

CARRIER HOURLY ANALYSIS PROGRAM v5.0 NEW FEATURES GUIDE



Carrier Software Systems
Carrier Corporation
Syracuse, New York

Rev. June 22, 2016

Copyright © 2016 Carrier Corporation, All Rights Reserved

Contents

Air-Side Features

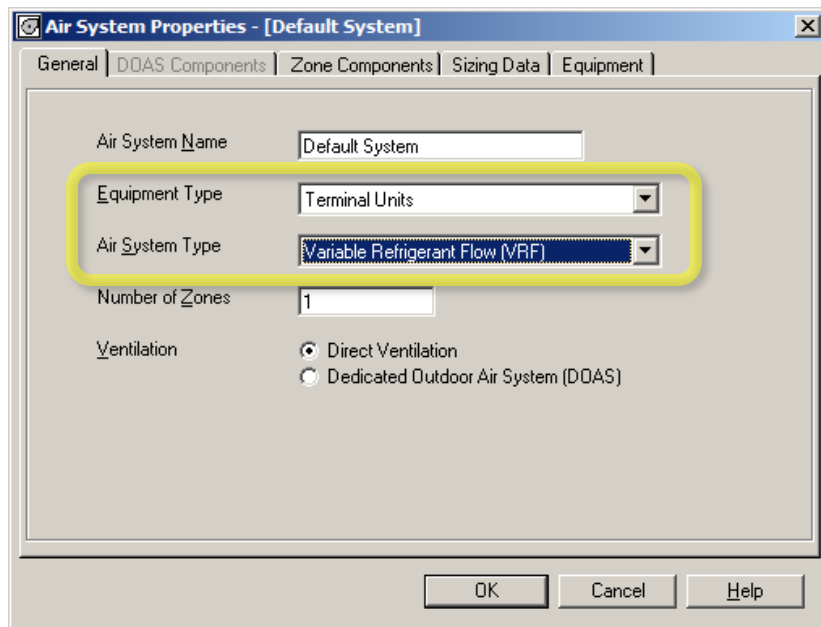
Wizard Features

Other Changes

AIR-SIDE FEATURES

Variable Speed Rotary VRF

Details: Added simulation performance curves for variable speed rotary compressor VRF condensing units. With this addition, HAP now offers three types of performance models for VRF: variable speed rotary, variable speed scroll, and digital scroll.



Air System Properties - [Default System]

General | DOAS Components | Zone Components | Sizing Data | Equipment

Air System Name: Default System

Equipment Type: Terminal Units

Air System Type: Variable Refrigerant Flow (VRF)

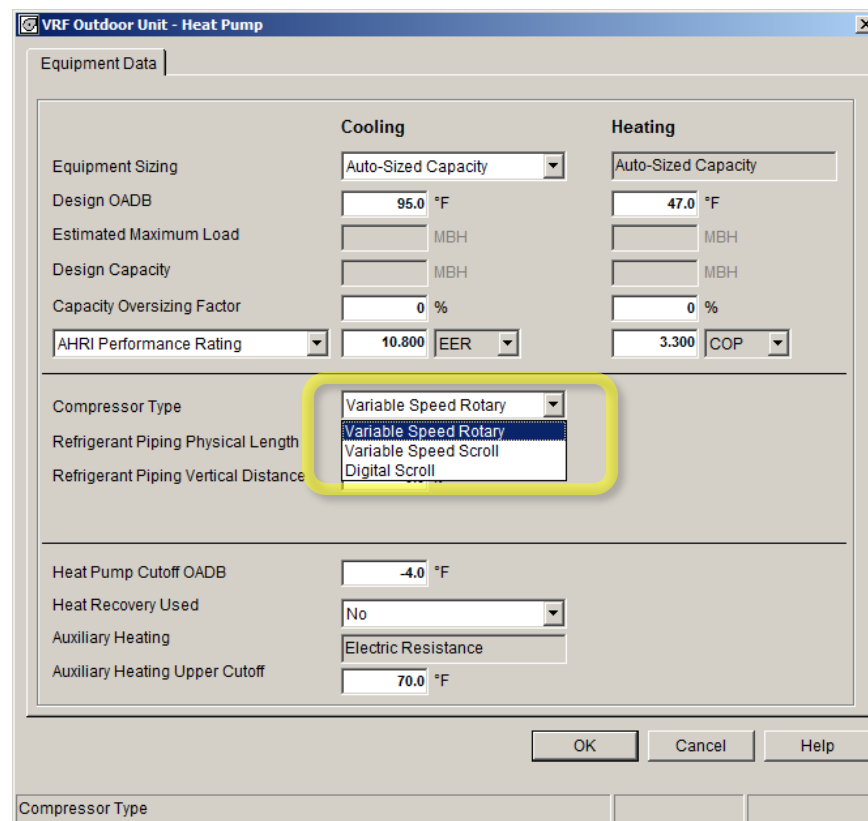
Number of Zones: 1

Ventilation:

☒ Direct Ventilation

☐ Dedicated Outdoor Air System (DOAS)

OK Cancel Help



VRF Outdoor Unit - Heat Pump

Equipment Data

| | Cooling | Heating |
|----------------------------|---------------------|---------------------|
| Equipment Sizing | Auto-Sized Capacity | Auto-Sized Capacity |
| Design OADB | 95.0 °F | 47.0 °F |
| Estimated Maximum Load | MBH | MBH |
| Design Capacity | MBH | MBH |
| Capacity Oversizing Factor | 0 % | 0 % |
| AHRI Performance Rating | 10.800 EER | 3.300 COP |

Compressor Type: Variable Speed Rotary

Refrigerant Piping Physical Length:

Refrigerant Piping Vertical Distance:

Heat Pump Cutoff OADB: -4.0 °F

Heat Recovery Used: No

Auxiliary Heating: Electric Resistance

Auxiliary Heating Upper Cutoff: 70.0 °F

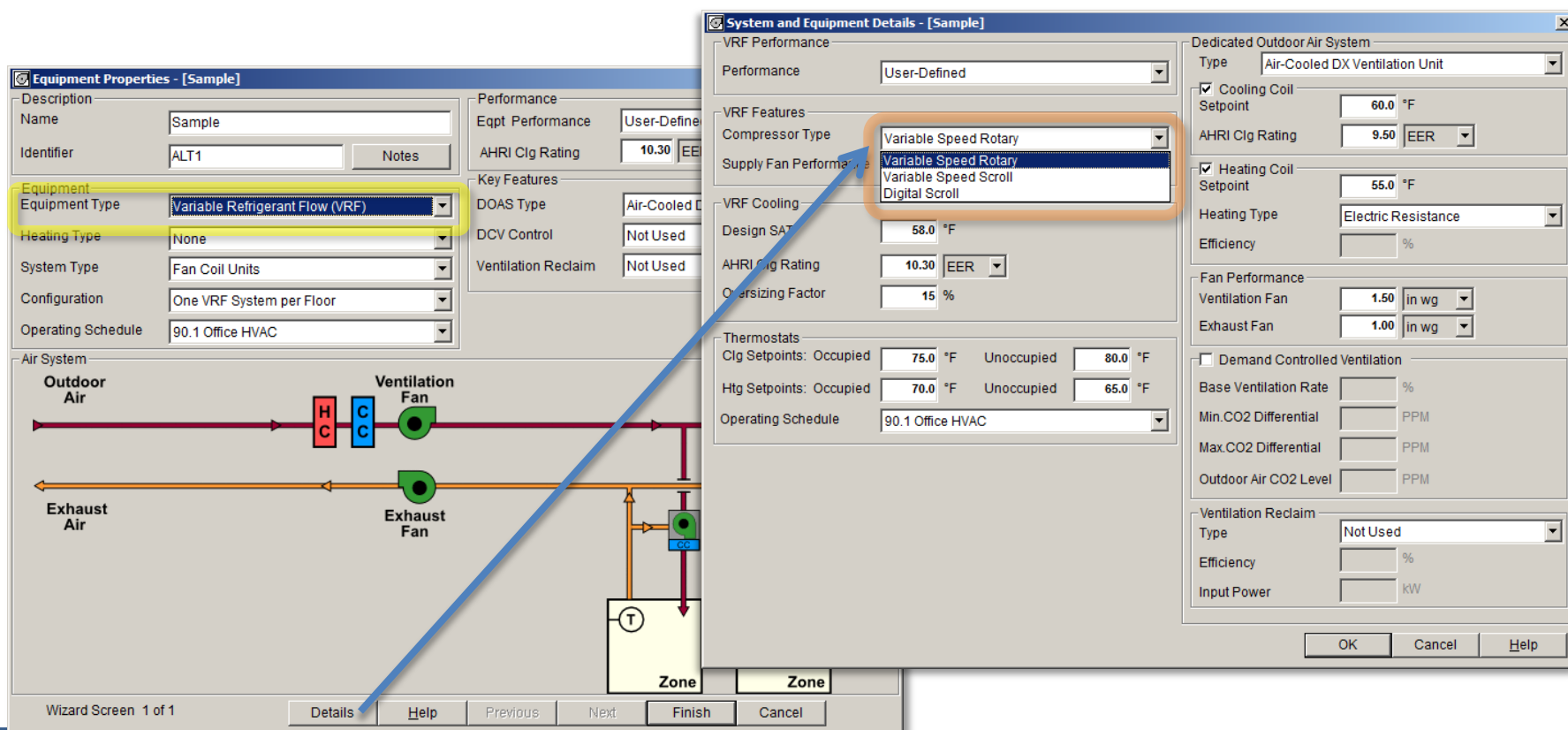
OK Cancel Help

Compressor Type

Figures show the HAP detailed input screens.

Variable Speed Rotary VRF

Details: Inputs specify capacity, EER, COP, compressor type, and controls. During energy simulation HAP applies these inputs to the performance curves to create a scaled performance model for the VRF condensing unit. The model then calculates how efficiency changes each hour with changing operating conditions.



The image displays two overlapping windows from the HAP software wizard. The background window is 'Equipment Properties - [Sample]', and the foreground window is 'System and Equipment Details - [Sample]'.

Equipment Properties - [Sample]

- Description: Name: Sample, Identifier: ALT1
- Equipment: Equipment Type: Variable Refrigerant Flow (VRF)
- Heating Type: None
- System Type: Fan Coil Units
- Configuration: One VRF System per Floor
- Operating Schedule: 90.1 Office HVAC
- Air System: Schematic showing Outdoor Air, Ventilation Fan, Exhaust Air, and Zone.

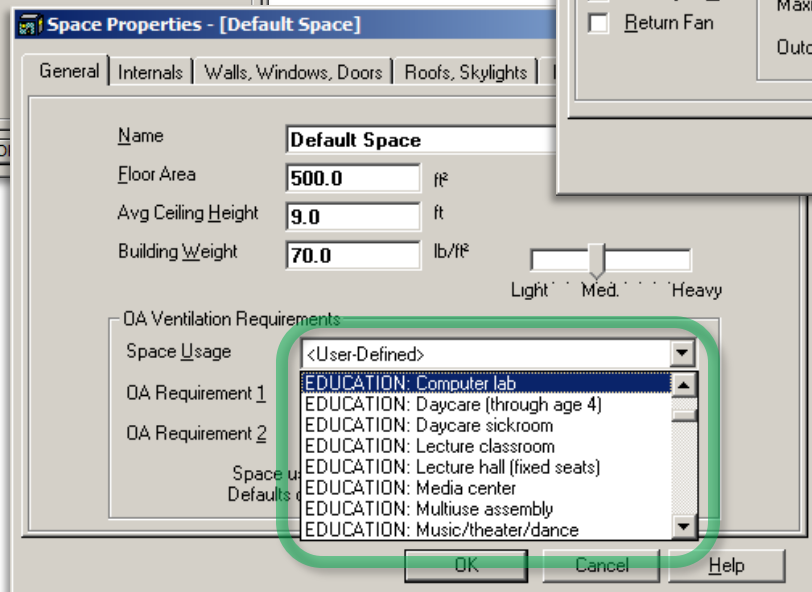
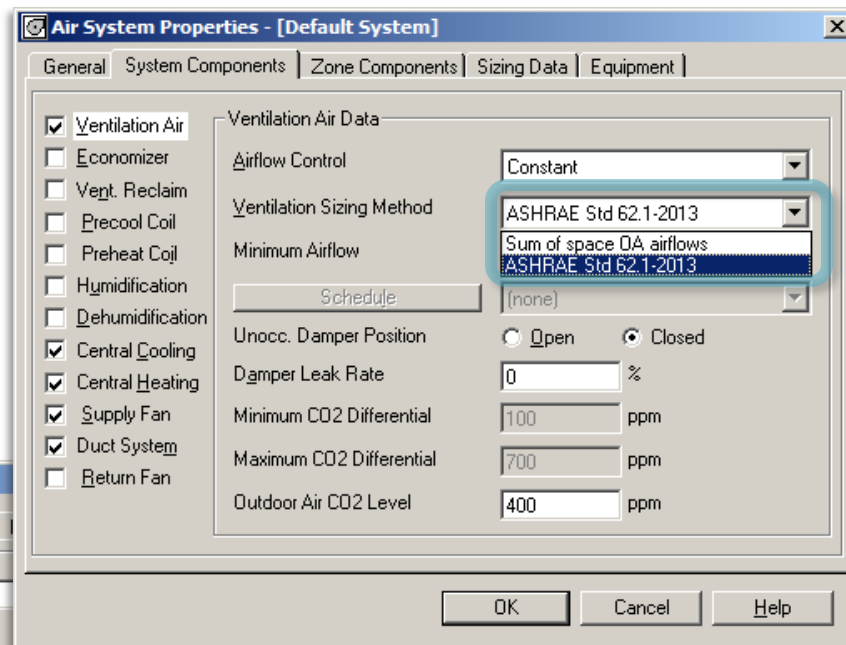
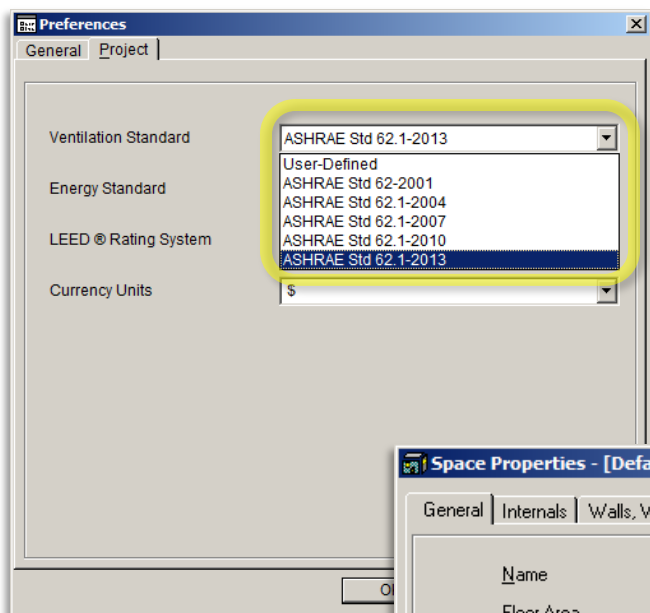
System and Equipment Details - [Sample]

- VRF Performance: Performance: User-Defined
- VRF Features: Compressor Type: Variable Speed Rotary, Supply Fan Performance: Variable Speed Rotary
- VRF Cooling: Design SAT: 58.0 °F, AHRI Ctg Rating: 10.30, EER: 15 %
- Thermostats: Ctg Setpoints: Occupied: 75.0 °F, Unoccupied: 80.0 °F; Htg Setpoints: Occupied: 70.0 °F, Unoccupied: 65.0 °F; Operating Schedule: 90.1 Office HVAC
- Dedicated Outdoor Air System: Type: Air-Cooled DX Ventilation Unit; Cooling Coil Setpoint: 60.0 °F; AHRI Ctg Rating: 9.50, EER: 15 %; Heating Coil Setpoint: 55.0 °F; Heating Type: Electric Resistance; Efficiency: %
- Fan Performance: Ventilation Fan: 1.50 in wg; Exhaust Fan: 1.00 in wg
- Demand Controlled Ventilation: Base Ventilation Rate: %; Min.CO2 Differential: PPM; Max.CO2 Differential: PPM; Outdoor Air CO2 Level: PPM
- Ventilation Reclaim: Type: Not Used; Efficiency: %; Input Power: kW

Figures show the HAP wizard screens.

ASHRAE Std. 62.1-2013

Details: ASHRAE Standard 62.1-2013 ventilation defaults has been added, as well as Ventilation Rate Procedure sizing calculations.



Ventilation Sizing Summary Report

Details: New layout for terminal systems clarifies sizing of zone ventilation airflow and DOAS airflow:

New table summarizes system ventilation requirements

Zones now listed separately, with individual per-zone totals. This better reflects actual sizing calculation procedures.

Ventilation Sizing Summary

Project Name: VSS

Prepared by: carrier corporation

1. Summary

Ventilation Sizing Method

Design Condition

ASHRAE Std 62.1-2007

Heating operation

| Zone Name | Zone Outdoor Airflow (CFM) (Voz) | Uncorrected Outdoor Air Intake (CFM) (Vou) | Ventilation Efficiency (Ev) | Outdoor Air Intake (CFM) (Vot) |
|---------------|----------------------------------|--|-----------------------------|--------------------------------|
| BLD1-F001-Z01 | | 606 | 0.929 | 652 |
| BLD1-F001-Z02 | 191 | | 1.000 | 191 |
| BLD1-F001-Z03 | | 1014 | 0.852 | 1190 |
| BLD1-F001-Z04 | 112 | | 1.000 | 112 |
| System Total | | | | 2144 |

Note: For terminal systems, Standard 62.1 considers each terminal unit to be a "ventilation system". Standard 62.1 calculations are performed separately for each terminal unit zone. Outdoor air intake flow rates for all terminal zones are summed to determine the total system outdoor air flow rate.

2. Space Ventilation Analysis

2.1 Zone: BLD1-F001-Z01

| Zone Name / Space Name | Mult. | Supply Air (CFM) (Vpz) | Space Floor Area (ft²) (Az) | Area Outdoor Air Rate (CFM/ft²) (Ra) | Time Averaged Occupancy (Occupants) (Pz) | People Outdoor Air Rate (CFM/person) (Rp) | Air Distribution Effectiveness (Ez) | Space Outdoor Air (CFM) (Voz) | Breathing Zone Outdoor Air (CFM) (Vbz) | Space Ventilation Efficiency (Evz) |
|----------------------------------|-------|------------------------|-----------------------------|--------------------------------------|--|---|-------------------------------------|-------------------------------|--|------------------------------------|
| BLD1-F001-Z01 | | | | | | | | | | |
| BLD1-F001-Z01 | 1 | 342 | 225.0 | 0.06 | 1.1 | 5.00 | 0.80 | 24 | 19 | 1.020 |
| BLD1-F001-Z02 | 2 | 1190 | 1800.0 | 0.06 | 9.0 | 5.00 | 0.80 | 191 | 153 | 0.929 |
| BLD1-F001-Z03 | 1 | 279 | 225.0 | 0.06 | 1.1 | 5.00 | 0.80 | 24 | 19 | 1.004 |
| BLD1-F001-Z04 | 1 | 1114 | 1050.0 | 0.06 | 5.3 | 5.00 | 0.80 | 112 | 89 | 0.990 |
| BLD1-F001-Z05 | 1 | 368 | 225.0 | 0.06 | 1.1 | 5.00 | 0.80 | 24 | 19 | 1.025 |
| BLD1-F001-Z06 | 1 | 2251 | 1800.0 | 0.06 | 9.0 | 5.00 | 0.80 | 191 | 153 | 1.005 |
| Totals (incl. Space Multipliers) | | 6735 | | | | | | | 606 | 0.929 |

2.2 Zone: BLD1-F001-Z02

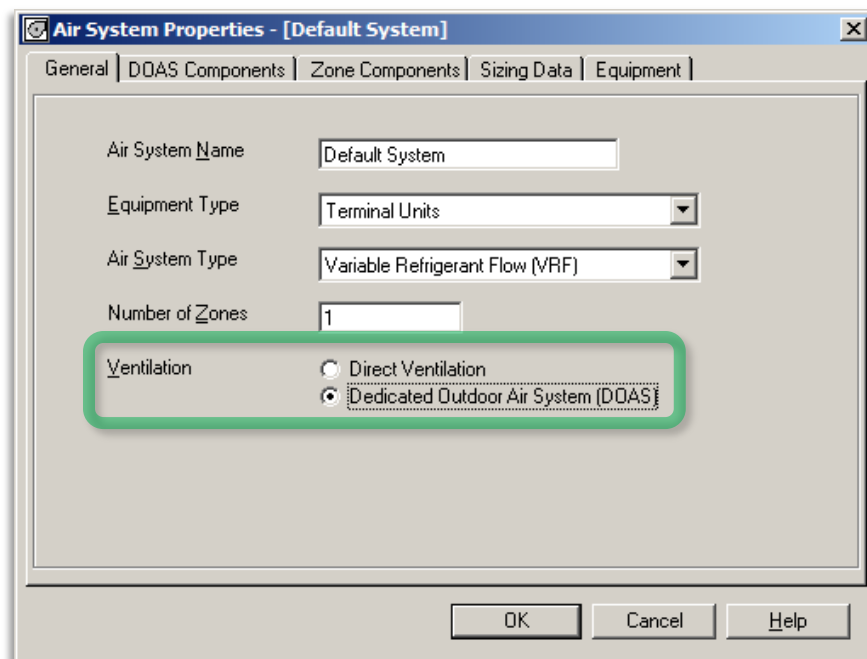
| Zone Name / Space Name | Mult. | Supply Air (CFM) (Vpz) | Space Floor Area (ft²) (Az) | Area Outdoor Air Rate (CFM/ft²) (Ra) | Time Averaged Occupancy (Occupants) (Pz) | People Outdoor Air Rate (CFM/person) (Rp) | Air Distribution Effectiveness (Ez) | Space Outdoor Air (CFM) (Voz) | Breathing Zone Outdoor Air (CFM) (Vbz) | Space Ventilation Efficiency (Evz) |
|----------------------------------|-------|------------------------|-----------------------------|--------------------------------------|--|---|-------------------------------------|-------------------------------|--|------------------------------------|
| BLD1-F001-Z02 | | | | | | | | | | |
| BLD1-F001-Z02 | 1 | 1190 | 1800.0 | 0.06 | 9.0 | 5.00 | 0.80 | 191 | 153 | 1.000 |
| Totals (incl. Space Multipliers) | | 1190 | | | | | | | 153 | 1.000 |

2.3 Zone: BLD1-F001-Z03

| Zone Name / Space Name | Mult. | Supply Air (CFM) (Vpz) | Space Floor Area (ft²) (Az) | Area Outdoor Air Rate (CFM/ft²) (Ra) | Time Averaged Occupancy (Occupants) (Pz) | People Outdoor Air Rate (CFM/person) (Rp) | Air Distribution Effectiveness (Ez) | Space Outdoor Air (CFM) (Voz) | Breathing Zone Outdoor Air (CFM) (Vbz) | Space Ventilation Efficiency (Evz) |
|----------------------------------|-------|------------------------|-----------------------------|--------------------------------------|--|---|-------------------------------------|-------------------------------|--|------------------------------------|
| BLD1-F001-Z03 | | | | | | | | | | |
| BLD1-F001-Z03 | 1 | 279 | 225.0 | 0.06 | 1.1 | 5.00 | 0.80 | 24 | 19 | 1.061 |
| BLD1-F001-Z07 | 1 | 406 | 225.0 | 0.06 | 1.1 | 5.00 | 0.80 | 24 | 19 | 1.087 |
| BLD1-F001-Z08 | 1 | 1279 | 1050.0 | 0.06 | 5.3 | 5.00 | 0.80 | 112 | 89 | 1.059 |
| BLD1-F001-Z09 | 1 | 3034 | 8400.0 | 0.06 | 42.0 | 5.00 | 0.80 | 893 | 714 | 0.852 |
| BLD1-F002-Z01 | 1 | 387 | 225.0 | 0.06 | 1.1 | 5.00 | 0.80 | 24 | 19 | 1.084 |
| BLD1-F002-Z02 | 1 | 1552 | 1800.0 | 0.06 | 9.0 | 5.00 | 0.80 | 191 | 153 | 1.023 |
| Totals (incl. Space Multipliers) | | 6937 | | | | | | | 1014 | 0.852 |

DOAS Terminology

Details: Updated terminology to consistently use “Dedicated Outdoor Air System” (or DOAS) throughout the program.



Air System Properties - [Default System]

General | DOAS Components | Zone Components | Sizing Data | Equipment

Air System Name: Default System

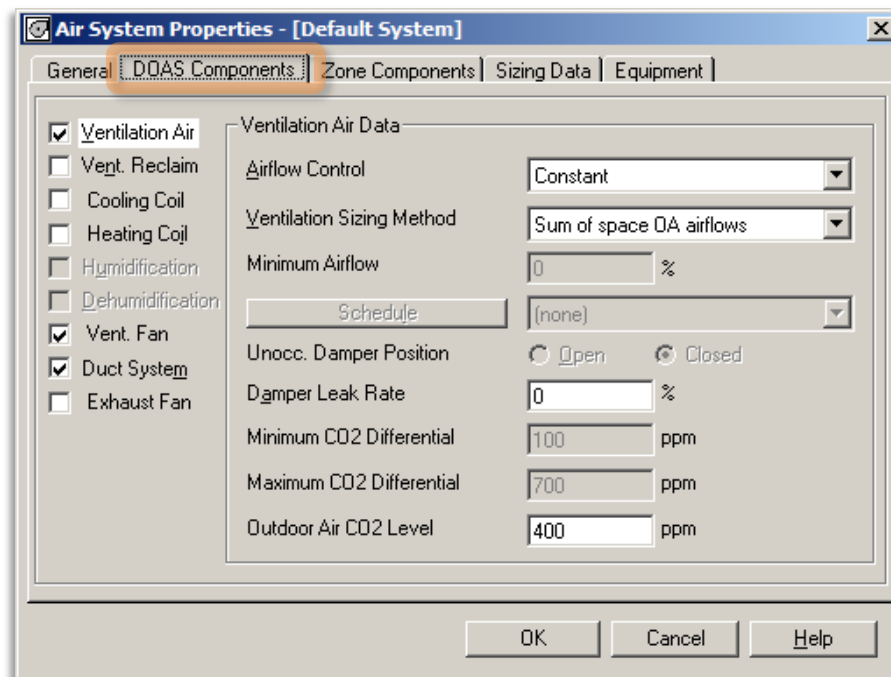
Equipment Type: Terminal Units

Air System Type: Variable Refrigerant Flow (VRF)

Number of Zones: 1

Ventilation: ☐ Direct Ventilation ☒ Dedicated Outdoor Air System (DOAS)

OK Cancel Help



Air System Properties - [Default System]

General | DOAS Components | Zone Components | Sizing Data | Equipment

☒ Ventilation Air

☐ Vent. Reclaim

☐ Cooling Coil

☐ Heating Coil

☐ Humidification

☐ Dehumidification

☒ Vent. Fan

☒ Duct System

☐ Exhaust Fan

Ventilation Air Data

Airflow Control: Constant

Ventilation Sizing Method: Sum of space OA airflows

Minimum Airflow: 0 %

Schedule: (none)

Unocc. Damper Position: ☐ Open ☒ Closed

Damper Leak Rate: 0 %

Minimum CO2 Differential: 100 ppm

Maximum CO2 Differential: 700 ppm

Outdoor Air CO2 Level: 400 ppm

OK Cancel Help

WIZARD FEATURES

Waterside Economizer for Air-Cooled Chiller Plants

Details: This feature models a cooling tower used for direct cooling duty alongside air-cooled chillers, when ambient conditions allow. Integrated and non-integrated configurations are supported. This complements existing features for water-cooled chiller plants.

Equipment Properties - [Sample]

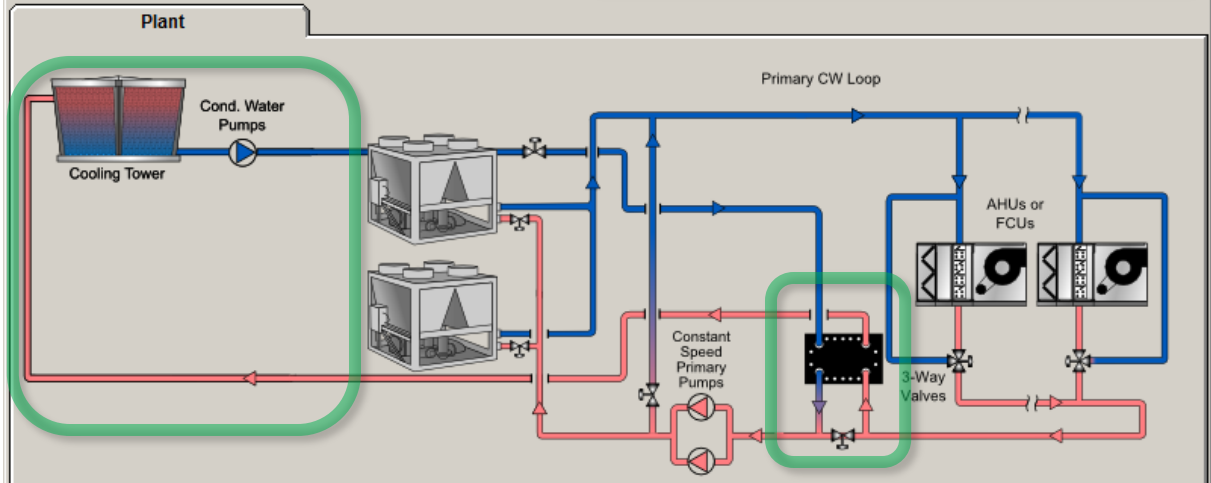
Plant Configuration

Plant Type: Chiller Plant
Number of Units: 2 Chillers - Equally Sized
Equipment Type: A/C Packaged Screw
Eqpt Performance: User-Defined
Input Power: 1.256 kW/Ton

Key Plant Features

Distribution System: Primary-Only, Constant Speed
Temperature Reset Control: Constant Leaving Temperature
DX Free Cooling: Not Used
Waterside Economizer: Integrated Waterside Economizer

Plant

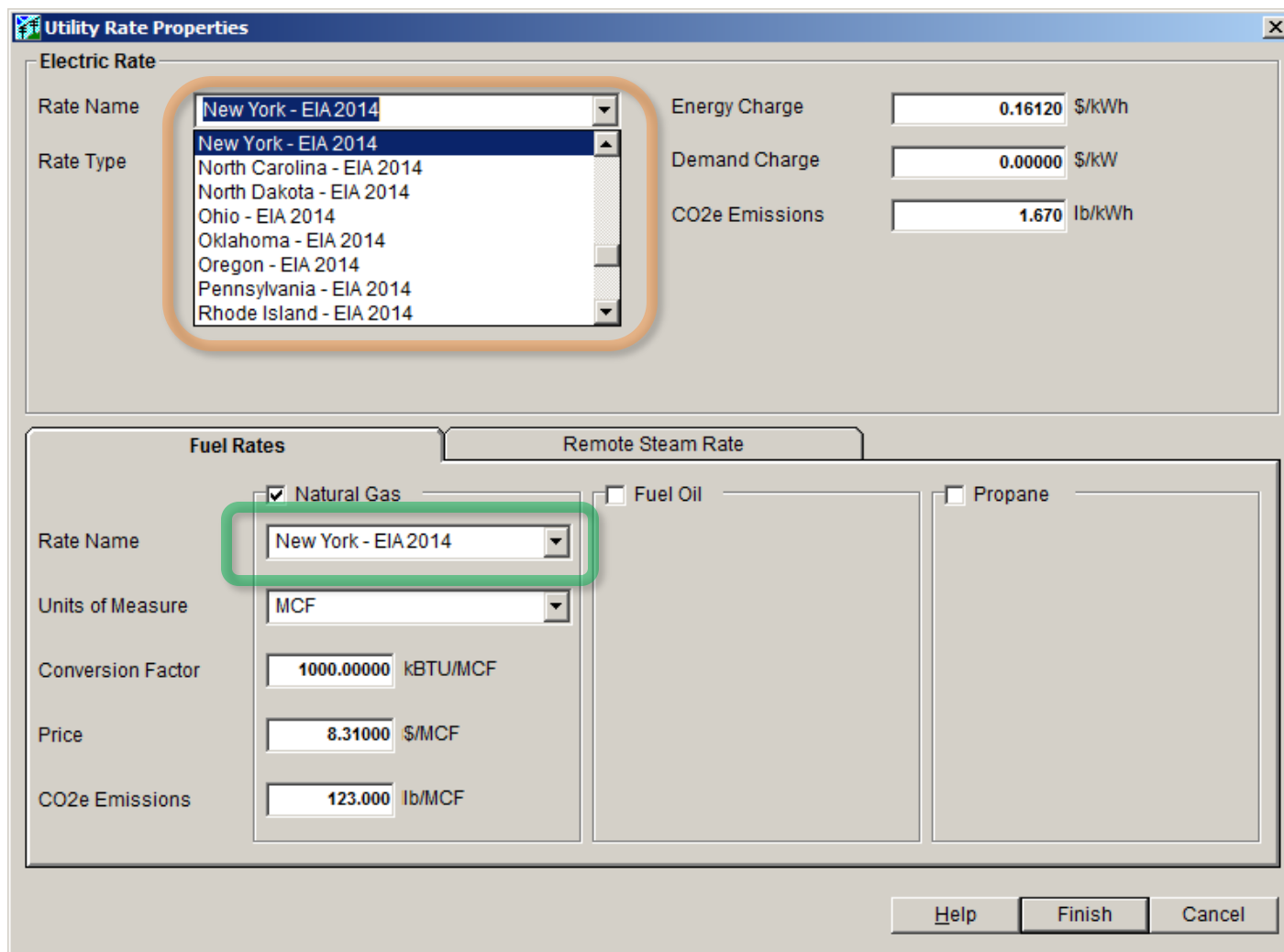


Wizard Screen 2 of 3

Details
Help
Previous
Next
Finish
Cancel

US Energy Information Administration (EIA) Rates

Details: The Utility Rate Wizard has been updated with 2014 EIA rates for gas and electricity. (2014 data was the latest available at time of release).



Utility Rate Properties

Electric Rate

Rate Name: New York - EIA 2014

Rate Type: New York - EIA 2014

Energy Charge: 0.16120 \$/kWh

Demand Charge: 0.00000 \$/kW

CO2e Emissions: 1.670 lb/kWh

Fuel Rates

☒ Natural Gas

Rate Name: New York - EIA 2014

Units of Measure: MCF

Conversion Factor: 1000.00000 kBTU/MCF

Price: 8.31000 \$/MCF

CO2e Emissions: 123.000 lb/MCF

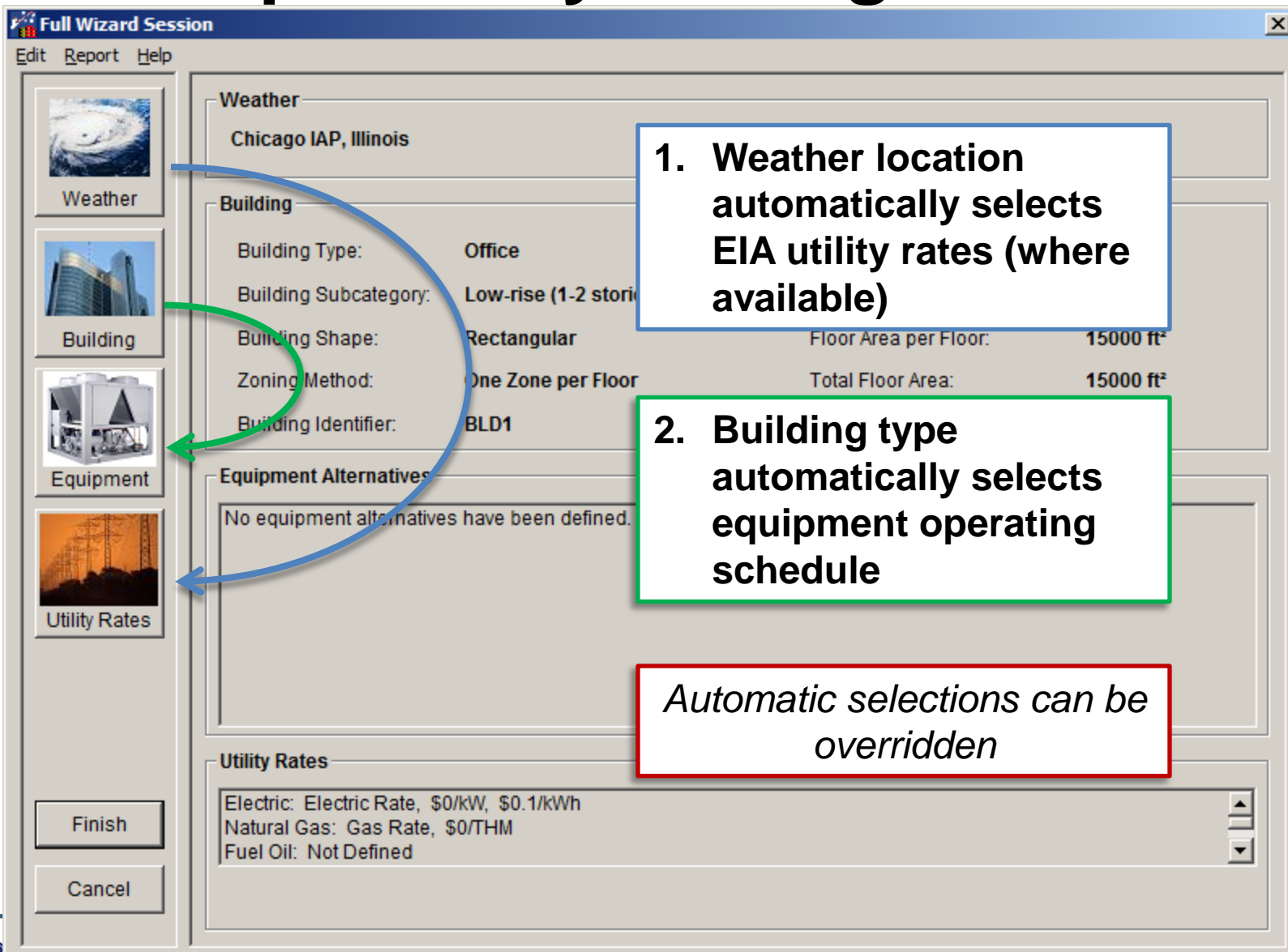
☐ Fuel Oil

☐ Propane

Remote Steam Rate

Help Finish Cancel

Interoperability Among Wizards



Full Wizard Session

Edit Report Help

Weather
Chicago IAP, Illinois

Building
Building Type: Office
Building Subcategory: Low-rise (1-2 stories)
Building Shape: Rectangular
Zoning Method: One Zone per Floor
Building Identifier: BLD1

Equipment Alternatives
No equipment alternatives have been defined.

Utility Rates
Electric: Electric Rate, \$0/kW, \$0.1/kWh
Natural Gas: Gas Rate, \$0/THM
Fuel Oil: Not Defined

Weather
Building
Equipment
Utility Rates

Finish
Cancel

1. Weather location automatically selects EIA utility rates (where available)

2. Building type automatically selects equipment operating schedule

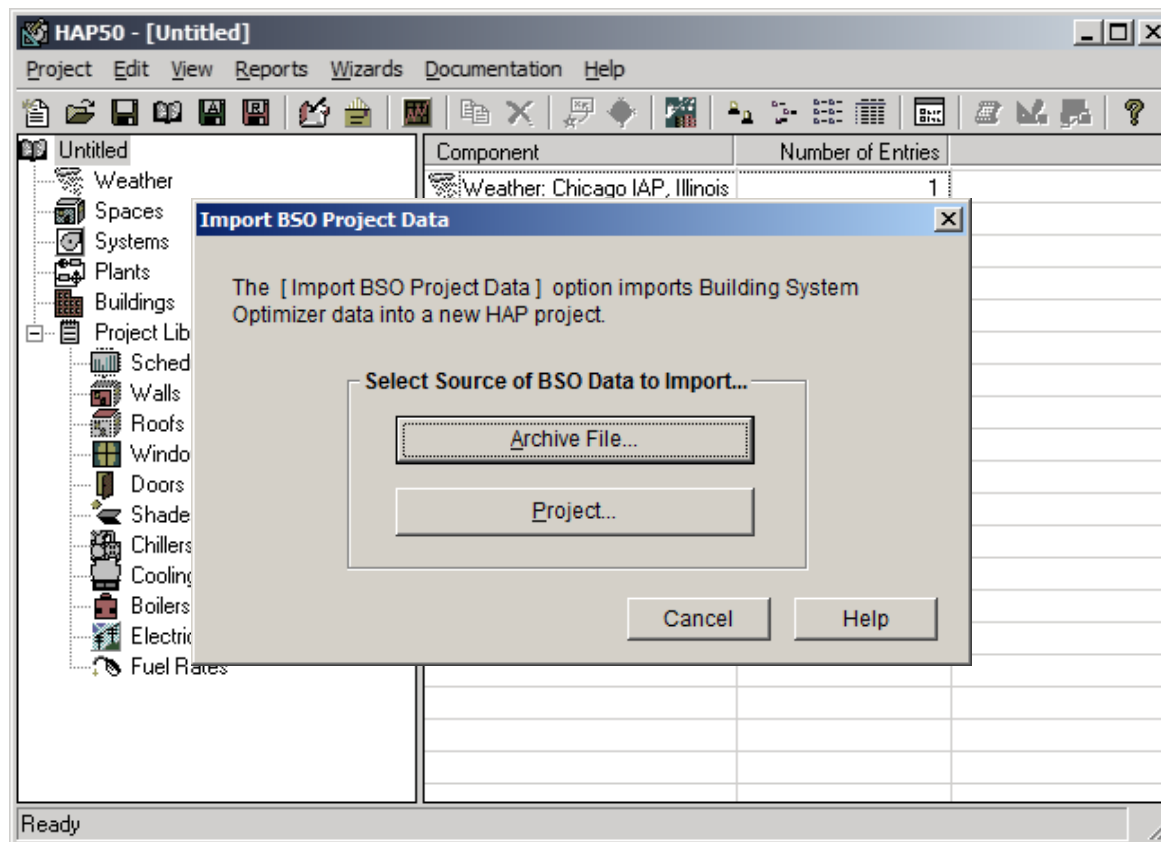
Automatic selections can be overridden

OTHER FEATURES

Import from Carrier Building System Optimizer

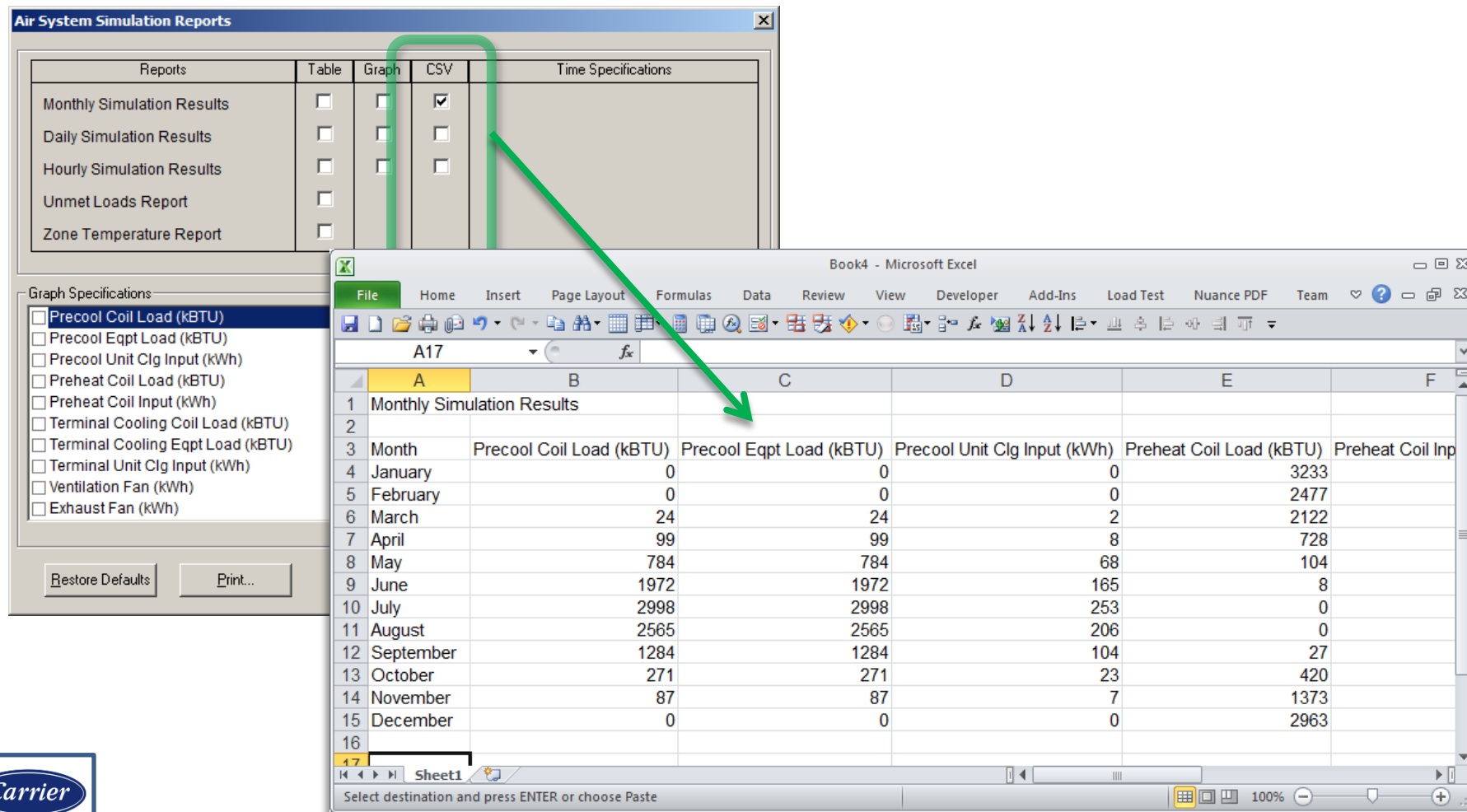
Details: Projects created in Building System Optimizer (BSO) can now be loaded into HAP. Once imported, full HAP capabilities can be used.

This facilitates scenarios where schematic design was done in BSO but further detailed design or analysis is required.



Export to Comma Separated Values (CSV) Files

Details: CSV is a common file format compatible with spreadsheets such as Microsoft Excel and other software. Energy simulation results for air systems, plants, and buildings can now be output in this format.



The screenshot shows the 'Air System Simulation Reports' window with the 'CSV' tab selected. A green arrow points from the 'CSV' checkbox in the 'Reports' section to the 'Monthly Simulation Results' row in the Excel spreadsheet. The spreadsheet displays the following data:

| Month | Precool Coil Load (kBTU) | Precool Eqpt Load (kBTU) | Precool Unit Clg Input (kWh) | Preheat Coil Load (kBTU) | Preheat Coil Input (kWh) |
|-----------|--------------------------|--------------------------|------------------------------|--------------------------|--------------------------|
| January | 0 | 0 | 0 | 3233 | |
| February | 0 | 0 | 0 | 2477 | |
| March | 24 | 24 | 2 | 2122 | |
| April | 99 | 99 | 8 | 728 | |
| May | 784 | 784 | 68 | 104 | |
| June | 1972 | 1972 | 165 | 8 | |
| July | 2998 | 2998 | 253 | 0 | |
| August | 2565 | 2565 | 206 | 0 | |
| September | 1284 | 1284 | 104 | 27 | |
| October | 271 | 271 | 23 | 420 | |
| November | 87 | 87 | 7 | 1373 | |
| December | 0 | 0 | 0 | 2963 | |

Bugs / Corrections

The following problems were corrected:

1. **Air System Inputs** – When the “90.1 Appendix G Fan kW” option was selected for supply fan performance, the button to display the A-Factor Calculations input screen appeared in the wrong position on the screen, obscuring other inputs.
2. **System Design Reports** – For an induction beam or active chilled beam system in which a zone contains multiple spaces, and in which the zone primary airflow is set by induction supply requirements rather than outdoor air ventilation requirement, the Ventilation Sizing Summary report showed incorrect Voz values for spaces in that zone. This was a cosmetic error. Calculation of ventilation airflow requirements for the system was correct.
3. **Building Simulation I** – It was possible to create a complex electric rate with zero energy charge steps. If that electric rate was used in a building simulation an error message appeared.
4. **Building Simulation II** – The unmet load hours shown on the LEED EAc1 report incorrectly included unmet loads for service hot water (SHW), but should only contain data for space conditioning. This only occurred for projects modeling a standalone SHW system.
5. **Building Wizard** – When a wall, roof, or window assembly created in the detailed user interface was selected in the Building Wizard, the overall U-value was shown as zero. In addition, an error occurred when generating the Building Wizard input report. These were cosmetic errors; inputs were successfully transformed into spaces, assemblies and schedules for the detailed HAP interface and were reliable for use in load calculations and energy simulations.
6. **Utility Rate Wizard** – When price data for remote steam was entered, it was incorrectly assigned to the remote hot water meter in the building.
7. **Reports** – Under specific conditions an “Error 521: Unable to open clipboard” error occurred when generating certain reports.
8. **gbXML Import** – For a very specific set of conditions the gbXML Import feature linked the wrong window or door assembly to spaces. This only occurred when window names exceeded 30 characters, and the first 30 characters of each name matched other names.
9. **Example Problem Results PDF** – Example problem results listed in the *Example Problems Results* PDF document did not match results produced by the HAP v4.9 example problem. This PDF document is used by customers performing validation of the program.

QUESTIONS?

***If you have any questions about Carrier Hourly Analysis Program v5.0
please contact Carrier Software Systems at***

software.systems@carrier.utc.com

Thank you!