Modeling Guide for Daikin VRV in TRACE 700

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Introduction

This modeling guide contains step-by-step instructions for modeling Daikin VRV IV, III and WIV systems in TRACE 700. To purchase and learn more about TRACE 700, please visit http://www.trane.com/commercial/north-america/us/en/products-systems/design-and-analysis-tools/analysis-tools/trace-700.html.

Please visit Daikin AC website: http://www.daikinac.com/content/resources/software-tools/, or Daikin city website https://www.daikincity.com/ following the path: **Library Home > 07 VRV/LC Sales Partners > Sales Tools & Applications Resources > Sales and Applications Tools > Energy Simulation** for new products information update.

The Daikin VRV library file includes cooling and heating performance curves for Daikin VRV IV air-cooled (RXYQ and REYQ series), VRV III air-cooled (RXYQ and REYQ series) and VRV WIV water-cooled (RWEYQ series) products. The cooling/heating curves are:

- Total Capacity; *f(t evaporator entering wet bulb, t condenser entering dry bulb)*

  These curves model equipment capacity at 100% load based on

  - For air-cooled products, ambient and indoor air temperature.

  - For water-cooled products, entering water and indoor air temperature.

- Electric Input Ratio; *f(t evaporator entering wet bulb, t condenser entering dry bulb)*

  These curves model equipment power input at 100% load based on

  - For air-cooled products, ambient and indoor air temperature.

  - For water-cooled products, entering water and indoor air temperature.

- Part Load Ratio; *f(part load ratio)*

  This curve adjusts system power input based on the part load ratio of the condensing unit.

This document and its associate library file are intended to provide necessary data to help designers optimize the design of Daikin VRV systems based on building energy cost. This guide should be used as a guideline only. The modeling accuracy is highly dependent on the user input data and it is the users' responsibility to understand how the input data will affect the program output.

Program Installation

Please purchase the software first and then follow the instructions provided by the sales.

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# Importing Daikin VRV Library File

This session demonstrates how to import the Daikin VRV library file into TRACE 700.

1. Download the library file (Daikin VRV LIB. EXP) from Daikin website:

    http://www.daikinac.com/content/resources/software-tools/.

    or Daikin City https://www.daikincity.com following the path: **Library Home > 07 VRV/LC Sales Partners > Sales Tools & Applications Resources > Sales and Applications Tools > Energy Simulation>TRACE**
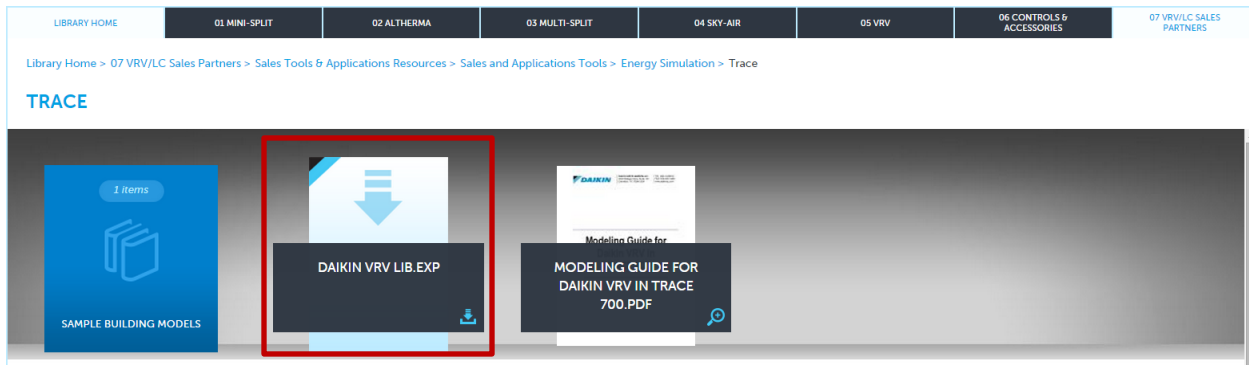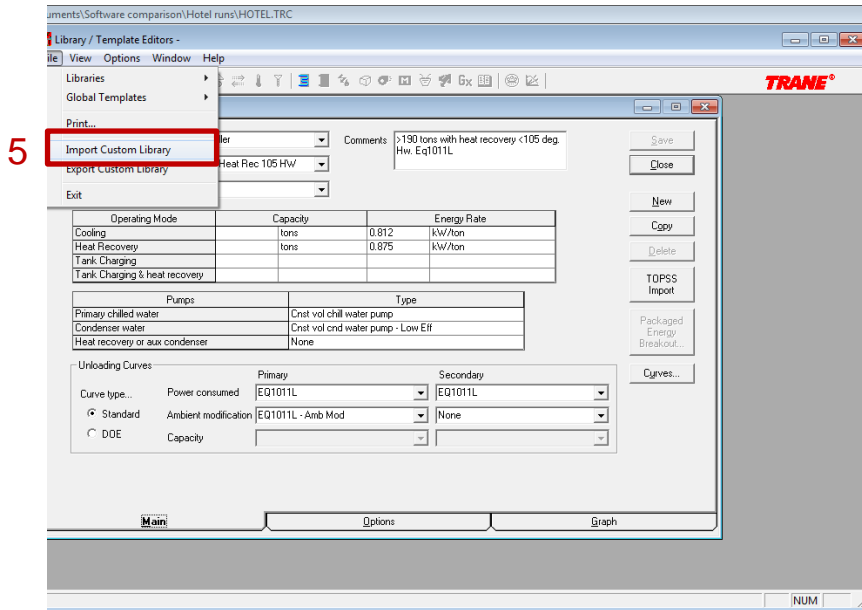

2. Double click the TRACE 700 icon on your desktop to launch TRACE 700. The TRACE 700 startup options dialog box appears:

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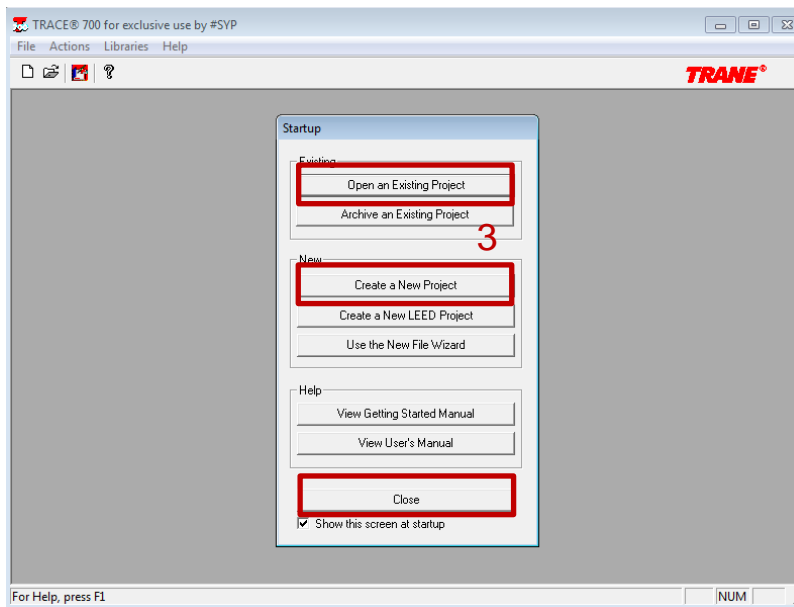
3. Select **Create a New Project** to create a new project or **Open an Existing Project**, if this is not the first time opening TRACE 700. Or click the **Close** button, if the intention is only to add the Daikin VRV library file.

4. When you click the Close button, the main window of TRACE 700 appears. Choose **Library > Equipment > Cooling** to open the library.
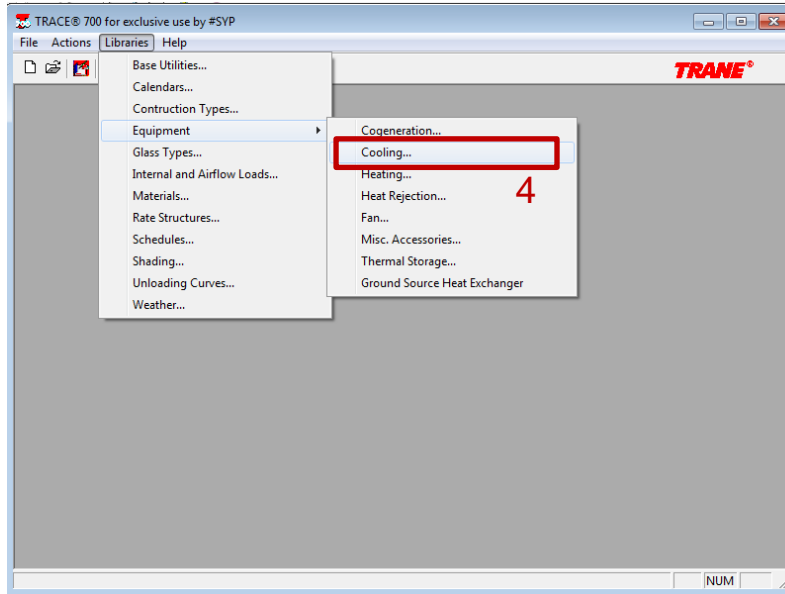
5. Go to **File > Import Custom Library** and choose the library file (Daikin VRV LIB. EXP) from the path this library file was copied to. *Note: During the library file import, if shown an option to overwrite an existing duplicate library data for Daikin products from the import file, set to 'Yes' will allow to overwrite an existing database.

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6. The air-cooled units can be found in the **Equipment Type** under the Cooling category of '**Air-cooled unitary'**, while the water-cooled units can be found under the Cooling category of '**Water source heat pump'**.

7. Click **File > Exit** to close the library.

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System Modeling

This session demonstrates how to model the VRV system in TRACE 700. It is the users' responsibility to evaluate the calculation methodology of the various system types within TRACE 700 and select the most proper one for their buildings. Also, this session only provides the necessary steps to set up the VRV system in TRACE 700. Users should make their own choices and inputs on the other variables that are not mentioned in this guide.

Modeling air-cooled outdoor units

TRACE 700 provides step by step project navigator to properly set up the building model. This process starts with Create Systems, followed with Assign Rooms to Systems, Create Plants and Assign Systems to Plants. The rest steps are defined based on users' needs.
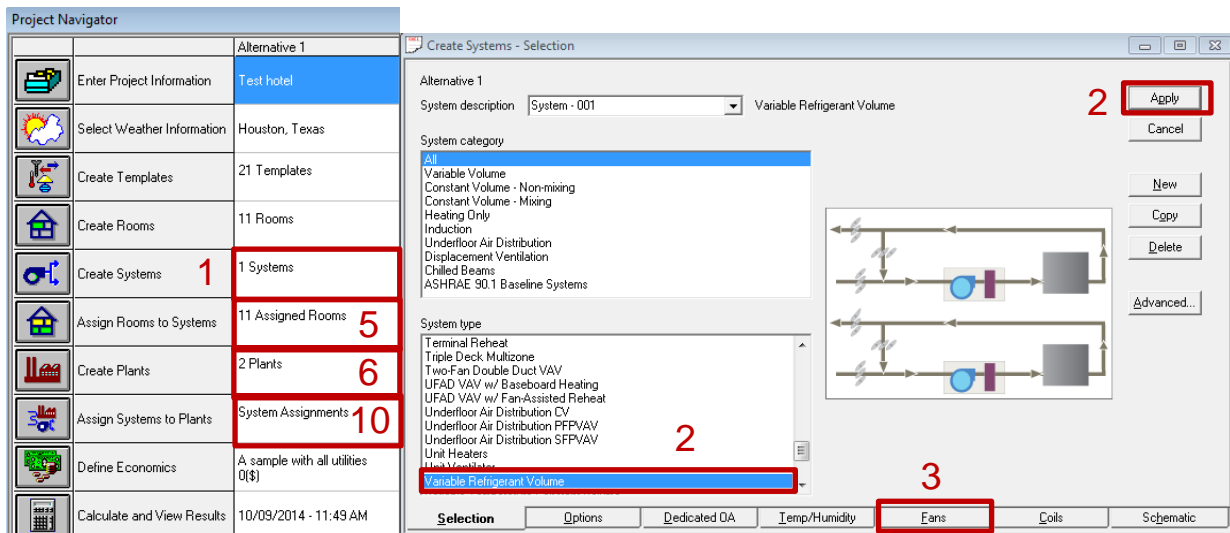
Create Systems

1. After setting up the project building, double click the box under Alternative 1 and Create Systems.
2. Select **Variable Refrigerant Volume** under System type for system-001. Click the **Apply** button.
3. Click the **Fans** button on the bottom toolbox to define the indoor unit fan power.

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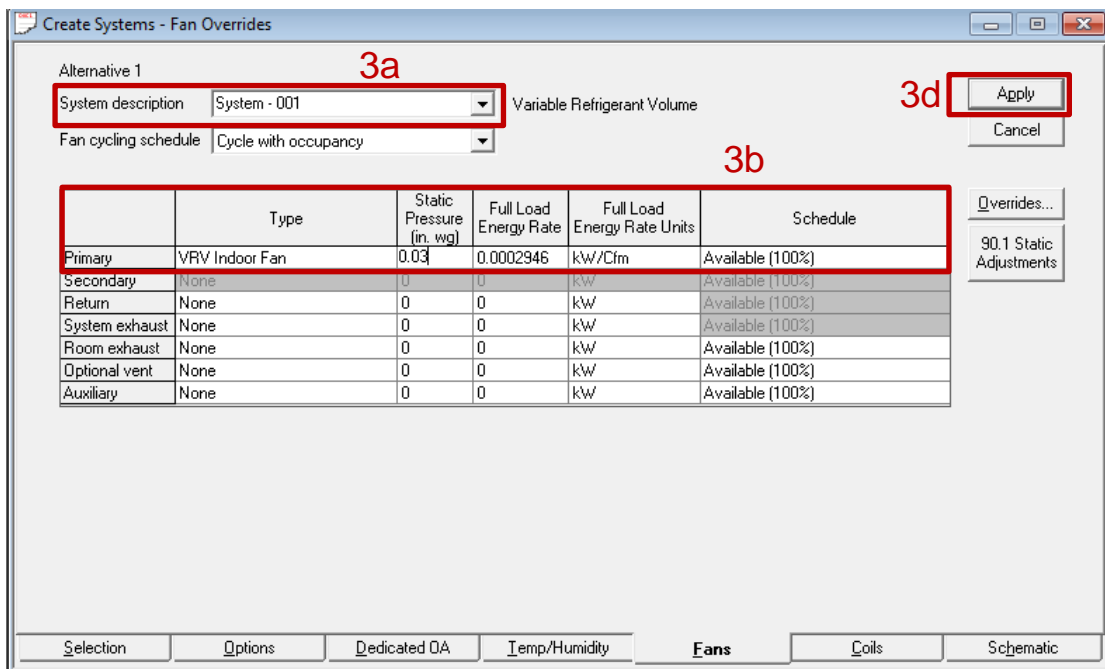
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a. Only 1 system is defined in this example. For multiple systems, make sure the defined fan power is corresponding to the right system.

b. Select **VRV Indoor Fan** as the Primary Fan and enter the static pressure and the full load energy rate. *Appendix A* lists the nominal External Static Pressure (ESP) and the full load energy rate for all the Daikin indoor units. For duct free units (FXFQ-T, FXZQ-M, FXHQ-M, FXAQ-P, FXLQ-M and FXNQ-M series), the static pressure input should be zero. Make sure the Full Load Energy Rate Units is kW/cfm to use the values in *Appendix A*.

c. TRACE 700 currently does not apply library files for zone level air side equipment. Only a single fan definition exists for the entire system, so an average assumed fan power density must be used for the system if different indoor units are used within the system. For example, the indoor units used for one system is 2 x FXDQ07MVJU, 3 x FXDQ09MVJU and 4 x FXDQ12MVJU. For 07 and 09, the capacity is 7500 and 9500 Btu/h.

The total capacity/1000 of the system is 2 x 7.5 + 3 x 9.5 + 4 x 12 = 91.5.

The average full load energy rate is (2 x 7.5 x 0.0002946 + 3 x 9.5 x 0.0002946 + 4 x 12 x 0.0003054)/91.5 = 0.00030027.

d. Click the **Apply** button.

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4. Click the **Close** button to close the Create Systems panel.

Assign Rooms to Systems

5. Double click the box under Alternative 1 and Assign Rooms to Systems. Drag the rooms under Unassigned Rooms to the wanted systems on the right column, until all the rooms are assigned to a system. Click the **Close** button.
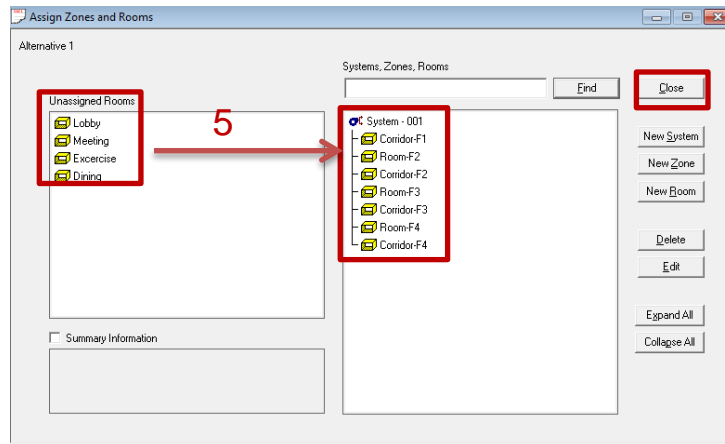

Create Plants

6. Double click the box under Alternative 1 and Create Plants. Drag the **Air-cooled unitary** to the Cooling Plant - 001 and select **Electric resistance** as the Heating Plant - 002.

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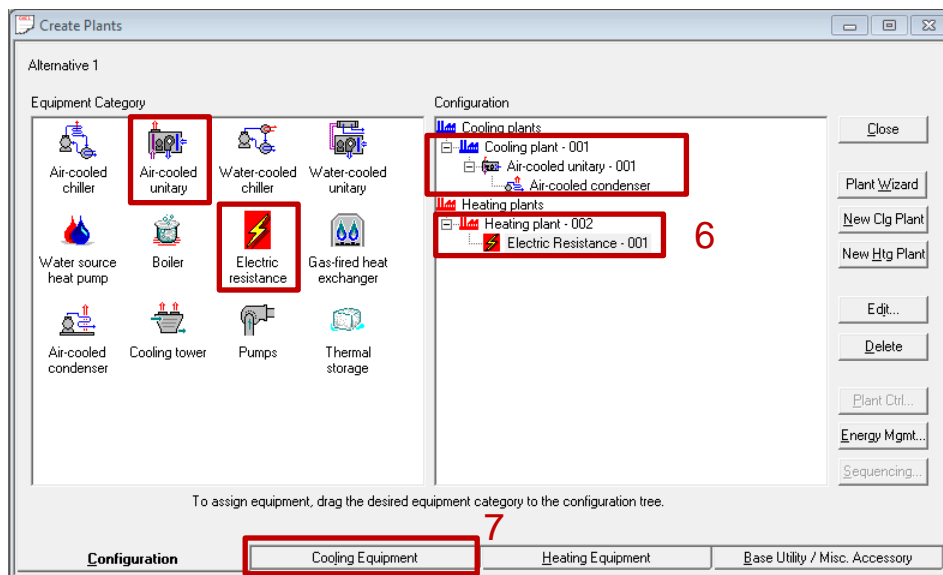
7. Click the **Cooling Equipment** on the bottom tool box.

   a. Choose the desired VRV series and model types in the Equipment type for Cooling plant – 001. The entry with *'VRT'* in the equipment name will enable the program to account for the VRT benefits for VRV IV series. If multiple cooling plants exist, choose the wanted Equipment type for each plant.

   b. The default COP value in the library file is an average value based on Daikin RXYQ and REYQ series correspondingly. If a product model is known for the plant, users can input the COP value for that model type based on the values listed in *Appendix B*. The heat recovery columns here are actually the 'heating mode'.

   c. The cooling capacity is left blank in the initial library entry for all the VRV units. The reason is if the system is not sized properly and the building load exceeds the capacity defined here, the maximum capacity the unit can provide is the value defined here and the exceeding load will be rolled over to the calculation of next hour, which will result in abnormal results and a lot of unmet load hours.

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8. Select 'Change your entered values to the library values for this equipment type' in the popped out window and then click the **OK** button.
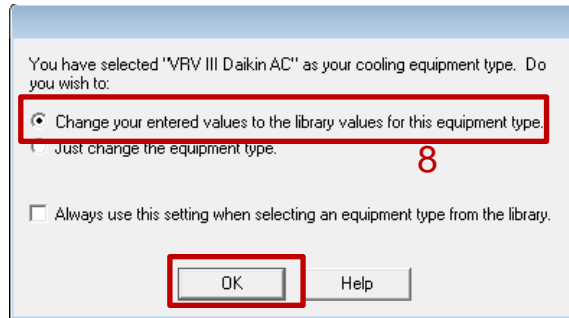
9. Click the **Apply** button and then close the window.

Assign systems to plants

10. Double click the box under Alternative 1 and Assign systems to plants. Drag the Cooling system under the cooling plant while heating system to the heating plant. Then close the window.
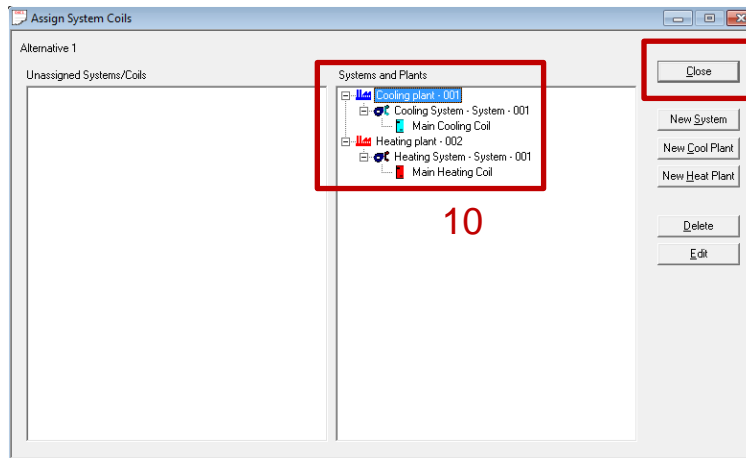
Modeling water-cooled outdoor units

To modeling water-cooled units, a water source heat pump loop should be chosen. The major different steps from modeling air-cooled units are Create Systems and Create Plants. For the rest steps please follow the guide for modeling air-cooled outdoor units.

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Create Systems

1. Pick the **Water Source Heat Pump** as the system type. Click the **Apply** button.
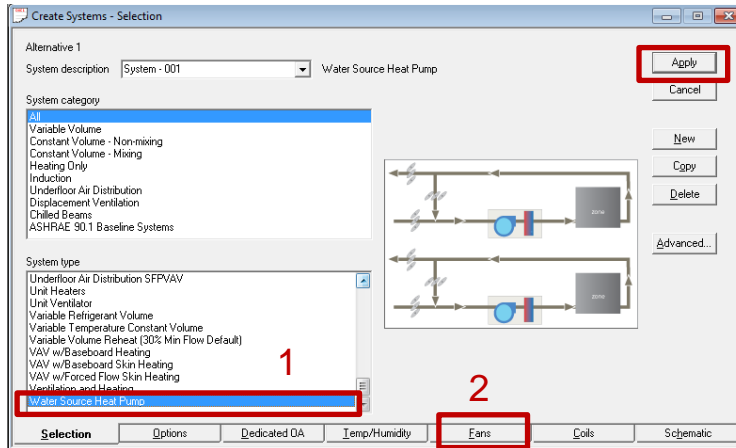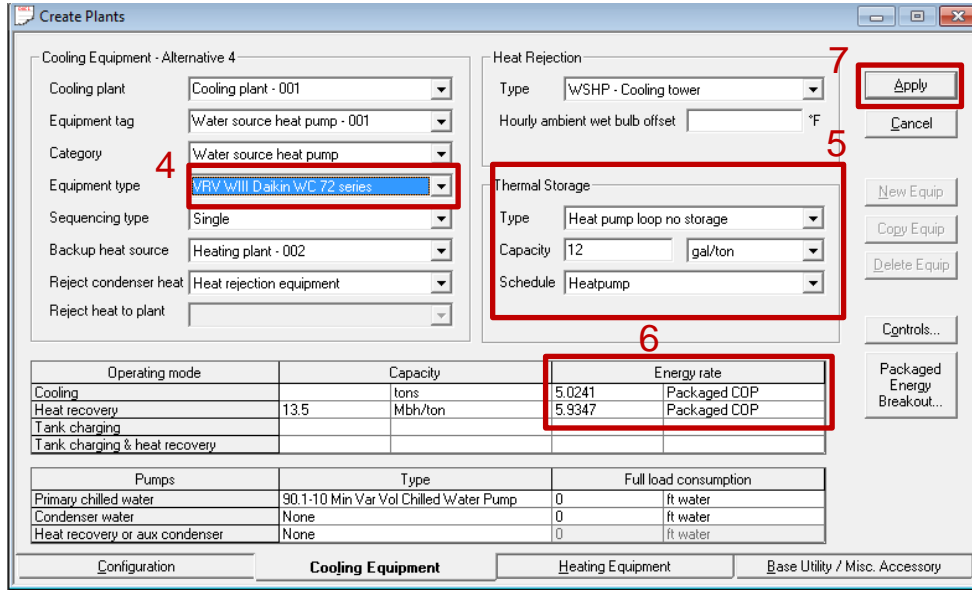
2. Click the Fans tab and define the fan power following the step 3 on page 6-7.

Create Plants

3. Select **Water Source Heat Pump** as the Cooling plant and select either Boiler or Electric resistance as the Heating plants, whichever fits the performance better.
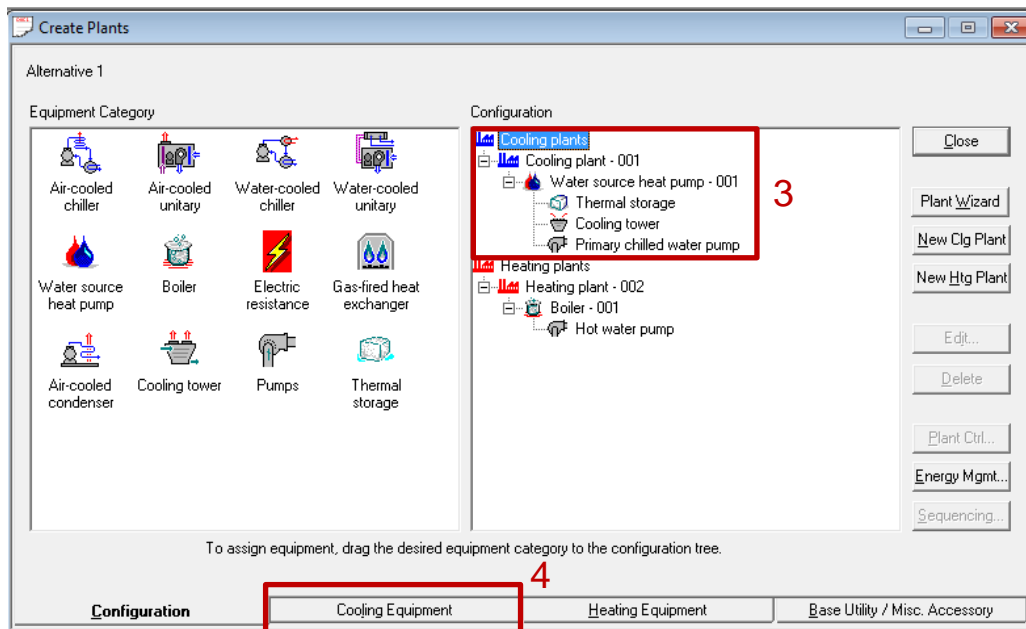
4. Click the **Cooling Equipment** tab. Select VRV WIV Daikin WC 72 series or 84 series as the Equipment type.

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5. Select **Heat pump loop no storage** as the Thermal Storage type. *Note: do not remove thermal storage as the water loop is modeled as a special thermal storage type in TRACE 700.

6. The input energy rate in the library file has an average COP value based on RWEYQ series. *Appendix C* gives the COP values for each model.

7. Click the **Apply** button. Then close the panel.

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Appendix A Fan Power for Indoor Units

<u>Non-ducted</u>

Model	Design (kW/cfm)	Model	Design (kW/cfm)	Model	Design (kW/cfm)
FXAQ07PVJU	0.00007308	FXFQ07TVJU	0.00006667	FXL(N)Q07MVJU9	0.00019184
FXAQ09PVJU	0.00010000	FXFQ09TVJU	0.00007029	FXL(N)Q09MVJU9	0.00019184
FXAQ12PVJU	0.00010345	FXFQ12TVJU	0.00007029	FXL(N)Q12MVJU9	0.00028214
FXAQ18PVJU	0.00006600	FXFQ15TVJU	0.00008008	FXL(N)Q18MVJU9	0.00021429
FXAQ24PVJU	0.00007874	FXFQ18TVJU	0.00010270	FXL(N)Q24MVJU9	0.00019286
FXEQ07PVJU	0.00013613	FXFQ24TVJU	0.00010296	FXUQ18PVJU	0.00011321
FXEQ09PVJU	0.00011947	FXFQ30TVJU	0.00015198	FXUQ24PVJU	0.00011321
FXEQ12PVJU	0.00012830	FXFQ36TVJU	0.00016652	FXUQ30PVJU	0.00018265
FXEQ15PVJU	0.00014791	FXHQ12MVJU	0.00021951	FXUQ36PVJU	0.00018265
FXEQ18PVJU	0.00011911	FXHQ24MVJU	0.00017887	FXZQ07MVJU9	0.00025000
FXEQ24PVJU	0.00013929	FXHQ36MVJU	0.00019398	FXZQ09MVJU9	0.00025000
				FXZQ12MVJU9	0.00023881
				FXZQ15MVJU9	0.00025773
				FXZQ18MVJU9	0.00026263

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Ducted

Model	ESP	Design (kW/cfm)	Model	ESP	Design (kW/cfm)
FXDQ07MVJU	0.03	0.00032857	FXMQ07PA(PB)VJU	0.2	0.00025237
FXDQ09MVJU	0.03	0.00032857	FXMQ09PA(PB)VJU	0.2	0.00025237
FXDQ12MVJU	0.04	0.00033929	FXMQ12PA(PB)VJU	0.2	0.00042222
FXDQ18MVJU	0.06	0.00042045	FXMQ15PA(PB)VJU	0.4	0.00035714
FXDQ24MVJU	0.06	0.00033103	FXMQ18PA(PB)VJU	0.4	0.00033071
FXTQ12PAVJU	0.3	0.00024750	FXMQ24PA(PB)VJU	0.4	0.00033430
FXTQ18PAVJU	0.3	0.00025500	FXMQ30PA(PB)VJU	0.4	0.00032907
FXTQ24PAVJU	0.3	0.00020250	FXMQ36PA(PB)VJU	0.4	0.00033628
FXTQ30PAVJU	0.3	0.00024900	FXMQ48PA(PB)VJU	0.4	0.00033406
FXTQ36PAVJU	0.3	0.00028000	FXMQ54PA(PB)VJU	0.4	0.00028325
FXTQ42PAVJU	0.3	0.00032000	FXMQ48MFVJU	0.88	0.00056693
FXTQ48PAVJU	0.3	0.00041313	FXMQ72MFVJU	0.96	0.00055668
FXTQ54PAVJU	0.3	0.00049167	FXMQ96MFVJU	1.03	0.00051780
			FXMQ72MVJU	0.95	0.00072789
			FXMQ96MVJU	0.95	0.00066116

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Appendix B1 Cooling and Heating COP for VRV III Products

VRV III Model	Cooling COP	Heating COP	VRV III Model	Cooling COP	Heating COP
RXYQ72PBTJ/PBYD	4.566	4.016	REYQ72PBTJ/PBYD	4.673	4.237
RXYQ96PBTJ/PBYD	4.049	4.000	REYQ96PBTJ/PBYD	3.831	3.817
RXYQ120PBTJ/PBYD	3.876	3.704	REYQ120PBTJ/PBYD	3.731	3.774
RXYQ144PBTJ/PBYD	4.167	3.831	REYQ144PBTJ/PBYD	4.065	3.861
RXYQ168PBTJ/PBYD	4.255	4.016	REYQ168PBTJ/PBYD	3.876	3.984
RXYQ192PBTJPBYD	4.115	3.984	REYQ192PBTJ/PBYD	3.610	3.817
RXYQ216PBTJ/PBYD	3.953	3.953	REYQ216PBTJ/PBYD	3.390	3.731
RXYQ240PBTJ/PBYD	3.876	3.953	REYQ240PBTJ/PBYD	3.226	3.650
RXYQ264PBTJ/PBYD	4.065	3.922	REYQ264PBTJ/PBYD	3.436	3.597
RXYQ288PBTJ/PBYD	4.082	4.000	REYQ288PBTJ/PBYD	3.571	3.788
RXYQ312PBTJ/PBYD	4.016	3.968	REYQ312PBTJ/PBYD	3.425	3.731
RXYQ336PBTJ/PBYD	3.922	3.937	REYQ336PBTJ/PBYD	3.322	3.676
RXYQ360PBTJ/PBYD	3.876	3.937			

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Appendix B2 Cooling and Heating COP for VRV IV Products

VRV IV Model	Cooling COP w/o VRT	Heating COP without VRT	Heating COP with VRT	VRV IV Model	Cooling COP w/o VRT	Heating COP without VRT	Heating COP with VRT
RXYQ72TTJU/TYDN	4.566	4.348	4.545	REYQ72TTJU/TYDN	5.102	4.348	4.545
RXYQ96TTJU/TYDN	4.608	4.785	5.000	REYQ96TTJU/TYDN	5.025	4.831	5.051
RXYQ120TTJU/TYDN	3.906	4.167	4.367	REYQ120TTJU/TYDN	4.292	4.149	4.348
RXYQ144TTJU/TYDN	3.571	4.274	4.484	REYQ144TTJU/TYDN	3.906	4.132	4.348
RXYQ168TTJU/TYDN	3.040	4.149	4.310	REYQ168TTJU/TYDN	3.546	3.876	4.065
RXYQ192TTJU/TYDN	4.132	4.115	4.405	REYQ192TTJU/TYDN	4.049	4.132	4.329
RXYQ216TTJU/TYDN	4.184	4.425	4.608	REYQ216TTJU/TYDN	3.937	4.310	4.525
RXYQ240TTJU/TYDN	3.906	4.167	4.367	REYQ240TTJU/TYDN	3.861	4.115	4.292
RXYQ264TTJU/TYDN	3.717	4.219	4.405	REYQ264TTJU/TYDN	3.663	4.000	4.149
RXYQ288TTJU/TYDN	3.597	4.274	4.484	REYQ288TTJU/TYDN	3.597	3.861	4.016
RXYQ312TTJU/TYDN	3.279	4.219	4.405	REYQ312TTJU/TYDN	3.425	3.759	3.937
RXYQ336TTJU/TYDN	3.049	4.167	4.348	REYQ336TTJU/TYDN	3.165	3.584	3.759
RXYQ360TTJU/TYDN	3.906	4.167	4.367	REYQ360TTJU/TYDN	3.584	4.082	4.274
RXYQ384TTJU/TYDN	3.597	4.310	4.484	REYQ384TTJU/TYDN	3.268	3.774	3.953
RXYQ408TTJU/TYDN	3.521	4.329	4.525	REYQ408TTJU/TYDN	3.155	3.546	3.717
				REYQ432TTJU/TYDN	3.012	3.460	3.610
				REYQ456TTJU/TYDN	2.732	3.322	3.460

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Appendix C Cooling and Heating COP for VRV WIV Products

Model	Cooling COP	Heating COP
RWEYQ72PCYD/PCTJ	5.025	5.935
RWEYQ84PCYD/PCTJ	4.396	5.128
RWEYQ144PCYD/PCTJ	5.025	5.935
RWEYQ168PCYD/PCTJ	4.396	5.128
RWEYQ216PCYD/PCTJ	5.025	5.935
RWEYQ252PCYD/PCTJ	4.396	5.120