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Instructions for Configuration of the Whole-Building Diagnostician Software Release 2.10-162

Project 2.6 - Enhancement of the Whole Building Diagnostician Task

2.6.3 - WBE Configuration Instructions

NN Bauman
TA Carlon

August 2003

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Energy Efficient and Affordable Small Commercial and Residential Buildings Research Program

Instructions for Configuration of the Whole-Building Diagnostician Software Release 2.10-162

Project 2.6 – Enhancement of the Whole-Building Diagnostician

Task 2.6.3 – WBE Configuration Instructions

Nathan N. Bauman
Teresa A. Carlon

August 2003

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Configuration of the Whole-Building Diagnostician Software

This document describes how to set up the Whole-Building Energy (WBE) module of the Whole-Building Diagnostician (WBD) for use in monitoring whole-building and major end-use energy consumption. It is a companion to the *Instructions for Installation of the Whole-Building Diagnostician Software Release 2.10-162*. Users should install the Whole-Building Diagnostician (WBD) and become familiar with it by using demonstration databases and following the instructions for installation before proceeding to this document. This document describes how to set up the WBE software to collect new data or process data in existing data bases.

Configuration Instructions for the Whole-Building Diagnostician (WBD) Software Release 2.10-162

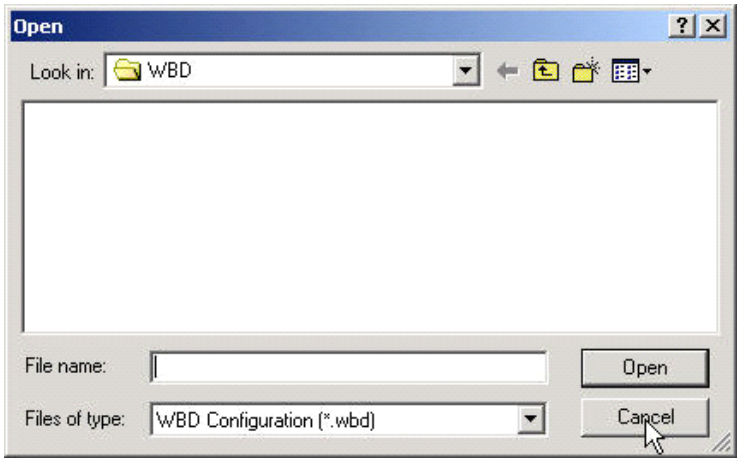
Before starting to use the WBD, you should plan the number of databases you will use in the configuration of the WBD. Presently, we recommend one database per diagnosed system [i.e., one database for each OAE set up for an air handling unit (AHU) and one database for each WBE module set up for a building or facility]. This recommendation is intended to help minimize the access and processing times; it is not an absolute constraint. Note, however, that each database must have at least one building in it, so that when our recommendation is followed, each AHU appears under its own building (and, as a result, a building will generally appear multiple times in the directory tree).

The user should also note the distinction between the WBD configuration file (*.wbd) and the database files (*.mdb). The *.wbd configuration file contains the tree structure to be displayed, literally the list of databases whose building and system configurations are displayed. The components of a single building may be contained in any arbitrary number of databases (*.mdb). The database files contain the tree structure (as well as other data) for the systems contained in that database, which must include one or more buildings and all or some subset of the systems in them. Other systems for the building may appear in separate databases, but then the building will appear more than once in the tree structure (once for each database containing some of the building's systems).

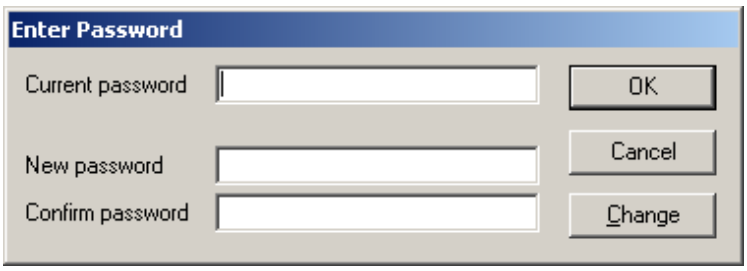
Configuring the WBE

1. Start the WBD by double clicking on the Whole-Building Diagnostician icon on the desktop.

2. A window will appear defaulting to the WBD directory. Click ***Cancel*** to create a new (untitled) configuration. Note: If configuration files exist already you may select one now. The steps that follow assume you are creating a new configuration (i.e., not selecting an existing configuration).

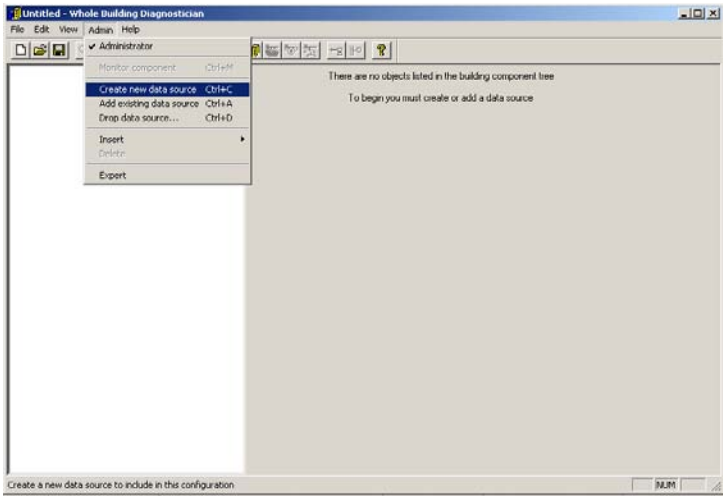


3. The WBD must be in Administrator mode to continue with configuration. You can check this by clicking on ***Admin*** on the menu bar. A drop-down menu will appear. The "***Administrator***" item in the menu should have a check mark before it. If it does, proceed to step 4.

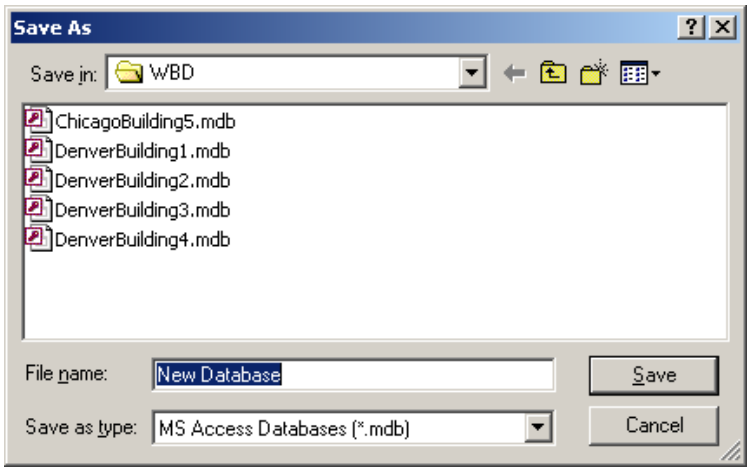


If there is no check mark before "***Administrator***" on the menu bar, click on "***Administrator***." The dialog box at right above will appear, and you will need to enter a password to re-enable the administrator setting. If an administrator password has already been set, enter it in the "Current password" box and click on ***OK***. If a password has not yet been set, you can enter the default password, *wbdadmin,* click ***OK***, and then proceed to step 4. If a password has not yet been set and you are the administrator for the site, you can enter your desired password in the box labeled "New password," re-enter it in the "Confirm password" box, and then click on the ***Change*** button. Then enter your new password into the "Current password" box and click on ***OK***. Be sure to select a password consistent with good password practices and remember your password for future use of the WBD as an administrator. Proceed to step 4.

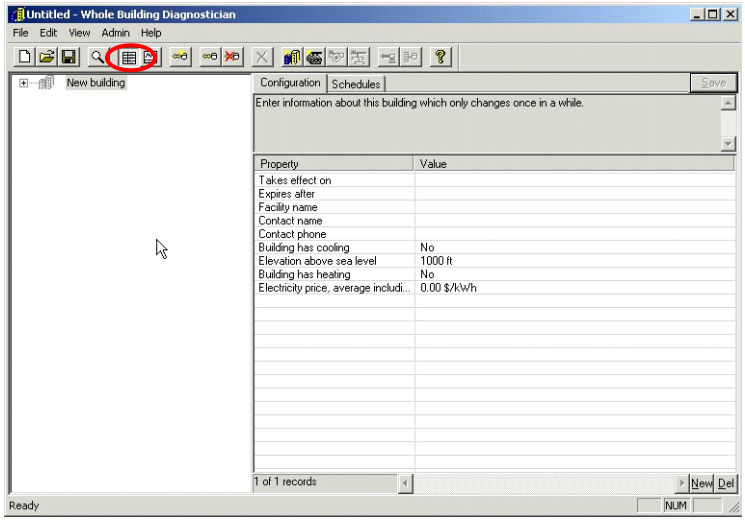
4. On the menu bar, select ***Admin*** and click on ***Create a new data source.***

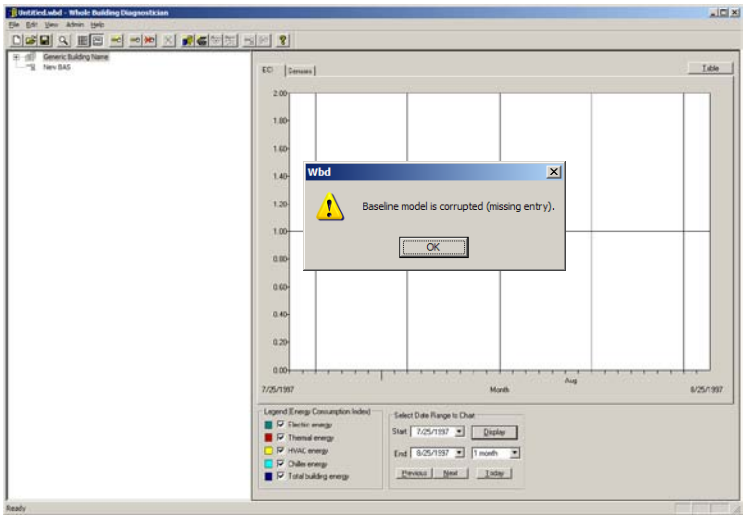


5. A "Save As" window will open for the WBD directory. Type the filename of your database in the box indicated. Example names include the building name, an abbreviation for the building, or an abbreviation for a grouping of buildings (e.g., a campus). Once you have input the name click ***Save***.



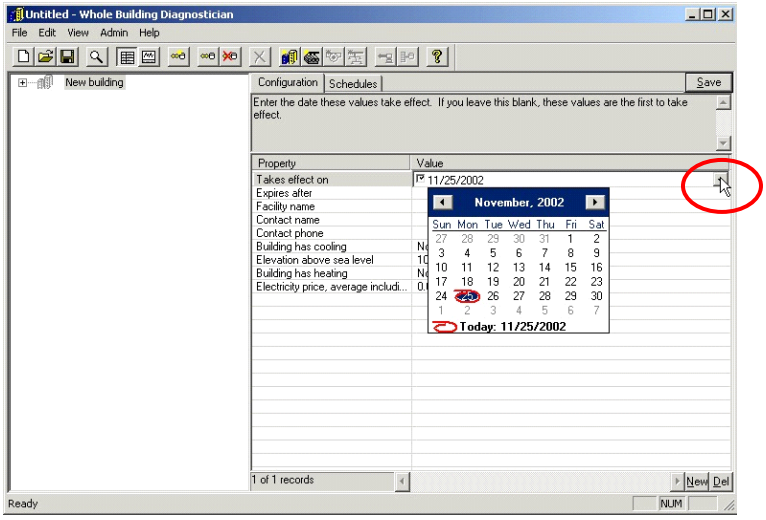
6. The window at right should appear once the database is created. If instead the second window (below right) or one like it with the WBD warning dialog box on it appears, click on the OK button in the dialog box as many times as necessary for it to disappear (may take 3 or 4 clicks). When the dialog box has disappeared, click on the "new component description" icon circled in red at right. This will display the first window (top right).





The left pane of the window is where the "tree" structure appears. The tree lists all buildings and components that are a part of this configuration. Similar to Windows© Explorer, a "+ "sign next to an object indicates that there are other subcomponents below and part of that object. By default, the *New building* displayed in the tree has a plant, an air-handling unit, and a zone as its components (which will be discussed in subsequent steps). The right-hand pane of the window shows the "Configuration" and "Schedules" tabs for the *New building*. Some of the properties have default values already entered. Later, you will review this list of properties and make the necessary changes to values for your configuration.

7. Today's date with a blank check box before it should appear as the value for the ***Takes effect on*** property. If no date is shown, double click on the space where it should be and it will appear. Then click on the check box before today's date to select it as the date on which this configuration will take effect.

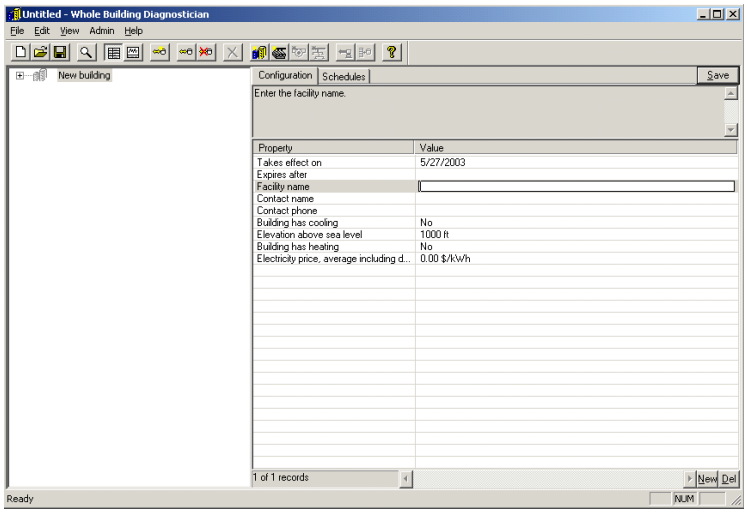


To select a different date, click the down arrow on the vertical scroll bar (shown in the red circle at right) A calendar box will appear. Use the left and right arrows on the calendar, respectively, to navigate backward and forward through the months. To select a specific date on the calendar as the date on which this software configuration will take effect, click on the date. The calendar will close and the chosen date will be shown with a check mark in the box preceding it.

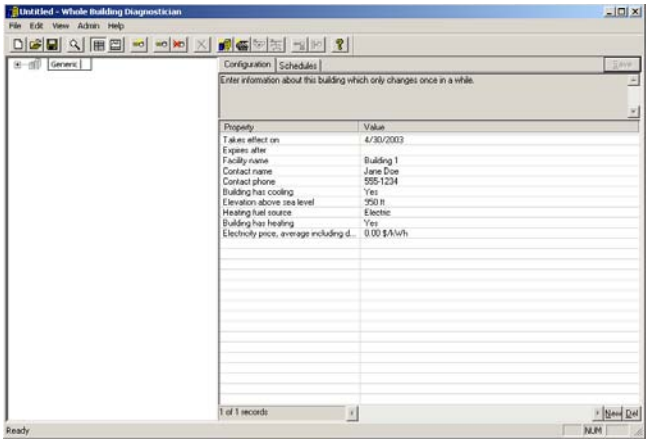
8. The second Property listed is the *Expires after* date. We recommend that this date be left blank now because it is usually not known at the time a configuration is created. Sometime in the future there may be modifications to the building or its configuration, and it may be necessary to create a new configuration. At that time, the date for this configuration to expire (value of the *Expires after* date) can be entered and a new configuration created.

Tip: A double mouse click on any value cell will open the selection box for that property.

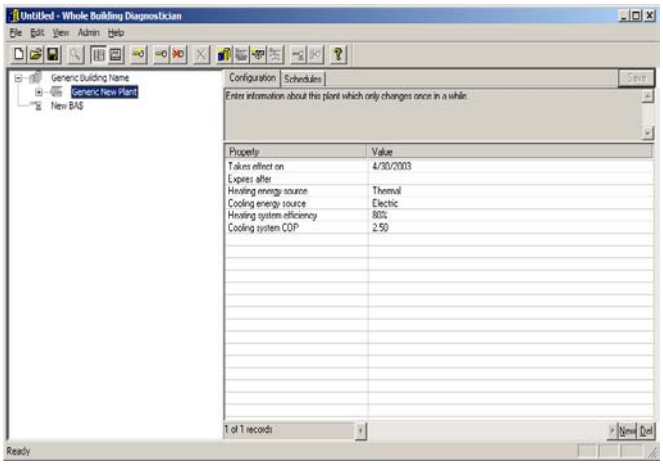
9. Double click on the property cell for ***Facility name*** and enter an appropriate building name in the Value column. Pressing the enter key after entering a name accepts the input value and moves the cursor to the next field. Repeat this process for both the ***Contact name*** and ***Contact phone*** for this building. For the next property, ***Building has cooling***, select whether the building has cooling or not. The default value is No, indicating that the building does not have cooling. If the building has cooling, select Yes from the drop down menu. Enter the value for ***Elevation above sea level*** in feet for the building location. By default, the value for the next property, ***Building has heating,*** is no. If the building has heating, select "Yes" from the drop down list. The final property is the ***Electricity price, average including demand*** (i.e., a blended rate per kWh accounting for both the amount of electricity used (kWh) and the demand charge, if any). Enter the appropriate amount in $/kWh in this cell. The building configuration values are now complete.



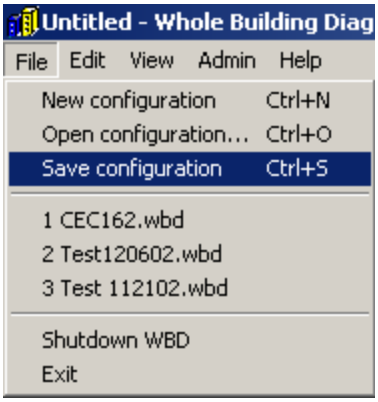
10. Rename the building on the tree by first clicking the left mouse button once on ***New building*** in the tree to highlight it. Then click the left mouse button again to enable editing of the name. Enter the name you prefer for this building. Then click anywhere outside the edit box to complete assignment of this name.



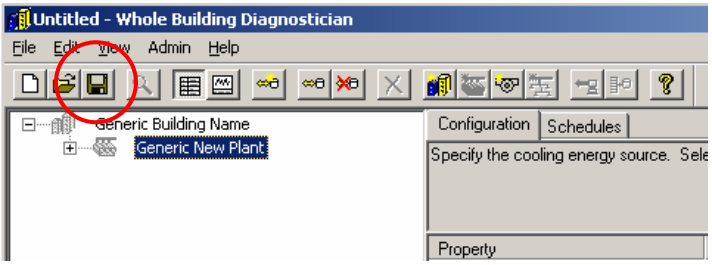
11. Click the "+" sign to the left of the building name to expand the next component level, ***New Plant***. Rename the *New Plant* using the same process as in step 10. The window on the right side of the screen displays the configuration properties for the *New Plant*. Some of the values have default entries. Enter the appropriate value for each property. Clicking enter selects the highlighted value from the list and moves the cursor to the next property. ***Takes effect on*** should be the same date entered at the building level. Leave the ***Expires after*** field blank. If the value for any property is not known, leave the default value until the correct information can be obtained and entered into the value column.



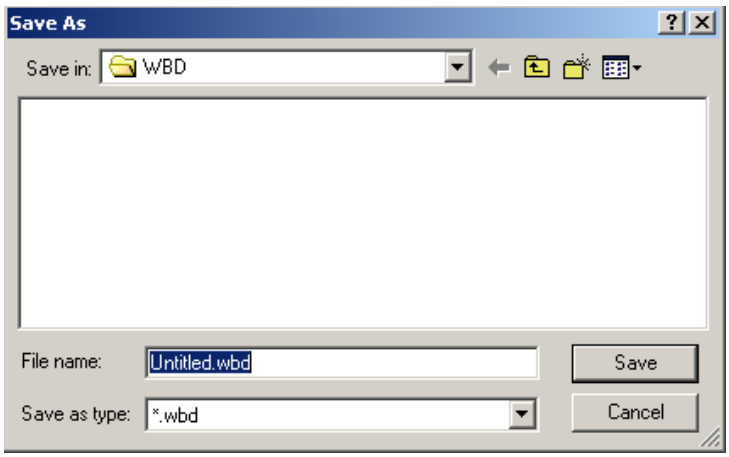
12. Now save the WBD configuration by clicking ***File***, ***Save configuration***.



Tip: Clicking on the "disk" icon on the toolbar also will start the save process and bring up the dialog box in the following step.



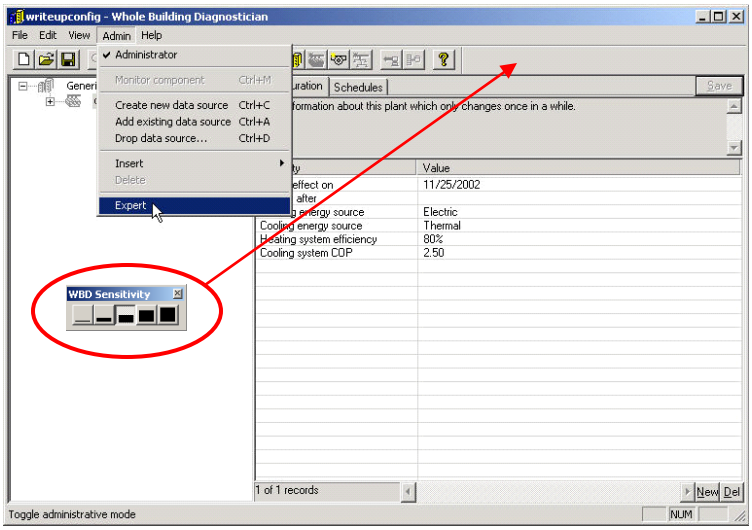
13. Type the filename for your configuration and click ***Save***.



Configuring for the Source of Data

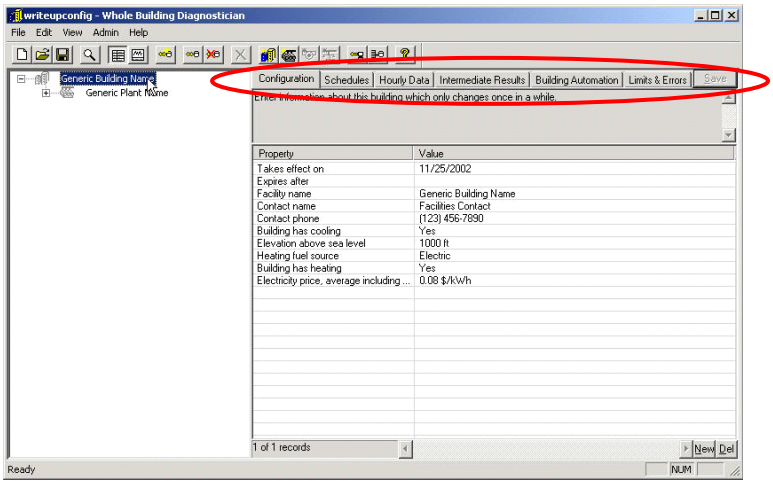
The following steps will add the network component and set up the data collection for the WBE module.

14. Using the toolbar, enter the *Expert* mode by selecting ***Admin*** and then clicking on ***Expert***. When asked to confirm switching to *Expert* mode, click ***Yes***. A *WBD Sensitivity* box will appear on your screen. Simply click and drag the box to your toolbar or click the "x" to close the box. The sensitivity setting will not be modified.

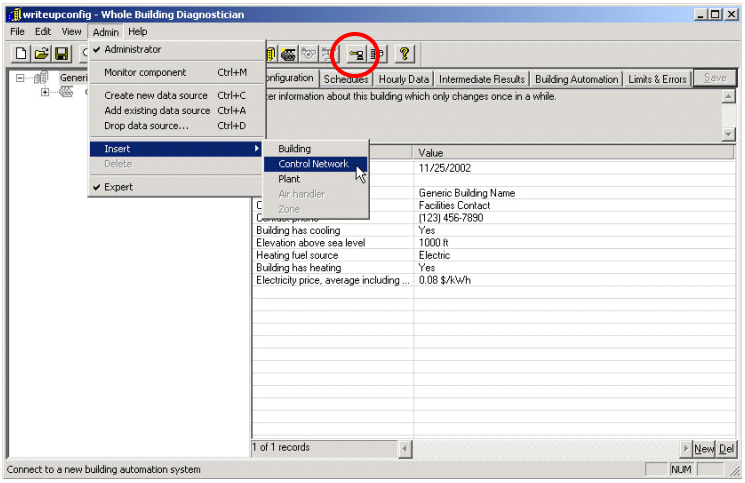


Caution! When in *Expert* mode, it is possible to cause irreparable damage to the database, therefore, the user should be careful not to change any parameters unless otherwise advised in this document.

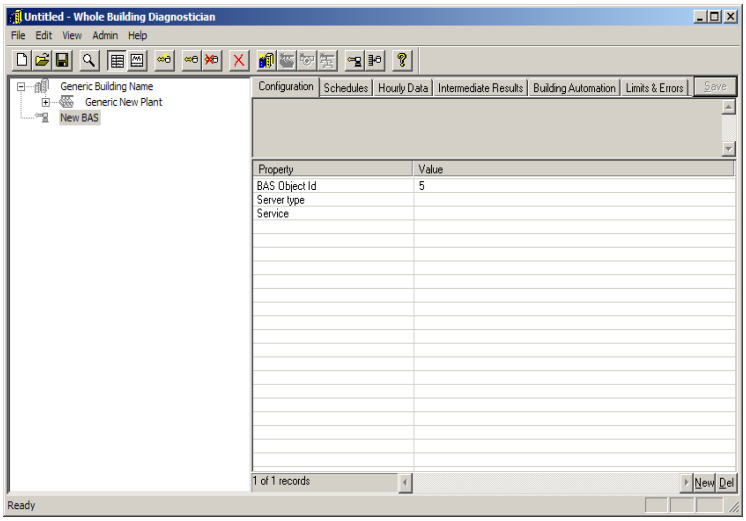
15. Refresh the screen by clicking once on another object on the tree. The circle in the diagram at right identifies tabs that will now appear across the top of the right-hand pane of the window, four of which are new: *Hourly Data, Intermediate Results, Building Automation, and Limits & Errors*.



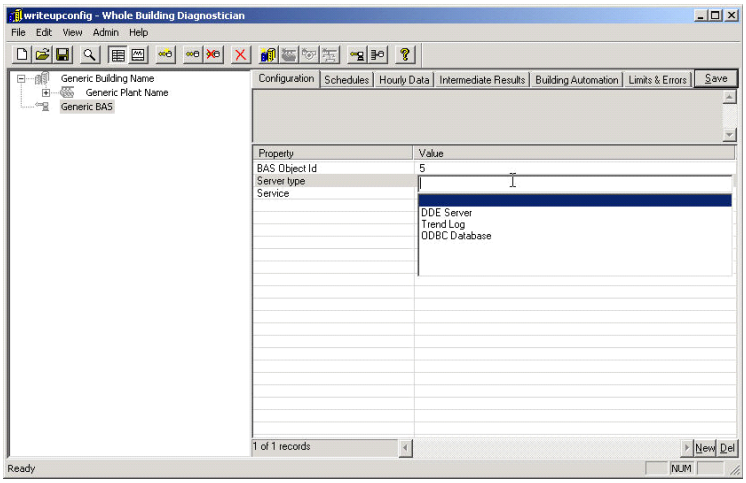
16. We will now add a network from which data will be gathered. There are two ways to add a *Network*, either from the menu bar by selecting ***Admin, Insert, Control Network*** or by selecting the ***Connect to BAS*** icon identified by the red circle in the diagram on the right.



The window at right will be displayed. A New BAS object will appear in the tree and the Configuration view for this object (network component) will appear in the right pane. Only the BAS Object Id property will have a value assigned. This value is automatically determined by the software and should not be modified.



17. Double click on the value cell for the ***Server type***. A drop down selection box will appear. Select the BAS server type that will be used. Select ***DDE Server*** if the data will come through a BAS DDE Link, select ***Trend Log*** if the data will come from a file, and select ***ODBC Database*** if the data will come from an ODBC database.

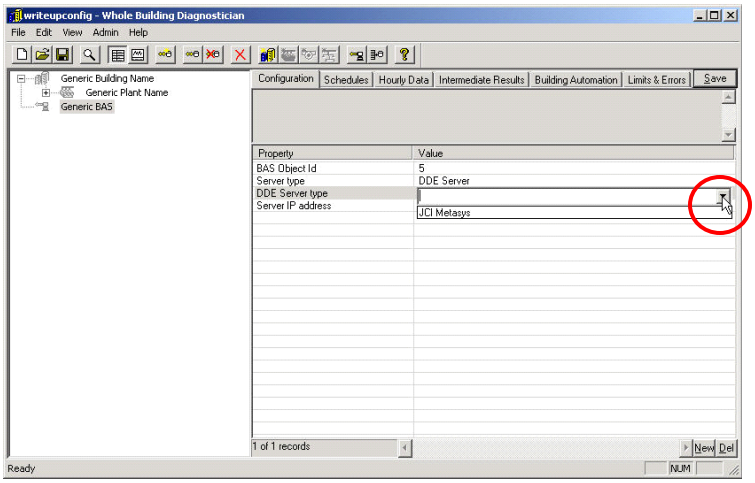


The next several steps depend on the type of server you have selected. If you are using a *DDE Server,* follow steps 18 through 20. If you are using a *Trend Log* server, see steps 21

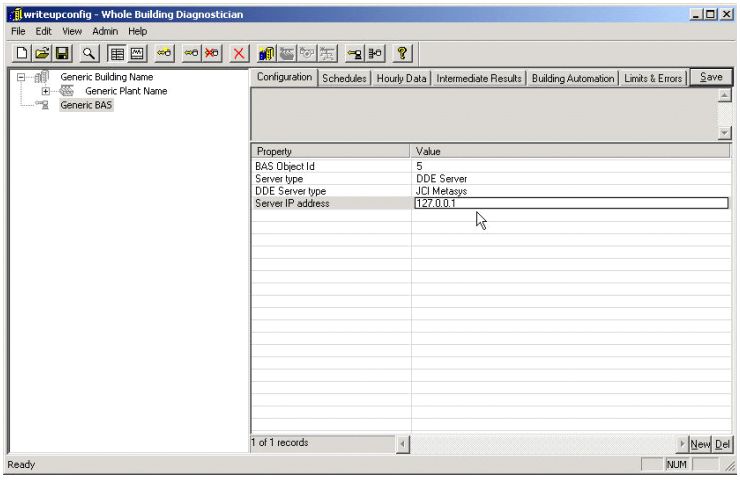
through 23, and for an *ODBC* server, see steps 24 through 26. Note that some of the properties on the configuration screen change depending on the specific server type, so selection of the correct server is crucial. The software automatically modifies the input requirements depending on the selections that you make.

DDE Server

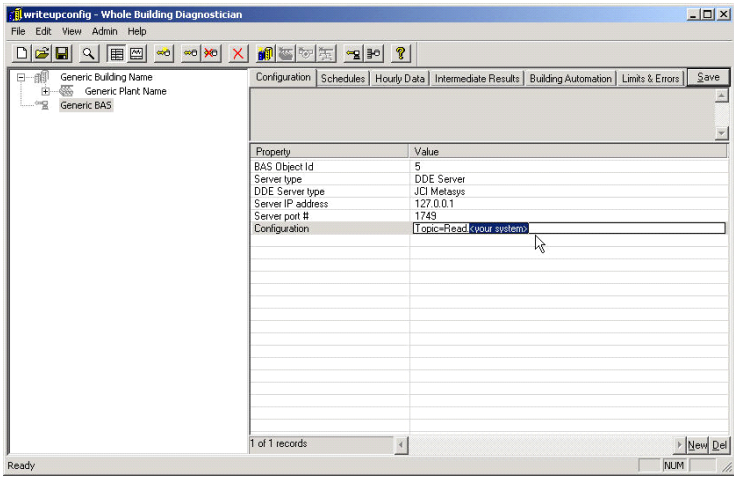
18. Double click in the value cell for the ***DDE Server type***. Click on the down arrow on the far right-hand side of the box to see the selectable entry, ***JCI Metasys***. If *JCI Metasys* is not your DDE Server type then a special driver will be required for the WBD to properly acquire your BAS data. There are a few drivers currently available for non-JCI DDE servers; please check with the PNNL representative for options concerning your system. For now we will assume that you are using JCI Metasys.



19. Double click the value cell for the ***Server IP address***. Enter the IP address that the DDE server resides on. If the DDE server resides on the same machine the WBD runs on, enter **127.0.0.1**. This IP address tells the WBD that it does not need to go over a network to connect to the server, but will find it on this machine. The ***Server port #*** will be automatically filled in—do not change this value!

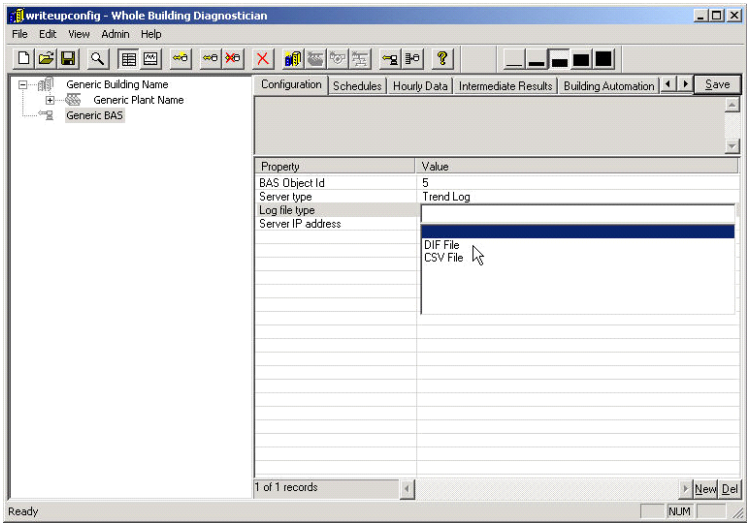


20. Double click on the ***value*** cell for the Configuration. Replace <your system> with the path for your building automation system. You may need to consult your controls specialist or contractor for this information. After entering the path, save the configuration file by clicking on ***File*** in the menu bar and ***Save configuration*** in the drop down menu. Then skip to step 27.



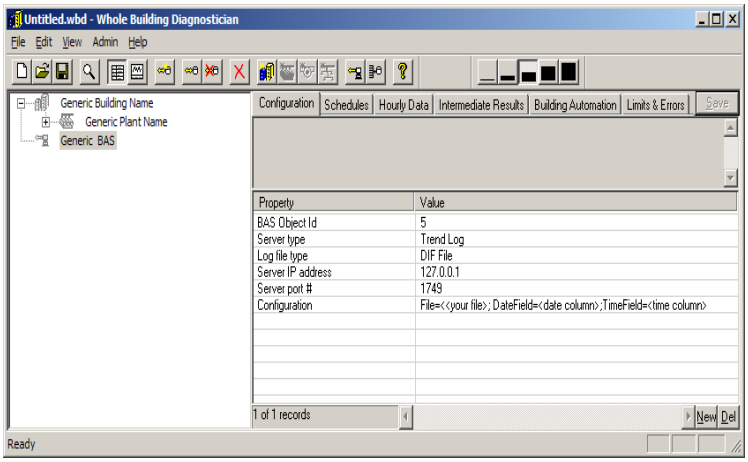
Trend Logs

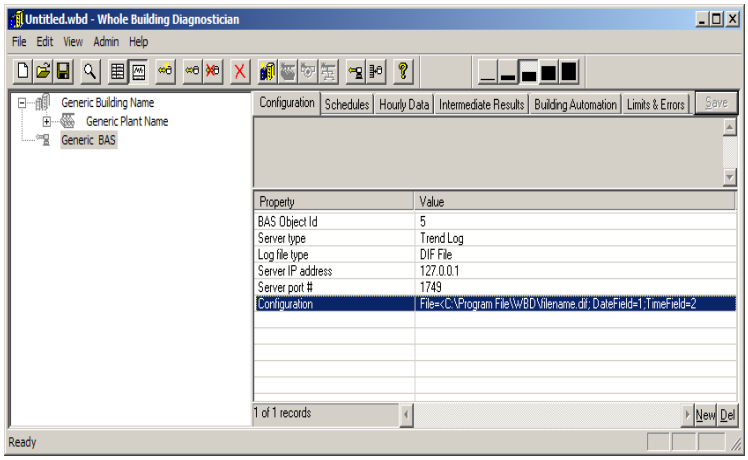
21. Continue the BAS configuration set up using a *Trend Log* server type. Double click on the cell for *Log **file type***. A drop down selection box will appear with two file types that can currently be read by the WBD—*DIF File* (tab delimited file) or *CSV File* (comma separated variable). Select the type that you will use. Note that Excel can save your systems text file as either of these types if your system cannot save to this format directly.



22. Double click the value cell for the ***Server IP address*** and input the IP address for the computer that will have the trend log file. If the trend log resides on the same machine as the WBD, input the IP address 127.0.0.1. The ***Server port #*** value will be filled in automatically—do not alter this entry!

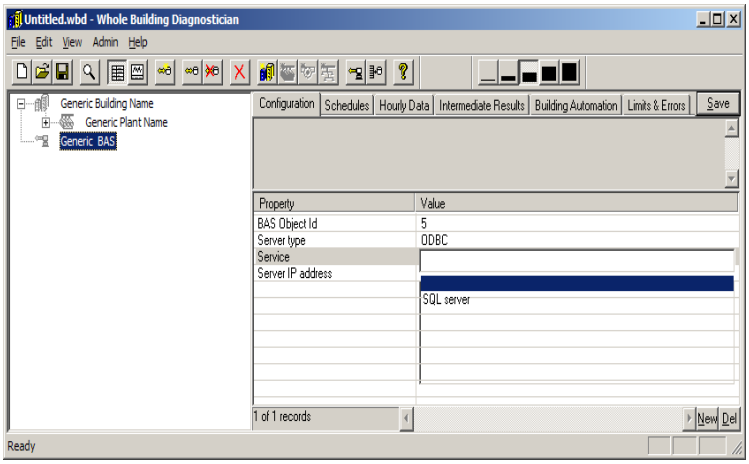
23. Double click to select the ***Configuration*** cell and then replace *<your file>* with the complete path to the trend log file. Note that the file needs to have a date and a time stamp associated with the data. To assign these, replace *<date column>* in the figure with the date field column number and *<time column>* with the time field column number, inserting the appropriate column numbers where the date and time are stored in the trend log. An example with a path entered is shown in the bottom right figure. After entering this complete path name, save the WBD configuration file and skip to step 27.





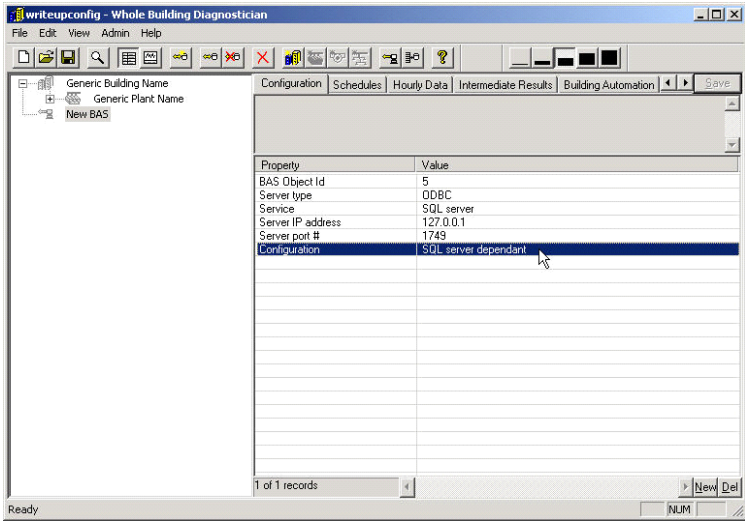
ODBC Database Server

24. Continue the BAS configuration set up using an *ODBC* server type. Double click on the value cell for ***Service***. A drop down box will appear with a single available selection, ***SQL server***. Select this as the service. Currently this is the only server supported by the WBE for ODBC server types.



25. Double click the value cell for the ***Server IP address*** and input the IP address for the computer that will have the ODBC file. If the ODBC file resides on the same computer as the WBD, input the IP address 127.0.0.1. The ***Server port #*** value will be filled in automatically—do not alter this entry!

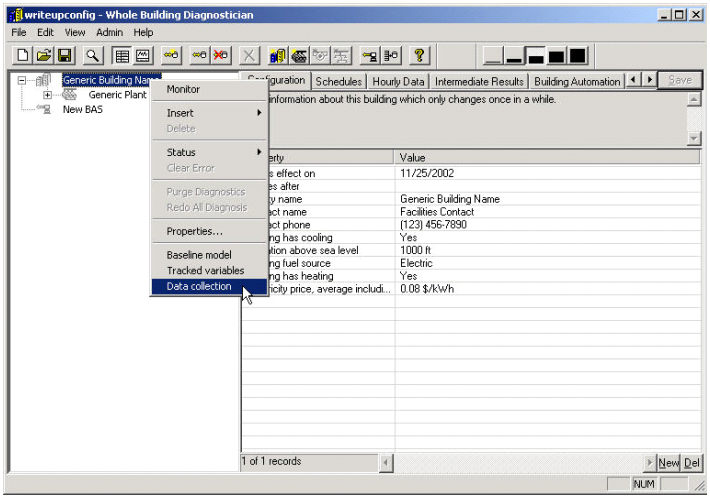
26. The final value, which is for the ***Configuration***, is server dependant. On your screen it will appear blank; however, we display text in the figure at right to indicate that you will need to contact your SQL server administrator to obtain this value. After entering the value, continue with step 27.



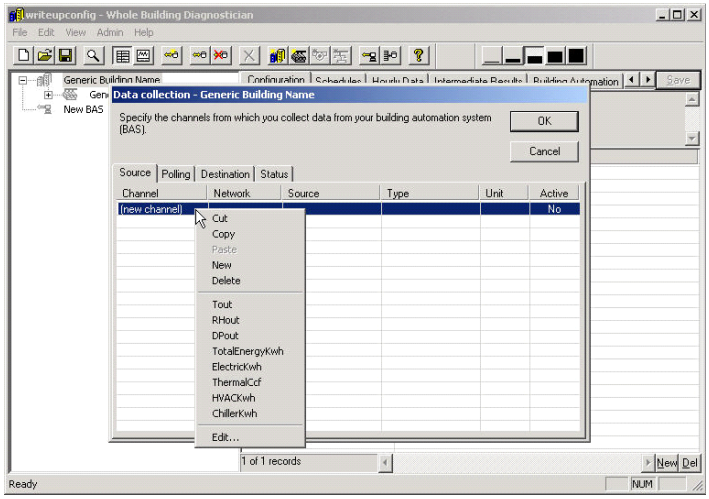
Configure Channels for Data Collection Using the WBD Interface

Now that the building, plant, and network components have been configured, you can set up the data collection for the *Whole Building Energy* module.

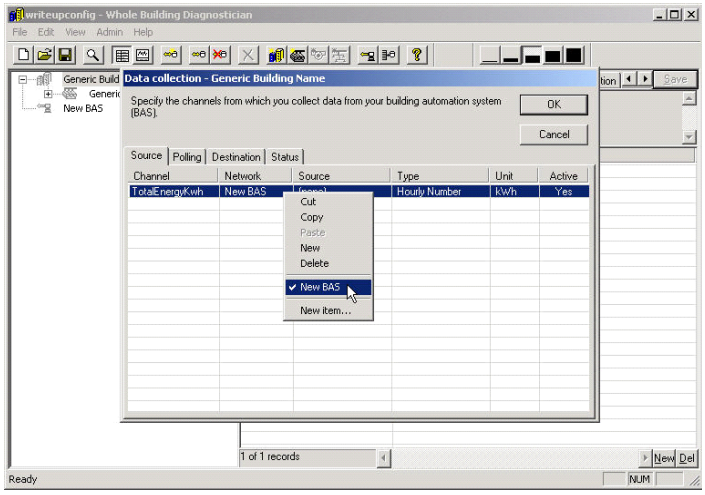
27. In the tree structure, right click on the building name. A drop down menu will appear. Click on ***Data collection***. A BASLink "no records matched" warning box will pop up. Click "***OK***."



28. A *Data collection* window will appear for your building. Right click on the first cell under ***Channel***, which has the text "(new channel)" in it. From the selection box, choose the channel you would like to set up data collection for. This is a ordinarily an energy use you wish to track. For this example, we start with *TotalEnergyKwh.*

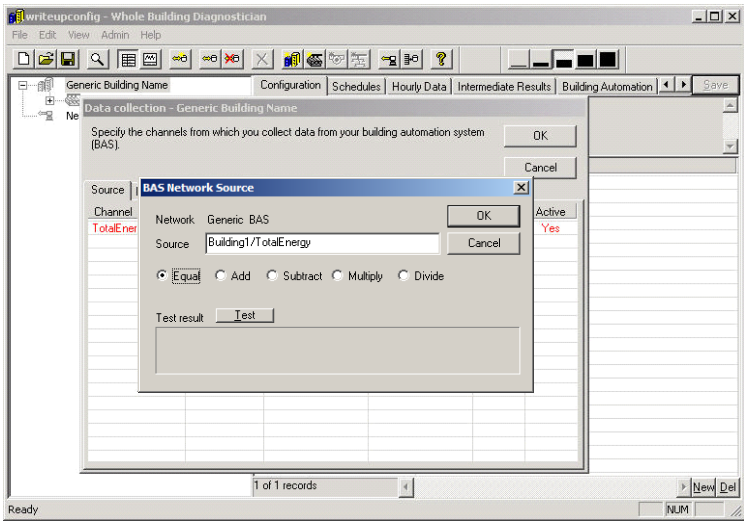


29. The remaining cells in the row populate with their default information. Right click on the Network cell and select the ***New BAS*** for this channel. Note that if you set up your configurations with multiple buildings and separate databases for each building, you will have multiple BAS networks in this list to choose from. Appropriate



meaningful naming of these will aid in setting up data collection.

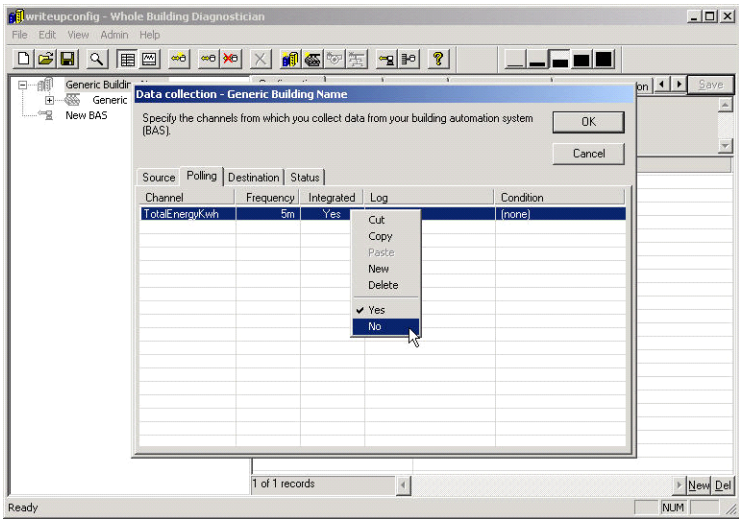
30. Right click on the ***Source*** cell and select ***Edit.*** A *BAS Network Source* dialog box will appear. Input the source identifier applicable to your data collection method in the white box after "Source". If you are using Metasys DDE, input the path to the specific BAS point. For *Trend Log* data, input the database column number for that data point (e.g., 3), and for *ODBC* data, input the ODBC specific identifier (see your database administrator, if you are unsure of this information). An example path for a Metasys DDE server is shown in the figure. The radio buttons allow sequential operations to be performed on that data point; however, for now we are only setting up straight data collection, so choose the *Equal* radio button, then click *OK.*



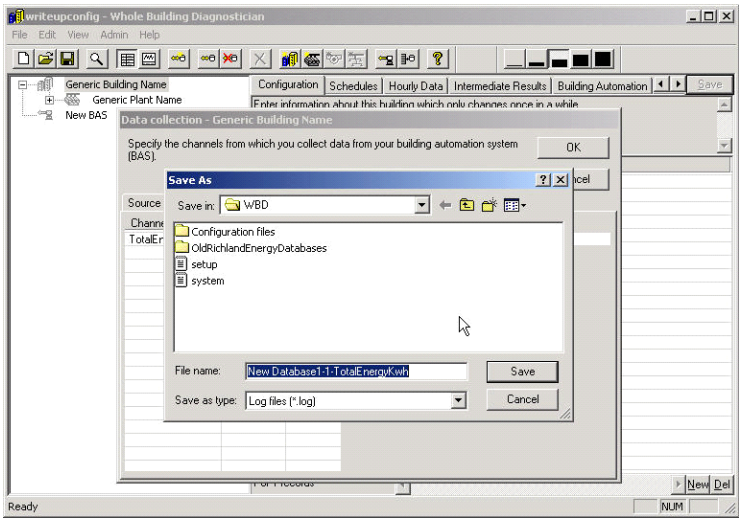
31. The *Type, Unit,* and *Active* cells will all have the default values associated with your selected channel automatically entered. All of the channel defaults that appear in the drop down selection box have these associated values. If you are creating a new channel that is not on the list, then you may need to modify the *Type* and *Unit* values. Right clicking on the cell for each of these provides you with the available options.

32. Select the *Polling* tab near the top of the *Data collection* window. The default values are set to collect the data at a frequency of 5 minutes (5m in the menu) and to integrate the values over the hour. Although we recommend a 5-minute frequency for data collection, this value can be modified provided that the frequency is no greater than 60 minutes. To modify the frequency, right click on the *Frequency* cell and select the value best suited for your needs.

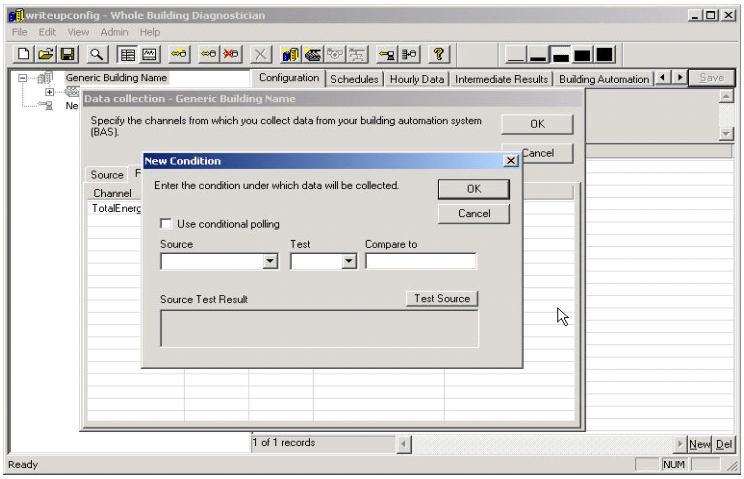
33. To modify the *Integration* of the data, right click on the cell, then select no (or yes). **NOTE: If you decide not to integrate the values, then you will be collecting instantaneous values—the WBE will assign the last instantaneous value collected during an hour to each hour. So, for a 5-minute data collection frequency, the WBD will assign the value collected at 1:55 p.m. to the time of 1:00 p.m.**



34. To log data for any point (which can be used to complement "live" data collection), right click on the ***Log*** cell and select ***Browse***. A *Save As* window will appear where you can name the file (this file name currently defaults to the database name "New Database1-1-<Channel>, with <Channel> replaced with the name of the specific channel associated with the row on which you right clicked). Enter the file name you prefer and then select the location in the "Save in:" box to which you want the file saved on your hard drive (currently defaults to the WBD folder). After naming the file and selecting a location for storage, click ***Save***.



35. To set up collection of data that is conditional on a relationship between data points or a data point and a benchmark, right click on the ***Condition*** cell, and select ***New item***. A New Condition window pops up. Click on the check box to "Use conditional polling." A check mark should appear in the box. Enter the



Source (the data point you want to evaluate in the condition) in the box provided, select the Test (a Boolean operation) that will be used to compare the source value, and then enter the "Compare to" data point (which must already be set up in data collection) or a constant. When finished, click ***OK***. Note that ordinarily this feature is not used for data collection associated with the WBE module.

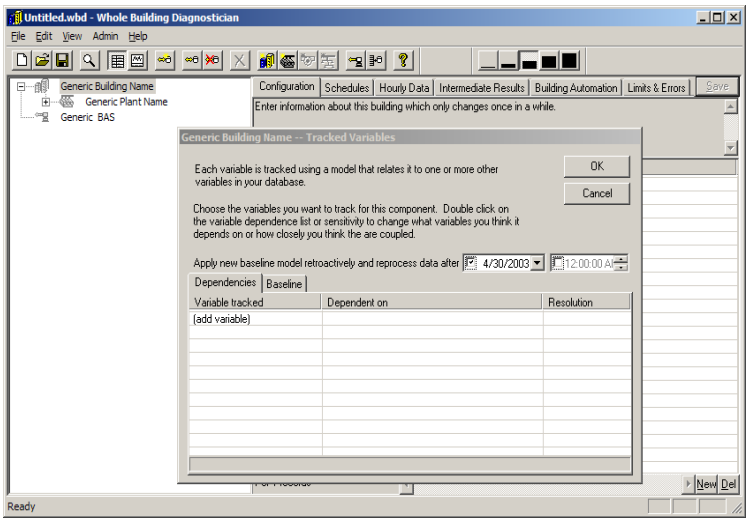
36. Now select the ***Destination*** tab in the Data collection window. This displays the units in which the data points are stored, their reliabilities, errors, and low- and high-limit values. Although most of the channels available in the selection box have defaults available, any new channels (tracked variables) and some of the pre-existing channels may need these values input by the user.

    Reliabilities represent the certainty to which you estimate the value of a data point is known (e.g., we recommend a value of 95% for electricity consumption). The error represents the estimated tolerance of the sensor used to measure the variable in the units of measurement (e.g., we generally use 1 kWh for electricity consumption, representing plus or minus 1 kWh). The values for the low- and high-limits are used to establish reasonable ranges for measured variables. Values below the low limit or above the high limit are flagged by the WBE in a pre-screening process as so unreasonably high or low that the data should not be used. These limits should be selected to define a sufficiently wide range between them that no physically reasonable values are flagged. For example, for outdoor-air temperature, values of -40°F and 170°F might be designated for the low and high limits, respectively. **Note: when modifying the *High limit* value of a channel, the input value will be a multiple of the unit that is associated with that channel (e.g., if the unit is kWh, then a value of 100 would produce a *High limit* of 100 kWh).**

37. The data collection setup for the first single channel is now complete. To add a new channel, click on the ***Source*** tab, right click on the current channel, and select ***New*** from the drop down box. Then repeat steps 28 through 36 for all of the channels that you would like to set up for data collection. After you have added all of the channels of interest, click ***OK***.

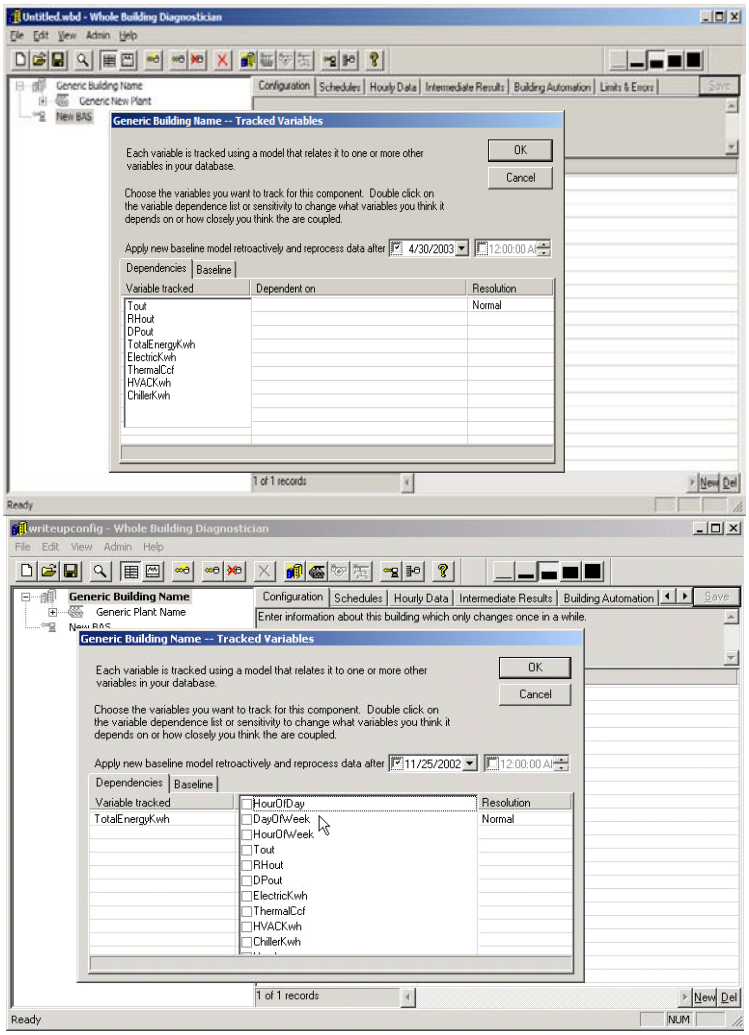
Baseline Model Setup

38. The WBE uses empirical (baseline) models to provide expected values for tracked variables. To set up a baseline model, right click on the building name in the WBE tree and select ***Baseline model***. A *Tracked Variables* box for the selected building will open. A typical setup will track all of the major energy uses by source (e.g., total

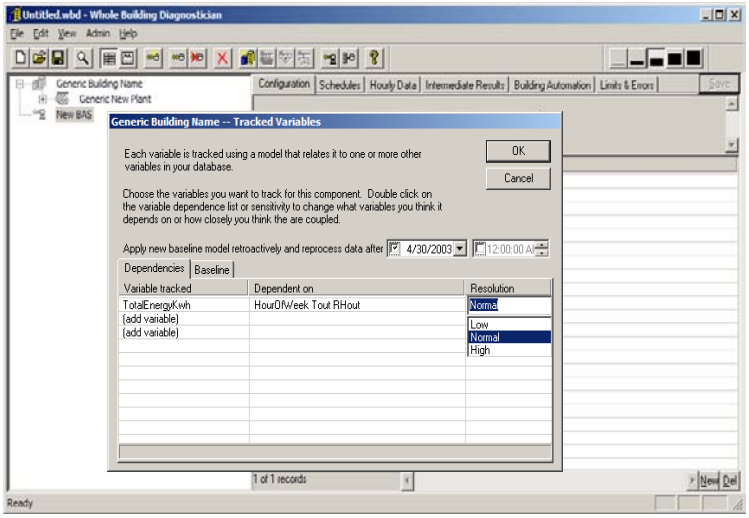


electricity, chiller electricity, gas, etc.) and make them dependent on weather variables (typically outdoor-air temperature and humidity) and schedule. Other variables can be used (such as number of hotel guests or number of hamburgers sold); however, only those variables set up for data collection are available for use by the models.

39. Double click on the ***Variable tracked*** cell with the entry "(add variable)." A drop down selection box will appear with all variables in the database shown. Select the data point that you want to track in the model and double click on it. The *Dependent on* selection box will open. Select the variables that you want the tracked variable to depend on in the model. Typically these are HourOfWeek, Tout (outdoor-air temperature), and RHout (outdoor relative humidity) for tracked variables that are driven primarily by schedules and weather. If relative humidity data are not being collected, we recommend using outdoor-air temperature along with a time variable.

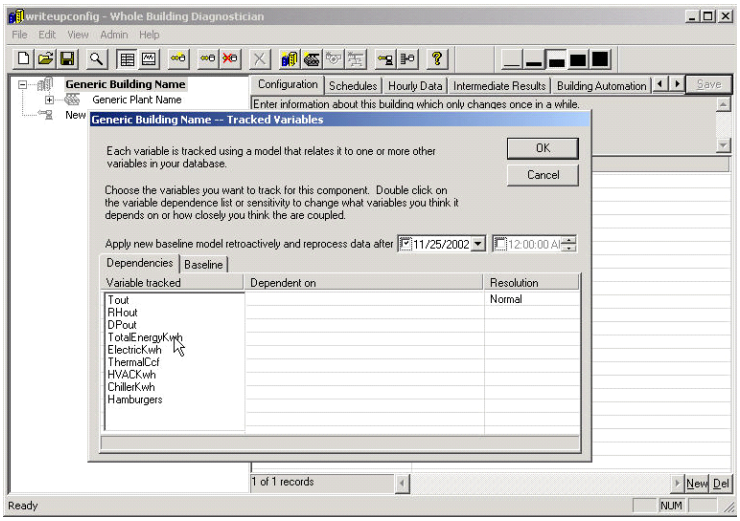


After making your selections, click on the first cell under ***Resolution***. Resolution determines the sensitivity of the resulting diagnostics. Low sensitivity requires larger differences from the baseline before an "alarm" is triggered for a tracked point, and High sensitivity uses small differences to trigger an alarm. In most cases, a Normal



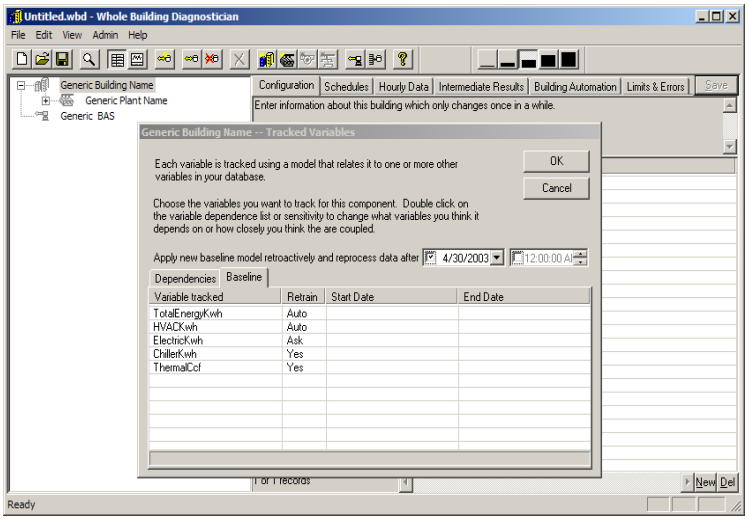
setting is sufficient. Note that there is a tradeoff between increased sensitivity for triggering alarms and the probability of false alarms—low sensitivity produces fewer false alarms but at the risk of missing a problem condition, while high sensitivity is better at detecting problems but will also provide more false alarms. New users should select a Normal setting initially and then adjust the sensitivity after developing experience with the WBE.

40. Repeat step 39 to add each additional tracked variable. There is a limit of five tracked variables per building entry in the directory tree. In addition, only those variables set up for data collection can be tracked.



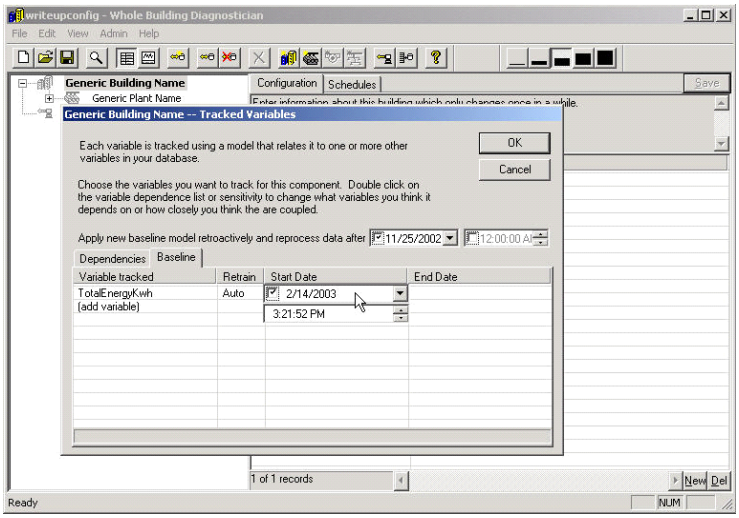
Caution! If you single click instead of double clicking on a variable in the "Variable tracked" drop down box, you will lose the ability to add more variables and may lose all previously selected variables to track. Be sure to <u>double click</u> when selecting variables to track. If you mistakenly single click, try again by double clicking. If this works, continue the process. If it does not, you can still recover but must re-select all previously selected variables to track. To recover, right click on the last variable in your list and select ***Delete***. The (add variable) option will then show back up. Then perform the process correctly, double clicking on the variables as you choose them.

41. After you have entered all variables to be tracked, the variables on which their models will depend, and the resolution (sensitivity), select the ***Baseline tab*** in the Tracked Variables window. Each variable tracked will need a retrain value of either Never, Auto, or Ask. "Yes" although entered as the default value, is not a valid choice. You must change the value to one of the other options. To change the value,

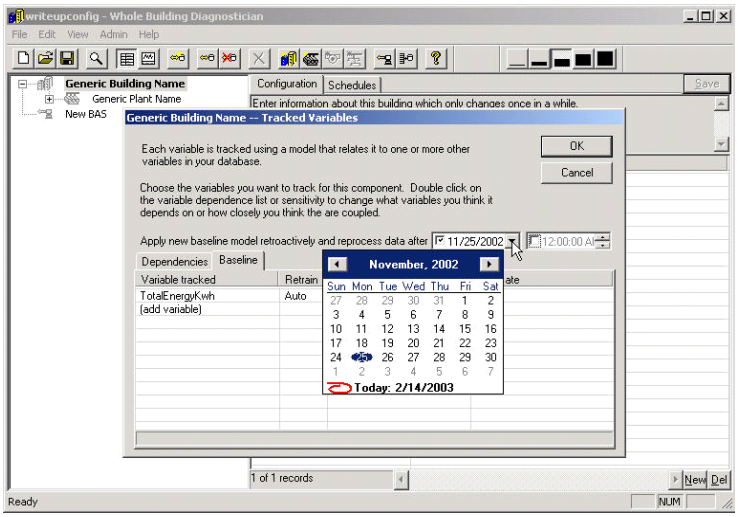


double click on the retrain cell for the variable you wish to modify. A new value will appear in the cell. Continue double clicking on that cell until the option you want appears. Typically, Auto is the choice used.

42. Next, input the ***Start date*** and ***End date*** for the model. This would be the date (and time) for which you have or plan to collect data for the dependent and independent variables to use as the baseline data. If this is an initial setup and you do not have access to historical data, leave the *End Date* blank. Repeat steps 41 and 42 for all of the tracked variables.



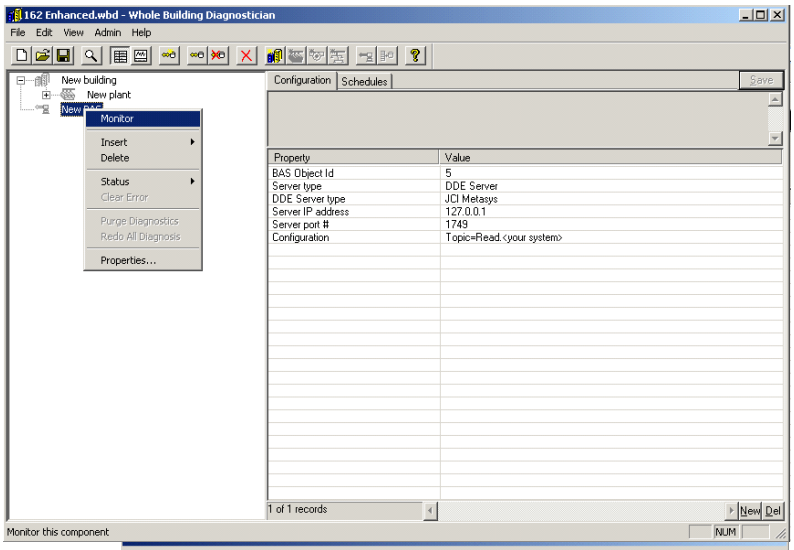
43. If this is an initial installation, set the "***Apply new baseline model retroactively and reprocess data after***" to today's date. If you have historical data, set it to the appropriate date that would be valid for your model. To change that date, click on the arrow on the right side of the date box. A calendar box will pop up. Use the left/right arrows on the calendar box to navigate to the appropriate month/year and select the date by clicking on it. The time can be modified by selecting the hour, minute, seconds, and AM-PM sections of the time display, one at a time, and then using the up and down arrows on the right side to adjust the value.



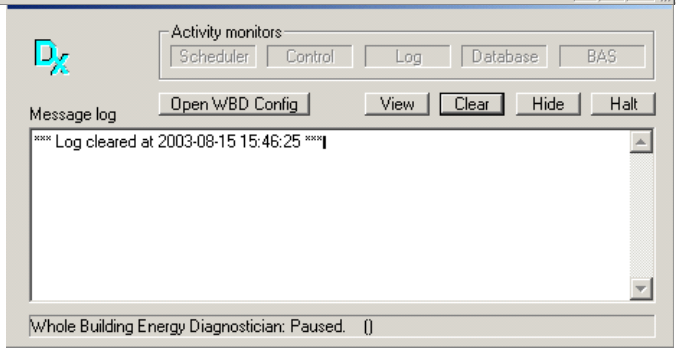
After making those changes select ***OK***. You are now ready to initiate data collection and building energy diagnostics.

Starting Data Collection

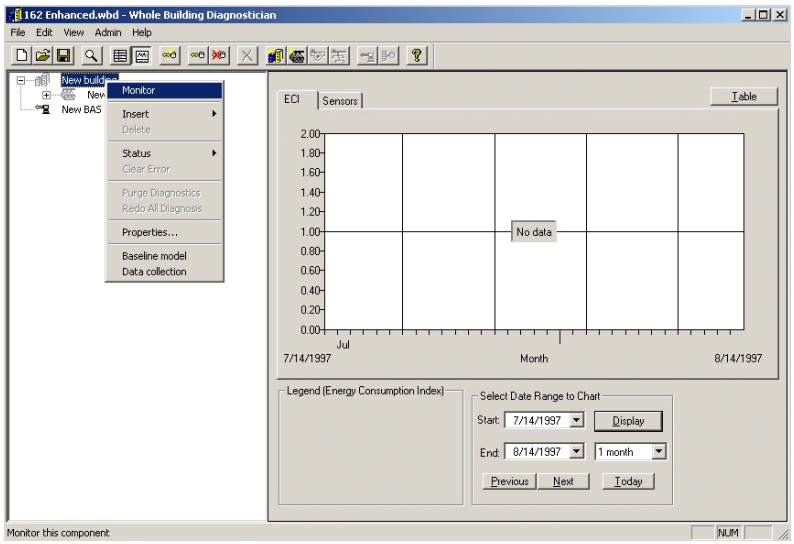
44. To turn on data collection, highlight the network name in the tree. For our example, the network is "New BAS." Right-mouse click on network name and click on ***Monitor***. This must be done by an administrative user.



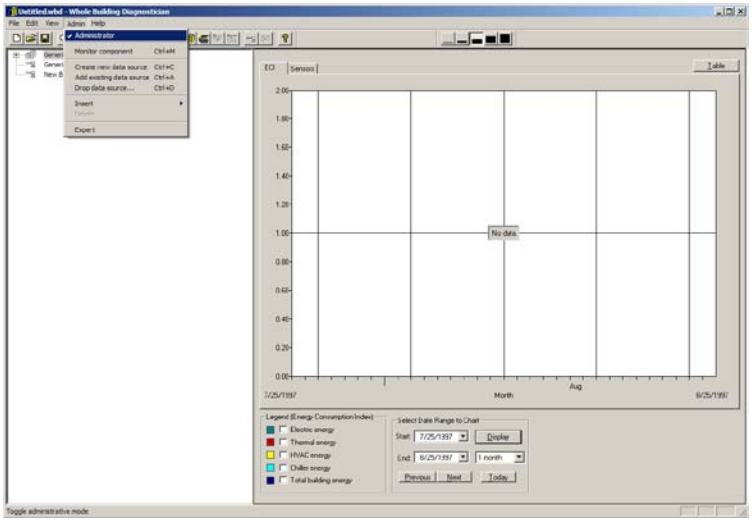
45. After the network is monitored, the window at right, referred to as the WBD Console, will appear. Notice that a red "**D_X**" will appear in the lower right-hand corner of your Windows task bar. This designates that data collection is active. From the console you may *open a WBD configuration*, *view* data collection text file messages, *clear* the console messages, *hide* the console window, or *halt* the data collection. If the administrative user hides the console, double-clicking on the D_X icon in the lower right corner will restore the console for viewing.



46. Whole-Building Energy diagnostic results will not be meaningful for 2 to 3 weeks because the system must first develop initial models for estimating expected energy consumption. After this initial data collection period, diagnostic results may be viewed by "monitoring" the building name on the tree. To view the results, right click on the building name ("Generic Building Name" in the figure) to reveal a drop down menu and then select



Monitor. Diagnostic results should now be displayed in the main (right hand) window pane. Repeat step 46 to monitor other networks or buildings in your configuration.



Any user can view diagnostic results, but only administrative users can start/stop diagnostics and create/change the configuration of the software. Administrators should make sure that administrative privileges are turned *off* when the computer is accessible by others. To verify administrator privileges are off, click on ***Administrator*** in the Admin drop down menu and confirm that no check mark appears before ***Administrator***.

The WBD user interface can be opened and closed without interrupting the data collection process and can be used by any level user to view diagnostic results.