

Variable Refrigerant Flow Modeling Using Trane TRACE 700 Software

Forward

Mitsubishi Electric has explored the modeling capabilities of several software programs as they relate to modeling energy performance and relative energy savings between variable refrigerant flow (VRF) systems and other standard systems. Mitsubishi Electric has provided input and collaboration with EnergySoft in developing accurate algorithms and proper inclusion of equipment unloading curve information relating to Mitsubishi Electric VRF equipment for use in EnergyPro.

Mitsubishi Electric recognizes the desire in the industry among design professionals to utilize software they are trained on, are accustomed to using, and have invested money in. For this reason it is Mitsubishi Electric's intent to try and provide information as accurate as possible for use in TRACE 700 as it pertains to our VRF equipment.

Mitsubishi Electric, however, does not have access to, nor is part of the background programming or algorithms inside the TRACE 700 computational engine. Mitsubishi Electric has performed evaluations of the TRACE 700 software as it relates to entering equipment performance curves for our VRF equipment. Mitsubishi Electric has also performed a simple model comparison between the TRACE 700 and the Energy Pro software.

The following pages summarizes the known limitations, as well as provides guidance for the designer on how to, within the capabilities of the TRACE 700 software, utilize our equipment library information. Accompanying this document is an electronic TRACE 700 Library file which contains the majority of our air source VRF equipment with capacity and power information, and limited unloading curve information.

It is the designer's responsibility to assess all information contained in any equipment library file and to apply sound engineering judgment and evaluation when performing any energy model. Mitsubishi Electric & Electronics USA, Inc. assumes no responsibility for the accuracy of this information used within the context of the Trane TRACE 700 software, nor for the misuse or extrapolation of data taken from this document or accompanying TRACE library file. Mitsubishi Electric & Electronics USA, Inc. makes no warranties or financial guarantees based on any information stated in this report or data contained within the accompanying TRACE library file.

Known Limitations & Clarifications

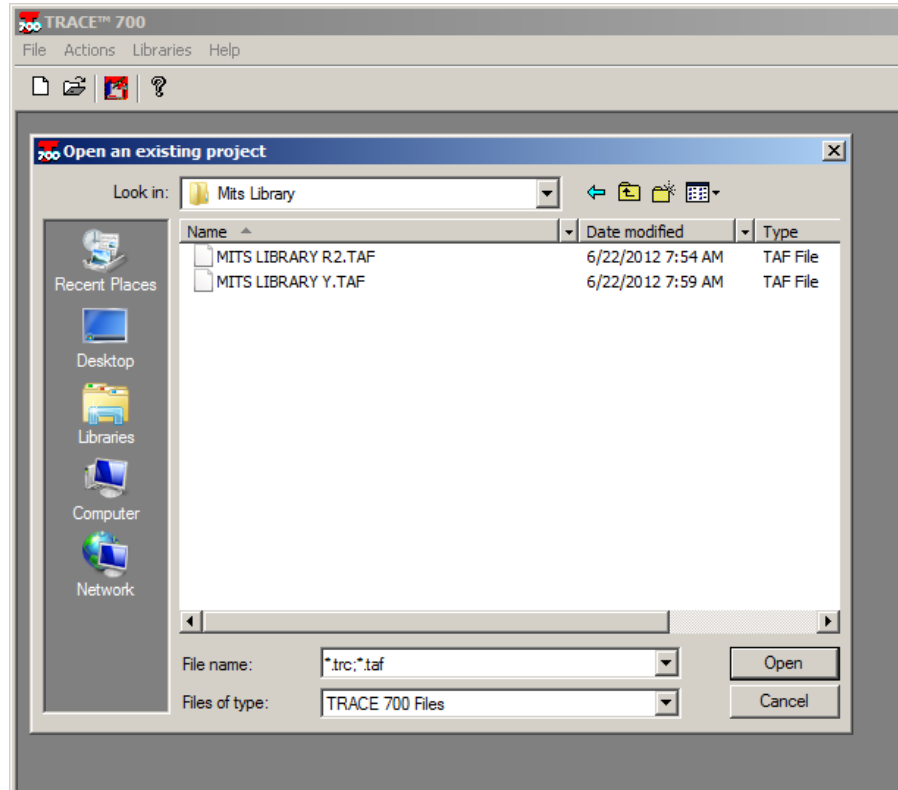
1. The actual heating ambient unloading curves within TRACE 700 can only be defined for a single temperature range. Mitsubishi Electric's VRF equipment heating ambient curves are different for different ambient temperature ranges. Trying to define a single bi-quadratic curve for all ambient conditions introduces significant error along the curve fit compared to actual tested conditions.
2. All the Mitsubishi Electric nominal capacity, peak power, and modification curves are for the outdoor compressor unit as a whole. The TRACE 700 library files for air to air heat pumps have the option for condenser fan power to be defined separately. This value in the Mitsubishi Electric library files has been zeroed out since condenser fan energy is already included in peak power values and part load custom curves.
3. No Mitsubishi Electric water source VRF equipment library files have been provided in the accompanying TRACE library file. It is currently not known to what extent TRACE 700 currently models water cooled VRF modules which provide heat recovery on the refrigerant side first before rejecting or absorbing heat to/from the water side heat sink.
4. No library files have been provided for the zone level indoor VRF equipment. TRACE 700 currently does not utilize library files for zone level air side equipment. Instead, a system type is defined in TRACE, and that system (contains associated zones/rooms) is assigned to the appropriate TRACE "Plant" (each individual outdoor VRF compressor unit).
 - a. At the system level only a single fan definition exists for the entire system, so an average assumed fan power density must be used for the system which is an average representation of the associated zones attached to that system.

TRACE Modeling Notes

Open the TRACE 700 program and select “Open” from the “File” menu.
Select the path where the sample TRACE archive projects (“MITS LIBRARY R2.TAF”
& “MITS LIBRARY Y.TAF”) are located that accompanied this document.

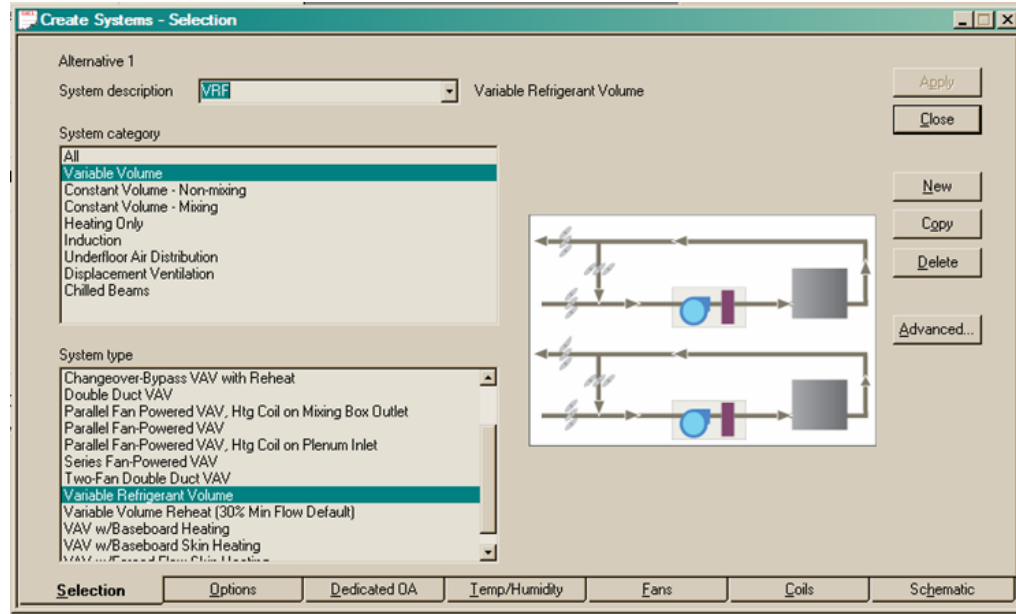
There are two files, one for the R2 Series equipment and another for the Y Series
Equipment. Open each of these files separately.

During the file import process, if given an option to overwrite an existing duplicate
library member for Mitsubishi Electric equipment, **always select “YES”**.



TRACE Modeling Notes Continued

The VRF system type in TRACE is listed under the “Variable Volume” system category under the “Create Systems” section.



TRACE Modeling Notes Continued

Under the “Fans” tab on the “Create Systems” dialog box, be mindful of the total static pressure and fan energy rate used (kw/cfm/inwg). This static pressure and fan energy rate will be different for different types of VRF indoor units. Ducted indoor VRF units will often have a lower energy rate than the default listed but will likely have a higher static pressure. Again, TRACE only allows a single entry that represents the average characteristics of the fans in the zone fan coil units associated with each VRF system.

Create Systems - Fan Overrides

Alternative 1

System description: **VRF System #1** Variable Refrigerant Volume

Fan cycling schedule: **Cycle with occupancy**

Buttons: Apply, Close, Overrides...

Consider using a ton weighted average energy rate (power density).

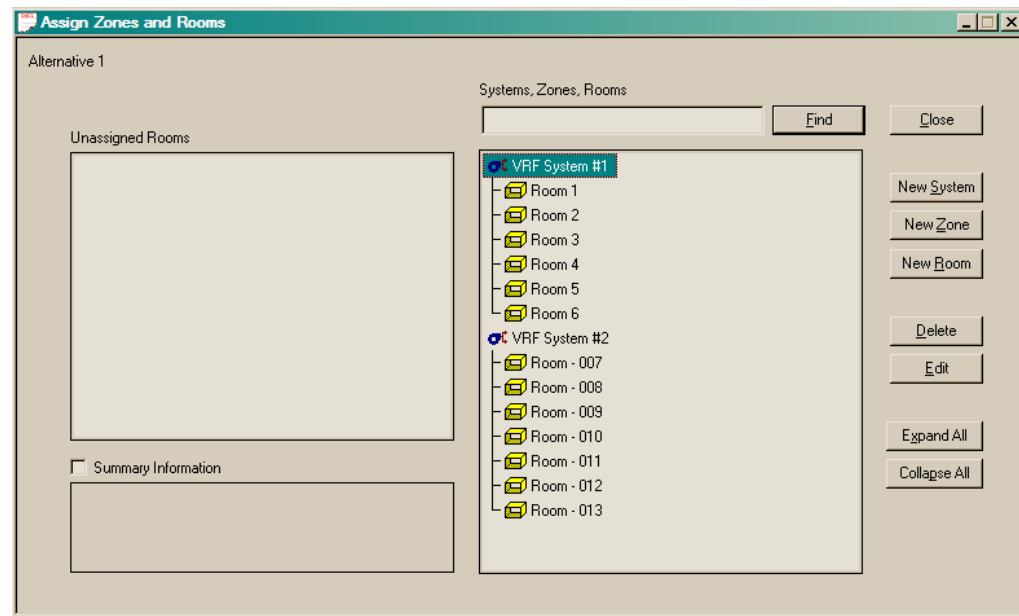
	Type	Static Pressure (in. wg)	Full Load Energy Rate	Full Load Energy Rate Units	Schedule
Primary	VRF Indoor Fan	1	0.001	kw/Cfm-in wg	Available (100%)
Secondary	None	0	0	kw	Available (100%)
Return	None	0	0	kw	Available (100%)
System exhaust	None	0	0	kw	Available (100%)
Room exhaust	None	0	0	kw	Available (100%)
Optional ventilation	None	0	0	kw	Available (100%)
Auxiliary	None	0	0	kw	Available (100%)

90.1 Primary Fan Power Adjustment in. wg

Selection Options Dedicated OA Temp/Humidity **Fans** Coils Schematic

TRACE Modeling Notes Continued

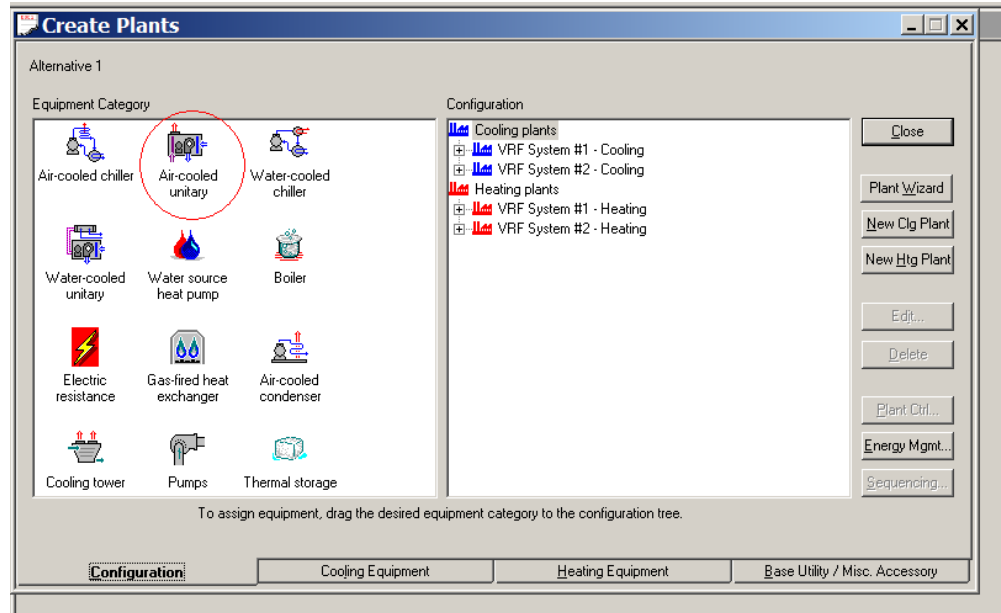
Create new independent VRF systems – 1 system for each group of indoor units/zones associated with their respective outdoor air cooled VRF module.



TRACE Modeling Notes Continued

Under “Create Plants” in TRACE, select “Air Cooled Unitary” as the cooling equipment type.

Assign “Air Cooled Unitary” type to the new plants you create - one plant for each outdoor VRF compressor unit system.



TRACE Modeling Notes Continued

Under “Create Plants” on the “Cooling Equipment” tab, select the appropriate model number (under “Equipment type” field) based on the calculated loads for the assigned system in TRACE.

Create Plants

Cooling Equipment - Alternative 1

Cooling plant: Sample VRF Cooling (Generic R2)

Equipment tag: Air-cooled unitary - 001

Category: Air-cooled unitary

Equipment type: VRF - Mitsubishi (R2) Generic

Sequencing type: VRF - Mitsubishi (R2) Generic

Backup heat source: VRF - Mitsubishi (R2) PURY-P072

Reject condenser heat: VRF - Mitsubishi (R2) PURY-P120

Reject heat to plant: VRF - Mitsubishi (R2) PURY-P144

Operating mode: VRF - Mitsubishi (R2) PURY-P168

Cooling: VRF - Mitsubishi (R2) PURY-P216

Heat recovery: VRF - Mitsubishi (R2) PURY-P240

Tank charging: VRF - Mitsubishi (R2) PURY-P264

Tank charging & heat recovery: VRF - Mitsubishi (R2) PURY-P288

Heat recovery: VRF - Mitsubishi (Y) PUHY-P072

Tank charging: VRF - Mitsubishi (Y) PUHY-P096

Tank charging & heat recovery: VRF - Mitsubishi (Y) PUHY-P120

Heat recovery: VRF - Mitsubishi (Y) PUHY-P144

Heat Rejection

Type: Included In Compressor Power

Hourly ambient wet bulb offset: °F

Thermal Storage

Type: None

Capacity: 0 ton-hr

Schedule: Storage

Energy rate

	Energy rate	
	0.9756	kW/ton
	0.96	kW/ton
		kW/ton
		kW/ton

Pumps

	Type	Full load consumption
Primary chilled water	None	0 ft water
Condenser water	None	0 ft water
Heat recovery or aux condenser	None	0 ft water

Configuration Cooling Equipment Heating Equipment Base Utility / Misc. Accessory

Apply Close New Equip Copy Equip Delete Equip Controls... Packaged Energy Breakout...

TRACE Modeling Notes Continued

Both the R2 Equipment and Y Series equipment library members have the peak heating nominal capacity entered in the “Heat Recovery” field in TRACE.

This does not mean that simultaneous heat recovery is taking place in the Y series. Simultaneous heat recovery in TRACE is defined by assigning the “Reject condenser heat” field to “Heating Plant”.

The Y series library members have this field automatically assigned to “Heat Rejection Equipment” instead, since no simultaneous heat recovery is present in the Y series.

Create Plants

Cooling Equipment - Alternative 1

Cooling plant: Library Only - R2-P240

Equipment tag: Air-cooled unitary - 008

Category: Air-cooled unitary

Equipment type: VRF - Mitsubishi (R2) PURY-P240

Sequencing type: Single

Backup heat source: VRF System #1 - Heating

Reject condenser heat: Heating plant

Reject heat to plant: VRF System #1 - Heating

Heat Rejection

Type: Included In Compressor Power

Hourly ambient wet bulb offset: °F

Thermal Storage

Type: None

Capacity: 0 ton-hr

Schedule: Storage

Buttons: Apply, Close, New Equip, Copy Equip, Delete Equip, Controls..., Packaged Energy Breakout...

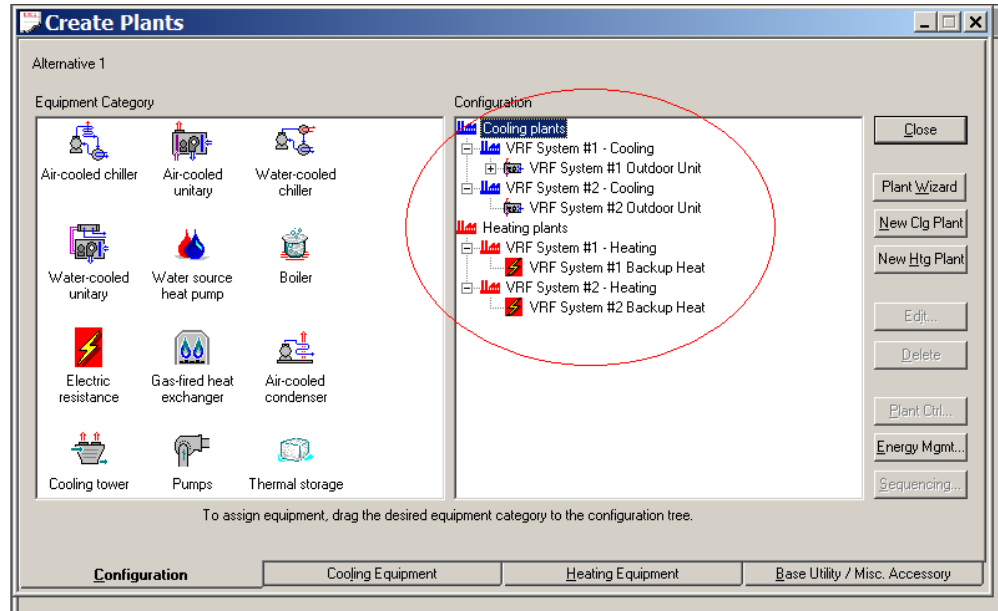
Operating mode	Capacity	Energy rate
Cooling	240 Mbh	21.11 kW
Heat recovery	270 Mbh	22.73 kW
Tank charging	tons	kW/ton
Tank charging & heat recovery	tons	kW/ton

Pumps	Type	Full load consumption
Primary chilled water	None	0 ft water
Condenser water	None	0 ft water
Heat recovery or aux condenser	None	0 ft water

Configuration | **Cooling Equipment** | Heating Equipment | Base Utility / Misc. Accessory

TRACE Modeling Notes Continued

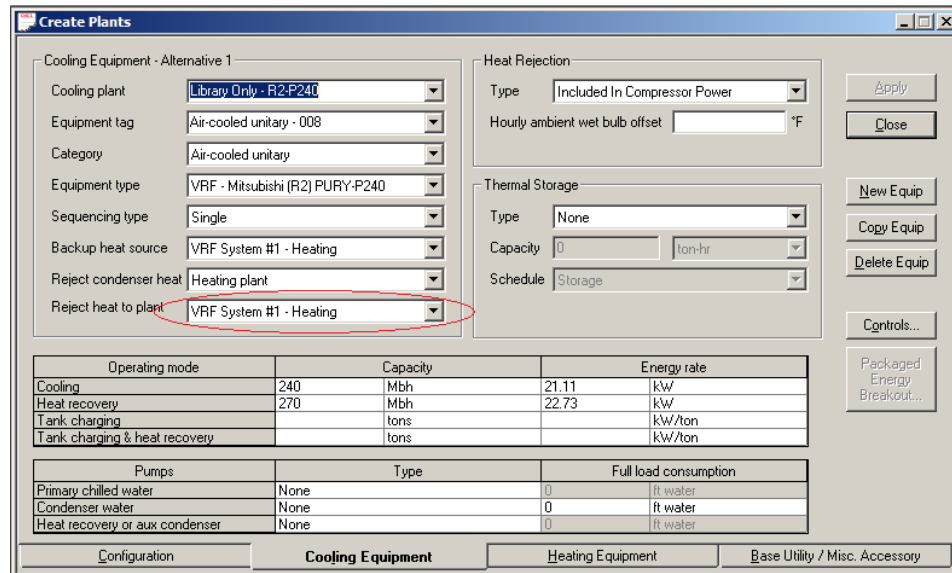
Make sure to create separate heating plants (and cooling plants) that correspond to each VRF outdoor compressor unit system. Since these are independent systems, heat recovery and backup heat occur independently among each outdoor compressor VRF system.



TRACE Modeling Notes Continued

Also remember to select the correct heating plant in the field “Reject heat to plant” under the “Cooling Equipment” Tab for each cooling equipment definition when using the R2 series equipment.

Again, each VRF module should have its’ own cooling plant and backup heating plant in TRACE 700.



Operating mode	Capacity	Energy rate
Cooling	240 Mbh	21.11 kW
Heat recovery	270 Mbh	22.73 kW
Tank charging	tons	kW/ton
Tank charging & heat recovery	tons	kW/ton

Pumps	Type	Full load consumption
Primary chilled water	None	0 ft water
Condenser water	None	0 ft water
Heat recovery or aux condenser	None	0 ft water

Conclusion/Summary

The Trane TRACE 700 software is a robust and complex modeling software program; however, Mitsubishi Electric has neither affiliation nor input into its' computational engine.

Mitsubishi Electric is focused, however, on providing support to engineers and designers to the extent possible to allow them to model VRF systems with software they are trained on and accustomed to using.

Again, it is intended that this information be used as a general guide offering some additional accuracy when modeling Mitsubishi Electric equipment for air cooled systems in the Trane TRACE 700 software.

However, it is ultimately the designer / engineer of record's responsibility to access all information provided.