TRANE®

Installation, Operation, and Maintenance

Sintesis™ Air-Cooled Chillers Model RTAF, 500 Tons

Middle East Applications Only

Supplement to RTAF-SVX001*-EN

⚠SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

April 2022

RTAF-SVX002D-EN

TRANE TECHNOLOGIES™

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

⚠WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/ GHS (Global Harmonized System of Classification and Labeling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

⚠WARNING

Refrigerant under High Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage. System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

Factory Warranty Information

Compliance with the following is required to preserve the factory warranty:

All Unit Installations

Startup MUST be performed by Trane, or an authorized agent of Trane, to VALIDATE this WARRANTY. Contractor must provide a two-week startup notification to Trane (or an agent of Trane specifically authorized to perform startup).

Copyright

Trademarks

Revision History

- Updated Start-Up chapter.
- Updated Wiring chapter.

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Model Number Descriptions

Digits 1, 2 — Unit Model
RT = Rotary Chiller

Digit 3 — Unit Type
A = Air-cooled

Digit 4 — Development Sequence
F = Development Sequence

Digits 5-7 — Nominal Capacity
500 = 500 Nominal Tons

Digit 8— Unit Voltage
C = 380/60/3
G = 400/60/3

Digit 9 — Manufacturing Location
U = Trane Commercial Systems, Pueblo, CO USA

Digits 10, 11— Design Sequence
** = Factory assigned

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H = High Efficiency

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X = Standard Noise

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A = ASME Pressure Vessel Code

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X = No Convenience Outlet

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M = Modbus™ Interface
L = LonTalk® Interface

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X = None
A = Hard Wired Bundle - All
B = Remote Leaving Water Temp Setpoint
C = Remote Leaving Temp and Demand Limit Setpoints
D = Programmable Relay
E = Programmable Relay and Leaving Water and Demand Limit Setpoint
F = Percent Capacity
G = Percent Capacity and Leaving Water and Demand Limit Setpoint
H = Percent Capacity and Programmable Relay

Digit 34 — Energy Meter
X = None

Digit 35 — Smart Flow Control
X = None

Digit 36 — Structural Options
A = Standard Unit Structure

Digit 37 — Appearance Options
X = No Appearance Options

Digit 38 — Unit Isolation
X = None
1 = Elastomeric Isolators

Digit 39 — Shipping Package
X = No Shipping Package
T = Shipped with Tarp Covering Full Unit

Digits 40-42
XXX= Reserved for future use

Digit 43 — Special Requirement
0 = None
S = Special Requirement

General Information

This manual is a supplement to Sintesis™ RTAF Installation, Operation, and Maintenance Manual RTAF-SVX001*-EN, and provides information on the RTAF configuration specifically designed for Middle East applications. Not all options listed in RTAF IOM RTAF-SVX001*-EN are available for this configuration.

General Data

Table 1. General data — 500 tons unit, middle east configuration

Compressor Model (ckt 1/ckt 2)[a]		120-120/120-120
Quantity	#	4
Evaporator		
Water Connection Size	in	8
Passes	#	1
Water Storage	gal (L)	46.1 (174.7)
Minimum Flow	gpm (l/s)	506 (31.9)
Maximum Flow	gpm (l/s)	1855 (117.1)
Condenser		
Qty of Coils (ckt 1/ckt 2)		14/14
Coil Length	in (mm)	77.4 (1967)
Coil Height	in (mm)	47.8 (1214)
Condenser Fans		
Fan Type		Fixed
Quantity (ckt 1/ckt 2)	#	14/14
Diameter	in (mm)	31.5 (800)
Nominal Speed	rpm	1030
Airflow	cfm (m^3/sec)	11800 (5.6)
Tip Speed	ft/min (m/s)	8493 (43.1)
Ambient Temperature Range		
High Ambient	°F (°C)	32 to 130 (0 to 54.4)
General Unit		
Refrigerant Ckts	#	2
Minimum Load	%	15
Refrigerant		R-134a
Refrigerant Charge (ckt 1/ckt 2)	lbs (kg)	310.6/323.3 (140.9/146.6)
Oil		Trane Oil 00311 (bulk)/OIL00315 (1 gal)/OIL00317 (5 gal)
Oil Charge (ckt 1/ckt 2)	gal (L)	4.33/4.37 (16.4/16.5)

(a) Nominal tonnage at 60 Hz. Where there are 2 compressors on a circuit, they are indicated 1A-1B/2A-2B.

Operating Principles

Circuit Schematic

Figure 1. Schematic, refrigerant and oil systems — RTAF middle east configuration

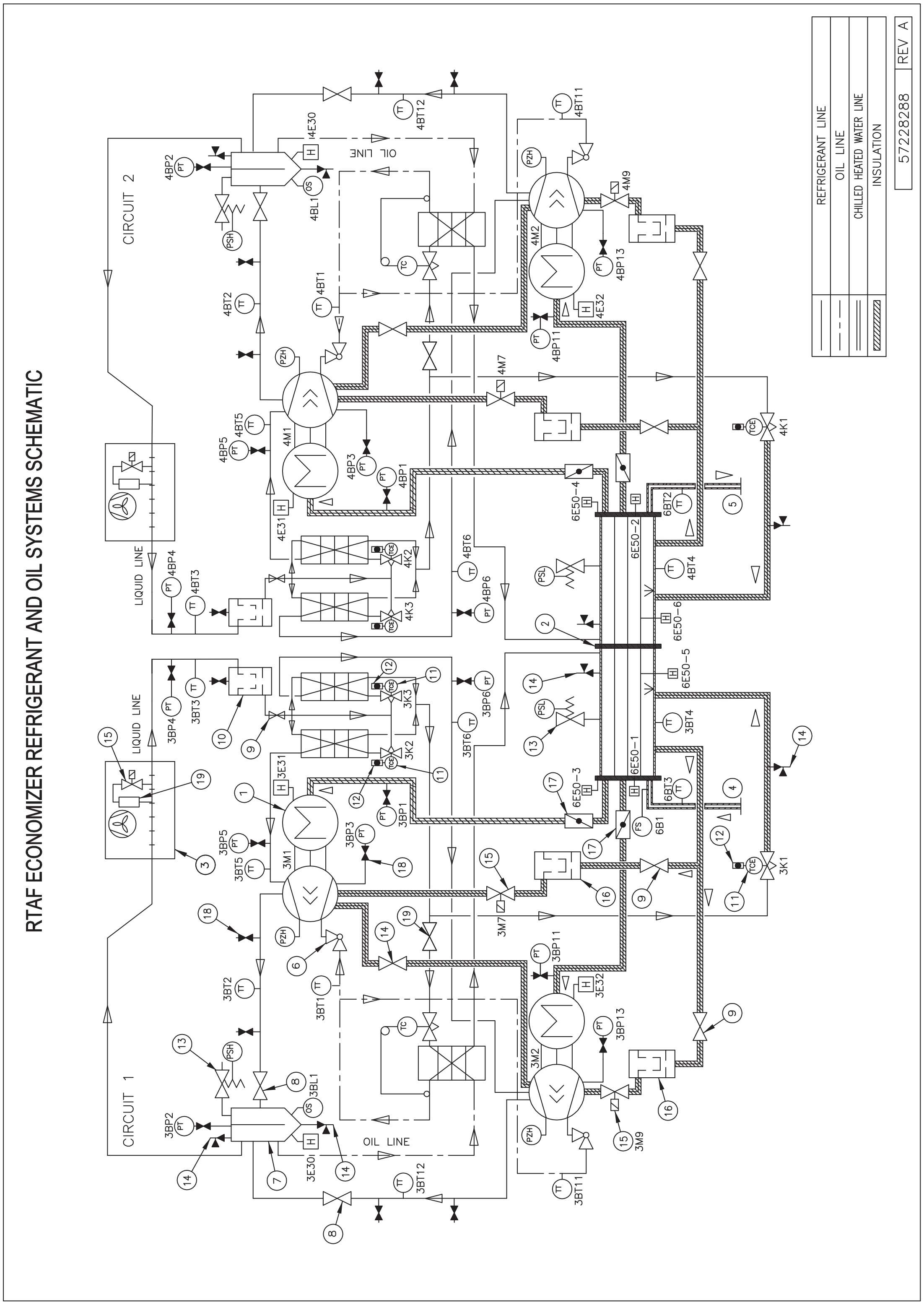


Table 2. Legend

No	Description	No	Description	No	Description
1	Screw Compressor	11	Electronic Expansion Valve	PT	Pressure Transducer
2	Evaporator	12	Sight Glass	PSH	High Pressure Relief Valve
3	Air-Cooled Condenser	13	Relief Valve	PSL	Low Pressure Relief Valve
4	Evaporator Water Inlet Connection	14	Service Valve	PZH	High Pressure Switch
5	Evaporator Water Outlet Connection	15	Solenoid Valve	TT	Temperature Sensor
6	Oil Service Valve	16	Oil Filter	TCE	Electronic Expansion Valve
7	Oil Separator	17	Suction Service Valve	TC	Expansion Valve
8	Discharge Service Valve	18	Schrader Valve	OS	Optical Sensor
9	Shutoff Valve	19	Refrigerant Tank	FS	Flow Switch
10	Filter Drier			H	Heater

Table 3. Device designators

Device	Description	Device	Description
3BL1	Level Sensor; Oil Loss - Ckt 1	4BL1	Level Sensor; Oil Loss - Ckt 2
3BP1	Pressure Transducer; Suction Pressure - Ckt 1A	4BP1	Pressure Transducer; Suction Pressure - Ckt 2A
3BP2	Pressure Transducer; Discharge Pressure - Ckt 1	4BP2	Pressure Transducer; Discharge Pressure - Ckt 2
3BP3	Pressure Transducer; Oil Pressure - Ckt 1A	4BP3	Pressure Transducer; Oil Pressure - Ckt 2A
3BP4	Pressure Transducer; Liquid Pressure Microchannel Evap - Ckt 1	4BP4	Pressure Transducer; Liquid Pressure Microchannel Evap - Ckt 2
3BP5	Economizer Pressure Sensor Circuit 1A	4BP5	Economizer Pressure Sensor Circuit 2A
3BP6	Economizer Pressure Sensor Circuit 1B	4BP6	Economizer Pressure Sensor Circuit 2B
3BP11	Pressure Transducer; Suction Pressure - Ckt 1B	4BP11	Pressure Transducer; Suction Pressure - Ckt 2B
3BP13	Pressure Transducer; Oil Pressure - Ckt 1B	4BP13	Pressure Transducer; Oil Pressure - Ckt 2B
3BT1	Temperature Sensor; Oil Temperature - Ckt 1A	4BT1	Temperature Sensor; Oil Temperature - Ckt 2A
3BT2	Temperature Sensor; Discharge Temperature - Ckt 1A	4BT2	Temperature Sensor; Discharge Temperature - Ckt 2A
3BT3	Temperature Sensor; Liquid Line Temperature Microchannel Evap - Ckt 1A	4BT3	Temperature Sensor; Liquid Line Temperature Microchannel Evap - Ckt 2A
3BT4	Temperature Sensor; Evap Pool Temperature - Ckt 1A	4BT4	Temperature Sensor; Evap Pool Temperature - Ckt 2A
3BT5	Economizer Fast-acting Temperature Sensor - Ckt 1A	4BT5	Economizer Fast-acting Temperature Sensor - Ckt 2A
3BT6	Economizer Fast-acting Temperature Sensor - Ckt 1B	4BT6	Economizer Fast-acting Temperature Sensor - Ckt 2B
3BT11	Temperature Sensor; Oil Temperature - Ckt 1B	4BT11	Temperature Sensor; Oil Temperature - Ckt 2B
3BT12	Temperature Sensor; Discharge Temperature - Ckt 1B	4BT12	Temperature Sensor; Discharge Temperature - Ckt 2B
3K1	Electronic Expansion Valve - Ckt 1A	4K1	Electronic Expansion Valve - Ckt 2A
3K2	Economizer Expansion Valve - Ckt 1A	4K2	Economizer Expansion Valve - Ckt 2A
3K3	Economizer Expansion Valve - Ckt 1B	4K3	Economizer Expansion Valve - Ckt 2B
3M1	Motor; Compressor 1A	4M1	Motor; Compressor 2A
3M2	Motor; Compressor 1B	4M2	Motor; Compressor 2B
3M7	Solenoid; Oil - Compressor 1A	4M7	Solenoid; Oil - Compressor 2A
3M9	Solenoid; Oil - Compressor 1B	4M9	Solenoid; Oil - Compressor 2B
6B1	Switch; Evaporator Water Flow	6E50-1	Submersion Heater; Evaporator Shell Antifreeze Heater
6BT2	Temperature Sensor; Evaporator Leaving Water Temperature	6E50-2	Submersion Heater; Evaporator Shell Antifreeze Heater
6BT3	Temperature Sensor; Evaporator Entering Water Temperature	6E50-3	Submersion Heater; Evaporator Shell Antifreeze Heater
		6E50-4	Submersion Heater; Evaporator Shell Antifreeze Heater
		6E50-5	Heat Tape; Evaporator Shell Antifreeze Heater
		6E50-6	Heat Tape; Evaporator Shell Antifreeze Heater

Economizer

The economizer system's two main components are an electronic expansion valve (EXV) and a brazed plate heat exchanger (BPHE).

The liquid flow leaving the condenser is routed through the economizer BPHE. One side is the economizer refrigerant flow and the other side is the evaporator refrigerant flow.

The economizer flow is expanded to a lower pressure and temperature through the economizer EXV, then routed through the BPHE to be superheated, and injected into the compressor. The evaporator flow is subcooled further in the BPHE and continues on to the evaporator EXV.

Start-Up and Shutdown

Important: *Initial unit commissioning start-up must be performed by Trane or an agent of Trane specifically authorized to perform start-up and warranty of Trane products. Contractor shall provide Trane (or an agent of Trane specifically authorized to perform start-up) with notice of the scheduled start-up at least two weeks prior to the scheduled start-up.*

Unit Start-Up

NOTICE

Equipment Damage!

Failure to follow instructions could result in equipment damage.
Ensure that the compressor and oil sump heaters have been operating properly for a minimum of 24 hours before starting.

NOTICE

Equipment Damage!

Snow, ice, or debris build up on fans could cause excessive imbalance and equipment damage.
Clear fans of build up prior to machine start-up.

If required, once the system has been operating for approximately 30 minutes and has become stabilized, complete the remaining start-up procedures, as follows:

1. Check the evaporator refrigerant pressure and the condenser refrigerant pressure under Refrigerant Report on the AdaptiView ™ TD7. The pressures are referenced to sea level (14.6960 psia).
2. Check the EXV sight glasses after sufficient time has elapsed to stabilize the chiller. The refrigerant flow past the sight glasses should be clear. Bubbles in the refrigerant indicate either low refrigerant charge or excessive pressure drop in the liquid line or a stuck open expansion valve. A restriction in the line can sometimes be identified by a noticeable temperature differential between the two sides of the restriction. Frost will often form on the line at this point. Proper refrigerant charges are shown in the General Information Section.

Important: *A clear sight glass alone does not mean that the system is properly charged. Also check system subcooling, liquid level control and unit operating pressures.*

If chiller is limited by any limiting conditions, contact local Trane service organization for more information.

Temporary Shutdown And Restart

To shut the unit down for a short time, use the following procedure:

1. Press the STOP key on the Adaptiview TD7. The compressors will continue to operate and an operational pumpdown cycle will be initiated.
2. Symbio™ 800 pump control will turn off the pump (after a minimum 1 min. delay) when the STOP key is pressed and automatically restart the pump when the unit starts normally.
3. The unit will start normally, provided the following conditions exist:
   a. The Symbio™ 800 receives a call for cooling and the differential-to-start is above the setpoint.
   b. All system operating interlocks and safety circuits are satisfied.

Extended Shutdown Procedure

The following procedure is to be followed if the system is to be taken out of service for an extended period of time, e.g. seasonal shutdown:

1. Test the unit for refrigerant leaks and repair as necessary.
2. Open the electrical disconnect for the chilled water pump. Lock the switches in the "OPEN" position.

NOTICE

Pump Damage!

Failure to follow instructions could result in pump damage.
Lock the chilled water pump disconnects open and verify pump is off before draining water.

3. Close all chilled water supply valves. Drain the water from the evaporator.
4. With the water drained from evaporator, disconnect 115 power from evaporator heaters at terminals 1X4-1 and 1X4-2.

NOTICE

Heater Damage!

Failure to follow instructions could result in heater damage.
Do not apply power to the evaporator heaters when no water is present.

5. Open the main electrical disconnect and lock in the "OPEN" position.

NOTICE

Equipment Damage!

Failure to follow instructions could result in equipment damage.
Lock the disconnect in the “OPEN” position to prevent accidental start-up and damage to the system when it has been shut down for extended periods.

6. At least every three months (quarterly), check the refrigerant pressure in the unit to verify that the refrigerant charge is intact.

Seasonal Unit Start-Up Procedure

1. Close all valves and re-install the drain plugs in the evaporator.
2. Service the auxiliary equipment according to the start-up/maintenance instructions provided by the respective equipment manufacturers.
3. Close the vents in the evaporator chilled water circuits.
4. Open all the valves in the evaporator chilled water circuits.
5. Open all refrigerant valves to verify they are in the open condition.
6. If the evaporator was previously drained, vent and fill the evaporator and chilled water circuit. When all air is removed from the system (including each pass), install the vent plugs in the evaporator water boxes.
7. Check the adjustment and operation of each safety and operating control.
8. Refer to the sequence for daily unit startup for the remainder of the seasonal startup.

System Restart After Extended Shutdown

NOTICE

Equipment Damage!

Failure to follow instructions could result in equipment damage.
Ensure that the compressor and oil sump heaters have been operating properly for a minimum of 24 hours before starting.

Follow the procedures below to restart the unit after extended shutdown:

1. Verify that the liquid line service valves, oil line, compressor discharge service valves and suction service valves are open (backseated).

NOTICE

Compressor Damage!

Failure to follow instructions below could cause catastrophic damage to the compressor.
Do not leave oil line shut off valve or the isolation valves closed on unit start-up.

2. Check the oil sump level.
3. Fill the evaporator water circuit. Vent the system while it is being filled. Open the vent on the top of the evaporator and condenser while filling and close when filling is completed.

NOTICE

Proper Water Treatment Required!

The use of untreated or improperly treated water could result in scaling, erosion, corrosion, algae or slime. Use the services of a qualified water treatment specialist to determine what water treatment, if any, is required. Trane assumes no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.

4. Close the fused-disconnect switches that provides power to the chilled water pump.
5. Start the evaporator water pump and, while water is circulating, inspect all piping for leakage. Make any necessary repairs before starting the unit.
6. While the water is circulating, adjust the water flows and check the water pressure drops through the evaporator. For water flow rates see “General Data,” p. 6.
7. Verify proper operation of flow switch on the evaporator waterbox.
8. Stop the water pump. The unit is now ready for start-up as described previously.

Sequence of Operation

This section will provide basic information on chiller operation for common events. With microelectronic controls, ladder diagrams cannot show today's complex logic, as the control functions are much more involved than older pneumatic or solid state controls.

Adaptive control algorithms can also complicate the exact sequence of operations. This section illustrates common control sequences.

Software Operation Overview

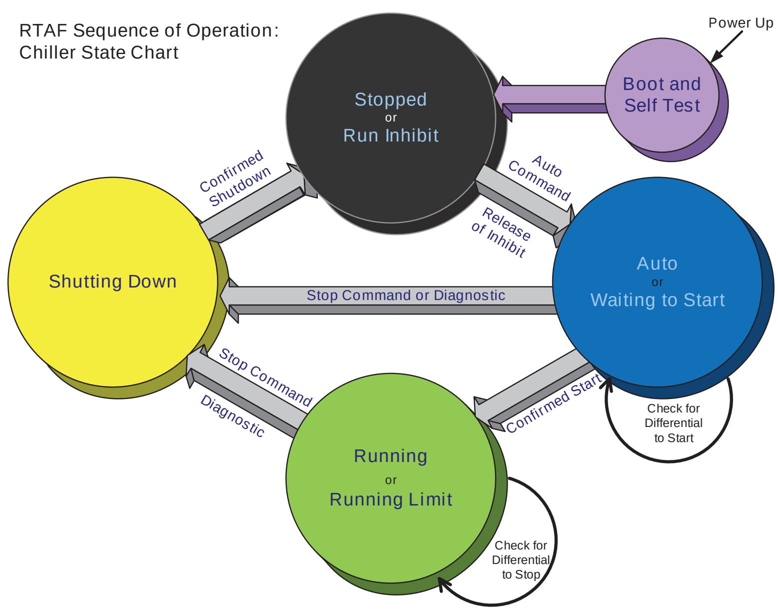
The Software Operation Overview shown below is a diagram of the five possible software states. This diagram can be though of as a state chart, with the arrows and arrow text depicting the transitions between states.

- The text in the circles is the visible top level operating mode displayed on Tracer™ AdaptiView.
- The shading of each software state circle corresponds to the shading on the time lines that show the state the chiller is in.

There are five generic states that the software can be in:

- Power Up
- Stopped
- Starting
- Running
- Stopping

Figure 2. Software operation overview



Timelines

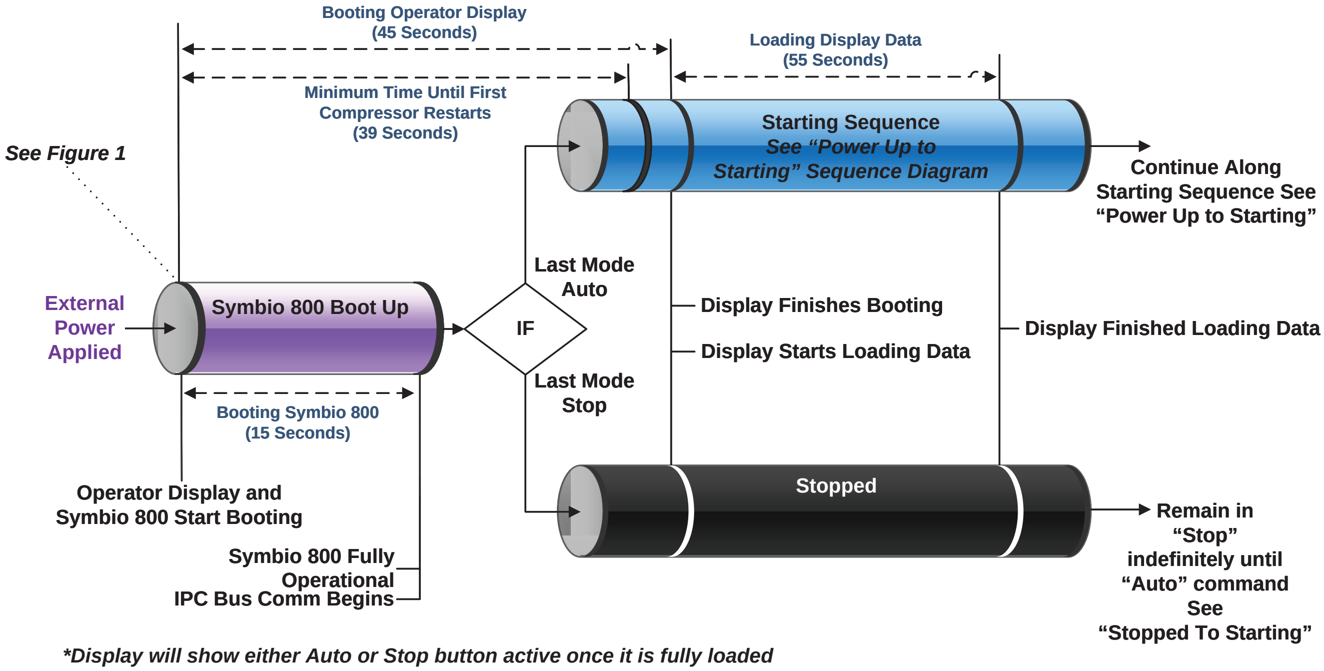
- The time line indicates the upper level operating mode, as it would be viewed on the Tracer AdaptiView.
- The shading color of the cylinder indicates the software state.
- Text in parentheses indicates sub-mode text as viewed on Tracer AdaptiView.
- Text above the time line cylinder is used to illustrate inputs to the Main Processor. This may include user input to the Tracer AdaptiView Touch screen, control inputs from sensors, or control inputs from a Generic BAS.
- Boxes indicate control actions such as turning on relays, or pulsing compressor load or unload solenoids.
- Smaller cylinders under the main cylinder indicate diagnostic checks.
- Text outside a box or cylinder indicates time based functions.
- Solid double arrows indicate fixed timers.
- Dashed double arrows indicate variable timers.

Important: *Sequence of events timelines include options that may not be available on specific unit configurations.*

Power Up Diagram

The Power up chart shows the respective TD-7 AdaptiView screens during a power up of the Symbio™ 800 and display. This process takes 25 seconds for the Symbio™ 800 and 100 seconds for the display. On all power ups, the software model always will transition through the 'Stopped' Software state independent of the last mode. If the last mode before power down was 'Auto', the transition from 'Stopped' to 'Starting' occurs, but it is not apparent to the user.

Figure 3. Sequence of operation: power up diagram



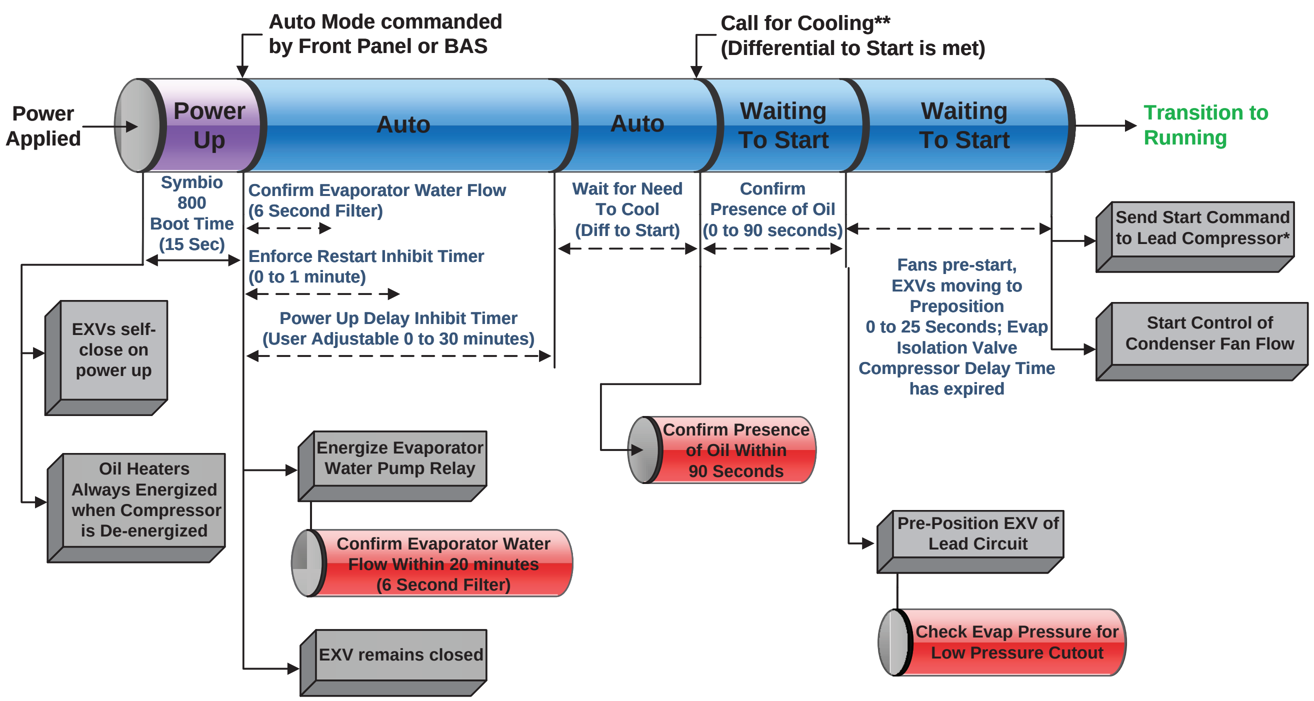
Power Up to Starting

The Power up to starting diagram shows the timing from a power up event to energizing the 1st compressor. The shortest allowable time would be under the following conditions:

- No motor restart inhibit time left from subsequent starts
- Evaporator Water flow occurs quickly with pump on command
- Power up Start Delay set to 0 minutes
- Need to cool (differential to start) already exists
- Oil level is detected immediately

The above conditions would allow for a minimum power up to starting the 1st compressor time of about 45 seconds (variations may exist due to options installed). Note that it is not advisable to start a chiller "cold", the oil heaters should be in operation for a sufficient length of time prior to first start. Consult the chiller's IOM for specifics.

Figure 4. Sequence of events: power up to starting



**If Free Cooling is available, it shall be the first level control to start.

Partial Free Cooling: will always be attached to circuit 1 and circuit 2 will be the lead circuit. If Free Cooling is available, then both compressors on circuit 2 should start before starting a compressor on circuit 1.

Total Free Cooling: balanced starts and hours or circuit x lead are available. However, just like Partial Free Cooling, both compressors on a circuit should be running before starting the other circuit.

*** Lead Compressor (and its lead circuit) is determined by staging algorithm – "Balanced", "Circuit 1 Lead", or "Circuit 2 Lead" selection – also influenced by lockouts, restart inhibit, or diagnostics present***

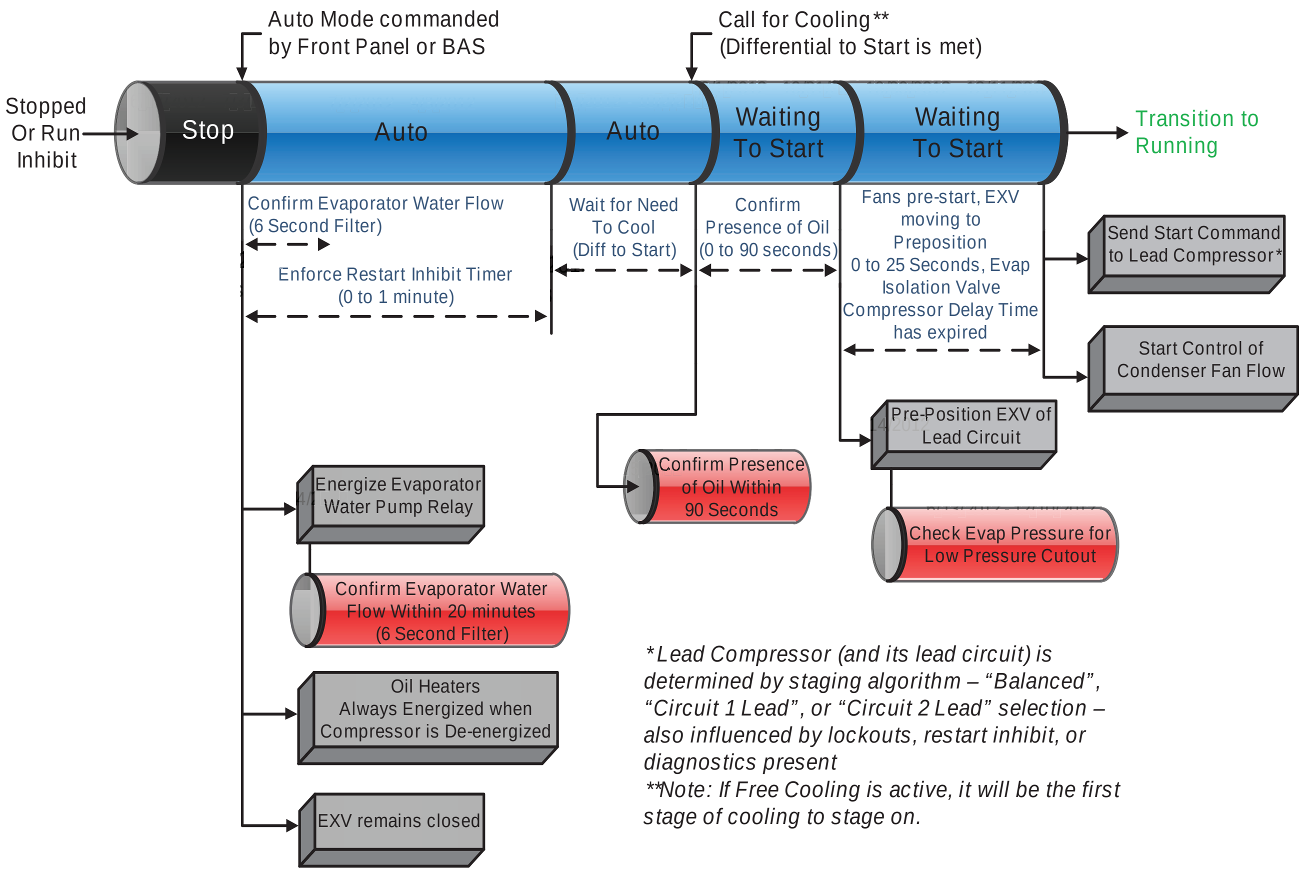
Stopped to Starting

The figure below shows the timing from a stopped mode to energizing the first compressor. The shortest allowable time would be under the following conditions:

- No motor restart inhibit time left from subsequent starts
- Evaporator Water flow occurs quickly with pump on command
- Need to cool (differential to start) already exists

The above conditions would allow a compressor to start in about 20 seconds.

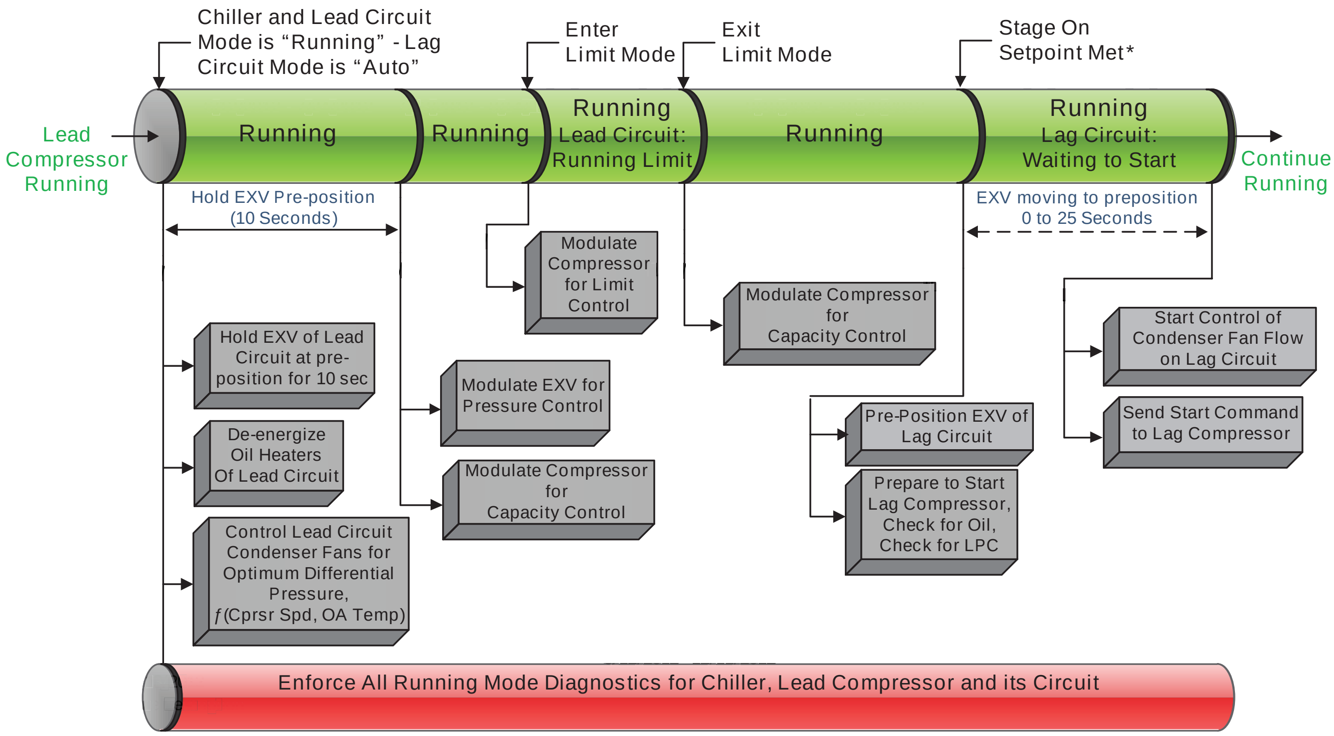
Figure 5. Sequence of events: stopped to starting



Running (Lead Compressor/Circuit Start and Run)

The figure below shows a typical start and run sequence for the lead compressor and its circuit.

Figure 6. Sequence of operation: running (lead compressor/circuit start nd run)

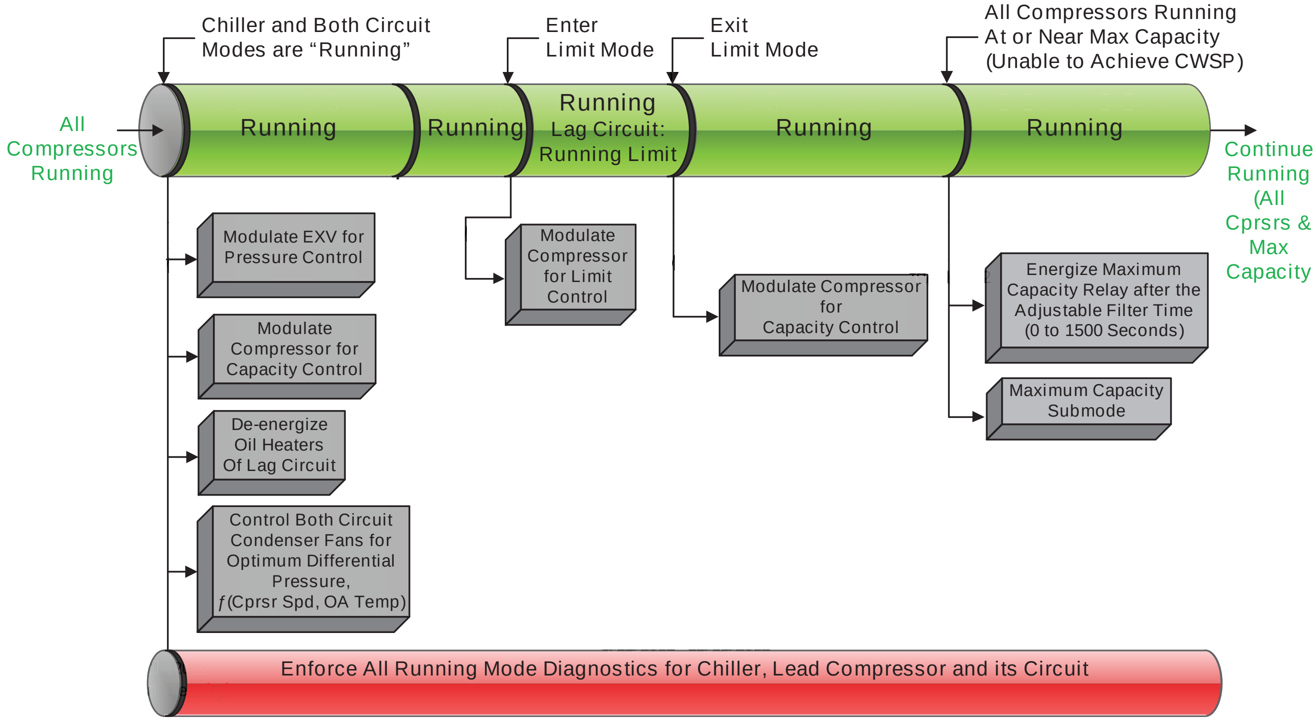


**Note: The decision to stage on or off another compressor is determined by the Average Running Compressor Load Command, Water Temperature Error, and Time Since Last Stage*
Circuit X Lead: A compressor on the selected circuit will lead followed by a compressor on the alternate circuit, given an appropriately increasing chiller load. Additional compressors will alternate between lead and lag circuits. Variable speed compressors will always be the first compressors to start and last compressors to stop.

Running (Lag Compressor/Circuit Start and Run)

The figure below shows a typical start and run sequence for the lag compressor and its circuit.

Figure 7. Sequence of operation: running (lag compressor/circuit start nd run)

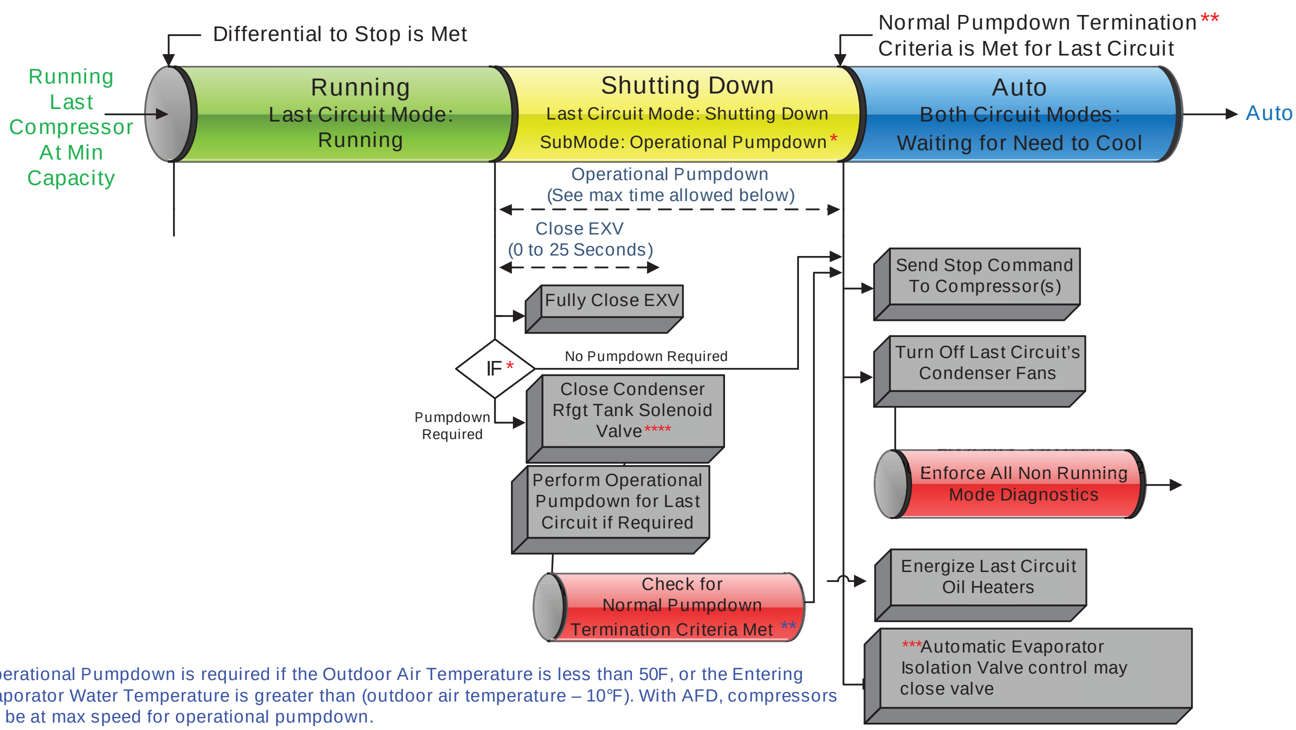


**Note:* The decision to stage on or off another compressor is determined by the Average Running Compressor Load Command, Water Temperature Error, and Time Since Last Stage*

Satisfied Setpoint

The figure below shows the normal transition from Running to shutting down due to the Evap Leaving water temp falling below the differential to stop setpoint.

Figure 8. Sequence of events: satisfied setpoint



*Operational Pumpdown is required if the Outdoor Air Temperature is less than 50F, or the Entering Evaporator Water Temperature is greater than (outdoor air temperature – 10°F). With AFD, compressors will be at max speed for operational pumpdown.

** Operational pumpdown is terminated normally in the following configurations when:

Water with 2-Pass Evaporator:
- The evaporator (suction) pressure is at or below the "Pumpdown Termination Pressure" setting OR LERTC saturated pressure (28.6F), which ever is greater
- The condenser (compressor discharge) pressure exceeds 315psia.
- The compressor pressure ratio exceeds 8.
- The system differential pressure exceeds 265psid or < 25min.

Glycol with 2-Pass Evaporator:
- The evaporator (suction) pressure is at or below the "Pumpdown Termination Pressure" setting OR LERTC saturated pressure (per guidance -5F minimum), which ever is greater
- The condenser (compressor discharge) pressure exceeds 315psia.
- The compressor pressure ratio exceeds 8.
- The system differential pressure exceeds 265psid or < 25min.

Water with Single Pass Evaporator:
- The evaporator (suction) pressure is at or below the "Pumpdown Termination Pressure" setting OR LERTC saturated pressure (32F), which ever is greater
- The condenser (compressor discharge) pressure exceeds 315psia.
- The compressor pressure ratio exceeds 12.3
- The system differential pressure exceeds 265psid.

Glycol with Single Pass Evaporator:
- The evaporator (suction) pressure is at or below the "Pumpdown Termination Pressure" setting OR LERTC saturated pressure (per guidance -5F minimum), which ever is greater
- The condenser (compressor discharge) pressure exceeds 315psia.
- The compressor pressure ratio exceeds 12.3
- The system differential pressure exceeds 265psid.

The maximum allowed time for Operational Pumpdown is Max Pumpdown Time setting (default to 120 sec.) * number of compressors configured on the circuit.

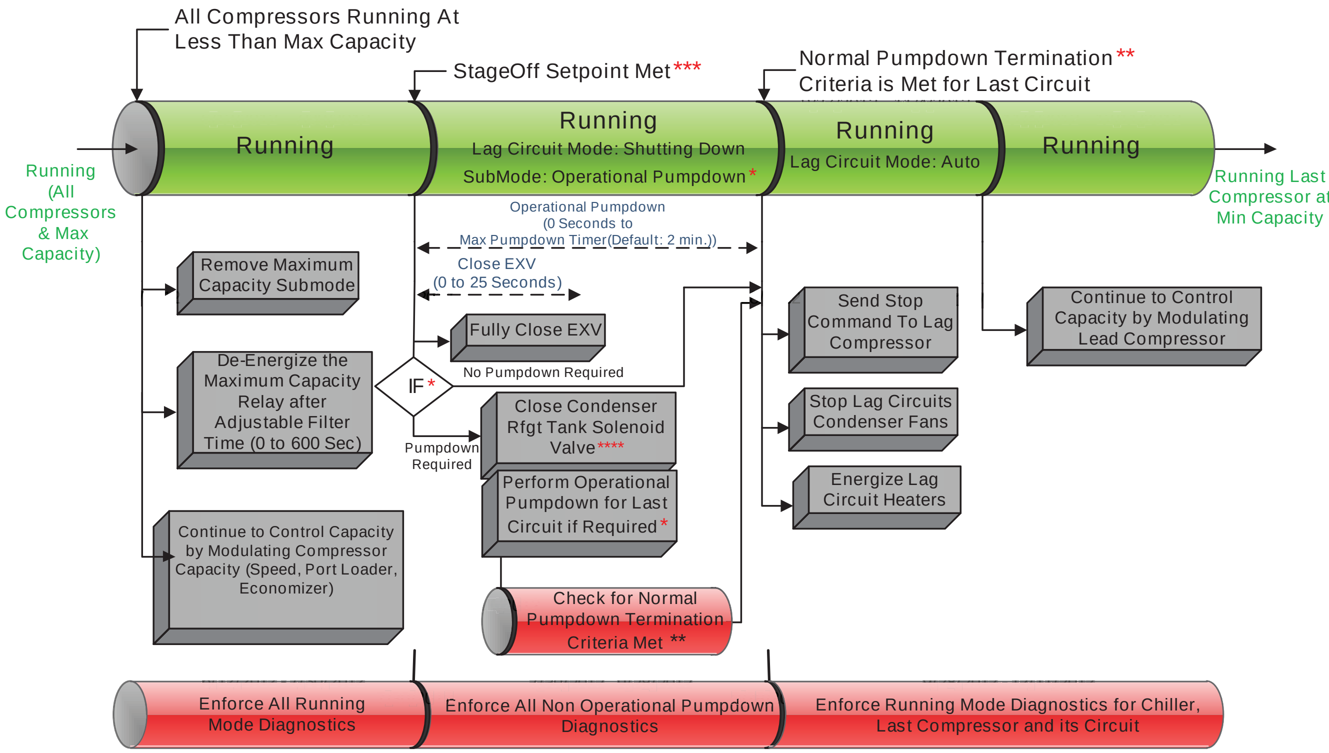
***Automatic evaporator isolation valve control will close valve if Outdoor Ambient Air Temperature at circuit shutdown is less than evaporator leaving water cutout setpoint plus 3°C.

****If Condenser Refrigerant Tanks are installed

Unloading Unstaging

The figure below shows the normal transition from full load to minimum load while the chiller is running.

Figure 9. Sequence of events: Unloading unstaging



* Operational Pumpdown is required if the Outdoor Air Temperature is less than 50F, or the Entering Evaporator Water Temperature is greater than (outdoor air temperature – 10F). With AFD, compressors will be at max speed for operational pumpdown.

**Operational Pumpdown - See Satisfied Setpoint Operational Pumpdown sequence diagram for specific criteria.

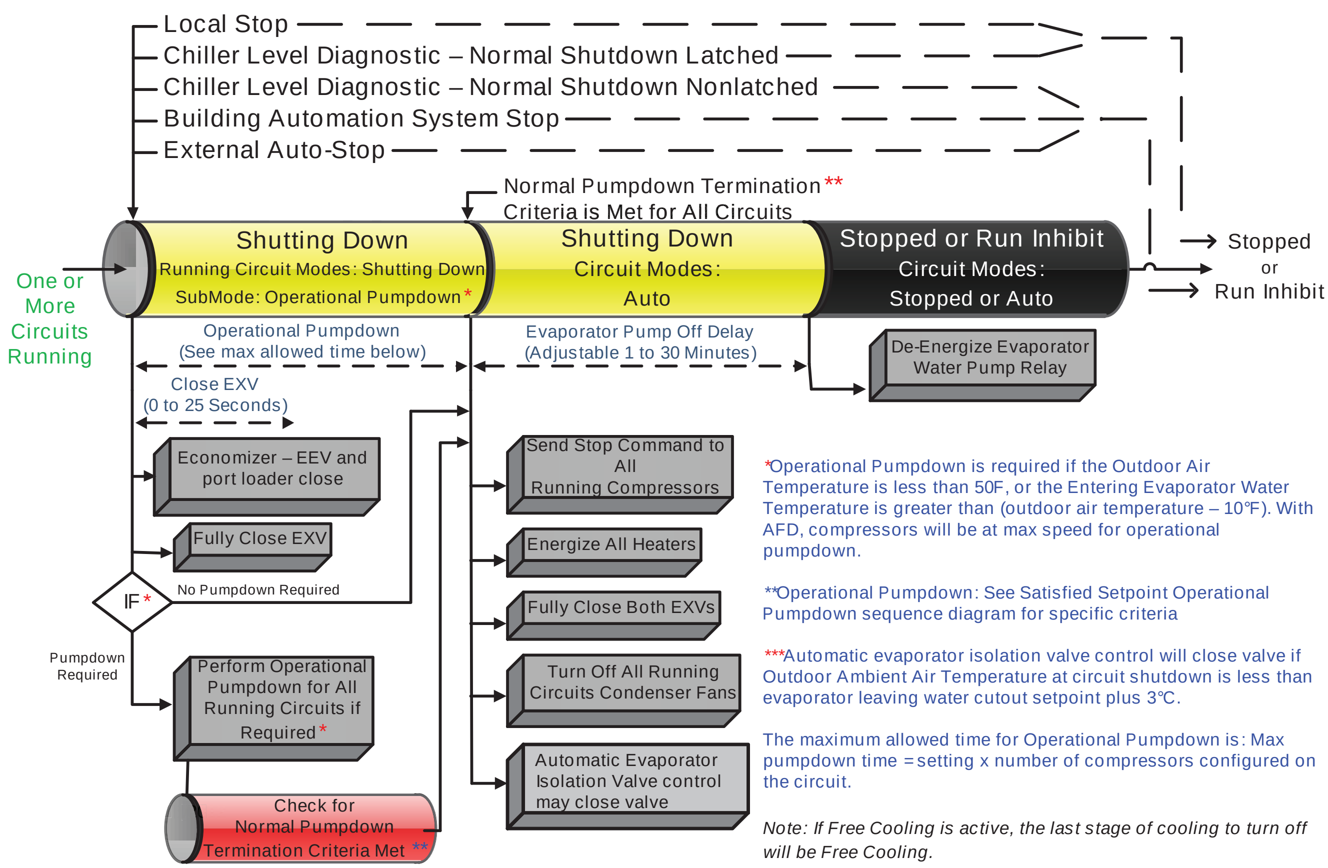
*** Note: The decision to stage off another compressor is determined by the Average Running Compressor Load Command, Water Temperature Error, and Time since Last Stage. Compressors will stage off in the reverse order they staged on. All fixed speed compressors will stage off before variable speed compressors stage off.

**** If Condenser Refrigerant Tank is installed.

Normal Shutdown to Stopped or Run Inhibit

The figure below shows the Transition from Running through a Normal (friendly) Shutdown. The Dashed lines on the top attempt to show the final mode if you enter the stop via various inputs.

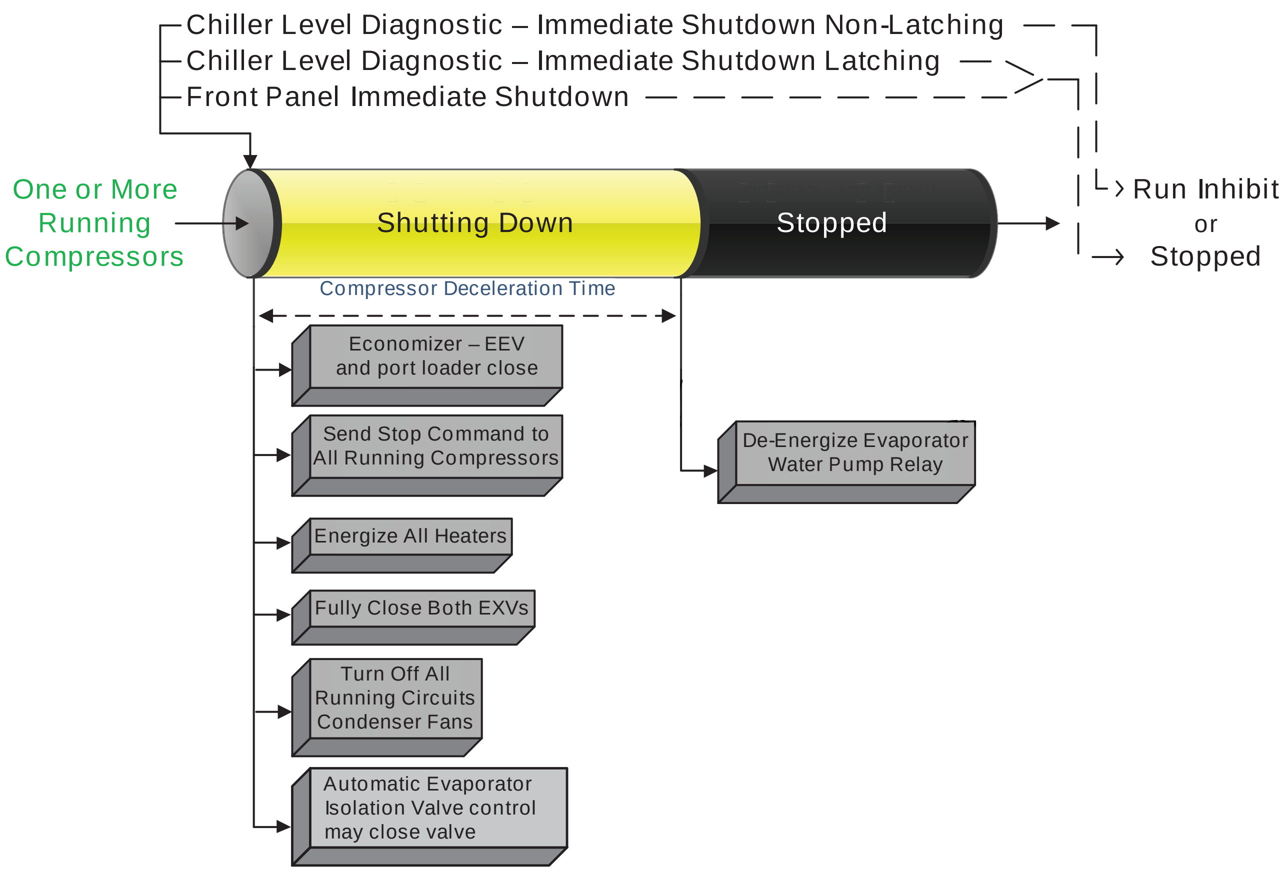
Figure 10. Sequence of events: normal shutdown to stopped or run inhibit



Immediate Shutdown to Stopped or Run Inhibit

The figure below shows the transition from Running through an Immediate Shutdown. The dashed lines on the top attempt to show the final mode if you enter the stop via various inputs.

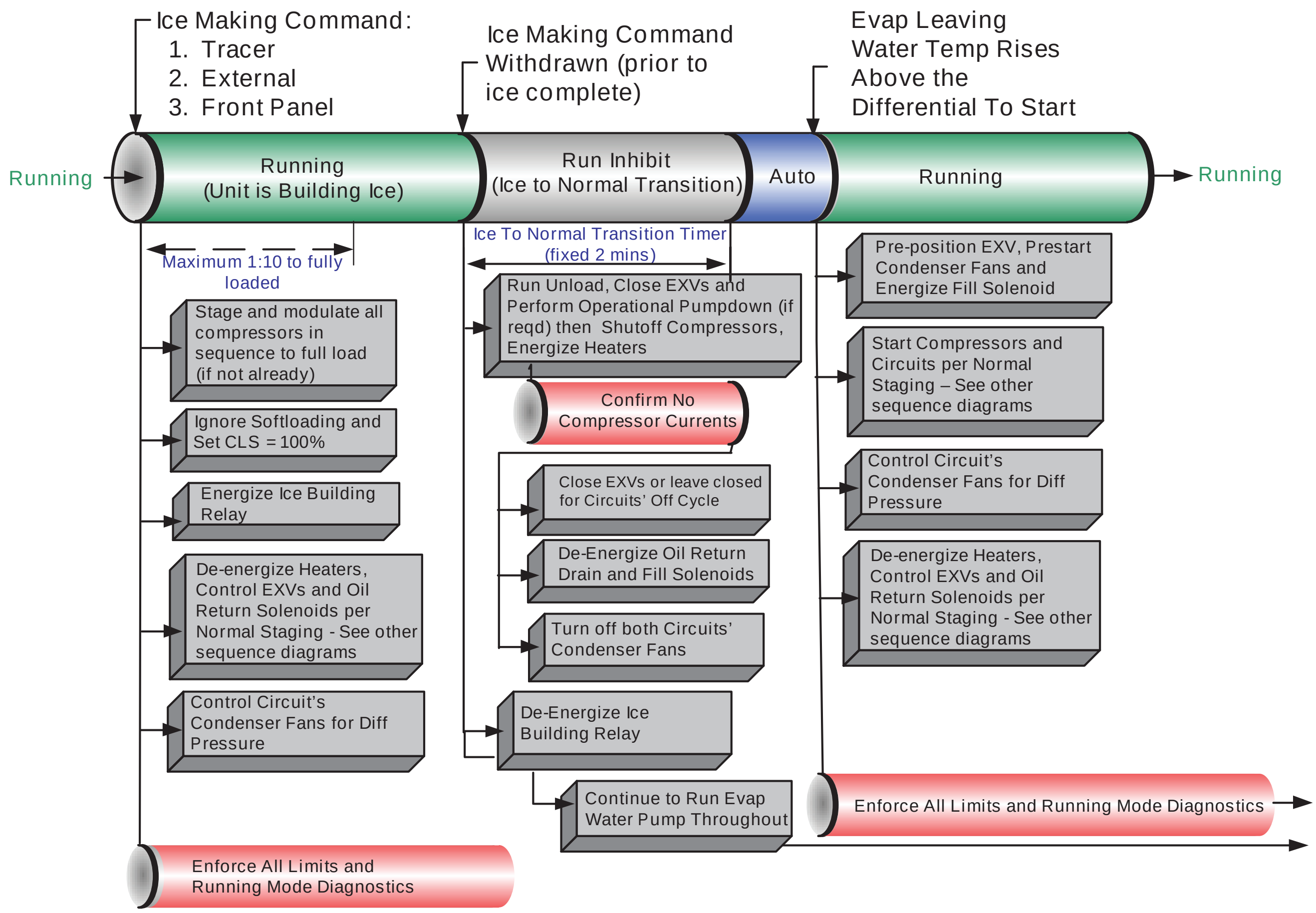
Figure 11. Sequence of events: immediate shutdown to stopped or run inhibit



Ice Making (Running to Ice Making to Running)

The figure below shows the transition from normal cooling to Ice making, back to normal cooling.

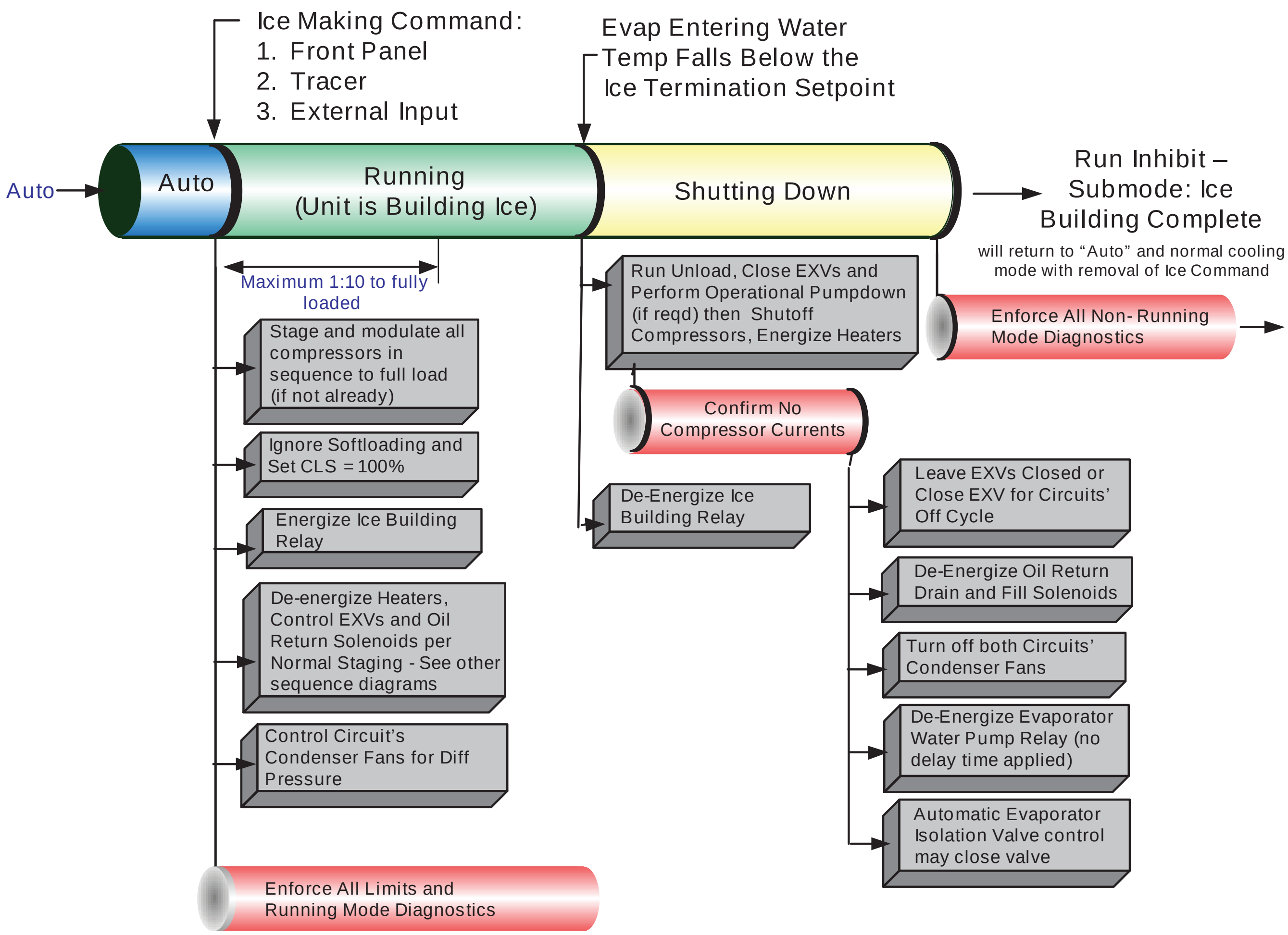
Figure 12. Sequence of events: ice making (running to ice making to running)



Ice Making (Auto to Ice Making to Ice Making Complete)

The figure below shows the transition from Auto to Ice making, to Ice Making Complete.

Figure 13. Sequence of events: ice making (auto to ice making to ice making complete)



Diagnostics

This list includes only those diagnostics unique to Middle East application configuration. See Sintesis™ RTAF Installation, Operation, and Maintenance Manual RTAF-SVX001*-EN for full unit diagnostics list.

Diagnostic Name (Text) and Source:

Black text is the full-context diagnostic name with few or no abbreviations. It has no intrinsic length limit. It may be used as a guide for translation, or in a human interface that can handle the unlimited length text. It is not currently used in any human interface.

Where diagnostic text is different from full-context diagnostic name:

- ***Italicized*** *text is intended for use on the Service Tool or on the operator Display.*
- <u>**Underlined** text is intended for use on LCI-C</u>.

Diagnostic Name Source: Diagnostics may be shown in the spec with a source of "xy". In this case, letter "x" can be either "1" or "2" (signifying which circuit) and letter "y" can be "A" or "B" (signifying which compressor on that circuit).

Affects Target: Defines the "target" or what is affected by the diagnostic. Usually either the entire Chiller, or a particular Circuit or Compressor is affected by the diagnostic (the same one as the source), but in special cases functions are modified or disabled by the diagnostic. None implies that there is no direct affect to the chiller, sub components or functional operation.

Design Note: TU does not support the display of certain targets on its Diagnostics pages although the functionality implied by this table is supported. Targets such as Evap Pump, Ice Mode, Heat Mode, Chilled Water Reset, External Setpoints etc. – are displayed as simply "Chiller" even though they do not imply a chiller shutdown – only a compromise of the specific feature.

Severity: Defines the severity of the above effect. Immediate means immediate shutdown of the affected portion; for AFD generated diagnostics, Immediate implies immediately de-energized compressor windings, while Immediate (decel) implies controlled deceleration to compressor stop. Normal means normal or friendly shutdown of the affected portion, Special Action means a special action or mode of operation (limp along) is invoked, but without shutdown, and Info means an Informational Note or Warning is generated. Design Note: TU does not support display of "Special Action", on its Diagnostics pages, so that if a diagnostic has a special action defined in the table below, it will be displayed only as "Informational Warning" as long as no circuit or chiller shutdown results. If there is a shutdown and special action defined in the table, then the TU Diagnostics Page display will indicate the shutdown type only.

Persistence: Defines whether or not the diagnostic and its effects are to be manually reset (Latched), or can be either manually or automatically reset when and if the condition returns to normal (Nonlatched).

Active Modes [Inactive Modes]: States the modes or periods of operation that the diagnostic is active in and, as necessary, those modes or periods that it is specifically "not active" in as an exception to the active modes. The inactive modes are enclosed in brackets, [ ]. Note that the modes used in this column are internal and not generally annunciated to any of the formal mode displays.

Criteria: Quantitatively defines the criteria used in generating the diagnostic and, if nonlatching, the criteria for auto reset. If more explanation is necessary a hot link to the Functional Specification is used.

Reset Level: Defines the lowest level of manual diagnostic reset command which can clear the diagnostic. The manual diagnostic reset levels in order of priority are: Local or Remote. For example, a diagnostic that has a reset level of Remote, can be reset by either a remote diagnostic reset command or by a local diagnostic reset command.

Help Text: Provides for a brief description of what kind of problems might cause this diagnostic to occur. Both control system component related problems as well as chiller application related problems are addressed (as can possibly be anticipated). These help messages will be updated with accumulated field experience with the chillers.

Main Processor Diagnostics

Table 4. Main processor diagnostics

Diagnostic Name	Affects Target	Severity	Persistence	Active Modes [Inactive Modes]	Criteria	Reset Level
Economizer Discharge Pressure Sensor - xy *Economizer Disch Press Sensor- xy* Econ Disch Press Sensor xy	Cprsr	Normal	Latch	All	Bad sensor or LLID	Remote
Economizer Discharge Temperature Sensor - xy *Economizer Disch Temp Sensor- xy* Econ Disch Temp Sensor xy	Cprsr	Normal	Latch	All	Bad Sensor or LLID	Remote

Communication Diagnostics

Notes:

- *The following communication loss diagnostics will not occur unless that input or output is required to be present by the particular configuration and installed options for the chiller.*
- *Communication diagnostics (with the exception of "Excessive Loss of Comm" are named by the Functional Name of the input or output that is no longer being heard from by the Main Processor. Many LLIDs, such as the Quad Relay LLID, have more than one functional output associated with it. A comm loss with such a multiple function board, will generate multiple diagnostics. Refer to the Chiller's wiring diagrams to relate the occurrence of multiple communication diagnostics back to the physical LLID boards that they have been assigned to (bound).*
- *Communication loss diagnostics shall be timed based on action (target status) and not annunciation on the operator display.*

Table 5. Communications diagnostics

Diagnostic Name	Affects Target	Severity	Persistence	Active Modes [Inactive Modes]	Criteria	Reset Level
Comm Loss: Economizer Valve - xy *Comm Loss: Economizer Valve - xy* Comm: Econ Valve xy	Cprsr	Normal	Latch	All	Continual loss of communication between the MP and the Functional ID has occurred for a 30 second period.	Remote
Comm Loss: Economizer Discharge Pressure - xy *Comm Loss: Economizer Disch Press - xy* Comm: Econ Disch Press xy	Cprsr	Normal	Latch	All	Continual loss of communication between the MP and the Functional ID has occurred for a 30 second period.	Remote
Comm Loss: Economizer Discharge Temp - xy *Comm Loss: Economizer Disch Temp - xy* Comm: Econ Disch Temp xy	Cprsr	Normal	Latch	All	Continual loss of communication between the MP and the Functional ID has occurred for a 30 second period.	Remote

Wiring

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

The table below provides a list of electrical schematics, field wiring diagrams and connection diagrams for Sintesis™ RTAF Middle East units. Wiring diagrams can be accessed via e-Library. A laminated wiring diagram booklet is also shipped with each chiller.

Table 6. RTAF middle east configuration — unit wiring drawings

Drawing Number	Description
2311-5966	Schematic
5722-9584	Panel Component Location Diagram
5722-8185	Unit Component Location Diagram
5722-9575	Field Wiring
5722-9581	Field Layout

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