

NOTE: This is an excerpt from the User Manual which may be helpful in understanding the difference between the old interface shown in the videos and the current interface. The full User Manual comes with the IECM and is also available on the Download page on our website.

6. A Case Study

6.1. Introduction

This chapter is meant to be used with the IECM Interface installed and running. The case study takes you to the commonly used screens described in the previous chapter. It is recommended that you:

1. Follow the directions to set up a plant, enter input parameters, and look at results for the sample plant.
2. Compare the screen shots to the screens you see.

If you have not already done so, you will need to install the IECM software as described in "3. Installing the IECM" on page 10.

A detailed description of all available screens is found in "5. How to Use the Modules Included With the IECM" on page 90.

6.2. Start the IECM

To start the IECM Interface, click on it in the Start Menu. (For more detailed instructions, see "4.1.1. Starting the IECM Interface" on page 19.) When the IECM launches, a Splash Screen is displayed:

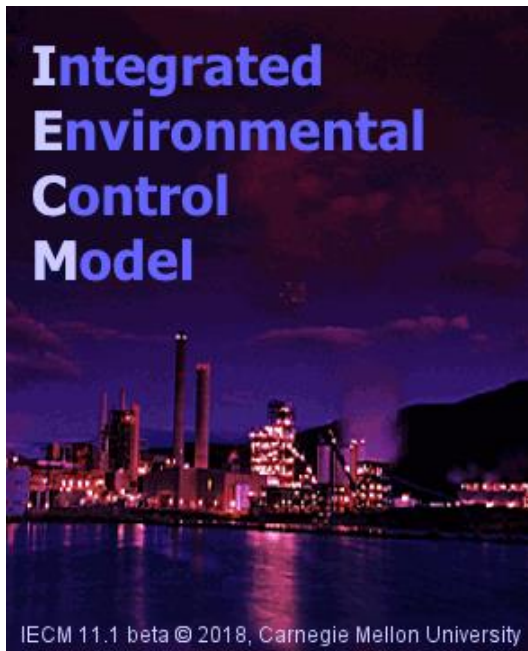


Illustration 599: The IECM Splash Screen

The Splash Screen will disappear after a few seconds, or you can click on it to dismiss it if you don't want to wait.

Once the IECM has started, the Main Window displays:

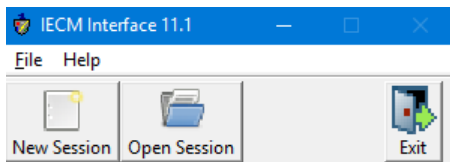


Illustration 600: The IECM Main Window

See "4.1.2. The Main Window" on page 20 for more information.

6.3. Create a New Session

The first time you use the software, you will have to create a new session. At subsequent startups, you can create a new session or use a previously saved session. See "4.1.3. Creating and Opening Sessions" on page 22 for more details.

To create a new session, do one of the following:

- Open the "File" menu (see "4.1.2.1.1. The File Menu" on page 20) and choose "New Session...".
- Click the "New Session" button on the toolbar in either the main window (see "4.1.2.2. The Main Window Toolbar" on page 21) or a session window (see "4.1.4.2.1. The "New Session" Button" on page 31).
- Type **Ctrl-N**.

Once you have activated the "New Session" command, a "New Session" dialog will be displayed:



Illustration 601: The "New Session" Dialog

Choose the "Pulverized Coal (PC)" plant type, and name it "Case Study". The dialog should look like this:

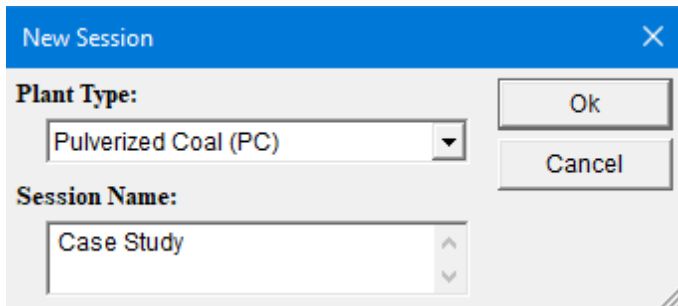


Illustration 602: The "New Session" Dialog: Case Study

Click the "Ok" button to create the session.

Once you have created a session, a session window will display. It contains all the screens used by the session. The screen should look like the following:

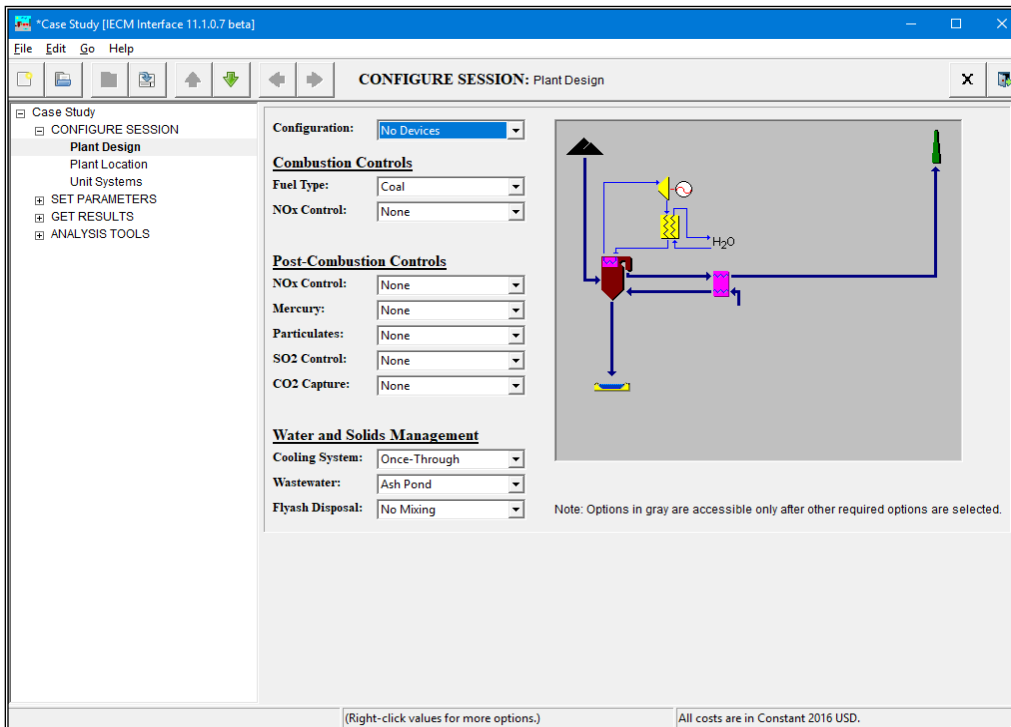


Illustration 603: The Session Window

See "4.1.4. The Session Window" on page 27 for more details.

The Navigation Panel on the left is used to select which screen will be displayed:

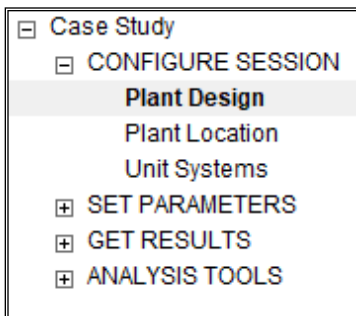


Illustration 604: The Navigation Panel

See "4.1.4.4. The Navigation Panel" on page 33 for more information on how the Navigation Panel is organized and how to use it.

6.4. Configure Session

The "Plant Design" screen in the "CONFIGURE SESSION" program area will be the first screen displayed in the session window. See "4.2. Configuring the Plant" on page 45 for more details.

On this screen, choose "Typical New Plant" from the "Configuration" menu at the top of the screen, and notice how the menus for individual technologies are updated. (See "2.3. Pull-Down Menus" on page 4 for details on how to use the pull-down menus.)

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Next, under "Post-Combustion Controls", set the "Mercury" option to "Carbon Injection". Notice that the value of the "Configuration" menu at the top changes to "<User Defined>" when you do this.

Detailed descriptions of the settings on this screen are given in "5.2.1.1. Plant Design" on page 107.

The screen should now look like this:

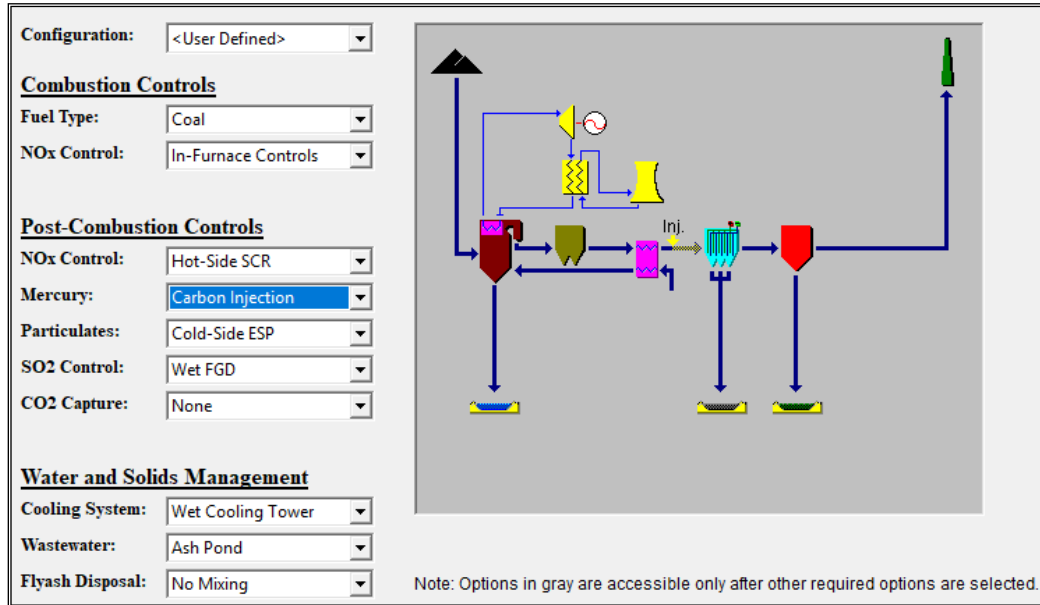


Illustration 605: The Plant Design Screen

We will accept the model default values for the other screens in "CONFIGURE SESSION". See "4.2.1.2. The "Plant Location" Screen" on page 49 and "4.2.1.3. The "Unit Systems" Screen" on page 50 for more details on these screens.

You may return to "CONFIGURE SESSION" at any time by clicking on it in the Navigation Panel.

6.5. Set Parameters

Click the "SET PARAMETERS" program area in the Navigation Panel. (See "4.1.4.4. The Navigation Panel" on page 33.) The screen should look like this:

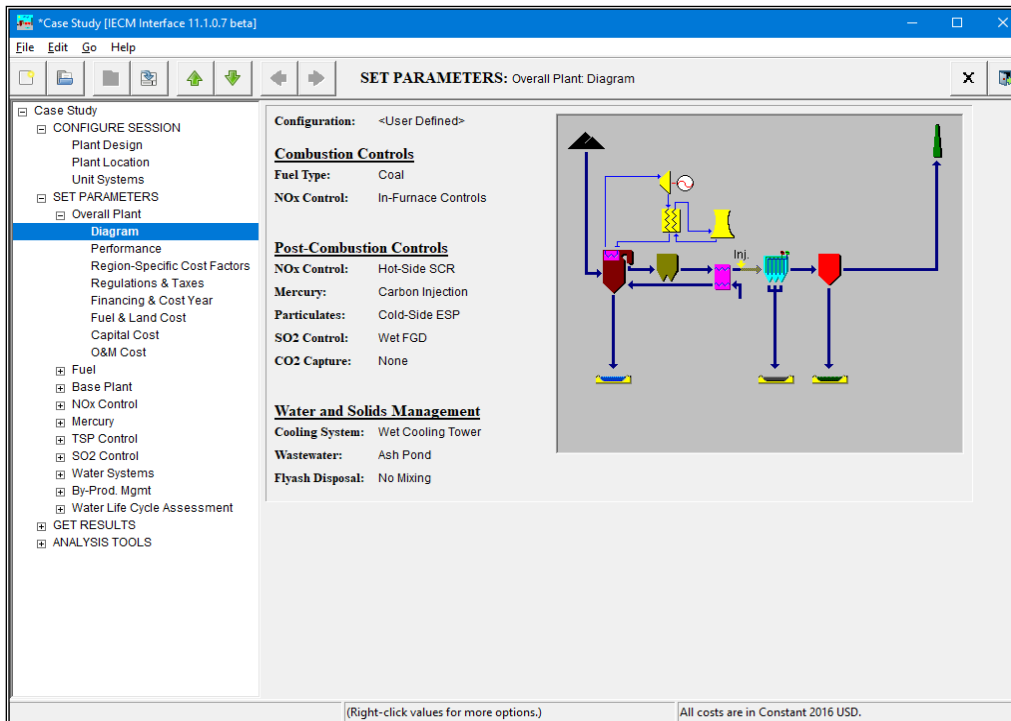


Illustration 606: The "SET PARAMETERS" Program Area

You may return to "SET PARAMETERS" and change the inputs at any time by clicking on it in the Navigation Panel. (See "4.1.4.4. The Navigation Panel" on page 33.) Information on how to use the parameter screens is found in "4.3. Setting Parameters" on page 53. Detailed descriptions of all inputs available in the PC plant are given "5.2.2. SET PARAMETERS" on page 115.

6.5.1. Overall Plant

The first screen in the "SET PARAMETERS" program area is the "Overall Plant Diagram":

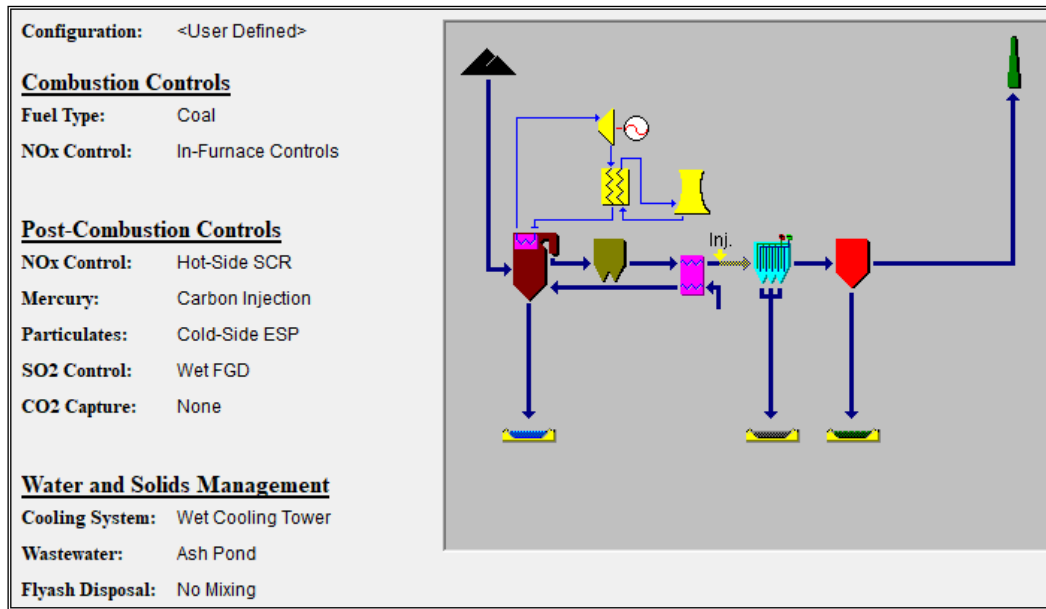


Illustration 607: SET PARAMETERS: Overall Plant: Diagram

This screen displays the plant configuration settings on the left side of the page and a diagram of the plant as configured at the right of the page. No inputs are entered on this screen.

You can navigate to the other Technologies by clicking on them in the Navigation Panel:

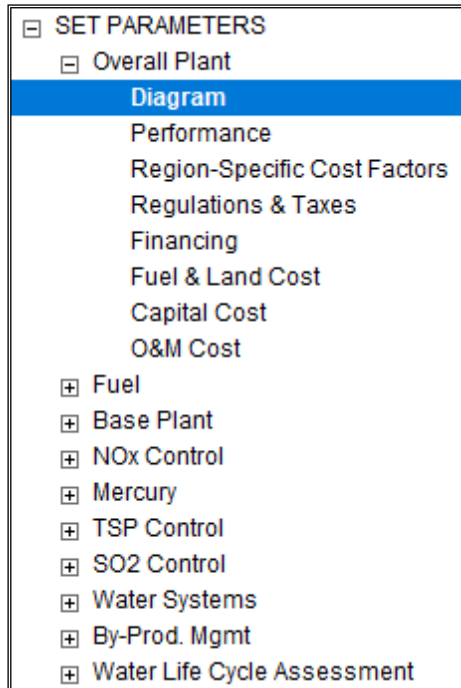


Illustration 608: SET PARAMETERS in the Navigation Panel

See "4.1.4.4. The Navigation Panel" on page 33 for details on how to use the Navigation Panel.

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6.5.1.1. Performance

Click "Performance", which is the second screen in the "Overall Plant" technology. The screen should look like this:

| Title | Unc | Value | Calc | Min | Max | Default |
|--|--------------------------|----------|-------------------------------------|-----------|----------|---------|
| Gross Electrical Output (MWg) <i>(See Base Plant to set this value)</i> | <input type="checkbox"/> | 650.0 | <input checked="" type="checkbox"/> | 100.0 | 2500 | Calc |
| Capacity Factor (%) | <input type="checkbox"/> | 75.00 | | 1.000e-15 | 100.0 | 75.00 |
| Ambient Air Temperature (Dry Bulb Average) (deg. F) | <input type="checkbox"/> | 66.00 | | 15.00 | 100.0 | 66.00 |
| Ambient Air Pressure (Average) (psia) | <input type="checkbox"/> | 14.70 | | 12.00 | 15.00 | 14.70 |
| Relative Humidity (Average) (%) | <input type="checkbox"/> | 50.00 | | 0.0 | 100.0 | 50.00 |
| Ambient Air Humidity (Average) (lb H2O/lb dry air) | <input type="checkbox"/> | 6.770e-3 | <input checked="" type="checkbox"/> | 0.0 | 3.000e-2 | Calc |
| Water Life Cycle Assessment Enabled? | <input type="checkbox"/> | Yes | | Menu | Menu | Yes |

Illustration 609: The Overall Plant Performance Parameter Screen

The inputs on this screen affect the overall plant, not just one component. A detailed description of this screen may be found in "5.2.2.1.2. Performance" on page 116.

The capacity factor is highlighted in blue to point out its importance. Select the value in the "Value" column for "Capacity Factor", change it to 80, and press the **return** key. (See "4.3.3.1.3. Value" on page 56 for more information on how to enter inputs.)

The screen should now look like this:

| Title | Unc | Value | Calc | Min | Max | Default |
|--|--------------------------|----------|-------------------------------------|-----------|----------|---------|
| Gross Electrical Output (MWg) <i>(See Base Plant to set this value)</i> | <input type="checkbox"/> | 650.0 | <input checked="" type="checkbox"/> | 100.0 | 2500 | Calc |
| Capacity Factor (%) | <input type="checkbox"/> | 80.00 | | 1.000e-15 | 100.0 | 75.00 |
| Ambient Air Temperature (Dry Bulb Average) (deg. F) | <input type="checkbox"/> | 66.00 | | 15.00 | 100.0 | 66.00 |
| Ambient Air Pressure (Average) (psia) | <input type="checkbox"/> | 14.70 | | 12.00 | 15.00 | 14.70 |
| Relative Humidity (Average) (%) | <input type="checkbox"/> | 50.00 | | 0.0 | 100.0 | 50.00 |
| Ambient Air Humidity (Average) (lb H2O/lb dry air) | <input type="checkbox"/> | 6.770e-3 | <input checked="" type="checkbox"/> | 0.0 | 3.000e-2 | Calc |
| Water Life Cycle Assessment Enabled? | <input type="checkbox"/> | Yes | | Menu | Menu | Yes |

Illustration 610: 80% Capacity Factor

6.5.2. Fuel

Next, click "Fuel", the second technology in the Navigation Panel. This will open the first screen in the "Fuel" technology, which in this case is "Coal Properties":

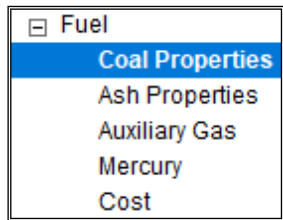


Illustration 611: Fuel Parameters in the Navigation Panel

Inputs in the "Fuel" technology define the composition and cost of the fuel(s) used in the plant. The "Coal Properties" screen in particular defines the composition and cost of the coal. It looks like this:

| Title | Unc | Value | Calc | Min | Max | Default |
|--|--------------------------|---------------------------|-------------------------------------|-------|----------|----------|
| Click here to retrieve a coal from the database. | | | | | | |
| Coal Rank | | Bituminous | <input checked="" type="checkbox"/> | Menu | Menu | Calc |
| Coal Name | | Appalachian Medium Sulfur | | | | |
| Coal Source | | Default | | | | |
| Higher Heating Value (Btu/lb) | <input type="checkbox"/> | 1.326e+4 | | 3000 | 3.000e+5 | 1.326e+4 |
| Carbon (wt %) | <input type="checkbox"/> | 73.81 | | 0.0 | 100.0 | 73.81 |
| Hydrogen (wt %) | <input type="checkbox"/> | 4.880 | | 0.0 | 100.0 | 4.880 |
| Oxygen (wt %) | <input type="checkbox"/> | 5.410 | | 0.0 | 100.0 | 5.410 |
| Chlorine (wt %) | <input type="checkbox"/> | 6.000e-2 | | 0.0 | 100.0 | 6.000e-2 |
| Sulfur (wt %) | <input type="checkbox"/> | 2.130 | | 0.0 | 100.0 | 2.130 |
| Nitrogen (wt %) | <input type="checkbox"/> | 1.420 | | 0.0 | 100.0 | 1.420 |
| Ash (wt %) | <input type="checkbox"/> | 7.240 | | 0.0 | 100.0 | 7.240 |
| Moisture (wt %) | <input type="checkbox"/> | 5.050 | | 0.0 | 100.0 | 5.050 |
| Total (wt %) | | 100.0 | <input checked="" type="checkbox"/> | 100.0 | 100.0 | Calc |
| Default Cost (\$/ton) | <input type="checkbox"/> | 45.24 | | | | 45.24 |

NOTE: uncertainty on this screen should only be used for batch processing.

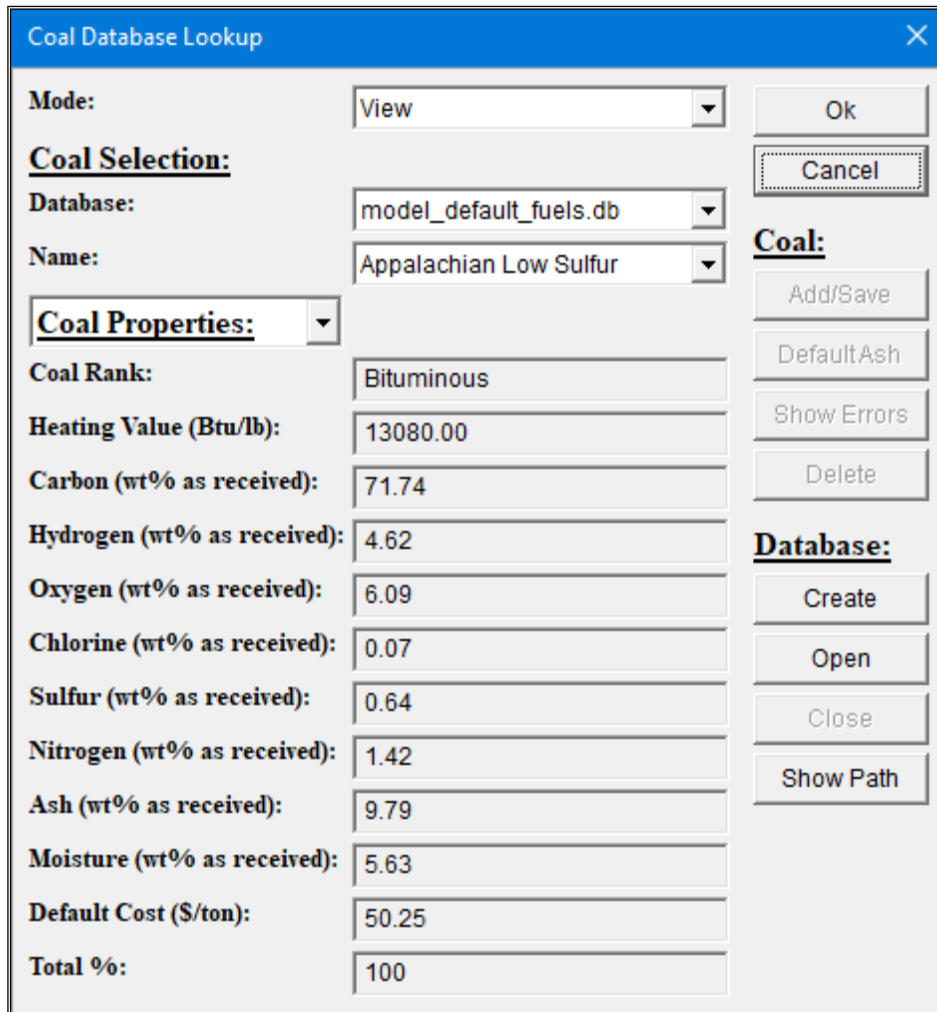
Illustration 612: Coal Properties

A detailed description of this screen may be found in "5.2.2.2.1. Coal Properties" on page 124.

6.5.2.1. Choose a Coal

Looking at the second line on the "Coal Properties" screen, we see that the name of the current coal is "Appalachian Medium Sulfur". We will be using "Illinois #6" for this case study. We will obtain the properties and cost of "Illinois #6" by retrieving it from the model default coals database, which is included with the IECM.

At the top of the screen, above the coal rank, name, etc., there is a button covering the entire width of the screen, labeled "Click here to retrieve a coal from the database." Click that button to bring up this dialog:



| Property | Value |
|-----------------------------|------------|
| Coal Rank: | Bituminous |
| Heating Value (Btu/lb): | 13080.00 |
| Carbon (wt% as received): | 71.74 |
| Hydrogen (wt% as received): | 4.62 |
| Oxygen (wt% as received): | 6.09 |
| Chlorine (wt% as received): | 0.07 |
| Sulfur (wt% as received): | 0.64 |
| Nitrogen (wt% as received): | 1.42 |
| Ash (wt% as received): | 9.79 |
| Moisture (wt% as received): | 5.63 |
| Default Cost (\$/ton): | 50.25 |
| Total %: | 100 |

Illustration 613: The Coal Database Lookup Dialog

Looking at the "Coal Selection" section near the top of the dialog, we see that the model default fuels database, "model_default_fuels.db" is already selected. Choose "Illinois #6" from the "Name:" menu. (See "2.3. Pull-Down Menus" on page 4.) The dialog should now look like this:

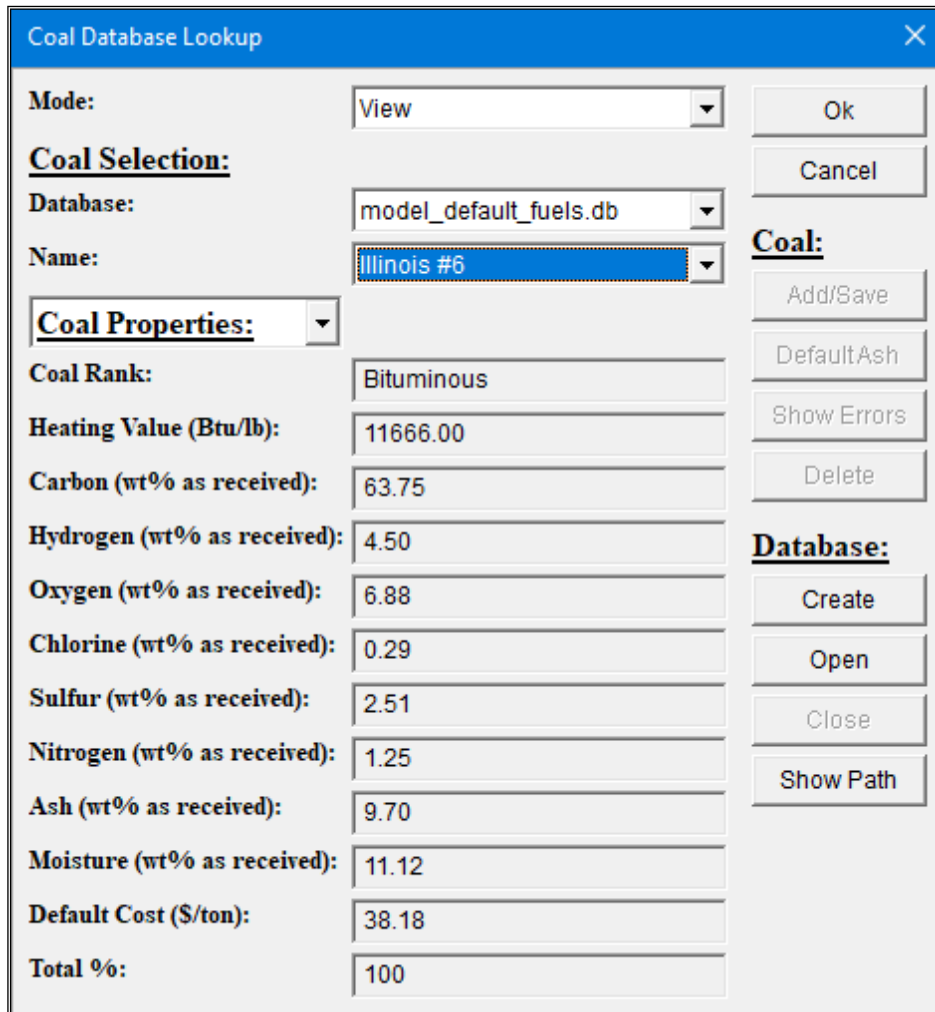


Illustration 614: The Coal Database Lookup Dialog: Illinois #6

Press the "Ok" button in the upper right corner to import the coal. The IECM will display a dialog to let you know that the coal was imported successfully:

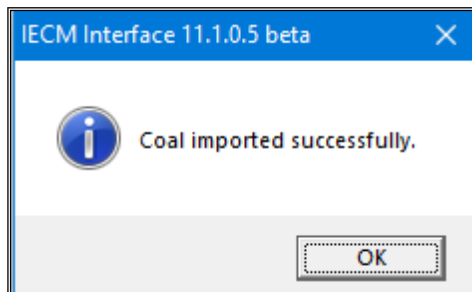


Illustration 615: Coal Imported Successfully

Click the "Ok" button to dismiss this dialog. You should now be back at the "Coal Properties" parameter screen, which looks like this:

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| Title | Unc | Value | Calc | Min | Max | Default |
|--|--------------------------|------------------------|-------------------------------------|-------|----------|----------|
| Click here to retrieve a coal from the database. | | | | | | |
| Coal Rank | | Bituminous | <input checked="" type="checkbox"/> | Menu | Menu | Calc |
| Coal Name | | Illinois #6 | | | | |
| Coal Source | | model_default_fuels.db | | | | |
| Higher Heating Value (Btu/lb) | <input type="checkbox"/> | 1.167e+4 | | 3000 | 3.000e+5 | 1.326e+4 |
| Carbon (wt %) | <input type="checkbox"/> | 63.75 | | 0.0 | 100.0 | 73.81 |
| Hydrogen (wt %) | <input type="checkbox"/> | 4.500 | | 0.0 | 100.0 | 4.880 |
| Oxygen (wt %) | <input type="checkbox"/> | 6.880 | | 0.0 | 100.0 | 5.410 |
| Chlorine (wt %) | <input type="checkbox"/> | 0.2900 | | 0.0 | 100.0 | 6.000e-2 |
| Sulfur (wt %) | <input type="checkbox"/> | 2.510 | | 0.0 | 100.0 | 2.130 |
| Nitrogen (wt %) | <input type="checkbox"/> | 1.250 | | 0.0 | 100.0 | 1.420 |
| Ash (wt %) | <input type="checkbox"/> | 9.700 | | 0.0 | 100.0 | 7.240 |
| Moisture (wt %) | <input type="checkbox"/> | 11.12 | | 0.0 | 100.0 | 5.050 |
| Total (wt %) | | 100.0 | <input checked="" type="checkbox"/> | 100.0 | 100.0 | Calc |
| Default Cost (\$/ton) | <input type="checkbox"/> | 38.18 | | | | 45.24 |
| NOTE: uncertainty on this screen should only be used for batch processing. | | | | | | |

Illustration 616: The Coal Properties Parameter Screen: Illinois #6

For more information on how to use databases, see "4.3.3.4. The Database Button" on page 67.

6.5.3. Base Plant

Click the "Base Plant" technology, located just below "Fuel", in the Navigation Panel:

| |
|-------------------------------------|
| <input type="checkbox"/> Base Plant |
| Boiler Diagram |
| Air Preheater Diagram |
| Base Plant Performance |
| Steam Cycle Diagram |
| Steam Cycle Performance |
| Furnace Factors |
| Capital Cost |
| O&M Cost |
| Retrofit or Adjustment Factors |

Illustration 617: SET PARAMETERS: Base Plant

Inputs in this technology define performance and costs directly associated with the power plant, particularly the boiler. The first screen in this technology, which is shown when you click on it, is the "Boiler Diagram":

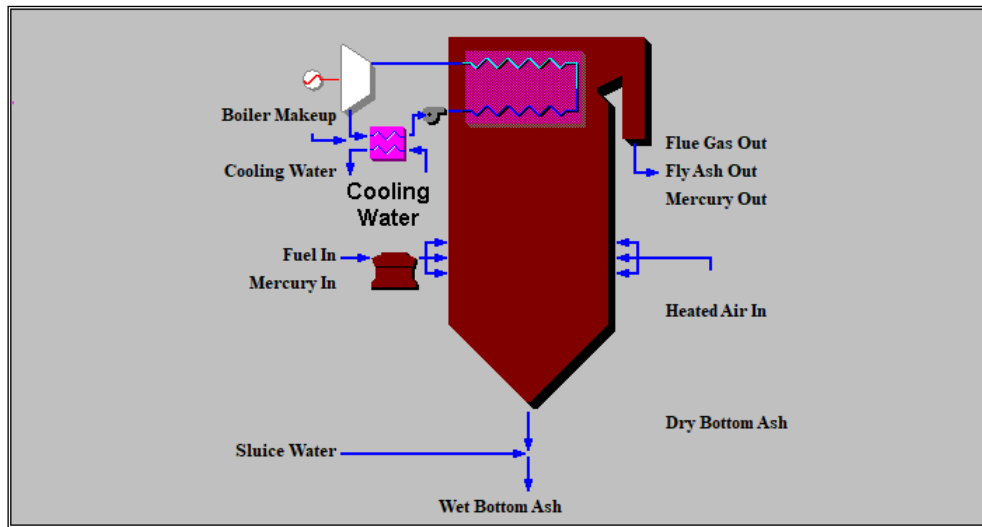


Illustration 618: SET PARAMETERS: Base Plant: Boiler Diagram

This diagram gives you an overview of the boiler. It does not include results. See "4.3.2. Diagram Screens" on page 53 for more information about diagrams in the "SET PARAMETERS" program area.

6.5.3.1. Base Plant Performance

Click "Base Plant Performance" under the "Base Plant" technology to go to the "Base Plant Performance" parameter screen:

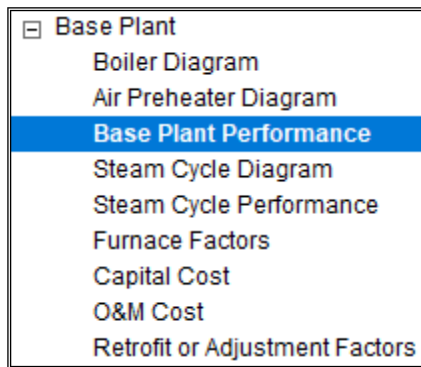


Illustration 619: SET PARAMETERS: Base Plant: Base Plant Performance

The "Base Plant Performance" parameter screen looks like this:

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| Title | Unc | Value | Calc | Min | Max | Default |
|--|--------------------------|---------------|-------------------------------------|-------|----------|---------------|
| Gross Electrical Output (MWg) | <input type="checkbox"/> | 650.0 | <input checked="" type="checkbox"/> | 100.0 | 2500 | Calc |
| Unit Type | <input type="checkbox"/> | Supercritical | | Menu | Menu | Supercritical |
| Steam Cycle Heat Rate, HHV (Btu/kWh) | <input type="checkbox"/> | 7359 | <input checked="" type="checkbox"/> | 6000 | 1.500e+4 | Calc |
| Boiler Firing Type | <input type="checkbox"/> | Tangential | | Menu | Menu | Tangential |
| Boiler Efficiency (%) | <input type="checkbox"/> | 88.64 | <input checked="" type="checkbox"/> | 50.00 | 100.0 | Calc |
| Excess Air For Furnace (% stoich.) | <input type="checkbox"/> | 20.00 | <input checked="" type="checkbox"/> | 0.0 | 40.00 | Calc |
| Leakage Air at Preheater (% stoich.) | <input type="checkbox"/> | 10.00 | <input checked="" type="checkbox"/> | 0.0 | 50.00 | Calc |
| Gas Temperature Exiting Economizer (deg. F) | <input type="checkbox"/> | 700.0 | | 250.0 | 1200 | 700.0 |
| Gas Temperature Exiting Air Preheater (deg. F) | <input type="checkbox"/> | 300.0 | | 150.0 | 500.0 | 300.0 |
| Percent Water in Bottom Ash Sluice (%) | <input type="checkbox"/> | 0.0 | <input checked="" type="checkbox"/> | 0.0 | 99.99 | Calc |
| Hydrated Lime for SO3 Removal (lb/kmol SO3) | <input type="checkbox"/> | 2335 | | | | 2335 |
| Base Plant Power Requirements | | | | | | |
| Coal Pulverizer (% MWg) | <input type="checkbox"/> | 0.5500 | <input checked="" type="checkbox"/> | 0.0 | 3.000 | Calc |
| Steam Cycle Pumps (% MWg) | <input type="checkbox"/> | 0.2000 | <input checked="" type="checkbox"/> | 0.0 | 3.000 | Calc |
| Forced / Induced Draft Fans (% MWg) | <input type="checkbox"/> | 1.510 | <input checked="" type="checkbox"/> | 0.0 | 5.000 | Calc |
| Miscellaneous (% MWg) | <input type="checkbox"/> | 0.9700 | <input checked="" type="checkbox"/> | 0.0 | 5.000 | Calc |

Illustration 620: The Base Plant Performance Parameter Screen

Inputs for the major flow rates and concentrations of the gas and solids streams are entered on this screen.

The first seven inputs are highlighted in blue to point out their importance. Detailed descriptions of all inputs are given in "5.2.2.3.3. Base Plant Performance" on page 130. Descriptions of how to enter inputs and replace calculated values are given in "4.3.3.1.3. Value" on page 56 and "4.3.3.1.4. Calc" on page 57, respectively.

When you change an input, the model is run to ensure that calculated inputs are correct. You may notice a slight delay as this happens.

Enter the following values for the first seven inputs:

- **Gross Electrical Output:** 600 MW (override calculated value)
- **Unit Type:** Supercritical (the default value)
- **Steam Cycle Heat Rate:** 8100 Btu/kWh (override calculated value)
- **Boiler Firing Type:** Tangential (the default value)
- **Boiler Efficiency:** this is calculated by the model – do not change it
- **Excess Air For Furnace:** this is calculated by the model – do not change it
- **Leakage Air at Preheater:** 10% (override calculated value)

When you are finished, the screen should look like this:

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| Title | Unc | Value | Calc | Min | Max | Default |
|--|--------------------------|---------------|-------------------------------------|-------|----------|---------------|
| Gross Electrical Output (MWg) | <input type="checkbox"/> | 600.0 | <input type="checkbox"/> | 100.0 | 2500 | Calc |
| Unit Type | <input type="checkbox"/> | Supercritical | | Menu | Menu | Supercritical |
| Steam Cycle Heat Rate, HHV (Btu/kWh) | <input type="checkbox"/> | 8100 | <input type="checkbox"/> | 6000 | 1.500e+4 | Calc |
| Boiler Firing Type | <input type="checkbox"/> | Tangential | | Menu | Menu | Tangential |
| Boiler Efficiency (%) | <input type="checkbox"/> | 88.64 | <input checked="" type="checkbox"/> | 50.00 | 100.0 | Calc |
| Excess Air For Furnace (% stoich.) | <input type="checkbox"/> | 20.00 | <input checked="" type="checkbox"/> | 0.0 | 40.00 | Calc |
| Leakage Air at Preheater (% stoich.) | <input type="checkbox"/> | 10.00 | <input type="checkbox"/> | 0.0 | 50.00 | Calc |
| Gas Temperature Exiting Economizer (deg. F) | <input type="checkbox"/> | 700.0 | | 250.0 | 1200 | 700.0 |
| Gas Temperature Exiting Air Preheater (deg. F) | <input type="checkbox"/> | 300.0 | | 150.0 | 500.0 | 300.0 |
| Percent Water in Bottom Ash Sluice (%) | <input type="checkbox"/> | 0.0 | <input checked="" type="checkbox"/> | 0.0 | 99.99 | Calc |
| Hydrated Lime for SO3 Removal (lb/kmol SO3) | <input type="checkbox"/> | 2335 | | | | 2335 |
| Base Plant Power Requirements | | | | | | |
| Coal Pulverizer (% MWg) | <input type="checkbox"/> | 0.5500 | <input checked="" type="checkbox"/> | 0.0 | 3.000 | Calc |
| Steam Cycle Pumps (% MWg) | <input type="checkbox"/> | 0.2000 | <input checked="" type="checkbox"/> | 0.0 | 3.000 | Calc |
| Forced / Induced Draft Fans (% MWg) | <input type="checkbox"/> | 1.510 | <input checked="" type="checkbox"/> | 0.0 | 5.000 | Calc |
| Miscellaneous (% MWg) | <input type="checkbox"/> | 0.9700 | <input checked="" type="checkbox"/> | 0.0 | 5.000 | Calc |

Illustration 621: The Updated Base Plant Performance Parameter Screen

Next, define a triangular distribution for boiler efficiency:

1. Click the "Boiler Efficiency (%)" uncertainty button in the "Unc" column. (See "4.3.3.1.2. Unc" on page 56.) This will bring up the Uncertainty Editor:

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| Plant Parameter | Value | Min | Max |
|-----------------------|-------|-------|-------|
| Boiler Efficiency (%) | 88.64 | 50.00 | 100.0 |

Distribution: None Use Nominal Values Sample Size: 50

Information:
No Uncertainty.

Illustration 622: The Uncertainty Editor

See "4.3.3.3. The Uncertainty Editor" on page 58 for more information on how to use the Uncertainty Editor.

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2. Select "Triangular" from the "Distribution:" drop-down menu. The Uncertainty Editor should look like this:

The screenshot shows the 'Uncertainty Editor' dialog box. At the top, there is a table with columns: Plant Parameter, Value, Min, and Max. The first row contains 'Boiler Efficiency (%)', '88.64', '50.00', and '100.0'. Below this, the 'Distribution:' dropdown is set to 'Triangular'. There is a checkbox for 'Use Nominal Values' which is unchecked, and a 'Sample Size:' field set to '50'. Below these are 'Nominal Min/Max:' fields. A table for 'Normalized:' and 'Nominal:' values is shown, with all fields set to '0.0'. To the right of this table is a 'Status:' field containing '- Min must be < Max.'. Below the table is a 'Requirements:' section with 'Min <= Mode <= Max' and 'Min < Max'. At the bottom is an 'Information:' section with a warning: 'WARNING: This value is calculated; if the value shifts, the nominal uncertainty will shift with it. If this is not what you intended, you should either un-check the calc box to prevent the value from changing automatically, or use nominal values.'

Illustration 623: The Uncertainty Editor: Triangular Distribution

3. Assume the boiler efficiency can be 1% higher or lower than the nominal value calculated by the IECM. This would be represented by entering 0.99, 1.00, and 1.01 in the **Min**, **Mode**, and **Max** input fields respectively. Notice that these are multiplicative factors. The nominal or actual values are displayed immediately below the normalized values you entered.

After you are finished entering the triangular distribution parameters, the screen should

look like this:

| Plant Parameter | Value | Min | Max |
|-----------------------|-------|-------|-------|
| Boiler Efficiency (%) | 88.64 | 50.00 | 100.0 |

Distribution: Triangular Use Nominal Values Sample Size: 50

Nominal Min/Max: 87.75 89.53

| | Min | Mode | Max | Status: |
|-------------|--------|-------|-------|---------|
| Normalized: | 0.9900 | 1.000 | 1.010 | OK |
| Nominal: | 87.75 | 88.64 | 89.53 | |

Requirements:
Min <= Mode <= Max
Min < Max

Information:
Triangular(a,b,c) describes a triangular-shaped distribution where the values a, b and c represent the minimum, most likely and maximum values, respectively.
WARNING: This value is calculated; if the value shifts, the nominal uncertainty will shift with it. If this is not what you intended, you should either un-check the calc box to prevent the value from changing automatically, or use nominal values.

Illustration 624: The Uncertainty Editor: Case Study Triangular Distribution

4. Click the "Ok" button in the upper right corner to save your changes and close the Uncertainty Editor.

Notice that a "?" appears inside the uncertainty button. This is a reminder that uncertainty has been applied to this input parameter:

Boiler Efficiency (%) ? 88.64

Illustration 625: The Boiler Efficiency Unc Button Indicates Uncertainty

6.5.4. Other Input Areas and Technologies

Default parameters will be used for all the other input areas for the base plant and other technology tabs. You may browse these input screens to view the defaults. All input screens available for the PC plant are described in detail in "5.2.2. SET PARAMETERS" on page 115.

6.6. Get Results

Click the "GET RESULTS" program area in the Navigation Panel. You may need to scroll down to get to it. (See "4.1.4.4. The Navigation Panel" on page 33.) The screen should look like this:

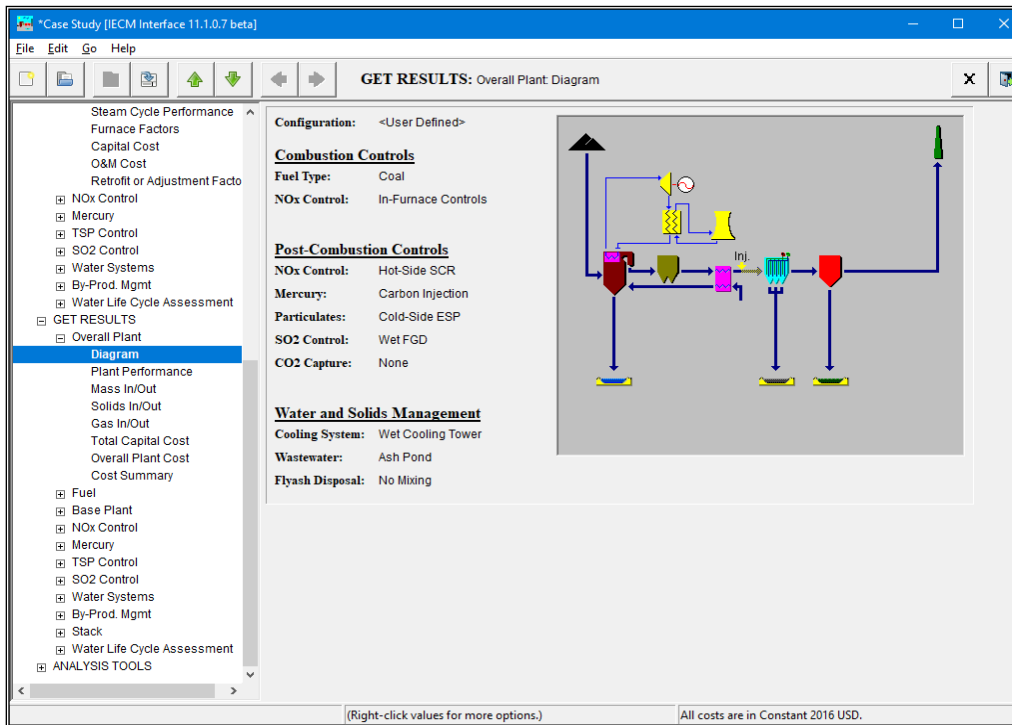


Illustration 626: The "GET RESULTS" Program Area

You may return to "GET RESULTS" to look at results at any time by clicking on it in the Navigation Panel. (See "4.1.4.4. The Navigation Panel" on page 33.) Information on how to use the result screens is found in "4.4. Getting Results" on page 75. Detailed descriptions of all results available in the PC plant are given in "5.2.3. GET RESULTS" on page 268.

6.6.1. Overall Plant

The first screen in the "GET RESULTS" program area is the "Overall Plant Diagram":

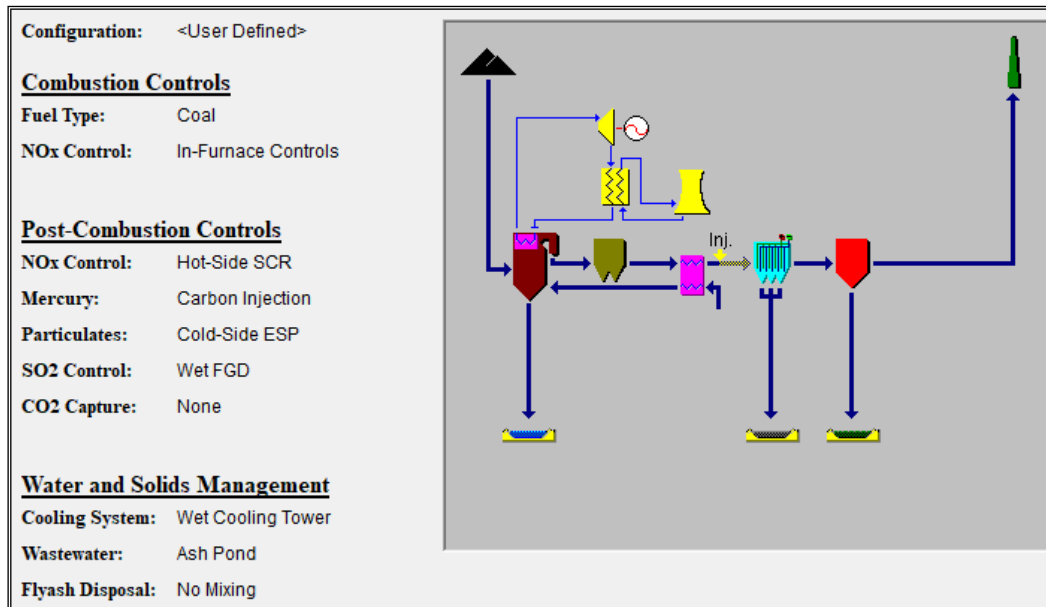


Illustration 627: GET RESULTS: Overall Plant: Diagram

This screen displays the plant configuration settings on the left side of the page and a diagram of the plant as configured on the right side of the page. It is the same as the "Overall Plant Diagram" found in "SET PARAMETERS".

You can navigate to the other Technologies by clicking on them in the Navigation Panel:

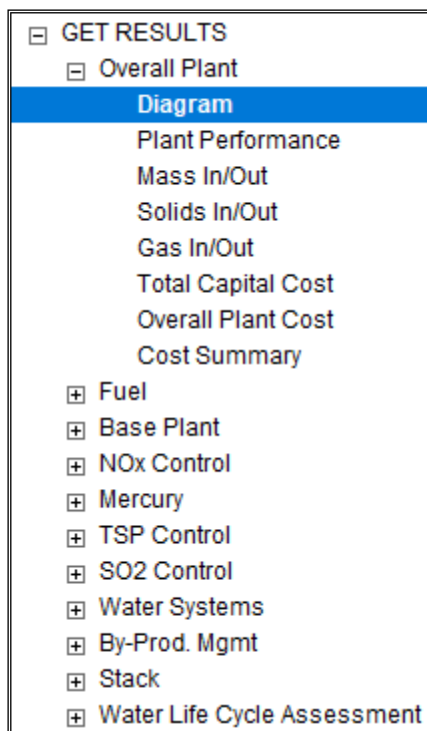


Illustration 628: GET RESULTS in the Navigation Panel

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See "4.1.4.4. The Navigation Panel" on page 33 for details on how to use the Navigation Panel.

6.6.1.1. Performance Summary

Click "Plant Performance", the second screen under "Overall Plant". It displays performance results for the plant as a whole. Values for the major input and outputs of the power plant are given. The screen should look like this:

| | A | B | | A | B |
|----|--------------------------------------|-------|----|-------------------------------------|----------|
| 1 | Performance Parameter | Value | 1 | Plant Electricity Requirements | Value |
| 2 | Net Electrical Output (MW) | 558.3 | 2 | Gross Electrical Output (MWg) | 600.0 |
| 3 | | | 3 | | |
| 4 | Primary Fuel Input (MBtu/hr) | 5483 | 4 | | |
| 5 | | | 5 | Base Plant Use (MW) | 19.38 |
| 6 | Total Plant Input (MBtu/hr) | 5483 | 6 | In-Furnace NOx Use (MW) | 0.0 |
| 7 | | | 7 | Hot-Side SCR Use (MW) | 3.208 |
| 8 | Gross Plant Heat Rate, HHV (Btu/kWh) | 9138 | 8 | Cold-Side ESP Use (MW) | 0.9944 |
| 9 | Net Plant Heat Rate, HHV (Btu/kWh) | 9820 | 9 | Wet FGD Use (MW) | 10.55 |
| 10 | | | 10 | Activated Carbon Injection Use (MW) | 6.633e-2 |
| 11 | Annual Operating Hours (hours) | 7013 | 11 | | |
| 12 | Annual Power Generation (BkWh/yr) | 3.915 | 12 | | |
| 13 | | | 13 | Cooling Tower Use (MW) | 7.500 |
| 14 | Net Plant Efficiency, HHV (%) | 34.75 | 14 | | |
| 15 | | | 15 | Net Electrical Output (MW) | 558.3 |
| 16 | | | 16 | | |

Illustration 629: GET RESULTS: Overall Plant: Plant Performance

You should notice that the Gross Plant Size is the same as you entered earlier. The other parameters are calculated by the model as a function of the other input parameters and technologies loaded. Each result is described in detail in "5.2.3.1.2. Plant Performance" on page 268.

6.6.1.2. Gas In/Out

Click "Gas In/Out", the fifth screen under "Overall Plant". It shows the flow of gas components in, through, and out of the power plant. The screen should look like this:

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| | A | B | C | D | E | F | |
|----|--|------------------------------|------------------------------|------------------------------|-------------------------------|------------------------------------|--------------------|
| 1 | Gas Components (at technology exit unless noted) | APH Oxidant In (lb-moles/hr) | APH Recycle In (lb-moles/hr) | APH Heated Air (lb-moles/hr) | Combustion Zone (lb-moles/hr) | Post-Combustion Zone (lb-moles/hr) | Econ (lb-moles/hr) |
| 2 | Nitrogen (N2) | 1.321e+5 | 0.0 | 1.321e+5 | 1.323e+5 | 1.323e+5 | 1.32 |
| 3 | Oxygen (O2) | 3.543e+4 | 0.0 | 3.543e+4 | 5883 | 5899 | 58 |
| 4 | Water Vapor (H2O) | 1833 | 0.0 | 1833 | 1.518e+4 | 1.518e+4 | 1.51 |
| 5 | Carbon Dioxide (CO2) | 0.0 | 0.0 | 0.0 | 2.494e+4 | 2.494e+4 | 2.49 |
| 6 | Carbon Monoxide (CO) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 7 | Hydrochloric Acid (HCl) | 0.0 | 0.0 | 0.0 | 38.43 | 38.43 | 38 |
| 8 | Sulfur Dioxide (SO2) | 0.0 | 0.0 | 0.0 | 355.8 | 355.8 | 35 |
| 9 | Sulfuric Acid (equivalent SO3) | 0.0 | 0.0 | 0.0 | 2.869 | 2.869 | 2.8 |
| 10 | Nitric Oxide (NO) | 0.0 | 0.0 | 0.0 | 72.76 | 44.34 | 72 |
| 11 | Nitrogen Dioxide (NO2) | 0.0 | 0.0 | 0.0 | 3.830 | 2.334 | 3.8 |
| 12 | Ammonia (NH3) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 13 | Argon (Ar) | 1579 | 0.0 | 1579 | 1579 | 1579 | 15 |
| 14 | Total | 1.709e+5 | 0.0 | 1.709e+5 | 1.803e+5 | 1.803e+5 | 1.80 |
| 15 | | | | | | | |
| 16 | | | | | | | |

Illustration 630: GET RESULTS: Overall Plant: Gas In/Out

Note the scroll bar at the bottom of the screen. This table contains more columns than will fit on the screen at one time; use the scroll bar to view the rest of the columns.

The total is highlighted in yellow. Each result is described in detail in "5.2.3.1.5. Gas In/Out" on page 271.

The results above are based on a maximum hourly flow rate which assumes 100% capacity. To see the annual average values, which takes into consideration the capacity factor you entered earlier, do the following:

1. Return to the "CONFIGURE SESSION" program area (see "4.1.4.4. The Navigation Panel" on page 33) and click on the third screen in that area, "Unit Systems". The screen should look like this:

Unit Options

IECM Default Unit System: English

Current Session Unit System: Default

Result Time Period: Max Hourly

Performance Table: Default

Cost Table: \$/kW(Cap), \$/MWh(O&M)

Illustration 631: CONFIGURE SESSION: Unit Systems

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- Select "Annual Avg." from the "Result Time Period" menu. (See "2.3. Pull-Down Menus" on page 4.) The screen should now look like this:

Unit Options

IECM Default Unit System: English

Current Session Unit System: Default

Result Time Period: Annual Avg.

Performance Table: Default

Cost Table: \$/kW(Cap), \$/MWh(O&M)

Illustration 632: CONFIGURE SESSION: Unit Systems

- Return to the "GET RESULTS" program area and click on the "Gas In/Out" screen in the "Overall Plant" technology. (See "4.1.4.4. The Navigation Panel" on page 33.) The screen should look like this:

| | A | B | C | D | E | F | |
|----|--|-----------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------------|-------------|
| 1 | Gas Components (at technology exit unless noted) | APH Oxidant In (lb-mole/yr) | APH Recycle In (lb-mole/yr) | APH Heated Air (lb-mole/yr) | Combustion Zone (lb-mole/yr) | Post-Combustion Zone (lb-mole/yr) | Econ (lb-m |
| 2 | Nitrogen (N2) | 9.264e+8 | 0.0 | 9.264e+8 | 9.278e+8 | 9.278e+8 | 9.27 |
| 3 | Oxygen (O2) | 2.485e+8 | 0.0 | 2.485e+8 | 4.126e+7 | 4.137e+7 | 4.12 |
| 4 | Water Vapor (H2O) | 1.285e+7 | 0.0 | 1.285e+7 | 1.065e+8 | 1.065e+8 | 1.06 |
| 5 | Carbon Dioxide (CO2) | 0.0 | 0.0 | 0.0 | 1.749e+8 | 1.749e+8 | 1.74 |
| 6 | Carbon Monoxide (CO) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | Hydrochloric Acid (HCl) | 0.0 | 0.0 | 0.0 | 2.695e+5 | 2.695e+5 | 2.69 |
| 8 | Sulfur Dioxide (SO2) | 0.0 | 0.0 | 0.0 | 2.495e+6 | 2.495e+6 | 2.49 |
| 9 | Sulfuric Acid (equivalent SO3) | 0.0 | 0.0 | 0.0 | 2.012e+4 | 2.012e+4 | 2.01 |
| 10 | Nitric Oxide (NO) | 0.0 | 0.0 | 0.0 | 5.103e+5 | 3.110e+5 | 5.10 |
| 11 | Nitrogen Dioxide (NO2) | 0.0 | 0.0 | 0.0 | 2.686e+4 | 1.637e+4 | 2.68 |
| 12 | Ammonia (NH3) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | Argon (Ar) | 1.107e+7 | 0.0 | 1.107e+7 | 1.107e+7 | 1.107e+7 | 1.10 |
| 14 | Total | 1.199e+9 | 0.0 | 1.199e+9 | 1.264e+9 | 1.264e+9 | 1.26 |
| 15 | | | | | | | |
| 16 | | | | | | | |

Illustration 633: GET RESULTS: Overall Plant: Gas In/Out (Annual Avg.)

Notice that the values are now in lb-moles/yr instead of lb-moles/hr.

6.6.1.3. Cost Summary

Click "Cost Summary", the last screen under "Overall Plant". It displays costs associated with the power plant as a whole. The screen should look like this:

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| | A | B | C | D | E |
|----|---|------------------------|------------------------------|---------------------------|---------------------------|
| 1 | Technology | Capital Required (M\$) | Capital Required (\$/kW-net) | Revenue Required (M\$/yr) | Revenue Required (\$/MWh) |
| 2 | In-Furnace NO _x Control | 8.577 | 15.36 | 1.096 | 0.2799 |
| 3 | Post-Combustion NO _x Control | 31.00 | 55.52 | 6.244 | 1.595 |
| 4 | Mercury Control | 9.039e-2 | 0.1619 | 0.1177 | 3.005e-2 |
| 5 | TSP Control | 26.92 | 48.22 | 6.687 | 1.708 |
| 6 | SO ₂ Control | 151.3 | 270.9 | 35.99 | 9.192 |
| 7 | Combined SO _x /NO _x Control | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | CO ₂ Capture, Transport & Storage | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | Subtotal | 217.9 | 390.2 | 50.13 | 12.80 |
| 10 | Cooling Tower | 60.13 | 107.7 | 13.71 | 3.501 |
| 11 | Wastewater Control | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 | Base Plant | 851.9 | 1526 | 177.5 | 45.34 |
| 13 | Land | 0.9306 | 1.667 | 0.1050 | 2.681e-2 |
| 14 | Emission Taxes | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 | Total | 1131 | 2025 | 241.5 | 61.67 |
| 16 | | | | | |

Illustration 634: GET RESULTS: Overall Plant: Cost Summary

The cost year is displayed on the right side of the status bar along the bottom edge of the window (see "4.1.4.3. The Status Bar" on page 33.) Since we didn't change it, the default is used, currently constant 2016 dollars. You may change this and other related financial parameters on the "SET PARAMETERS: Overall Plant: Financing" parameter screen (see "5.2.2.1.5. Financing & Cost Year" on page 119) if needed.

Each result is described in detail in "5.2.3.1.8. Cost Summary" on page 274.

6.6.2. Base Plant

Click the "Base Plant" technology in the "GET RESULTS" program area:

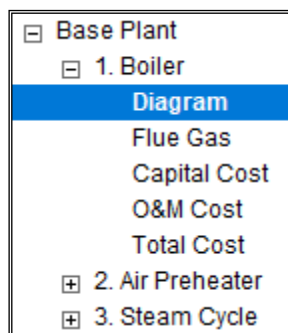


Illustration 635: GET RESULTS: Base Plant

This area contains result screens for flows and costs related to the base plant.

The first process type in the "Base Plant" technology, which will be automatically selected when you click it, is "1. Boiler". (See "4.1.4.4. The Navigation Panel" on page 33.) This area contains result screens for flows and costs related to the boiler itself.

6.6.2.1. Diagram

The first screen in the "1. Boiler" process type is the boiler diagram. This screen displays an icon for the Boiler and values for major flows in and out of it.

Since the boiler diagram is the first screen in the "Base Plant" technology, it will be automatically selected when you click "Base Plant". The screen should look like this:

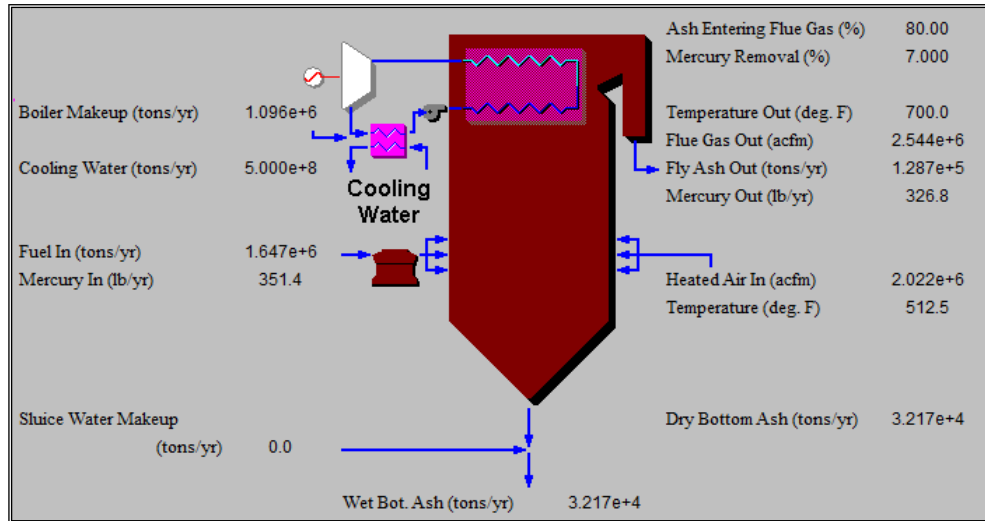


Illustration 636: GET RESULTS: Base Plant: 1. Boiler: Diagram

The flow rates are shown in annual average units (tons/yr) due to the unit change made earlier. Due to the trace flow rates of mercury, its flow rate is reported in lb/yr.

Each result is described in detail in "5.2.3.3.1.1. Diagram" on page 276.

6.6.2.2. Capital Cost

Click the third screen in the "1. Boiler" process type, "Capital Cost". This screen displays tables for the direct and indirect capital costs related to the boiler. The screen looks like this:

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| | A | B | | A | B |
|----|-------------------------------|--------------------------|----|---------------------------------|--------------------------|
| 1 | Base Plant Process Area Costs | Capital Cost (\$/kW-net) | 1 | Base Plant Plant Costs | Capital Cost (\$/kW-net) |
| 2 | Steam Generator | 488.6 | 2 | Process Facilities Capital | 1068 |
| 3 | Turbine Island | 257.0 | 3 | General Facilities Capital | 106.8 |
| 4 | Coal Handling | 156.0 | 4 | Engineering & Home Office Fees | 69.41 |
| 5 | Ash Handling | 27.73 | 5 | Process Contingency Cost | 21.35 |
| 6 | Water Treatment | 25.08 | 6 | Project Contingency Cost | 115.9 |
| 7 | Auxiliaries | 113.3 | 7 | Interest Charges (AFUDC) | 100.3 |
| 8 | Process Facilities Capital | 1068 | 8 | Royalty Fees | 0.7474 |
| 9 | | | 9 | Preproduction (Startup) Cost | 42.84 |
| 10 | | | 10 | Inventory (Working) Capital | 0.8288 |
| 11 | | | 11 | Financing Cost | 0.0 |
| 12 | | | 12 | Other Owner's Costs | 0.0 |
| 13 | | | 13 | Total Capital Requirement (TCR) | 1526 |
| 14 | | | 14 | | |
| 15 | | | 15 | | |
| 16 | | | 16 | Effective TCR | 1526 |

Illustration 637: GET RESULTS: Base Plant: 1. Boiler: Capital Cost

The cost year is always shown on the right side of the status bar at the bottom of the window. (See "4.1.4.3. The Status Bar" on page 33.) You may change this and other related financial parameters on the "SET PARAMETERS: Overall Plant: Financing" parameter screen if needed.

Totals are highlighted in yellow. Each result is described in detail in "5.2.3.3.1.3. Capital Cost" on page 278.

6.6.2.3. O&M Cost

Click the fourth screen in the "1.Boiler" process type, "O&M Cost". This screen displays tables for the variable and fixed O&M costs involved with the Boiler. It looks like this:

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| | A | B | | A | B |
|----|--|-----------------------------|----|--------------------------------|-----------------------------|
| 1 | Variable Cost Component | Levelized O&M Cost (\$/MWh) | 1 | Fixed Cost Component | Levelized O&M Cost (\$/MWh) |
| 2 | Fuel | 16.07 | 2 | Operating Labor | 2.017 |
| 3 | Water | 7.579e-2 | 3 | Maintenance Labor | 1.298 |
| 4 | Hydrated Lime | 0.4289 | 4 | Maintenance Material | 2.411 |
| 5 | Disposal | 8.718e-2 | 5 | Administrative & Support Labor | 0.2321 |
| 6 | Internal Electricity Cost (*) | -1.813 | 6 | Taxes & Insurance | 0.0 |
| 7 | Total Variable Costs | 14.84 | 7 | Total Fixed Costs | 5.959 |
| 8 | | | 8 | | |
| 9 | | | 9 | | |
| 10 | | | 10 | | |
| 11 | (*) Negative cost reflects credits for | | 11 | | |
| 12 | electricity supplied to other plant | | 12 | | |
| 13 | components. | | 13 | | |
| 14 | | | 14 | | |
| 15 | | | 15 | | |
| 16 | | | 16 | Total O&M Costs | 20.80 |

Illustration 638: GET RESULTS: Base Plant: 1. Boiler: O&M Cost

As with "Capital Cost", the cost year may be found on the right side of the status bar. Totals are highlighted in yellow. Each result is described in detail in "5.2.3.3.1.4. O&M Cost" on page 279.

6.7. Graphs

On the "GET RESULTS: Base Plant: 1. Boiler: O&M Cost" screen, locate the "Total Variable Costs" line. This line is toward the middle of the left table and is highlighted in yellow. Right-click this line and choose "Display a Graph of this Result" from the menu that pops up:

| | | | | |
|----|--|--------------|----|--------------------------------|
| 5 | Disposal | 8.718e-2 | 5 | Administrative & Support Labor |
| 6 | Internal Electricity Cost (*) | -1.813 | 6 | Taxes & Insurance |
| 7 | Total Variable Costs | 14.84 | 7 | Total Fixed Costs |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | (*) Negative cost reflects credits for | | 11 | |

Copy this Result as Text

Copy this Result as a Graph

Display a Graph of this Result

Illustration 639: Total Variable Costs Right-click Menu

Double-click the result value on the Boiler—3. O&M Cost result screen for the Total Variable costs. A graph of the value will display. The graph should look something like this:

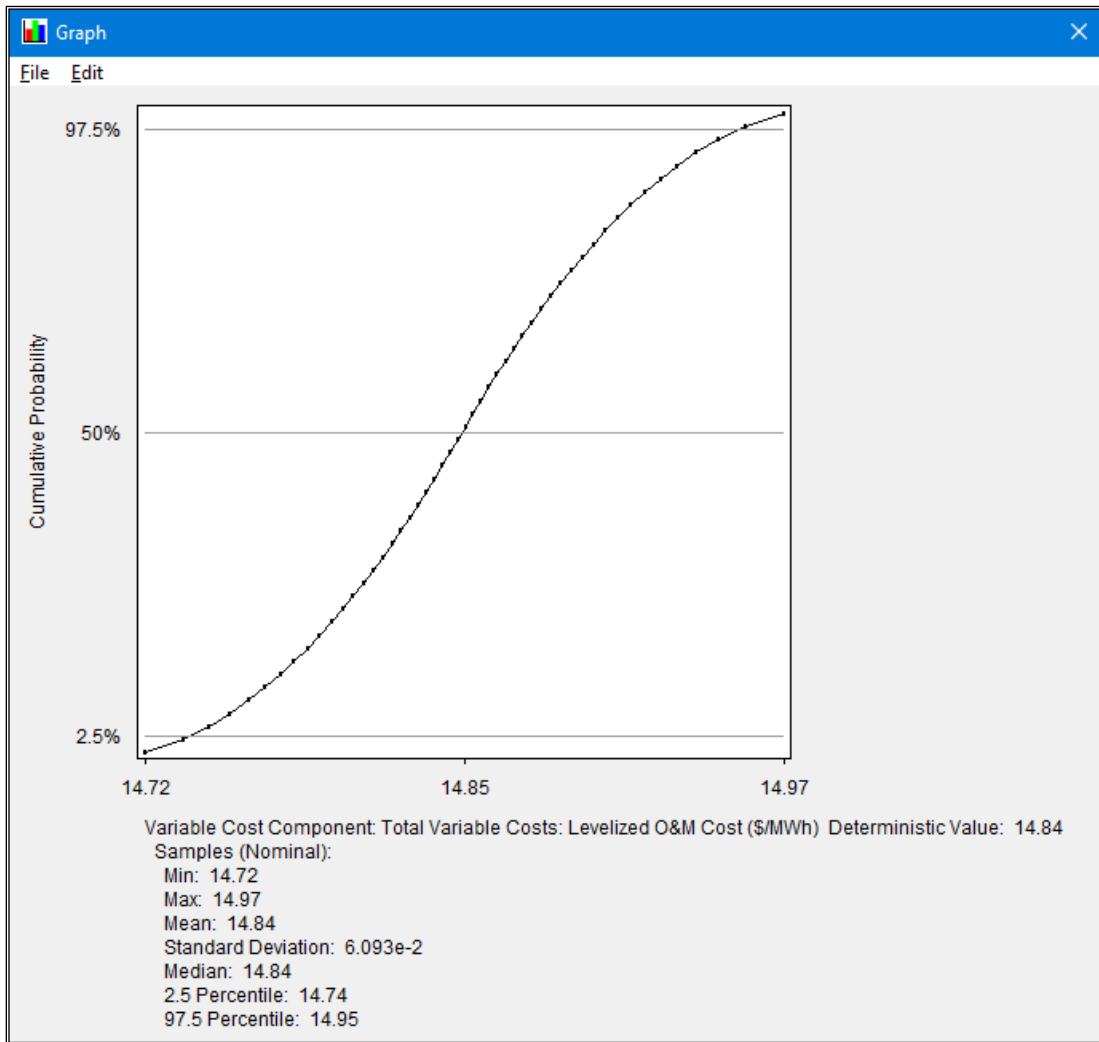


Illustration 640: Graph of Total Variable Costs (Uncertain)

When you first bring up a graph, there may be a short delay as all result samples are calculated. Once all the samples are calculated, there should be little more than a split second delay when you choose another graph. (However, if you change the plant configuration or input values and then return to "GET RESULTS", the samples will have to be recalculated, causing another delay.)

While all of the values displayed in diagrams and tables are deterministic, some have uncertainty in their calculation. If there is no uncertainty in the value's calculation, the graph displays "(No Uncertainty)". If uncertainty is present, the graph displays a curve of all possible values.

See "4.3.3.6. The Right-Click Menu" on page 74 for information on options (including graphs) available on the right-click menu for parameters. "4.4.4. The Right-Click Menu" on page 79 gives similar information for results. Additional options for viewing graphs are also available in the "Uncertainty" tool in the "ANALYSIS TOOLS" program area as described in "4.5.3. Uncertainty" on page 85.