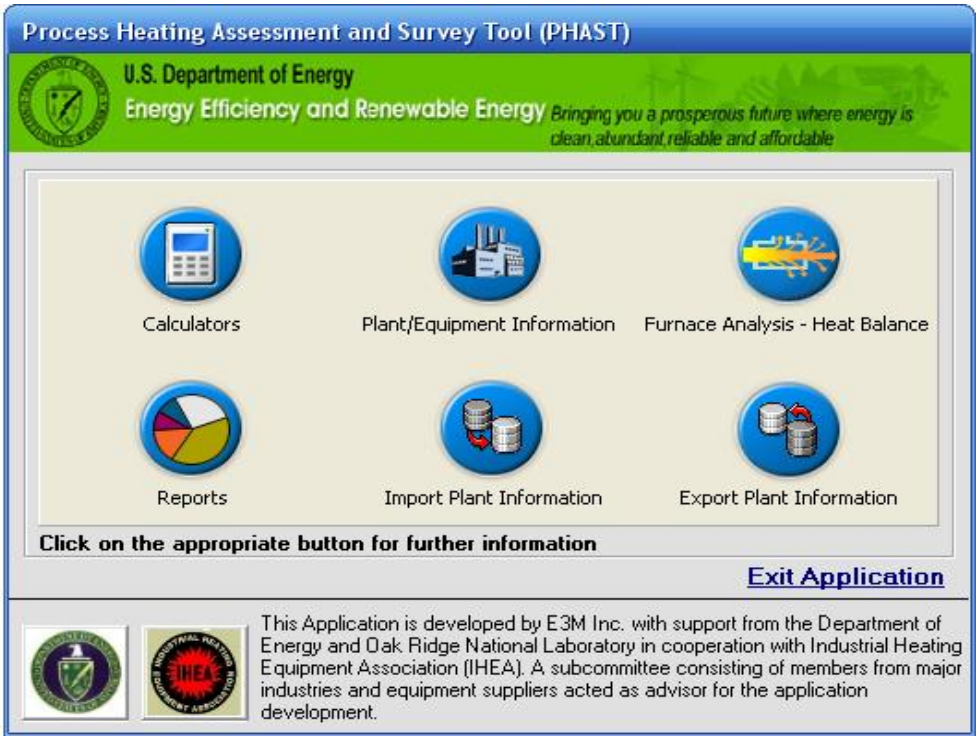
Process Heating Assessment and Survey Tool
PHAST 3.0

Fuel Fired Technology (FF) – International (MKS) Units

User Manual – Version 1.0
November 2010



Developed by Oak Ridge National Laboratory in cooperation with the Industrial Heating Equipment Association (IHEA). A subcommittee consisting of members from major industries (steel, aluminum, heat treating, petro-chemical industry etc.) and equipment suppliers acted as advisor for the tool development.

Development supported by E3M, Inc.

Please contact ARVIND THEKDI, E3M, Inc. for all comments or suggestions

(Phone: 240.715.4333 or E-mail athekdi@e3minc.com)

What is PHAST 3.0?

PHAST 3.0 *is a user-friendly tool that can be used to assess energy use and estimate reduction in energy use with application of selected methods of energy efficiency improvement for industrial process heating equipment such as furnaces, ovens, heaters, melters, boilers etc. The tool is designed for use with parameter input in U.S. – English units and International units of measurements with option of using local currency value for energy cost and savings calculations.*

Note: The term "furnace" is used as a generic term to describe all commonly used process-heating equipment such as furnaces, ovens, heaters, melters, boilers, kilns, dryers etc.

The tool serves three major functions:

1. *Provides an introduction to process heating methods and energy conversion tools. It also includes simple calculators for the performance comparison of furnaces at different operating conditions, flow calculations for orifice based gas flow meters and heat input calculations, with links to additional sources of information on topics related to process heating.*

2. *Survey of the process equipments that use fuel, steam, or electricity as energy source for heating processes and a method to select the most energy consuming equipment. The user input is in the form of heat (energy) input and operating practices of the plant equipment being surveyed. The end result is a report that summarizes estimated annual energy use and energy cost in local currency as well as in U.S. dollars. The report identifies the high priority equipment that use the top 80% of the total process heating energy cost for the plant.*

3. *Perform an energy (heat) balance for the selected process heating equipment (furnace) to identify major areas of energy use in the furnace and to provide guidance on how to reduce the non-productive use or loss of energy. The tool includes instructions on the required data, how to collect the data, methods to lower energy usage for each of the major areas of the furnace and a list of resources where the plant can get additional help.*

The tool allows the user to compare performance of the furnace at different operating conditions and test "what-if" scenarios for various energy saving options.

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Please contact ARVIND THEKDI, E3M, Inc. (Phone: 240.715.4333 or E-mail athekdi@e3minc.com) for all comments and suggestions.

Your cooperation and support is greatly appreciated.

Installing PHAST 3.0

The tool can be installed by 1) using a setup CD or 2) downloaded from the U. S. Department of Energy web site.

System Requirement:

- A PC running Windows 2000 /Windows XP/ Windows Vista with latest service pack
- At least 1200MB free space in hard disk
- A processor (preferably Pentium) 133 MHz or faster.
- A monitor supporting resolution of at least 1024 x 768.
- A mouse or compatible tracking device.
- An optical drive.
- Microsoft Office 2000 or higher with MS Access 2000 or higher
- Acrobat PDF Reader

1) PHAST 3.0 Setup CD

The CD includes:

- **PHAST 3.0 Setup**
- **User Manual** as PDF document
- **Survey Forms**

Installation Instructions:

- Insert the Setup Disc in the CD ROM Drive.
- Follow the on screen instructions.
- Unless otherwise changed/specified, the default path of the application is Start ->Programs ->PHAST3.0 -> PHAST3.0.
- Open the Application (Alternatively PHAST can be opened through the shortcut created on the Desktop)

Note: In case of problem during Installation

- *Update the operating system with latest service pack and run the PHAST Setup again.*
- *Disable any memory resident programs and run the PHAST setup again.*
- *Contact your IT support personnel for permission/security issues.*

Uninstall Instructions:

- *Start -> Control Panel -> Add or Remove Programs*
- *Select "PHAST3.0" from the list*
- *Click "Change/Remove"*
- *Choose either "Yes" or "Remove None" during course of uninstall*

2) PHAST 3.0 Setup - Web Download

For the web download, go to the U. S. Department of Energy web site- www.eere.energy.gov/industry. On this web site

- Go to the link "Software Tools"

- Go to “Quick link to resources”
- Select “Software Tools”
- Select “Process Heating Assessment and Survey Tool (PHAST v3.0)” to down load the tool

Installation Instructions:

- Click ‘Run’ to initiate the setup of PHAST 3.0
- Follow the on screen instruction
- Unless otherwise changed/specified, the default path of the application is Start ->Programs ->PHAST3.0 -> PHAST3.0.
- Open the Application (Alternatively PHAST can be opened through the shortcut created on the Desktop)

Table of Contents

Summary:

A. Calculators.
This section includes several tools or calculators that can be used to assess (calculate) improvements in efficiency, reduction in fuel use and flow calculations for commonly used gases with a provision to calculate heat input for gaseous fuel-fired process heating equipment (furnaces etc.)

B. Plant/Equipment Information
This section can be used to:

- Survey energy use and the annual cost of energy in a local currency or US dollars for a heating system (fuel fired, electric heating, steam heating) and auxiliary equipment (i.e. pumps, motors, compressors, fans, vacuum pump etc.) associated with a heating system used in a plant;
- Assess and Summarize the expected annual cost of operation in a local currency or US dollars of each of the surveyed equipment;
- Identify specific heating equipment that account for a large (80%) percentage of the process heating energy cost for the plant;
- Add new heating equipment on over all annual energy use and energy cost for the plant
- Evaluate the effect of decommissioning or eliminating the use of any one or more existing pieces of heating equipment surveyed;
- Select equipment (furnaces) for detailed analysis to identify the distribution of energy used in various parts or sectors of the furnace.

C. Furnace Analysis - Heat Balance
This section can be used to analyze the energy used in various parts of the selected furnace under a given operating condition. The furnace has to be included in the Plant/Equipment Information section. The areas for energy use include charge or load, fixtures, trays etc., wall losses, water cooling losses, losses through openings and exposed hot parts, flue products (or exhaust gases) and heat storage. The load or material being processed can be in the form of solid, liquid or gas with phase change (melting, evaporation) and may include chemical reaction. This section allows the user to identify major areas of energy use and the magnitude of losses to study the effect of changes in operating conditions and their effect on the energy used in the furnace.

D. Reports
This section provides four reports in the form of tables and charts. The **Plant Summary** report includes a table of energy used, expected cost of operation for the furnaces surveyed and their comparison. The **Furnace Analysis** report includes a table of energy used in various parts of the furnace analyzed, their relative importance in terms of the percentage of the total energy used, and the effect of changes in key operating parameters on energy consumption for the furnace. The **Furnace Summary** report includes a schematic of heat loss/use distribution of the selected furnace components in the form of a "Static' Sankey Diagram format. The **Input Data** report includes all the data that has been given as input for a selected plant.

Note: All reports can be printed or saved as PDF for future reference

E. Import Other Plant Information

This section provides functionality of importing plant and furnace information of the plants previously assessed and for which the user has exported information through another installation of PHAST (Version 3.0). The complete information about plant, its furnaces, heat zones, energy sources used, cost of energy used, heat balance analysis of each furnace can be imported to the existing PHAST (Version 3.0) database. Later such information can be analyzed/ modified/ reviewed as discussed in the above section.

Note: The data entered/analyzed through earlier versions PHAST (such as v1.2, 1.3, 2.0) *cannot be imported to latest versions of PHAST such as PHAST (Version 3.0)*

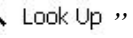
F. Export Plant Information

This section provides functionality of exporting plant and furnace information of selected plant that is entered through PHAST (Version 2.0). The complete information about plant, its furnaces, heat zones, energy sources used, cost of energy used, heat balance analysis of each furnace can be exported as an MS Access database. Later such information can be imported in to the existing PHAST (Version 3.0) database through Import Feature and new information can be analyzed/ modified/ reviewed as discussed in the above section.

Note: The data entered/analyzed through PHAST (Version 3.0) *cannot be exported to earlier versions of PHAST such as PHAST (*such as v1.2, 1.3, 2.0*)*

Description and Use of the Tool:

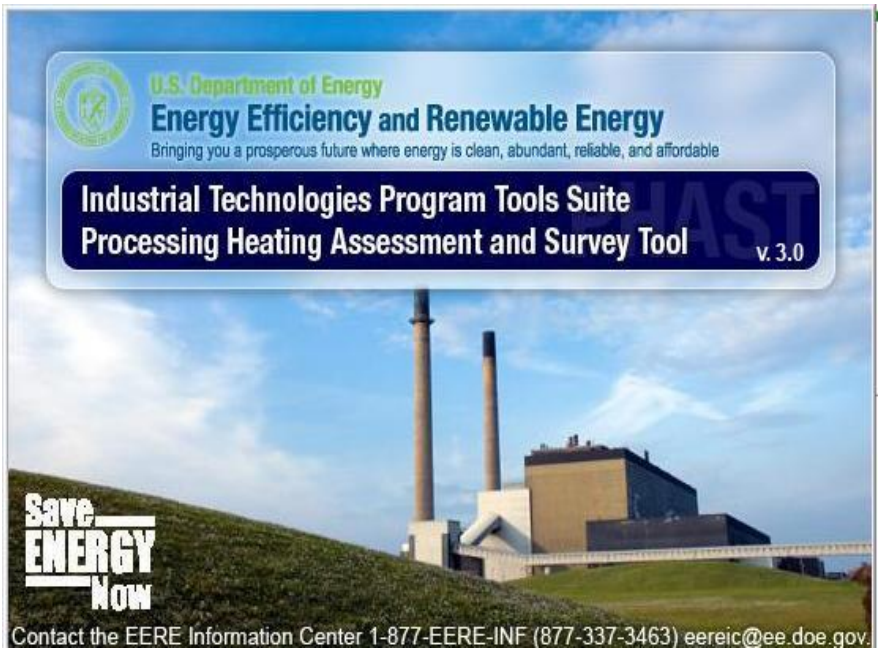
General Notes:

- *The screens of the PHAST are best viewed with the screen resolution of 1024 x 768 pixels.*
- *On all screens, enter the required information in the "white background" text boxes. The results will be shown in "colored background" text boxes or as labels.*
- *Do not use special characters (',", &,*, #, etc.) while entering the data in different text boxes. This may cause the problem when other user imports such data.*
- *Throughout the application, invoke specific unit converter by pressing "F2". On pressing "F2", the specific unit converter will be invoked if the cursor is in any input text box and the data being filled has unit attached to it. Also invoke general unit converter through top menu bar option (Information → Unit Converter) or by clicking*  (a button *given in bottom of the Furnace Analysis screen).*
- *Click on*  *(a button at bottom left corner of each screen) will open a new window with detailed information related to each field on the screen.*
- *Click on "* 

" buttons (available on some screens) for additional references. This will open a PDF document in new window with related guidance
- *On all screens, move the mouse over the label next to the input boxes to display a "tool-tip" and get a hint about the information that user is expected to fill in the respective text box.*
- *Refer to "Information" menu in the top bar for accessing user manual, additional references and knowledge material.*

Starting PHAST 3.0:

On starting PHAST 2.0, user is greeted with flash screen for a brief time.



Selection of Heating System

After brief display of splash screen, user is presented with an option to select Heating System – "Electrotechnology" or "Fuel Fired". User can select one of the heating systems and click **"OK"** to proceed or **"Exit"** to shut down the application. After the system selection, screen with unit selection is displayed.

Note: The application remembers which heating system was used on its last run, and automatically keeps the unit selection for the next run of the application. However, user can always change the selection.

Selection of Unit

After brief display of splash screen, user is presented with an option to select the units – US (SI) or International (MKS). User can select one of units and click **"OK"** to proceed or **"Exit"** to shut down the application. Based on the unit selection, screens with related unit labels are displayed for all modules.

Note: The application remembers which unit system was used on its last run, and automatically keeps the unit selection for the next run of the application. However, user can always change the unit selection.

The initial screen describes the six major sections of the application.

1. Calculators
2. Plant/Equipment Information
3. Furnace analysis – Heat Balance
4. Reports
5. Import Other Plant Information
6. Export Plant Information

Click on **"Exit Application"** to close all screens and leave PHAST 2.0
Click on "**logo"** of DOE and IHEA to go their respective website.

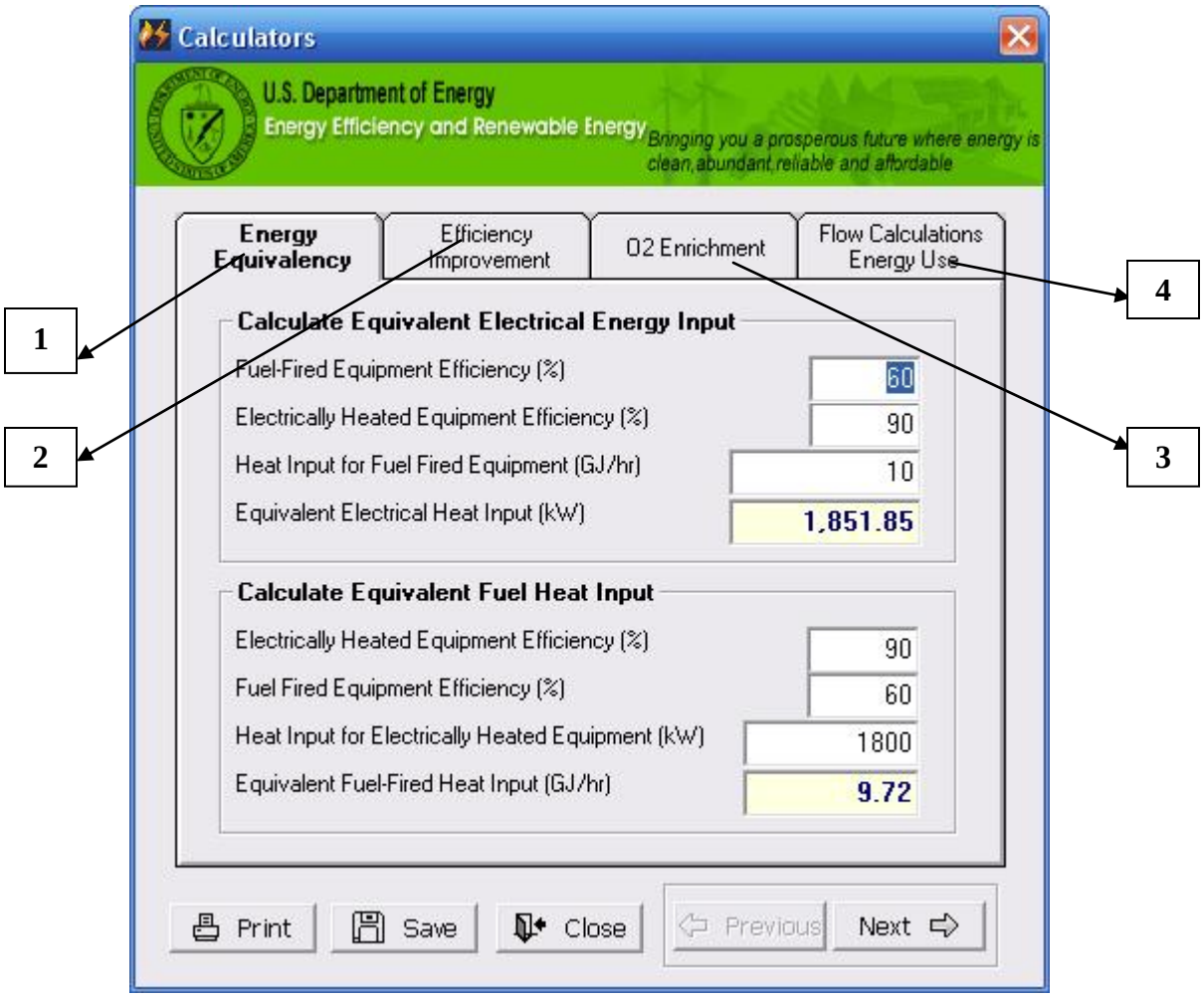
Calculators:

This section includes several tools or calculators (four) that can be used to assess (calculate) improvements in efficiency, reduction in fuel use, and flow calculations for commonly used gases with a provision to calculate heat input for gaseous fuel-fired process heating equipment (furnaces etc.).

Common Instructions for ALL four tabs:

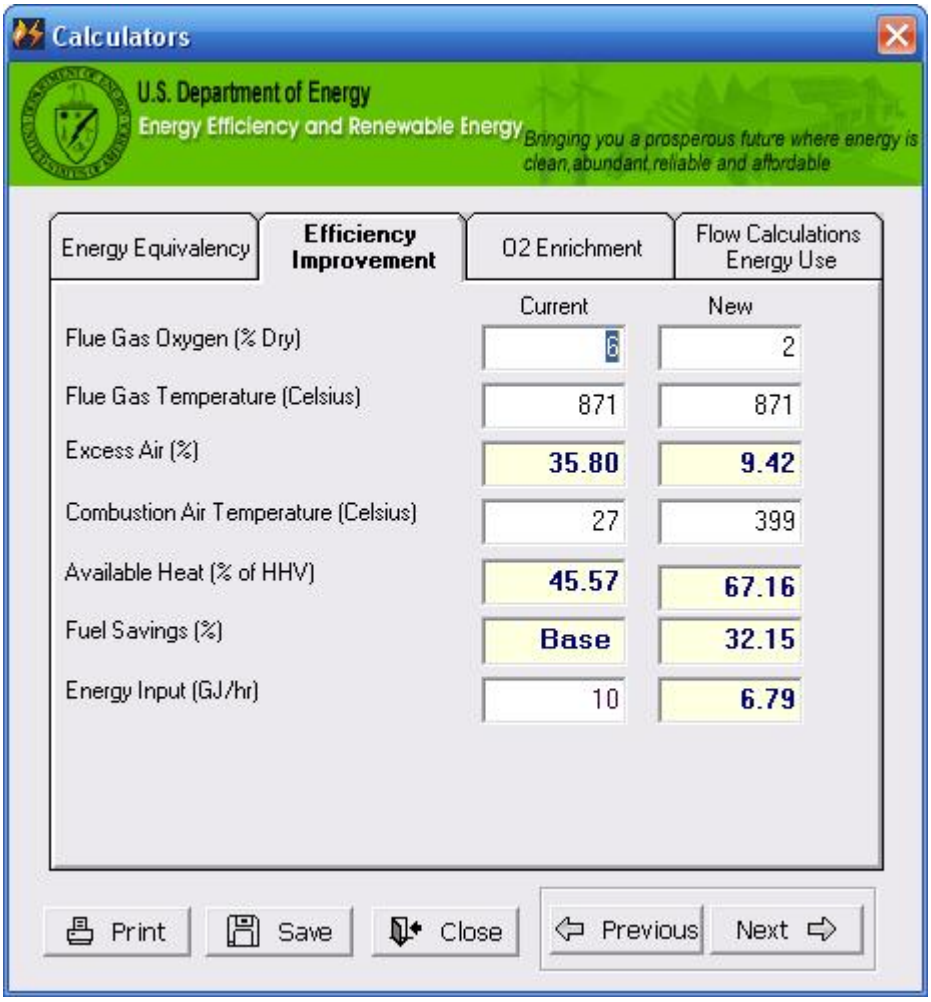
- Insert the required information in the boxes or "white" areas. The results will be shown in "yellow colored" boxes.
- Use the **Tab** key or your mouse to go from one text box to another.
- Click on "**Save"** to save the information that can be displayed next time. User should save the changes in information on each tab before moving to the next tab.
- Click on "**Print"** Button to print the current screen that contains calculations.
- Click on either "**Previous"** or **"Next"** to toggle between different screens of Introduction.
- Click on the "**Close"** button to close the screen and return to the main screen.

Energy Equivalency:
Calculations for converting values of energy requirements when the heat source is changed from fuel firing (kJ/hr) to electricity (kW) or vice versa.

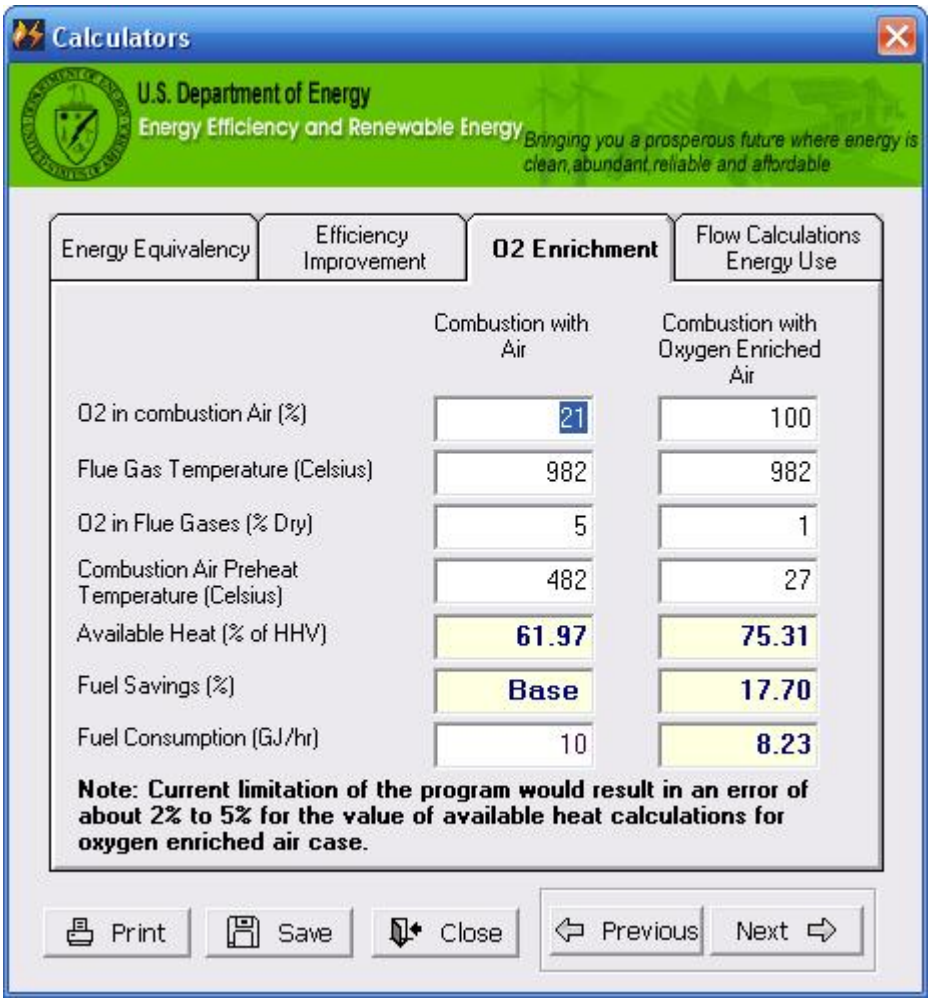


- Enter furnace efficiency (in terms of percentage) for fuel fired equipment (60% in the example)
- Enter furnace efficiency (in terms of percentage) for electric heating system (90% in the example)
- Enter Heat Input for Fuel fired equipment (10 GJ/hr in the example)
- Equivalent Electrical Heat Input (1851.85 kW in the example) is calculated and displayed in colored text box

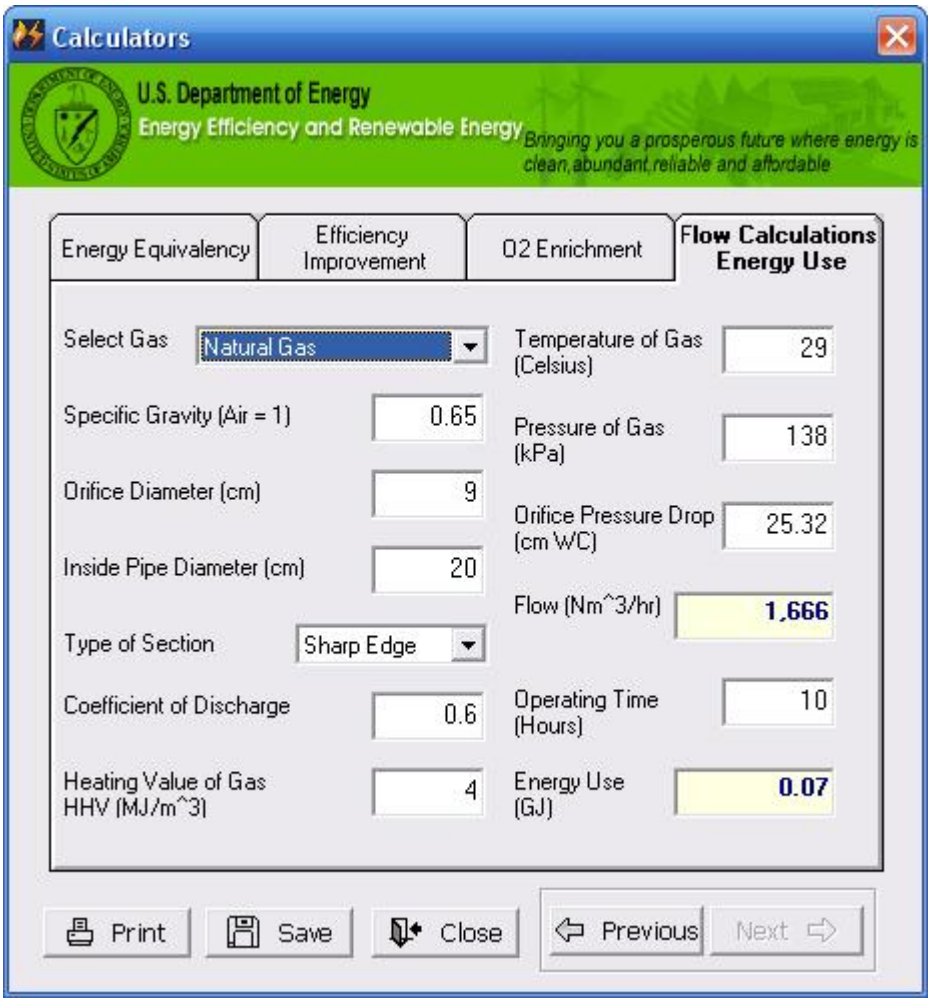
Efficiency Improvement:
Calculation of available heat (an indication of thermal efficiency) for fuel fired furnaces and expected energy savings when the burner operating conditions (exhaust flue gas temperature, excess air and preheated air) are changed for the burners.



O2 Enrichment:
Calculation of available heat (an indication of thermal efficiency) for fuel fired furnaces and expected energy savings when oxygen in combustion, "air", is changed from standard (21%) to a higher value.



Flow Calculations/Energy Use:
Calculation of flow rates for commonly used gases using data for an orifice type flow meter and heat input calculations when the gas is a fuel (i.e. natural gas, propane).

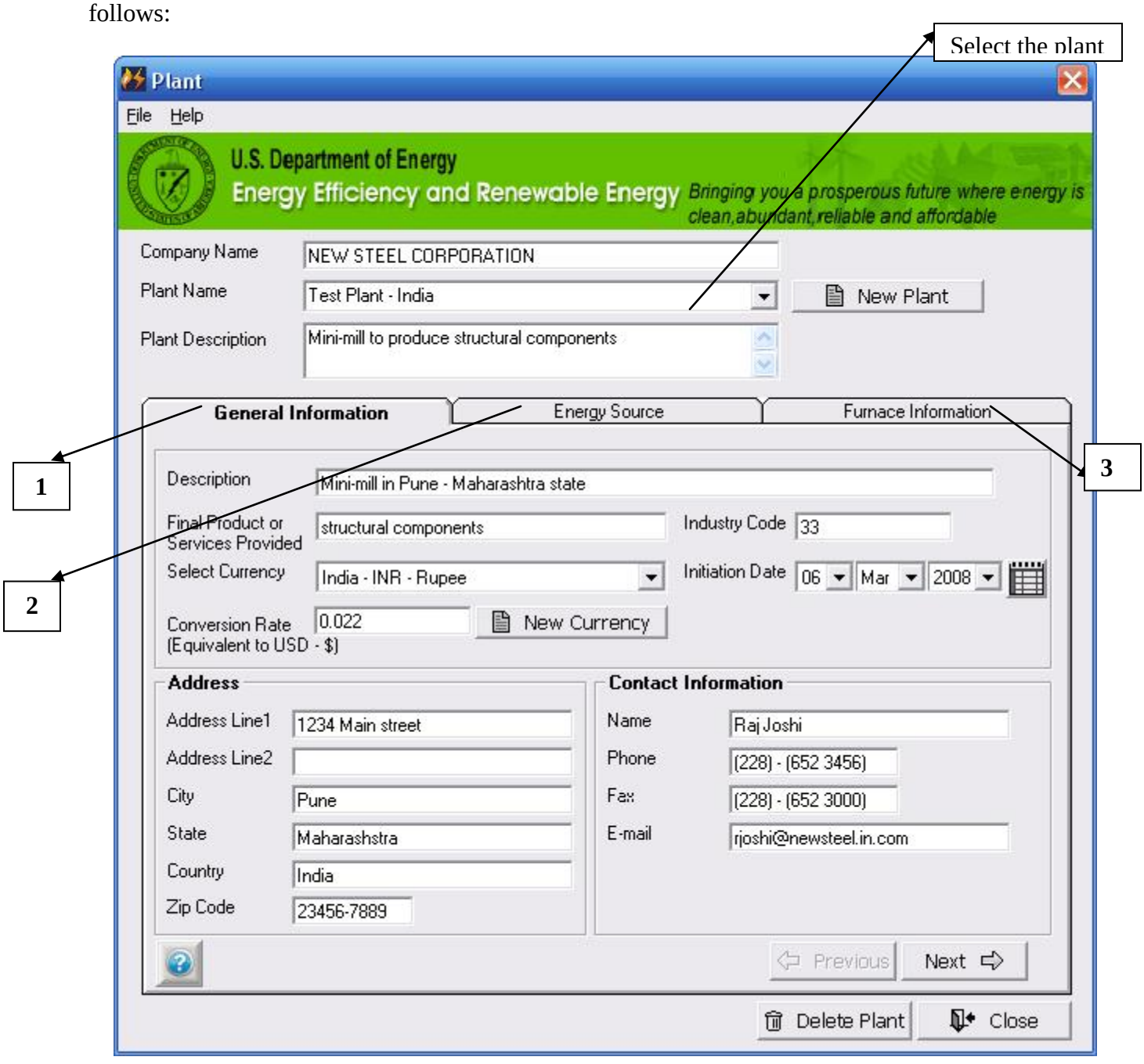


Plant/Equipment Information:

General Notes:

- *Do not use special characters (‘,”, &,*, #, etc.) while entering the data in different text boxes. This may cause the problem when other user imports such data.*

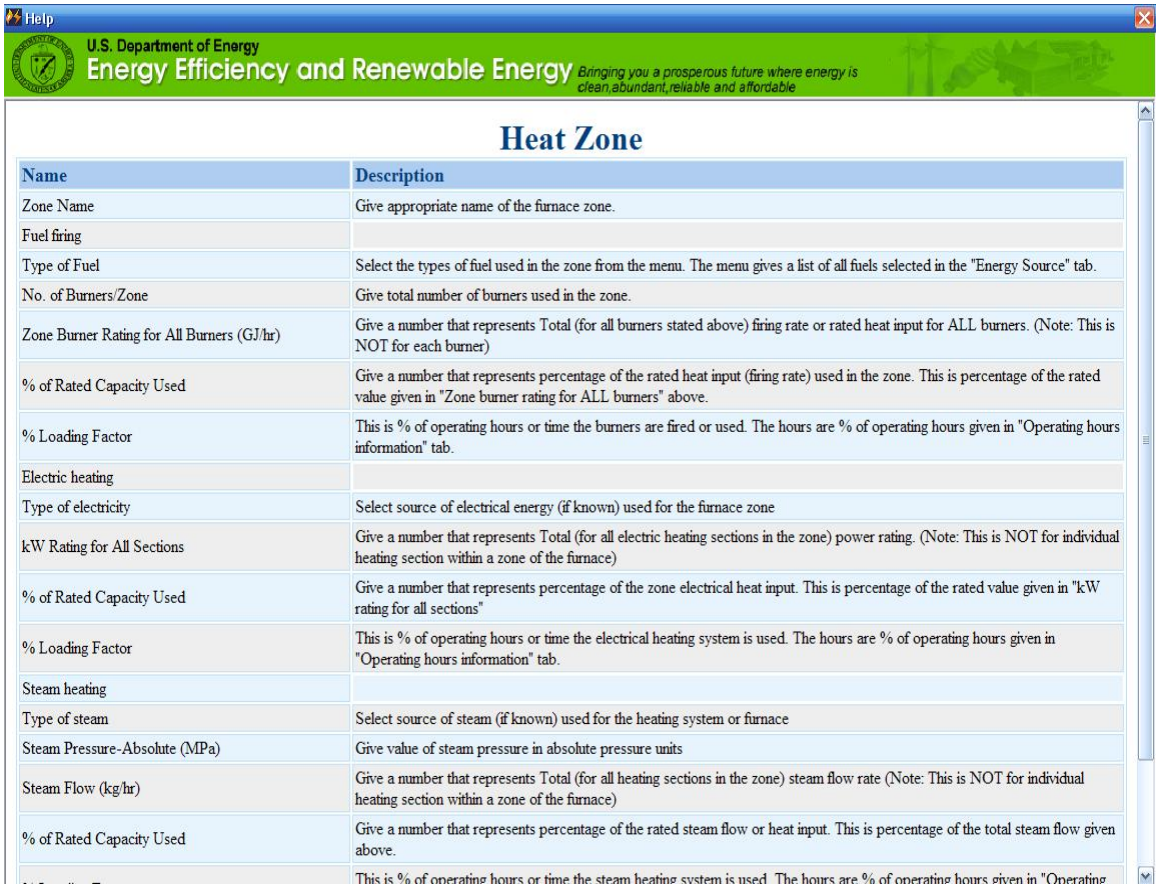
This section contains three tabs. An image of the section is shown below and a description of each tab follows:



1. **General Information:**
   Collect general information related to the plant, including its Description, Final Product, Industry Segment, Contact Information and Currency for Cost Estimation.
2. **Energy Sources:**
   Select available energy sources for the plant and input values for the fuel heating value and cost data using appropriate units. A library of energy sources, which are used in the plant's process heating equipment, can be prepared and viewed. An option for the input of a new energy source with heating value and cost with appropriate units is provided.
3. **Furnace Information:**
   View the list of all process heating equipment (furnaces) within the plant. An option for viewing the details of each furnace or adding a new one is provided here.

Common Instructions for ALL tabs:

- Click on "**New Plant"** to add the general information, energy sources used and furnaces for the plant. The user must provide the Plant Name before adding other details.
- Click on either "**Previous"** or **"Next"** to toggle between the different screens of Plant/Equipment Information.
- **Click on "Delete Plant"** to delete all the related information of the currently selected plant and the details *will not* be available for future analysis.
- Click on "**Close"** to close the screen and return to the main screen.
- Click on  (a button at bottom left corner of each screen) will open a new window with detailed information related to each field on the screen.



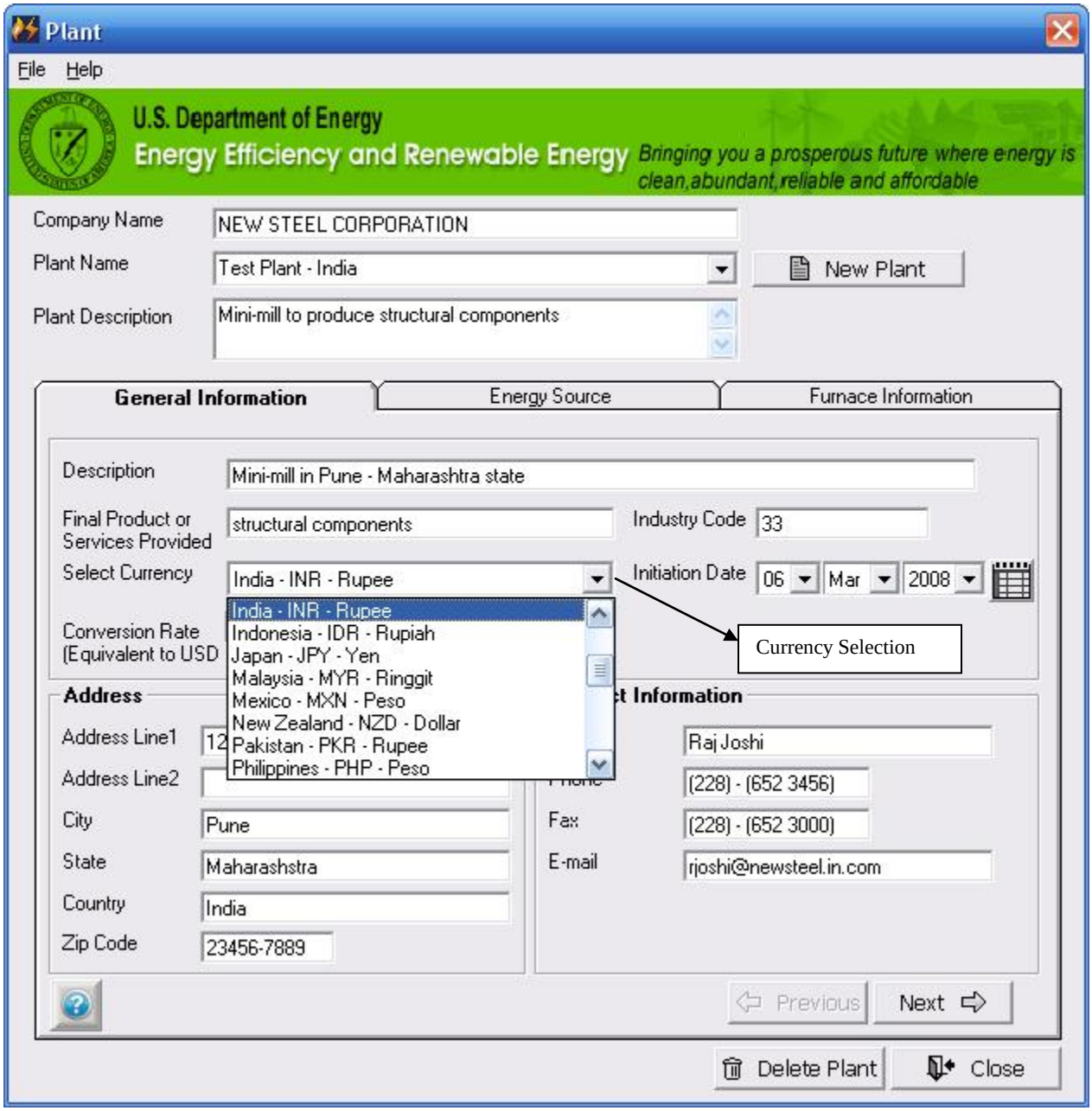
Heat Zone

Name	Description
Zone Name	Give appropriate name of the furnace zone.
Fuel firing	
Type of Fuel	Select the types of fuel used in the zone from the menu. The menu gives a list of all fuels selected in the "Energy Source" tab.
No. of Burners/Zone	Give total number of burners used in the zone.
Zone Burner Rating for All Burners (GJ/hr)	Give a number that represents Total (for all burners stated above) firing rate or rated heat input for ALL burners. (Note: This is NOT for each burner)
% of Rated Capacity Used	Give a number that represents percentage of the rated heat input (firing rate) used in the zone. This is percentage of the rated value given in "Zone burner rating for ALL burners" above.
% Loading Factor	This is % of operating hours or time the burners are fired or used. The hours are % of operating hours given in "Operating hours information" tab.
Electric heating	
Type of electricity	Select source of electrical energy (if known) used for the furnace zone
kW Rating for All Sections	Give a number that represents Total (for all electric heating sections in the zone) power rating. (Note: This is NOT for individual heating section within a zone of the furnace)
% of Rated Capacity Used	Give a number that represents percentage of the zone electrical heat input. This is percentage of the rated value given in "kW rating for all sections"
% Loading Factor	This is % of operating hours or time the electrical heating system is used. The hours are % of operating hours given in "Operating hours information" tab.
Steam heating	
Type of steam	Select source of steam (if known) used for the heating system or furnace
Steam Pressure-Absolute (MPa)	Give value of steam pressure in absolute pressure units
Steam Flow (kg/hr)	Give a number that represents Total (for all heating sections in the zone) steam flow rate (Note: This is NOT for individual heating section within a zone of the furnace)
% of Rated Capacity Used	Give a number that represents percentage of the rated steam flow or heat input. This is percentage of the total steam flow given above.
This is % of operating hours or time the steam heating system is used. The hours are % of operating hours given in "Operating	

General Information:
On this tab provide General Information about the plant such as Description, Final Product, Industry Segment, Currency and its conversion rate to USD, Initiation Date and Contact Information.
Note:

- *Currency selection and its conversion rate are required to proceed further.*
- *Conversion Rate entered on this screen (tab) is used for cost calculations.*
- *Instead of entering an Initiation Date, a calendar image can be used to select the date*

Add New Plant:
Click on **"New Plant"** to add a new plant. On the same screen, all the input boxes will clear out for new data entry.

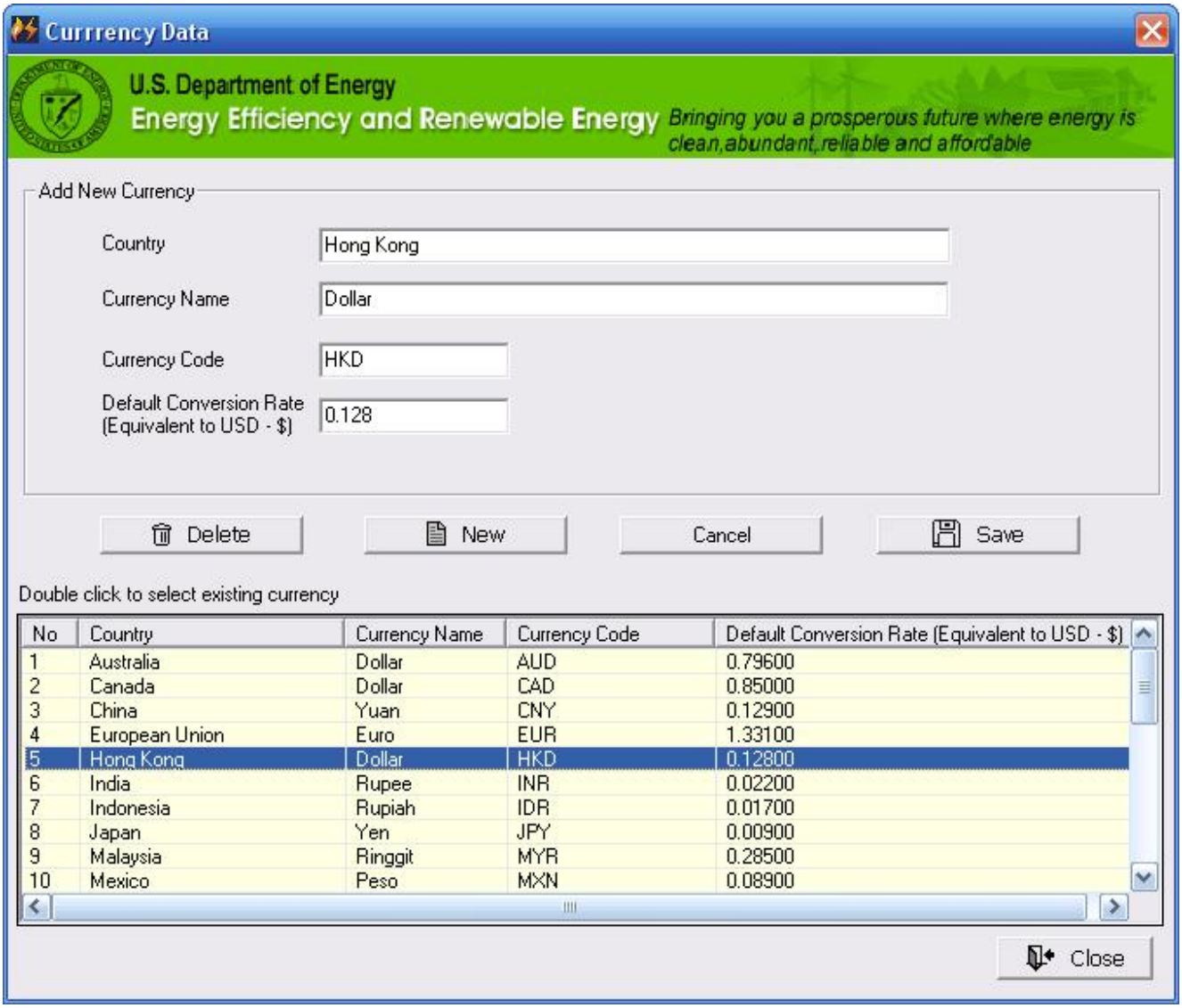


- Enter **"Company Name"** (mandatory to proceed further or save the data)
- Enter **"Plant Name"** (mandatory to proceed further or save the data)
- Select **"Currency"** from the drop down list (mandatory to proceed further or save the data)
- Enter/modify **"Conversion Rate"** for currency (mandatory to proceed further or save the data)
- Enter other data (optional) such as description, product, address, contact information etc.

Add New Currency:

For US units' version, application selects US Dollars as default currency. However, user can change the selection from the available drop-down list of currencies (Appendix – B). A new currency that is not in the list can be added to the database.

Click on **"Add New Currency"** to add a new currency. A new screen will be presented to enter the data of new currency as given below.



The grid table displays all currencies available in the database. Double click on any row of the currency will populate the data in the upper boxes.

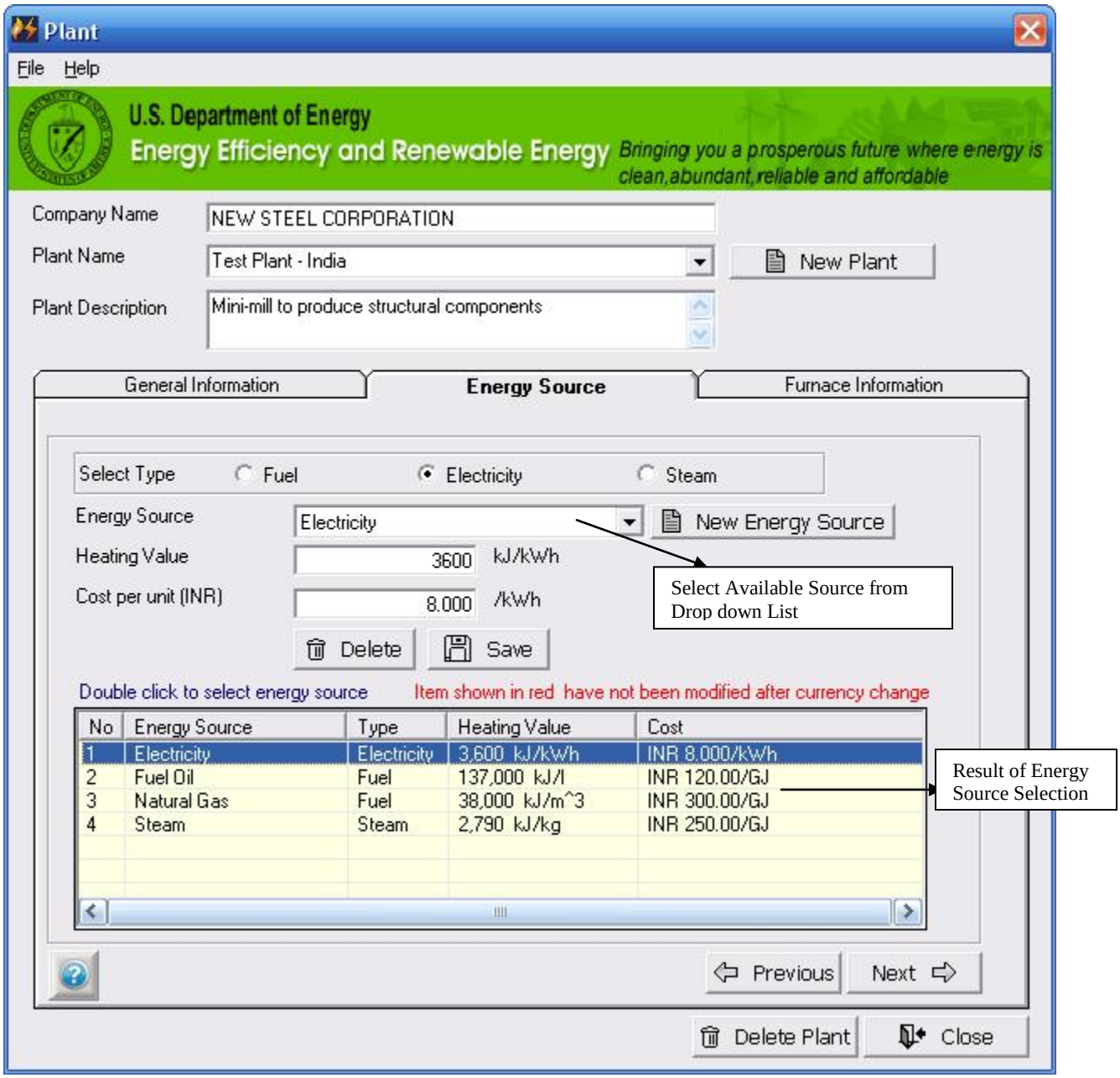
User cannot edit the details of the default currencies shown in Appendix – B and encouraged to enter a new currency if it is not available in the list. The details of currency entered by user can be edited.

- Click on "**New"** to add a new currency.

Note: Country Name, Currency Name, three letters Currency Code and conversion rate with reference to US Dollar are required to have a new currency for future use.

- Click on **"Save"** to save the new currency data for future use.
- Click on **"Delete"** to delete the selected currency
  Note: Currency cannot be deleted if it is used in any of the plant analysis or part of master list (Appendix –B). Application will display the message with a reason if user cannot delete the currency.
- Click on **"Cancel"** to cancel the action.
- Click on "**Close"** to close the screen and return to the Plant – General Information tab.

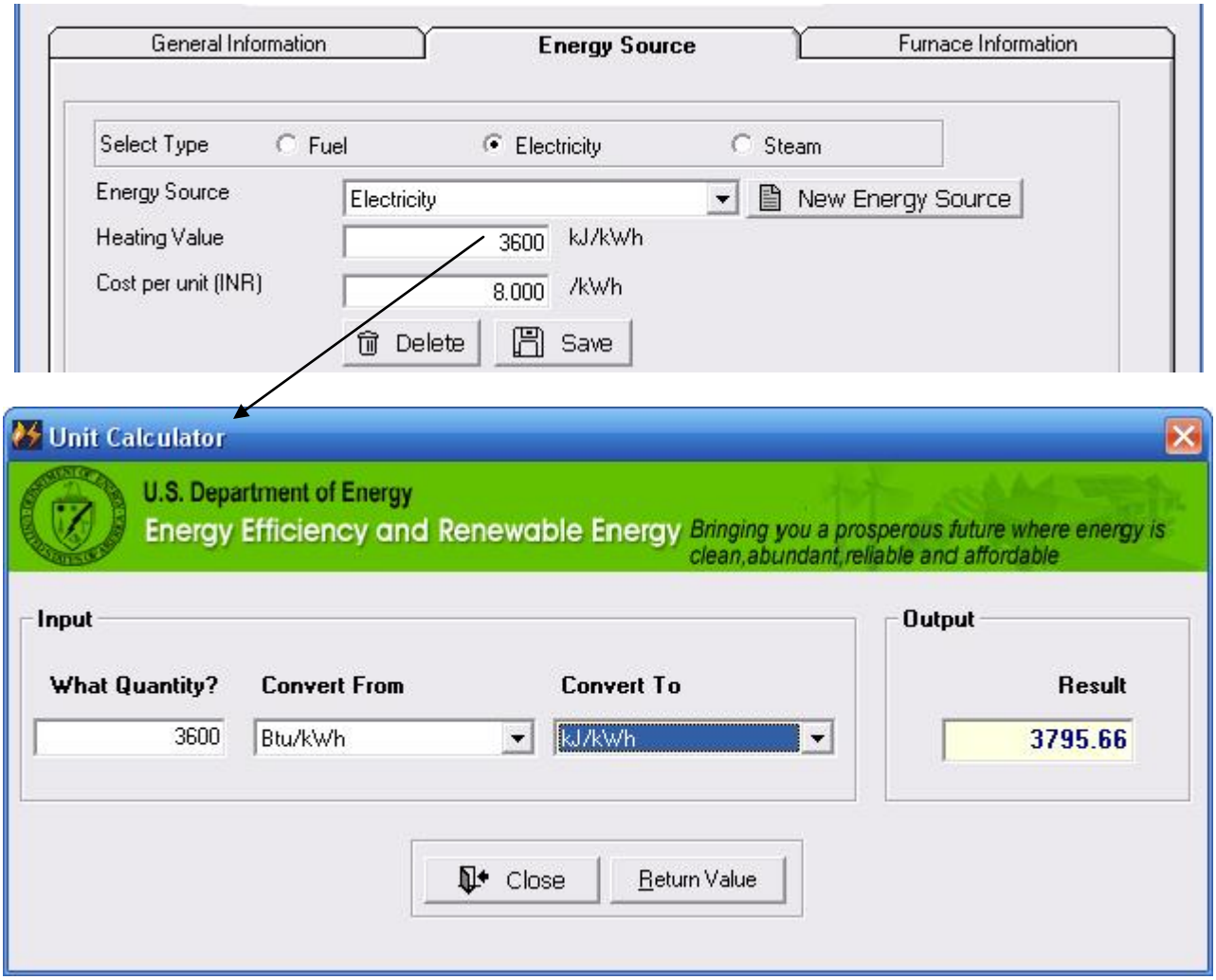
Energy Source:
On this tab, provide information of energy sources such as fuel heating value and cost that are used in the plant.



For any new plant, application provides three energy sources - Electricity, Natural Gas and Steam along with their heating value and standard costs in selected currency as default values. However, user can change these default values to values of his/her choice. A new energy source that is not in the list (Appendix – C) can be added to the database. Application must have at least one energy source of each type for analysis otherwise a selection for Fuel/Electricity/Steam in the Heat Zone information will not be available. The heating value and cost data for Fuel, Electricity and Steam are used to calculate plant wide energy consumption and its cost distribution.

Note: Heating value and cost units are required to have this energy source available for plant.

- Select the energy source from the drop list.
- Edit/enter the Heating Value input box *(Note: this value will be used for calculation)*
  Note: User can invoke specific unit converter by pressing "F2", if cursor is in Heating Value input box. User will be presented with unit converter screen as given below.



  - Enter/Edit the **"What Quantity"** value
  - Select the unit from **"Convert From"** list
  - Select the unit from **"Convert To"** list"
  - Click on **'Return Value"** to bring the calculated result (output) to the input box from where F2 was invoked i.e. Heating Value on energy source tab
  - Click on **"Close"** to close the unit converter form without brining the calculated result (output) to the input box
- Edit/enter the cost of energy source in the selected currency (Note: this value will be used for calculation)
- Click on **"Save"** to save the energy source for selected plant.

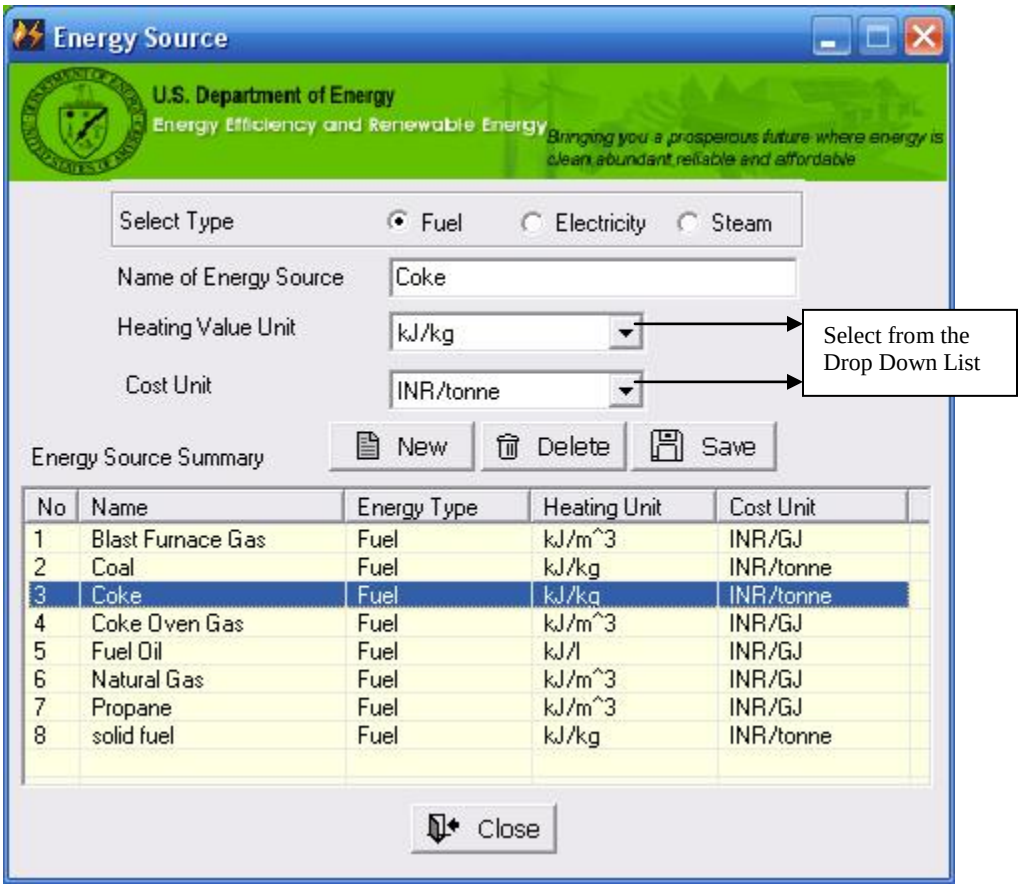
Note: The grid table displays all energy sources that are saved and available for the plant. Double click on any row of the energy source will populate the data in the upper boxes.

- Click on **"Delete"** to delete the selected energy source.
  Note: Energy source cannot be deleted if it is used in any of the plant analysis. Application will display the message with a reason if user cannot delete the energy source.

The application has a provision to add more than one type of Electricity and Steam with a different name, heating value and cost. The application calculates energy cost according to the selected energy source in the heat zone data in furnace information section of the application.

Add New Energy Source

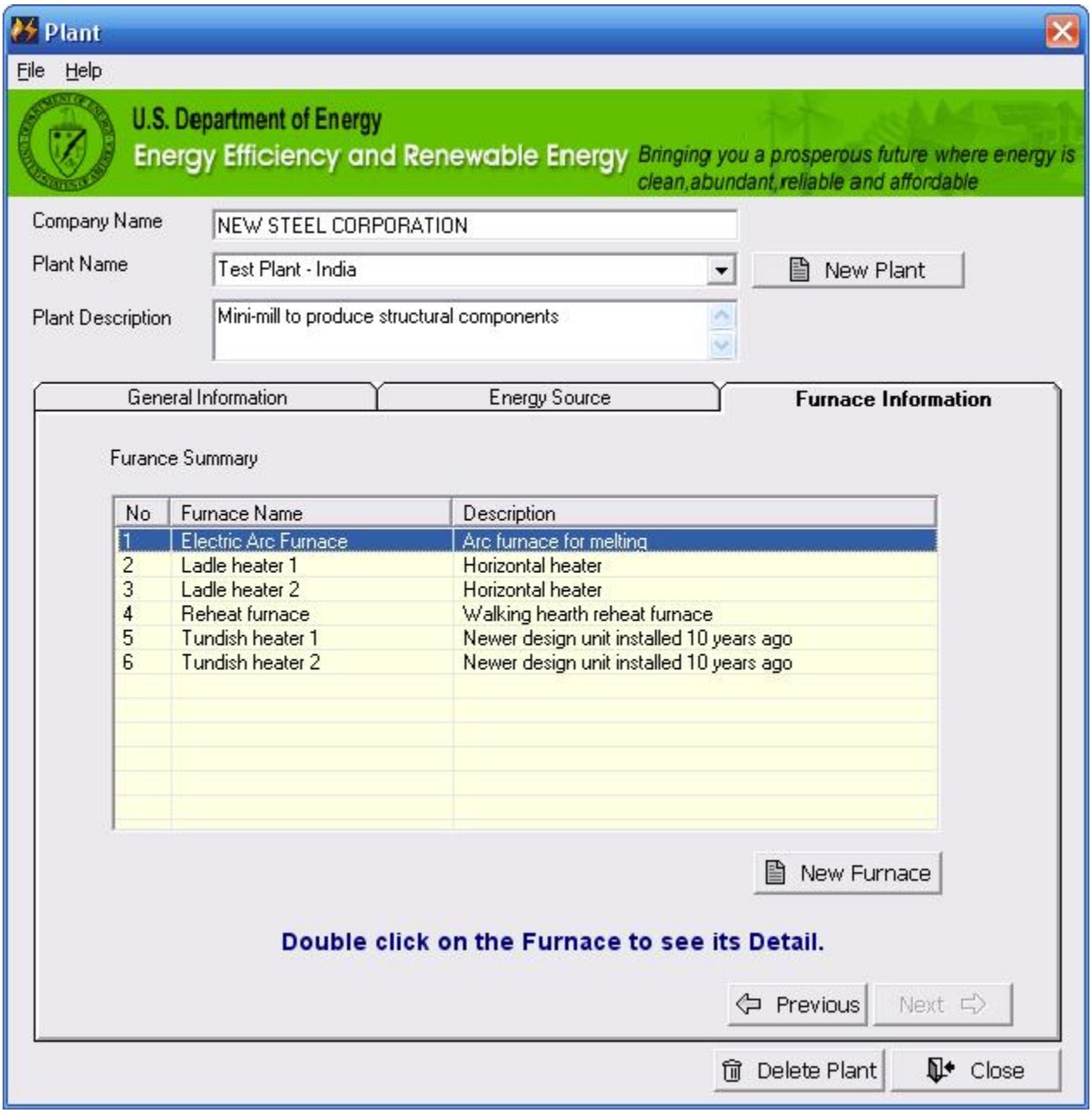
Click the "**New"** button to add a new Energy Source. A separate screen (shown below) will pop up.



- Select **Type of new Energy Source** (Fuel, Electricity or Steam)
- Enter/Input the **"Name of Energy Source"**
- Select the "**Heating Value Unit"** form the drop down list *(Note: The list of available units is dependent on the selected fuel type)*
- Select the **"Cost Unit"** form the drop down list *(Note: The list of available units is dependent on the selected fuel type and currency)*
- Click on **"Save"** to save the information. *(Note: The saved information can be viewed in the Summary list and is later available when this energy source is selected for plant analysis.)*

- Click on **"New"** to add another Energy Source and its information. *(Note: Double click any row in the Summary list to make it the current selection for edit/update).*
- Click on **"Delete"** to delete the current Energy Source selection *(Note: Energy source cannot be deleted if it is used in any of the plant analysis or part of master list (Appendix –C). Application will display the message with a reason if user cannot delete the energy source.)*
- Click on **"Close"** to return to the Energy Source tab of the **Plant/Equipment Information** section.

Furnace Information:
The user can view a list of all the Process Heating Equipment (Furnaces) previously entered for analysis.



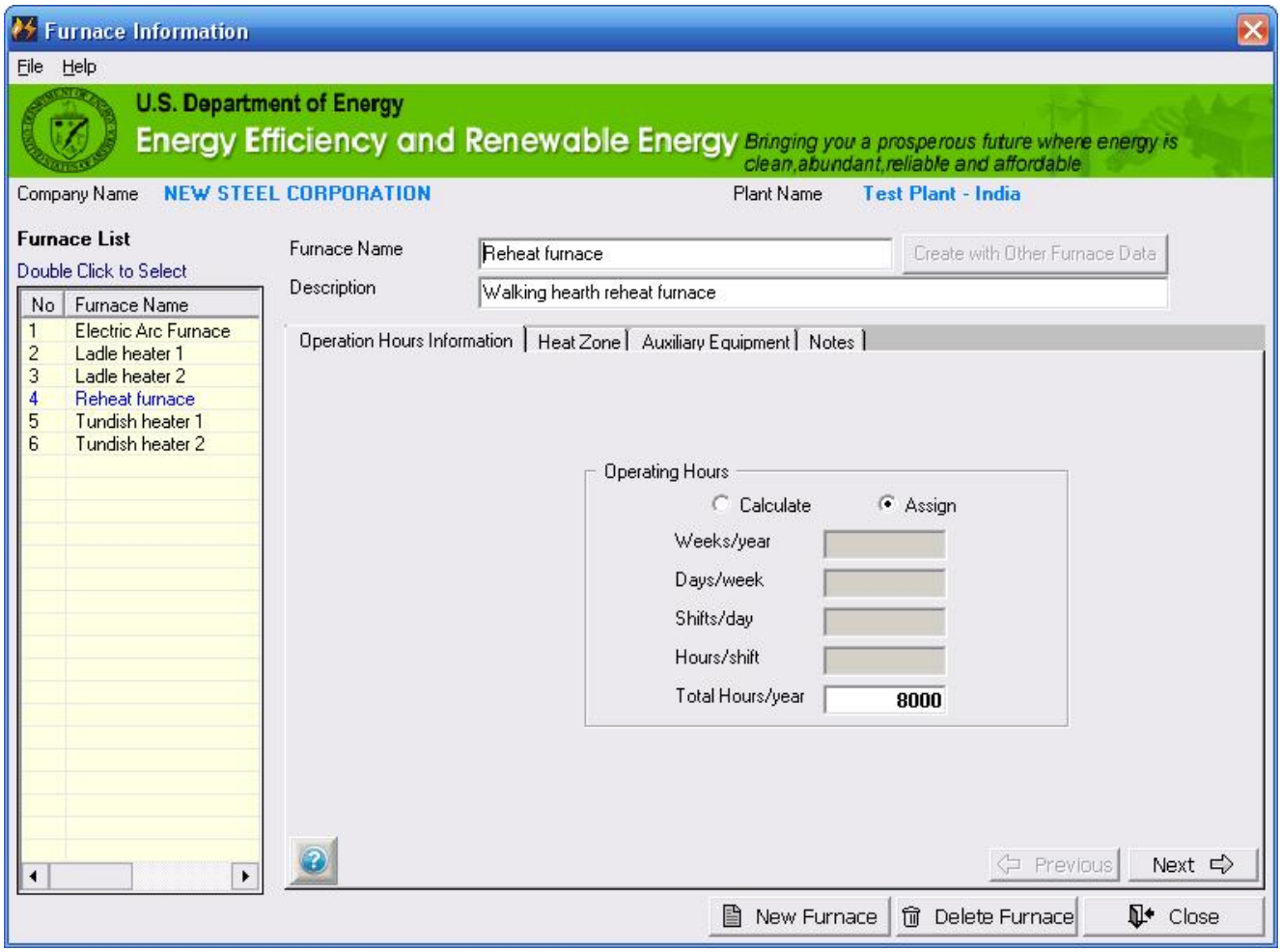
Double click on any row of **"Furnace"** in the list. A separate screen will pop up showing previously entered and saved information of the selected furnace.
Note: For a new plant, the summary list will not show any furnace and user must add furnaces and their operational information through "New Furnace"

Add New Furnace:

Click on **"New Furnace"** to add operational information for a new furnace. A separate interface screen as shown below will pop up where the appropriate information for the new furnace can be added.

Double click the any of the **"Furnace Name"** in the furnace list to edit the furnace information.

Note: The current furnace is highlighted with blue colored text in the list on left side.



Operating Hours

- Select the option of **"Calculate"** or **"Assign"**
  - For "Calculate" option *(Note: user must enter all individual numbers and application calculates the total hours based on the input)*
    - Enter the number of **"Weeks/year"** for which furnace is operating
    - Enter the number of **"Days/week"** for which furnace is operating
    - Enter the number of **"Shifts/day"** for which furnace is operating
    - Enter the number of **"Hours/shift"** for which furnace is operating
    - Application will calculate and display the **"Total Hours/year"**

- For "Assign" option *(Note: user won't be given an option to enter individual numbers and must enter the total hours)*
  - Enter the number of "**Total Hours/year"**

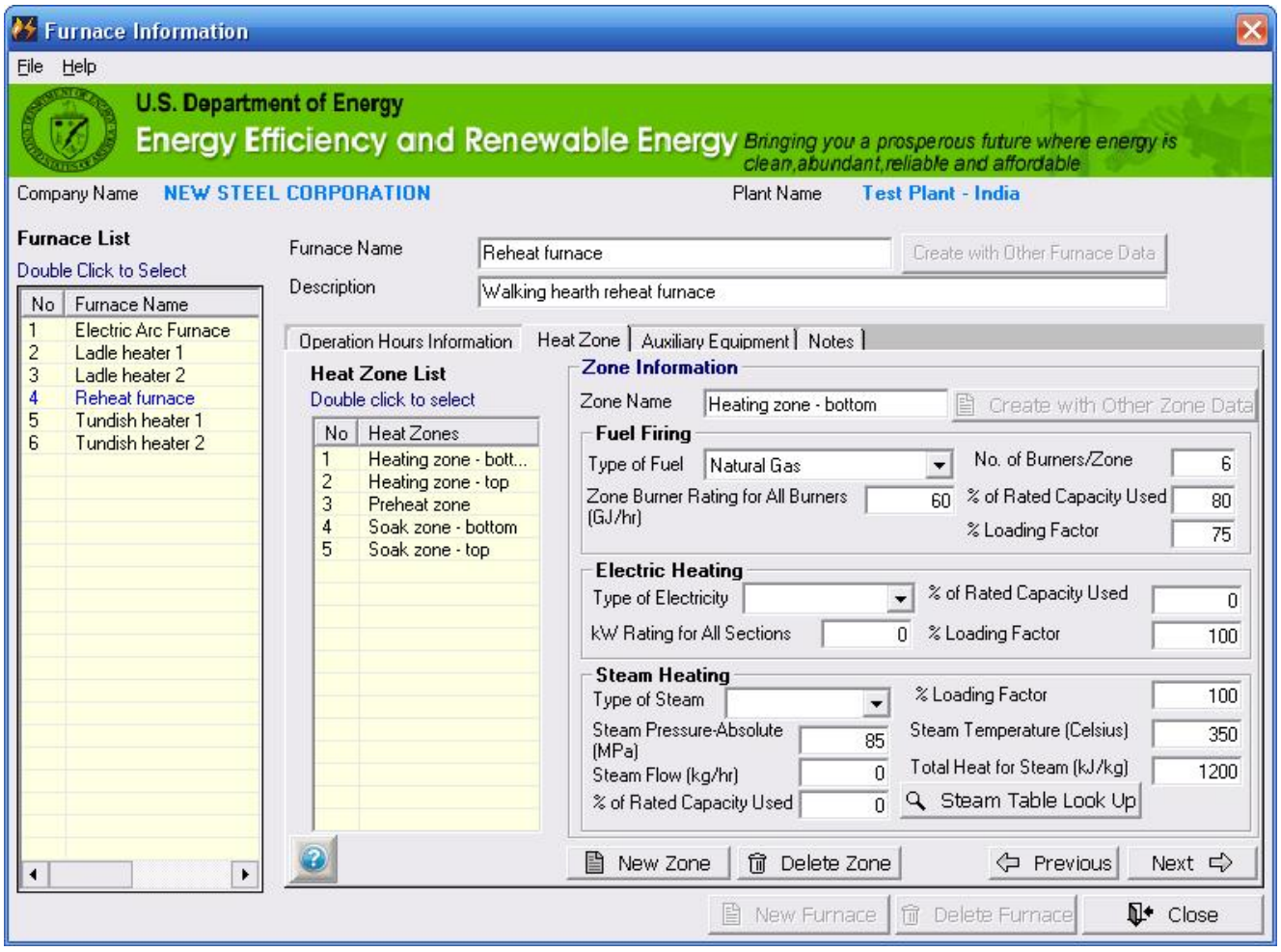
- Click on **"Next"** or **"Heat Zone tab"** to enter information about furnace's zones (Note: The information entered is saved and available for later edit/update)

Heat Zone

A separate screen as shown below will be displayed where user can enter each zone's information or, add/delete new zone

The zone information has three options. Depending on the source of heat, the user can select Fuel firing of burners, Electric Heating (through resistance heating, induction heating, electric arc/plasma or other types), or Steam Heating, commonly used for heating of liquids such as water or air for drying.

- In case of Fuel Firing, the drop down list of fuel type will display only those fuels that are available in the "Energy Sources" of the plant information.
- In case of Electric Heating, the drop down list of electricity type will display only that electricity that is available in the "Energy Sources" of the plant information.
- In case of Steam Heating, the drop down list of steam type will display only those steams that are available in the "Energy Sources" of the plant information.
- In case of steam heating, a set of nominal values for saturated steam is used as standard values for their respective text boxes when actual values are not available. It is advised that whenever possible, the actual operating conditions be used.



- Enter the operating information of zone in the input boxes

- Click on **"Next"** to enter Auxiliary Equipment information. *(Note: The zone information entered is saved and available for later edit/update)*
- Click on **"Previous"** to go to operational information tab *(Note: The zone information entered is saved and available for later edit/update)*
- Click **"New Zone"** to add a new zone to a furnace. All input boxes turn to blank or default values for data entry. *(Note: The zone information entered is saved and available for later edit/update. The saved zone is displayed in the zone list)*
- Click **"Delete Zone"** to delete the selected heat zone of current furnace. *(Note: Make sure that the appropriate zone is selected before attempting to delete its information)*
- Click on "**Close"** to close the screen and return to the **Plant/Equipment Information** screen. *(Note: The zone information entered is saved and available for later edit/update)*

On this screen also, a specific unit converter can be invoked by pressing "F2" key. Following text boxes allow invocation of specific unit converter.

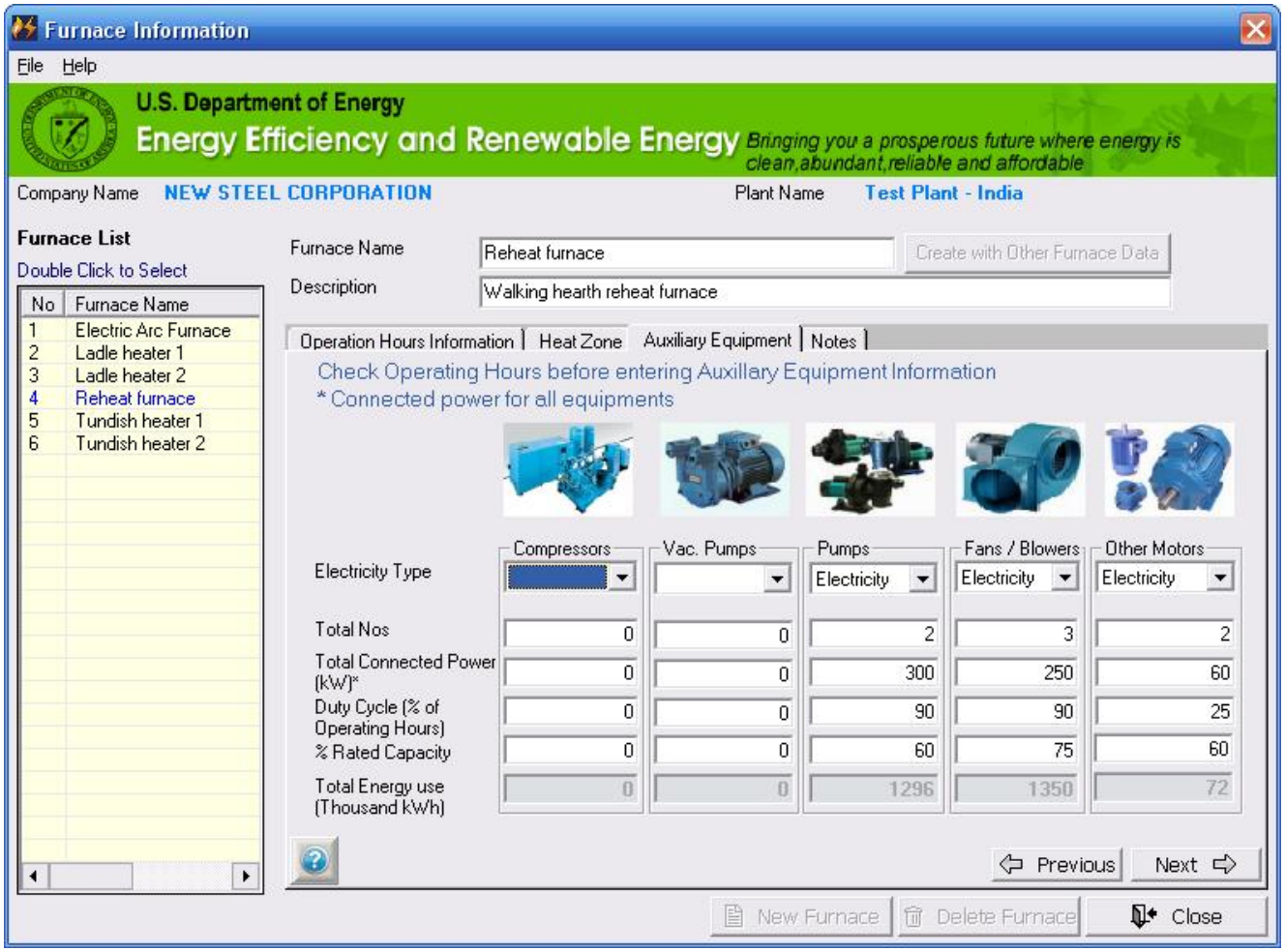
- Zone Burner Rating for All Burners
- kW Rating for All Sections
- Steam Pressure Absolute
- Steam Temperature
- Steam Flow
- Total Heat for Steam

Note: A furnace can be selected by double clicking the furnace name in the furnace list. The respective information about Operation, Heat Zone and Auxiliary Equipment will be available for review/modification. Similarly, the heat zone for a particular furnace can be selected by double clicking the heat zone name in the heat zone list (Heat Zone tab) and the respective data will be available for review/modification.

Auxiliary Equipment

Click on **"Auxiliary Equipment tab"** to enter information about plant's auxiliary equipments. Major equipments included are: compressors, fans/blowers (outside or inside the furnace), vacuum pumps and other electric motors used for material handling/processing or other motor driven production equipment. This information is used to calculate energy used by auxiliary equipment associated with the furnace. A separate screen as shown below will be displayed where user can enter such information.

Note: It is assumed that all auxiliary equipments are powered by electricity. The drop down list of electricity type will display only that electricity which is available in the "Energy Sources" of the plant information.



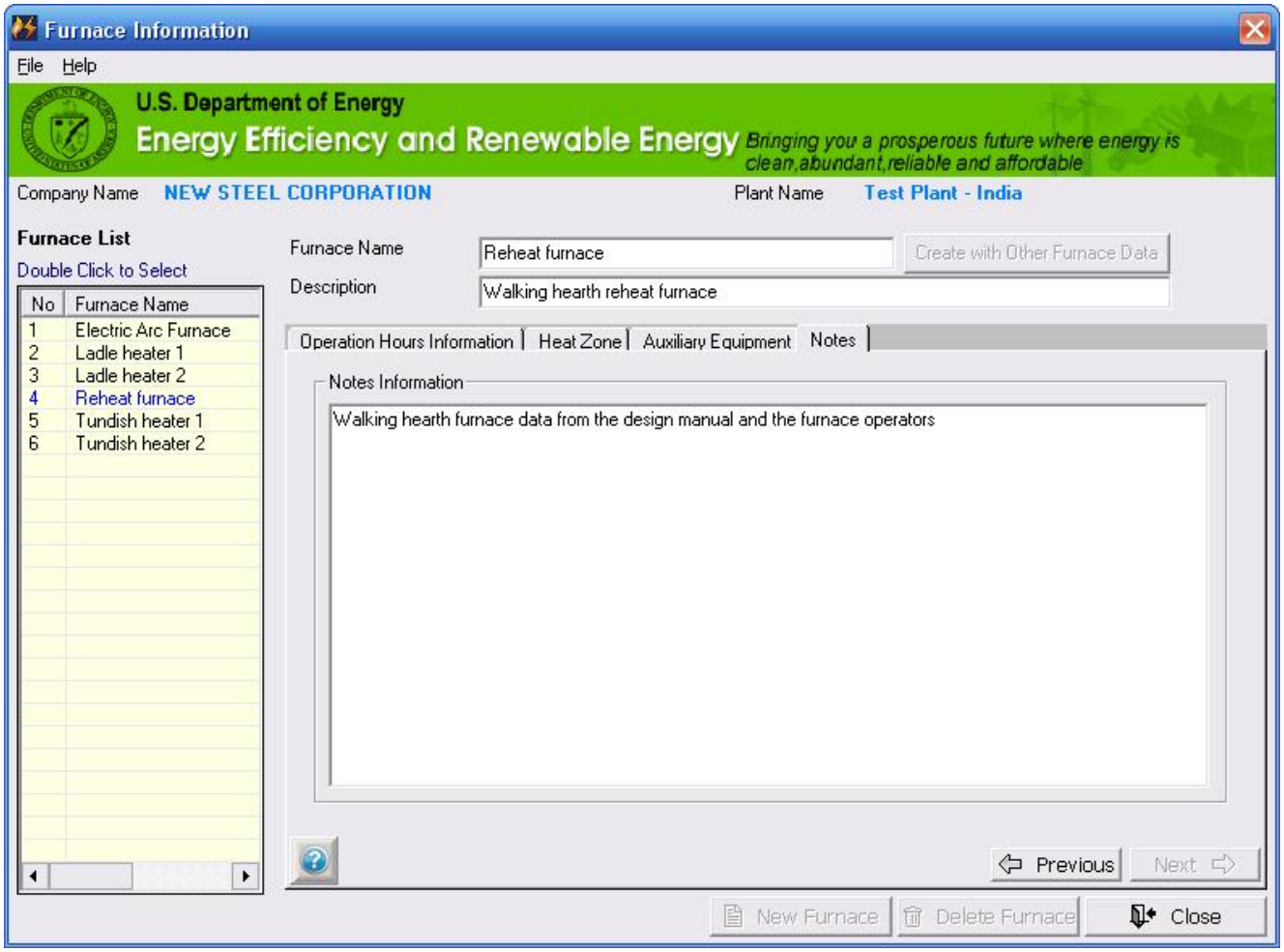
- Enter the operating information of auxiliary equipments in the input boxes
- Click on **"Next"** to go to Notes/Comments tab (Note: The information entered is saved and available for later edit/update)
- Click on **"Previous"** to go to zone information tab *(Note: The zone information entered is saved and available for later edit/update)*
  Note: On this screen also, a specific unit converter can be invoked by pressing "F2" key. Following text boxes allow invocation of specific unit converter - Total connected Power

- Click on **"New Furnace"** to add information of a new furnace.
- Click on **"Delete Furnace"** to delete the currently selected furnace. *(Note: Make sure that the appropriate furnace is selected before attempting to delete its information)*

  Note: These two buttons are enabled only for the Operation Hour Information tab of furnace information screen.
- Click the **"Close"** button to close the screen and return to the main screen.

Notes:

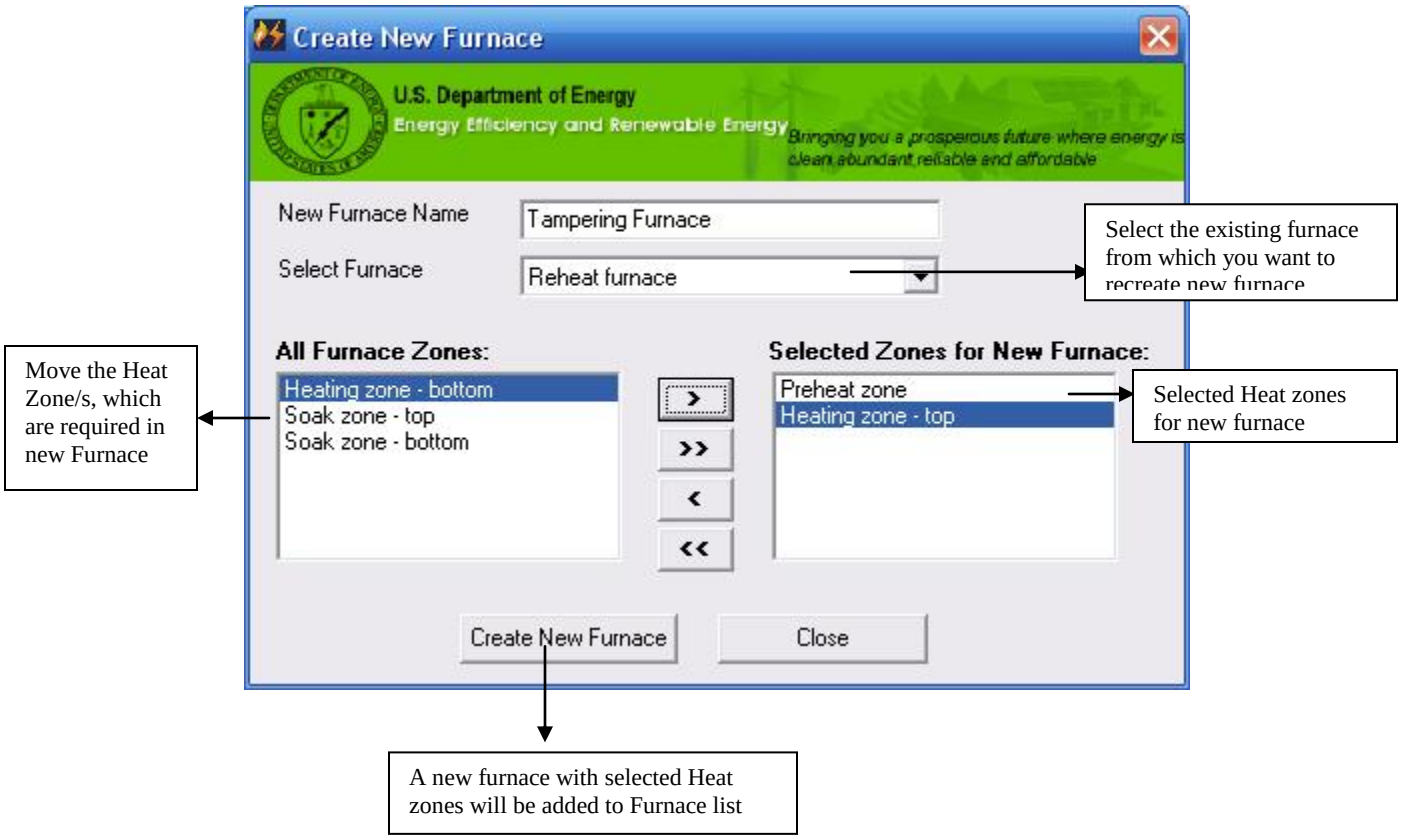
Click on **"Notes tab"** to enter information about plant's general notes/comments.



Recreate New Furnace:

Application has an option to recreate the furnace using the existing furnace's information of the current plant including heat zone information. The newly created furnace will have similar information to the existing one. Further information for the Heat Zone, Auxiliary Equipment or other Operation can be added or modified later.

- Click on **"Create with Other Furnace Data"** next to the **Furnace Name** on the screen. A separate screen interface will pop up as shown below.
  *Note: This button is enabled only when new furnace is being added and at least one character is entered in **"Furnace Name"** Text box.*

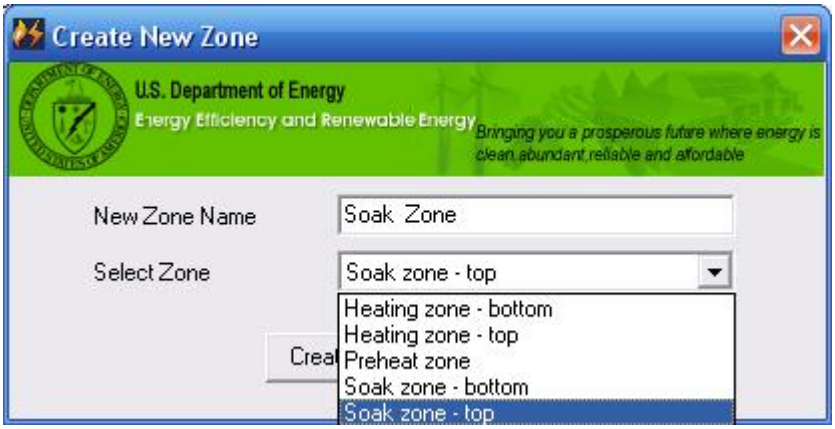


- Select the **furnace from the drop-down list** of existing furnaces i.e. the one which is recreated
- Select the **zones from left side window** (All Furnace Zones) and move **to the right side window** (Selected Zones for New Furnace)
  Note: Use Arrow Keys (>, >>, <, <<) to move the zones between two windows.
- Click on **"Create New Furnace"** to create a new furnace with selected zones and their data.
  Note: The newly created furnace will appear in the furnace list.
- Click on **"Close"** to close the screen without saving the data and return to the **Furnace Information** screen.

Recreate New Zone:

Application has an option to recreate the zone of a furnace using the existing zone information of the current furnace. The newly created zone will have similar information to the existing one can that can be modified later.

- Click on **"Create with Other Zone Data"** next to the **Zone Name** on the screen. A separate screen interface will pop up as shown below.
  *Note: This button is enabled only when new furnace is being added and at least one character is entered in **"Zone Name"** Text box*



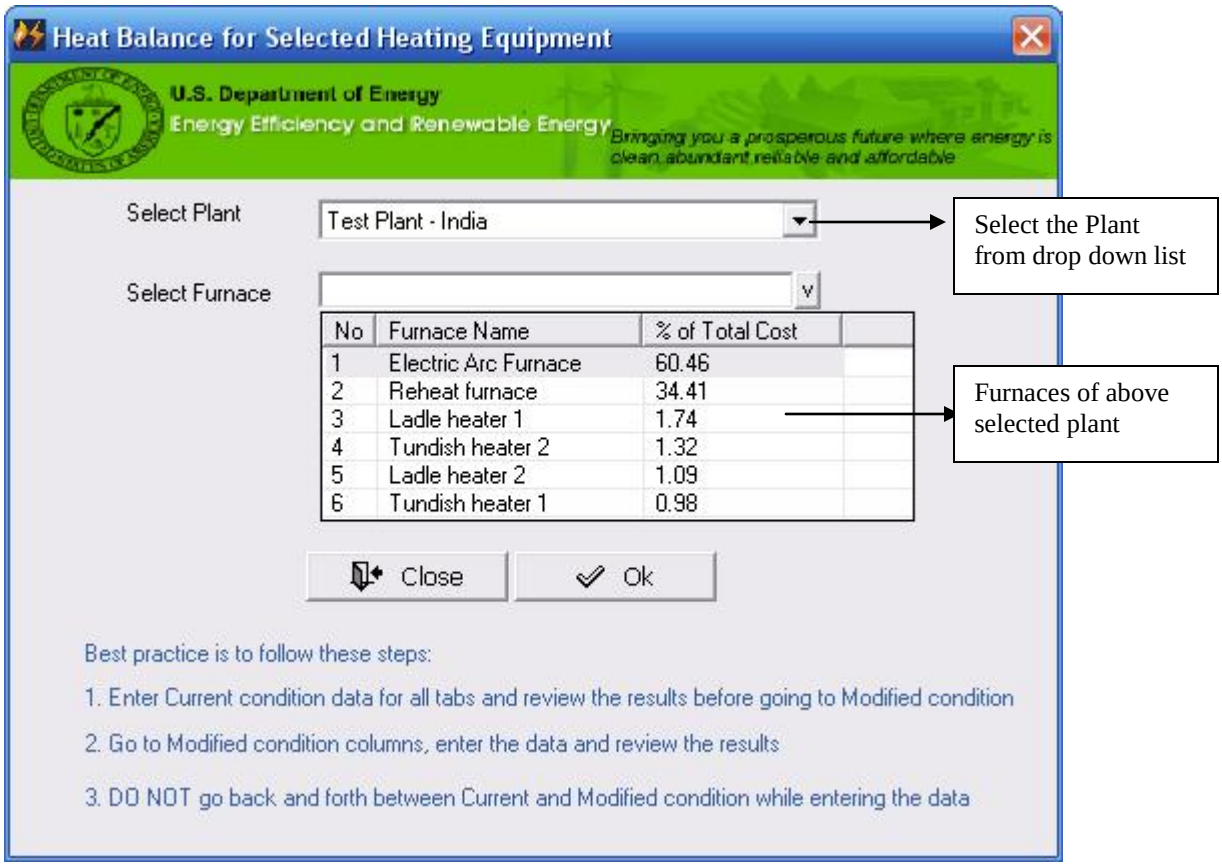
- Select the **zone from the drop-down list** of existing zones i.e. the one which is recreated
  Note: Only zones of the current furnace are available for selection to recreate. Note that the zones of other furnaces can not be recreated
- Click on **"Create New Zone"** to create a new zone with data. (*Note: The newly created zone will appear in the zone list of tab.*)
- Click on **"Close"** to close the screen without saving the data and return to the Heat Zone tab screen.

Furnace Analysis and Heat Balance:

This section is used to analyze the energy used in various parts of the furnace under given operating conditions. The areas for energy use include charge or load, fixtures, trays etc., wall losses, water cooling losses, losses through openings and exposed hot parts and flue products (or exhaust gases). It allows the user to identify major areas where energy is consumed and to study the effect of changes in operating conditions, which affect energy consumption in a furnace.

Select Furnace for Analysis

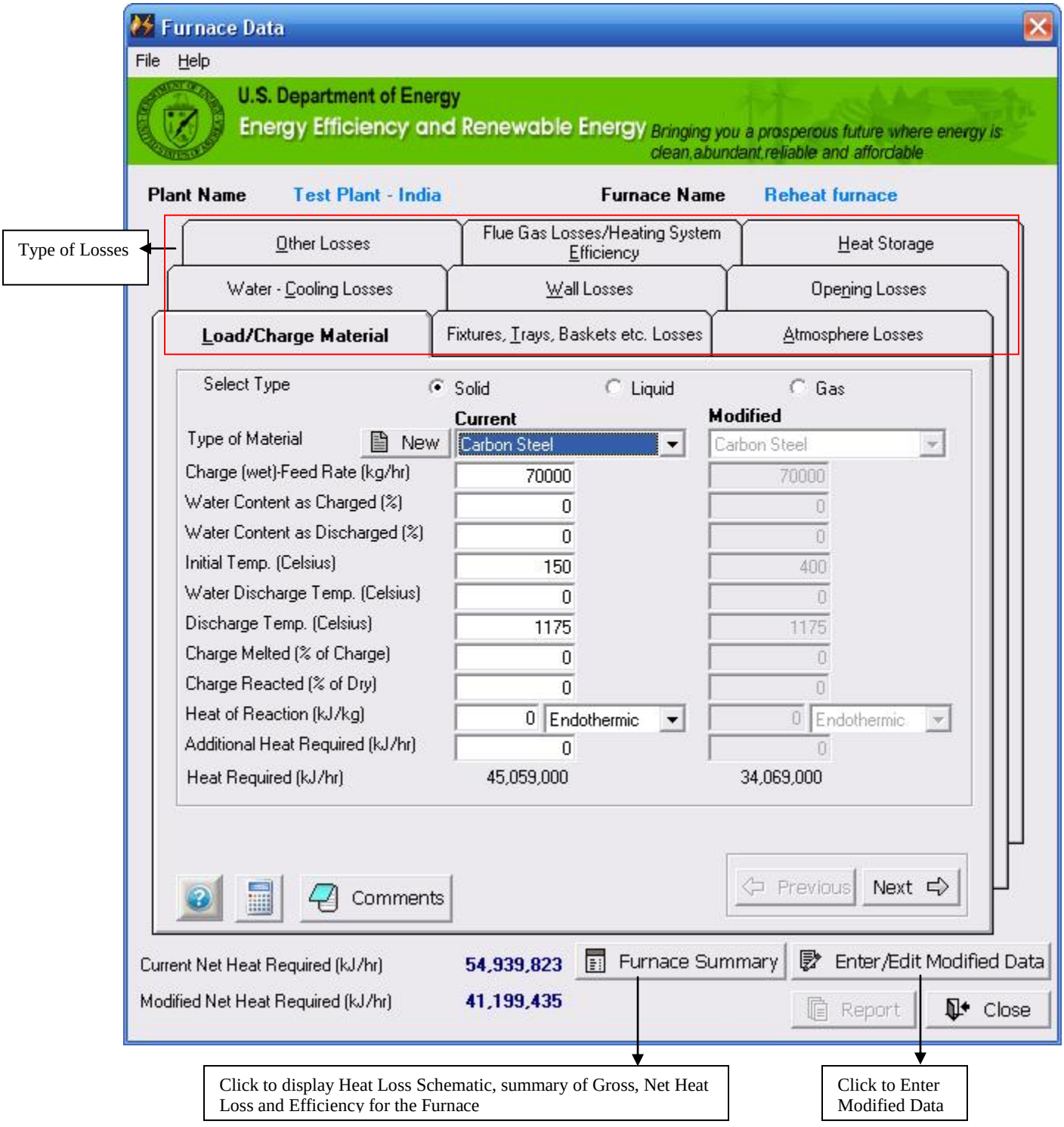
Click on **"Furnace Analysis"** from the main screen. Separate screens will pop-up as shown below



The screen includes a list of furnaces surveyed in the Plant Information section with the amount of energy cost (in terms of percentage of the total cost calculated during the survey) for each furnace. The furnace analysis can be carried out for selected furnaces or for all furnaces, one at a time. It is recommended that to begin with, you select the furnaces that use a relatively large amount (80% of the plant total) of energy. In the case shown above, the four furnaces use approximately 80% of the total plant energy and it will be advisable to perform a detailed analysis for only these four furnaces in the beginning.

Note: Furnace Names shown in blue colored text indicates that those furnaces have never been analyzed while black colored text indicates that those furnaces have been analyzed previously and have the saved data.

- Select the **Plant** from the drop down list.
- Select the **Furnace** from the drop down list.
- Click **"OK"** to analyze the selected furnace. A new screen as showed below will open up where information on different types of energy use (for the product) and losses for the furnace can be viewed or added.
- Click **"Close"** to exit without analyzing any furnace and return to main screen.



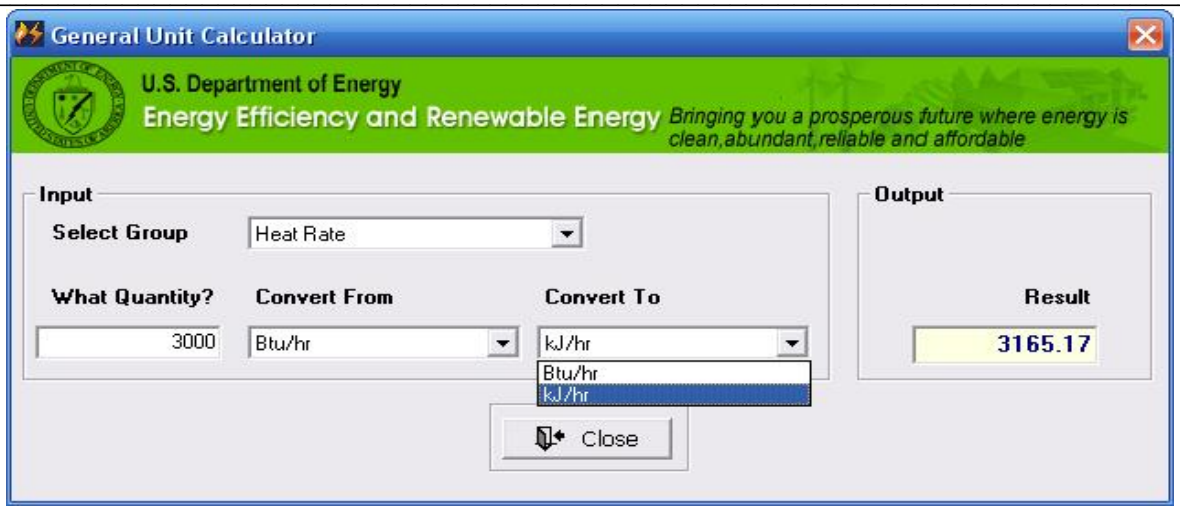
There are nine tabs that represent commonly encountered losses (mentioned below) in a furnace. The screens are designed for use with fuel fired furnaces but can also be used for electrically heated (i.e. induction, resistance, arc/plasma or other) furnaces.

1. Load Charge Material
2. Fixtures, Trays, Baskets etc. Losses
3. Atmosphere Losses
4. Water-cooling losses
5. Wall Losses
6. Opening Losses
7. Other Losses
8. Flue Gas Losses/System Heating Efficiency
9. Heat Storage

Common Instructions for ALL tabs

Each screen has two columns. One is used to enter "current" operating information and the other for "modified" operating conditions. At any particular instance either of these is enabled. The user should start with the current information column for each tab and complete the analysis to study the results. The results can be used to decide on possible changes in operating conditions that can be inserted in the "modified" column to study the effect of the changes.

- Click on "**Previous"** or **Next** to toggle between different screens of Furnace Analysis section. Alternatively user can click on the name of the tab to access a specific screen.
- Click on **"Enter/Edit Modified Data"** to enable the portion of the screen where the user can enter/edit the information for the current/modified condition of the Furnace. This button toggles between the current and modified conditions. Later, this information is used in comparing the performance of the Furnace in Summary and Reporting Furnace Analysis.
  Note: Initially data entered for "Current" condition will automatically be transferred to "Modified" condition upon clicking on ***"Enter/Edit Current Data".*** *The user can always review/modify this data. The purpose is to reduce unnecessary data input.*
- Click on **"Report"** to view the Furnace Analysis Report (described in detail at end of this manual) for the current furnace. This button is enabled only for the tab *Flue gas losses/Heating System Losses* as it is one of the largest heat usage areas. The purpose of it is to ensure that the user fills in the data for all tabs before viewing the report
- Click on "**Close"** to close the screen and return to the main screen.
- Click on  to access the general unit converter. A separate screen will pop up where user can select different unit groups and their conversions. The table of units is shown in Appendix – A

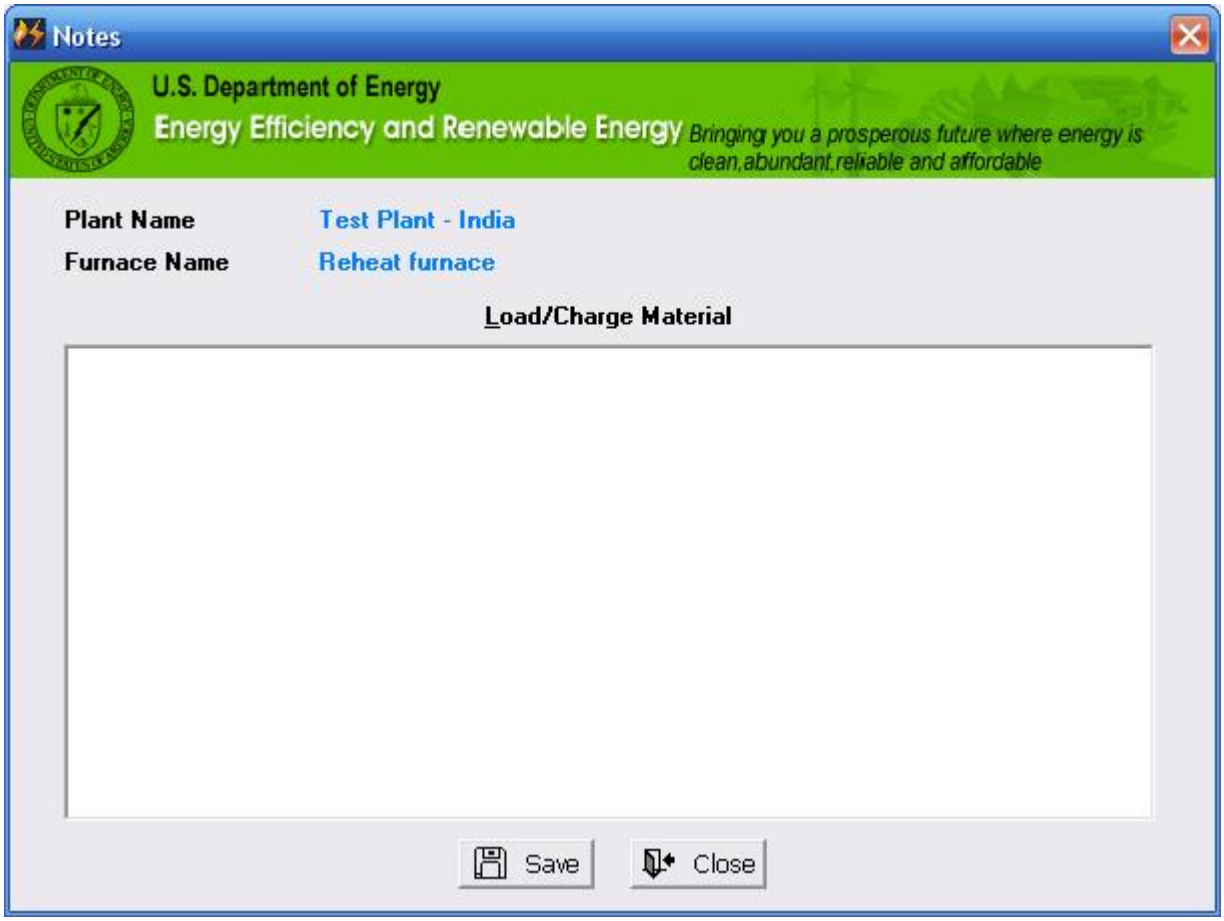


- Click on  to view the each field's description and their detailed explanation for each tab. A separate screen will pop up and display the help content specific to the tab from where it is clicked.

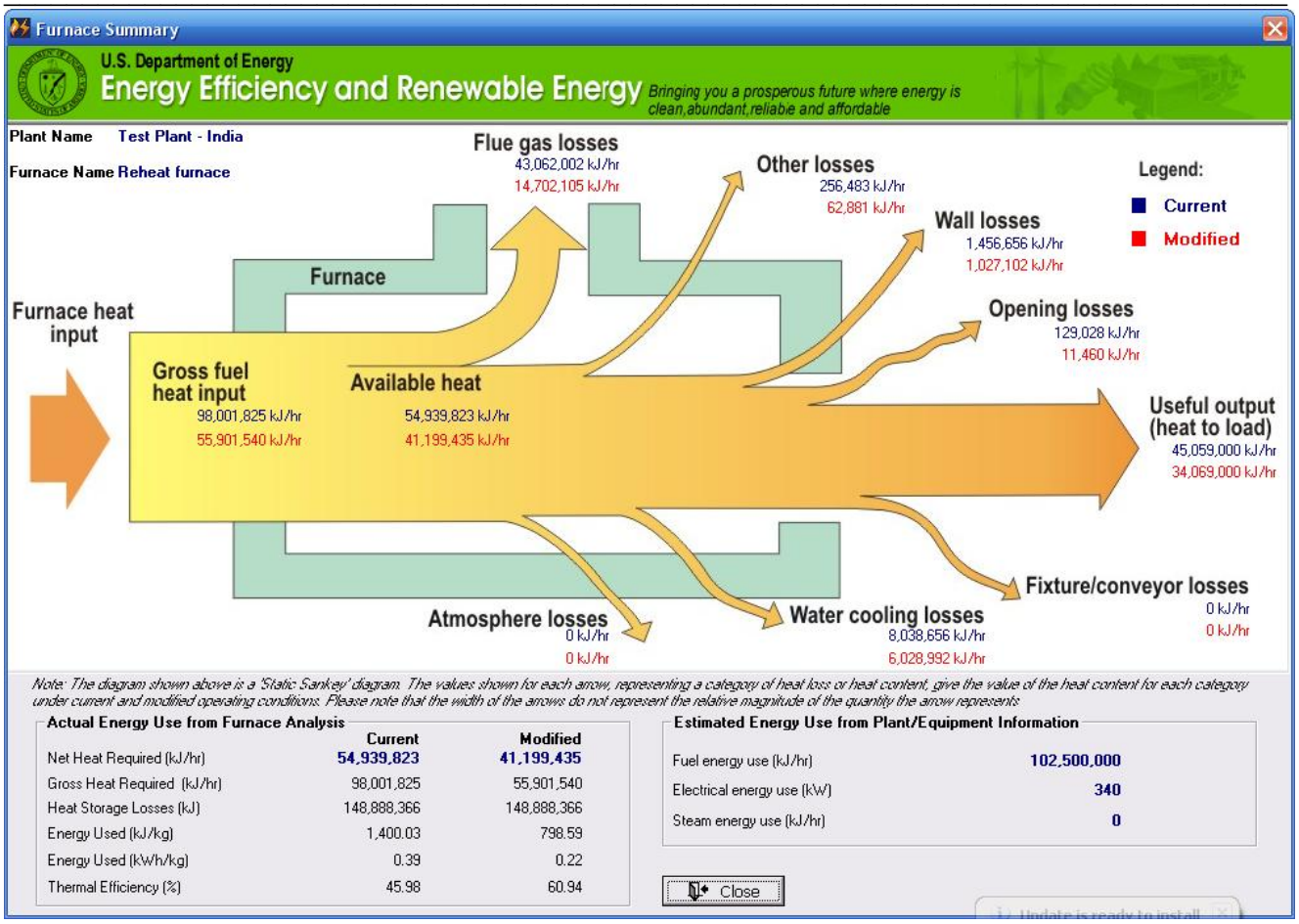
Load/Charge Material - Solid

Name	Description
Type of Material	Select material from the drop down list.
Charge (wet)-Feed Rate (kg/hr)	Weight of material charged per hour. Use total weight including moisture in the charge material. Note that for batch furnaces the total weight should be corrected for cycle time to obtain weight per hour value.
Water Content as Charged (%)	Water content of the charge material as percentage of total charge weight - wet basis. This value can be obtained from moisture tests or specifications for the material charged.
Water Content as Discharged (%)	Water content of the discharged material as percentage of total discharged weight - wet basis. This value can be obtained from moisture tests or specifications for the material discharged.
Initial Temp. (Celsius)	Inlet temperature for the charge material. Use production data or actual measurement.
Water Discharge Temp. (Celsius)	Temperature of water vapor (usually mixed with exhaust air or flue gases) as it is discharged form the furnace/oven.
Discharge Temp. (Celsius)	Discharge temperature for the material as it is discharged from the furnace or oven. Use production data or actual measurement.
Charge Melted (% of Charge)	Charge material melted (as % of solid material charged). Use value or data from process/production engineering or measurement of the final product.
Charge Reacted (% of Dry)	Charge material (as % of dry material) reacted. Use value or data from process/production engineering or measurement of the final product.
Heat of Reaction (kJ/kg)	Insert value of heat of reaction when chemical or metallurgical reactions are involved during heating. Use positive (+) value for endothermic reactions, use negative (-) sign for exothermic reactions.
Additional Heat Required (kJ/hr)	Insert value of additional heat required and not accounted for in the above calculations.
Heat Required (kJ/hr)	Heat Required - calculated by using the information given in previous cells.

- Click on " Comments " to enter the additional notes or comments while analyzing the each type of loss /consumption. A separate screen will pop up where user can enter the notes specific to the furnace losses.



- Click on " Furnace Summary " to open up a new screen where summarized data of Heat Loss, Energy Used and Efficiency with schematic of furnace losses can be viewed. A schematic showing furnace summary is shown below.

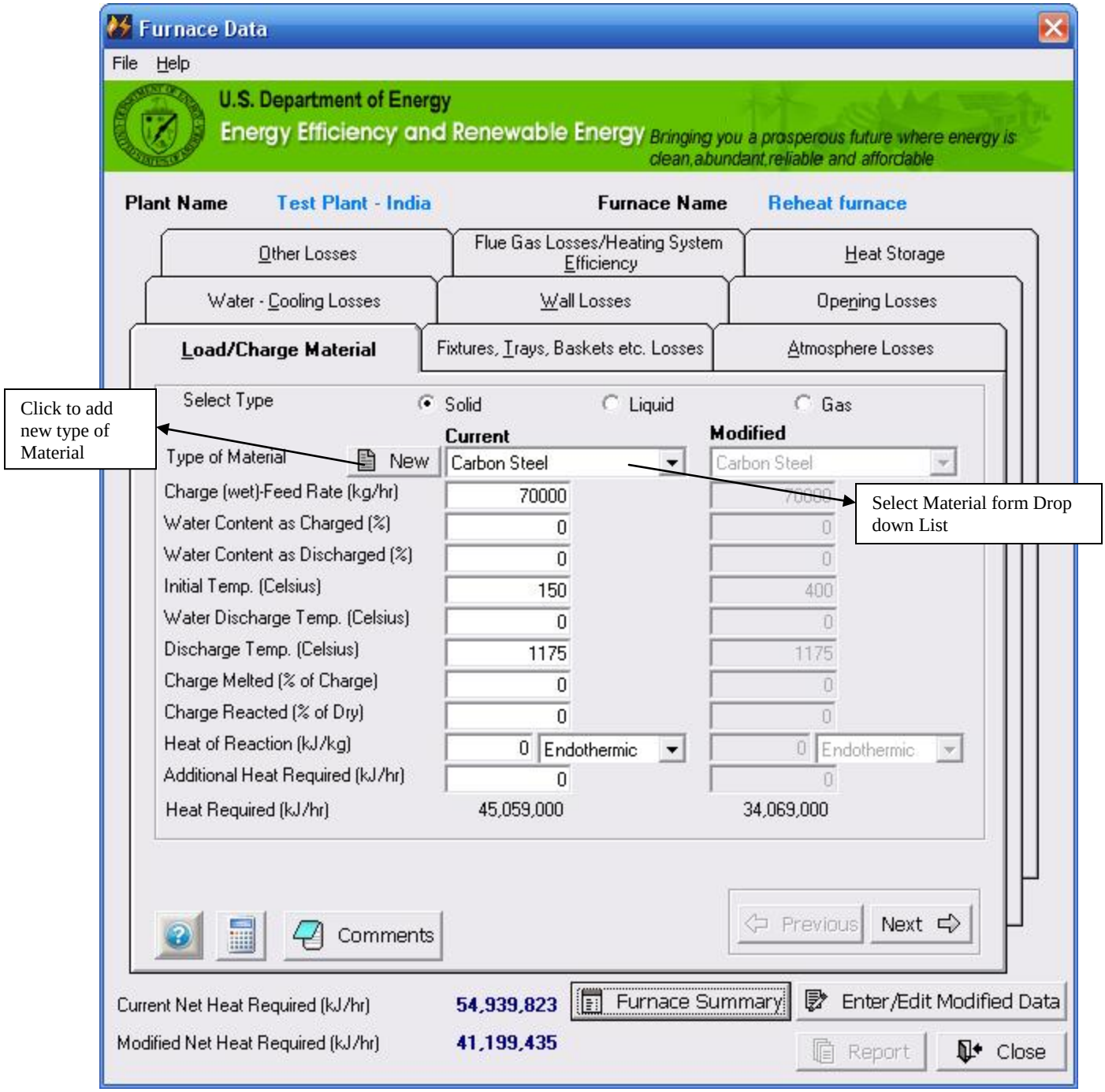


Additional Notes:

- *Refer to "Help", "Calculator", "Look up" or "Tool-tip" for additional references or knowledge material.*
- *Move the mouse over the label on each screen to display a "tool-tip" and get hint about the information that user is expected to fill in the respective text box.*
- *On all screens, a specific unit converter can be invoked by pressing "F2" key when cursor is in specific text box. Text boxes that allow invocation of specific unit converter are mentioned in each tab's details.*
- *A change of value in the text boxes will affect the Gross and Net Heat Required for the Current/Modified Condition. Application calculates and displays these "real-time" values at the bottom of each screen. The overall status and comparison of it can be analyzed with the Furnace Analysis Report, which is described later in this document.*

Load Charge Material:

A list of commonly used materials for charge material, fixtures and process atmosphere in process heating applications is given in the Type of Material drop-down menus. As described below, it is possible to add more materials (or modify properties of the existing materials) if the one for your specific application is not available in this list. The user added material (and data) would be automatically added to the database.



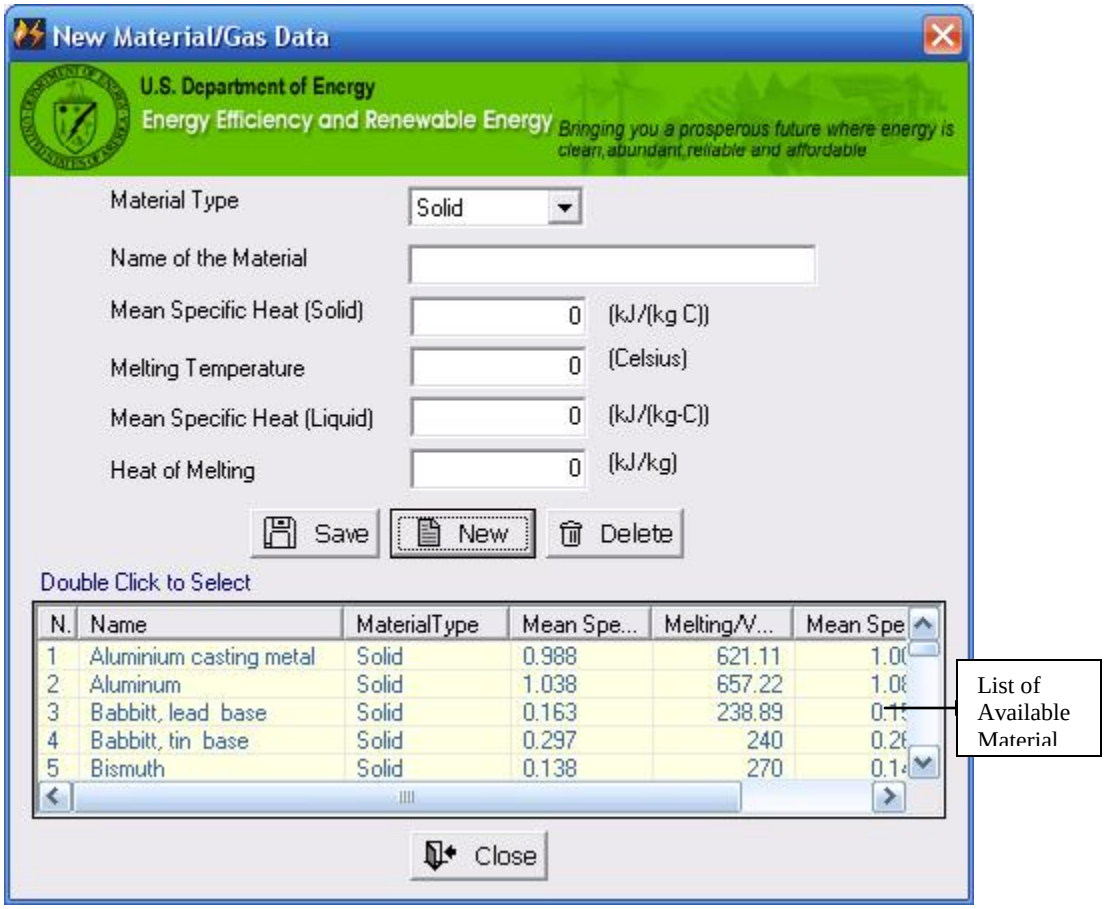
- Select the **Type** of material (i.e. Solid, Liquid, and Gas) for load charge.

- Select the **Material** from drop down *(Note: if desired material is not available, a new material can be added as described later in this section)*
- Enter the **"Other Information"** in the provided text boxes
- **"Heat Required"** is calculated based on the input provided and displayed at the bottom of the tab.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

Add New Material:

Click on **"New"** to enter new material that is not in the list or edit the information about the existing material. A new interface screen as showed below will open up where the users can enter/edit the data.

Note: Please do not change the property values for default material included in the master database. Changes in these values can give inaccurate results when the application is exported and used by other user. It is advisable to add material as a new material with different name.

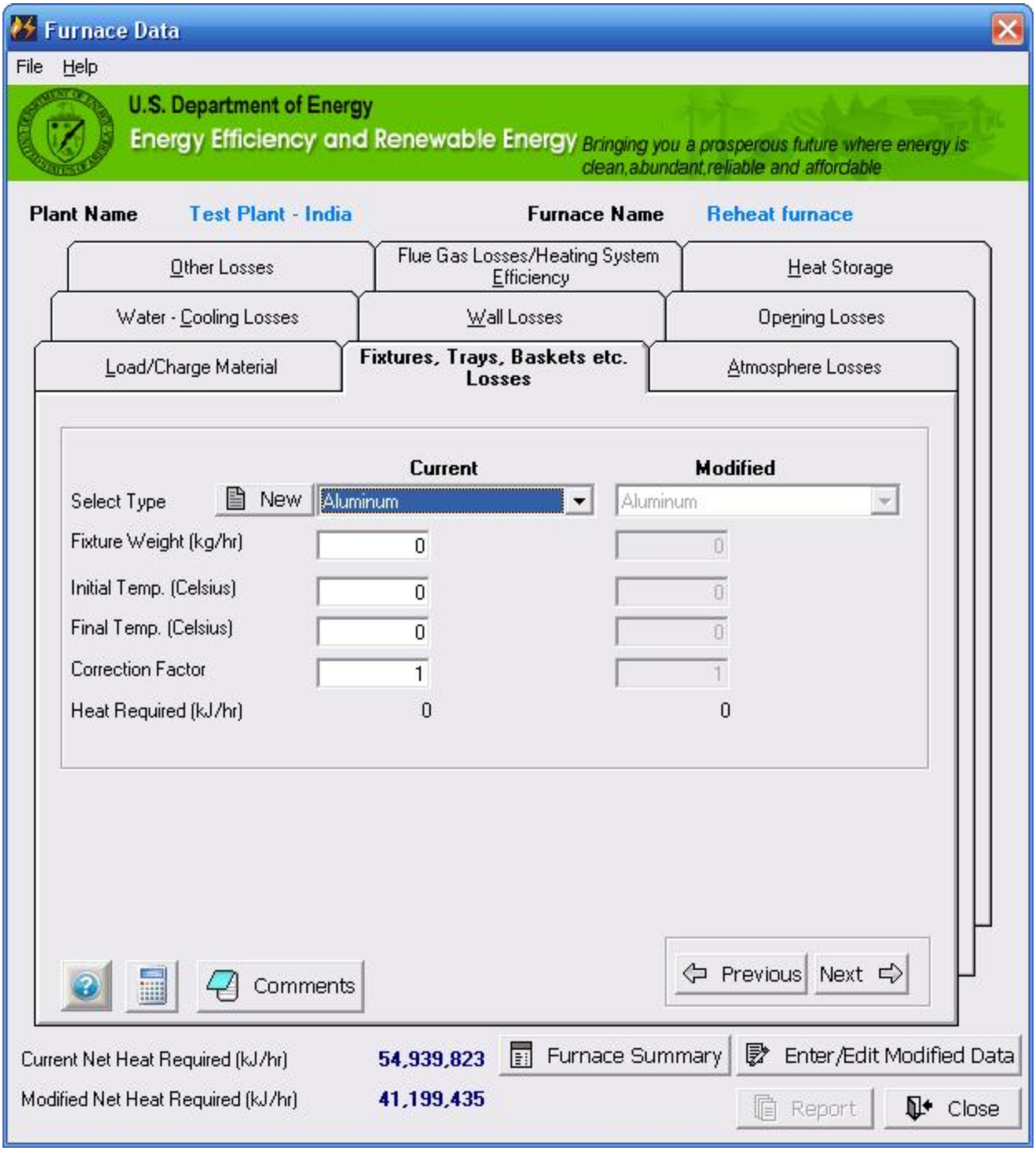


- Select the **Type** of material from drop down list (i.e. Solid, Liquid or Gas)
- Enter the required **Information** such as Mean Specific Heat (Solid), Melting Temperature, Mean Specific Heat (Liquid), and Heat of Melting etc.
- Click on **"Save"** to save the new material. A saved material will appear in the bottom list as well as in the drop down list on the **Furnace Analysis** screen.
- Click on **"New"** to add another new material with required information

Note: Name, Mean specific Heat (Solid) and Melting point of the Material are mandatory information for new material. If the final temperature of the process is greater than the melting point of the material, Mean Specific Heat (Liquid) and Heat of Melting will be required for calculations and must be provided here. Otherwise, Heat Loss calculations will be wrong/misleading.

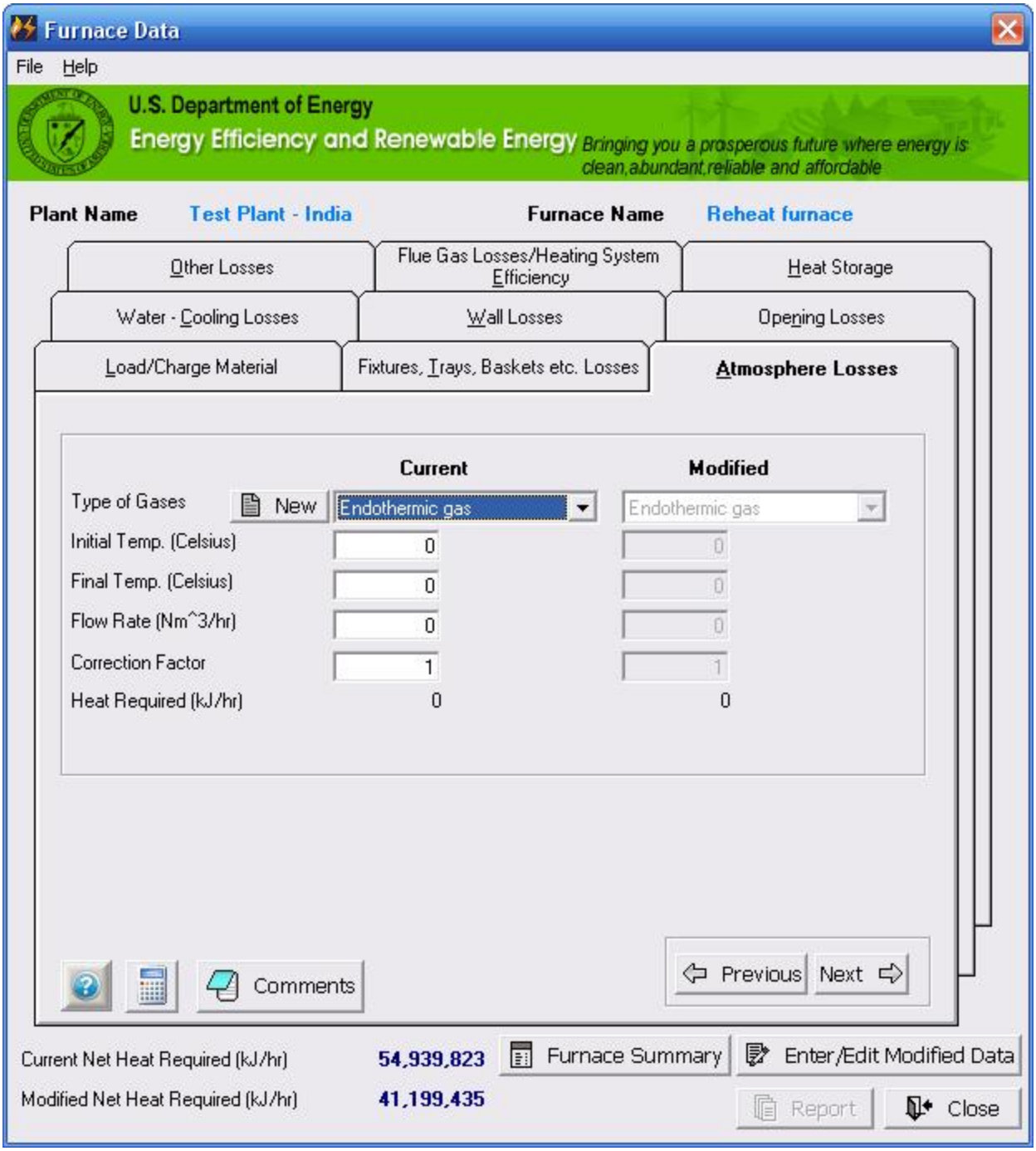
- Click on **"Delete"** to delete the material from the list. The material will not be available for selection from Drop down list on the Furnace Analysis screen. The application will not allow deletion of materials which are in master database or which have been selected in any of the plant.

Fixtures, Trays, Baskets etc. Losses



- Select the **Material** from drop down. *(Note: if desired material is not available, a new material can be added as described later in this section)*
- Enter the **"Other Information"** in the provided text boxes.
- **"Heat Required"** is calculated based on the input provided and displayed at the bottom of the tab.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

Atmosphere Losses

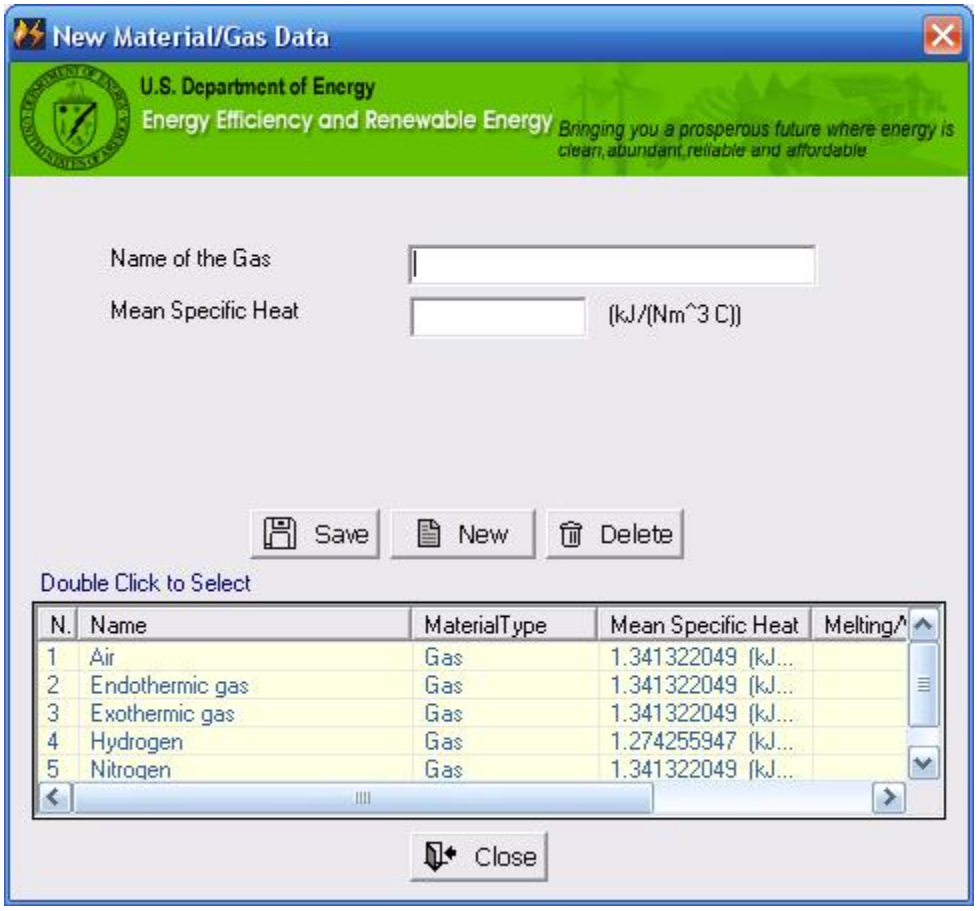


- Select the **Atmospheric Gas** from drop down. *(Note: if desired gas is not available, a new gas can be added as described later in this section)*
- Enter the **"Other Information"** in the provided text boxes.
- **"Heat Required"** is calculated based on the input provided and displayed at the bottom of the tab.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

Add New Gas:

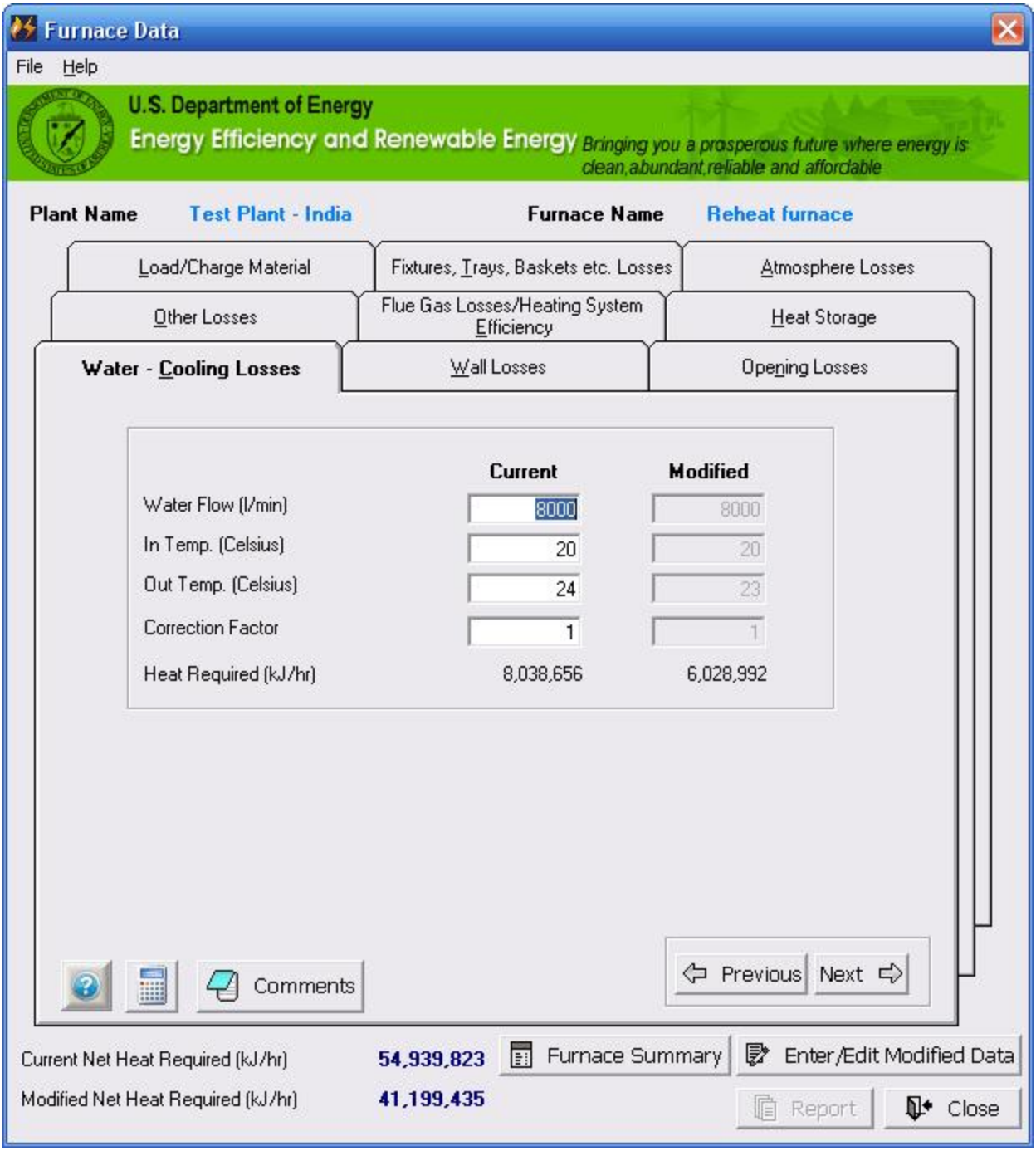
Click on **"New"** to enter new gas that is not in the list or edit the information about the existing atmosphere gas. A new interface screen as showed below will open up where the users can enter/edit the data.

Note: Please do not change the property values for default gases included in the master database. Changes in these values can give inaccurate results when the application is exported and used by other user. It is advisable to add gas as a new gas with different name.



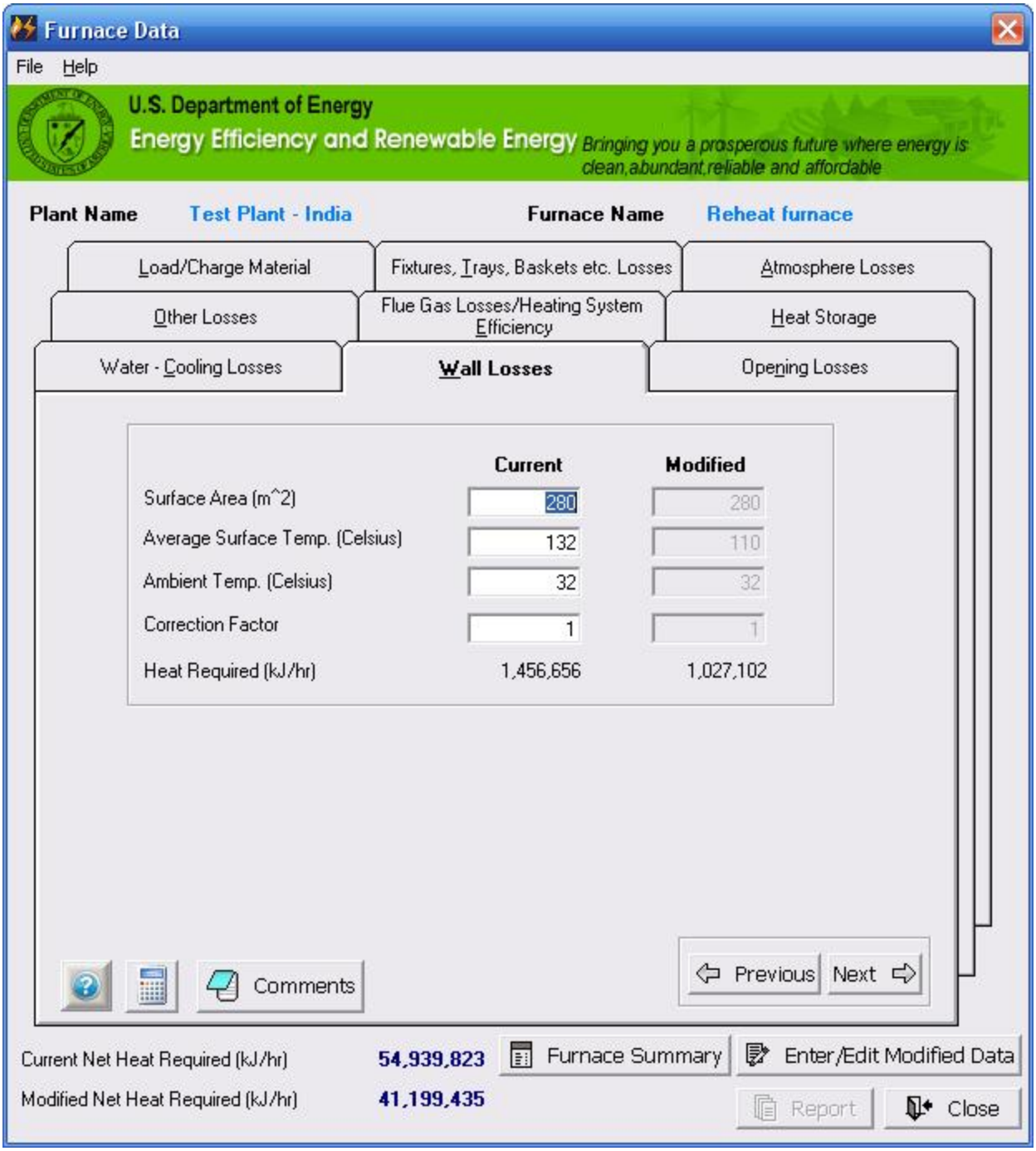
- Enter the required **Information** such as Name of the Gas and Mean Specific Heat
- Click on **"Save"** to save the new gas. A saved gas will appear in the bottom list as well as in the drop down list on the **Furnace Analysis - Atmosphere Losses** tab screen.
- Click on **"New"** to add another new material with required information
  Note: Name, Mean specific Heat of the Gas is mandatory information for new gas.
- Click on **"Delete"** to delete the gas from the list. The gas will not be available for selection from Drop down list on the **Furnace Analysis - Atmosphere Losses** tab screen. The application will not allow deletion of materials which are in master database or which have been selected in any of the plant.

Water-Cooling Losses



- Enter the **"Information"** in the provided text boxes.
  Note: 1.0 is used as default value of Correction Factor. Use can always change to different number.
- **"Heat Required"** is calculated based on the input provided and displayed at the bottom of the tab.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

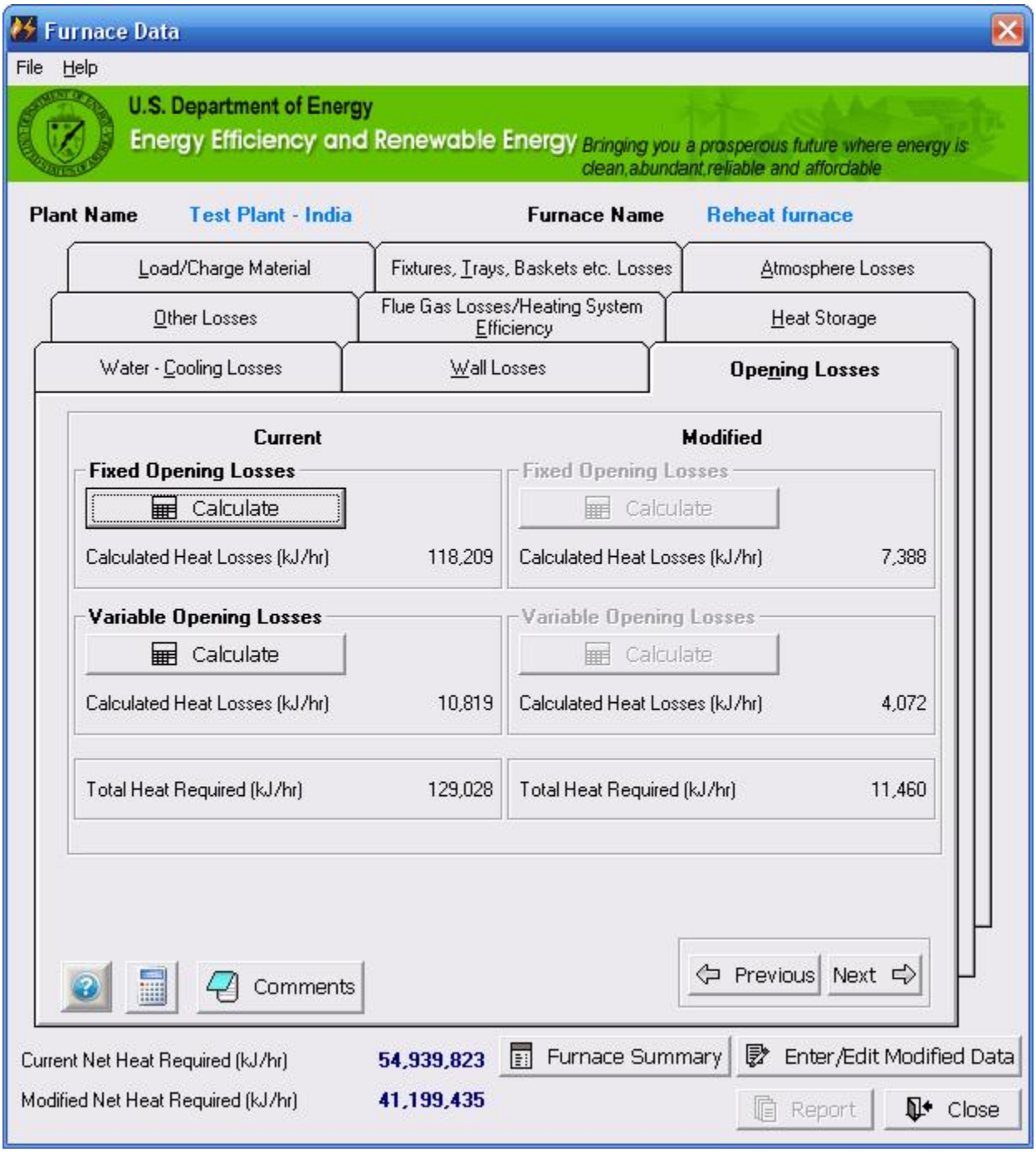
Wall Losses



- Enter the **"Information"** in the provided text boxes.
  Note: 1.0 is used as default value of Correction Factor. Use can always change to different number.
- **"Heat Required"** is calculated based on the input provided and displayed at the bottom of the tab.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

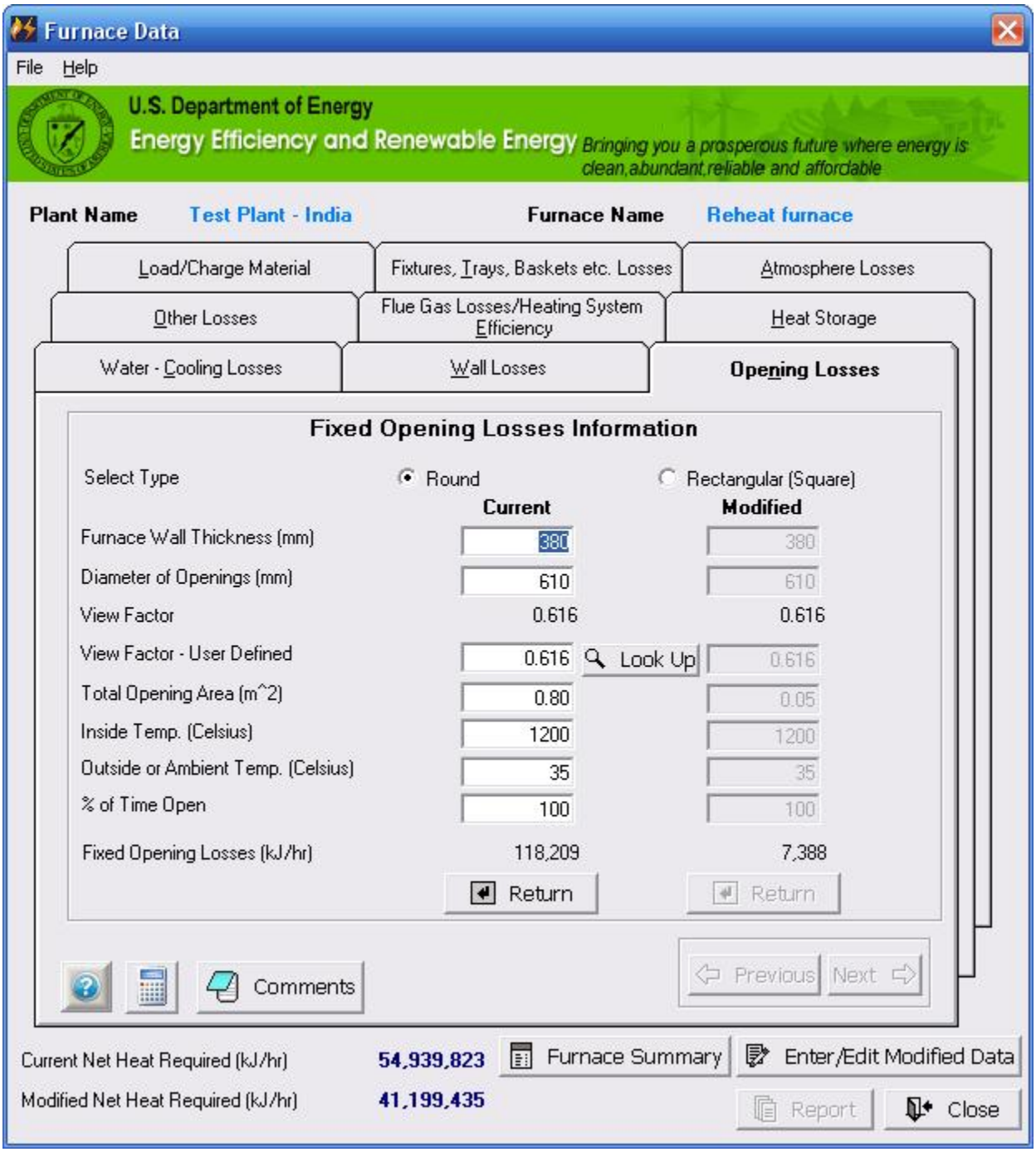
Opening Losses

Click on the **Opening Losses tab** to display the following main screen from which the user can perform the calculation for fixed and variable opening losses for current as well as modified condition. The calculated result of fixed and variable opening losses are displayed as an individual losses and total of both opening losses is also calculated and displayed on the screen.



Fixed Opening Losses

Click on **"Calculate"** in the fixed opening area will display the secondary screen as shown below. User has an option to choose from round or rectangular opening



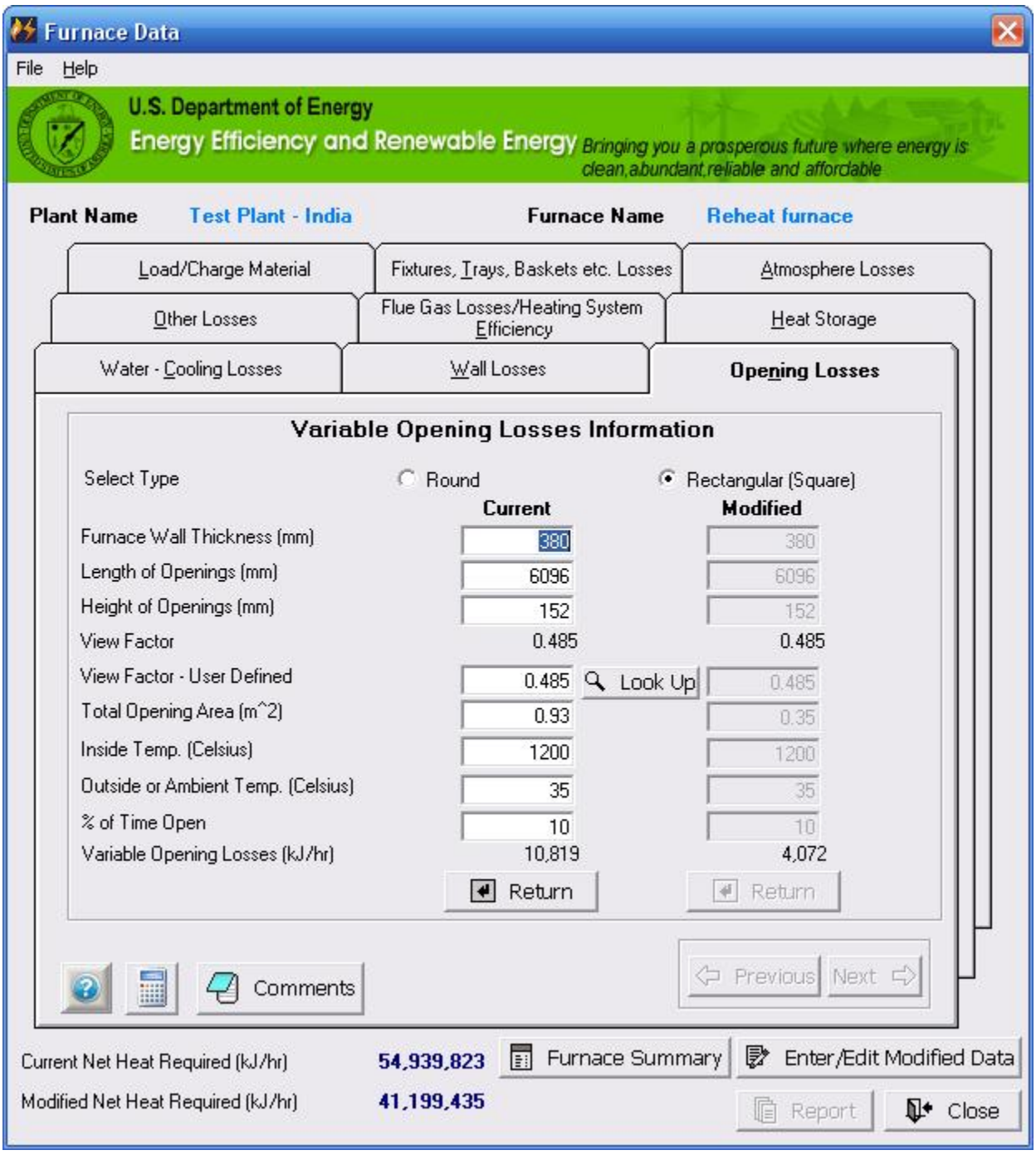
- Select the **Type** of opening i.e. Round or Rectangular
- Enter the **dimensions** for openings.
- Modify **"View Factor-User Defined"** (Optional)

*Note: A view factor is calculated based on the input and set as default value for View Factor-User Defined. User can refer **"Look Up"** next to the input box for further information*

- Enter **"Other Information"** related to fixed opening.
- Based on the input provided, a **fixed opening loss** is calculated and displayed.
- Click on **"Return"** to bring the calculated number of fixed opening losses to the main screen.

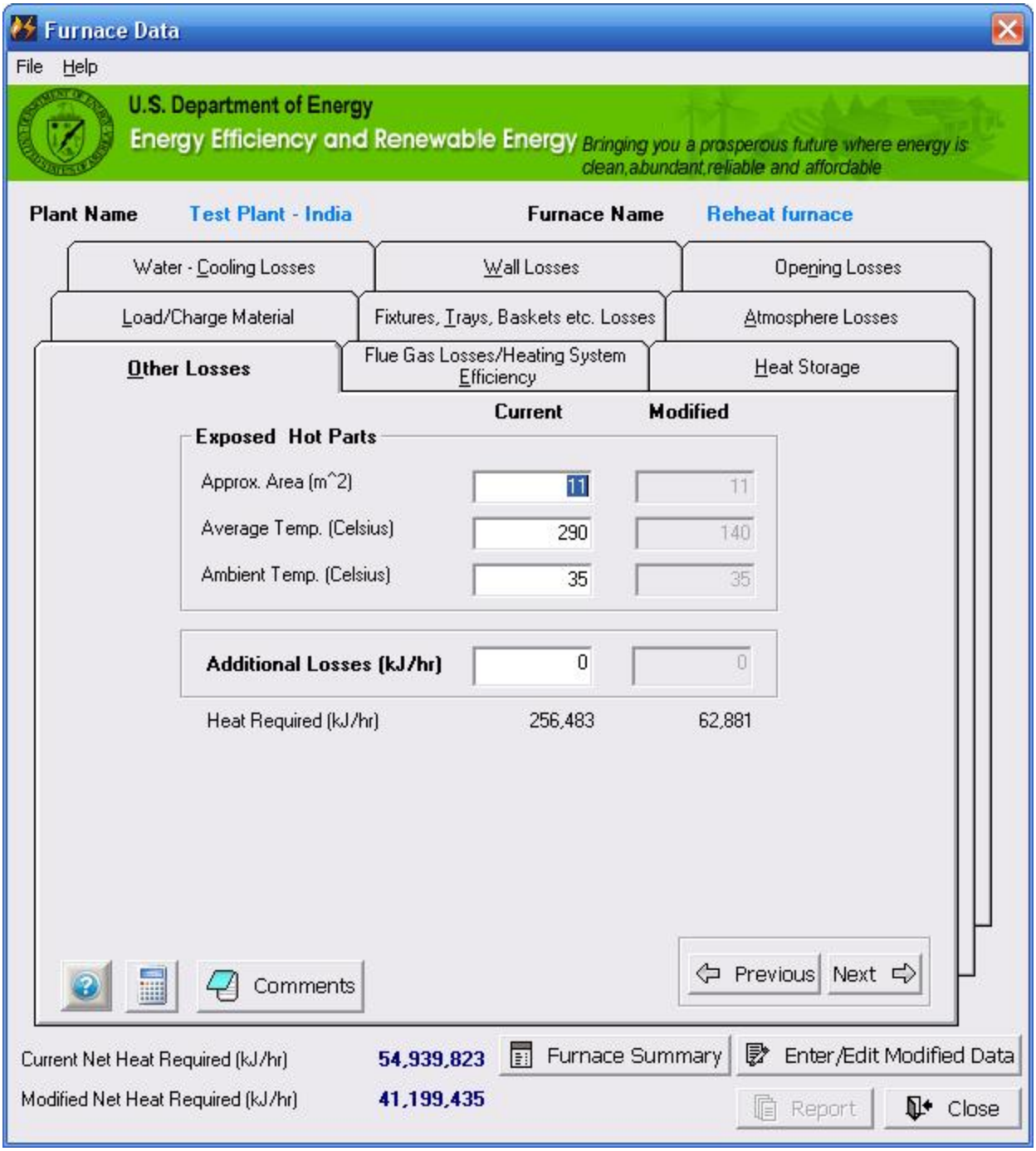
Variable Opening Losses:

Click on **"Calculate"** in the variable opening area will display the secondary screen as shown below. User has an option to choose from round or rectangular opening



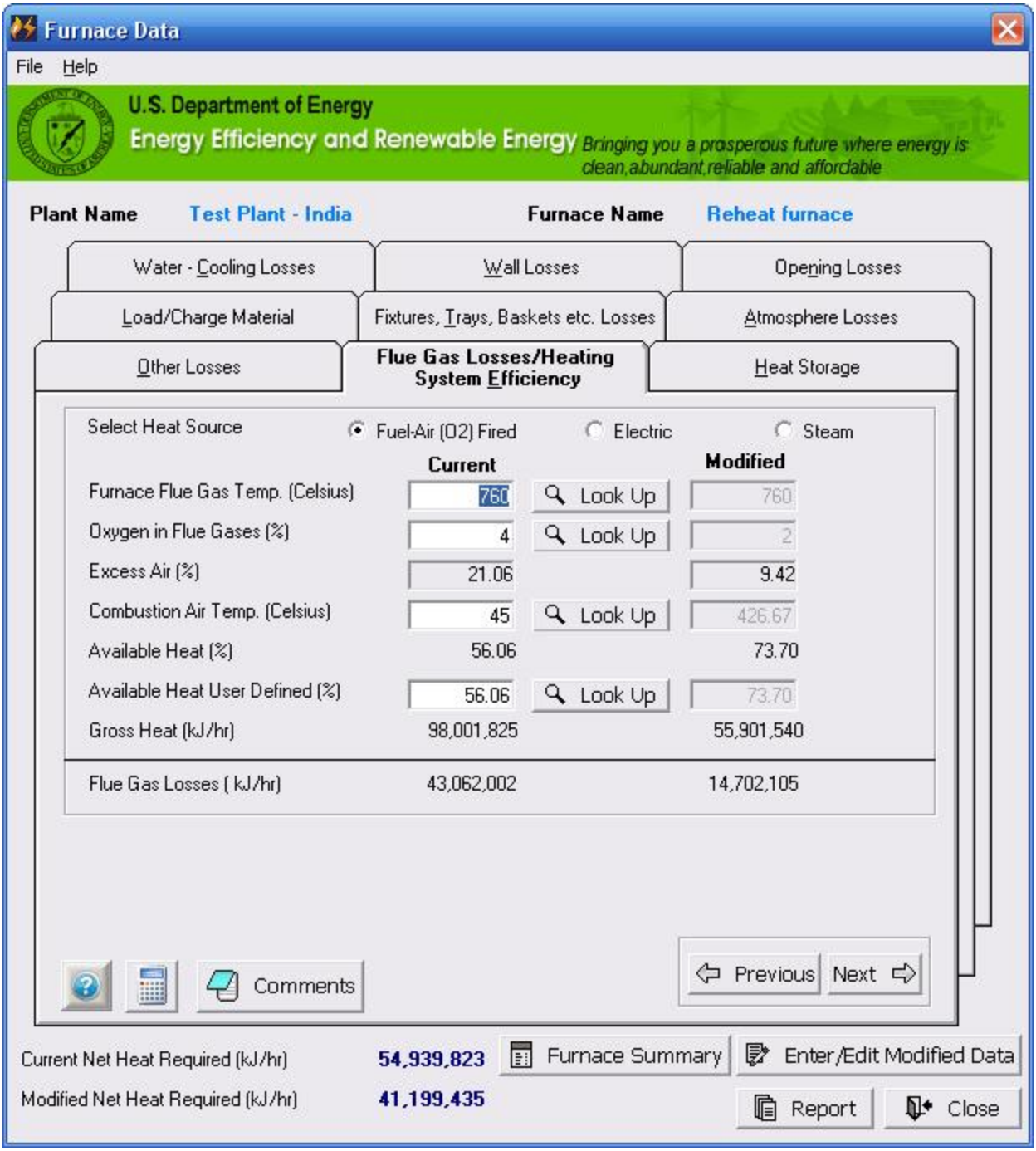
- Select the **Type** of opening i.e. Round or Rectangular
- Enter the **dimensions** for openings.
- Modify **"View Factor-User Defined"** (Optional)
  *Note: A view factor is calculated based on the input and set as default value for View Factor-User Defined. User can refer **"Look Up"** next to the input box for further information*
- Enter **"Other Information"** related to variable opening.
- Based on the input provided, a **variable opening loss** is calculated and displayed.
- Click on **"Return"** to bring the calculated number of variable opening losses to the main screen.

Other Losses



- Enter the **"Information"** in the provided text boxes.
- Enter the **"Additional Losses"** (optional).
- **"Heat Required"** is calculated based on the input provided and displayed at the bottom of the tab.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

Flue Gas Losses/System Heating Efficiency

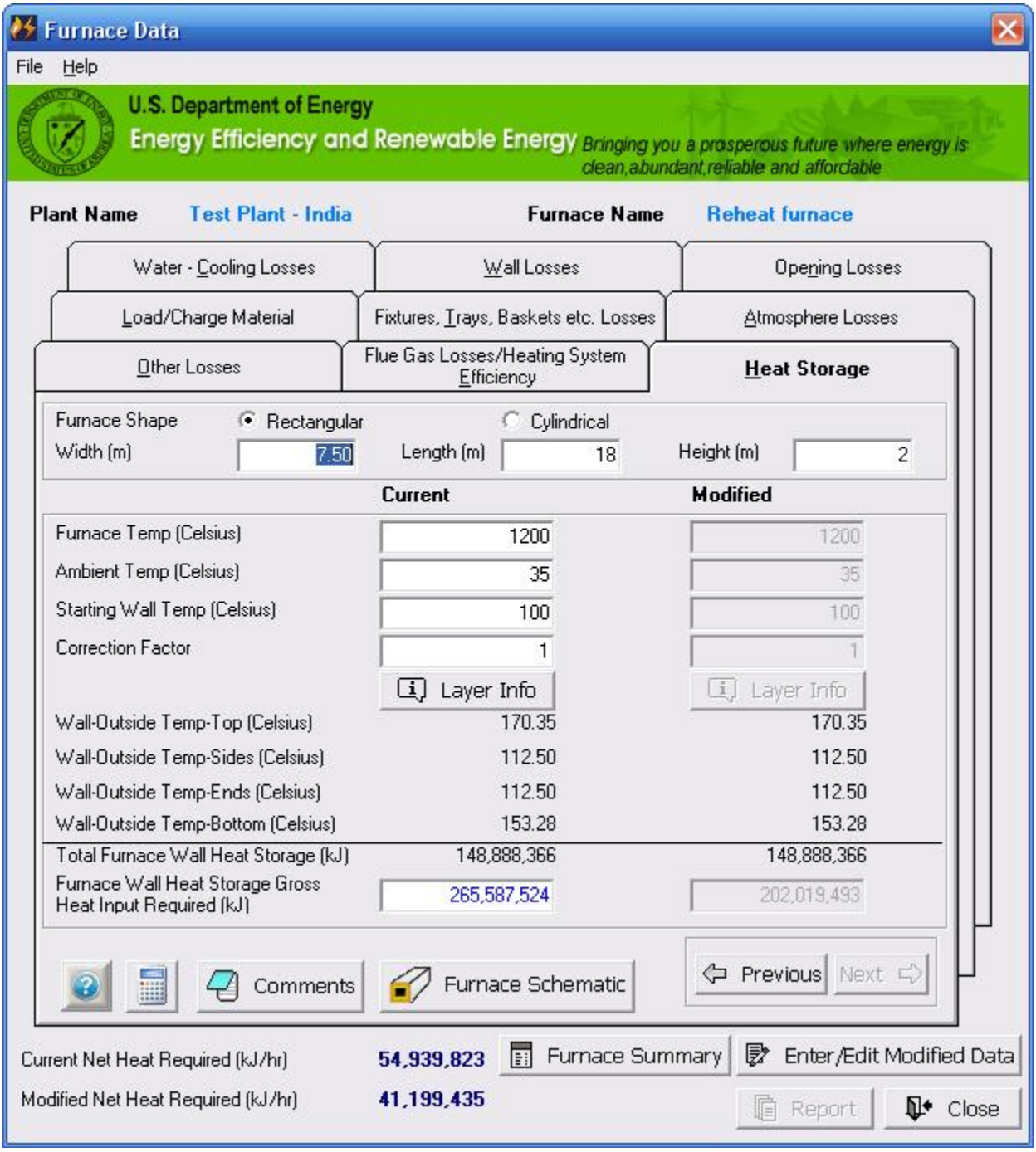


- Select the **Heat Source** of the system i.e. Fuel-Air (O2) fired, Electric or Steam
- Enter **"Other Information"** in the provided text boxes. Refer **"Look Up"** next to each text box for further, related information.
- Modify **"Available Heat-User Defined"** (Optional)
  *Note: An Available Heat is calculated based on the input and set as default value for Available Heat-User Defined. User can refer **"Look Up"** next to the input box for further information*

- Based on the input provided, a **flue gas loss** is calculated and displayed.
- Click on **"Next"** to move to next tab. The entered data will be saved automatically.

Heat Storage

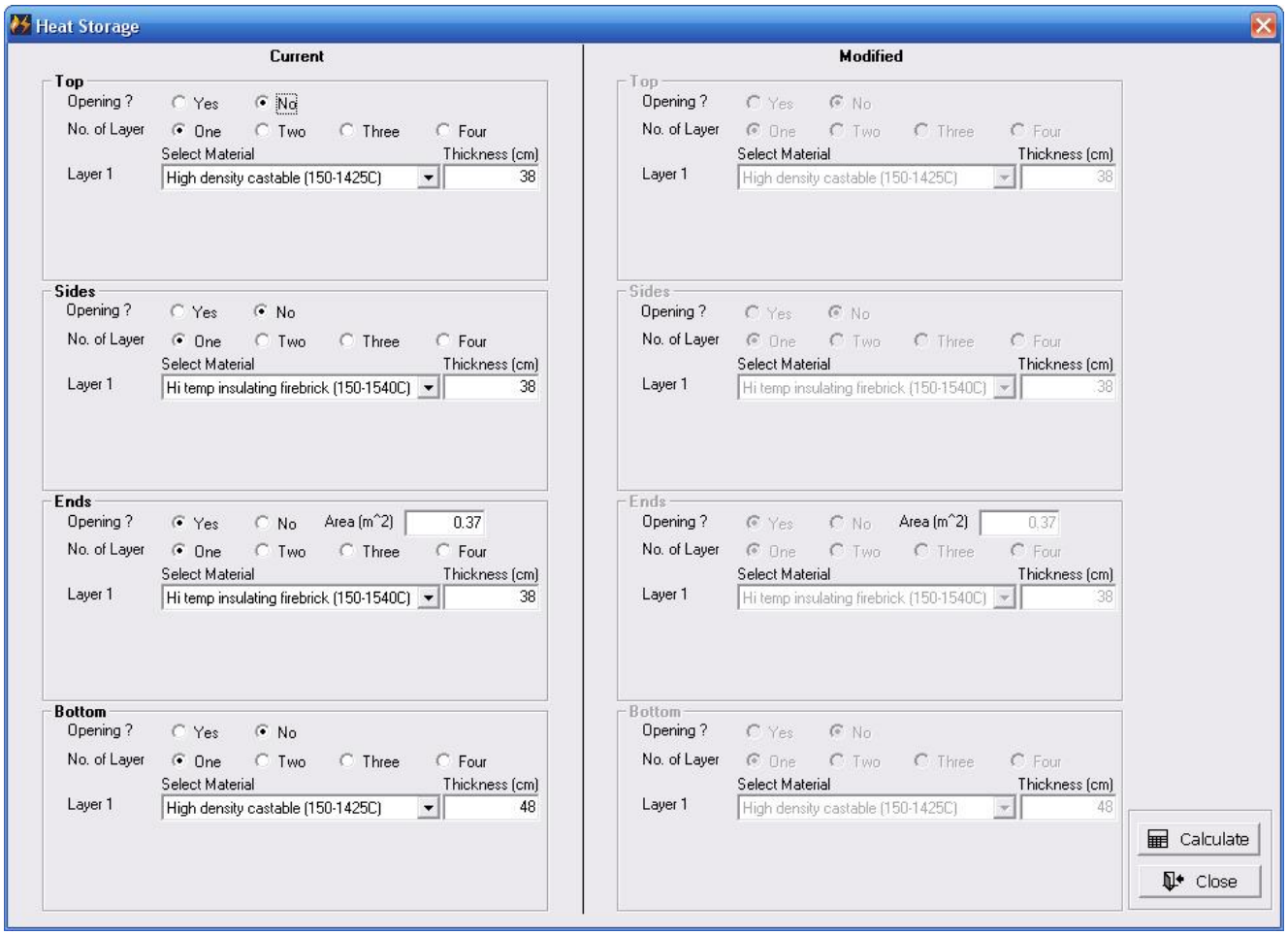
Click on the **Heat Storage tab** to display the following screen from which the user can perform the calculation for heat storage and theoretical heat loss for current as well as modified condition. The result is displayed in the respective text boxes of Heat storage and Theoretical heat loss.



- Enter the **Information** about furnace shape, dimensions and temperatures.

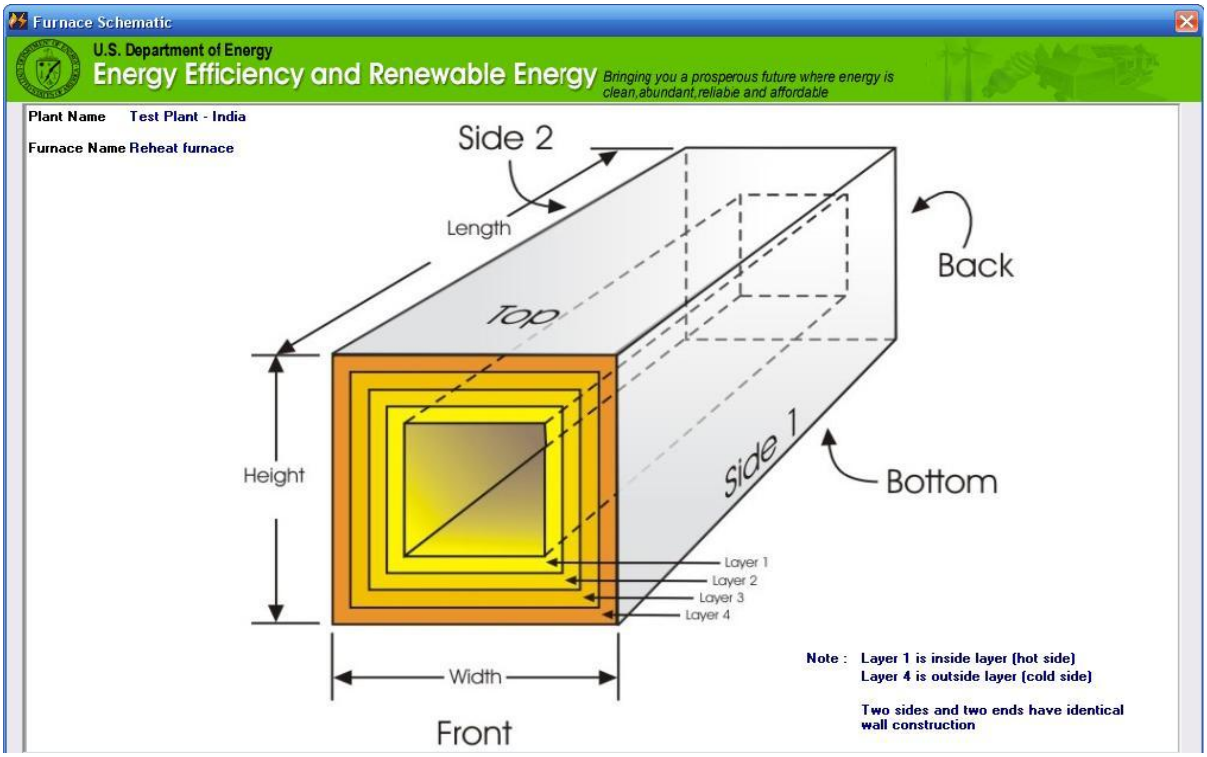
- Click on **"Layer Info"** to open a new screen (as shown below) that can be used to enter the required information. This button is enabled once information about furnace shape, dimensions and temperatures

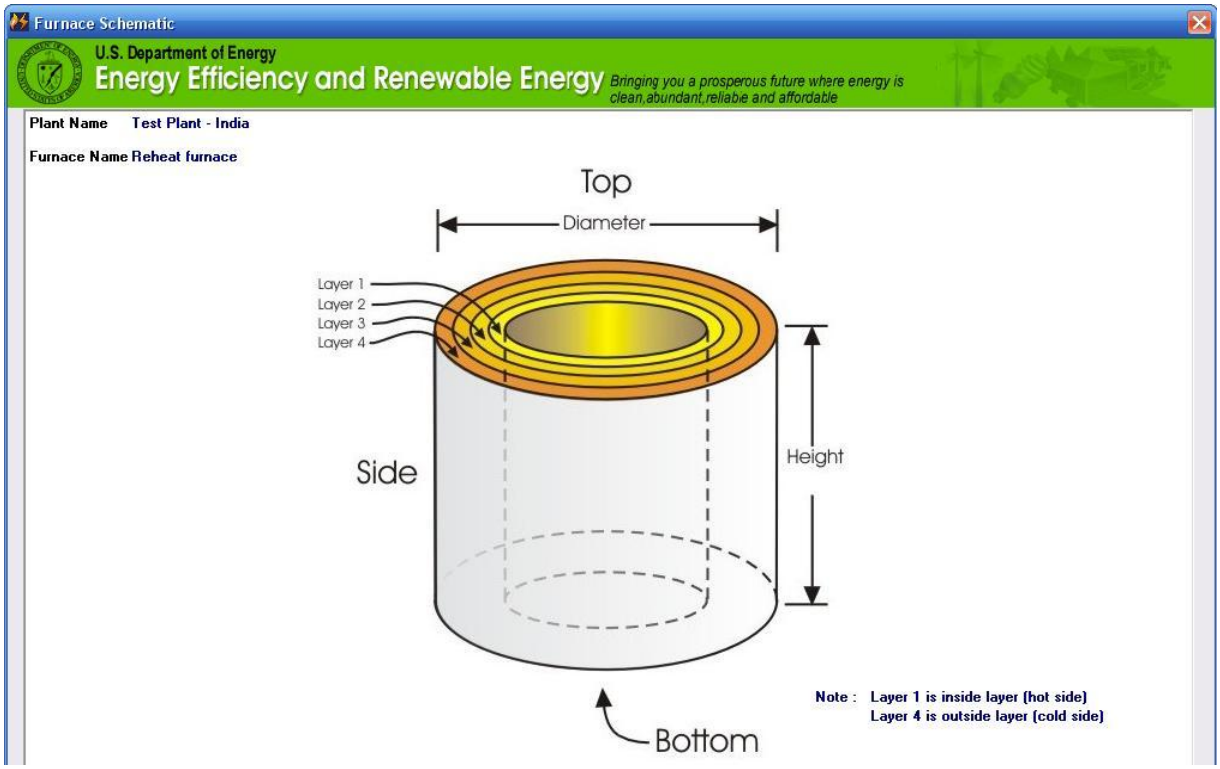
  Note: The user can select the up to four layers for the furnace wall, the material from the list and enter the thickness of each layer. The user can edit the information or change the selection before performing calculations. The selection and data input will be available later when the user is selecting the same furnace for review.



- Select an option of **Opening**. Provide the area of opening if there is an opening.
- Select the **Number of Layers**. *(Note: Based on this selection, the drop down for material selection and input box for thickness will appear)*
- Select **Material** for each layer
- Enter **Thickness** for each layer
- Click on **"Calculate"** to calculate the heat storage from the given input and return to the furnace analysis-heat balance screen. The calculated results are displayed on the furnace analysis-heat balance screen.
- Click on **"Close"** to return to the Furnace- Heat balance analysis screen without performing calculations and without saving the newly entered data.

- Click on " Furnace Schematic " or " Furnace Schematic " (depends on selection of furnace shape). It will open up a new window where use can refer the schematics of rectangular or round furnace.

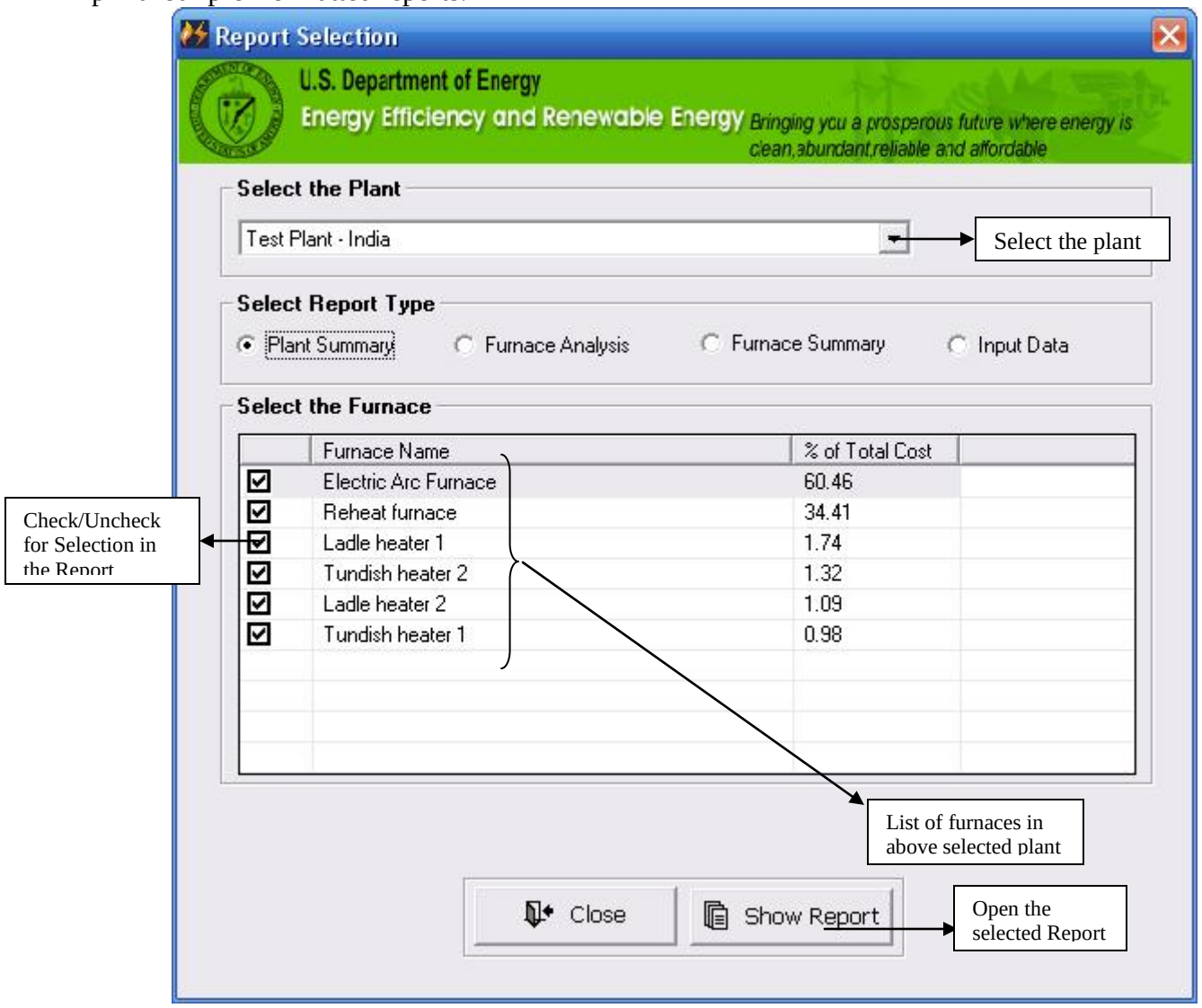




Reports:

This section provides four summary reports in the form of tables and charts. The **Plant Summary** report includes a table of energy used, expected cost of operation for the furnaces surveyed and their comparison. The **Furnace Analysis** report includes a table of energy used in various parts of the furnace analyzed, their relative importance in terms of the percentage of the total energy used and the effect of changes in key operating parameters on the energy used for the furnace. The **Furnace Summary** report presents schematic of heat loss/use distribution of the selected furnace. The **Input Data** report presents all the data that has been given as input for selected plant.

Click on **Reports** on the main screen to open a new user interface. Here the user can opt to view or print four pre- formatted reports.



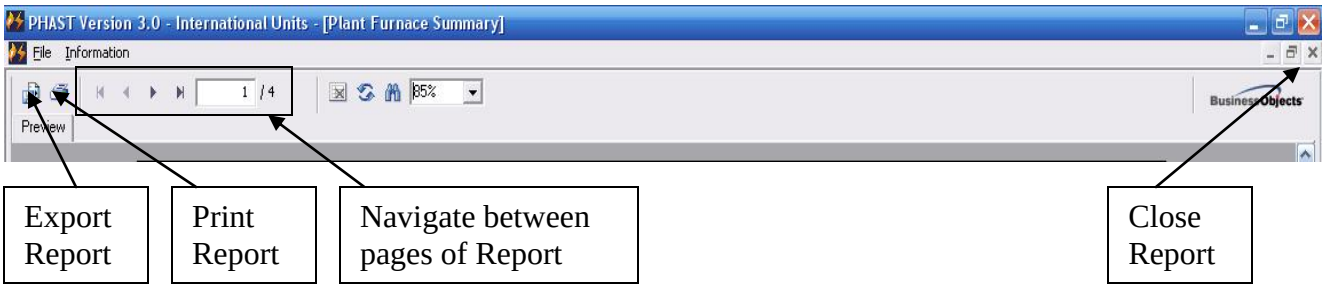
- Select a **Plant** from the drop down list. All furnaces of the selected plant will be displayed as a list with the percentage of total cost of the plant.
- Select an **Option** of the reports

- Select the **Furnace/s** from the displayed list.
  - For **Plant Summary** option, the user can select <u>any number</u> of furnaces that are required for analysis.
  - For **Furnace Analysis** or **Furnace Summary** option, the user can select <u>any one</u> furnace for detailed analysis..
  - For **Input Data** option, the user will not have a choice to select furnaces and report is generated for all the furnaces of the plant.
- Click **"Show Report"** to generate a pre-formatted report with actual data and calculations with graphs/images. *(Note: Generating a report calls for intensive calculation in background and may take time to display a report. A status bar with a note on the screen indicates the progress of opening of report)*
- Click **"Close"** to return to the main screen without displaying the report

Common Instructions for Report Viewer Window:

Each report is opened in a window that has header tool bar (as shown below). User has following options for working with reports.

- Navigate between the pages of the reports
- Print the displayed report
- Export the displayed report in PDF for electronic transfer or later analysis



Following pages shows the representative images of actual reports generated from the application.

Plant Summary:

Initiation Date : 3/6/2008

Plant Summary

Company Name	NEW STEEL CORPORATION				
Plant Name	Test Plant - India				
Address	1234 Main street Pune	Maharashstra	India	23456-7889	
Contact Information	Raj Joshi **EMail** rjoshi@newsteel.in.com			**Phone** (228) - (652 3456) **Fax** (228) - (652 3000)	
Currency	India - INR - Rupee		**Conversion Rate Used** (Equivalent to USD)		0.022C

Summary of Energy Sources Used

Energy Name	Heating Value	Heating Value Units	Cost (INR per Unit)	Cost Units
Electricity	3,600	kJ/kWh	8.0C	/kWh
Fuel Oil	137,000	kJ/l	120.0C	/GJ
Natural Gas	38,000	kJ/m^3	300.0C	/GJ
Steam	2,790	kJ/kg	250.0C	/GJ

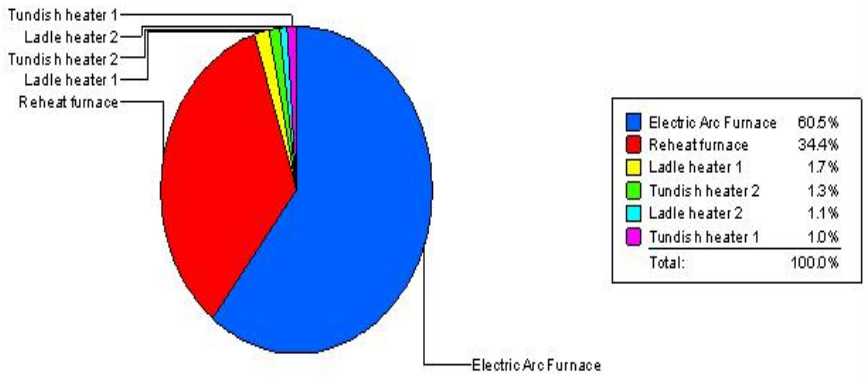
Print Date : 10/22/2010 PHAST v2.0 Page 1 of 4

Initiation Date : 3/6/2008

Plant Summary

Company Name	NEW STEEL CORPORATION
Plant Name	Test Plant - India

Process Heating Equipment - Energy Cost Distribution



Print Date : 10/22/2010 PHAST v2.0 Page 2 of 4

Initiation Date : 3/6/2008

Plant Summary

Company Name	NEW STEEL CORPORATION
Plant Name	Test Plant - India

Process Heating Equipment-Energy Used and Cost Distribution

Heating Equipment	Fuel Energy Use (GJ/Year)	Annual Cost (INR/Year)	Electric Energy Use (Thousand kWh/Year)	Annual Cost (INR/Year)	Steam Energy Use (GJ/Year)	Annual Cost (INR/Year)	Annual Total Cost (INR/Year)	Annual Cost (USD/Year)	% of Total Cost
Electric Arc Furnace	0	0	58,800	470,400,000	0	0	470,400,000	10,348,800	60.46
Reheat furnace	820,000	246,000,000	2,718	21,744,000	0	0	267,744,000	5,890,368	34.41
Ladle heater 1	108,000	12,960,000	73	583,200	0	0	13,543,200	297,950	1.74
Tundish heater 2	84,375	10,125,000	22	172,800	0	0	10,297,800	226,552	1.32
Ladle heater 2	67,200	8,064,000	49	392,000	0	0	8,456,000	186,032	1.09
Tundish heater 1	61,440	7,372,800	29	230,400	0	0	7,603,200	167,270	0.98
Total	**1,141,015**	**284,521,800**	**61,690**	**493,522,400**	**0**	**0**	**778,044,200**	**17,116,972**	**100.00**

Print Date : 10/22/2010 PHAST v2.0 Page 3 of 4

Initiation Date : 3/6/2008

Plant Summary

Company Name	NEW STEEL CORPORATION
Plant Name	Test Plant - India

Comments / Notes

Furnace Name : Electric Arc Furnace
This is an older furnace
Furnace Name : Reheat furnace
Walking hearth furnace data from the design manual and the furnace operators
Furnace Name : Ladle heater 1
Horizontal heater used regularly.
Furnace Name : Tundish heater 2
This is larger unit with capability to be used as a dryer also.
Furnace Name : Ladle heater 2
Vertical heater used as secondary heater
Furnace Name : Tundish heater 1
Used frequently

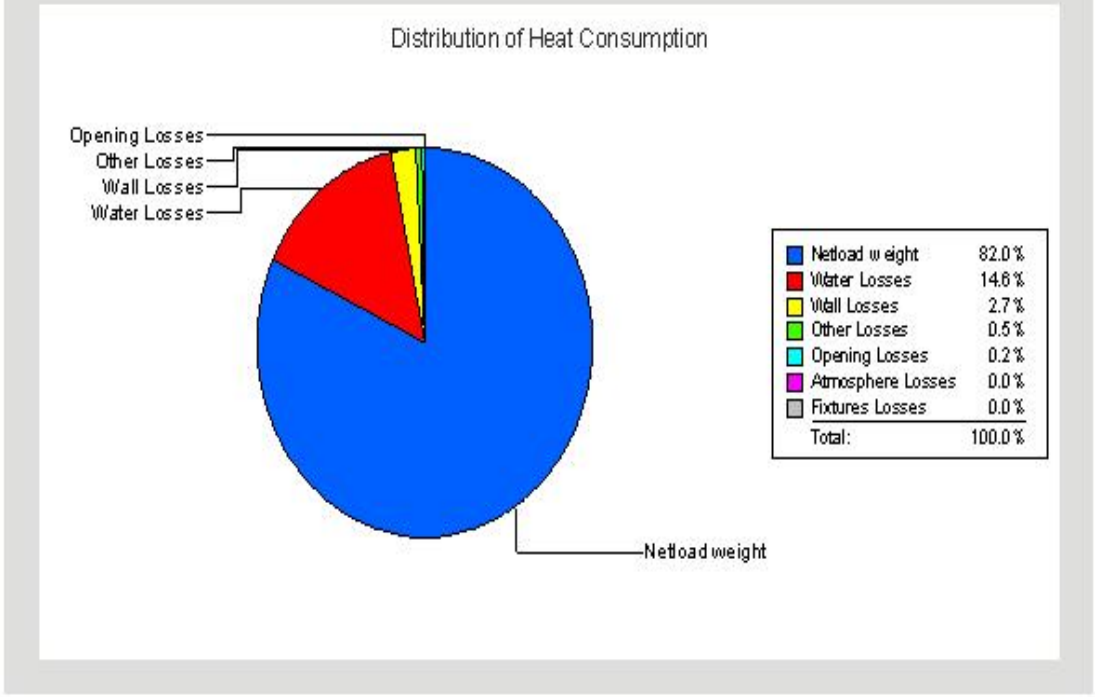
Furnace Analysis:

Initiation Date : 3/6/2008

Furnace Analysis

Company	NEW STEEL CORPORATION	**Furnace**	Reheat furnace
Plant	Test Plant - India	**Heat Source**	Fuel-Air (O2) Fired

Current Condition Heat Consumption (kJ/hr) Net Heat Consumption Data



Heat Storage (kJ) : 50,539,732 **Thermal Efficiency (%) : 45.98**

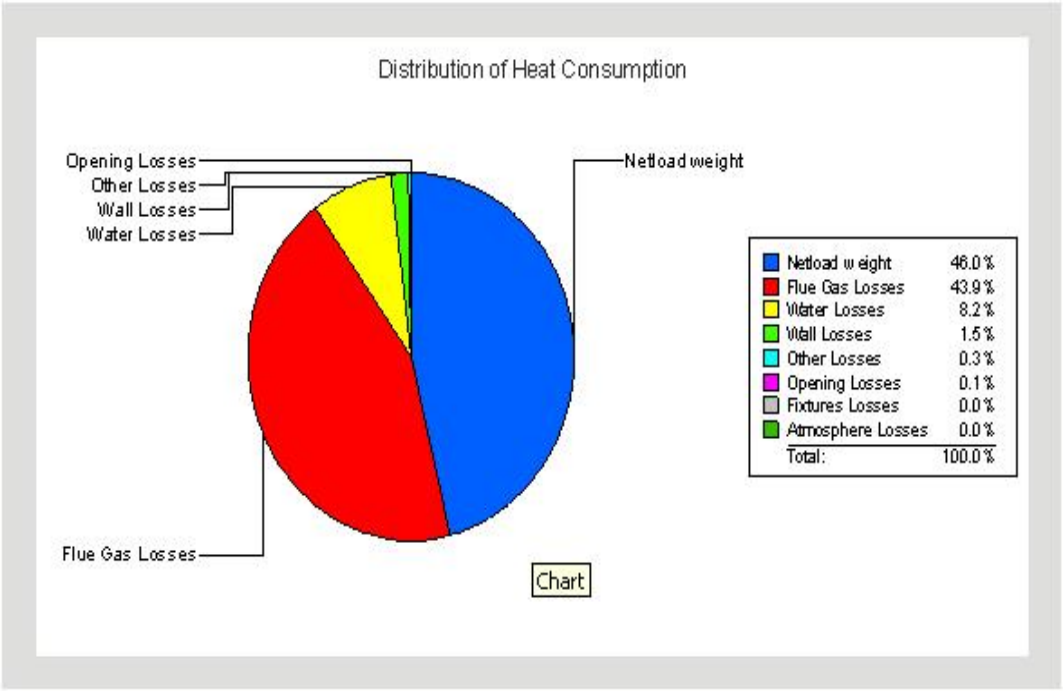
Area of Heat Consumption	kJ/hr
Netload weight	45,059,000
Water Losses	8,038,656
Wall Losses	1,456,656
Other Losses	256,483
Opening Losses	129,028
Atmosphere Losses	0
Fixtures Losses	0
Total	**54,939,823**

Initiation Date : 3/6/2008

Furnace Analysis

Company	NEW STEEL CORPORATION	**Furnace**	Reheat furnace
Plant	Test Plant - India	**Heat Source**	Fuel-Air (O2) Fired

Current Condition Heat Consumption (kJ/hr) **Gross Heat Consumption Data**



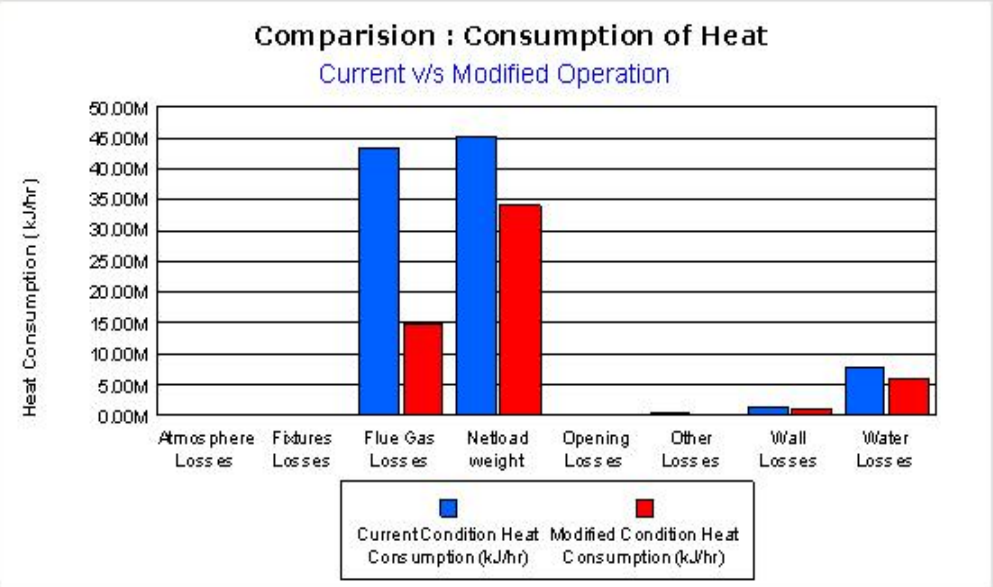
Heat Storage (kJ) : 90,152,929 **Thermal Efficiency (%) : 45.98**

Area of Heat Consumption	kJ/hr
Netload weight	45,059,000
Flue Gas Losses	43,062,002
Water Losses	8,038,656
Wall Losses	1,456,656
Other Losses	256,483
Opening Losses	129,028
Fixtures Losses	0
Atmosphere Losses	0
Total	**98,001,825**

Initiation Date : 3/6/2008

Furnace Analysis

Company	NEW STEEL CORPORATION	**Furnace**	Reheat furnace
Plant	Test Plant - India	**Heat Source**	Fuel-Air (O2) Fired



	Current Condition Heat Consumption (kJ/hr)	Modified Condition Heat Consumption (kJ/hr)
Atmosphere Losses	0	0
Fixtures Losses	0	0
Flue Gas Losses	43,062,002	14,702,105
Netload weight	45,059,000	34,069,000
Opening Subreport:funacefinal3.rpt	129,028	11,460
Other Losses	256,483	62,881
Wall Losses	1,456,656	1,027,102
Water Losses	8,038,656	6,028,992
Total	***98,001,825***	***55,901,540***

Initiation Date : 3/6/2008

Furnace Analysis

Company	NEW STEEL CORPORATION	**Furnace**	Reheat furnace
Plant	Test Plant - India	**Heat Source**	Fuel-Air (O2) Fired

Comments / Notes

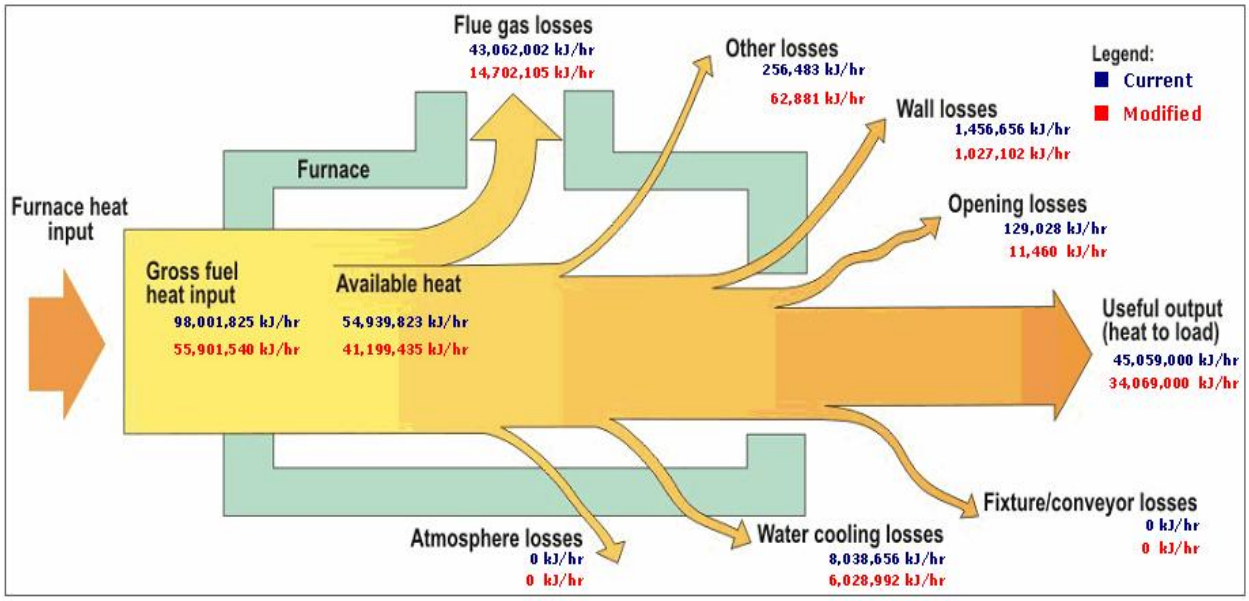
Section Name : Load/Charge Material
None
Section Name : Fixtures, Trays, Baskets etc. Losses
None
Section Name : Atmosphere Losses
None
Section Name : Water - Cooling Losses
None
Section Name : Wall Losses
None
Section Name : Opening Losses
None
Section Name : Other Losses
None
Section Name : Flue Gas Losses/Heating System Efficiency
None
Section Name : Heat Storage
None

Furnace Summary:

Initiation Date : 3/6/2008

Furnace Summary

Company	NEW STEEL CORPORATION	Furnace	Reheat furnace
Plant	Test Plant - India	Heat Source	Fuel-Air (O2) Fired



Actual Energy Use from Furnace Analysis

Description	Current	Modified
Net Heat Required (kJ/hr)	54,939,823	41,199,435
Gross Heat Required (kJ/hr)	98,001,825	55,901,540
Heat Storage Losses (kJ)	50,539,732	148,888,366
Energy Used (kJ/kg)	1,400.03	798.59
Energy Used (kWh/kg)	0.41	0.23
Thermal Efficiency (%)	45.98	60.94

Estimated Energy Use from Plant/Equipment information

Description	Estimated Value
Fuel energy use (kJ/hr)	102,500,000
Electrical energy use (kW)	340
Steam energy use (kJ/hr)	0

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<u>Note:</u> The diagram shown above is a "Static Sankey" diagram.
The values shown for each arrow, representing a category of heat loss or heat content, give the value of the heat content for each category under current and modified operating conditions. Please note that the width of the arrows do not represent the relative magnitude of the quantity the arrow represents.

Input Data:

Initiation Date : 3/6/2008

Input Data

Plant General Information

Company Name	NEW STEEL CORPORATION		
Plant Name	Test Plant - India		
Plant Description	Mini-mill to produce structural components		
Final Product	structural components		
Contact Name	Raj Joshi		
Phone	(228) - (652 3456)	**E-Mail**	rjoshi@newsteel.in.com

Fuel (Energy Source) Information

Name of Fuel-Energy	Heating Value Units	Heating Value	Cost Unit	Cost (INR per Unit)
Electricity	kJ/kWh	3,600	/kWh	8.00
Fuel Oil	kJ/l	137,000	/GJ	120.00
Natural Gas	kJ/m^3	38,000	/GJ	300.00
Steam	kJ/kg	2,790	/GJ	250.00

Initiation Date : 3/6/2008

Input Data

Company Name	**NEW STEEL CORPORATION**
Plant Name	**Test Plant - India**

Furnace Information

Furnace Name	**Electric Arc Furnace**				
Furnace Description	**Operating Hour Information**				
Arc furnace for melting	**Weeks/ Year**	**Days/ Week**	**Shifts/ Day**	**Hours/ Shift**	**Hours/Year**
	50	7	3	8	8,400
	Auxiliary Equipment Information				
	Total Nos.	**Total Connected HP (all equipment)**	**% of Cycle Time**	**% Loading**	
Compressors	0	0	0	0	
Vacuum Pumps	0	0	0	0	
Pumps	0	0	0	0	
Fans / Blowers	2	500	100	80	
Other Motors	0	0	0	0	

Heat Zone Information

Zone Name	**Furnace zone**				
Fuel Firing					
Type of Fuel			*No. of Burners/Zone*		0
Zone Burner Rating for All Burners (GJ/hr)	0.00	*% of Rated Capacity Used*	0	*% Loading Factor*	100
Electric Heating					
Type of Electricity	Electricity				
kW Rating for All Sections	20,000.00	*% of Rated Capacity Used*	60	*% Loading Factor*	55
Steam Heating					
Type of Steam					
Steam Pressure-Absolute (MPa)	85.00	*Steam Temperature (Celsius)*	350	*Steam Flow (kg/hr)*	0
Total Heat for Steam (kJ/kg)	1,200	*% of Rated Capacity Used*	0	*% Loading Factor*	100

Comments / Notes

This is an older furnace

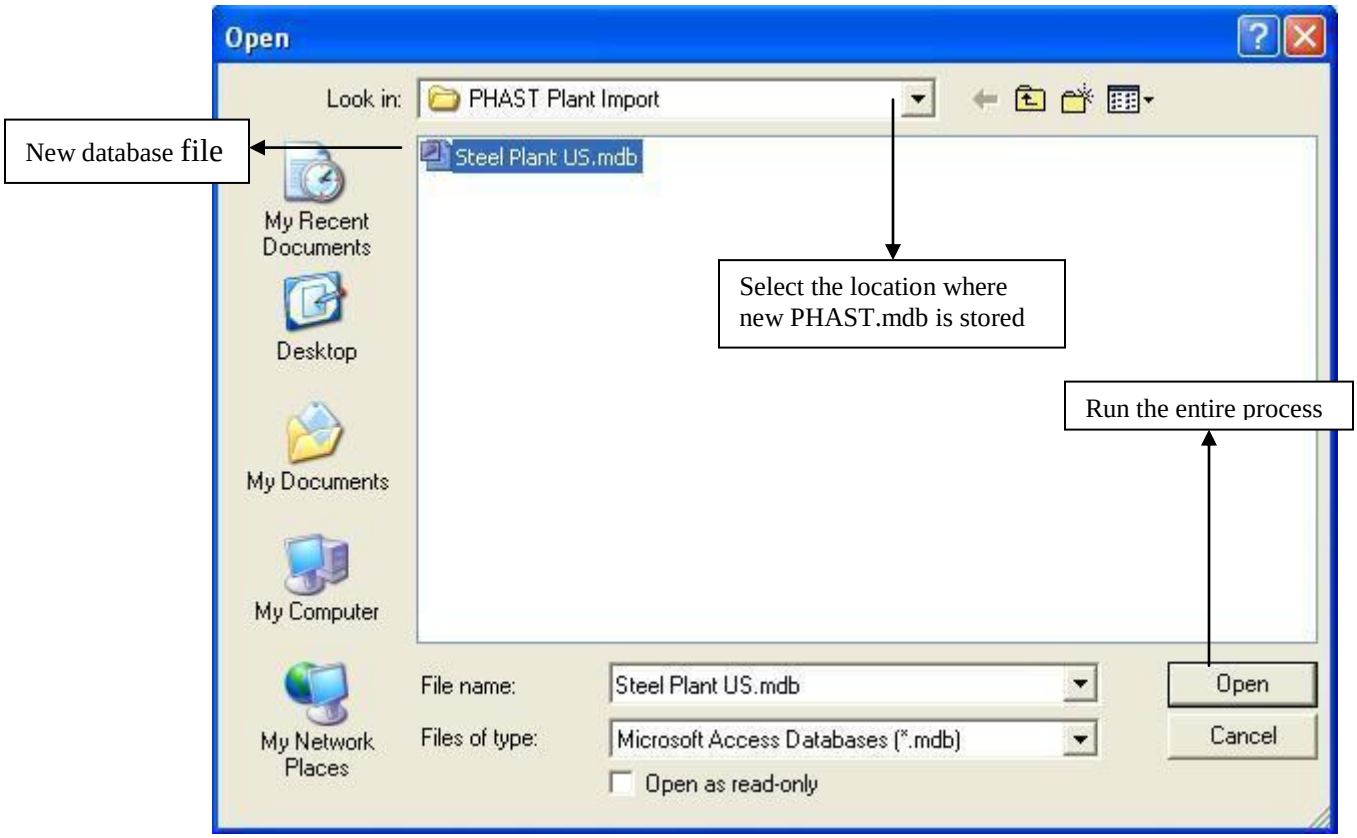
Import Plant Information:

This section provides the capability of importing and integrating the entire information of other plant into the existing database of PHAST. **This feature can be used once the user receives the Microsoft Access Application file (PHAST.mdb or with any name as sent by another user) from the plant for which information is to be imported and integrated. Please note that plant exported with earlier versions of PHAST cannot be imported in this version.** The Microsoft Access Application file can be received through Email or any media and should be stored on the computer or local network from where it can be accessed later. (User can save the received file with same or different name)

Note:
This is mandatory step and must be performed before using the feature of importing data.
Do not save the new database file with name as "Phast.mdb" at default location. It will replace the existing database. Save the new database file either with different name or at different location.

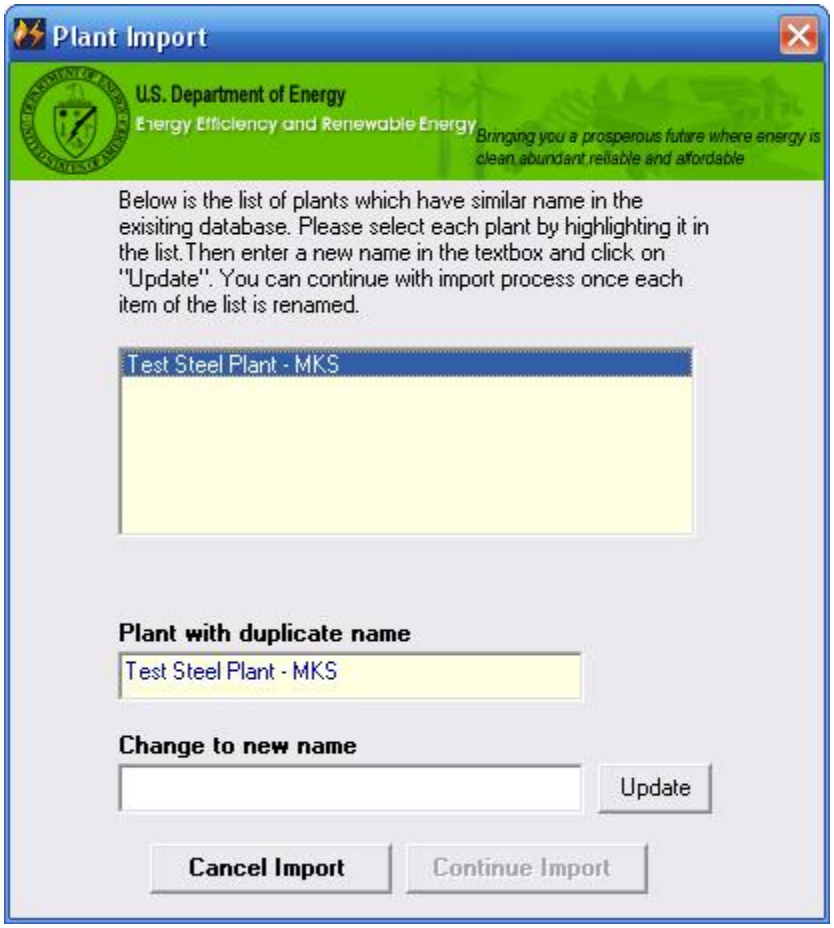
Do not save the Database file as Read-Only.

- Click on the "**Import Plant Information"** on the main screen of PHAST. This will open a new user interface as shown below. Here the user can select the Microsoft Access Application file (Phast.mdb or file with any name sent by other user) received from the other plant and stored locally as mentioned above. This file contains the information of the plant to be imported and to be integrated with existing database.



- Select the location from the **Look-in** drop-down menu where the received file is stored upon receipt (as described above) and select this file.
- Click on **"Open"** to carry out the entire process of importing the new database and integrating it with existing database of PHAST.
  *Note: It may be noted that above screen image is of WindowsXP operating system file **Open** dialog box. User having different operating system will have different layout of the open dialog box. Do not open the saved database file as a Read-only.*

If new file information contains the plant with similar name it will display the list of plant that are having similar name (duplicating with existing PHAST database) otherwise will continue with import process.



- Select each **Plant Name** from the list by clicking on it and change to new plant name (by entering the name in the text box provided)
- **'Update"** will change the plant's name to the new name as entered in the text box and take out the name from the list.
- *Note: If list has more than one plant with duplicate name, User must update each one by entering new name and clicking "Update"*
- Click on **"Continue Import"**. *(Note: This button will be enabled once all duplicate plants' names are changed to new name.)*
- **Click on "Cancel Import"** to cancel the process. No information will be imported/integrated to PHAST.

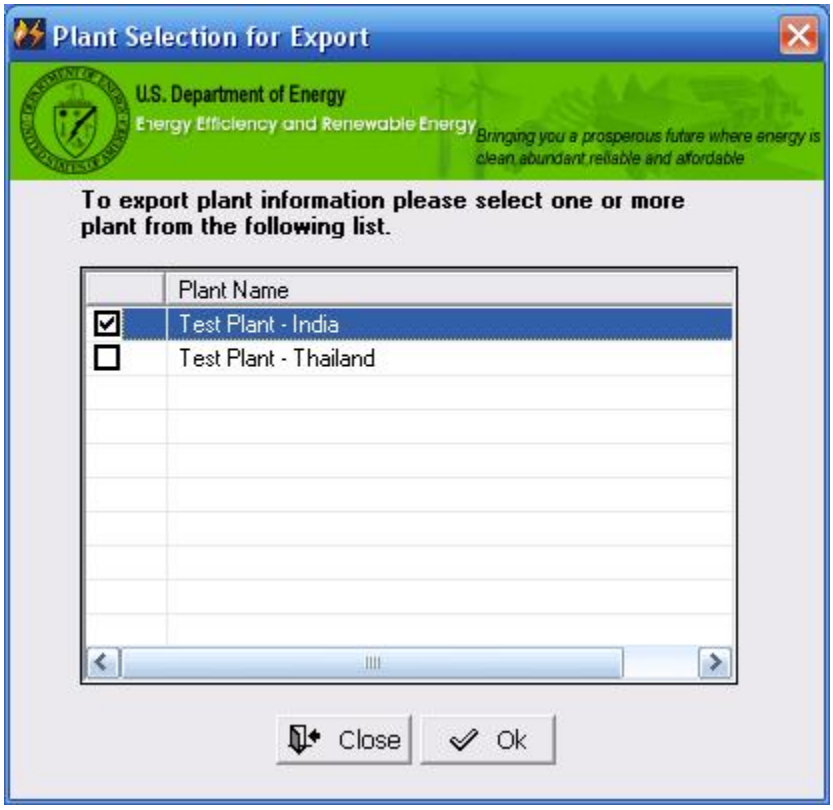
Once the information is imported successfully, it can be viewed/analyzed/modified as discussed in the earlier sections of the PHAST. Reports can also be generated for the new plant's information. System will display an informational message if the information is not imported successfully.

Note: The data of the US Units version of PHAST 3.0 cannot be imported into the International Units version of PHAST 3.0. Before aborting the action, system will display an appropriate message if that is attempted.

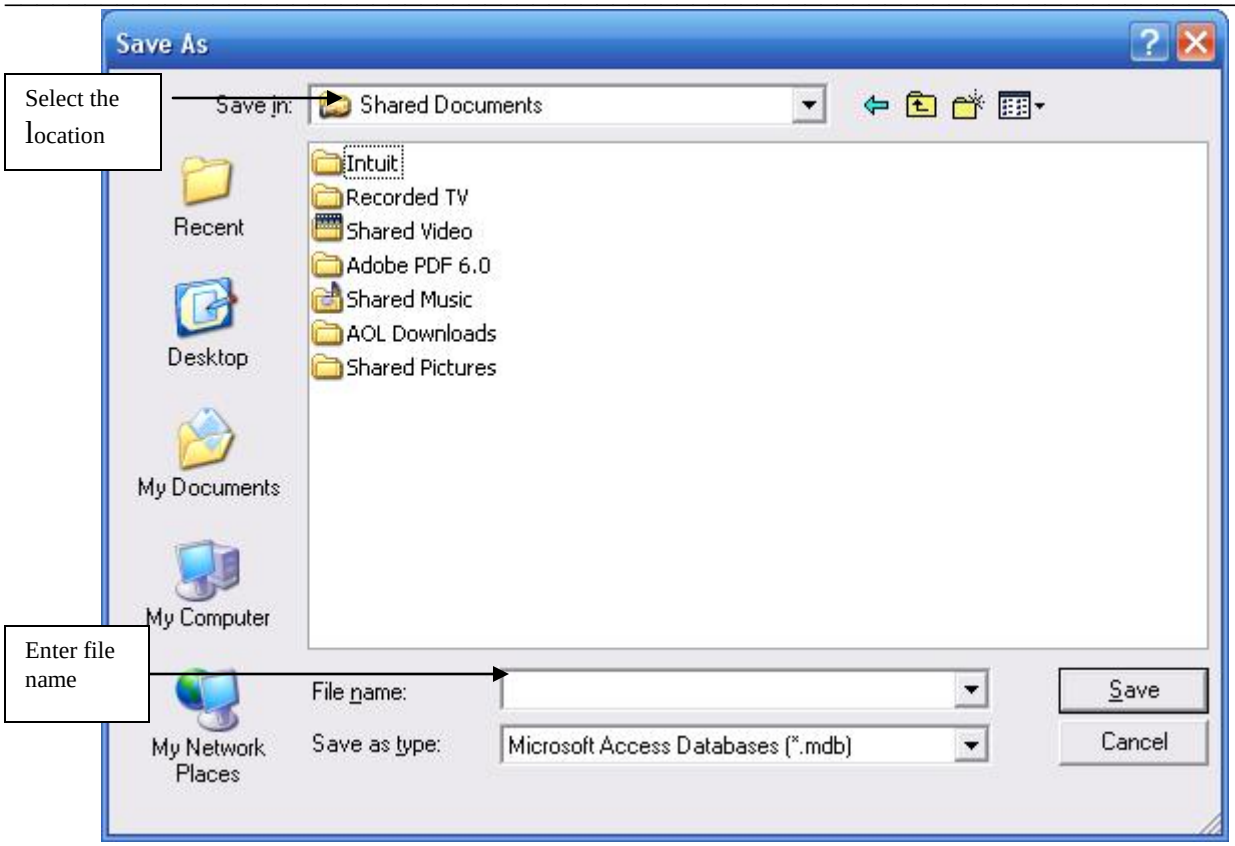
Export Plant Information:

This note is for the PHAST User who is sending the file containing all information.
This feature will make Microsoft Access Application file (.mdb) of selected plants from the entire information. The same file can be sent to other PHAST User through Email or any other media.

- Click on **"Export Plant Information"** on the main screen to open a new interface as shown below. It will display the list of plant for which information is entered through PHAST (Version 3.0).



- Select one or more **Plant** from the list for which information is to be exported.
- Click **"Ok"** to proceed further. This will open a new user interface as shown below. *(Note: The file can be saved and stored with any name and location.)*



- Select the location from the **Look-in** drop-down menu where you want to save/store the exported file
- Enter the name of the file that you want to save.
- Click on **"Save"** to carry out the entire process of exporting the selected plant database.
  *Note: It may again be noted that users having operating system different than WindowsXP will see different layout of **Save As** dialog box.*

The same file can be sent through Email or other media to other PHAST3.0 Users. Other users can import this file by using the import feature as discussed earlier.

Appendix – A: Units for Conversion

Both unit converters have got following categories of units.

Sr. No.	Units
1.	Temperature
2.	Heat Input Rate - Power
3.	Length
4.	Calorific Value of Gas
5.	Pressure
6.	Volumetric Flow Rate
7.	Mass Flow Rate
8.	Heat of Reaction
9.	Liquid Flow
10.	Area
11.	Specific Heat - Entropy
12.	Electrical Power
13.	Heat Rate
14.	Heating Value of Gas
15.	Calorific Value of Liquid Fuel
16.	Thermal Conductivity
17.	Energy
18.	Density
19.	Mass
20.	Heat Transfer Coefficient
21.	Heat Flux Density
22.	Velocity - Speed
23.	Volume
24.	Heating Value of Electricity

Though both converters are essentially same, unit category is selected automatically based on from where it was invoked.

Appendix – B: Currency and Default Conversion Rate

Country Name	Currency ID	Currency Symbol	Exchange Rate
Australia	Dollar	AUD	0.796
Canada	Dollar	CAD	0.85
China	Yuan	CNY	0.129
European Union	Euro	EUR	1.331
Hong Kong	Dollar	HKD	0.128
India	Rupee	INR	0.022
Indonesia	Rupiah	IDR	0.017
Japan	Yen	JPY	0.009
Malaysia	Ringgit	MYR	0.285
Mexico	Peso	MXN	0.089
New Zealand	Dollar	NZD	0.697
Pakistan	Rupee	PKR	0.017
Philippines	Peso	PHP	0.021
Poland	Zloty	PLN	0.342
Russia	Ruble	RUB	0.038
Saudi Arabia	Riyal	SAR	0.268
South Africa	Rand	ZAR	0.134
South Korea	Won	KRW	0.001
Sweden	Kronor	SEK	0.144
Taiwan	Dollar	TWD	0.03
Thailand	Baht	THB	0.03
Trinidad and Tobago	Dollar	TTD	0.5
Turkey	Lira	TRY	0.7065
United Arab Emirates	Dirham	AED	0.272
United Kingdom	Pound	GBP	1.96
United States	Dollar	USD	1.00
Venezuela	Bolivar	VEB	0.001
Vietnam	Dong	VND	0.017

Appendix – C: Default Energy Sources (Fuel, Electricity, Steam)

Energy Name	Unit	Heating Value unit	Default Heating Value
Electricity	/kWh	kJ/kWh	3600
Natural Gas	/GJ	kJ/m^3	38000
Fuel Oil	/GJ	kJ/l	137000
Coal	/tonne	kJ/kg	14030
Blast Furnace Gas	/GJ	kJ/m^3	90
Coke Oven Gas	/GJ	kJ/m^3	570
Coke	/tonne	kJ/kg	12700
Propane	/GJ	kJ/m^3	2500
Steam	/GJ	kJ/kg	2790

Appendix – D: Properties of Default Material/Gas Used for Furnace Analysis

Substance	Density (kg/m^3)	Mean Specific Heat of solid (kJ/(kg °C)	Latent Heat of Fusion kJ/kg	Mean Specific Heat of Liquid (kJ/(kg °C)	Melting Point (Deg. C.)	Average Pouring Temp (Deg. C)	Heat Content of Solid at Melting Point (kJ/kg)	Heat Content of Liquid at Melting Temp (kJ/kg)	Heat Content of Liquid at Pouring Temp (kJ/kg)
SOLID									
Aluminum	2670.53	1.038	393.094	1.089	657.22	748.89	665.236	1058.330	1156.022
Babbitt, lead base	0.00	0.163	60.941	0.159	238.89	329.44	36.751	97.692	111.648
Babbitt, tin base	7401.24	0.297	79.317	0.264	240.00	491.11	66.524	157.470	211.666
Bismuth	9804.24	0.138	43.031	0.147	270.00	326.67	35.123	78.154	86.527
Brass, Muntz metal	8394.48	0.440	160.494	0.523	887.78	1010.00	383.790	544.284	607.086
Brass, red	8746.92	0.435	201.199	0.482	1066.67	1232.22	458.222	659.421	739.203
Brass, yellow	8458.56	0.440	165.146	0.515	920.00	1065.56	397.746	562.892	637.789
Bronze, bearing	8907.12	0.398	185.847	0.456	1000.00	1121.11	391.466	577.313	632.672
Bronze, aluminum	8170.20	0.528	229.344	0.523	1050.00	1204.44	546.610	775.954	855.968
Bronze, bell metal	8650.80	0.419	177.474	0.498	890.00	1037.78	366.112	543.586	617.320
Bronze, gun metal	8811.00	0.448	195.849	0.444	1010.00	1148.89	445.429	641.278	702.452
Bronze, Tobin	8410.50	0.448	170.961	0.519	885.00	1010.00	389.605	560.566	625.461
Carbon Steel	7689.60	0.628	139.560	0.000	1537.78	-17.78	0.000	0.000	0.000
Copper	8955.18	0.435	211.666	0.465	1083.33	1204.44	465.200	676.866	732.690
Die casting metal	2819.52	0.988	379.138	1.009	621.11	760.00	598.480	977.618	1118.806
Die casting metal	2819.52	0.159	40.705	0.155	315.56	437.78	47.683	88.388	339.596
Die casting metal	2819.52	0.293	70.245	0.260	232.22	343.33	64.198	134.443	162.820
Die casting metal	2819.52	0.431	111.648	0.578	415.56	526.67	172.124	283.772	348.900
German silver	2819.52	0.456	200.501	0.515	1010.00	1148.89	451.244	651.745	723.386
Gold	19304.10	0.138	66.291	0.142	1062.78	1176.67	144.677	210.968	227.250
Inconel - 600	7689.60	0.586	0.000	0.000	1371.11	-17.78	0.000	0.000	0.000
Iron, cast, gray	7689.60	0.796	96.296	0.000	1230.00	1537.78	965.290	1060.656	1356.058
Iron, cast, white	7689.60	0.754	140.258	0.000	1150.00	1593.33	855.968	995.528	1423.512
Iron, pig	7689.60	0.641	194.454	0.000	1100.00	1260.00	695.474	893.184	1046.700
Iron, pure	7865.82	0.703	272.142	0.628	1538.89	1704.44	1049.026	1321.168	1456.076
Lead	11342.16	0.134	23.260	0.142	327.22	382.22	41.868	65.128	72.106
Linotype	11214.00	0.151	50.009	0.151	252.22	326.67	35.588	85.597	96.762
Magnesium	1739.77	1.139	194.686	1.114	651.11	748.89	723.851	918.537	1027.394
Manganese	7433.28	0.716	153.516	0.804	1230.00	1315.56	869.924	1023.440	1090.894
Monel metal	8811.00	0.540	273.072	0.582	1323.89	1510.00	707.104	980.176	1088.568
Nickel 60 to 2644 F	8907.12	0.561	305.869	0.557	1451.11	1565.56	804.796	1110.665	1174.630
Silver	10493.10	0.264	108.857	0.293	961.11	1065.56	248.882	357.739	388.442

solder, bismuth	9291.60	0.167	38.146	0.163	111.11	165.56	21.632	59.778	68.617
Solder, plumbers	9291.60	0.214	53.498	0.205	212.22	260.00	41.868	95.366	104.670
Stainless Steel - 300 series	7689.60	0.586	0.000	0.000	1398.89	-17.78	0.000	0.000	0.000
Stainless Steel - 410	7689.60	1.047	111.648	0.000	1537.78	1537.78	1744.500	293.076	330.292
Tin	7289.10	0.289	58.150	0.267	232.22	343.33	62.802	120.952	148.864
Zinc	7128.90	0.448	111.648	0.611	418.89	482.22	180.963	292.611	330.292
LIQUID									
Water - std. atmospheric pressure		4.187	2256.918	1.968	100.00				
Water - 150 psig		4.396	2018.968	2.261	185.00				
Acetic Acid		2.135	404.724	1.675	118.00				
Acetone		1.453	555.914	1.675	54.44				
Alcohol- ethyl		2.713	858.294	1.884	77.78				
Alcohol - methyl		2.516	1118.806	1.382	66.11				
Benzene		1.771	395.420	1.382	80.00				
Bromine		0.448	190.732	0.230	61.11				
Carbon tetrachloride		0.900	194.221	1.047	76.67				
Fuel oil no. 2 (average)		2.387	244.230	2.303	190.56				
Fuel oil no. 6 (average)		2.428	251.208	2.303	315.56				
Kerosene		2.387	604.760	2.596	126.67				
Methanol		2.512	1093.220	2.512	64.44				
GAS									
Water vapor - near atm. pressure		1.968							
Steam - 50 psig, 400 Degree F.		2.052							
Steam - 150 psig, 500 Degree F.		2.135							
Steam - 600 psig, 700 Degree F.		2.470							
Air - low pressure		1.026							
Nitrogen - low pressure		1.047							
Oxygen - low pressure		0.963							
Carbon dioxide - low pressure		1.005							
Carbon monoxide - low pressure		1.047							
Hydrogen - low pressure		14.445							