User's Guide

for Completing the

HVAC Construction and Maintenance Cost Survey

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I. Introduction

Purpose

Thank you for participating in the HVAC Construction and Maintenance Cost Survey. This survey was developed and is administered by the Buildings Technology Center (BTC) at Oak Ridge National Laboratory (ORNL).

This survey will provide input to a database of HVAC systems and the construction and maintenance costs associated with those systems. The database is available to the public and is supported by the public by their participation and contributions of data. Users can download the entire database or query the on-line database as well as contributing information.

The database will encompass all types of HVAC systems, though it was originally intended to focus primarily on geothermal heat pump (GHP) systems. Very little reliable information about the construction and maintenance costs for GHP systems is available, and one of our main goals is to address this lack. This database represents significant progress toward ushering GHP systems into the mainstream by providing data upon which commercial cost estimating guides for GHP systems can be based.

Our focus was expanded to include all HVAC system types in the database in order to improve the quality and quantity of construction and maintenance cost data currently available to the engineering community. Our goal is to provide a means by which engineers can share information on construction and maintenance costs for HVAC equipment. The database is capable of accepting information from projects whose costs vary in scope (e.g., mechanical, electrical, site work included in construction costs; e.g., repair, preventive, predictive, maintenance for maintenance costs) and data source (e.g., maintenance budget, work order database, or maintenance contractor fees). When contributors qualify the scope and source of information entered into the database, users are able to gain a better understanding of the circumstances associated with the cost data.

This survey and database are designed to collect all offered data about your building, its HVAC systems, and those systems' construction costs, or maintenance costs, or both. Data will be qualified so that users will be able to distinguish the applicability and accuracy of the data.

The database is built on the basis of individual HVAC systems and the cooling and heating plants that service them. Each building in the database may have several different systems (multizone, packaged, single-zone, etc.). For buildings with multiple systems, please complete the survey (as far as possible) for each of the prominent systems in each building. It is conceivable that time constraints may prevent you from entering all of your data during a single session. In this case, you may log on to the survey as many times as necessary to enter the requested information and submit your data.

Identifying information (site name, contact person, etc.) will be treated as confidential. This information will not be accessible in the on-line database, will not be included in the results of users' queries of the database, and will not be included in the downloadable version of the database. We request this information so that we may contact you if questions arise in the data-quality-assurance process.

Any database is only as good as the data it contains. Your participation in developing a reliable and useful HVAC construction- and maintenance-cost resource will benefit the entire community of HVAC professionals. Thank you very much for your contribution to this effort.

Getting Started

Before you begin, you may find it helpful to gather some information to have at your fingertips as you work on the survey. Here is a list of information you will need:

- Building history (original equipment, additions, retrofit/remodeling)
- Building square footage (total, cooled, heated)
- Capacities (heating and cooling) for systems, cooling and heating plants
- Commissioning/construction dates of HVAC equipment
- Maintenance data (scope of tasks typically performed)
- Maintenance costs (total cost or detailed cost breakdown)
- Construction data (scope of work)
- Construction costs (total cost or detailed cost breakdown)

You need not complete the entire survey in one visit. You may enter data in stages and as time permits to complete the required areas. Once you are finished entering your data, you will submit the completed survey to the database administrator.

You may wish to print the entire User's Guide to help you with the survey. These guidelines will also be available on-line on each respective screen. The on-line guide will provide help only for the screen in question and may not include generalized information found in the guide.

The User's Guide also provides a running example of an elementary school building for each screen to show how various information is input into the survey. You can follow this example in the guidelines as a reference or log on and "practice," using the guidelines as a tutorial.

II. Navigation

You will need Netscape 3.0 or Internet Explorer 4.0 or higher to use this web-based survey. If your browser is not compatible with our survey, you will get an error message indicating the problem and a web address for downloading the latest version. Alternatively, contact the database administrator at dbadmin@ornl.gov, and we will fax or mail the survey forms to you.

Input Screen Functions

- Each screen has **"Save"** and **"Reset"** buttons:
  - **Save** — Saves the data on the respective screen and returns you to the **Survey Menu** screen. The **Survey Menu** screen will show the date of the last change to the section.
  - **Reset** — Clears all current inputs to the screen. If you have saved information previously, the screen will return to your previously saved data. If you have not saved the data, the screen will become blank. Only **"Save"** will save data to the database.

- The **Back** button on your navigator will return you to the **Survey Menu**, but any unsaved data **will be lost**. Use this if you need to "escape" a screen and continue working on another screen.

- The "**Help**" link at the top of each screen will connect you to the area of the User's Guide applicable to that screen. Use your browser's **Back** button to return to the survey or **Print** button to print the guidelines for the screen you are viewing.

Survey Menu Functions

In addition to the above functions on each page, the **Survey Menu** screen has specialized buttons:

- **View Survey** — This link is used to view and print the latest version of your input information. You cannot make changes here; changes can be made only from the **Survey Menu**. Print the screens using your browser print function. Once the data has been submitted and approved by the administrator, it can no longer be edited on-line. Any changes to approved data must be directed to the database administrator.

- **Submit Survey** — After you have input data into each section and saved it, the **"submit survey"** button will become visible. This button allows you to submit your completed survey, in its entirety, to the database administrator.

- **Return to Main Menu** — Allows you to see the overview of buildings and systems you are working on or have submitted.

- **Delete the System** — To permanently remove a system from your account.

- **Guidelines for Filling Out the Survey** — Link to this User's Guide. Each screen's **"help"** button links to the appropriate section.

Links – Bottom of Screen

- The "**BTC Home**" link at the bottom of each screen connects you to the Buildings Technology Center at Oak Ridge National Laboratory.

- The "**ORNL**" link at the bottom of each screen connects you to the Oak Ridge National Laboratory home page.

- The **"Contact Us"** link at the bottom of each screen will send e-mail to the database administrator, dbadmin@ornl.gov. Please include any problems, questions, or comments about the survey.

- The "**Query**'" link at the bottom of each screen will connect you to the Log On screen where you can select **Query Construction Database** or **Query Maintenance Database**.

- The "**Help**" link at the bottom of each screen will connect you to the area of the User's Guide applicable to that screen.

Other Features

- The survey has a timeout feature. If you have been inactive for some time, you will need to log on again.

Examples of data entry are provided throughout this guide to assist users in filling out the survey. The sample data entries, from a 70,000-ft^2 elementary school building, are shown indented and in **boldface,** following the description of the data requested for each field**.** For example, under **Building Information**:

- Owner's name/number for building (name) — your building identifier
  Ex.: [Main Elementary Building]

This guide also shows **screen names,** text on navigational or command **buttons,** and **links** in boldface.

III. Data Input

Log-On Screen

The log-on screen is used to protect the database from corruption by unscrupulous characters. You will need to create a unique User ID and password for access to the survey. Your User ID and password will create your "account" for providing and submitting data and keep your inputs confidential. Only the database administrator will see your complete input for quality-assurance purposes. You may wish to bookmark the log-on screen with the your browser for quick access.

You will not need to log on to access the queries or download the public database.

- New User — Follow the instructions on screen to register.

- Repeat/Returning User
  - Type in your log-on ID and password
  - If you forget your password, contact the database administrator at dbadmin@ornl.gov.

- To go to Query Area — Click **Query Construction Data** or **Query Maintenance Data** to go to the quick query area of choice. The query function allows users to quickly view a summary of available construction and maintenance cost data using the web browser.

- **Download Excel File** — Users who are interested in studying the entire database may do so by downloading a public version, in Excel format. The Data Dictionary in the Appendix in this User's Guide provides information on correlating the database headings and the survey inputs. The Data Dictionary is also provided in Excel at the download area.

- **Download User's Guide** — To download a PDF version of the User's Guide to assist you in completing the survey. Bookmarks will be provided to direct you to guideline topics.

Input Format

Inputs are assigned field types such as text, numeric-integers, numeric-decimals, and full dates. In some fields, inputs are chosen from pull-down menus, radio buttons, or check boxes. Certain inputs are required before you can save the data.

Here are a few tips for data input:

- Numeric input fields do not accept commas. Decimals are permitted for certain inputs.

- Date input fields require the mm/dd/yyyy format. Please include the slashes. If you do not know the exact date, use 01/01/yyyy format to provide the estimated year.

- Text boxes will accept more than 100 words. However, it is best to keep your descriptions brief, but thorough.

- Pull-down menus showing types of systems, cooling and heating plants, and control systems should have sufficient types for selection. If your data is not described by one of the menu selections, please contact the database administrator at dbadmin@ornl.gov.

- If you have not provided input for all the required fields on the screen, you will get an error message concerning missing data. Data cannot be saved until the requested data is entered. You can return to the **Survey Menu** (using the **"Back"** navigation button on your browser) and continue with another input section and return to those areas later. Your data will not be saved.

- The **Survey Menu** is the main screen from which to work. This screen displays all the sections where data should be entered and shows the last change to the sections. You can also view your inputs from this screen. The **Survey Menu** is explained in more detail below.

Saving Inputs

- After completing an input screen, use the **SAVE** button to save your data. Your browser's **BACK** button will return you to the previous screen, but unsaved data **will be lost**.

- Saved data will be stored in the working database and will be available for edits until it is submitted to the database administrator. Once QA checked and approved, the data will become part of the public database.

- You may review your saved inputs at any time using **View Survey** on the **Survey Menu** screen. You may print the **View Survey Info** using your browser.

- You need not finish the entire survey in one visit. Return as necessary to complete the required areas before submitting the data to the database administrator.

- You do not need to complete entering all data for one building system before beginning another. The survey is designed so that you can provide information for multiple buildings and systems and work on them as you have time and data. You may have several building system surveys in various stages of completion.

Submitting Data

Once you have input data in all the required areas of the survey for a system, you will be able to submit the data via the **Submit Survey** button at the bottom of the **Survey Menu**. A notice will appear indicating you have completed the necessary inputs to submit the data to the database administrator. You may wish to review your data before submitting it.

Reviewing Your Data

The **Survey Menu** screen will allow you to **View Survey** to for a final (or intermediate) check of the data you have entered. If you wish change any of your entries, switch to the input screens that are accessible from the **Survey Menu**.

Submitting Data to Administrator

If you have entered data in all the required fields, you will see the **Submit Survey** button and instructions. Please make a final check of your data (using **View Survey**) and make any necessary changes from the **Survey Menu**. If the data is completed to your satisfaction, submit it to the database administrator.

After submitting your data for a particular building, you will see a confirmation of your submission. If you wish to continue working on another building, use the link to the **Main Menu**. The **Main Menu** will show which system surveys have been submitted, with date of submission. This will help you see which items are pending approval from the database administrator and need no further inputs.

Should you find an error after submission, please contact the database administrator to make any changes.

Quality Assurance Procedure

An e-mail will notify the database administrator of newly submitted surveys. The database administrator will review your data and contact you to clarify any inconsistencies, if necessary.

After submission, the data cannot be changed by the user. After the QA check and approval, the data will become part of the database and will be available for public query. The **Main Menu** will show “view only” notation after the system name to indicate the survey data has been approved and is incorporated into the public database.

If you discover an error, contact the database administrator at dbadmin@ornl.gov to have the data corrected.

Continuing

After data is submitted, you can return to the **Main Menu** and follow the same procedure for another HVAC system in the subject building. The **Building Information** needs to be entered only once, regardless of how many of its systems are described.

You can also return to the **Main Menu** and begin entering data for another building.

Input Process

The following figure (Figure 1) depicts the survey input process, beginning with the log-on screen. The figure shows the progression of data input, how the survey captures data into the working database, and the submission and approval process to incorporate the data into the public database.

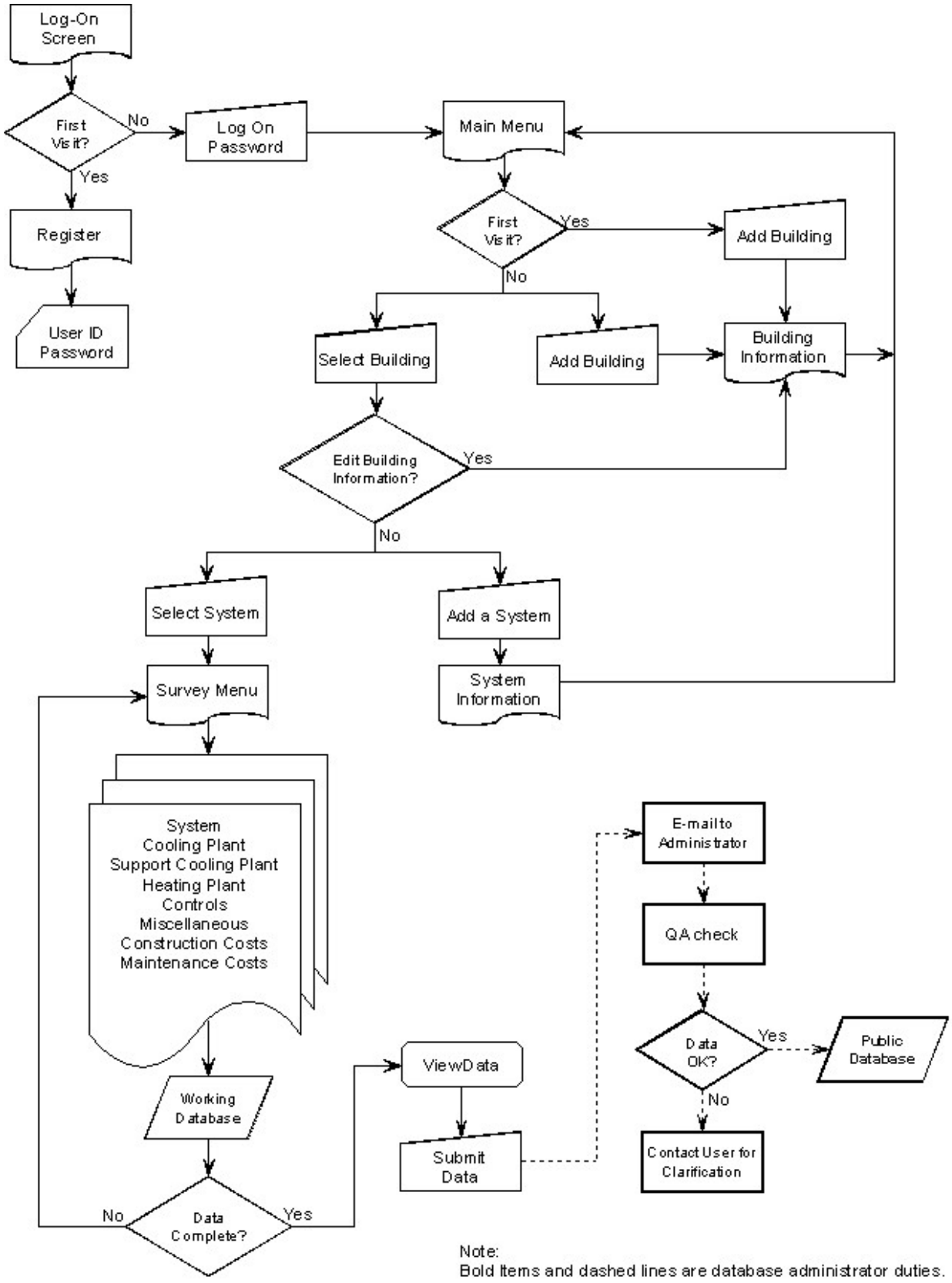

Figure 1. Flowchart for Data Input.

IV. Construction and Maintenance Costs Survey

Overview of Survey

This survey begins with questions about the building, and then branches into HVAC systems and their corresponding plants. The system survey should be completed iteratively for each separate HVAC system identified for the building (**System Information**). The system survey requests data concerning the system's

cooling plant,
heating plant,
geothermal plant (if applicable),
control system,
miscellaneous equipment,
HVAC system construction costs, and
HVAC maintenance costs.

Figure 2 provides a generalized outline of the input tree. You will need to fill in data for the system, the plants, the controls, and the equipment. You can submit data on construction costs, or maintenance costs, or both.

After entering all the data required and you are satisfied with the inputs, you may submit your data to the database administrator for inclusion in the database. The database administrator will review your input before it becomes an entry that is available for public queries. If you need to make changes to the public database, please contact the database administrator. If there is a question concerning your input, you may be contacted for clarification. It is for this reason that we request an e-mail address.

If you have any questions or need assistance, contact the database administrator at dbadmin@ornl.gov.

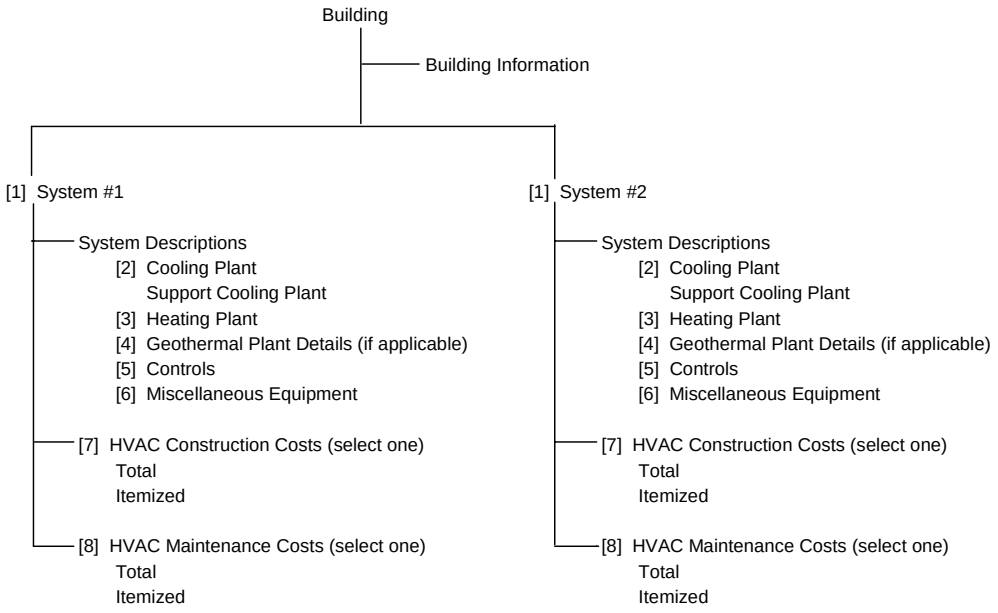

Figure 2. Input tree for the HVAC Construction and Maintenance Cost Database Survey.

Main Menu

The **Main Menu** is the first screen of the survey. If you have not yet entered any data, you will see only one link: **Add a New Building**. If you have entered data, this menu will list the buildings and systems you have entered into the survey. You can click on the building name/number to go to the **Building Information** screen, or click the system and go to the **Survey Menu** screen for updating or reviewing your entries.

- **Add a New Building**
  - First-time user — You will see a message: "No building found in database for user X." Following the link will take you to the **Building Information** screen (see below).
  - Returning user — Click to add new building to survey and then continue on to *Add a New System*.

- **Building and System (data previously entered by user)**
  - Building = *Owner's name/number* for building (name) from **Building Information** screen
    - System = *Current System Type* from **System Information** screen
    - **Add a new system** — Click to add a new system to buildings previously entered.

    If the words "(view only)" appear beside a building name, the data for that building have been submitted to the database administrator and may not be modified by the user. You may view the inputs for the systems from the **Main Menu** screen. If you need to make adjustments to the data, contact the database administrator at dbadmin@ornl.gov. See more at **Survey Menu** below.

- **Viewing Status of Systems**
  The **Main Menu** shows the status of systems entered in the survey by means of a notation beside the system type.

  - "(view only)" — indicates the system and all data associated with it (building information, construction data, and/or maintenance data) have been approved and are located in the public database. Users cannot change this data. Contact the database administrator if there is a problem.

  - "(submitted mm/dd/yyyy)" — indicates the user has input all the required data and submitted the data for review by the database administrator. No further inputs are needed by the user. If an error is found, contact the database administrator directly to correct the problem.

  - No notation indicates the required data is not complete for that system.

The Example

Examples of data entry, based on a 70,000-ft^2 elementary school building, are provided throughout this guide to assist users in filling out the survey. The sample data entries are shown indented and in boldface, following the description of the data requested for each field**.** For example, under **Building Information** you will see

- Owner's name/number for building (name) — your building identifier
  Ex.: [Main Elementary Building]

The following figure depicts the major items for the sample elementary school in the input tree (based on Figure 2). Use this graphic to follow the guideline example.

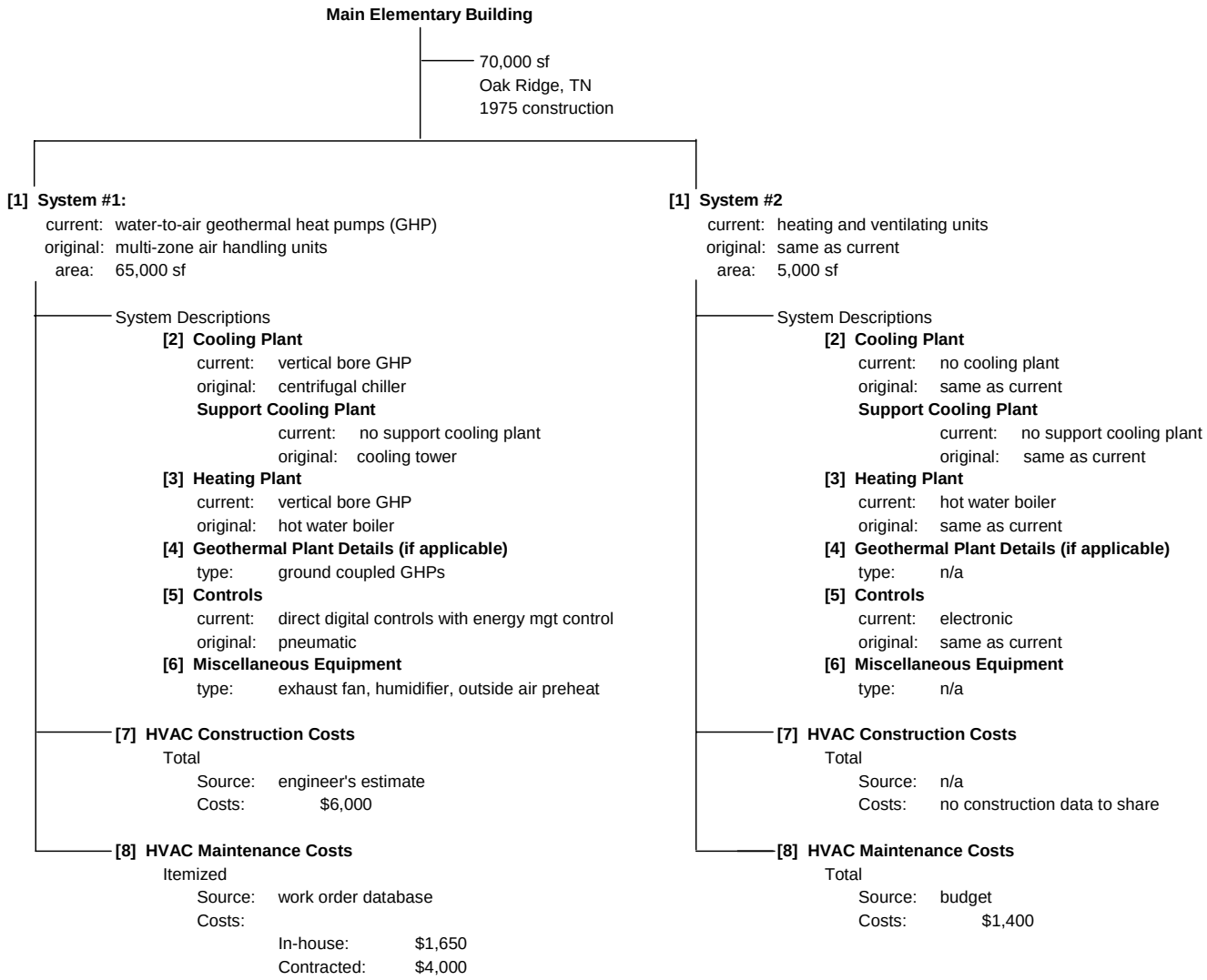

Figure 3. Detailed input tree for elementary school example.

Building Information

This screen is used for entering general information on your building or to view/change information that you have already provided. Building information needs to be supplied only once, even if you supply information for more than one system in the building. Information is required for all the fields on this screen. An example is shown below.

The sample inputs are from an elementary school building in Oak Ridge, Tennessee, with a total square footage of 70,000 ft^2. The building is cooled and heated throughout, but the gymnasium (5,000 ft^2) is heated and ventilated only, with no cooling. The building was constructed in 1975. The building and HVAC system were renovated in 1995.

- Owner's name/number for building (name) — your building identifier
  Ex.: [Main Elementary Building]

- Location of building (city)
  Ex.: [Oak Ridge]

- Location of building (state)
  Ex.: [TN]

- Gross floor area (square feet)
  Ex.: [70000]

- Percentage floor area cooled (%) — Provide your best estimate of the percentage of the gross floor area that is cooled mechanically.
  Ex.: [93]

- Percentage floor area heated (%) — Provide your best estimate of the percentage of the gross floor area that is heated.
  Ex.: [100]

- Original construction date, or date when building was first occupied (mm/dd/yyyy) — Provide your best estimate if unknown. Use the date of the original building if additions to the main building exist. If additions exist, discuss their construction date and HVAC system in the *Building HVAC systems overview* at the bottom of this screen.
  Ex.: [01/01/1975]

- Dominant function of building(s) — Select the most prominent.
  - ❍ school (primary/secondary)
  - ❍ school (post-secondary)
  - ❍ laboratory
  - ❍ medical
  - ❍ office
  - ❍ small commercial (<10,000 sf)
  - ❍ large commercial (>10,000 sf)
  - ❍ manufacturing
  - ❍ retail
  - ❍ residential: single-family
  - ❍ residential: multi-family
  - ❍ dormitory/barracks
  - ❍ lodging
  - ❍ Other _____[Space is given for functions not provided above]
    Ex.: [school (primary/secondary)]

- Building HVAC systems overview — Provide a brief, descriptive overview of the building's systems, plants, controls, construction or retrofit/replacement projects, and maintenance protocols/issues. [Note: A separate system survey should be filled out for each prominent system identified for the building (**System Information**).]

  Ex.: [Original building was 50,000 ft^2. An addition of 20,000 ft^2 occurred in 1995. Renovations in 1995 converted the multizone air handling units to geothermal heat pumps. Heating and ventilating (H&V) system for gymnasium remained with its small dedicated hot water boiler. Repair and service is performed by in-house personnel. Preventive and corrective maintenance are performed by a maintenance contractor.]

- After entering building information, return to the **Main Menu** to add a system for this building.

System Information

Collecting data on HVAC systems is the foundation of this survey. Construction and maintenance cost data will refer to system types. Single buildings commonly have more than one HVAC system, and this survey is designed to take data on as many dominant systems per building as necessary. A separate survey should be completed for each system.

Also, if the subject building has multiple, distinct functions (e.g., offices with a laboratory addition) that reflect separate construction costs or maintenance issues, consider providing a system survey for each distinct area/function, even if the different areas are served by the same type of system.

The sample inputs below reflect a system (System #1) of geothermal heat pumps (GHPs) (water-to-air heat pumps) throughout the air-conditioned space (65,000 ft^2). These were installed in 1995. Forty GHPs were installed, for a total capacity of 200 tons of cooling and 900 MMBtu/hr of heating. The original system was multizone (MZS) air handling units. Ductwork for the MZS was reused where possible for the GHP system. The gymnasium is a small area (5,000 ft^2) and can be considered as a separate heating and ventilating system (System #2), with a dedicated single-zone air handler and hot water boiler. The following running example will be for System #1, water-to-air heat pumps.

- **Current System**
  This information pertains to the system currently in place. These are required inputs (the system data cannot be saved until the inputs are provided).

  - Current HVAC system — Use the pull-down menu to select the system type which best represents the system. **"Click here for descriptions"** provides the abbreviation, full title, and a brief description of the system types listed on the menu.
    Ex.: [WAHP - Water-to-Air Heat Pump - geothermal application]

  - Current system — Choose one:
    - Original equipment (has always been there)
    - Retrofit (replacement in whole or in part of older equipment, even if only partial retrofit) — A retrofit represents an improvement over or distinct change from the original system. The equipment may be a different type system, new capacity (larger/smaller), or new model (more efficient).
    - Replacement (one-for-one) — An exact replacement, with no upgraded features
    - New (new construction or addition) — A system that was installed when the building was originally constructed or installed in a new addition to the building.
      Ex.: [retrofit]

- Commissioning date of current system (mm/dd/yyyy) — Your best estimate of the start-up date or commissioning date for this system. This is not necessarily the building construction date, unless this is the equipment initially installed in the building.
  Ex.: [01/01/1995]

- Floor area served by current system (square feet) — Consider all areas served by the system. This will be considered the dedicated area for this system. If multiple systems serve an area, give your best estimate of the area served by this system.
  Ex.: [65000]

- Current system cooling capacity — Tons (tons = Btu/hr / 12,000) of cooling this system equipment provides to the dedicated area. (Cooling plant total capacity is addressed elsewhere. For systems with single system and single plant, system and plant capacity are the same.)
  Ex.: [200]

- Current system heating capacity — MMBtu/hr of heating this equipment provides to the dedicated area (MMBtu/hr = 1,000,000 Btu/hr). (Heating plant total capacity is addressed elsewhere. For systems with single system and single plant, system and plant capacity are the same.)
  Ex.: [900]

- **<u>Original System</u>**
  Data on the original system is of interest only in the case of recent retrofit or replacement projects; otherwise, leave this section blank. Data inputs for original systems are not required to save system information.

  - Original HVAC system type — Use the pull-down menu to select the system type that best represents the system before the retrofit or replacement. "*Click here for descriptions*" provides descriptions of the types listed on the pull-down menu. If the original system is the current system, select "*N/A — Current System same as Original*" (default) from the pull-down menu.
    Ex.: [MZS - Multizone Constant Volume Air Handing Unit]

  - Commissioning date of original system (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this system.
    Ex.: [01/01/1975]

  - Original system cooling capacity — Tons (tons = Btu/hr / 12,000) of cooling this equipment provides to the dedicated area. (Cooling plant total capacity is addressed elsewhere. For systems with single system and single plant, system and plant capacity are the same.)
    Ex.: [150]

  - Original system heating capacity— MMBtu/hr of heating this equipment provides to the dedicated area (MMBtu/hr = 1,000,000 Btu/hr). (Heating plant total capacity is addressed elsewhere. For systems with single system and single plant, system and plant capacity are the same.)
    Ex.: [800]

  - Percentage of original equipment/system demolished/removed — Estimate the percentage of the entire system that was retrofitted or replaced. For example, all equipment, controls and ductwork would be 100%; new thermostats would be 5%.
    Ex.: [80]

- If you have just completed entering the first HVAC system for a building, return to the **Main Menu**. To continue data entry on this system, select the system on the **Main Menu** and continue data entry from the **Survey Menu** screen. If you prefer, you can select **"Add a new system"** and begin entering data for a second system for this building.

In our example, the user would now return to the **Main Menu**, having entered data on the first system described for the subject building. To continue with data input, the user would select this system (water-to-air heat pump) again and continue from the **Survey Menu** screen. Or the user could select "**Add a new system"** and begin the data input for System #2 (heating and ventilating unit for the gymnasium). System #2 is the original system from 1975 and has a heating capacity of 100 MMBtu/hr.

Survey Menu

After building and systems information is entered, the **Survey Menu** screen is the main screen to work from. This screen lists the building and system you are working on and provides links to the input screens so that you can provide information on the characteristics of the system. Click on the links to go to the input screens. A minimum amount of information must be provided for each of the categories that apply to the system in question:

- System Information
- Cooling Plant
- Heating Plant
- Geothermal Plant (if applicable)
- Controls
- Miscellaneous Equipment

Information may be provided for either or both:

- HVAC Construction Costs
- HVAC Maintenance Costs

See below for details on each section.

You will return to the **Survey Menu** screen after saving your information on each screen (i.e., click the **"Save"** button to return to the **Survey Menu**). You can also use the **"Back"** button on your navigator, but unsaved inputs will be lost.

The **Survey Menu** also tracks the date of your last change or input to the screens. This will help you see which screens have been successfully saved, and those which will need input to complete the survey.

At the bottom on the list of input links are two additional links:

- **View Survey** — This link is used to view and print the latest version of your input information. You cannot make changes here; changes can be made only from the **Survey Menu**. Print the screens using your browser print function.

- **Submit Survey** — After you have input data into each section and saved it, the **"submit"** button will become visible. This button allows you to submit your completed survey, in its entirety, to the database administrator.

    - After the system data is submitted, changes may not be made by the user. Contact the database administrator at dbadmin@ornl.gov to make adjustments.

    - Buildings Technology Center (BTC) staff will review submitted data to resolve any inconsistencies. If necessary, BTC staff will contact you to clarify information and modify data with your permission. After review by BTC staff, the data will become part of the on-line database and will be available for queries by the engineering community.

The following links are also available on the **Survey Menu** screen:

- **Return to Main Menu** — Allows you to see the overview of buildings and systems you are working on or have submitted.

- **Delete the System** — To permanently remove a system from your account.

- **Instructions for Filling Out the Survey** — Link to this User's Guide. Each screen's **"help"** button links to the appropriate section.

Cooling Plant Information

Data on the source of cooling (e.g., air-cooled, water-cooled chilled water systems) for the HVAC system is entered on this screen. Packaged, direct-expansion, and self-contained systems are not included here.

"Packaged" equipment typically contains a compressor, a condenser, and an evaporator, and does not require chilled water from a chiller. Therefore, it is incorrect to indicate that a packaged unit receives chilled water. Conversely, a variable-air-volume (VAV) or constant-volume (CV) air handler does receive chilled water. A packaged system has no associated cooling plant, as cooling is provided as part of the system. For packaged system types, select "*None — No Cooling Plant,*" because no chilled water is generated. No further information will be required for the cooling plant screen for a packaged system.

Only cooling plant information that pertains to the one system being described should be entered. For example, in a building having three system types including multizone (MZ), variable-air-volume (VAV), and packaged, the MZ and VAV both use chilled water service, but the packaged system does not. The chilled water plant may be dedicated to one system only, or may serve both systems. Where one cooling plant serves more than one system, cooling plant data (e.g., total capacity) is reported, but the portion of the chilled water plant's capacity that is dedicated to serving each separate system must also be reported. For example, the survey for the MZ system should include cooling plant (chiller) information (percentage of total capacity) for the portion of the cooling plant capacity dedicated to that system only. Likewise, the survey describing the VAV system should reflect the percentage of the cooling plant capacity dedicated to only the VAV system. Use your best engineering judgement when indicating plant contributions to multiple systems.

The sample inputs below reflect System #1 geothermal heat pumps used for the cooling and heating system. The system utilizes a ground-coupled, vertical bore system. The ground heat exchanger has a capacity of 180 tons of cooling. The original cooling plant was a water-cooled 150-ton closed centrifugal compressor chiller with a cooling tower. The chiller, pumps, piping, and cooling tower were removed with the installation of the GHP system.

Cooling Plant

- Current Cooling Plant Information
  This information pertains to the cooling plant currently in place. These are required inputs; the cooling plant data cannot be saved until the inputs are provided.

  - Current cooling plant type — Use the pull-down menu to select the cooling plant type that best represents your plant. "*Click here for descriptions*" provides the abbreviation, full title, and a brief description of the plant types. Select "*None — No Cooling Plant*" if no cooling plant is used; the remaining inputs for current cooling plant will not be required.
    Ex.: [GCHP w/VBORE - Vertical Bore Heat Exchanger]

- Current cooling plant — Choose one:
  - Original Equipment (has always been there)
  - Retrofit (replacement in whole or in part of older equipment, even if only partial retrofit) — A retrofit represents an improvement over or distinct change from the original plant. The equipment may be a different type plant, new capacity (larger/smaller), or new model (more efficient).
  - Replacement (one-for-one) — An exact replacement, with no upgraded features
  - New (new construction or addition) — A plant that was installed when the building was originally constructed or installed in a new addition to the building.

    Ex.: [Retrofit]

- Current cooling plant total capacity — Tons (tons = Btu/hr / 12,000) — Enter the total cooling plant capacity, even if the cooling plant serves multiple systems. (The percentage of total cooling plant capacity dedicated to this system is to be entered below.)

  Ex.: [180]

- Floor area served by current cooling plant (square feet) — with respect to the system in question.

  Ex.: [65000]

- Percentage of current cooling plant total capacity dedicated to system (%) — the portion of total plant capacity that supports this system (for example, 25%, 75%, 100%).

  Ex.: [100]

- Commissioning date of current cooling plant (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this plant. This is not necessarily the building construction date, unless this is the equipment initially installed in the building.

  Ex.: [01/01/1995]

- <u>Original Cooling Plant Information</u>
  Data on the original cooling plant is of interest only in the case of recent retrofit or replacement projects; otherwise, leave this section blank. Data inputs for the original cooling plant are not required to save the cooling plant information.

  - Original cooling plant type — Use the pull-down menu to select the plant which best represents the original plant before the retrofit or replacement. "*Click here for descriptions*" provides descriptions of the types listed on the pull-down menu. If the original plant is the current plant, select "*N/A —Current Plant same as Original*" (default).

    Ex.: [CENTCLS - Closed Centrifugal Compressor Chiller]

  - Original cooling plant total capacity [Tons (tons = Btu/hr / 12,000)] — Enter the total capacity of the original cooling plant that served the system in question.

    Ex.: [150]

  - Commissioning date of original cooling plant (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this plant.

    Ex.: [01/01/1975]

  - Percentage of original cooling plant demolished/removed (%) — Estimate the percentage of the entire cooling plant that was demolished/removed (for example, 100% if it includes chillers, pumps, piping, and controls; 10% for variable speed drives for pumps).

    Ex.: [100]

Support Cooling (Condensing) Plant

This information pertains to the support cooling plant currently in place. You may not have a support cooling (condensing) plant. If not, select "*N/A — No Support Cooling Plant*" from the pull-down menu. These are not required inputs; the cooling plant data screen requires current cooling plant data only.

In our example, the current system does not have any support cooling equipment. The original chiller utilized a 150-ton cooling tower.

- Current Support Cooling Plant
  This information pertains to the support cooling plant currently in place. These are not required inputs; the support cooling plant data can be saved with limited inputs provided, if any.

  - Current support cooling plant type — Use the pull-down menu to select the support cooling plant type which best represents your plant. "*Click here for descriptions*" provides the abbreviation, full title, and a brief description of the plant types. Select "*N/A — No Support Cooling Plant*" if there is no support cooling plant.
    Ex.: [N/A - No Support Cooling Plant]

  - Current support cooling plant:
    - Original Equipment (has always been there)
    - Retrofit (replacement in whole or part for older equipment, even if only partial retrofit) — A retrofit is an improvement over or distinct change from the original plant. The equipment may be a different type plant, new capacity (larger/smaller), or new model (more efficient).
    - Replacement (one-for-one) — An exact replacement, with no upgraded features
    - New (new construction or addition) — A plant that installed when the building was originally constructed or installed in a new addition to the building.
      Ex.: [blank]

  - Current support cooling plant total capacity — Tons [tons = gpm (chilled water) × water temperature difference/24] — Enter the total support cooling plant capacity, even if the support cooling plant serves multiple systems. (The percentage of total support cooling plant capacity dedicated to this system is to be entered below.)
    Ex.: [blank]

  - Floor area served by current support cooling plant (square feet) — with respect to the system in question.
    Ex.: [65000]

  - Percentage of current support cooling plant total capacity dedicated to system (%) — the portion of total plant capacity that supports this system (for example, 25%, 75%, 100%).
    Ex.: [100]

  - Commissioning date of current support cooling plant (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this plant. This is not necessarily the building construction date, unless this is the equipment initially installed in the building.
    Ex.: [blank]

- <u>Original Support Cooling Plant</u>
  Data on the original support cooling plant is of interest only in the case of recent retrofit or replacement projects; otherwise, leave this section blank. Data inputs for the original support cooling plant are not required to save the cooling plant information.

  - Original support cooling plant type — Use the pull-down menu to select the plant that best represents the original support cooling plant before the retrofit or replacement. "*Click here for descriptions*" provides descriptions of the types listed on the pull-down menu. If the original plant is the current plant, select "*Not/Appl —Current support cooling plant same as original*" (the default).
    Ex.: [CT - Cooling Tower]

  - Original support cooling plant total capacity — Tons [tons = gpm (chilled water) × water temperature difference/24] - Enter the total capacity of the original support cooling plant which served the system in question.
    Ex.: [150]

  - Commissioning date of original support cooling plant (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this plant.
    Ex.: [01/01/1975]

  - Percentage of original support cooling plant demolished/removed (%) — Estimate the percentage of the entire cooling plant that was demolished/removed (for example, 100% if it includes chillers, pumps, piping, and controls; 10% for variable speed drives for pumps).
    Ex.: [100]

In our example, System #2 serves the gymnasium, which is ventilated only, and has no cooling plant. Select *"None — No Cooling Plant"* for cooling plant data and *"N/A — No Support Cooling Plant"* for support cooling plant data.

<u>Heating Plant Information</u>

Data on the source of heating (e.g., hot water, steam, GHP) for the HVAC system being described is entered on this screen. Packaged, direct-expansion, and self-contained systems are not included here.

"Packaged" equipment typically contains a compressor, condenser, and evaporator, and does not require hot water or steam from a boiler. Therefore, it is incorrect to indicate that a packaged unit receives hot water or steam. A variable-air-volume (VAV) or constant-volume (CV) air handler does receive hot water or steam, but a packaged system has no associated heating plant, as the heating is provided as part of the system. For packaged system types, select "*None — No Heating Plant,*" because no hot water or steam is generated. No further information will be required for the heating plant screen for a packaged system. system.

Only heating plant information that pertains to the one system being described should be entered. For example, in a building having three system types including MZ, VAV, and packaged, the MZ and VAV both use hot water service, but the packaged system does not. The heating plant may be dedicated to one system only, or may serve both systems. Where one heating plant serves more than one system, heating plant data (e.g., total capacity) is reported, but the portion of the hot water plant's capacity that is dedicated to serving each separate system must also be reported. For example, the survey for the MZ system should include heating plant (boiler) information (percentage of total capacity) for the portion of the heating plant capacity dedicated to that system only. Likewise, the survey describing the VAV system should reflect the percentage of the heating plant capacity dedicated to only the VAV system. Use your best engineering judgement when indicating plant contributions to multiple systems.

In the example, the inputs below reflect System #1, geothermal heat pumps used for the cooling and heating system. The system utilizes a ground-coupled, vertical bore system. The ground heat exchanger has a capacity of 900 MMBtu/hr of heating. The original heating plant consisted of a natural gas hot water boiler with a capacity of 800 MMBtu/hr, pumps, and piping. The original heating plant was removed with the GHP system installation.

- Current Heating Plant Information
  This information pertains to the heating plant currently in place. These are required inputs; the heating plant data cannot be saved until the inputs are provided.

  - Current heating plant type — Use the pull-down menu to select the heating plant type that best represents your plant. "*Click here for descriptions*" provides the abbreviation, full title, and a brief description of the plant types. Select "*None — No Heating Plant*" if no heating plant is used; the remaining inputs for current heating plant will not be required.
    Ex.: [GCHP w/VBORE - Vertical Bore Heat Exchanger]

  - Current heating plant:
    - Original Equipment (has always been there)
    - Retrofit (replacement in whole or part for older equipment, even if only partial retrofit) — A retrofit represents an improvement over or a distinct change from the original plant. Equipment may be a different type of plant, new capacity (larger/smaller), or new model (more efficient).
    - Replacement (one-for-one) — An exact replacement, with no upgraded features
    - New (new construction or addition) — A plant that installed when the building was originally constructed or installed in a new addition to the building.
      Ex.: [Retrofit]

  - Current heating plant total capacity — [MMBtu/hr (MMBtu/hr = 1,000,000 Btu/hr)] — Enter the total heating plant capacity, even if the heating plant serves multiple systems. (The percentage of total heating plant capacity dedicated to this system is to be entered below.)
    Ex.: [900]

  - Floor area served by current heating plant (square feet) — with respect to the system being input
    Ex.: [65000]

  - Percentage of current heating plant total capacity dedicated to system (%) — the portion of total plant capacity that supports this system (for example, 25%, 75%)
    Ex.: [100]

  - Commissioning date of current heating plant (mm/dd/yyyy) — Your best estimate of commissioning or construction date for this plant. This is not necessarily the building construction date, unless this is the equipment initially installed in the building.
    Ex.: [01/01/1995]

- Original Heating Plant Information.
  Data on the original heating plant is of interest only in the case of recent retrofit or replacement projects; otherwise, leave this section blank. Data inputs for the original heating plant are not required to save the heating plant information.

  - Original heating plant type — Use the pull-down menu to select the plant which best represents the original heating plant before the retrofit or replacement. "*Click here for descriptions*" provides descriptions of the types listed on the pull-down menu. If the original plant is the current plant, select "*N/A —Current Plant same as Original*" (default).
    Ex.: [HW Boiler - Hot Water Boiler - non-electric boiler with induced draft fan]

- Original heating plant total capacity — [MMBtu/hr (MMBtu/hr = 1,000,000 Btu/hr)] — Enter the total capacity of the original cooling plant that served the system in question.
  Ex.: [800]

- Commissioning date of original heating plant (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this plant.
  Ex.: [01/01/1975]

- Percentage of original heating plant demolished/removed (%) — Estimate the percentage of the entire cooling plant that was demolished/removed (for example, 100% if it includes chillers, pumps, piping, and controls; 10% for variable speed drives for pumps).
  Ex.: [100]

  In the example, even though the entire building is heated, System #1 reflects the GHP systems only. System #2 (gymnasium heating and ventilating) is served by the original, dedicated hot water boiler with a capacity of 100 MMBtu/hr.

Geothermal Plant Info

This section is applicable only to geothermal heat pumps. Please provide details about your specific installation as best you can.

The sample inputs below reflect System #1, a ground-coupled, vertical-bore geothermal heat pump used for the cooling and heating system. The borefield consists of 150 boreholes, 250 ft deep, with a 4.25-in. diameter, spaced 20 ft apart. U-tubes are used in the sandy and soft rock soil and are backfilled with thermally enhanced grout. No casing was required. Two 30-hp variable-speed-drive pumps circulate 550 gpm (max) through the system. The school has 40 GHPs. The Geothermal Plant Info section does not apply to System #2 (gymnasium heating and ventilating).

Ground-Coupled Heat Pumps

- Number of GHP units served (#).
  Ex.: [40]

- Heat exchanger configuration — Select one
  - horizontal trench
  - vertical bore
  - slinky
  Ex.: [vertical bore]

- Average depth per borehole or length per trench (feet)
  Ex.: [250]

- Diameter of boreholes or width of trenches (inches)
  Ex.: [4.25]

- Number of boreholes or trenches (#).
  Ex.: [200]

- Total length of heat exchanger piping (feet) — Total length for outside exchanger only; includes supply and return piping, manifolds, etc.
  Ex.: [78000]

- Soil conditions — Select all that apply
  - ❍ clay
  - ❍ sand
  - ❍ soft rock
  - ❍ medium rock
  - ❍ hard rock

    Ex.: [sand and soft rock]

- Backfill material — Select all that apply
  - ❍ grouting
  - ❍ concrete
  - ❍ cuttings
  - ❍ gravel

    Ex.: [cuttings]

- Grouting material — Select one
  - ❍ standard
  - ❍ thermally enhanced
  - ❍ none

    Ex.: [thermally enhanced]

- Grouting depth (feet) — Per borehole or trench

  Ex.: [20]

- Casing type — Select one
  - ❍ temporary
  - ❍ permanent
  - ❍ none

    Ex.: [none]

- Average depth of casing remaining in soil per borehole (feet) — Use “0” if casing was removed or was not used.

  Ex.: [0]

- Casing material — Select one
  - ❍ steel
  - ❍ PVC
  - ❍ other — Describe
  - ❍ none

    Ex.: [none]

- Loop field design flow rate (gpm)

  Ex.: [550]

- Number of circulation pumps (#) — Include redundant pumps

  Ex.: [2]

- Total pumping capacity (hp) — Include redundant pumps

  Ex.: [60]

- Pumping control — Select most prevalent or primary control used
  - ❍ fixed speed
  - ❍ variable speed

    Ex.: [variable]

Groundwater Heat Pumps

Note: this section does not apply to our example (System #1 or #2).

- Number of GHP units served (#)

- Water source — Select one
  - ❍ aquifer
  - ❍ standing column well

- Well construction — Select one
  - ❍ open hole
  - ❍ naturally developed
  - ❍ gravel packed

- Disposal means — Select one
  - ❍ injection well
  - ❍ surface water
  - ❍ standing column

- Number of supply wells (#)

  - ➢ Average depth per supply well (feet)

  - ➢ Supply well casing configuration — Select one
    - ❍ none
    - ❍ surface
    - ❍ extensive

  - ➢ Average depth of supply well casing remaining in soil per supply well (feet) — Use “0” if casing was removed or was not used.

  - ➢ Supply well casing material — Select one
    - ❍ steel
    - ❍ PVC
    - ❍ none
    - ❍ other _____ (describe)

- Number of injection wells (#)

  - ➢ Average depth per injection well (feet)

  - ➢ Injection well casing configuration — Select one
    - ❍ none
    - ❍ surface
    - ❍ extensive

  - ➢ Average depth of injection well casing remaining in soil per injection well (feet) — Use “0” if casing was removed

  - ➢ Injection well casing material — Select one
    - ❍ steel
    - ❍ PVC
    - ❍ none
    - ❍ other _____ (describe)

- Groundwater flow rate (gpm)

- Number of production pumps (#) — Include redundant pumps

- Total production pumping capacity (hp) — Include redundant pumps

- Production pumping control — Select most prevalent or primary control used
  - ❍ fixed speed
  - ❍ variable speed

- Plate heat exchanger — Select one
  - ❍ yes
  - ❍ no

- Circulation (interior) flow rate (gpm)

- Number of circulation (interior) pumps (#) — Include redundant pumps

- Total circulation (interior) pumping capacity (hp) — Include redundant pumps

- Circulation (interior) pumping control — select most prevalent or primary control used
  - ❍ fixed speed
  - ❍ variable speed

<u>Surface Water or Other Heat Pumps</u>

Note: this section does not apply to our example (System #1 or #2).

- Number of GHP units served (#).

- Heat exchanger configuration — Select one
  - ❍ closed loop
  - ❍ open loop

- Surface water flow rate (gpm)

- Number of surface water pumps (#) — Include redundant pumps

- Total surface water pumping capacity (hp) — Include redundant pumps

- Surface water pumping control — select most prevalent or primary control used
  - ❍ fixed speed
  - ❍ variable speed

- Plate heat exchanger — Select one
  - ❍ yes
  - ❍ no

- Maximum circulation (interior) flow rate (gpm)

- Number of circulation (interior) pumps (#) — Include redundant pumps

- Total circulation (interior) pumping capacity (hp) — Include redundant pumps

- Circulation (interior) pumping control — select most prevalent or primary control used

- ❍ fixed speed
- ❍ variable speed

Controls

Controls can be as simple as a system that runs continuously and is manually operated with switches or automatically operated with standard or programmable thermostats, or as complex as elaborate energy management control systems with remote monitoring and control features. Enter the control system data that best fits your control scheme.

Ex.: The example inputs below reflect System #1 direct digital controls with energy management features. The original controls were pneumatic.

- **Current control system**
  This information pertains to the control system currently in place. These are required inputs (the control system data cannot be saved until the inputs are provided).

  - ➢ Current control system type — Use the pull-down menu to select the control system type that best represents your system. "*Click here for descriptions*" provides abbreviations, full titles, and brief descriptions of the control systems.
    Ex.: [DDCE- Direct Digital Controls - Monitoring with Energy Conservation Controls]

  - ➢ Current control system:
    - ❍ Original Equipment (has always been there)
    - ❍ Retrofit (replacement in whole or part for older equipment, even if only partial retrofit) — A retrofit represents an improvement over or distinct change from the original control system. Equipment may be a different type; have improved programmable capacity, deluxe features, or monitoring capability (local or remote); or be capable of making configuration changes.
    - ❍ Replacement (one-for-one) — An exact replacement, with no upgraded features
    - ❍ New (new construction or addition) — A control system that was installed when the building was originally constructed or installed in a new addition to the building.
      Ex.: [Retrofit]

  - ➢ Commissioning date of current control system (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this system. This is not necessarily the building construction date, unless this is the equipment initially installed in the building.
    Ex.: [01/01/1995]

- **Original control system**
  Data on the original control system is of interest only in the case of recent retrofit or replacement projects; otherwise, leave this section blank. Data inputs for the original control system are not required to save the control system information.

  - ➢ Original control system type — Use the pull-down menu to select the control system type that best represents the original system before the retrofit or replacement. "*Click here for descriptions*" provides descriptions of the types listed on the pull-down menu. If the original system is the current system, select "*N/A — Current System same as Original*" (default) from the pull-down menu.
    Ex.: [PN- Pneumatic]

  - ➢ Commissioning date of original control system (mm/dd/yyyy) — Your best estimate of the commissioning or construction date for this system.
    Ex.: [01/01/1975]

- Percentage of original controls demolished/removed (%)— Estimate the percentage of the entire control system that was demolished/removed. For example, use 100% if the changes included all EMS equipment, sensors, wiring, programming, and user interfaces; 20% if new sensors only; or 90% for replaced thermostats.

  Ex.: [100]

  In the example, System #2 has original electronic thermostats.

Miscellaneous Equipment

There are many miscellaneous and accessory-type items for HVAC systems. The pull-down menu lists significant items. Use the cursor plus the Control key to select the miscellaneous equipment that is part of this particular system. If you have no accessory items, select "*N/A - No Miscellaneous Equipment*" (default).

This information pertains to miscellaneous or accessory equipment currently in place. These are required inputs (the miscellaneous equipment data cannot be saved until the inputs are provided).

Our example uses exhaust fans, humidifiers, and outdoor air preheat for System #1. System #2 has no miscellaneous or accessory items.

"*Click here for descriptions*" provides abbreviations, the full titles, and brief descriptions of the equipment types.

Ex.: [EF, HUM and OAPREH]

HVAC Construction Costs

Gathering data on HVAC system construction costs (and maintenance costs) is the principal purpose of this survey. For your convenience, you may enter your construction cost data either as total costs on the **Total HVAC Construction Costs** screen or as itemized costs on the **Itemized HVAC Construction Costs** screen. Both screens ask for feasibility and survey costs, design costs, HVAC construction costs, and contractor mark-up. The **Itemized Construction Costs** screen breaks the HVAC construction costs into areas such as site work, demolition and removal, mechanical, HVAC controls, testing and balancing (TAB), electrical, and construction management.

Do your best to determine the breakdown of these costs for the system and its portion of the dedicated cooling and heating plants. This exercise may require some engineering judgment on your part. Total costs should include labor, material and equipment, taxes, and contractor mark-up. Use the Deviations/Exceptions text box to explain data that does not fit the survey. If you do not have construction cost data to share, please select "*No Construction Data to Share*."

A reply of "*No Construction Data to Share*" or data input on either the **Total HVAC Construction Costs** screen or **Itemized HVAC Construction Costs** screen is required for each system.

The sample inputs below reflect a System #1 retrofit consisting of a new distribution system (GHPs), ground-coupled heat exchanger, new control system (DDC), exhaust fans, humidification and outside air preheat equipment. The total project cost for System #1 is $1,440,000, based on the engineer's estimate.

In the example, System #2 (gymnasium heating and ventilating) was part of the original building. No information was available to sufficiently separate its cost from the whole building cost. Therefore, we would select *"No Construction Data to Share."*

Total HVAC Construction Costs ($US)

- No Construction Data to Share — If you have no data, select this input to help us with the QA procedure. If you find later that you do have data, you can still enter and save it at that time.

If *"No Construction Data to Share"* is not selected, the following input will be required before this screen can be saved.

- Project Scope (select all that apply)
  The construction costs will reflect costs associated with these items:
  - System
  - Cooling Plant
  - Support Cooling Plant
  - Heating Plant
  - Controls
  - Miscellaneous Equipment

  Ex.: [system, cooling plant, heating plant, controls, miscellaneous equipment]

- Project Description: Describe the project (100 words or less) — Indicate, for example, whether system improvements include the entire air handling unit or just the coil, whether cooling plant improvements include new pumps and variable speed drives, whether the control system has been upgraded to an EMS system from standard thermostats, and so on.

  Ex.: [All existing multizone air handling units, chiller, cooling tower and boiler were removed. Associated pumps and piping were also removed. Ductwork runs will be reused as possible. Recreation field was used for heat exchanger field. Forty new water-to-air GHPs, two variable speed pumps, and associated piping was installed. Direct Digital Control System with Energy Management features was also installed. GHP System was commissioned and turned over to the school system on July, 1995.]

- Cost data source — Select one to qualify the source of your cost data.

  - Preliminary Estimate — Typically determined in 2 to 3 hours, based on previous experiences with similar types of facilities and systems; requires economy-of-scale adjustments.
  - Square Foot (SF) Estimate — Represents a slight improvement in accuracy over preliminary estimates because additional variables such as floor area, specific building type, and common additives are involved.
  - Conceptual Estimate — Also called an intermediate estimate; may be performed using designs that are 10–60% complete; is adjusted to reflect local labor costs.
  - Engineer's Estimate — Used on government projects to establish budgets for appropriations requests and evaluate contractor bids; may be based on line item estimates. Generally, an engineer's estimate falls between 5% and 15% of low bids.
  - Contractor's Bid – Considered the most accurate estimate of construction costs as it is based on local labor rates, construction methods, and material costs. Contractor bids may also contain line item details and are generally within 8–16% of final invoiced costs.
  - Final Invoice —True cost, including any and all change orders
  - Feasibility Study —Preliminary estimate used to evaluate proposed changes, to determine if a project is warranted to continue development.
  - Other — [Space is given to describe data sources not named above]
    Ex.: [Engineer's Estimate]

- Provide the following data ($US), doing your best to break out costs into the given categories if costs are combined in your records.
  Describe any deviations below.
  - Feasibility and survey costs ($US) -Include soil conductivity tests, test bores, etc.
    Ex.: [225000]

- Design costs ($US).
  Ex.: [90000]

- HVAC installation costs ($US).
  Ex.: [1125000]

➢ Costs included in HVAC installation (includes material, equipment and labor) — Select all that apply
  - ❍ site work
  - ❍ mechanical
  - ❍ electrical
  - ❍ demolition and removal
  - ❍ controls
  - ❍ construction management
  - ❍ commissioning

  Ex.: [all of the above]

➢ Total HVAC Construction Costs ($US)— This number is automatically calculated for you based on the above inputs.
  Ex.: [1440000]

➢ Contractor markup (%, included in total construction project costs) — "surcharge" added to itemized costs to cover contractor's overhead and profit
  Ex.: [20]

➢ Labor source — Select one
  - ❍ union
  - ❍ open shop

  Ex.: [Union]

➢ Deviations/Exceptions — Discuss any inputs which deviate from or do not follow the survey format. Explain as necessary. (100 words)
  Ex.: [Contractor's markup is estimated.]

<u>Itemized HVAC Construction Costs ($US)</u>

If you can provide itemized rather than total construction costs, use this input screen instead of **Total Construction Costs**.

The sample inputs below reflect the System #1 retrofit, which consists of a new distribution system (GHPs), a ground-coupled heat exchanger, a new control system (DDC), exhaust fans, and humidification and outside air preheat equipment. The total project cost is $1,196,000 based on the contractor bid package. System #2 (gymnasium heating and ventilating) was part of the original building. No information was available to sufficiently separate its cost from the whole building cost. Therefore, *"No Construction Data to Share"* would be selected.

Note that the Itemized Construction Cost example is different from the previous Total Construction Cost example. It is only necessary to provide data for one or the other, not both. The example shows both data screens for Construction Costs as a reference only.

➢ No Construction Data to Share — If you have no data, select this input to help us with the QA procedure. If you find later that you do have data, you can still enter and save it at that time.

If *"No Construction Data to Share"* is not selected, the following input will be required before this screen can be saved.

- Project Scope (select all that apply)
  The construction costs will reflect costs associated with these items.
  - System
  - Cooling Plant
  - Support Cooling Plant
  - Heating Plant
  - Controls
  - Miscellaneous Equipment
    Ex.: [system, cooling plant, heating plant, controls, miscellaneous equipment]

- Project Description: Describe the project (100 words or less) — Indicate, for example, whether system improvements include the entire air handling unit or just the coil, whether cooling plant improvements include new pumps and variable speed drives, whether the control system has been upgraded to an EMS system from standard thermostats, and so on.
  Ex.: [All existing multizone air handling units, chiller, cooling tower and boiler were removed. Associated pumps and piping were also removed. Ductwork runs will be reused as possible. Recreation field was used for heat exchanger field. Forty new water-to-air GHPs, two variable speed pumps, and associated piping was installed. Direct Digital Control System with Energy Management features was also installed. GHP System was commissioned and turned over to the school system on July, 1995.]

- Cost data source — Select one to qualify the source of your cost data.

  - Preliminary Estimate — Typically determined in 2 to 3 hours, based on previous experiences with similar types of facilities and systems; requires economy-of-scale adjustments.
  - Square Foot (SF) Estimate — Represents a slight improvement in accuracy over preliminary estimates because additional variables such as floor area, specific building type, and common additives are involved.
  - Conceptual Estimate — Also called an intermediate estimate; may be performed using designs that are 10–60% complete; is adjusted to reflect local labor costs.
  - Engineer's Estimate — Used on government projects to establish budgets for appropriations requests and evaluate contractor bids; may be based on line item estimates. Generally, an engineer's estimate falls between 5% and 15% of low bids.
  - Contractor's Bid – Considered the most accurate estimate of construction costs as it is based on local labor rates, construction methods, and material costs. Contractor bids may also contain line item details and are generally within 8–16% of final invoiced costs.
  - Final Invoice —True cost, including any and all change orders
  - Feasibility Study —Preliminary estimate used to evaluate proposed changes, to determine if a project is warranted to continue development.
  - Other — [Space is given to describe data sources not named above]
    Ex.: [Contractor's Bid]

- Enter costs ($US) for the following items, doing your best to break out costs into the given categories if costs are combined in your records. CSI Divisions based on 1995 CSI Master Format. Describe any deviations below.

  - Feasibility and survey ($US) — Includes soil conductivity tests, test bores, etc.
    Ex.: [21000]

  - Design ($US).
    Ex.: [83000]

  - Site work costs (CSI Division 2) ($US) — Includes loop installation, repaving, etc.
    Ex.: [175000]

  - Demolition and removal ($US).
    Ex.: [75000]

- Mechanical (CSI Division 15 items) ($US) — Includes air handling units, heat pumps, pumps, piping, ductwork, valves, chillers, boilers, etc.
  Ex.: [560000]

- HVAC Controls (CSI Division 15900, HVAC only) ($US) — Includes energy management systems and controls, thermostats, sensors, tubing, etc.
  Ex.: [110000]

- Test and balance; commissioning (CSI 15990) ($US)
  Ex.: [25000]

- Electrical (CSI Division 16 items) ($US) — Includes conduit, wiring, cabinets, variable speed drives, etc.
  Ex.: [95000]

- Construction management ($US)
  Ex.: [52000]

➢ Total HVAC Construction Costs ($US) — This number is automatically calculated for you based on the above inputs.
  Ex.: [1196000]

➢ Contractor markup included in these costs (%) — "surcharge" added to itemized costs to cover contractor's overhead and profit
  Ex.: [20]

➢ Deviations/Exceptions — Discuss any inputs which deviate from or do not follow the survey format. Explain as necessary. (100 words)
  Ex.: [Contractor markup (percent) is based on percentages of labor and material costs.]

HVAC Maintenance Costs

HVAC maintenance costs are a primary focus of this survey. You may enter data on either the **Total Annual Maintenance Costs for HVAC Systems** screen or the **Itemized Annual Maintenance Costs for HVAC Systems** screen. Both screens ask for percentage breakdowns of in-house vs. contractor maintenance costs and planned vs unplanned maintenance activities. The **Itemized Annual Maintenance Costs** screen also asks for labor hours and costs and material costs for both in-house and contractor maintenance activities.

Definitions of relevant maintenance activities are presented in Table 1. Capital Renewal projects, such as replacing a chiller at the end of its service life, are not considered to be maintenance activities. Including capital renewal costs will falsely inflate data on annual maintenance costs and should not be included. Maintenance activities typically do not include replacement of equipment at the end of its service life. This type of replacement is more appropriately considered as a construction project.

Do your best to determine the breakdown of these maintenance costs for your system and its dedicated cooling and heating plants. This may require some sound engineering judgment on your part. Use the Deviations/Exceptions text box to explain inputs that do not fit the survey. If you have no maintenance costs to share, select "*No Maintenance Data to Share*" on either screen.

A reply of "*No Maintenance Data to Share*" or data input on either the **Total Annual HVAC Maintenance Costs** screen or **Itemized Annual HVAC Maintenance Costs** screen is required for each system.

Table 1: Definitions of Maintenance Cost Terms	
Total Maintenance Costs	Both planned and unplanned maintenance activities
Planned Maintenance	Prudently selected activities at specified intervals before or preventing failure, including • predictive activities (inspections/testing to determine corrective action), • preventive activities (tasks to ensure proper operation, durability, reliability, efficiency and/or safety), • corrective maintenance (remedial action, typically occurs during a shutdown, and • service (tasks typically based on manufacturer's recommendation, just short of repair).
Unplanned Maintenance	Activities that occur after failure, including • repair (to restore to good or sound condition without embellishment).

Total Annual Maintenance Costs for HVAC Systems ($US)

The sample inputs below represent repair and service performed by in-house staff for $2,000 each year; and preventive and corrective maintenance performed by contractor services for $4,500 annually. No sales tax is charged to the school system. All fringe benefits are included in labor costs. The data is based on the school system budget. The school budget does not specify the breakdown by equipment type; thus, the values reported below are estimated for the GHP systems.

In the example, System #2 maintenance (gymnasium heating and ventilating) was estimated from the budget at $1,400. Approximately $400 (30% of the budget amount) is allocated for in-house maintenance, with the breakdown of 30% for planned maintenance and 70% for unplanned maintenance. Approximately $1,000 (70% of budget amount) is allocated for contracted services with all costs contributing to planned maintenance.

Note that the Total Maintenance Cost is different from the following Itemized Maintenance Cost example. It is necessary to provide data only for one or the other, not both. The example shows both data screens for Maintenance Costs as a reference only.

- No Maintenance Data to Share — If you have no data, select this input to help us with the QA procedure. If you find later that you do have data, you can still enter and save it then.

If “No Maintenance Data to Share” is not selected, the following input will be required before this screen can be saved.

- Scope of maintenance activities (total system and dedicated portion of cooling/heating plants) — Describe type of maintenance, work performed, equipment affected, and frequency of activity
  Ex.: [Preventive Maintenance: GHP filters are replaced monthly. Motors on fans and pumps are lubricated every three months. Corrective Maintenance: Coils are cleaned during summer season. Repairs: as needed, typically expansion valve replacement. Service: Clean coils, check belt tension, and check compressor.]

- Dates covered by maintenance cost data (FY yyyy or CY yyyy)
  Ex.: [FY 1999]

- Total annual (planned and unplanned) maintenance costs per system ($US) — Include all labor, materials, supplies, parts, equipment, taxes, and markups
  Ex.: [6500]

- Source of cost data (if multiple sources apply, choose the most prominent) — Select one to identify the source of your cost data.
  - ❍ work order database
  - ❍ maintenance contract
  - ❍ budget
  - ❍ commercial estimating guides
  - ❍ previous ASHRAE data
  - ❍ specialized task studies/in-house experience
  - ❍ consulting estimate
  - ❍ other — [Space is given to describe data sources not named above]
    Ex.: [budget]

- Indicate whether or not the following expenses are included in total costs:
  If these items are not applicable (i.e., no contract labor employed), just indicate "No."

  - In-house labor (including base rate, fringe benefits, WC, fixed OH)
    - ❍ yes
    - ❍ no
      Ex.: [yes]

  - Contract labor (including base rate, fringe benefits, WC, fixed OH, operating OH, profit)
    - ❍ yes
    - ❍ no
      Ex.: [yes]

  - Materials, supplies, and parts
    - ❍ yes
    - ❍ no
      Ex.: [yes]

  - Sales tax on materials, supplies, and parts
    - ❍ yes
    - ❍ no
      Ex.: [no]

  - Equipment
    - ❍ yes
    - ❍ no
      Ex.: [no]

  - Sales tax on equipment
    - ❍ yes
    - ❍ no
      Ex.: [no]

- <u>Maintenance Activities Performed by In-House Employees</u>

  - In-house labor source — Select one
    An entry in this field is required. If you do not have in-house maintenance labor, select either option and enter a zero for total cost of maintenance performed by in-house employees.
    - ❍ union
    - ❍ open shop
      Ex.: [union]

- Percentage of total maintenance performed by in-house employees (%) — The value entered here plus the percentage of maintenance performed by contract employees (below) must equal 100%.
  Ex.: [30]

- Percentage of in-house activities dedicated to planned maintenance actions (%) — The value entered here plus the percentage of in-house activities dedicated to *unplanned* maintenance actions (below) must equal 100%.
  Ex.: [70]

- Percentage of in-house activities dedicated to unplanned maintenance actions (%) — Unplanned and planned in-house maintenance must total 100%.
  Ex.: [30]

➢ Contracted Maintenance Activities

- Contracted labor source— Select one
  - union
  - open shop
  Ex.: [union]

- Percentage of total maintenance performed by contract labor (%) — The value entered here plus the *Percentage of total maintenance performed by in-house employees* (above) must equal 100%.
  Ex.: [70]

- Percentage of contracted activities dedicated to planned maintenance actions (%) — The value entered here plus the *Percentage of contracted activities dedicated to unplanned maintenance actions* (below) must equal 100%.
  Ex.: [100]

- Percentage of contracted activities dedicated to unplanned maintenance actions (%) — Unplanned and planned contracted maintenance must total 100%.
  Ex.: [0]

➢ Deviations/Exceptions (text box) — Discuss any inputs which deviate or do not follow the survey format. Explain as necessary.
  Ex.: [HVAC maintenance costs for GHP systems (only) are estimated from the total school budget for all maintenance activities. The percentage of planned vs. unplanned maintenance costs was also an estimate.]

Itemized Annual Maintenance Costs for HVAC Systems ($US)

If you can provide more details on maintenance costs, use this input screen instead of **Total Maintenance Costs**.

The sample inputs below represent in-house and contracted services maintenance activities. The in-house staff are employed for repair and service activities. Repair and service activities for GHP systems in 1998 consumed 50 hours at a cost of $1,300 for labor and $350 for supplies. This data is based on an actual work order database. Preventive and corrective maintenance is performed by contractor services. The contractor estimated approximately 70 hours per year at an estimated cost of $4,000 ($2,300 for labor and $1,700 for supplies). No sales tax is charged to the school system. All fringe benefits are included in labor costs.

In the example, System #2 (gymnasium heating and ventilating) maintenance costs are also based on the work order database. In-house activities cost $385 ($260 labor for 10 hours and $125 materials). Repairs are 20% of the costs and service activities are 80% of the costs. Contracted activities are estimated as a portion of the total contract at $1,335 (20 hours, $650 labor and $300 materials). Contracted work is 60% preventive and 40% corrective maintenance.

Note that the Itemized Maintenance Cost example is different from the Total Maintenance Cost example. It is necessary to provide data only for one or the other, not both. Examples of both data screens for Maintenance Costs are given for reference only.

- No Maintenance Data to Share —If you have no data, selecting this input will help us with the QA procedure. If you find later that you do have data, you can still enter and save it then.

If “No Maintenance Data to Share” is not selected, the following input will be required before this screen can be saved.

- Scope of maintenance activities (total system and dedicated portion of cooling/heating plants) — Describe type of maintenance, work performed, equipment affected, and frequency of activity.
  Ex.: [Preventive Maintenance: GHP filters are replaced monthly. Motors on fans and pumps are lubricated every three months. Corrective Maintenance: Coils are cleaned during summer season. Repairs: as needed, typically expansion valve replacement. Service: Clean coils, check belt tension, and check compressor.]

- Dates covered by maintenance cost data (FY yyyy or CY yyyy)
  Ex.: [FY 1999]

- Source of cost data (if multiple sources apply, choose the most prominent) — Select one to qualify the source of your cost data.
  - ❍ work order database
  - ❍ maintenance contract
  - ❍ budget
  - ❍ commercial estimating guides
  - ❍ previous ASHRAE data
  - ❍ specialized task studies/in-house experience
  - ❍ consulting estimate
  - ❍ other — [Space is given to describe data sources not named above]
    Ex.: [work order database]

- Indicate whether or not the following expenses are included in total costs:
  If these items are not applicable (i.e., no contract labor), indicate "No."

  - In-house labor (including base rate, fringe benefits, WC, fixed OH)
    - ❍ yes
    - ❍ no
    Ex.: [yes]

  - Contract labor (including base rate, fringe benefits, WC, fixed OH, operating OH, profit)
    - ❍ yes
    - ❍ no
    Ex.: [yes]

  - Sales tax on materials, supplies and parts
    - ❍ yes
    - ❍ no
    Ex.: [no]

- Sales tax on equipment
  - ❍ yes
  - ❍ no

    Ex.: [no]

➢ <u>In-House Maintenance Activities (for planned and unplanned actions)</u>

- In-house labor source — Select one
  An entry in this field is required. If you have no in-house maintenance labor, select either option and enter a zero for in-house labor hours.
  - ❍ union
  - ❍ open shop

    Ex.: [union]

- Annual in-house labor hours (person-hours/year) — If no in-house labor is employed, enter a zero and skip to Contracted Maintenance Activities.

  Ex.: [50]

- Annual in-house labor cost ($US/year)

  Ex.: [1300]

- Annual materials, supplies, parts, and equipment costs ($US/year)

  Ex.: [350]

- Annual total in-house maintenance costs ($US/year) — Calculated from labor costs and materials, supplies, parts and equipment costs

  Ex.: [1650]

- Breakdown of in-house maintenance activities/costs — Percentages must total 100%. What percentage of in-house maintenance costs went towards
  - predictive maintenance activities ? **Ex.: [0]**
  - preventive maintenance activities ? **Ex.: [0]**
  - corrective maintenance activities ? **Ex.: [0]**
  - service actions ? **Ex.: [75]**
  - repair actions ? **Ex.: [25]**

➢ <u>Contracted Maintenance Activities (for planned and unplanned actions)</u>

- Contracted labor source
  - ❍ union
  - ❍ open shop

    Ex.: [union]

- Annual contracted labor hours (person-hours/year) — If no contract labor is employed, enter a zero and skip to Contracted Maintenance Activities.

  Ex.: [70]

- Annual total contracted maintenance costs ($US/year) — Include all labor, materials, supplies, parts and equipment covered in the contract.

  Ex.: [4000]

- Breakdown of contract maintenance activities/costs — Percentages must total 100%. What percentage of contract maintenance costs went towards
  - predictive maintenance activities ? **Ex.: [0]**
  - preventive maintenance activities ? **Ex.: [75]**
  - corrective maintenance activities ? **Ex.: [25]**
  - service actions ? **Ex.: [0]**
  - repair actions ? **Ex.: [0]**

- Deviations/Exceptions (text box) — Discuss any inputs which deviate from or do not follow the survey format. Explain as necessary.

  Ex.: [Database detail was sufficient to select only System #1 GHP systems' repair and service. Repair activities are usually minor (expansion valve). Contract did not specify between System #1 (GHPs) and #2 (H&V), so contracted activities are estimated (70 hrs for GHPs, 20 hrs for H&V). Percentage of preventive and corrective maintenance is also estimated as the contract did not specify individual costs for those activities.]

V. Queries

The log-on screen has links to the construction cost and maintenance cost query screens.

The “canned” queries built into the database will provide a snapshot of information based on your filter selections. You may select the system type, cooling plant type and/or heating plant type to run a query. A screen of prescribed information will show based on your selections. Only certain database fields will be shown on the query results screen.

If you wish to see the entire database select **Download Excel File** from the **Log On** screen. The complete database download will permit you to analyze the data on your own. An appendix to this User's Guide will help you decipher the database.

Be Warned! This database is quite large. The download screen will show you the Excel file name and file size. Your computer configuration may allow you to open the Excel file or save it to a disk. Please be patient.

The database will be updated periodically with new entries from other participants’ submittals. The download screen will track the latest update to the database. Check the database area often for update information.

Construction Cost and Maintenance Cost Queries

Query Selection

You may limit your query by choosing to see results for just one system type, one type of cooling plant, or one type of heating plant, or you may specify one of each. If you choose *“All System Types”* or make no choice, your results will include all records in the database in that category.

Click here for descriptions will open a box showing descriptions of the query filters (system, cooling plant, and heating plant types).

- **Navigation**

  - Query selections — Click to select an item
  - **Run Query** — After making your selection(s), click on the **Run Query** button to generate the output screen.
  - **Reset** — Clears query selection(s)
  - **Download Database** — Downloads the database in the form of an excel file.
  - After generating an output screen showing query results, use your browser's **Back** button to return to the query screen to define another query.

- **Output Screen**

An output screen is automatically generated based on your query choices. The output screen will show the fields listed below for construction and maintenance cost queries, respectively.

Output Screen Results for Construction Cost Queries

- Current Primary System
- Current System Construction (CX) Date
- Building Floor Area (sqft)
- System Floor Area (sqft)
- Current System Cooling Capacity (tons)

- Current System Heating Capacity (MMBtu/hr)
- Current Control System Type
- Current Cooling Plant Type
- Current Cooling Plant Construction (CX) Date
- Current Cooling Plant Capacity (tons)
- Current Support Cooling Plant Type
- Current Heating Plant Type
- Current Heating Plant Construction (CX) Date
- Current Heating Plant Capacity (MMBtu/hr)
- Total HVAC Installation $
- Total Installation $/Building Floor Area
- Location of Installation (state)
- Primary Building Function

Output Screen Results for Maintenance Cost Queries

- Current Primary System
- Current System Age (years)
- Building Floor Area (sqft)
- System Floor Area (sqft)
- Current Control System Type
- Current Cooling Plant Type
- Current Cooling Plant Age (years)
- Current Support Cooling Plant Type
- Current Heating Plant Type
- Current Heating Plant Age (years)
- Annual Maintenance $
- Annual $/Building Floor Area
- Annual $/System Floor Area
- Location (state)
- Primary Building Function

The maximum, minimum, and average values and the number of inputs for the output fields are shown at the bottom of the screen. Records without data entries (no value entered) are not included in calculating the minimum, maximum, and average for the field.

Printing Your Queries

Select the landscape print mode when printing the output screen from your browser.

All fields included in query results may not show on your printout, depending on your computer system setup. We apologize if you cannot print all the fields.

Your browser's **Back** button will return you to the query screen to define another query.

Appendix

Pull-Down Menu Tables

Data Dictionary

Database Survey

Pull-Down Menu Tables

Contents

Table 1 System Information
Table 2 Cooling Plant
Table 3 Heating Plant
Table 4 Controls
Table 5 Miscellaneous Equipment

Table 1 System Information

Abbreviation	Equipment Title	Description
AAHP	Packaged or Split System Air-to-Air Heat Pump	Packaged or split system heat pump which utilizes refrigerant, air cooled condenser, heat exchanger coil (evaporator), indoor supply fan. Air is the heat source/sink.
BBH	Baseboard/Finned Tube Radiation	A heating coil of hot water, steam, or electric resistance coil without a supply fan. No outside air is introduced. Thermostats cycle fan on/off to control space temperature (heating only).
CONHP	Console Water-to-Air Heat Pump	Heat pump which may use a chiller/condenser; or for geothermal systems, the ground (boreholes), water wells or surface water; as a heat exchanger to heat/cool air. CONGHPs are console type units and do not have ductwork.
DDS	Dual Duct constant volume or variable volume air handling unit	Constant Volume: Similar to MZS, except hot and cold streams/ducts are extended to individual mixing boxes in the zones being served. Mixing occurs in the zones. Variable Volume: Same except mixing box can reduce flow in response to decreased cooling demand. Mixing occurs only after a minimum flow is reached. Minimum airflow is required, but can save total energy.
EVAPCOOL	Evaporative cooling unit	Can be stand-alone or add-on unit. Can be direct, indirect-direct, or indirect. Comfort cooling is achieved by evaporating water directly into the air by direct evaporative coolers, spray-filled and wetted surface air washers, spray coil unit and humidifiers. Indirect evaporative cooling combines the evaporative effect in a secondary air stream with a heat exchanger to produce cooling without adding moisture to the primary system. Dry bulb temperatures are reduced and relative humidity is increased.
HVSYS	Heating and Ventilating System	Typically this system consists of a fan and heating coil (hot water, steam, electric). The system can provide 100% outside air for ventilation with a range down to 0% for 100% return air circulation. This system may provide outside air conditioning to other systems.

Abbreviation	Equipment Title	Description
MZS	Multizone constant volume air handling unit	Constant flow, forced air heating and cooling to multiple, individually controlled zones from a air handling unit with heating and cooling coils (each located in a separate casing on discharge side of fan), a set of mixing damper for each zone, filters and blow-through supply fan. Preheat coil is likely. Discharge air temperature is controlled by two different temperature air streams (hot deck, cold deck) and mixed by dampers in air handling unit and ducted separately to each zone.
N/A	Current System Same as Original	Use this code to indicate the Current System is the same as the Original System (new construction or original building). Do not use this code if the original system is of different capacity than the current system.
PIU	Powered Induction Unit	Central air handling unit with cooling and optional heating coils with draw-through type fan. Return fan is typically used. Power induction boxes are in series or parallel. Similar to VAV terminal box. Induction air is pulled from ceiling plenum.
PMZS	Packaged multi zone DX unit	Multizone constant volume forced air system with one or more compressors, air-cooled condensers with fans, evaporators, with blow-through supply fan heating devices and filters. May also have outside ventilation air, economizer cooling. Thermostats for each zone may have night setback and cycle control. Units may be roof-top mounted or split system.
PSZ	Packaged single zone variable temperature DX unit	Usually considered a commercial unit, in its most simplest form, consists of a compressor, air-cooled condenser, evaporator with supply fan, and filters. These forced air packages may be unitary (rooftop) or split system. DX coils are used with optional heat from gas, hot water, or electric resistance heater. Constant Volume to main area, Constant or variable volume to subzones. Reheat is available for subzones. Thermostat may use night setback or cycle control.
PTAC	Packaged terminal air conditioner/heat pump	Commercial units to provide total heating and cooling to room or zone. Typically thru-the-wall type units without ductwork. DX cooling and electric heat units as well as air-to-air heat pumps are typical. Thermostats may use night setback.

Table 1
System Information - 2

Abbreviation	Equipment Title	Description
PTGSD	Packaged total gas solid desiccant	A small (5-10 ton) packaged unit with a desiccant wheel with direct and indirect evaporative cooling instead of DX coils. It uses gas-fired hydronic heater to regenerate the desiccant and to provide heating. Unit will have supply and return fans (variable speed), desiccant wheel, indirect evaporative cooler, heat coil, direct evaporative cooler and a reactivation air heater coil. Thermostats control the air temperature by a variable air volume system.
PVAVS	Packaged variable volume DX unit	Consists of a compressor, air-cooled condenser with fan, evaporator with supply fan, reheat coils, filters, and VAV control boxes. DX cooling and heat from gas/oil, hot water or electricity will serve the heating coil. Each zone thermostat may have night setback and cycle control. Constant temperature for cooling, variable cooling airflow to meet demand. Heating will utilize minimum airflow and adjust supply temperature.
PVVT	Packaged variable volume, variable temperature unit	Similar to PSZ system, supplies mixed air even when no heating or cooling is needed, but fan may also cycle. Basically a single zone system, sub zones may utilize VAV boxes and control the space condition, but must be in same(heating or cooling) mode as the zone. Typically has a variable speed compressor and variable volume fan. PVVT has a constant outside air volume. Thermostats control the zone and subzones.
RADCLG	Radiant Ceiling Heaters	Electric, oil- or gas-fired. Vented and Unvented. Low-, Medium- and High-Intensity systems temperatures range from 300F to 5000F. Mostly used in large areas (warehouses) and open areas. Infrared warms objects, not air, and warm objects release heat to environment and creates convection. Typically suspended from ceilings.
RADPNL	Radiant Panel Heating	Panels in ceiling, walls or floors circulate water, air or electric current through a circuit embedded in the panel. Panels may supplement another type of heating/cooling system. Panels control the surface temperature within the occupied space, utilizing radiant heat transfer. No air is heated directly, but room surface temperature increases.

Table 1

Abbreviation	Equipment Title	Description
RESVVT	Residential variable volume, variable temperature unit	A forced air residential system with multiple, individually ducted and thermostatically controlled zones. Central heating and cooling are available from a high efficiency variable speed heat pump. Thermostats control motor-driven zone dampers. Dampers may close completely permitting no airflow to zone. Simultaneous heating and cooling is possible. The electronically controlled compressor and supply fan allow heat pump to adjust the cfm and compressor rpm to meet total heating or cooling load.
RESYS	Residential furnace and packaged condensing unit/heat pump	Typically a split system with direct expansion air cooled condensing unit. Can consider a cooling-only condensing unit with a heating coil or a cooling/heating heat pump condensing unit. DX cooling with heating coil provides heating through hot water coil, electric heater , gas/oil furnace; cooling from DX coil and utilizes a supply fan. Heat Pump options consists of a compressor, 4-way valving for reversing refrigerant for heat pump cycles, air cooled condenser with fan, evaporator with fan, filters and thermostat.
RHFS	Reheat constant volume air handling unit	Constant volume, forced-flow heating and cooling to a number of individually controlled zones from an air handling unit with heating coil, cooling coil, filters and a draw-through supply fan. Reheat coil is installed in the supply air distribution duct serving each zone. Space temperature is controlled by throttling heating fluid to reheat coils.
SELFAC	Self-contained Indoor Units	Dedicated PSZ units typical for computer rooms or other special purpose.
SZRH	Variable temperature, constant volume air handling unit	Constant volume, forced air heating and cooling for a single zone from an air handling unit with heating coil, cooling coil, filters and supply fan. Discharge air temperature is controlled by a thermostat to maintain space conditions. Usually a small system. May provide outside air ventilation or recirculate conditioned air.
TFPIND	Two- or four-pipe induction unit (also ceiling unit)	Central air handling unit with cooling and optional heating coils with draw-through type fan. Return fan is typically used. Power induction boxes are in series or parallel. Similar to VAV terminal box. Induction air is pulled from ceiling plenum. Cooling and Heating coils are serviced by TFPIPE system

Table 1

Abbreviation	Equipment Title	Description
TFPIPE	Two- or four-pipe fan coil	Provides heating and cooling to individually controlled zones. Two pipe systems must be operating in the same mode (all heat, all cool). Four pipe systems can heat or cools as needed as each coil has separate piping system. TFPIPE consists of a heating/cooling coil (2 pipes) or separate heating and cooling coils (4 pipes), filter and fan. Pipes are connect to hot or cold water, depending upon the mode. Unit provides fixed outside air ventilation or recirculates conditioned air. Temperature is controlled by throttling water flow through coil(s). Thermostats usually have separate heating and cooling setpoints.
UHT	Unit heater	A heating coil of hot water, steam, or electric resistance coil with a supply fan. No outside air is introduced. Thermostats cycle fan on/off to control space temperature (heating only).
UVT	Unit ventilator	Similar to UHT, a heating coil of hot water, steam, or electric resistance coil with a supply fan. A fixed amount of outside air is available for heating and a variable amount from damper operation is available for cooling. Thermostats cycle fan on/off to control space temperature.
VAV	Variable volume air handling unit	Central air handling unit with cooling coils, heating coils, filters and draw-through fan. Duct system distributes supply air to VAV terminal units in each zone served. VAV boxes are controlled by thermostats to vary amount of primary air to space to control temperature. As cooling demand diminishes, so does airflow, to a minimum setting. Reheat coil is activated as necessary with minimum airflow setting.
WAC	Window Air Conditioners	Simple window air conditioner
WAHP	Water-to-Air Heat Pump - geothermal application	Heat pump which may use a chiller/condenser; or for geothermal systems, the ground (boreholes), water wells or surface water; as the heat source/sink (exchanger) to heat/cool air. WAGHPs usually have ductwork. An indirect heat exchanger may exist between the source loop and the heating/cooling loop to prevent contamination.
WWHP	Water-to-Water Heat Pump - geothermal application	Heat pump which may use a condenser/evaporator; or for geothermal systems, the ground (boreholes), water wells or surface water; as a heat exchanger to heat/cool water for HVAC, domestic or process water. An indirect heat exchanger may exist between the source loop and the heating/cooling loop to prevent contamination.

Table 1

Table 2 Cooling Plant Information

Abbreviation	Equipment Title	Description
ABSORB1	One-stage absorption chiller	One-stage absorption chiller supplied by 12-lb steam or 240F water; usually requires steam or HW boiler and cooling tower. This water-chilling device uses water as the refrigerant and a salt solution (i.e. lithium bromide) as an absorbent.
ABSORB2	Two stage absorption chiller	Two-stage absorption chiller supplied by 125-lb steam or 400F water; usually requires steam or HW boiler and cooling tower. This water-chilling device uses water as the refrigerant and a salt solution (i.e. lithium bromide) as an absorbent.
ABSORBG	Absorption chiller with HWG - gas fired	Direct gas-fired absorption chiller can also operate as a hot water generator. Also uses cooling tower, chilled water pump, condenser water pump and hot water pump. This water-chilling device uses water as the refrigerant and a salt solution (i.e. lithium bromide) as an absorbent.
ACC	Air Cooled Condenser	Dissipates heat from refrigeration circuit directly to the air. The refrigerant gas is condensed by air passed over the condensing coils by fans.
CCCOOL	Closed Circuit Cooler	An evaporative cooler is used to supplement heat rejection for heat pump units (or coils) which have a majority of cooling mode.
CENTCLS	Hermetic centrifugal compression chiller	Hermetic centrifugal chiller also uses a cooling tower, condenser water pump and chilled water pump.
CENTOPN	Open centrifugal compression chiller	Open centrifugal chiller also uses a cooling tower, condenser water pump and chilled water pump.
CT	Cooling tower	Dissipates heat from water cooled refrigeration, or air conditioning. Water to be cooled is distributed in the tower by spray nozzles, bars or fills, which exposes the water surface area to atmospheric air. This air is circulated by fans, convective currents, natural wind, or induction effect from sprays. It is used with water cooled chillers or water source heat pumps.

Abbreviation	Equipment Title	Description
DBUN	Double bundle chiller	Centrifugal type chiller with two condenser tube bundles, on piped to the cooling tower, and the other to the building hot water heating circuit. Unit can operate as a chiller (if no heat is needed) or a heat pump to reject heat to the heating circuit, supplemented by a hot water boiler.
DISC	District Cooling	Utilizes chilled water from a central plant/source. This service is supplied much like electricity (billed, no maintenance needed).
ENG	Gas engine driven reciprocating chiller	Typically a nominal 150 ton twin screw (or centrifugal or reciprocating) compressor chiller driven by a modified diesel engine. Engine speed is modulated to meet building load. Heat from engine can supplement space heating loads or domestic hot water. Typically uses a cooling tower, but can be air-cooled.
EVAPCOND	Evaporative Condenser	Reject heat from a condensing vapor into the environment. Similar to a cooling tower, hot high pressure vapor from a compressor circulates through a condensing coil which is continually wetted on the outside by a recirculating water system. Some water will evaporate, removing heat from the coil, thereby cooling and condensing the vapor.
GCHP w/HORIZ	Horizontal (trench) Ground Heat Exchanger	Utilizes trench loop installation.
GCHP w/SLINKY	Horizontal Ground Heat Exchanger	Utilizes slinky coil loop installation.
GCHP w/VBORE	Vertical Bore Heat Exchanger	Utilizes deep wells (~200 ft), ~6 inch diameter. Wells are filled with grout or other fill. Loop system utilizes U-tubes and header system.
GWHP-AQ	Ground Water Heat Exchanger - Aquifers	Utilizes aquifers
GWHP-SC	Ground Water Heat Exchanger -Standing Column Well	Utilizes wells filled with water.
N/A	No Support Cooling Plant	No support cooling plant for this system.

Table 2
Cooling Plant Information - 2

Abbreviation	Equipment Title	Description
N/A	Current Cooling Plant Same as Original	Use this code to indicate the Current Cooling Plant is the same as the Original Plant (new construction or original building). Do not use this code if the original plant is of different capacity than the current plant.
NONE	No Cooling Plant	No chilled water is circulated for cooling. Use this for Packaged or DX Systems.
Not/Appl	Current Support Cooling Plant Same as Original	Use this code to indicate the Current Support Cooling Plant is the same as the Original Plant (new construction or original building). Do not use this code if the original plant is of different capacity than the current plant.
PWHX	Potable Water Heat Exchanger	Utilized once-thru heat exchange with potable (incoming fresh) water. Used water is returned to the storm sewer or sanitary sewer. May use dedicated heat exchanger to keep systems separate.
RECCLS	Hermetic reciprocating compression chiller	Hermetic reciprocating chiller with multiple compressors or unloading compressor types. Also uses a cooling tower, condenser water pump and chilled water pump. Can also use an air cooled condenser.
RECOPN	Open reciprocating compression chiller	Open reciprocating chiller with multiple compressors or unloading compressor types. Also uses a cooling tower, condenser water pump and chilled water pump. Can also use an air cooled condenser.
SCWCLS	Hermetic rotary screw compression chiller	Hermetic rotary screw chiller. The cooler may be flooded or direct expansion. Requires cooling tower, air cooled, or evaporative condenser for heat rejection.
SCWOPN	Open rotary screw compression chiller	Open rotary screw chiller. The cooler may be flooded or direct expansion. Requires cooling tower, air cooled, or evaporative condenser for heat rejection.
SWHP-CL	Surface Water Heat Exchanger - Closed Loop	Utilizes ponds or lakes with still or moving water. Surface water is enclosed in a dedicated HX loop. Heat exchangers may be used.
SWHP-OL	Surface Water Heat Exchanger - Open Loop	Utilizes ponds or lakes with still or moving water. Surface water runs directly to the GHPs.
WCC	Water Cooled Condenser	Dissipates heat from refrigeration circuit to water in a shell and tube heat exchanger. This water may be wasted, or recirculated to the condenser.

Table 2
Cooling Plant Information - 3

Abbreviation	Equipment Title	Description
WWHX	Waste Water Heat Exchanger	Utilizes water from a waste stream (sanitary sewer - outgoing water). May use a dedicated heat exchanger to keep systems separate.

Table 2
Cooling Plant Information - 4

Table 3 Heating Plant Information

Abbreviation	Equipment Title	Description
DISHW	District Heating	Utilizes hot water from a central plant/source. This service is supplied much like electricity (billed, no maintenance needed).
DISSTM	District Heating	Utilizes steam from a central plant/source. This service is supplied much like electricity (billed, no maintenance needed).
ELEC HW BOILER	Electric hot water boiler	A multi-stage electric resistance HW generator
ELEC STM BOILER	Electric steam boiler	A multi-stage electric resistance unit
GCHP w/HORIZ	Horizontal (trench) Ground Heat Exchanger	Utilizes trench loop installation.
GCHP w/SLINKY	Horizontal Ground Heat Exchanger	Utilizes slinky coil loop installation.
GCHP w/VBORE	Vertical Bore Heat Exchanger	Utilizes deep wells (~200 ft), ~6 inch diameter. Wells are filled with grout or other fill. Loop system utilizes U-tubes and header system.
GWHP-AQ	Ground Water Heat Exchanger - Aquifers	Utilizes aquifers
GWHP-SC	Ground Water Heat Exchanger -Standing Column Well	Utilizes wells filled with water.
HW BOILER	Hot water boiler - non-electric boiler with induced draft fan	Boiler may be gas-fired (natural, propane), oil-fired, coal-fired, or wood-fired. also called a generator.
N/A	Current Heating Plant Same as Original	Use this code to indicate the Current Heating Plant is the same as the Original Heating Plant. Do not use this code if the original plant is of different capacity than the current plant.
NONE	No Heating Plant	No Hot Water or Steam is circulated for heating. Use this for packaged DX systems.

Abbreviation	Equipment Title	Description
PWHX	Potable Water Heat Exchanger	Utilized once-thru heat exchange with potable (incoming fresh) water. Used water is returned to the storm sewer or sanitary sewer. May use dedicated heat exchanger to keep systems separate.
STM BOILER	Steam boiler - non-electric boiler with induced draft fan	Boiler may be gas-fired (natural, propane), oil-fired, coal-fired, or wood-fired. also called a generator.
SWHP-CL	Surface Water Heat Exchanger - Closed Loop	Utilizes ponds or lakes with still or moving water. Surface water is enclosed in a dedicated HX loop. Heat exchangers may be used.
SWHP-OL	Surface Water Heat Exchanger - Open Loop	Utilizes ponds or lakes with still or moving water. Surface water runs directly to the GHPs.
WWHX	Waste Water Heat Exchanger	Utilizes water from a waste stream (sanitary sewer - outgoing water). May use a dedicated heat exchanger to keep systems separate.

Table 3
Heating Plant Information - 2

Table 4 Control System Information

Abbreviation	Equipment Title	Description
AUTO	Internal Thermostat (built-in)	A built-in thermostat in basic equipment such as PTACs, Window AC units, Space Heaters, etc. These are electronic and regulate the units.
DDCB	Direct Digital Controls-Monitoring and Basic Control	Microprocessor control for a single system or one building. Basic controls (on/off operations) and parameter monitoring is typical.
DDCE	Direct Digital Controls - Monitoring with Energy Conservation Controls	Microprocessor control for a single system or one building. Parameter monitoring and energy conservation controls (temperature setback/up, optimum start-up, temperature reset...) are typical for simple DDC applications.
EL	Electronic	Electrical-actuated controls: thermostats (standard and programmable), variable speed drives,….
EMS	Energy Management System	A comprehensive control system which can control and monitor all equipment. Typical configuration for several buildings or systems to be interlocked to a central control station. Energy conservation scenarios (temperature setback/up; temperature reset, optimum startup….) are usually applied.
MAN	Manual Control	Manually controlled by user (switch).
N/A	Current Controls Same as Original	Use this code to indicate the Current Control System is the same as the Original Control System (new construction or original building).
NONE	No Controls	No Controls, Continuous Operation.
PN	Pneumatic	Compressed air-actuated controls. May include electric/pneumatic controls.
TIMER	Time Clock	Device typically used for on/off control. Uses a timer (number of hours) or time clock (specific hours of the day) for control.

Table 5 Miscellaneous Equipment Information

Abbreviation	Equipment Title	Description
COGEN	Cogeneration	Simultaneous production of electrical or mechanical energy (power) and useful thermal energy from a single energy stream (oil, coal, gas, biomass, solar). Waste heat is captured and applied for cogeneration to operate at greater efficiencies.
DEHUM	Dehumidifiers	Devices to remove excess humidity from space. Desiccants, heat pipes, …
DESUP	Desuperheaters	Devices on heat pumps to utilize the heat rejected from the compressor to assist in domestic hot water heating.
ECONA	Air-side Economizer	A device which will allow outside air to assist in mechanical cooling or heating as weather conditions permit.
ECONW	Water-side Economizer	A device which will allow low temperature cooling tower water to precool the entering air, assist mechanical cooling or provide total system cooling.
EF	Exhaust Fan	A dedicated exhaust fan to remove odors, fumes, process air or other air flow which is equal to the amount of outside air brought into the facility.
FRESHAIR	Fresh Air Units	Dedicated air handling units to supply fresh air to spaces.
HEATPIPE	Heat Pipe Heat Exchanger	Heat pipes have the appearance of an ordinary plate-finned water or steam coils except that the tubes are not interconnected and the heat exchanger is divided into evaporator and condenser sections by a partition plate. The heat pipe tubes are fabricated with an integral capillary wick structure, evacuated, filled with a suitable working fluid (typically refrigerant or water) and permanently sealed. Temperature difference drives the closed-loop evaporation/condensation cycle via vapor pressure gradient. Heat pipe heat exchanger is a passive energy recovery device for sensible heat transfer, but condensation on the fines does allow latent heat transfer.

Abbreviation	Equipment Title	Description
HEATWHL	Heat Wheel Heat Exchanger	A rotary air-to-air energy exchangers has a revolving cylinder filled with an air permeable medium having a large internal surface area. Adjacent supply and exhaust airstreams each flow through one-half the exchanger in a counter-flow pattern. Heat transfer medium may be selected to recover only sensible or total heat.
HOOD	Fume Hoods / Cabinets	A ventilated enclosed work space intended to capture, contain, and exhaust fumes, vapors, and particulate matter generated inside the enclosure.
HUM	Humidifiers	Devices to increase humidity in space.
HWHX	Hot Water Heat Exchanger	Heat exchanger to convert steam to hot water.
HWPRE	Hot Water Preheat	An energy saving method to reduced the amount of energy to heat domestic hot water.
ION	Ionizers	Charges the atmosphere with negative ions to reduce air contaminant levels and bacteria levels.
NONE	No Miscellaneous Equipment	No Miscellaneous Equipment installed.
OAPREH	Outside Air Preheat	Coils (electric, HW or steam) which preheat the outside air (typically to 55F) before it enters the air handling unit for heating.
ODOR	Odor Control	Devices to control odors in ductwork systems. Ultraviolet radiation, filtration…
PLATEHX	Fixed Plate Heat Exchanger	Heat exchanger has no moving parts. Alternate layers of plates, separated and sealed form the exhaust and supply airstream passages. Heat is transferred directly from the warm airstreams through the separating plates into the cool airstreams.

Table 5
Miscellaneous Equipment - 2

Abbreviation	Equipment Title	Description
PRECOOL	Pre-Cooling	Supply air is cooled below the desired delivery temperature to condense moisture and reduce humidity. Outdoor air passes through the heat exchanger and is pre-cooled by supply air leaving the cooling coil. Outdoor air is further cooled and dehumidified in the cooling coil. It then passes through the other side of the heat exchanger, for reheating. This reduces the air-conditioning load, allowing refrigeration equipment to be downsized and eliminating reheat.
REHEAT	Reheat Coils	Reheat coils are electric, hot water or steam coils which reheat air after it has been cooled. Reheat coils can be placed in ductwork downstream of the air handling unit. Reheat coils can also be placed after a cooling coil in the air handling unit. These are typically used with a dehumidification process.
RUNLOOP	Run Around Loop Heat Exchanger	Coil energy recovery loop system places extended surface, finned tube water coils in the supply and exhaust airstreams of a building or process. The coils are connected to a closed loop via counterflow piping through an intermediate heat transfer fluid (typically water or anti-freeze solution). For sensible heat recovery only.
SMOKE	Smoke Control	Fan system used to pressurize appropriate areas (stairwells) to limit smoke movement in fire situations.
TES	Thermal Storage	Generates chilled water during off-peak hours for use during on-peak hours for energy savings.
TSIPHON	Thermosiphon Heat Exchanger	Two-phase thermosiphon heat exchangers are sealed systems, similar to heat pipes. Systems include evaporator, condenser piping and intermediate working fluid. There are not wicks and rely on gravity for return condensate and may require large temperature differences. Two types: sealed tube or coil type. Typical for solar water heating.
TWNTWR	Twin Tower Enthalpy Recovery Loop	Air-to-liquid, liquid-to-air enthalpy recovery system, a sorbent liquid (typically halogen salt solution, such as lithium chloride and water) circulates continuously between supply and exhaust airstreams, alternately contacting both airstreams directly in contactor towers. This liquid transports water vapor and heat. Pumps circulate solutions between supply and exhaust contactor towers.

Table 5
Miscellaneous Equipment - 3

Data Dictionary

Contents

Heading	Description
Name	Database download (field) heading - Placeholder names will have suffix "-sp" at end of heading and will be in blue text - Placeholder names are used for input options and relationships/consequences - Placeholders are used to keep multiple lines together during sorting/searching
Database Input Name/Description	Actual name of data found in survey
Screen	Screen where data is found
Data Type	Data type required for input
Input Options	Lists selection options - Radio button selections - Check box selections - Pull down menu selections - "Other" will reference related field in relationship/consequences column - Input Options will be in blue text
Relationships/ Consequences	Lists other fields where data is used for input - "Other" options for user descriptions - Other fields which make up particular data - Provides guidance on outcomes of certain inputs e.g. If 'None' input, then another input is not required

Data Dictionary

The following 'data dictionary' will provide the field headings listed in alphabetical order. The field headings and/or inputs may not be fully seen on the spreadsheet without expanding the cell width. The data dictionary will correlate the heading to the database input, the screen it is found on, type of input required, typical inputs (radio buttons, check boxes, pull-down menus) and related fields with consequences to inputs.

Typical input types:

- Text fields contain data from the pull-down menus, radio buttons, and user inputs.
- Pull-down Menu Tables found in this Appendix show the abbreviated title, full title and the description of the equipment. Only the abbreviated title will show in the database download.
- Memo fields are large text fields from descriptions, exceptions, etc.
- Numeric fields may be integers (long) or decimals (double), dependent on the requested input.
- Date fields use the mm/dd/yyyy convention (Date/Time).
- True/false fields are equivalent to yes/no, respectively. These are used for check boxes to indicate selected (true/yes) or not selected (false/no).
- Blank fields are typically fields which are not required based on another input (e.g. no cooling plant will have a blank capacity value). Zeros may also be shown here. The relationship/consequences heading in the data dictionary will describe these interactions and the other fields affected by certain inputs.

Data Dictionary

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
bldg_area_cooled_pcnt	Percentage of floor area cooled (%)	Building Information	Number (Long)		
bldg_area_heated_pcnt	Percentage of floor area heated (%)	Building Information	Number (Long)		
bldg_area_sqft	Gross floor area (square	Building Information	Number (Long)		
bldg_construct_dt	Original Construction date or date first occupied	Building Information	Date/Time		
bldg_function	Dominant function of building	Building Information	Text	select one school (primary/secondary) school (post-secondary) laboratory medical office small commercial (<10,000 sf) large commercial (>10,000 sf) manufacturing retail residential: single-family residential: multi-family dormitory/barracks lodging other	bldg_function_other bldg_function_other
bldg_function_other	Dominant function of building (describe)	Building Information	Text		bldg_function
bldg_hvac_desc	Building HVAC systems overview (describe)	Building Information	Memo		
bldg_state	Location of Building (state)	Building Information	Text		
control_commission_dt	Commissioning date of current control system	Controls	Date/Time		
control_system_name	Current control system type	Controls	Text	Table 4	

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
control_system_origin_typ	Current control system	Controls	Text	select one original equipment retrofit replacement new construction	
cooling_capacity_pcnt	Percentage of current cooling plant total capacity dedicated to system (%)	Cooling Plant	Number (Long)		
cooling_capacity_tons	Current cooling plant total capacity (tons)	Cooling Plant	Number (Double)		
cooling_installation_dt	Commissioning date for current cooling plant	Cooling Plant	Date/Time		
cooling_service_area_sqft	Floor area served by current cooling plant (square feet)	Cooling Plant	Number (Long)		
cooling_system_name	Current cooling plant type	Cooling Plant	Text	Table 2	if 'None - No Cooling Plant' is selected, these inputs are not required. Capacity, area served, and percent demolished will show zero; commissioning date will be blank cooling_capacity_tons cooling_service_area_sqft cooling_capacity_pcnt cooling_installation_dt
cooling_system_origin_typ	Current cooling plant status	Cooling Plant	Text	select one original equipment retrofit replacement new construction	
gchp_backfill_concrete_fl	Backfill material- concrete	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_backfill_cuttings_fl	Backfill material- cuttings	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_backfill_gravel_fl	Backfill material- gravel	Ground-coupled Geothermal Heat Pumps	Yes/No		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
gchp_backfill_grouting_fl	Backfill material- grouting	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_borehole_trench_count	Number of boreholes or trenches (#)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_borehole_trench_length_ft	Average depth per borehole or length per trench (feet)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_borehole_trench_width_in	Diameter of boreholes or width of trenches (inches)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_casing_depth_ft	Average depth of casing remaining in soil per borehole (feet)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_casing_material	Casing material	Ground-coupled Geothermal Heat Pumps	Text	select one	gchp_casing_material_other
				steel	
				PVC	
				none	
				other	gchp_casing_material_other
gchp_casing_material_other	Casing material - other (describe)	Ground-coupled Geothermal Heat Pumps	Text		gchp_casing_material
gchp_casing_typ	Casing type	Ground-coupled Geothermal Heat Pumps	Text	select one	
				permanent	
				temporary	
				none	
gchp_circulation_pump_count	Number of circulation pumps (#)	Ground-coupled Geothermal Heat Pumps	Number (Long)		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
gchp_exchanger_configuration	Heat exchanger configuration	Ground-coupled Geothermal Heat Pumps	Text	select one horizontal trench vertical bore slinky	
gchp_exchanger_piping_length_ft	Total length of heat exchanger piping (feet)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_grouting_depth_ft	Grouting depth (feet)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_grouting_material	Grouting material	Ground-coupled Geothermal Heat Pumps	Text	select one standard thermally enhanced none	
gchp_loop_flow_rate_gpm	Loop field design flow rate (gpm)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_no_units_served	Number of GHP units served (#)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gchp_pumping_control	Pumping control	Ground-coupled Geothermal Heat Pumps	Text	select one fixed speed variable speed	
gchp_soil_clay_fl	Soil conditions- clay	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_soil_hard_rock_fl	Soil conditions- hard rock	Ground-coupled Geothermal Heat Pumps	Yes/No		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
gchp_soil_med_rock_fl	Soil conditions- medium rock	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_soil_sand_fl	Soil conditions- sand	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_soil_soft_rock_fl	Soil conditions- soft rock	Ground-coupled Geothermal Heat Pumps	Yes/No		
gchp_total_pumping_capacity_hp	Total pumping capacity (hp)	Ground-coupled Geothermal Heat Pumps	Number (Long)		
gwhp_circulation_flow_rate_gpm	Circulation (interior) flow rate (gpm)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_circulation_pump_count	Number of circulation (interior) pumps (#)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_circulation_pumping_control	Circulation (interior) pumping control	Groundwater Geothermal Heat Pumps	Text	select one fixed speed variable speed	
gwhp_disposal_casing_configuration	Injection well casing configuration	Groundwater Geothermal Heat Pumps	Text	select one none surface extensive	
gwhp_disposal_casing_depth_ft	Average depth of injection casing remaining in soil per injection well (feet)	Groundwater Geothermal Heat Pumps	Number (Long)		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
gwhp_disposal_casing_material	Injection well casing material	Groundwater Geothermal Heat Pumps	Text	select one steel PVC none other	gwhp_disposal_casing_material_other gwhp_disposal_casing_material_other
gwhp_disposal_casing_material_other	Injection well casing material-other (describe)	Groundwater Geothermal Heat Pumps	Text		gwhp_disposal_casing_material
gwhp_disposal_means	Disposal means	Groundwater Geothermal Heat Pumps	Text	select one injection well surface water standing column	
gwhp_groundwater_flow_rate_gpm	Groundwater flow rate (gpm)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_injection_well_count	Number of injection wells (#)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_no_units_served	Number of GHP units served (#)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_plate_heat_exchanger_fl	Plate heat exchanger	Groundwater Geothermal Heat Pumps	Yes/No		
gwhp_production_pump_count	Number of production pumps (#)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_production_pumping_control	Production pumping control	Groundwater Geothermal Heat Pumps	Text	select one fixed speed variable speed	

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
gwhp_supply_well_count	Number of supply wells (#)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_total_circulation_pumping_capacity_hp	Total circulation (interior) pumping capacity (hp)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_total_injection_well_depth_ft	Average depth per injection well (feet)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_total_production_pumping_capacity_hp	Total production pumping capacity (hp)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_total_supply_well_depth_ft	Average depth per supply well (feet)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_water_source	Water source	Groundwater Geothermal Heat Pumps	Text	select one	
				aquifer standing column well	
gwhp_well_casing_configuration	Supply well casing configuration	Groundwater Geothermal Heat Pumps	Text	select one	
				none surface extensive	
gwhp_well_casing_depth_ft	Average depth of supply well casing remaining in soil per supply well (feet)	Groundwater Geothermal Heat Pumps	Number (Long)		
gwhp_well_casing_material	Supply well casing material	Groundwater Geothermal Heat Pumps	Text	select one	gwhp_well_casing_material_other
				steel PVC none other	 gwhp_well_casing_material_other

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
gwhp_well_casing_material_other	Supply well casing material-other (describe)	Groundwater Geothermal Heat Pumps	Text		gwhp_well_casing_material
gwhp_well_construction	Well construction	Groundwater Geothermal Heat Pumps	Text	select one open hole naturally developed gravel packed	
heating_capacity_mmbtus	Current system heating plant total capacity (MMBtu/hr)	Heating Plant	Number (Double)		
heating_capacity_pcnt	Percentage of current heating plant total capacity dedicated to system (%)	Heating Plant	Number (Long)		
heating_installation_dt	Commissioning date of current heating plant	Heating Plant	Date/Time		
heating_service_area_sqft	Floor area served by current heating plant (square feet)	Heating Plant	Number (Long)		
heating_system_name	Current heating plant type	Heating Plant	Text	Table 3	if 'None - No Heating Plant' is selected, these are not required. Capacity, area served, and percent demolished will show zero; commissioning date will be blank heating_capacity_mmbtus heating_service_area_sqft heating_capacity_pcnt heating_installation_dt
heating_system_origin_typ	Current heating plant status	Heating Plant	Text	select one original equipment retrofit replacement new construction	
install_comments	Deviations/Exceptions (describe)	Total HVAC Construction Costs	Memo		
install_contractor_markup_pcnt	Contractor markup (%, included in Total HVAC Construction Costs)	Total HVAC Construction Costs	Number (Long)		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
install_cost	HVAC installation costs ($US)	Total HVAC Construction Costs	Number (Long)		part of Total HVAC construction costs install_total_cost
install_cost_source	Cost data source	Total HVAC Construction Costs	Text	select one Preliminary estimate SF estimate Conceptual estimate Engineer's estimate Contractor's bid Final Invoices including any and all change orders Feasibility study Other	install_cost_source_other install_cost_source_other
install_cost_source_other	Cost data source- other (describe)	Total HVAC Construction Costs	Text		install_cost_source
install_engr_design_cost	Engineering design costs ($US)	Total HVAC Construction Costs	Number (Long)		part of Total HVAC construction costs install_total_cost
install_feasibility_cost	Feasibility and survey costs ($US)	Total HVAC Construction Costs	Number (Long)		part of Total HVAC construction costs install_total_cost
install_includes_commissioning_fl	Costs included in HVAC installation- commissioning	Total HVAC Construction Costs	Yes/No		
install_includes_controls_fl	Costs included in HVAC installation- control	Total HVAC Construction Costs	Yes/No		
install_includes_demolition_fl	Costs included in HVAC installation- demolition and removal	Total HVAC Construction Costs	Yes/No		
install_includes_electrical_fl	Costs included in HVAC installation- electrical	Total HVAC Construction Costs	Yes/No		
install_includes_management_fl	Costs included in HVAC installation- construction management	Total HVAC Construction Costs	Yes/No		
install_includes_mechanical_fl	Costs included in HVAC installation- mechanical	Total HVAC Construction Costs	Yes/No		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
install_includes_site_work_fl	Costs included in HVAC installation- site work	Total HVAC Construction Costs	Yes/No		
install_labor_source	Labor Source	Total HVAC Construction Costs	Text	select one union open shop	
install_scope_controls	Project Scope- controls	Total HVAC Construction Costs	Yes/No		
install_scope_cooling_plant	Project Scope- cooling plant	Total HVAC Construction Costs	Yes/No		
install_scope_heating_plant	Project Scope- heating plant	Total HVAC Construction Costs	Yes/No		
install_scope_misc_equipment	Project Scope- miscellaneous equipment	Total HVAC Construction Costs	Yes/No		
install_scope_support_cooling_plant	Project Scope- support cooling plant	Total HVAC Construction Costs	Yes/No		
install_scope_system	Project Scope- system	Total HVAC Construction Costs	Yes/No		
install_scope_txt	Describe the project scope for which costs are provided below (describe)	Total HVAC Construction Costs	Memo		If 'No Construction Data to Share' is selected, no entries on this screen will be required. All associated fields will be blank.
install_total_cost	Total HVAC construction costs ($US)	Total HVAC Construction Costs	Number (Long)		sum of Total HVAC construction costs or sum of Itemized HVAC Construction costs, respective of data input (total or itemized data). install_feasibility_cost install_engr_design_cost install_cost itemized_install_feasibility_cost itemized_install_engr_design_cost itemized_install_site_work_cost itemized_install_demolition_cost itemized_install_mechanical_cost itemized_install_controls_cost itemized_install_commissioning_cost itemized_install_electrical_cost itemized_install_management_cost

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
itemized_install_comments	Deviations/Exceptions (describe)	Itemized HVAC Construction Costs	Memo		
itemized_install_commissioning_cost	Test and balance; commissioning (CSI 15990) ($US)	Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost
itemized_install_controls_cost	HVAC Controls (CSI Division 15920, HVAC only) ($US)	Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost
itemized_install_cost_source	Cost data source	Itemized HVAC Construction Costs	Text	select one Preliminary estimate SF estimate Conceptual estimate Engineer's estimate Contractor's bid Final Invoices including any and all change orders Feasibility study Other	itemized_install_cost_source_other itemized_install_cost_source_other
itemized_install_cost_source_other	Cost data source- other (describe)	Itemized HVAC Construction Costs	Text		itemized_install_cost_source
itemized_install_demolition_cost itemized_install_demolition_cost-sp	Demolition and removal ($US) Demolition and removal	Itemized HVAC Construction Costs Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost
itemized_install_electrical_cost itemized_install_electrical_cost-sp	Electrical (CSI Division 16 items) ($US) Electrical (CSI Division 16 items)	Itemized HVAC Construction Costs Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost
itemized_install_engr_design_cost itemized_install_engr_design_cost-sp	Engineering design costs ($US) Engineering design costs	Itemized HVAC Construction Costs Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost
itemized_install_feasibility_cost itemized_install_feasibility_cost-sp	Feasibility and survey costs ($US) Feasibility and survey costs	Itemized HVAC Construction Costs Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
itemized_install_management_cost	Construction management ($US)	Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs
itemized_install_management_cost-sp	Construction management ($US)	Itemized HVAC Construction Costs			install_total_cost
itemized_install_markup_pcnt	Contractor markup included in these costs (%)	Itemized HVAC Construction Costs	Number (Long)		
itemized_install_mechanical_cost	Mechanical (CSI Division 15 items) ($US)	Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs
itemized_install_mechanical_cost-sp	Mechanical (CSI Division 15 items)	Itemized HVAC Construction Costs			install_total_cost
itemized_install_scope_controls	Project Scope- controls	Itemized HVAC Construction Costs	Yes/No		
itemized_install_scope_cooling_plant	Project Scope- cooling plant	Itemized HVAC Construction Costs	Yes/No		
itemized_install_scope_heating_plant	Project Scope- heating plant	Itemized HVAC Construction Costs	Yes/No		
itemized_install_scope_misc_equipment	Project Scope- miscellaneous equipment	Itemized HVAC Construction Costs	Yes/No		
itemized_install_scope_support_cooling_plant	Project Scope- support cooling plant	Itemized HVAC Construction Costs	Yes/No		
itemized_install_scope_system	Project Scope- system	Itemized HVAC Construction Costs	Yes/No		
itemized_install_scope_txt	Describe the project scope for which costs are provided below (describe)	Itemized HVAC Construction Costs	Memo		If 'No Construction Data to Share' is selected, no entries on this screen will be required. All associated fields will be blank.
itemized_install_site_work_cost	Site work costs (CSI Division 2 items) ($US)	Itemized HVAC Construction Costs	Number (Long)		contributes to Total HVAC Construction Costs install_total_cost
maint_annual_cost	Total annual (planned and unplanned) maintenance costs per system ($US)	Total Maintenance Costs	Number (Long)		Also represents Total (in-house + contracted) Itemized Maintenance Costs maint_in_house_total_cost maint_contract_total_cost

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
maint_comments	Deviations/Exceptions (describe)	Total Maintenance Costs	Memo		
maint_contract_corrective_pcnt	Percentage of contracted maintenance costs went towards corrective maintenance activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_contract_predictive_pcnt maint_contract_preventative_pcnt maint_contract_repair_pcnt maint_contract_service_pcnt
maint_contract_labor_fl	Contract labor (including base rate; fringe benefits; WC, fixed OH, operating OH, profit)	Total Maintenance Costs	Yes/No		
maint_contract_labor_hours	Annual contracted labor hours (person-hours/year)	Itemized Maintenance Costs	Number (Long)		
maint_contract_labor_source	Contracted labor source	Total Maintenance Costs	Text	select one union open shop	
maint_contract_pcnt	Percentage of total maintenance performed by contract labor (%)	Total Maintenance Costs	Number (Long)		Percentage with in-house maintenance must equal 100% maint_in_house_pcnt
maint_contract_planned_pcnt	Percentage of contracted activities dedicated to planned maintenance actions (%)	Total Maintenance Costs	Number (Long)		Percentage with contracted unplanned maintenance must equal 100% maint_contract_unplanned_pcnt
maint_contract_predictive_pcnt	Percentage of contracted maintenance costs went towards predictive maintenance activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_contract_corrective_pcnt maint_contract_preventative_pcnt maint_contract_repair_pcnt maint_contract_service_pcnt

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
maint_contract_preventative_pcnt	Percentage of contracted maintenance costs went towards preventive maintenance activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_contract_predictive_pcnt maint_contract_corrective_pcnt maint_contract_repair_pcnt maint_contract_service_pcnt
maint_contract_repair_pcnt	Percentage of contracted maintenance costs went towards repair actions (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_contract_predictive_pcnt maint_contract_corrective_pcnt maint_contract_preventative_pcnt maint_contract_service_pcnt
maint_contract_service_pcnt	Percentage of contracted maintenance costs went towards service activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_contract_predictive_pcnt maint_contract_corrective_pcnt maint_contract_preventative_pcnt maint_contract_repair_pcnt
maint_contract_total_cost	Annual total contracted maintenance costs ($US)	Itemized Maintenance Costs	Number (Long)		
maint_contract_unplanned_pcnt	Percentage of contracted activities dedicated to unplanned maintenance actions (%)	Total Maintenance Costs	Number (Long)		Percentage with contracted planned maintenance must equal 100% maint_contract_planned_pcnt
maint_cost_source	Source of cost data	Total Maintenance Costs	Text	select one Work order database Maintenance contract Budget Commercial estimating guides Previous ASHRAE data Specialized task studies/In-house experience Consulting estimate Other	maint_cost_source_other maint_cost_source_other

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
maint_cost_source_other	Source of cost data- other (describe)	Total Maintenance Costs	Text		maint_cost_source
maint_duration_yr	Dates covered by maintenance costs data (FY xx or CY xxxx)	Total Maintenance Costs	Text		
maint_equipment_fl	Equipment	Total Maintenance Costs	Yes/No		
maint_equipment_sales_tax_fl	Sales tax on equipment	Total Maintenance Costs	Yes/No		
maint_in_house_corrective_pcnt	Percentage of in-house maintenance costs went towards corrective maintenance activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_in_house_predictive_pcnt maint_in_house_preventative_pcnt maint_in_house_repair_pcnt maint_in_house_service_pcnt
maint_in_house_labor_cost	Annual in-house labor costs ($US/year)	Itemized Maintenance Costs	Number (Long)		Part of sum for total in-house maintenance costs maint_in_house_total_cost
maint_in_house_labor_fl	In-house labor (including base rate; fringe benefits; WC, fixed OH)	Total Maintenance Costs	Yes/No		
maint_in_house_labor_hours	Annual in-house labor hours (person-hours/year)	Itemized Maintenance Costs	Number (Long)		
maint_in_house_labor_source	In-house labor source	Total Maintenance Costs	Text	select one union open shop	
maint_in_house_material_cost	Annual materials, supplies, parts, and equipment costs ($US/year)	Itemized Maintenance Costs	Number (Long)		Part of sum for total in-house maintenance costs maint_in_house_total_cost
maint_in_house_pcnt	Percentage of total maintenance performed by in-house employees (%)	Total Maintenance Costs	Number (Long)		Percentage with contracted maintenance must equal 100%

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
					maint_contract_pcnt
maint_in_house_planned_pcnt	Percentage of in-house activities dedicated to planned maintenance actions (%)	Total Maintenance Costs	Number (Long)		Percentage with in-house unplanned maintenance must equal 100% maint_in_house_unplanned_pcnt
maint_in_house_predictive_pcnt	Percentage of in-house maintenance costs went towards predictive maintenance activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_in_house_corrective_pcnt maint_in_house_preventative_pcnt maint_in_house_repair_pcnt maint_in_house_service_pcnt
maint_in_house_preventative_pcnt	Percentage of in-house maintenance costs went towards preventive maintenance activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_in_house_predictive_pcnt maint_in_house_corrective_pcnt maint_in_house_repair_pcnt maint_in_house_service_pcnt
maint_in_house_repair_pcnt	Percentage of in-house maintenance costs went towards repair actions (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_in_house_predictive_pcnt maint_in_house_corrective_pcnt maint_in_house_preventative_pcnt maint_in_house_service_pcnt
maint_in_house_service_pcnt	Percentage of in-house maintenance costs went towards service activities (%)	Itemized Maintenance Costs	Number (Long)		All five percentages must equal 100% maint_in_house_predictive_pcnt maint_in_house_corrective_pcnt maint_in_house_preventative_pcnt maint_in_house_repair_pcnt
maint_in_house_total_cost	Annual total in-house maintenance costs ($US/year)	Itemized Maintenance Costs	Number (Long)		Sum of labor costs and materials, supplies, parts and equipment costs maint_in_house_labor_cost maint_in_house_material_cost

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
maint_in_house_unplanned_pcnt	Percentage of in-house activities dedicated to unplanned maintenance actions (%)	Total Maintenance Costs	Number (Long)		Percentage with in-house planned maintenance must equal 100% maint_in_house_planned_pcnt
maint_itemized_comments	Deviations/Exceptions (describe)	Itemized Maintenance Costs	Memo		
maint_itemized_contract_labor_fl	Contract labor (including base rate; fringe benefits; WC, fixed OH, operating OH, profit)	Itemized Maintenance Costs	Yes/No		
maint_itemized_contract_labor_source	Contracted labor source	Itemized Maintenance Costs	Text	select one union open shop	
maint_itemized_cost_source	Source of cost data	Itemized Maintenance Costs	Text	select one Work order database Maintenance contract Budget Commercial estimating guides Previous ASHRAE data Specialized task studies/In-house experience Consulting estimate Other	maint_itemized_cost_source_other maint_itemized_cost_source_other
maint_itemized_cost_source_other	Source of cost data- other (describe)	Itemized Maintenance Costs	Text		maint_itemized_cost_source
maint_itemized_duration_yr	Dates covered by maintenance costs data (FY xx or CY xxxx)	Itemized Maintenance Costs	Text		
maint_itemized_equipment_sales_tax_fl	Sales tax on equipment	Itemized Maintenance Costs	Yes/No		
maint_itemized_in_house_labor_fl	In-house labor (including base rate; fringe benefits; WC, fixed OH)	Itemized Maintenance Costs	Yes/No		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
maint_itemized_in_house_labor_source	In-house labor source	Itemized Maintenance Costs	Text	select one union open shop	
maint_itemized_materials_sales_tax_fl	Sales tax on materials, supplies and parts	Itemized Maintenance Costs	Yes/No		
maint_itemized_scope_txt	Scope of maintenance activities (describe)	Itemized Maintenance Costs	Memo		If 'No Maintenance Data to Share' is selected, no entries on this screen will be required. All associated fields will be blank.
maint_materials_fl	Materials, supplies and parts	Total Maintenance Costs	Yes/No		
maint_materials_sales_tax_fl	Sales tax on materials, supplies and parts	Total Maintenance Costs	Yes/No		
maint_scope_txt	Scope of maintenance activities (describe)	Total Maintenance Costs	Memo		If 'No Maintenance Data to Share' is selected, no entries on this screen will be required. All associated fields will be blank.
misc_equipment_name	Current miscellaneous equipment names	Miscellaneous Equipment	Text	Table 5	
original_control_commission_dt	Commissioning date of original control system	Controls	Date/Time		
original_control_demolished_pcnt	Percentage of original controls demolished/removed (%)	Controls	Number (Long)		
original_control_system_name	Original control system type	Controls	Text	Table 4	
original_cooling_capacity_tons	Original cooling plant total capacity (tons)	Cooling Plant	Number (Double)		
original_cooling_demolished_pcnt	Percentage of original cooling plant demolished/removed (%)	Cooling Plant	Number (Long)		
original_cooling_installation_dt	Commissioning data for original cooling plant	Cooling Plant	Date/Time		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
original_cooling_system_name	Original cooling plant type	Cooling Plant	Text	Table 2	if 'N/A - Current cooling plant same as original', original cooling plant capacity and percentage demolished/removed will show zero; original commissioning date will show blank original_cooling_capacity_tons original_cooling_installation_dt original_cooling_demolished_pcnt
original_heating_capacity_mmbtus	Original system heating plant total capacity (MMBtu/hr)	Heating Plant	Number (Double)		
original_heating_demolished_pcnt	Percentage of original heating plant capacity demolished/removed (%)	Heating Plant	Number (Long)		
original_heating_installation_dt	Commissioning date of original heating plant	Heating Plant	Date/Time		
original_heating_system_name	Original heating plant type	Heating Plant	Text	Table 3	if 'N/A - Current heating plant same as original', original heating plant capacity and percentage demolished/removed will show zero; original commissioning date will show blank original_heating_capacity_mmbtus original_heating_installation_dt original_heating_demolished_pcnt
original_support_cooling_capacity_tons	Original support cooling plant total capacity (tons)	Cooling Plant- Support Cooling Plant	Number (Double)		
original_support_cooling_demolished_pcnt	Percentage of support cooling plant demolished/removed (%)	Cooling Plant- Support Cooling Plant	Number (Long)		
original_support_cooling_installation_dt	Commissioning data of original support cooling plant	Cooling Plant- Support Cooling Plant	Date/Time		
original_support_cooling_system_name	Original support cooling plant type	Cooling Plant- Support Cooling Plant	Text	Table 2	if 'Not/Appl - Current support cooling plant same as original', original support cooling plant capacity and percentage demolished/removed will show zero; original commissioning date will show blank original_support_cooling_capacity_tons original_support_cooling_installation_dt original_support_cooling_demolished_pcnt

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
original_system_cooling_capacity_tons	Original system cooling capacity (tons)	System Information	Number (Double)		
original_system_heating_capacity_mmbtus	Original system heating capacity (MMBtu/hr)	System Information	Number (Double)		
original_system_installation_dt	Commissioning date of original system	System Information	Date/Time		
original_system_name	Original HVAC system type	System Information	Text	Table 1	if 'N/A - Current system same as original', original system cooling capacity, heating capacity and percentage demolished/removed will show zero; original commissioning date will show blank
original_system_replacement_pcnt	Percentage of original equipment/system demolished/removed (%)	System Information	Number (Long)		
support_cooling_capacity_pcnt	Percentage of current support cooling plant total capacity dedicated to	Cooling Plant- Support Cooling Plant	Number (Long)		
support_cooling_capacity_tons	Current support cooling plant total capacity (tons)	Cooling Plant- Support Cooling Plant	Number (Double)		
support_cooling_installation_dt	Commissioning data of current support cooling plant	Cooling Plant- Support Cooling Plant	Date/Time		
support_cooling_service_area_sqft	Floor area served by current support cooling plant (square feet)	Cooling Plant- Support Cooling Plant	Number (Long)		
support_cooling_system_name	Current support cooling plant type	Cooling Plant- Support Cooling Plant	Text	Table 2	if 'None - No Support Cooling Plant' is selected, these inputs are not required. Capacity and percent demolished will show zero; commissioning date will be blank support_cooling_capacity_tons support_cooling_installation_dt original_support_cooling_system_name

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
support_cooling_system_origin_typ	Current support cooling plant status	Cooling Plant- Support Cooling Plant	Text	select one original equipment retrofit replacement new construction	
swhp_circulation_flow_rate_gpm	Maximum circulation (interior) flow rate (gpm)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		
swhp_circulation_pump_count	Number of circulation (interior) pumps (#)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		
swhp_circulation_pumping_control	Circulation (interior) pumping control	Surface Water and Other Geothermal Heat Pumps	Text	select one fixed speed variable speed	
swhp_exchanger_configuration	Heat exchanger configuration	Surface Water and Other Geothermal Heat Pumps	Text	select one closed loop open loop	
swhp_flow_rate_gpm	Surface water flow rate (gpm)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		
swhp_no_units_served	Number of GHP units served (#)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		
swhp_plate_heat_exchanger_fl	Plate heat exchanger	Surface Water and Other Geothermal Heat Pumps	Yes/No		
swhp_pump_count	Number of surface water pumps (#)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		

Name	Database Input Name / Description	Screen	Data Type	Input Options	Relationships / Consequences
swhp_pumping_control	Surface water pumping control	Surface Water and Other Geothermal Heat Pumps	Text	select one fixed speed variable speed	
swhp_total_circulation_pumping_capacity_hp	Total circulation (interior) pumping capacity (hp)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		
swhp_total_pumping_capacity_hp	Total surface water pumping capacity (hp)	Surface Water and Other Geothermal Heat Pumps	Number (Long)		
system_cooling_capacity_tons	Current system cooling capacity (tons)	System Information	Number (Double)		
system_heating_capacity_mmbtus	Current system heating capacity (MMBtu/hr)	System Information	Number (Double)		
system_installation_dt	Commissioning date of current system	System Information	Date/Time		
system_name	Current HVAC system type	System Information	Text	Table 1	
system_origin_typ	Current system type status	System Information	Text	select one original equipment retrofit replacement new construction	
system_service_area_sqft	Floor area served by current system (square feet)	System Information	Number (Long)		