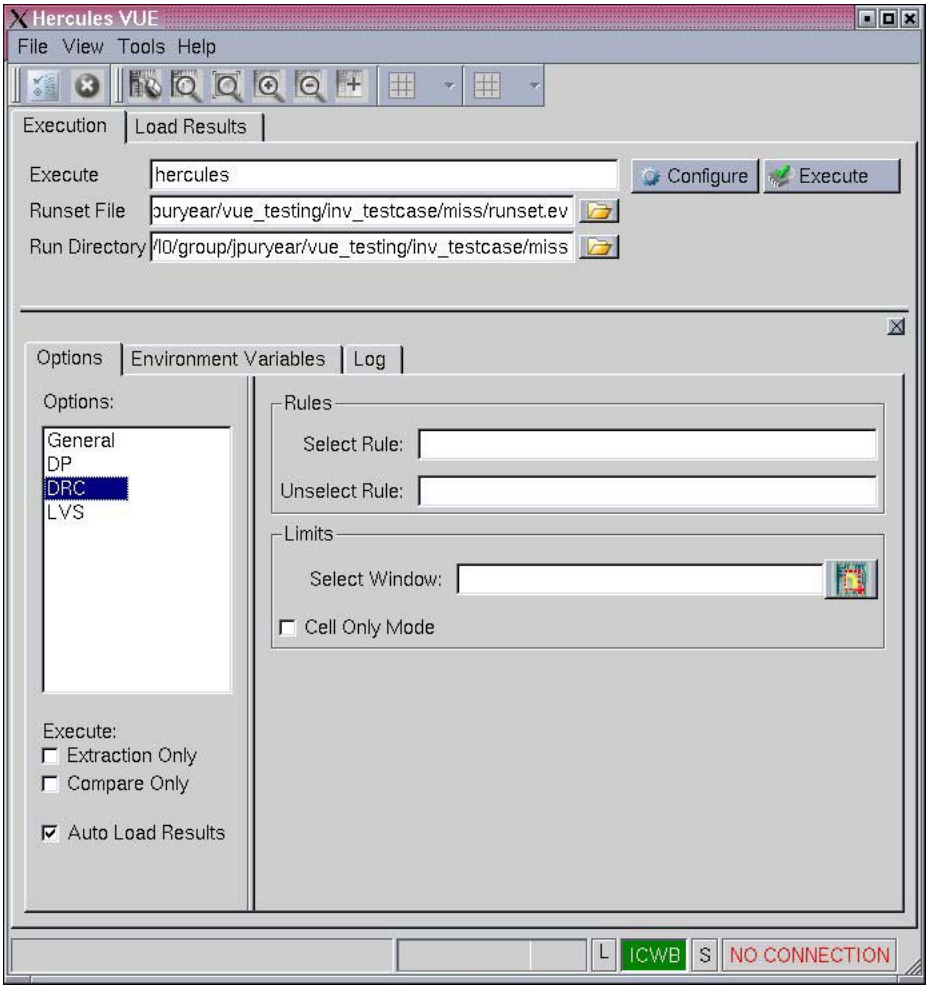
- DP Options control Distributed Processing. You can select the number of distributed processes and threads, and specify the host machines for the run. See Figure 3-2 on page 3-3.

Figure 3-2 Execute Tab with DP Options



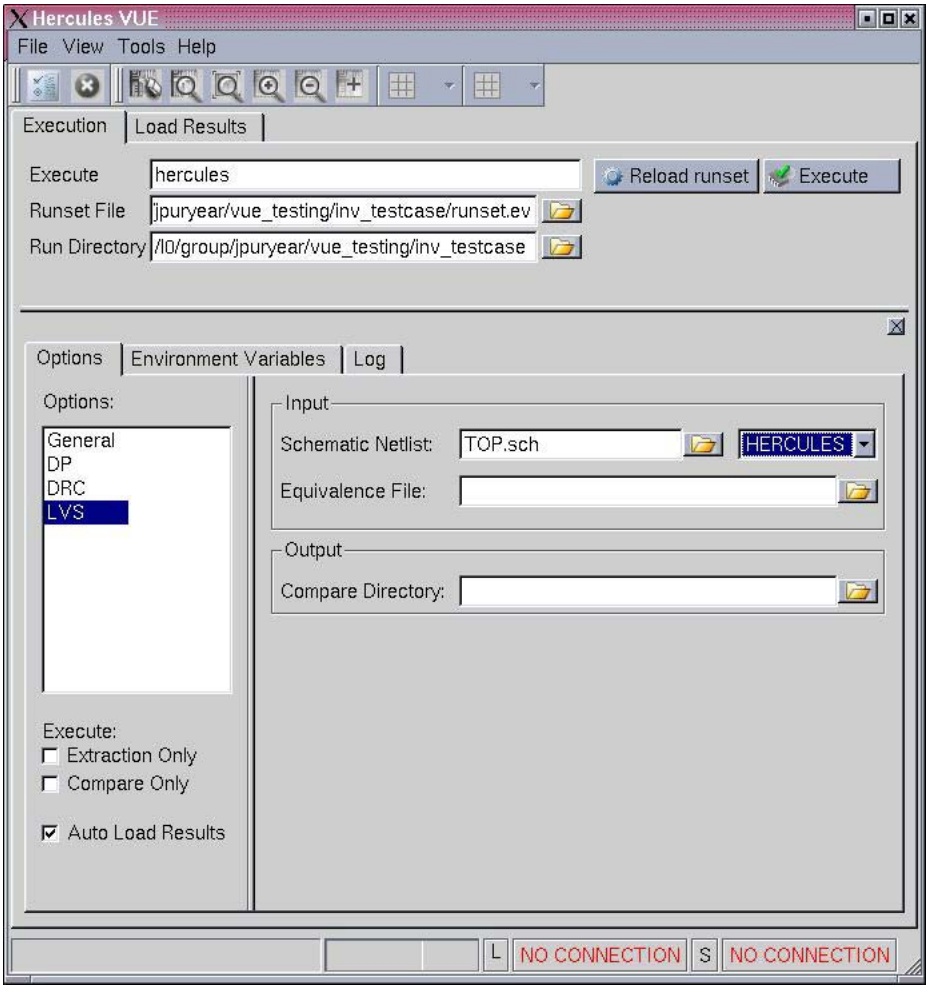
- DRC options allow you to select/unselect rules or specify a select window for your run. If specified, Hercules runs on only the defined extents. See Figure 3-3 on page 3-4.

Figure 3-3 Execute Tab with DRC Options



- LVS options provide control over the schematic netlist, schematic netlist format, equivalence file, and location of LVS output. See Figure 3-4 on page 3-5.

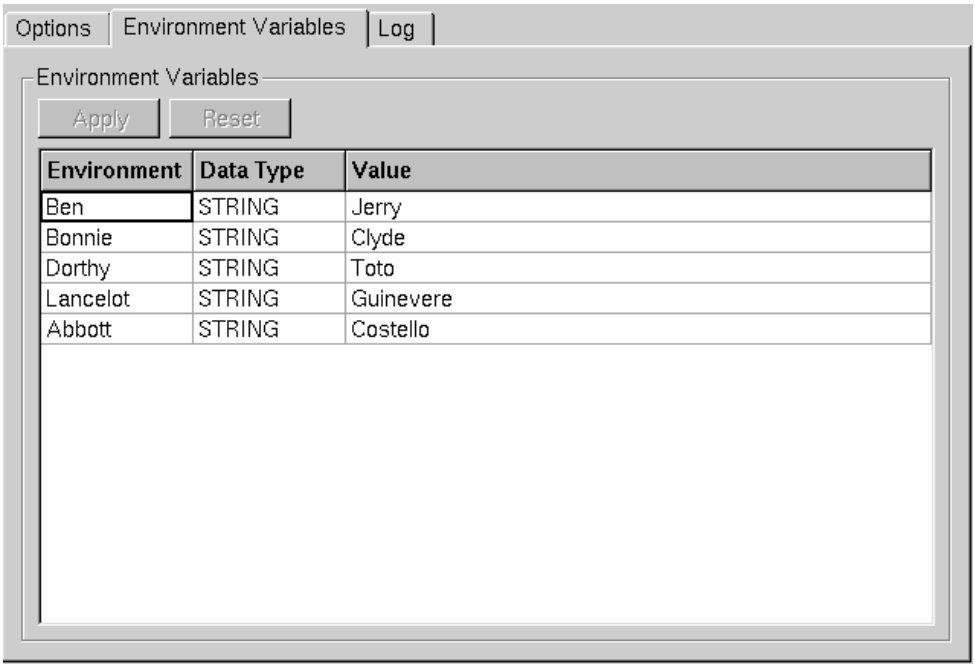
Figure 3-4 Execute Tab with LVS Options



Environment Variables Tab

If the runset loaded into VUE contains environment variables, you can manage those from within VUE using the Environment Variables tab. See Figure 3-5 on page 3-6.

Figure 3-5 Environment Variables Tab



The Environment Variables tab displays all environment variables defined in the runset as well as their current value upon VUE startup. If the environment variable is not defined in the shell, VUE populates the table with the DEFAULTS TO value.

You can change the values within this tab. Click Apply to set the changes for the run. Click Reset to return the table to the initial values defined on VUE startup.

Loading Hercules Results into VUE

After Hercules has successfully completed its run, VUE, by default, loads the error output. This is controlled by an Auto Load Results check box in the Execution Configuration tab.

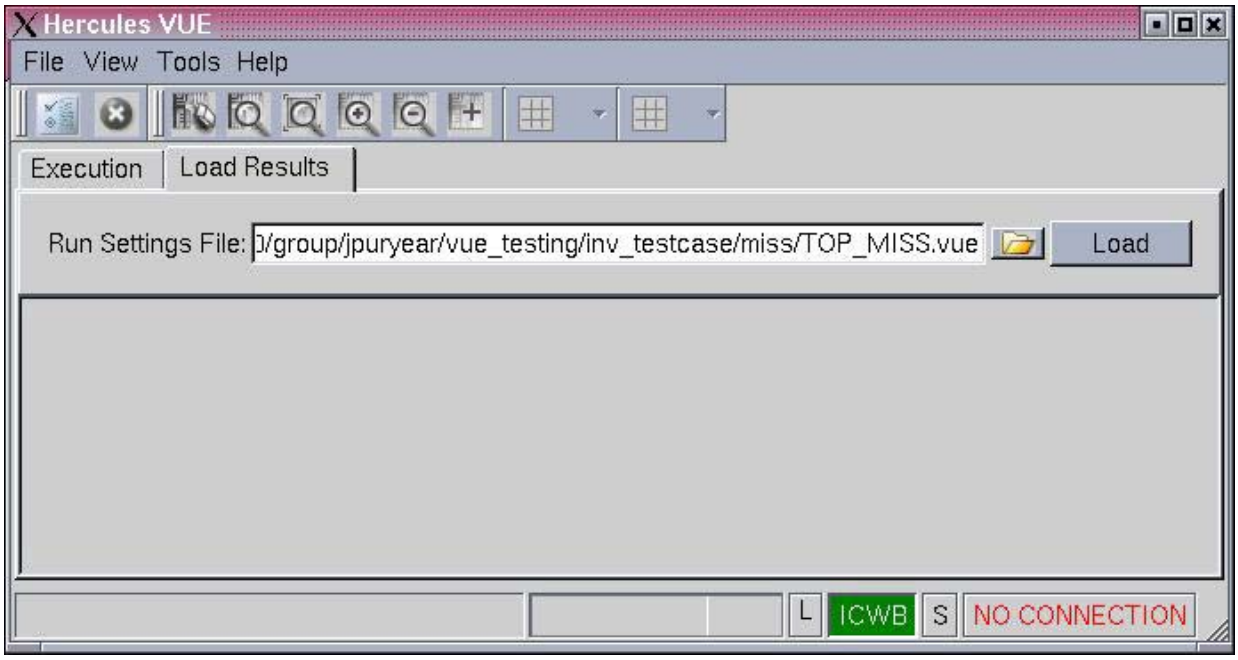
VUE loads the results after execution only if there are no Hercules execution errors with an exit status of zero. If an intermediary script or executable is used to launch Hercules, it must return with a status that accurately reflects the Hercules return code. Occasionally, system network problems cause error messages to appear in the Messages window when executing a runset from the Hercules interface. If this occurs, execute the runset from the UNIX command line.

Run Settings File (*block*.vue)

The run settings file (*block*.vue) is an ASCII file that contains all of the information VUE needs to correctly display the results. It is auto-generated by Hercules in the working directory if CREATE_VUE_OUTPUT = TRUE in the runset. Within the Load Results tab, the Run Settings File entry field is auto-populated if the *block*.vue file exists in the same directory from which VUE was started. Otherwise, you can manually browse for *block*.vue.

VUE is designed to correctly load information even when it is moved from the original working directory. All of the information in the *block*.vue file is relative to the run directory. As long as all the data is kept in the same location relative to the run directory when it is moved, it is loaded automatically. If data is moved relative to the run directory, you can edit the appropriate line in the *block*.vue file to retrieve the information.

Figure 3-6 Load Results Tab



If necessary, you can browse for the *block*.vue file and then load. The browser displays only directories and files with the .vue extension.

A load status bar in the lower right corner is displayed when loading data into VUE.

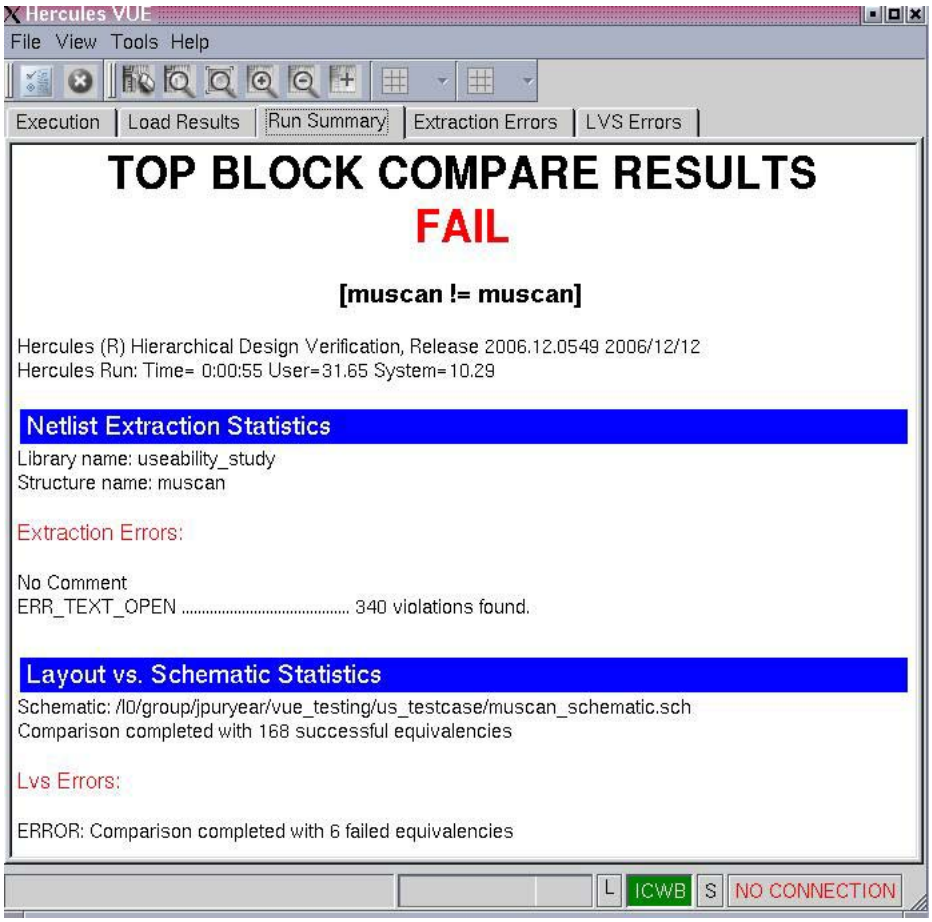
Run Summary

Once data is loaded into VUE, additional tabs are added to the debugging flow. The first of these is the Run Summary tab, which provides a high-level summary of the Hercules run. The first thing you see is the top-level result of the run.

If DRC/Extraction errors exist, a summary of each error and count are given.

If LVS errors exist, a summary of the number of equivalence points that pass and fail is given.

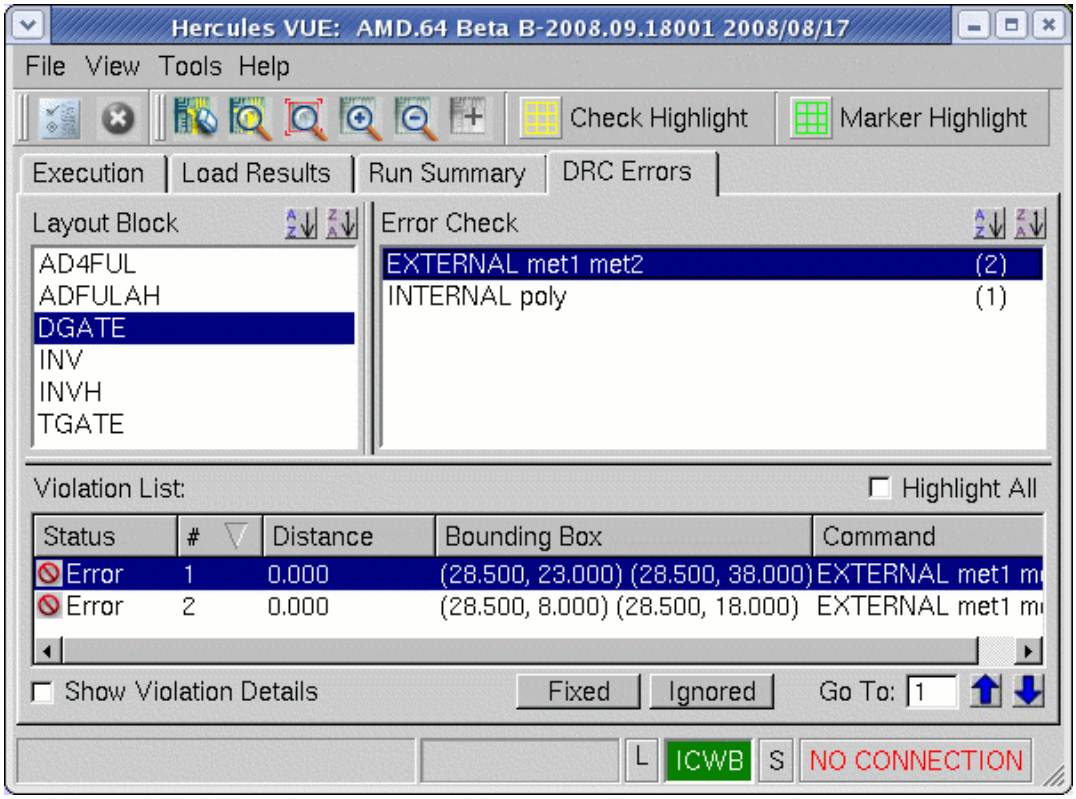
Figure 3-7 Run Summary Tab with DRC Errors



Extraction Errors/DRC Errors

The DRC/Extraction Errors tab provides an organized list of blocks, DRC and device extraction violations. This tab can be organized in one of two ways: List by Block then Error Check or List by Error Check then Block. The setting can be changed in the DRC/Extraction Options Window.

Figure 3-8 Extraction Errors Tab



Layout Block Pane

The Layout Block pane displays all structures in the layout that contain errors. Selecting a block in the Layout Block window updates the Error Check window with the error vectors pertaining to the block. The layout block list can be sorted alphabetically.

Error Check Pane

The Error Check pane reports the number and types of errors associated with each structure highlighted in the Layout Block pane. The Error Check list can be sorted alphabetically

Violation List

The Violation List displays all errors for the selected block and error check. This allows you to highlight, assign and save an attribute to the displayed error vector, which facilitates the analysis and debugging of the layout. The list can be sorted by selecting the column headers. By default, the list is sorted by violation number.

By Checking Highlight All, all errors within the selected block/error check are highlighted within the layout editor. When an individual error can be selected, all errors are highlighted, and VUE zooms to that particular error shape while retaining all other highlights.

Prev and Next Buttons

The Prev and Next buttons highlight the next or previous violations within the violation list as it is currently sorted.

Goto

The Goto field allows you to select an individual error by simply entering the error number.

Status

For each vector displayed, you can assign a Fixed or Ignored status. Error vectors are initially assigned an Error status. After an error is corrected, click Fixed to set the error vector status to Fixed or click Ignored to set the error vector status to Ignored. Click Fixed or Ignored again to change the status back to Error.

Table 3-1 Status Field Values

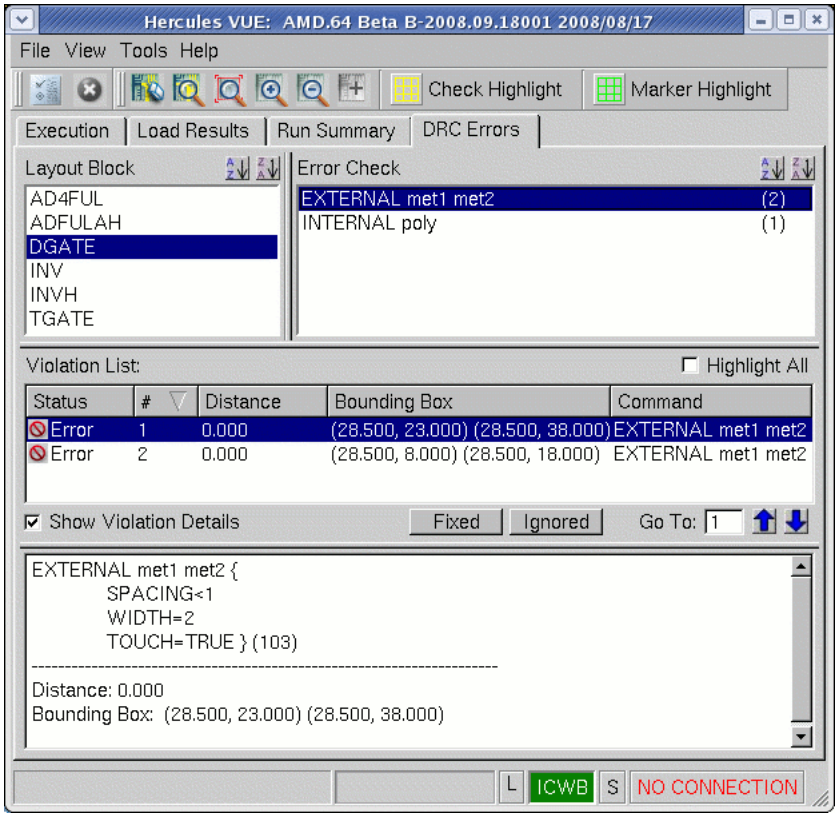
Status	Description
Error	Appears by default for each highlighted error listed in the Error File.
Fixed	Appears for a highlighted error assigned Fixed status. Fixed implies a physical change to a layout and the error is not the same in the next run.
Ignored	Appears for a highlighted error assigned Ignored status. Ignored errors allow for secondary verification by other users.

Note:
All status updates you apply are cleared the next time Hercules is run.

Show Violation Details

When Show Violation Details is checked, an additional window within VUE displays the DRC runset code or a message describing the extraction error that reported the results of the operation to the error hierarchy.

Figure 3-9 Show Violation Details



C_THRU Graphical Violation Reporting

C_THRU violations can be viewed within the Extraction Errors or DRC Errors tab. The number of C_THRU violations reported is based on the number of violating layer2 polygons.

Highlight and zoom features are available from the Highlight pull-down list for each of the following C_THRU layer1 and layer2 polygon highlight types.

See Figure 3-10 for more information.

- Individual violations: Multiple C_THRU violations can be accessed one at a time by clicking the next or prev buttons.
- VUE highlights and zooms to the layer2 polygon extents when a C_THRU violation is initially loaded.

  Color and Fill selection is available for layer2.
- VUE highlights and zooms to layer1 polygons.

  Color and Fill selection is available for layer1 on a per net basis.
- Nets are sorted from lowest to highest for layer1 polygon counts.

  Nets with lower polygon counts are have an increased probability of invalid C_THRU nets.
- All violations in selected check: Highlights and zooms to all C_THRU layer2 polygons in the selected check.
- All violations in selected block: Highlights and zooms to all C_THRU layer2 polygons plus any non-C_THRU related violations reported in the selected block.

Figure 3-10 shows the following:

1. Number of violating C_THRU nets
2. Layer2 color selection widget when the C_THRU violation is loaded
3. Layer2 coordinates
4. Eight C_THRU violations

Figure 3-10 Highlight and Zoom Control

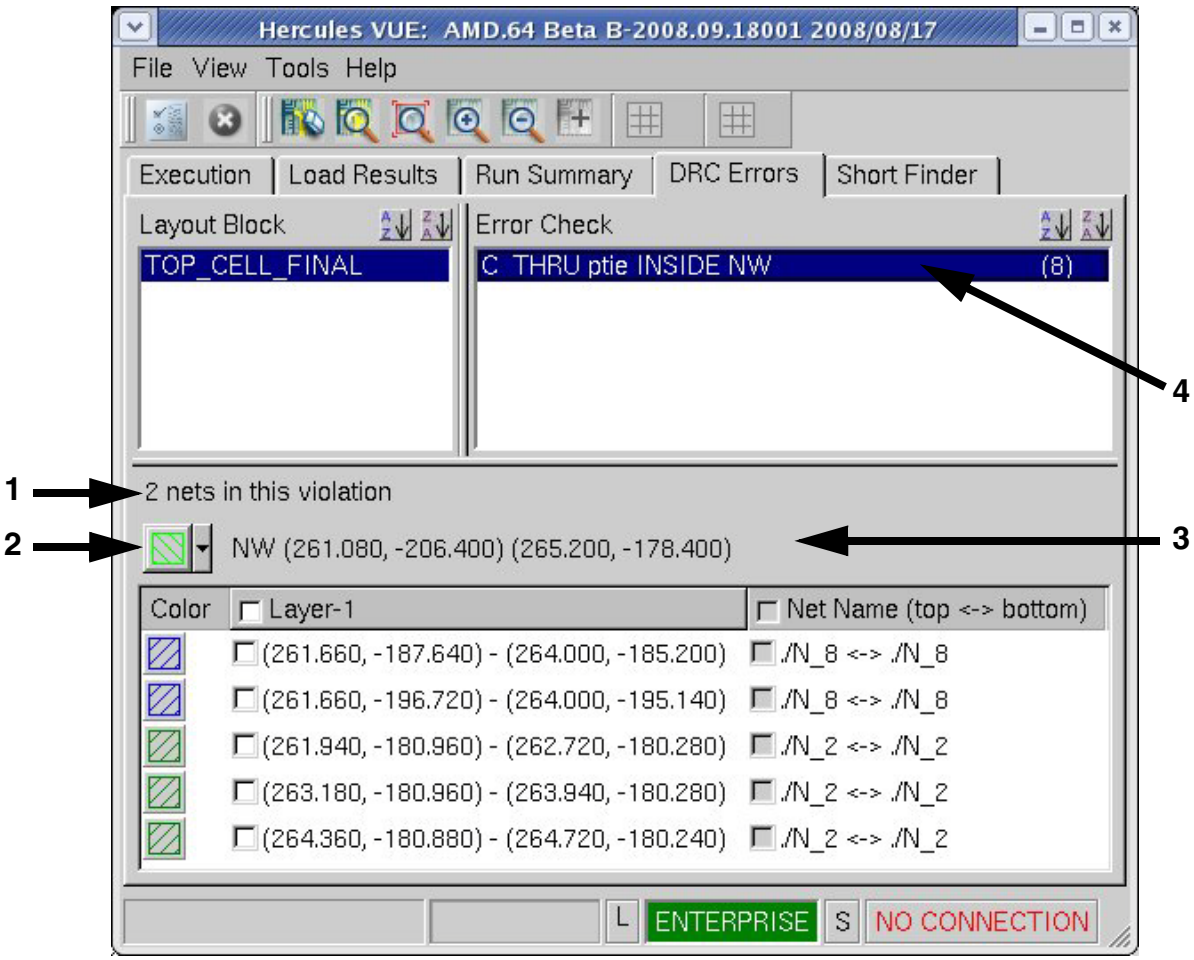


Figure 3-11 shows the following:

1. Number of layer1 polygons on net ./N_23
2. Color selection widget for each C_THRU net
3. Global check box to activate or deactivate all layer1 check boxes
4. Highlight and zoom control
   - Click the layer1 coordinates to zoom to the layer1 polygon. Click the layer1 check box to zoom to the extents of all layer1 polygons with active check boxes.
   - Net paths for each layer1 polygon are reported, resulting in the following:
   - The top of the net is equivalent for each layer1 polygon on a given net.

- The bottom of the net could be different for each layer1 polygon, depending on the layer1 cell location.

Figure 3-11 Loading a C_THRU Violation

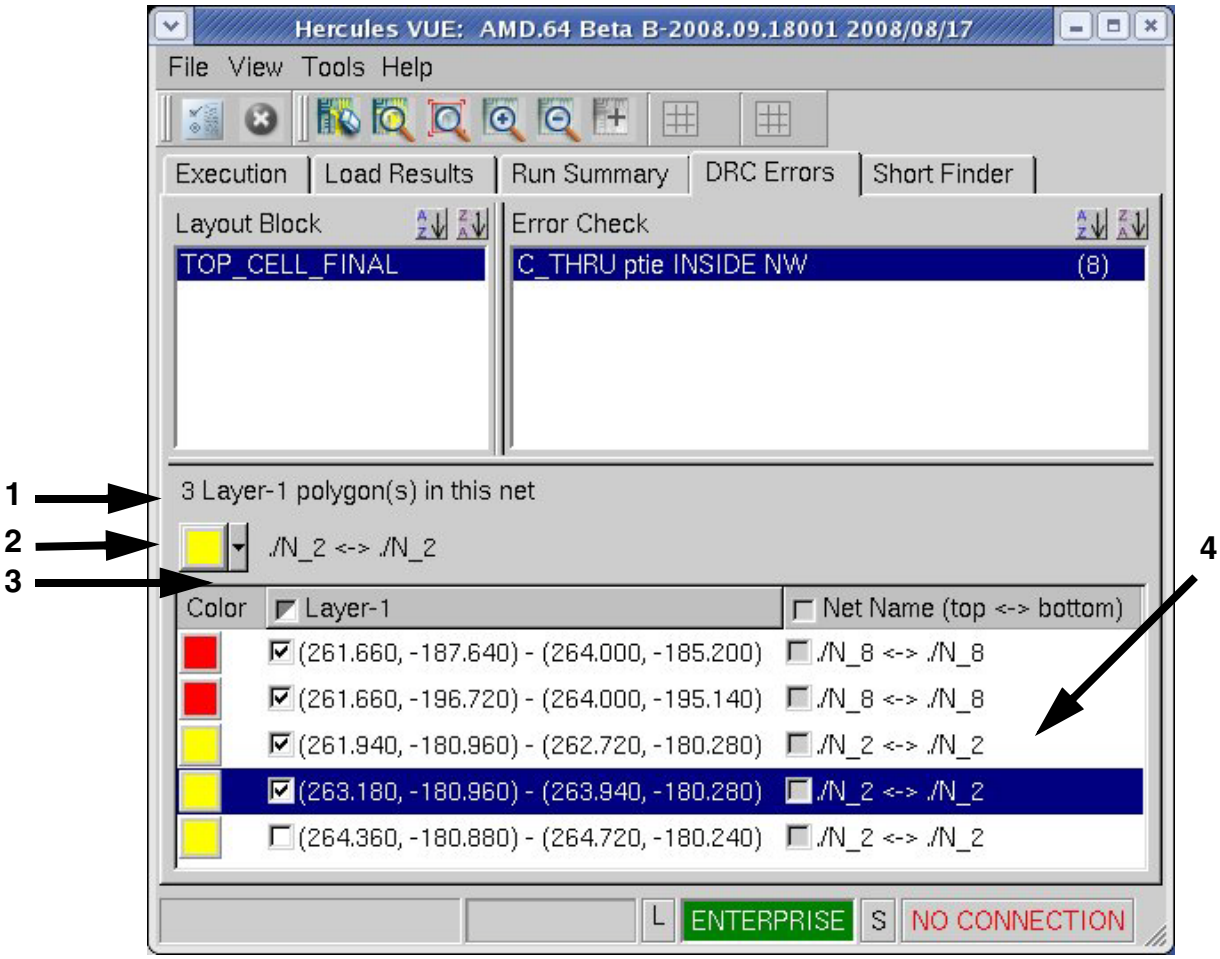
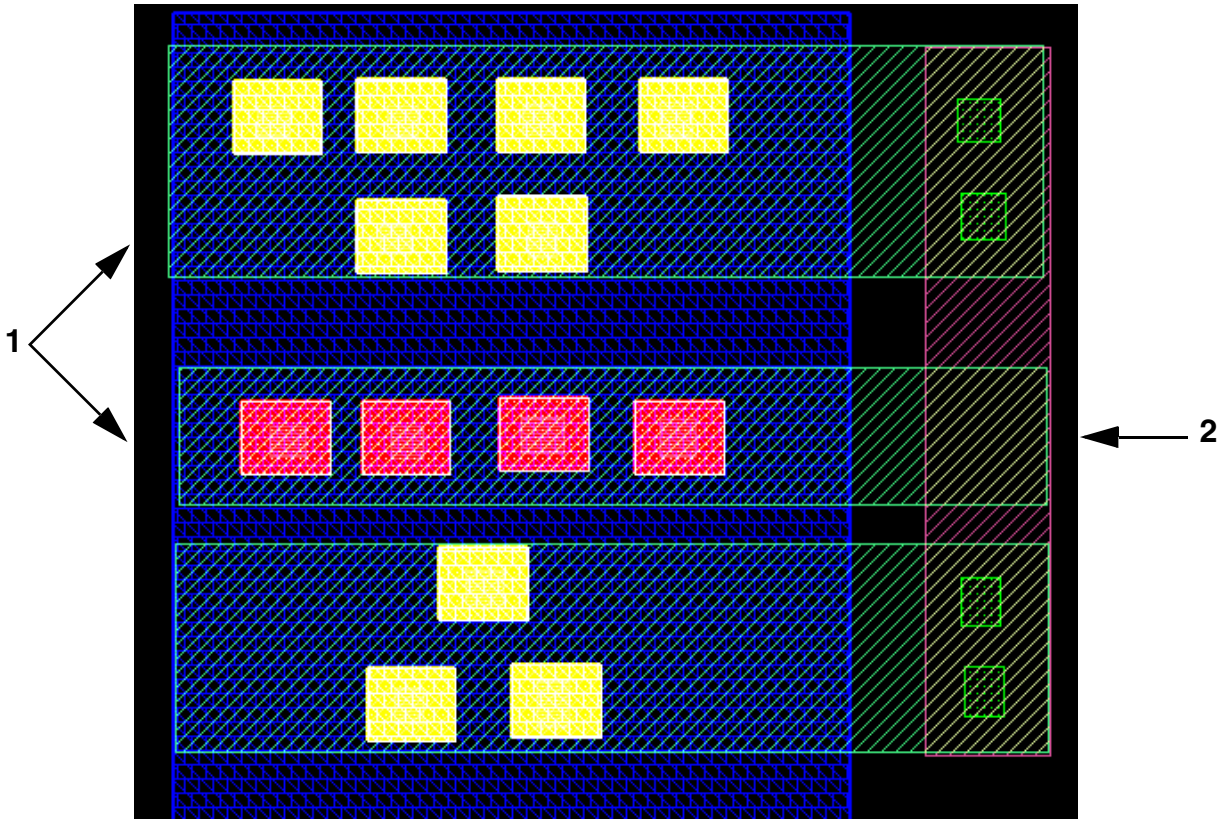


Figure 3-12 shows the following:

1. Layers and colors
   - Layer2 color is blue.
   - Layer1 color on the first C_THRU net is yellow.
   - Layer1 color on the second C_THRU net is red.
2. Missing vias caused the C_THRU violation.

Connect the layer1 polygons with different colors to fix the C_THRU violation.

Figure 3-12 Cumulative Layer Highlight Zoom Control



Text Short/Open Violations

The violation list for Text Short and Open violations selected provides a summary description of each short or open, the text and layer involved in the individual violation, and the coordinates of the text objects. You can select a row to see a highlight fly-line between the pieces of text. You can zoom to a piece of text by clicking on the appropriate coordinates.

The Show Violation Details check box brings up information about the connect sequence/ text statement causing the problem.

Device Tab

The Device tab allows you to debug a device in the design by looking at how that device is created. You can view all of the layers that were used to derive the device, and highlight them in the input library.

To enable this functionality, set the following option:

```
OPTIONS {
RETAIN_DEVICE_LAYERS = ALL_DEVICES
}
```

When set to ALL_DEVICES, Hercules maintains all of the data required to completely debug all layers that are used within all device extraction commands, whether the device was extracted or not.

Note:
Setting the ALL_DEVICES option uses more disk space than a normal Hercules run.

It is recommended that Hercules runs only on a small block when debugging devices using the Device tab. Sending large amounts of highlighted data to the layout editor could result in performance issues. The default is NONE.

The Device tab lists all devices that meet the criteria set by RETAIN_DEVICE_LAYERS. This tab is sectioned into three panes: A Devices pane, a Layers pane, and a Description pane.

The Devices pane is used to select one or all devices that will be debugged. To select all devices, scroll through the list of devices and check the All_Devices check box. After selecting one or all devices, you can select the layers to highlight from the Layers pane. The Description pane lists the runset commands associated with the selected devices. It is also possible to select layers associated with the device terminal layers.

Figure 3-13 shows an example of how the n device is selected in the Devices pane. The layers listed in the Layers pane are specific to the creation of the n device. Likewise, the commands listed in the Description pane are specific to the n device.

Figure 3-13

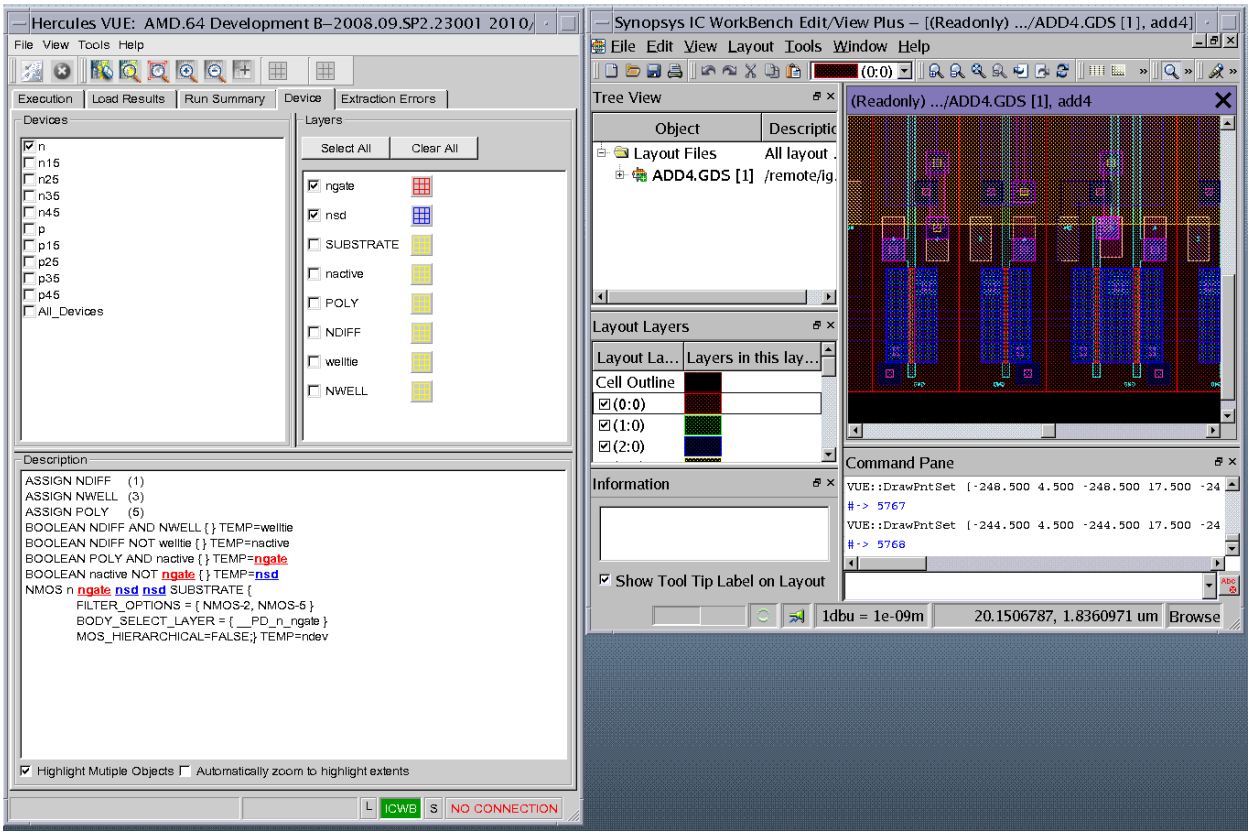
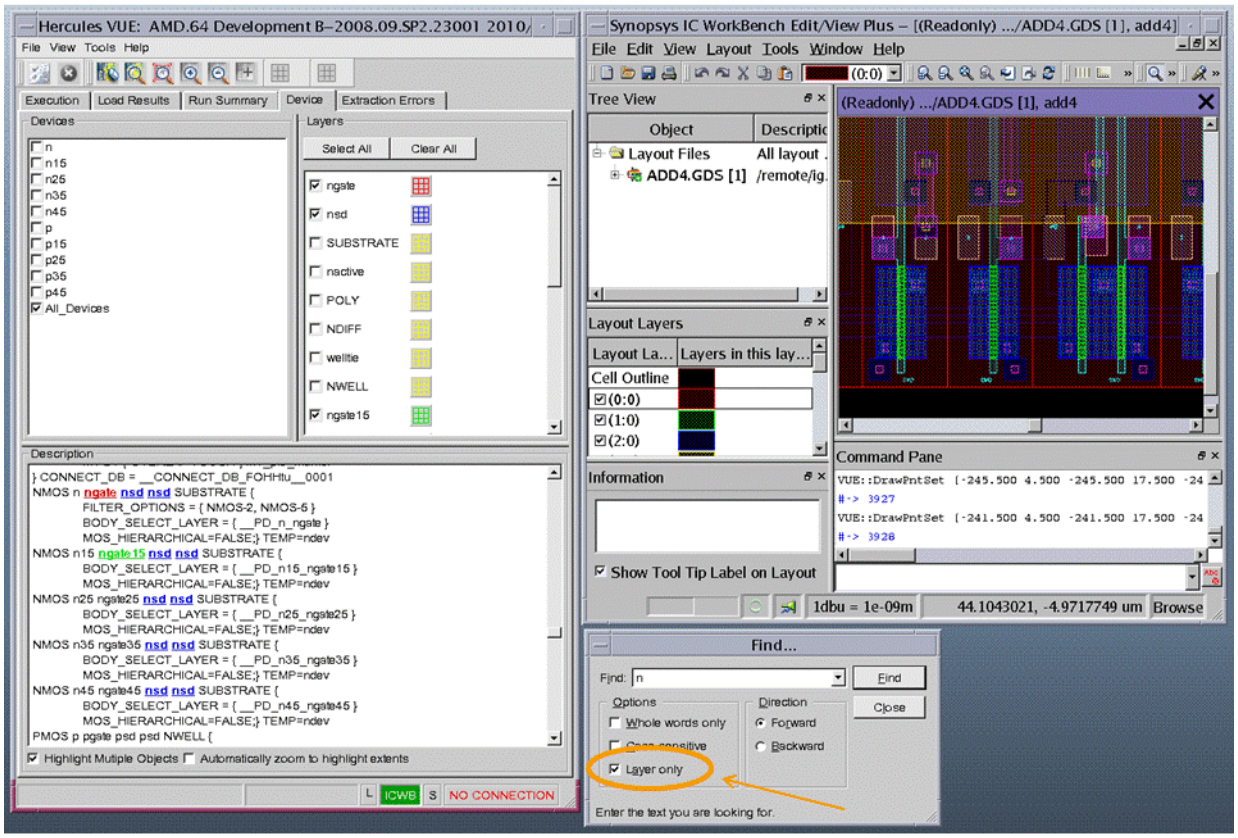


Figure 3-14 shows that the All_Devices check box is selected. In this case, all layers related to deriving the terminals for all of the devices and are shown in the Layers pane, and the entire runset is displayed in the Description pane.

Figure 3-14 Device Tab



Note:

Any layers not involved in forming device terminals (for example, routing layers) are not selectable.

Within the Device tab, the color and fill setting of a layer can be saved and loaded. The layer colors from both the Layers pane and Description pane are maintained when moving from the individual mode to the All_Devices mode.

You can right-click in any of the panes to sort or find a device. When right-clicking in the Description pane, select the "Layer only" check box to restrict the search to layers.

- Color/fill setting is saved in *block*.vue.
- When VUE is launched, the color/fill setting in *block*.vue is loaded, and is saved when VUE quits.
- The color/fill setting in *block*.vue is reset when you start a new run. This indicates that device and layer errors might be different after completing the new run and older color/fill information no longer matches.

Note:

When more than one layer is selected, the Device tab may incorrectly draw polygons with some layout editors because of their highlight order capabilities. VUE cannot override these settings.

Devices Pane

The Devices pane shows an alphabetical list of devices in the runset which meet the criteria set in RETAIN_DEVICE_LAYERS. Only one device can be highlighted at a time. The device list can be sorted alphabetically in ascending or descending order by right-clicking within the Devices pane. The list can be searched by right-clicking within the pane and selecting Find.

Layers Pane

The Layers pane provides a check box list of all the layers that form the highlighted device in the Devices pane. Multiple layers may be highlighted at the same time, with each having its own color and fill, by selecting the Highlight Multiple Objects check box below the Description pane. When unselected, only one layer will be highlighted; all previous highlights are cleared before the new highlight is displayed. By default, the terminal layers are at the top of the list as well as the remaining layers that are ordered as written in the runset. Empty layers have disabled check boxes. The layer list can be sorted alphabetically in ascending or descending order by right-clicking within the Devices pane. The list can be searched by right-clicking within the pane and selecting Find.

Description Pane

The runset commands that create the device layers, including the device extraction command, are shown here. If the layer is an assign layer, the Description pane shows the ASSIGN layer (layer number;datatype) ASSIGN command. This helps you better understand the runset dependencies. The layers within the Description pane are selectable and highlight the appropriate layer within the layout editor. The text for that layer changes to the highlight color.

Zoom Control

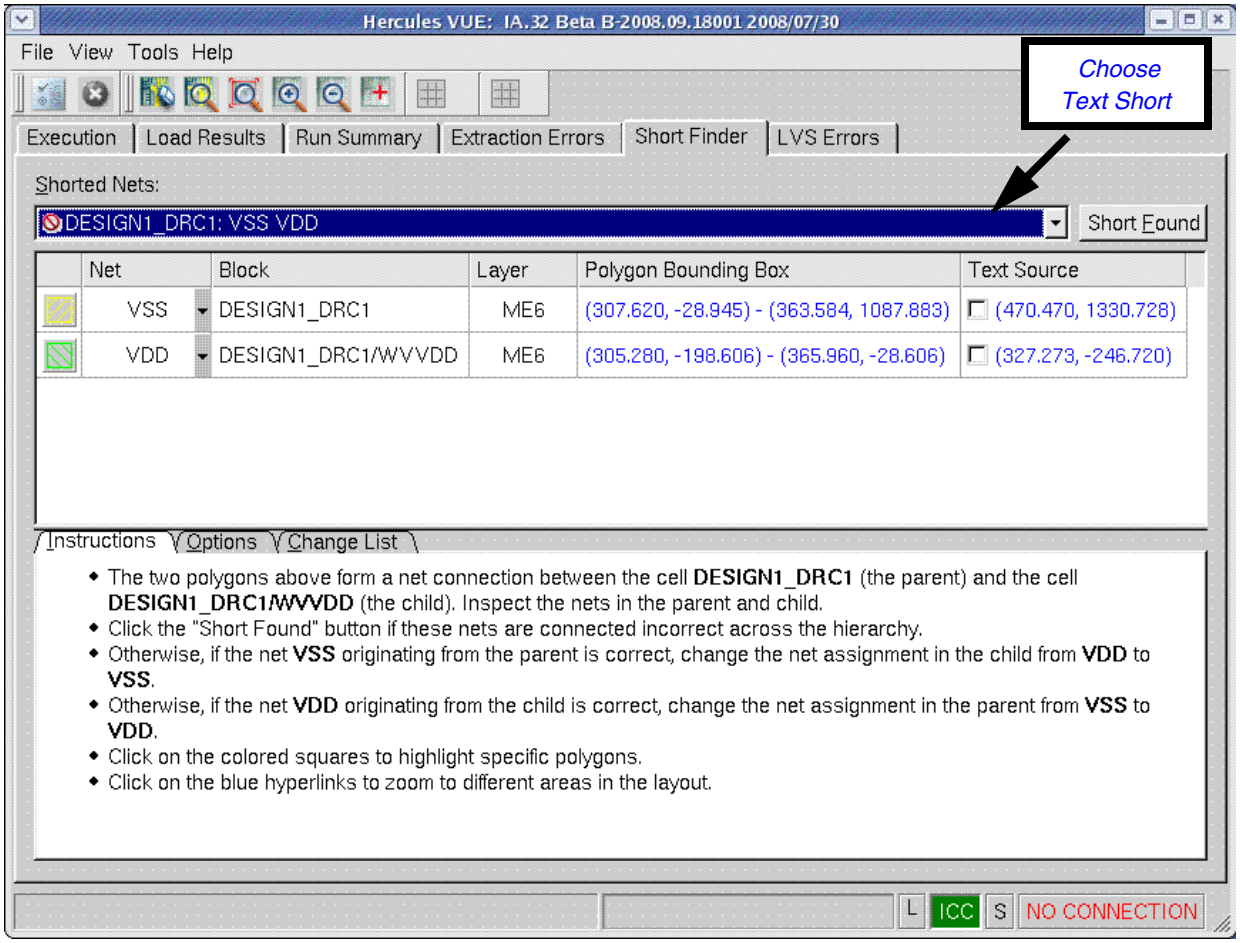
The Device tab has an Automatically Zoom to selected Polygons check box. By checking this box, you can zoom to the extents of all highlighted polygons. When not checked, VUE does not adjust the zoom of the highlight. The default is not checked.

Hierarchical Short Finder

The hierarchical Short Finder enables you to easily identify the root cause of text shorts discovered during a Hercules run. A number of features within the Short Finder allow you to trace the path of a reported short, label polygons according to your knowledge of the connectivity, and find multiple shorting paths between the texts that are shorted. Polygons can be highlighted and zoomed, and you can use different colors to show pruning of polygons that are properly connected.

Figure 3-15 shows the initial window for the Short Finder interface.

Figure 3-15 Initial VUE Short Finder Window



The Instructions tab gives clear instructions on how to use the interface most efficiently to navigate polygons and find your short.

All text shorts identified in the layout errors file (*.LAYOUT_ERRORS) are available from a Shorted Nets list in the Short Finder tab of the GUI. After selecting and loading a short from the list, follow the given instructions.

Each row of the list of polygons shows a net assignment that the Short Finder has given to that polygon, the runset layer it came from, and bounding box coordinates for that polygon.

Controls for Each Pane

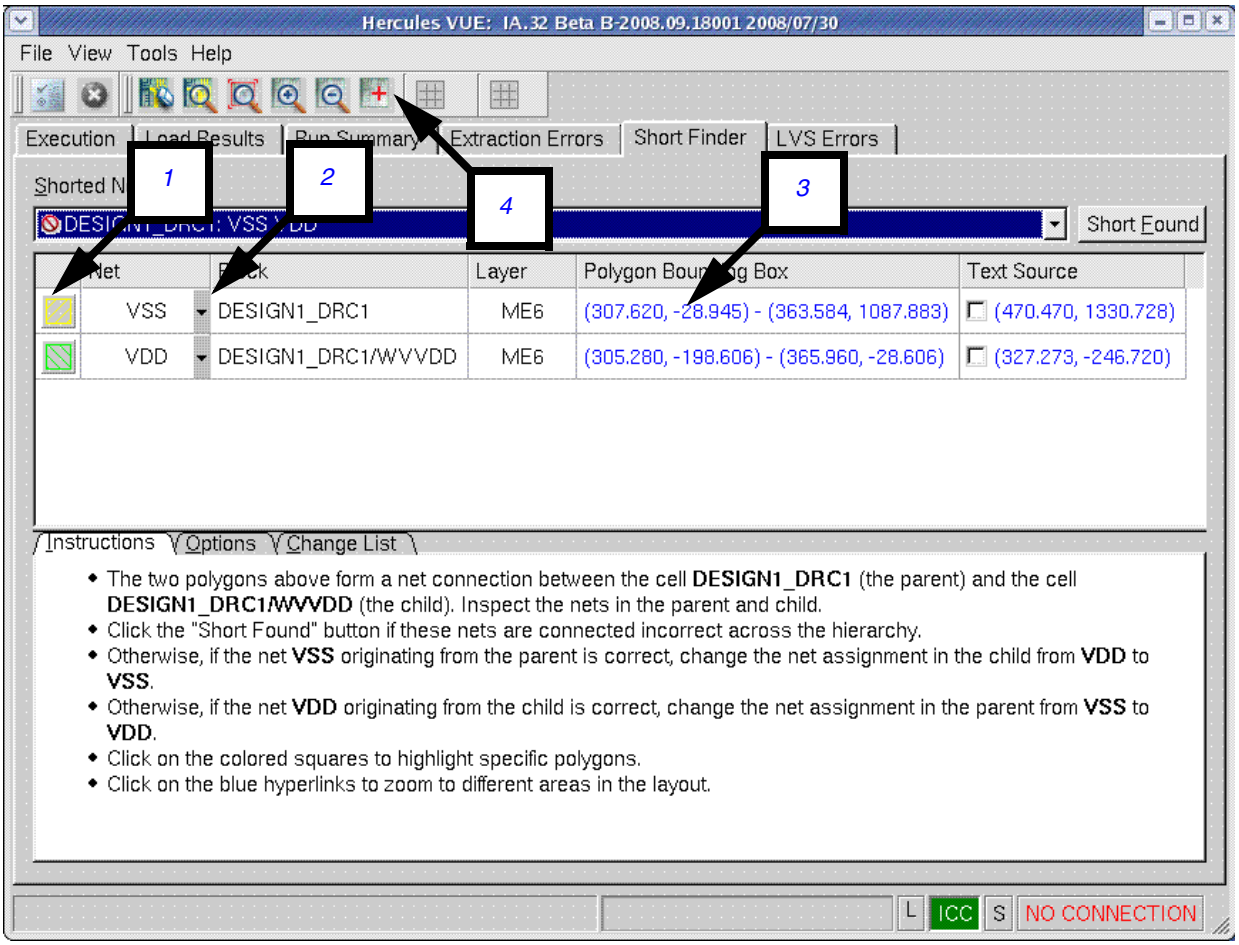
For any window displayed by the Short Finder, you can highlight polygons, change highlighting colors, and undo previous path pruning choices. The controls available for each row of polygon information include:

1. Colored square to the left of Net name - Click it to highlight that polygon and zoom to it.
2. Pull-down arrow to right of the Net name - Click it to get a list of Net names to assign to that polygon. Assigning different net names changes the name of the Short Found button to the Update Connectivity button.
3. Coordinates to far right of the Net name - Click these after you have turned off Zoom to Highlight (from the Options tab) so that you can zoom into that polygon.

In addition, the common VUE controls for Unhighlighting and Zooming are at the top of the window. Also:

4. The Probe Point button at the top is used to choose a highlighted polygon in the Layout window. The appropriate row of information is then scrolled to from the polygon list for that polygon. This is useful for focusing on an interesting highlighted part of the text short path. The related row of polygon information for the Probe Point click scrolls to your view in the window.

Figure 3-16 Top of Window and Polygon Row Controls



There are additional controls on the Options and the Change List tabs at the bottom of the window.

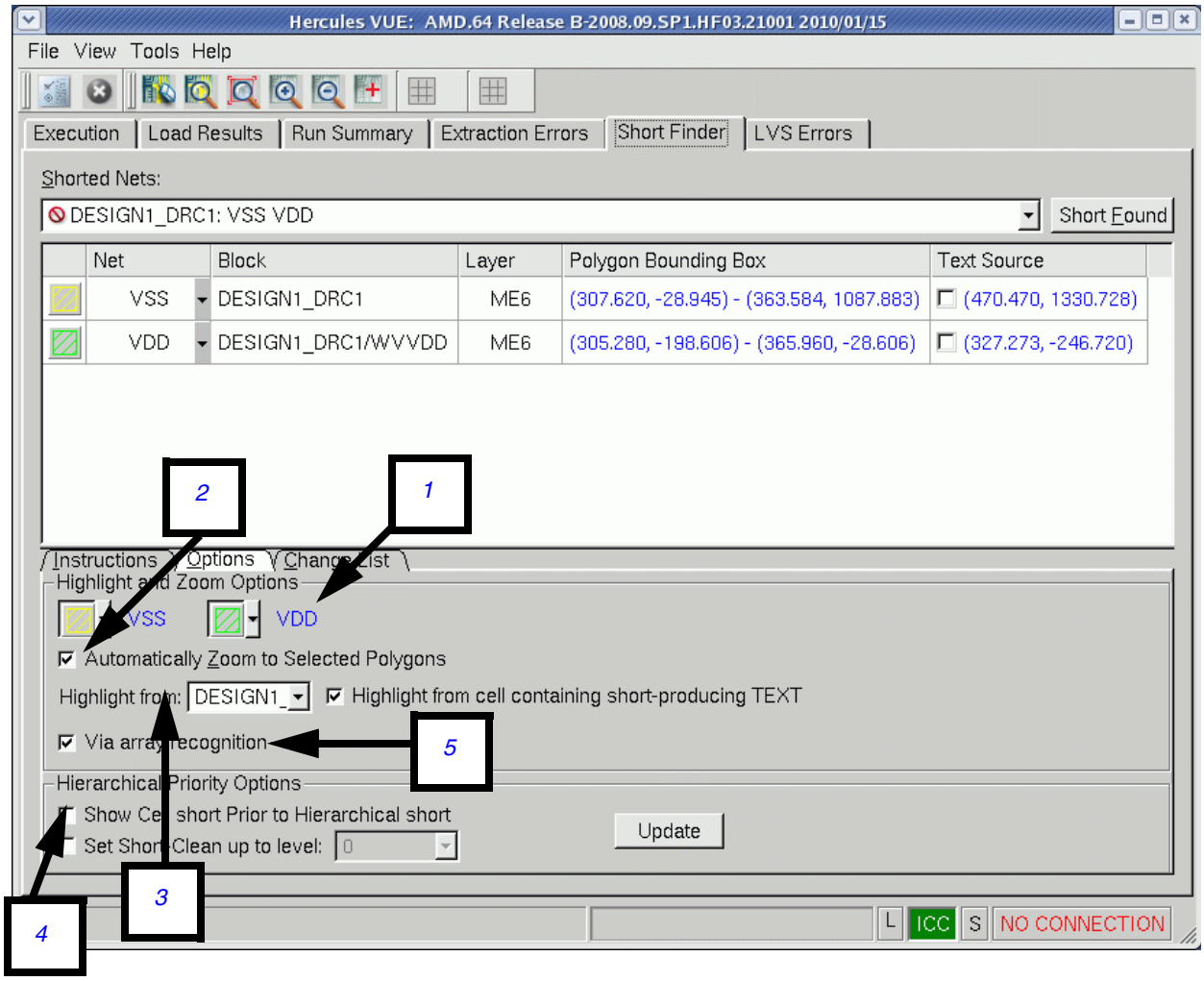
The Options tab allows you to:

1. Change the highlight colors and fills with the pull-down arrow next to the color square.
2. Turn off the feature that automatically zooms to a selected polygon. Notice that this is ON by default. It is useful when you have zoomed out in the layout and can click through the sequence of polygons to follow a long path.
3. Choose to view a lower-level path either within the context of the lower-level cell or within the context of a higher-level parent block.

4. Reprioritize shorted-path traversal such that paths within individual cells are traversed prior to analyzing cell-to-cell interactions. This helps you more quickly isolate a short if you believe that a short is likely contained within an individual cell rather than being due to a cell-to-cell interaction.

5. Enable via array recognition, which allows a group of vias to be considered as a single unit for purposes of shorted-path traversal.

Figure 3-17 Options Tab Controls



The Change List tab allows you to:

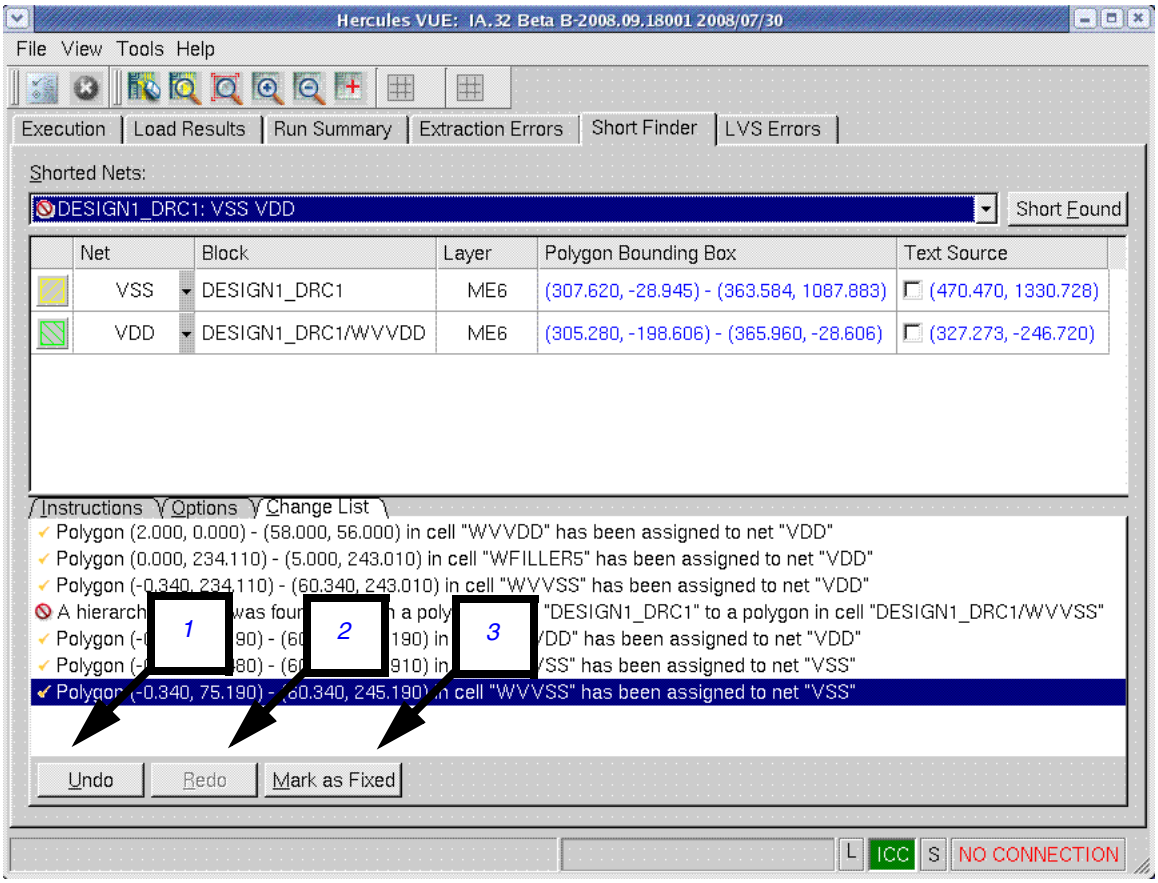
1. Undo previous choices (net assignments) to view previous states of the short finding process.

2. Redo choices (net assignments) that were made previously to readvance along in the list.

3. Mark certain discovered shorts as Fixed. Generally, you can do this for shorts that have been found and fixed in the layout.

Note:
Choices made during this Short Finder session are saved as information in the run directory where the VUE file is created. If you quit the current VUE session and come back to debugging shorts, the former choices you made are loaded.

Figure 3-18 Change List Tab Controls



Overview of Short Finding

There are two phases of analyzing a given short.

- The first phase of analysis of the short leads you through pairs of polygons that have a hierarchical interaction. The path of a short might go up and down the layout cell hierarchy. The short might be found as a hierarchical polygon interaction.

- If all hierarchical components of the shorting path are analyzed without finding the short, the cell-level phase of analyzing the path is presented. You see a longer list of polygons, all from the cell to which the short has been isolated. Once the shorting is discovered, specify that the short has been found and search for possible additional shorting paths between the current net names.

During both phases, the Instructions tab explains how to annotate (change the net assignment of) the identified and highlighted polygons. This is done to eliminate or prune the displayed polygon interaction as being the cause of the short. You can choose to change either polygon to a different net name. The down arrow beside the Net name is used to change the net assignment of one of the polygons.

Note:
By default, VUE performs hierarchical short analysis before performing cell-level short analysis. However, if Show Cell short Prior to Hierarchical short is selected on the Short Finder Options tab, Short Finder then re-prioritizes path traversal to perform cell-level short analysis first. If you think the short is more likely to be inside a specific cell rather than due to a hierarchical interaction between cells, setting this option will enable you to isolate the short more quickly.

Hierarchical Short Analysis

During this phase of short analysis only two polygons are presented for your changes. The short might be found as a polygon from one cell connecting hierarchically to a polygon of another cell. Each row of polygon information contains the name of the polygon's runset layer name, the parent cell/child cell path information, and the bounding box coordinates of that polygon. You can either:

- Change one of the polygons to a different net assignment and choose the Update Connectivity button to see additional hierarchical interactions or a list of cell-level polygons.
- Indicate that these hierarchical polygons represent the short by selecting Short Found.

In Figure 3-19, the two polygons highlighted in yellow and green represent a hierarchical connection between the level-1 cells WVVSS and WFILLER5 inside the top-block DESIGN1_DRC1.

Figure 3-19 Hierarchically Interacting Polygons and VUE

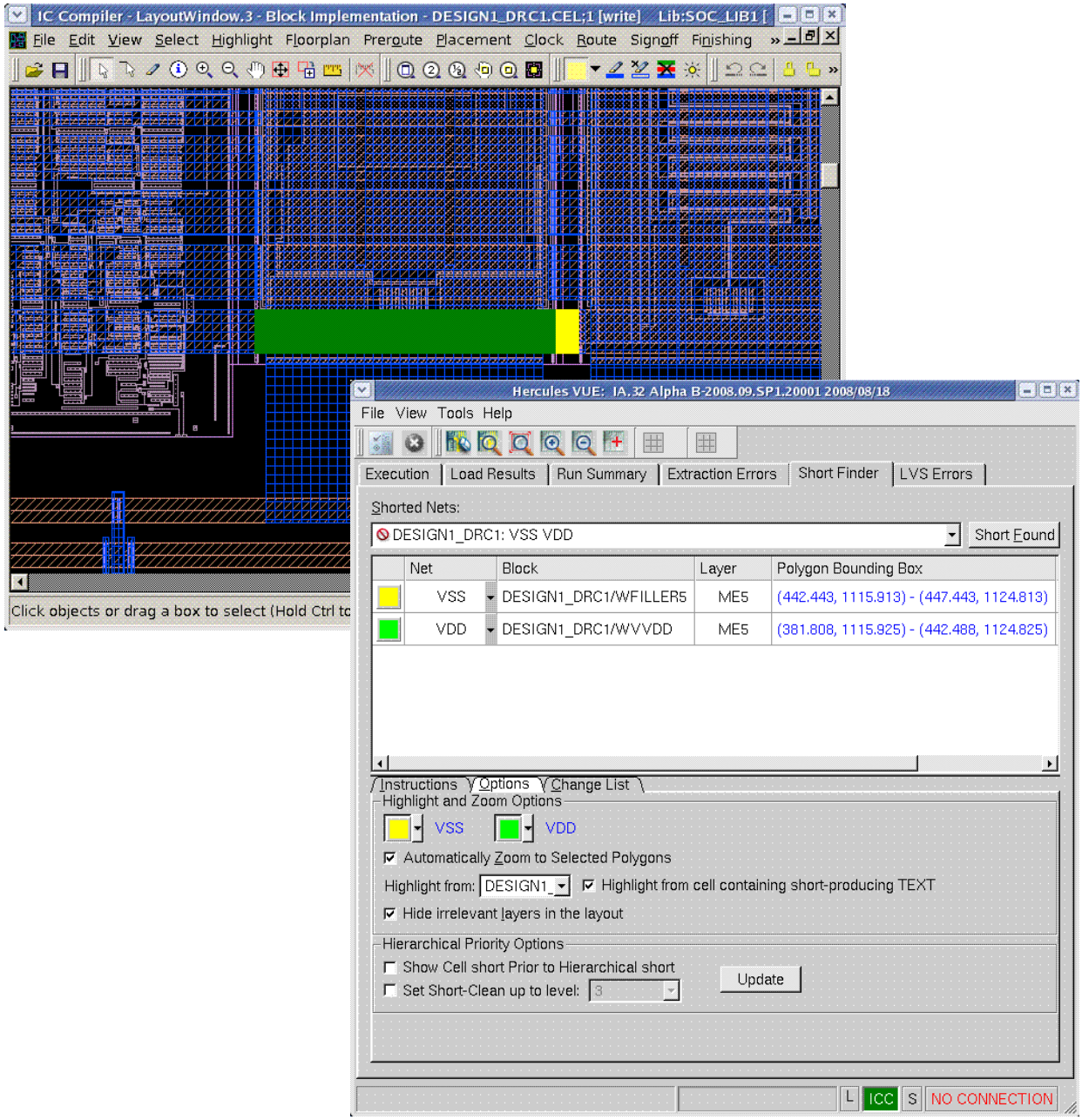
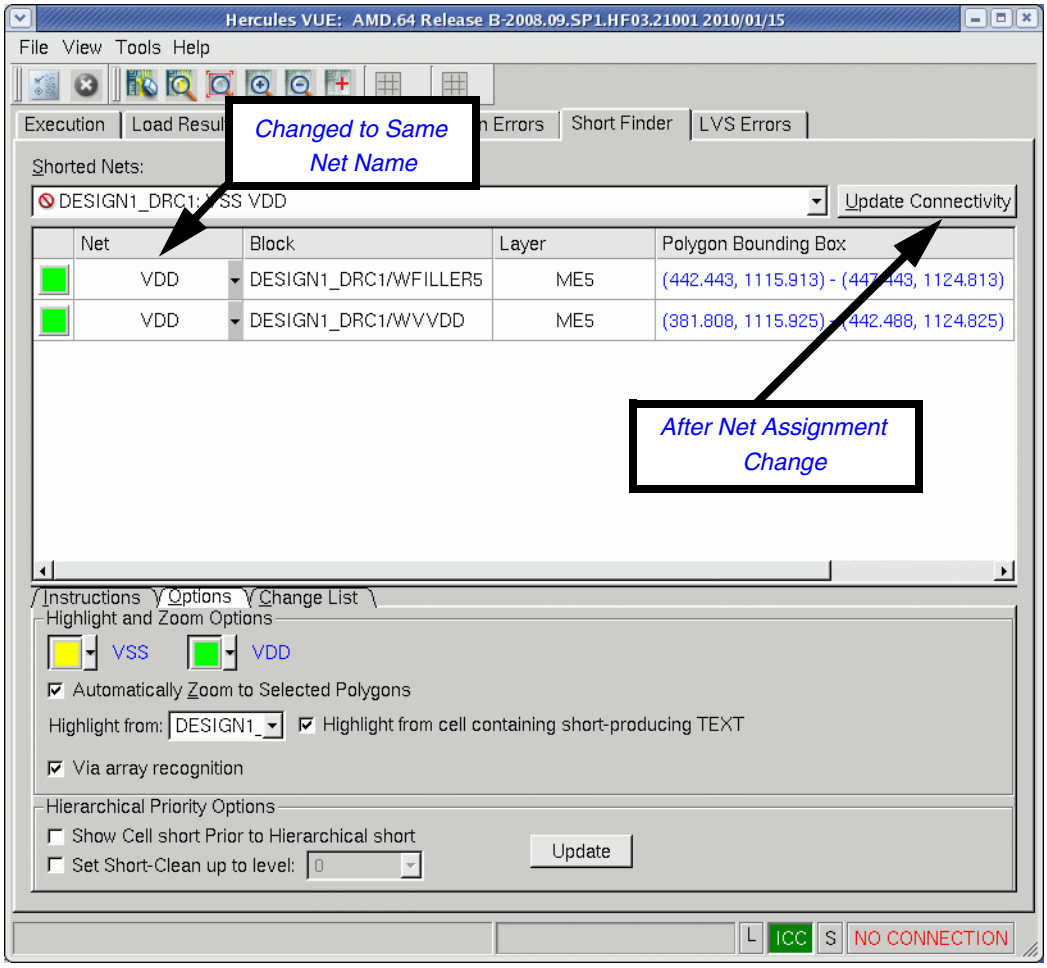


Figure 3-20 shows the changes to the VUE window after you have changed a net assignment of one of the polygons. The Short Found button changes to Update Connectivity. Choose this button to advance the Short Finder to the next hierarchical interaction or cell-level list of polygons.

Figure 3-20 Update Connectivity in Hierarchical Analysis



Cell-Level Short Analysis

During this phase of short analysis, a longer list of polygons appears. One polygon is assigned to the first net name of the short and another polygon is assigned to the second net name of the short. All the polygons in between are assigned either to a short or to N/A (not associated). The short is identified by assigning two adjacent polygons in the list to the two different net names and then selecting the Short Found button.

Each row of polygon information contains the name of the runset layer and the bounding box coordinates of that polygon. You can:

- Change any polygon to a different net assignment in which the Update Connectivity button becomes active. If you select this button, an updated and shortened list of polygons is presented with the polygon that had its net assignment changed appearing at the top or bottom of the list.

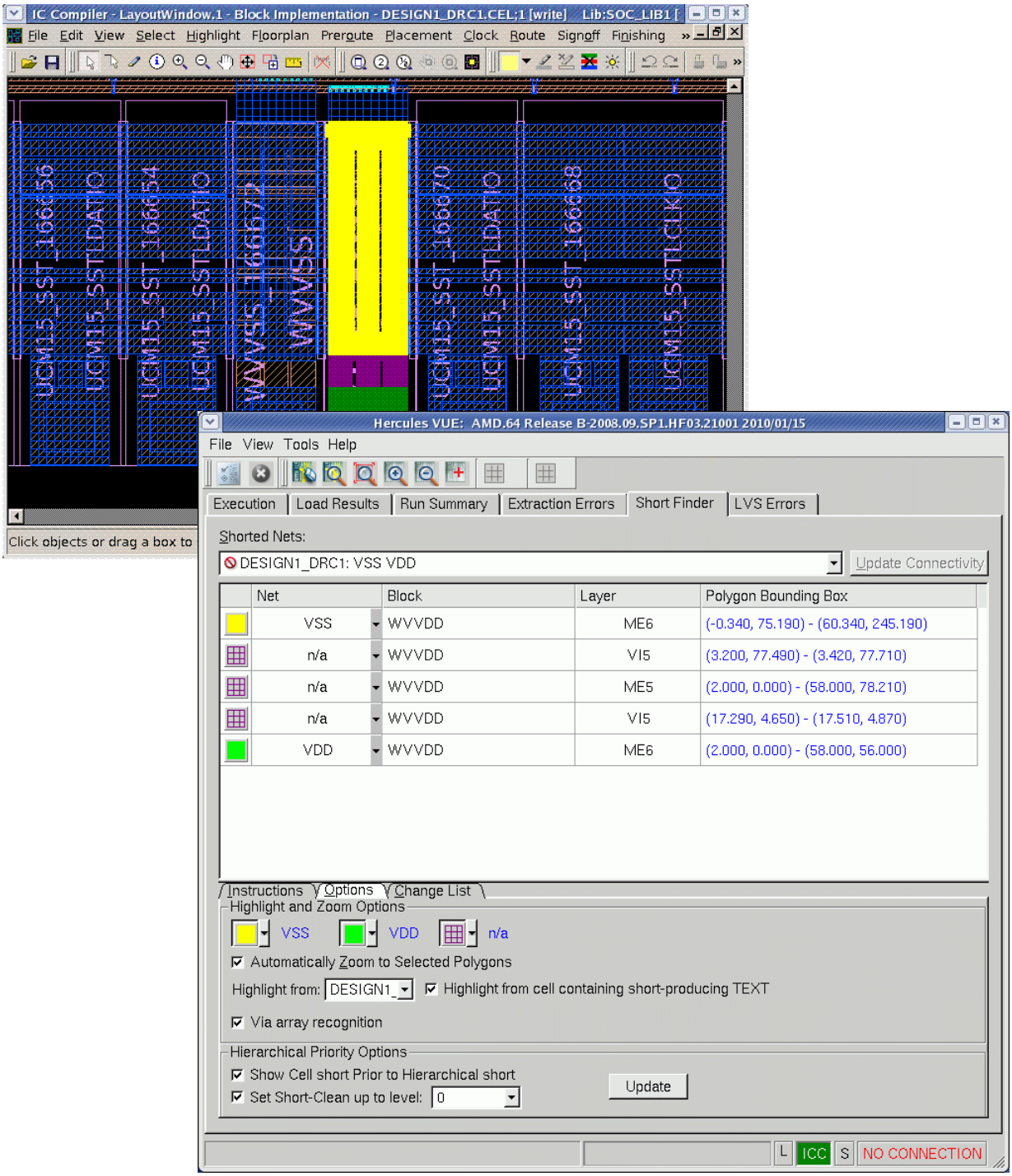
  Note:
  You are not required to select the Update Connectivity button as you change each polygon net assignment, but doing so may reduce the complexity of the layout highlighting and make the problem easier to see.

- Change the net assignments of two adjacent polygons to the two different net names. After this is done, the Update Connectivity button changes to Short Found. You can select this button if the specified net assignments represent the cause of the short.

In Figure 3-21, see the path of polygons highlighted in yellow, green, and purple. Yellow and green represent starting and ending polygons on the path that have already been assigned to one of the net names. Green polygons represent one net name and yellow polygons represent the other net name. The purple polygons do not yet have a net name assigned to them.

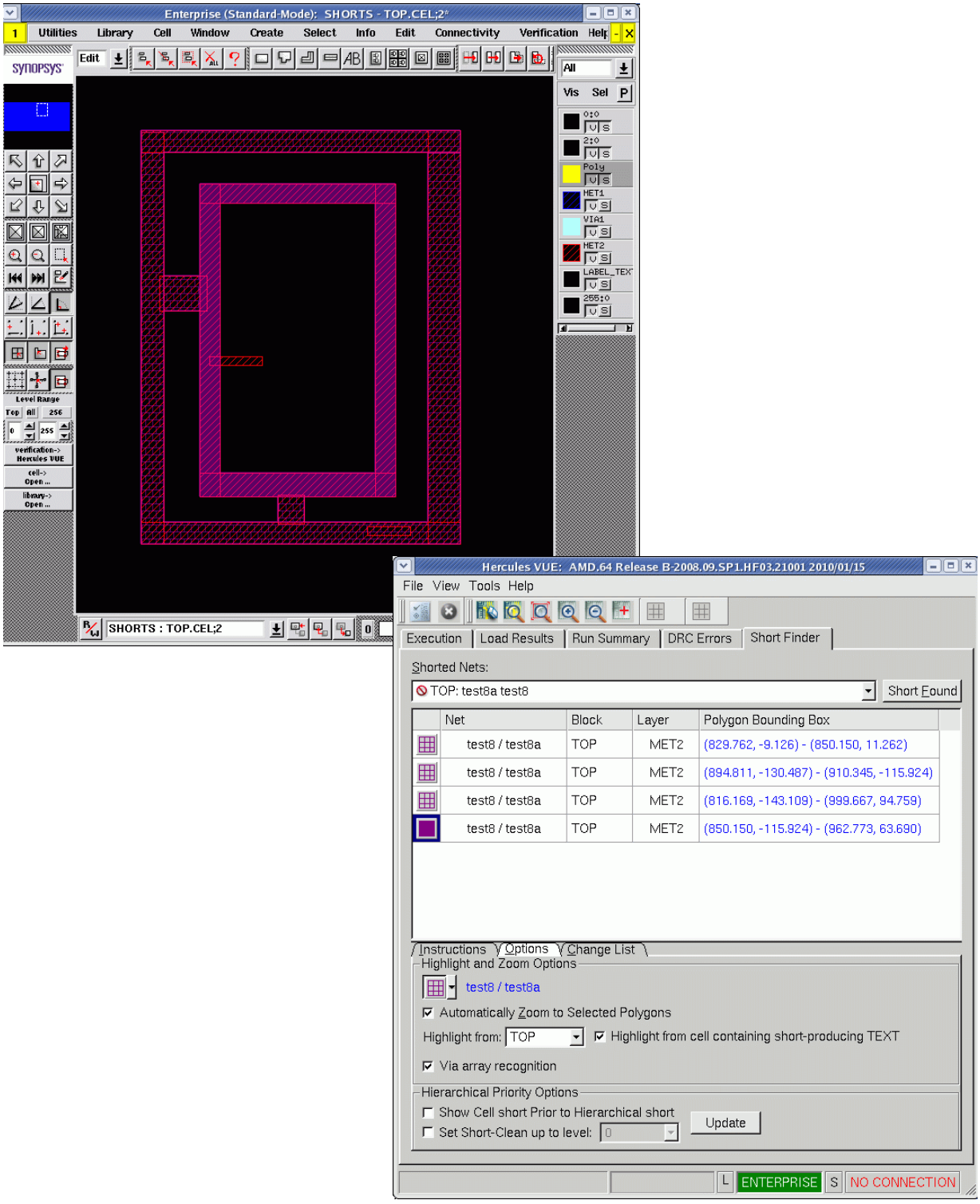
Your goal is to change the N/A assigned polygons to one or the other net names as part of the process of finding the short-causing polygon interaction.

Figure 3-21 Cell Level Polygon Path and VUE



Occasionally a short might be due to conflicting connectivity which occurs due to either a single complex polygon or to different interacting polygons of the same layer. In such cases, VUE merges and re-fractures the same-layer polygon or polygons to assist the user in isolating the portion of the layer that contains the short. See Figure 3-22 for a common example of concentric power / ground rings which occur on the same metal layer.

Figure 3-22 Polygon Fracturing



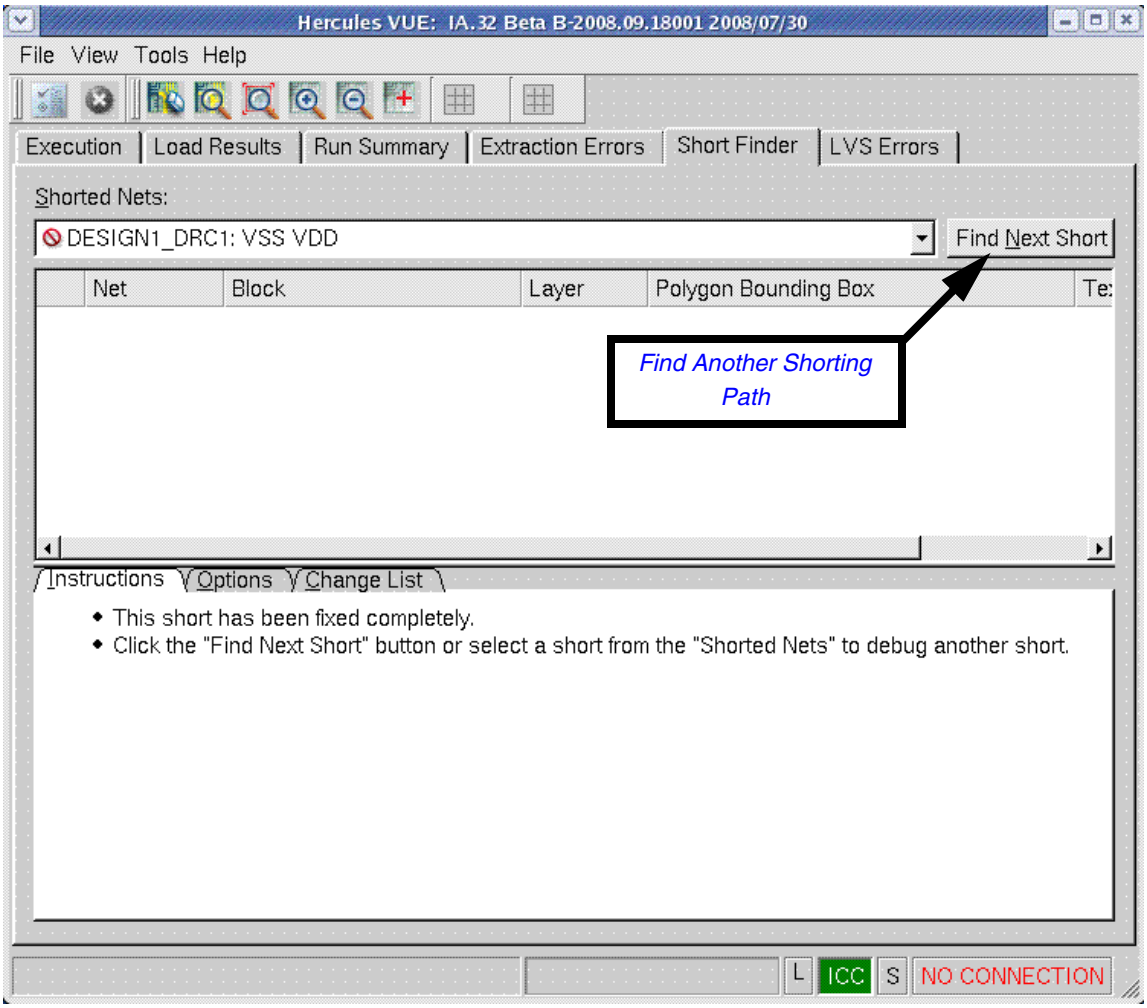
Additional Shorting Paths

Once you have selected the Short Found button (during either hierarchical or cell-level analysis), the following screen appears, instructing you to either:

- Choose to work on another text short in the Shorted Nets list, or
- Search for possible additional shorting paths that might exist between the same two texts, per the Find Next Short button. The Short Finder is able to find additional shorting paths until all paths are discovered.

Note:
This is highly recommended in the case that there are other shorting paths that need to be discovered between this text pair.

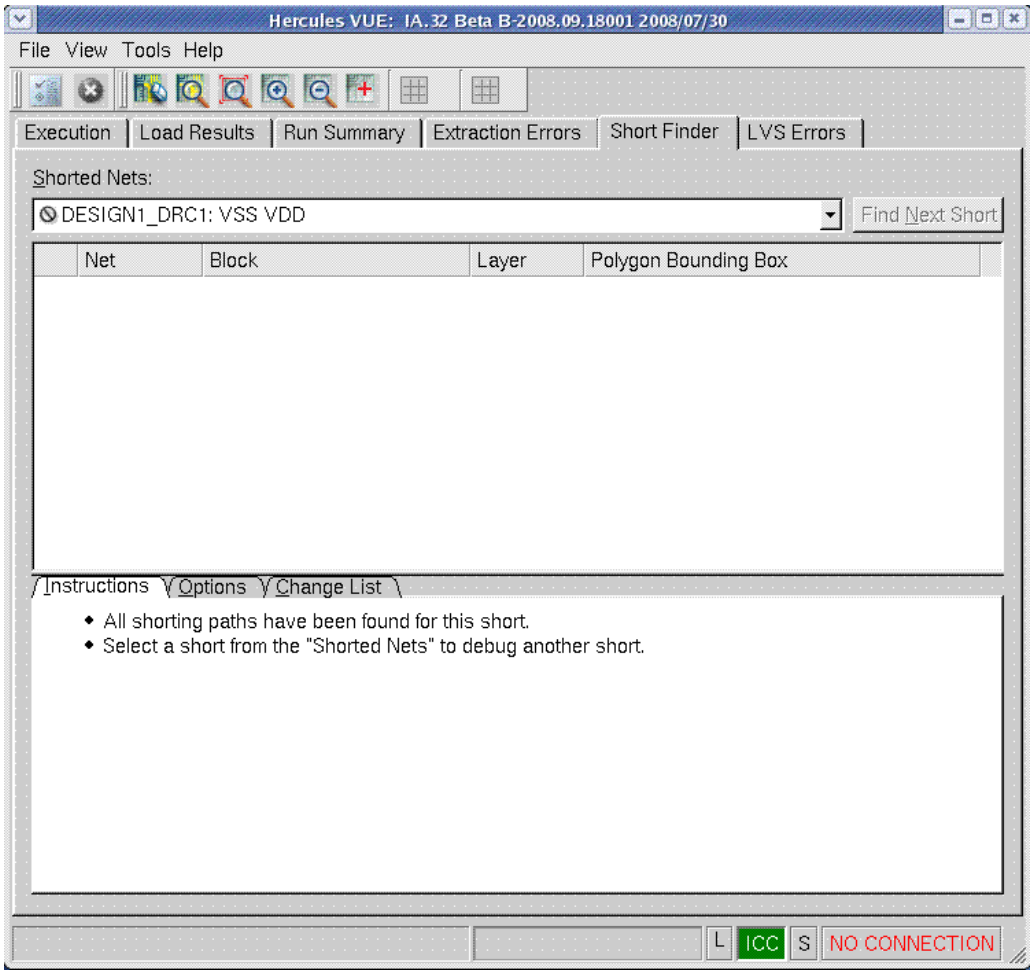
Figure 3-23 Find Next Short



If additional shorting paths are found, the short-finding process starts again.

If no more shorting paths are discovered, the window shown in Figure 3-24 appears.

Figure 3-24 All Shorting Paths Found



Short Finder Flylines

To display a polygon's flylines to the text source, check the box next to the coordinates in the Text Source column of the Short Finder screen. VUE highlights the physical location of the text involved in a hierarchical text short and displays a flyline from the polygon to its respective text. This functionality allows you to see the exact physical locations of the texts involved in a hierarchical short.

Figure 3-25 Short Finder Showing Polygons in Hierarchy

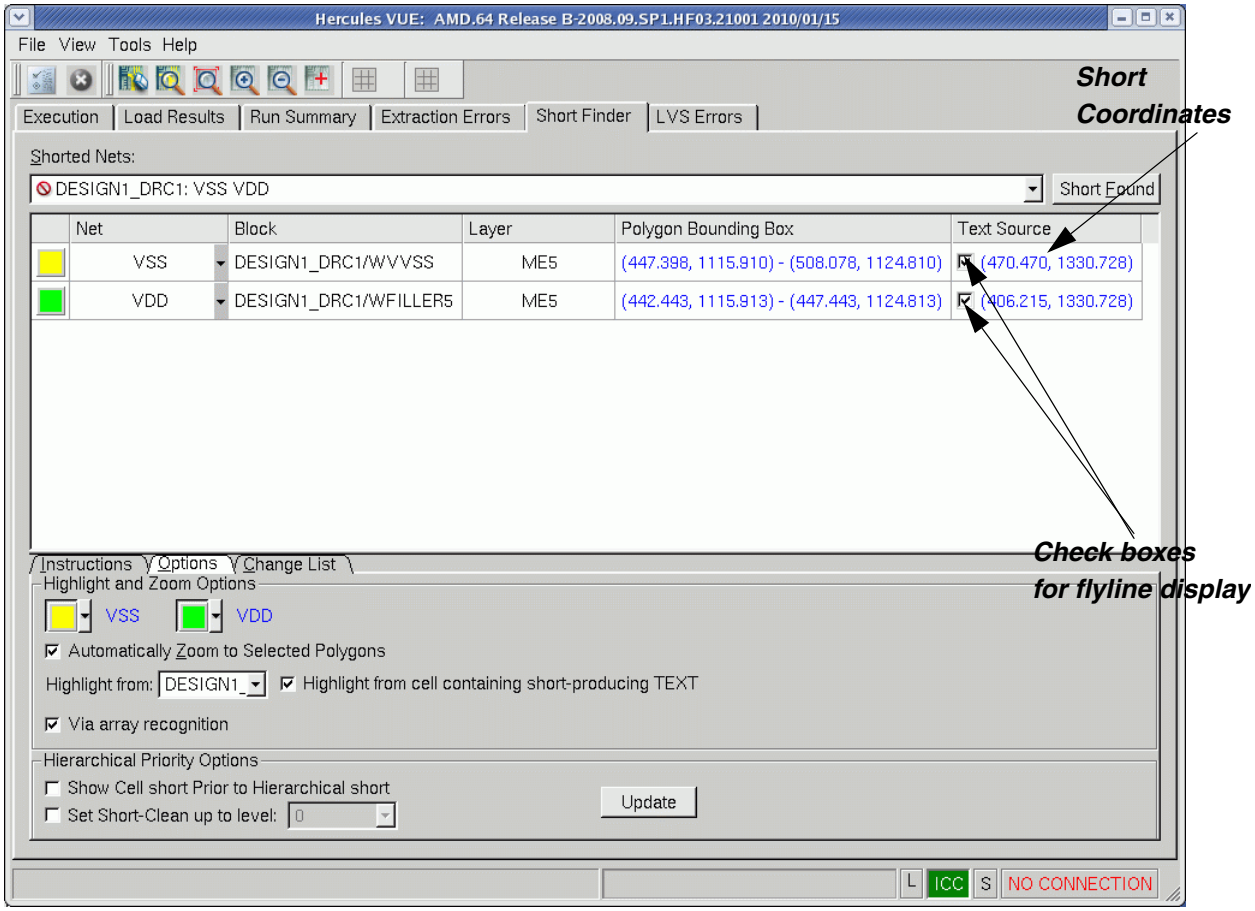
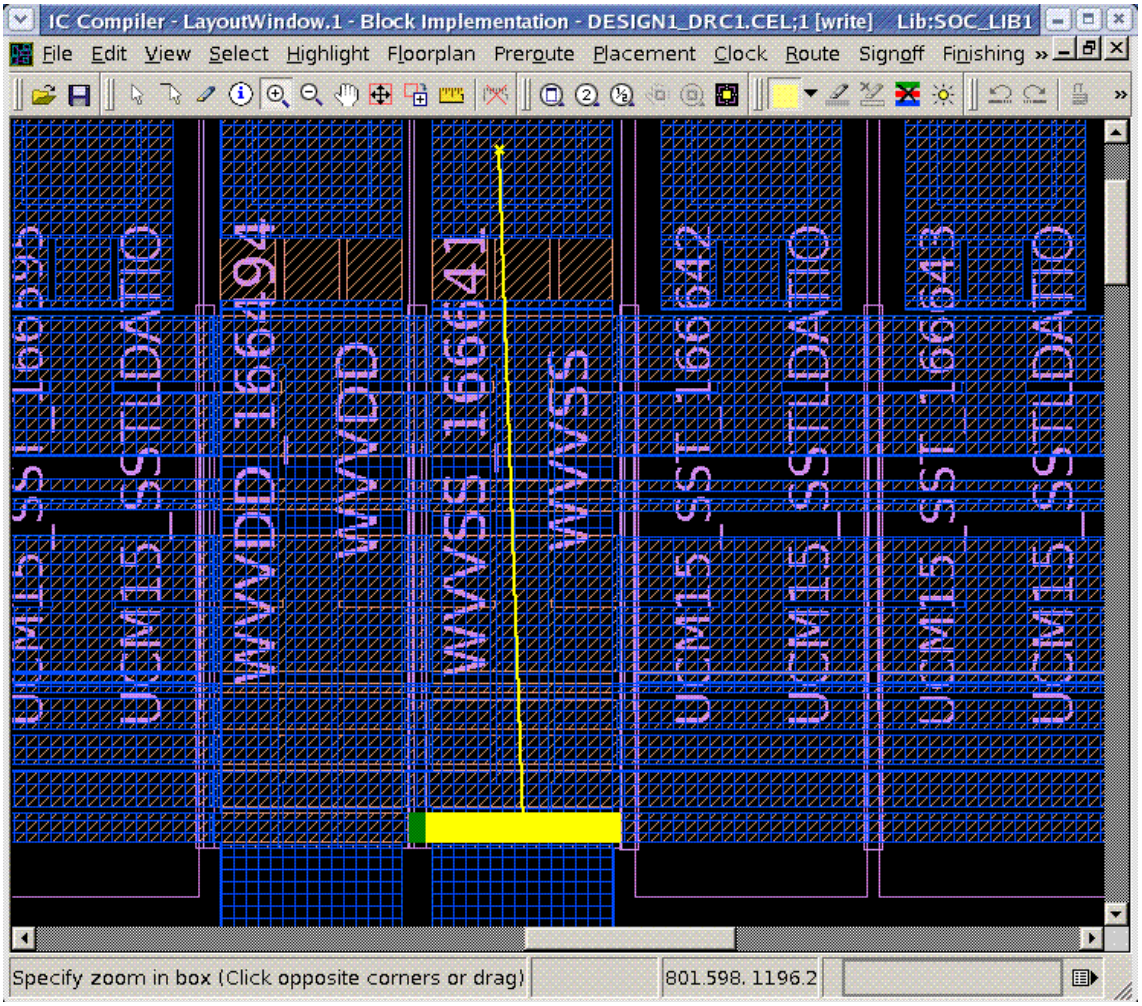


Figure 3-26 Short Finder Flyline Output



Via Array Recognition

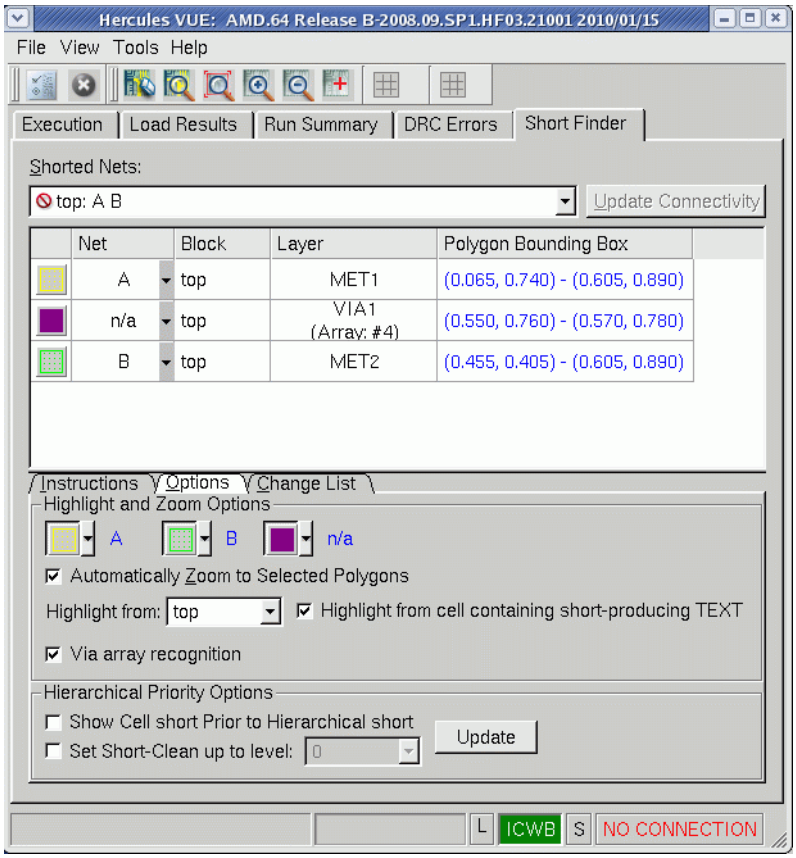
Short Finder recognizes via arrays as single polygon units and eliminates the need to traverse numerous individual via polygons while walking shorted net paths. Via array recognition can be activated or deactivated on the fly with the "Via array recognition" check box on the Short Finder Options tab.

Short Finder detects via arrays by identifying groups of adjacent via polygons that are

- contained inside the same cell,
- enclosed by the same upper and lower layout polygons, and
- are all part of the same short.

When a via array is identified, the corresponding polygon entry in the polygon selection pane will have its layer name annotated with (Array: #N), where N represents the number of vias within the array. In Figure 3-27, the array is identified on layer VIA1 with four polygons.

Figure 3-27 Via Array Recognition



For a recognized via array, the Short Finder prompts you to assign a single net ID to the entire array, not to individual vias within the array. By default, the Short Finder highlights one representative polygon from the array. However, if you click the polygon highlight icon to the left of the net name in the polygon selection pane, all polygons participating in the array are highlighted.

Figure 3-28 Short Finder Highlighting Single Via From Array by Default

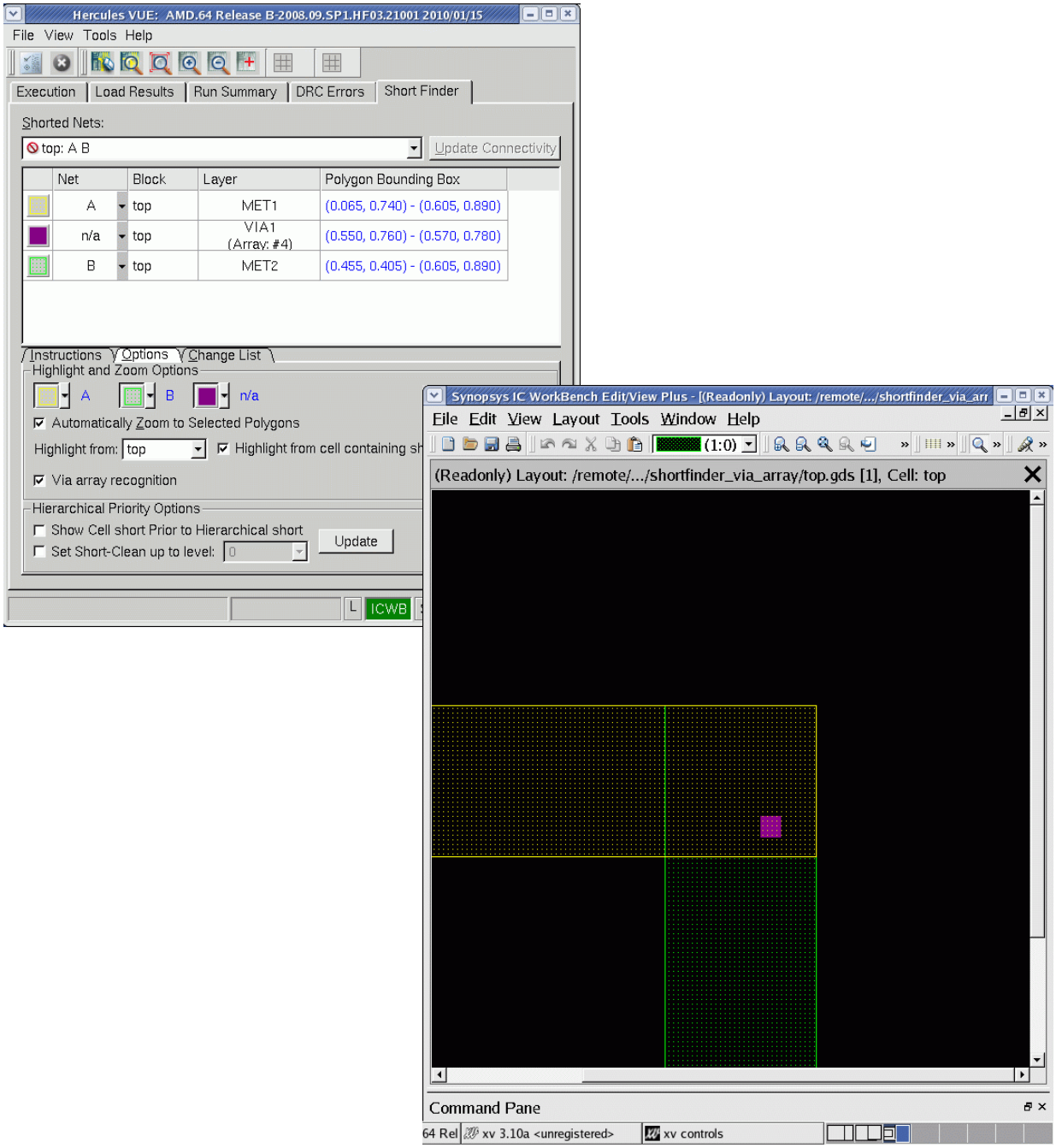
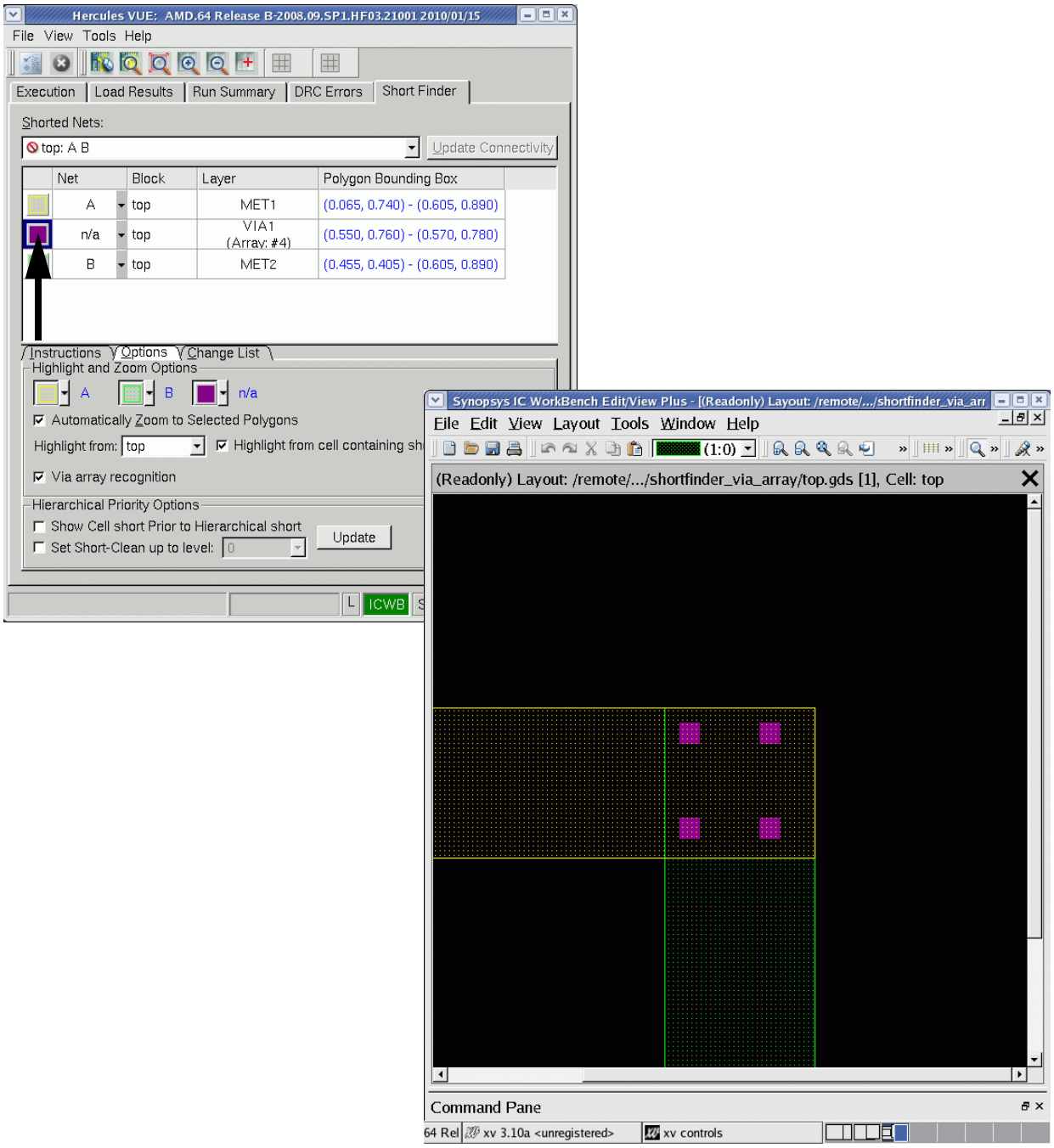


Figure 3-29 Short Finder Highlighting Entire Via Array After Selecting Via Layer Highlight Icon in Polygon Selection Pane



LVS Errors

The LVS Errors tab provides an organized list of blocks and LVS violations. The Error Viewing section includes the Design Level Info with Equivalence List and Highlight List panes to the left, and the main window, as shown in Figure 3-30.

Note:

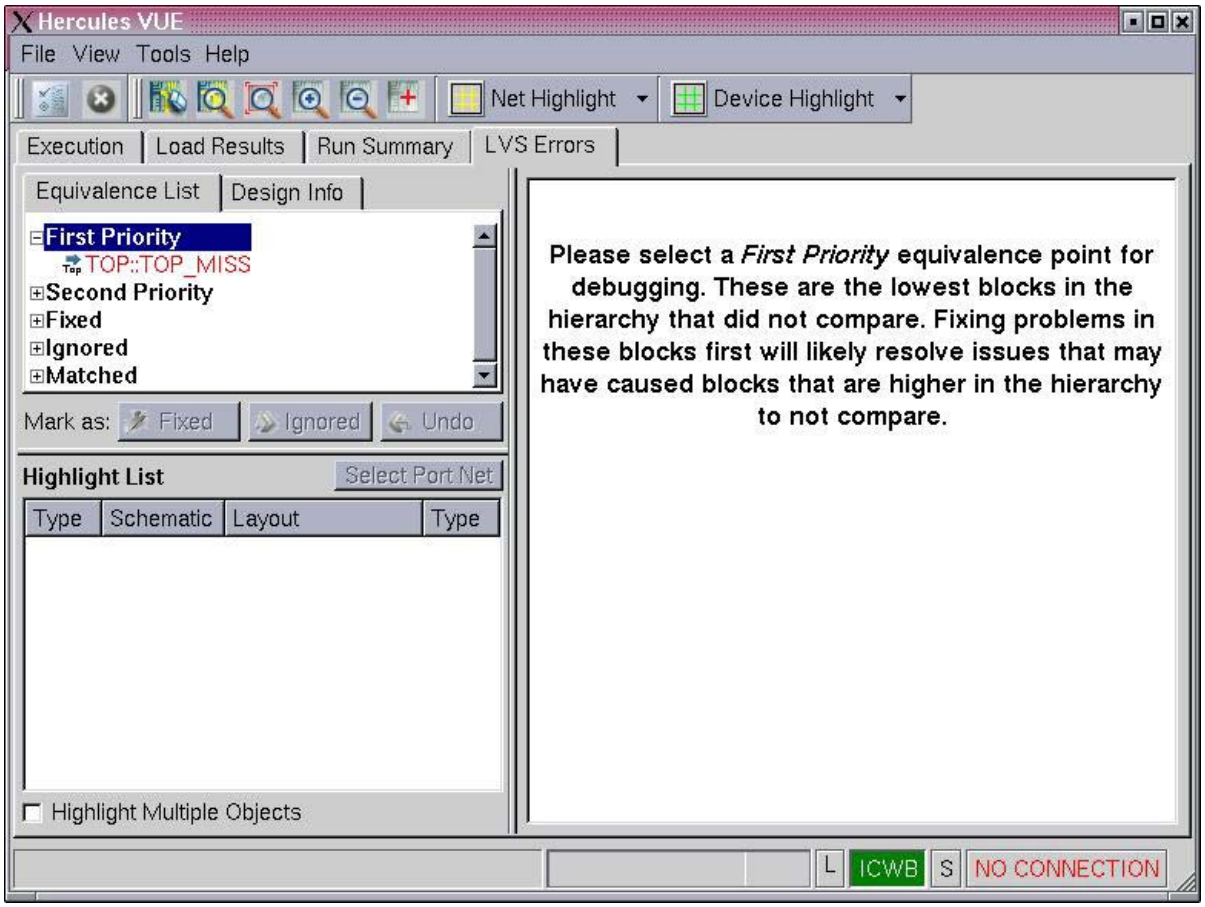
To highlight nets and devices when debugging LVS errors, VUE requires Hercules to create an output library with the polygon data. This output library is automatically created if CREATE_VUE_OUTPUT = TRUE, a NETLIST{} command is in the runset, required to generate a layout netlist, and WRITE_NETLISTS is not explicitly set to FALSE in the COMPARE section.

Hercules prioritizes failed equivalence points and prompts you to fix the highest priority points first. See the *Hercules LVS User Guide* for additional information on first priority equivalence. All failed equivalence points that are not considered first priority are listed in a second priority block.

Note:

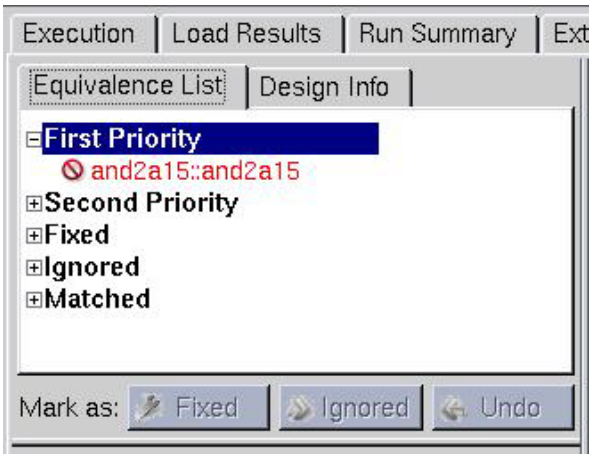
VUE automatically finds and scrolls to the first highlight that exists. VUE also allows you to tell VUE what net/device it should zoom to, and which occurrence of that net/device should be highlighted.

Figure 3-30 LVS Errors Tab



When you select the First Priority equivalence point, details on this block are displayed. See Figure 3-31.

Figure 3-31 Viewing LVS Errors for First Priority Equivalence Points



Summary, netlist and detail information is loaded for the equivalence point with errors.

Summary Tab

The Summary tab provides four types of messages containing debugging hints. You can either scroll or search the types of messages by using the text list in Figure 3-32.

Figure 3-32 Summary Tab for LVS Errors

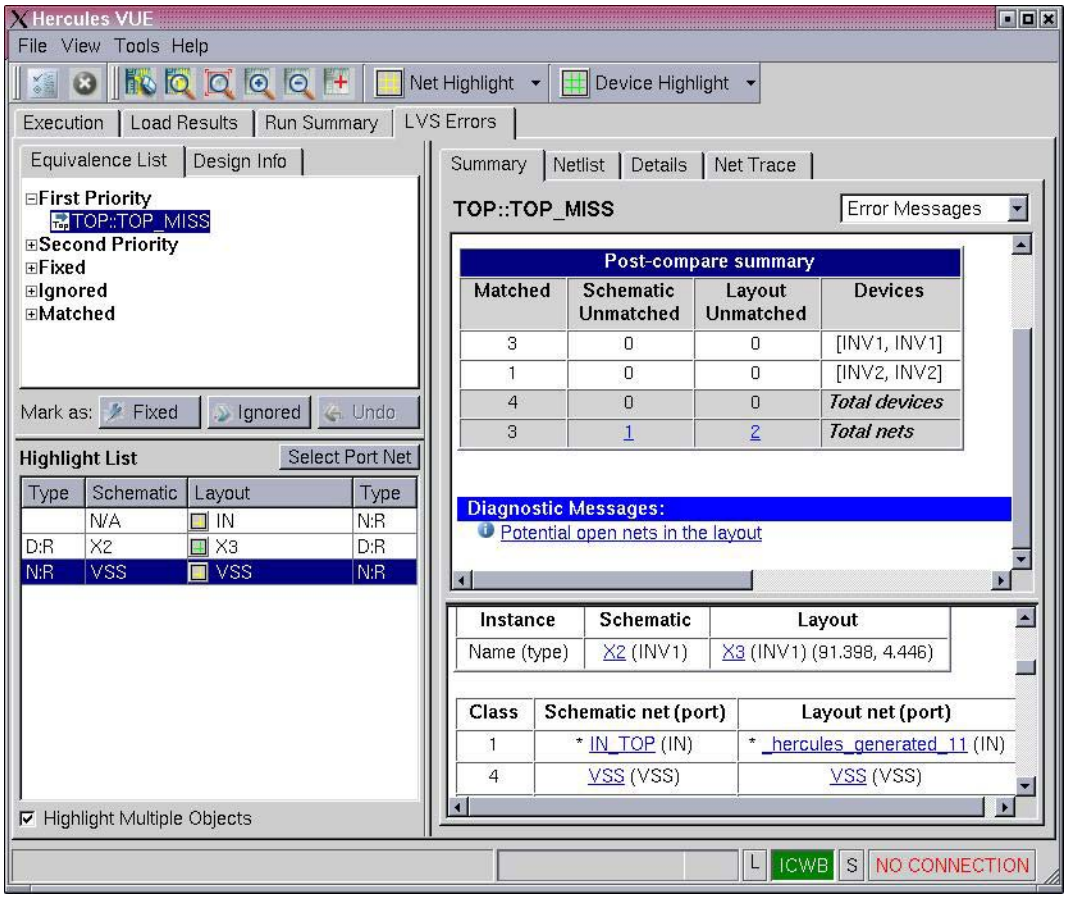


Table 3-2 Summary Tab Message Types

Message	Description
Error Messages	Lists errors for a cell with unmatched nets and devices in the schematic and layout. Selecting an unmatched net or device highlighted in blue provides details on that specific net or device in the bottom panel. At this point, selecting an unmatched net or device highlights appropriate areas in the layout and schematic tools.
Post-Compare Messages	Summarizes the number of all devices and nets (matched and unmatched) in an equivalence point.
Diagnostic Messages	Provides debugging hints and possible causes of an error in a cell. Selecting a diagnostic message provides details of debugging. You can select nets and devices to be highlighted in the layout.

Table 3-2 Summary Tab Message Types

Message	Description
Warning Messages	Displays warning messages in a cell if any are reported.

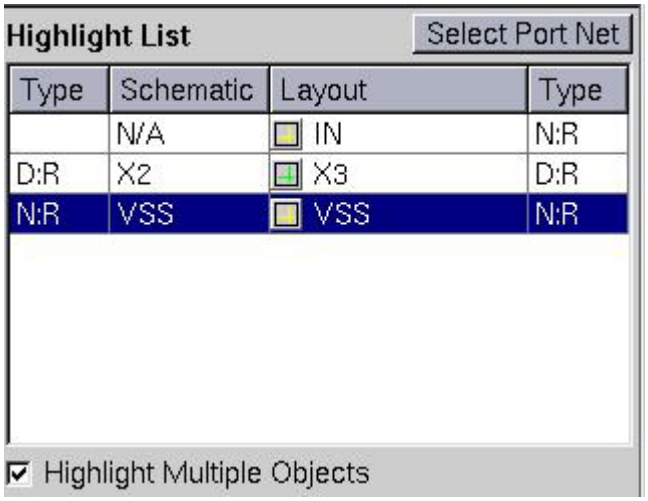
Netlist Tab

The Netlist tab shows the cell-level schematic and layout netlists for the equivalence point. This netlist is generated during the LVS run. It is a flat netlist where all blocks that successfully compared at a lower level are now only black-box instances. When debugging a comparison error, it is helpful to use both netlists for cross-probing or probing in the layout.

To cross-probe between the schematic and layout, select a net or device in either netlist. If it is a matched net or device, the Highlight List window shows the details shown in Figure 3-33. If it is an unmatched net or device, the details are not displayed.

To search the netlists, right-click within the window to bring up the find window. This window keeps a history of highlighted objects and you can easily jump between highlighted objects.

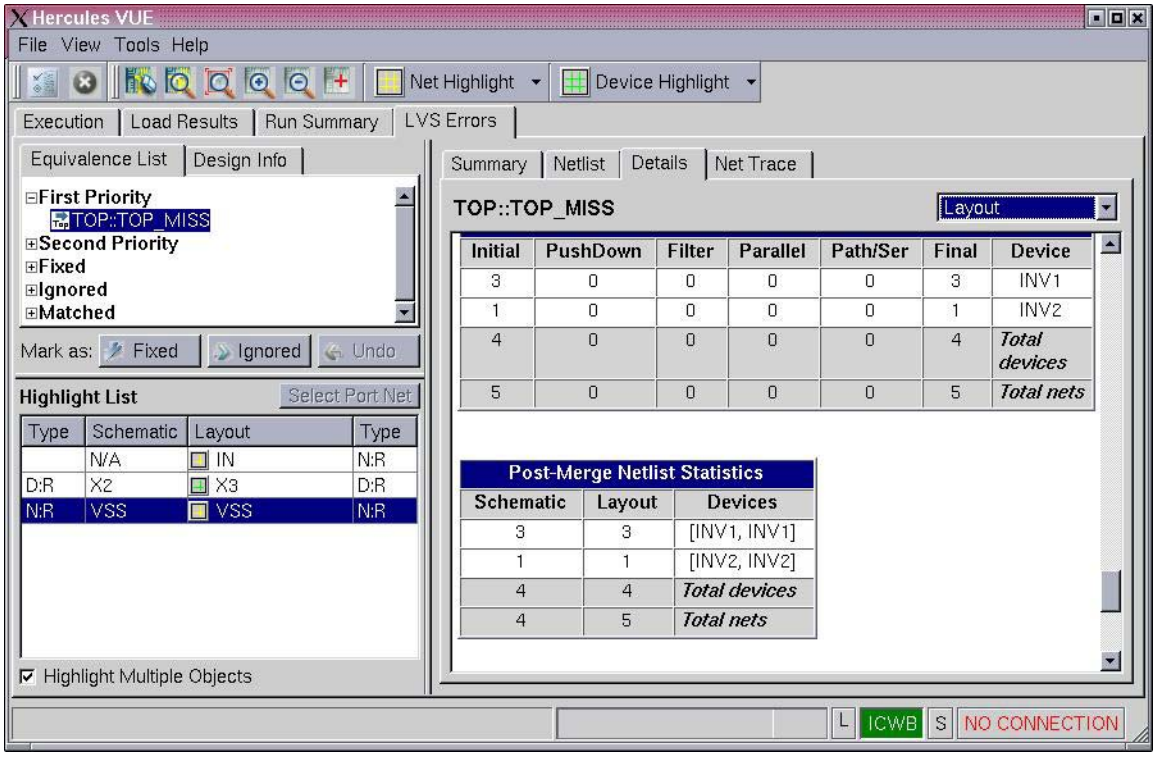
Figure 3-33 Highlight List for LVS Errors



Details tab

The Details tab shows the compare summary of a cell. You can either scroll or search the information by using the text list in Figure 3-34.

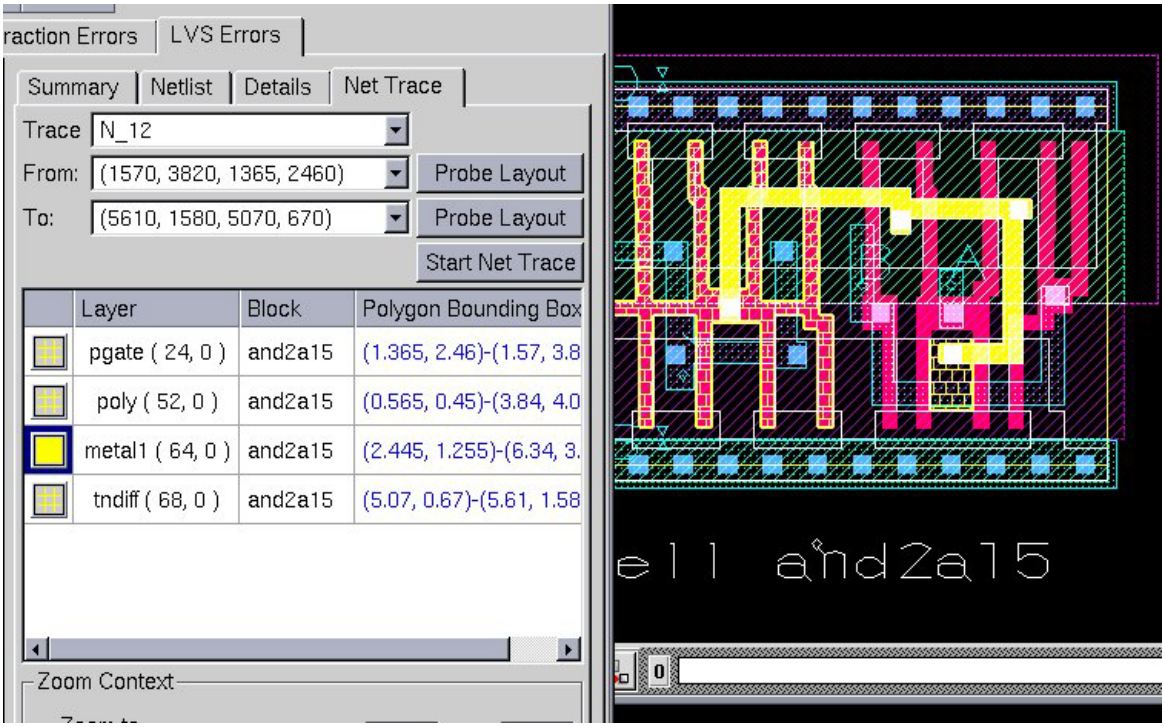
Figure 3-34 Details Window for LVS Errors



Net Trace Tab

The Net Trace tab within the LVS Errors section of VUE enables you to walk a net, polygon by polygon. This can be very useful when working with isolated untexted shorts or device connection issues.

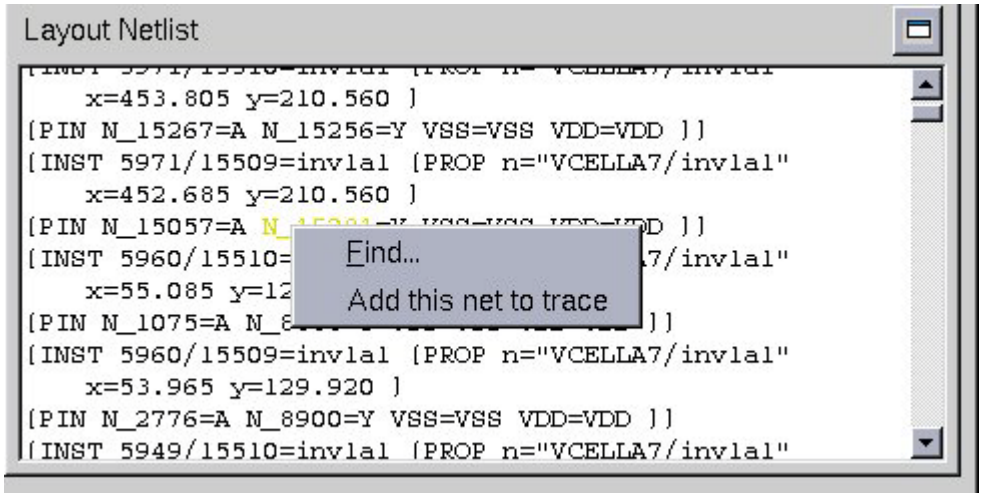
Figure 3-35 VUE Net Trace Utility



To begin, select a net from the Trace pull-down box. All nets within the equivalence netlist are listed alphabetically in this list. The net is highlighted in the layout editor upon selection.

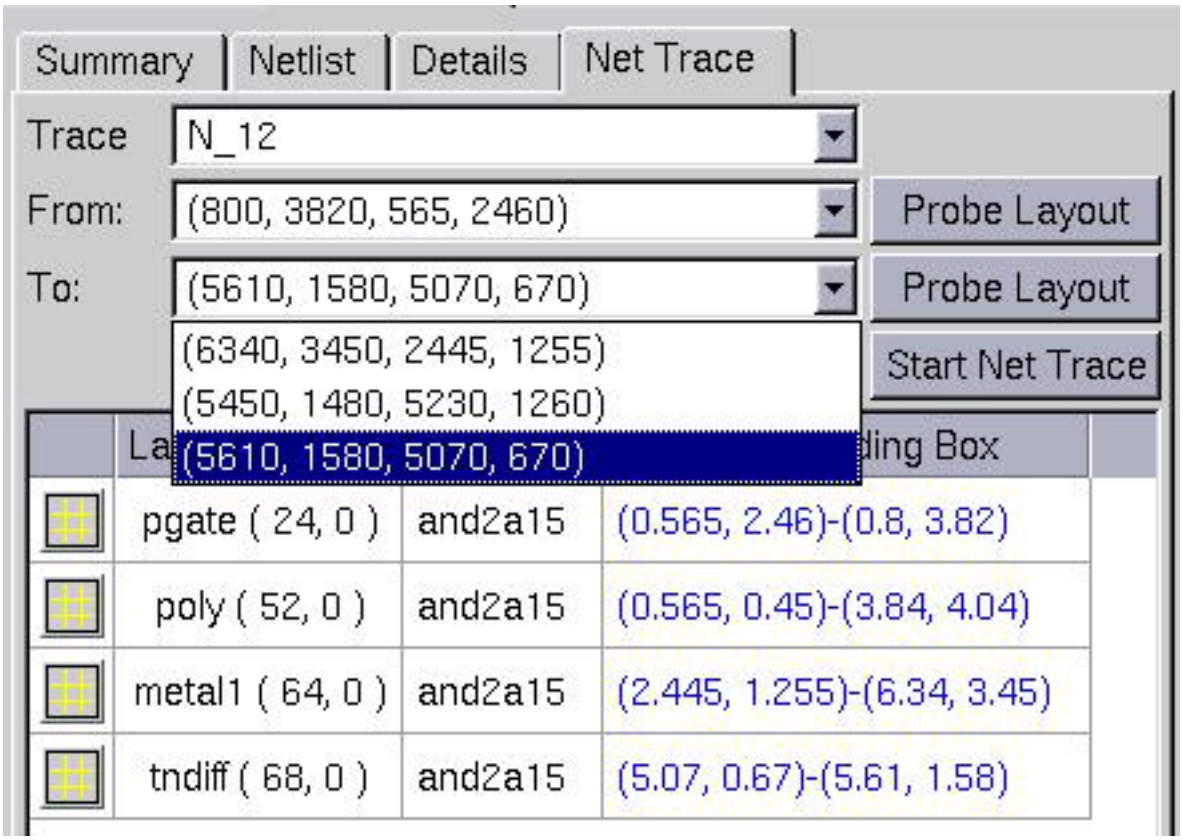
If there are more than 100 nets within the cell, the Trace list will be empty. To populate the list, right-click on a net from the Netlist tab and select Add this net to trace.

Figure 3-36 Netlist Tab



Next, select a starting point from which to start tracing by using the Probe Layout button next to the From entry field. The bounding box of the polygon is added to the field. If more than one polygon exists beneath the point selected, you can choose which one to use in the trace from within the pull-down box. See Figure 3-37.

Figure 3-37 Selecting the Starting Polygon within Net Trace

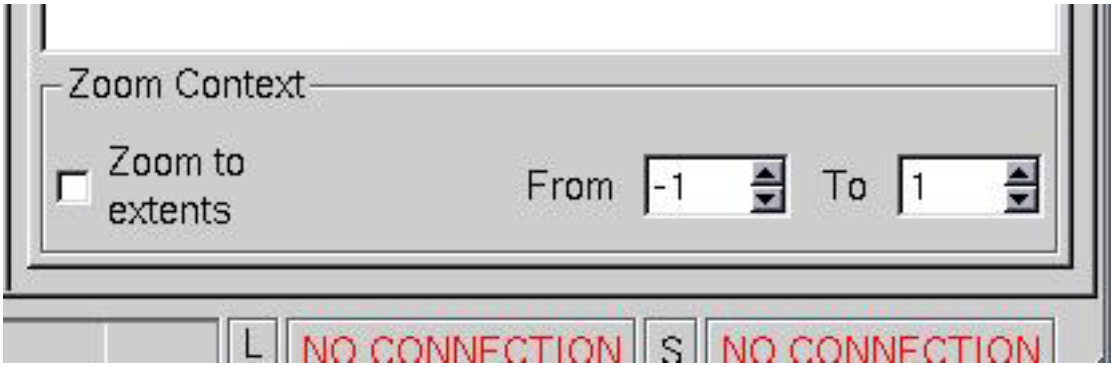


When a new starting box is selected, it is highlighted in the layout to help you identify it.

When both From and To boxes are filled, click Start Net Trace to get the list of polygons. The path is highlighted in the layout. The color and fill can be changed by right-clicking the colored box on the left side of the table.

Click on an individual polygon to highlight it in a bolder color within the layout. Use the Shift key to highlight more than one polygon at a time. Use the Ctrl key to select non-consecutive polygons in the list.

The Zoom Context section at the bottom of the Net Trace utility controls how VUE zooms the selected polygons. Zoom to Extents used the From and To settings to control the extents of the zoom. The range specifies the extents of the polygons before and after the selection in the list. See the following figure for more information.



Highlight Pane

The VUE Highlight pane gives you complete control of the highlighting of nets and devices for LVS. When a net or device is highlighted, it is listed here with cross-reference information, highlight color and fill, as well as type of object being highlighted.

To highlight more than one object at a time, click the Highlight Multiple Objects check box below the window.

When highlighting a large net, a status bar in the lower right corner tracks the progress of the highlight being displayed in the layout editor.

Highlight Control

If more than one highlight is listed, you can click on a single object to zoom, select-left click to select a range of objects, or control-left click to select multiple, non-consecutive objects.

Any object's highlight color/fill can be changed without clearing all highlights by changing the color/fill in the toolbar, then re-highlighting the object.

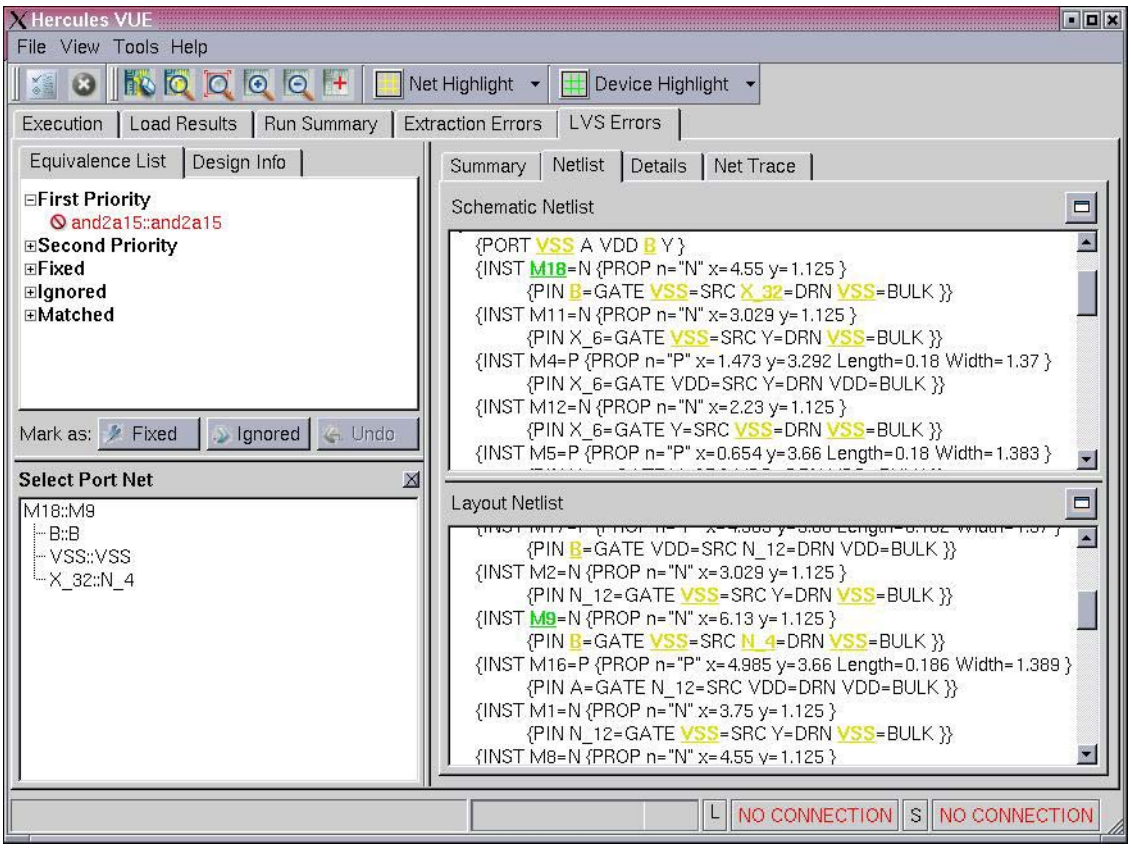
For additional highlighting control, right-click in the highlight list and choose either Select Layer List or Select Area. This brings up the LVS options window. From here, you can turn off highlighting layers, or limit the highlighting to a specific region.

Note:
The LVS options apply to *all* highlights.

Select Port Net

The Select Port Net utility enables you to highlight a specific device, along with all nets attached to the ports or pins of that device. The associated cross- reference information is also displayed. See Figure 3-38.

Figure 3-38 Select Port Net



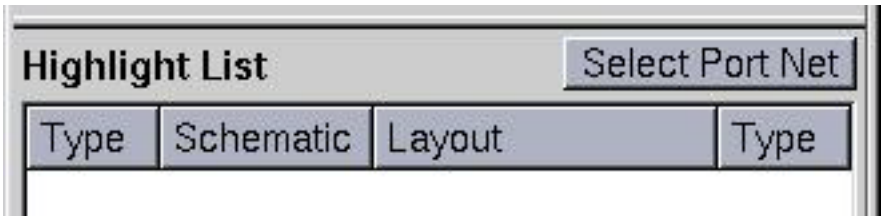
Each element can be individually highlighted from the tree structure listed in the Select Port Net frame.

Note:

If a net is connected more than once to a device (for example, a PMOS whose source and bulk are connected to VDD) that net is listed only once.

To use this utility, click on the Select Port Net button within the Highlight frame. Click on a device within the Summary or Netlist tabs.

Figure 3-39 Select Port Net Button



To close the Select Port Net frame, click the small x in the upper right corner. The Highlight Pane will return.

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