# Vertiv™ Liebert® DS
# Guide Specifications

## 1.0 GENERAL

### 1.1 Summary

These specifications describe requirements for a Thermal Management system. The system shall be designed to control temperature and humidity conditions in rooms containing electronic equipment, with good insulation and vapor barrier. The manufacturer shall design and furnish all equipment to be fully compatible with heat-dissipation requirements of the room.

### 1.2 Design Requirements

The Thermal Management system shall be a Liebert® self-contained, factory-assembled unit. Standard 60 Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard, “CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment” and are marked with the CSA c-us logo.

The system shall be AHRI Certified, the trusted mark of performance assurance for heating, ventilation, air conditioning, and commercial refrigeration equipment, using AHRI Standard 1360.

### 1.3 Submittals

The specified system shall be factory tested before shipment. Testing shall include but shall not be limited to: Quality Control Checks, Hi-Pot. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

# 2.0 PRODUCT

## 2.1 Frame

The frame shall be welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.

### 2.1.1 Downflow Air Flow Configurations

#### 1. Downflow Air Supply

The supply air shall exit from the bottom of the unit.

#### 2. Downflow Air, Under Floor Discharge

The supply air shall exit from the bottom of the unit.

#### 3. Downflow Air, EC Fans Lowered into Floor Stand

The supply air shall exit from all sides of the floor stand.

#### 4. Downflow Air Return

The return air shall enter the unit from the top.

### 2.1.2 Upflow Air Flow Configurations

#### 1. Upflow Air Supply

The supply air shall exit from the top of the unit.

#### 2. Upflow Top Air Supply, Front Throw

The supply air shall exit from the top of the cabinet (or plenum) with the air throw toward the front.

#### 3. Upflow Top Air Supply, Rear Throw

The supply air shall exit from the top of the unit.

#### 4. Upflow Top Air Supply, Front Throw

The return air shall enter the unit from the front of the cabinet through factory installed grilles. Grilles shall be painted black.

#### 5. Upflow Air Return, Rear

The return air shall enter the unit from the back of the cabinet.

### 2.1.3 Exterior Panels

The exterior panels shall be insulated with a minimum 1 in. (25 mm), 1.5 lb. (0.68 kg) density fiber insulation. The main front panel shall have captive quarter-turn fasteners. The main unit color shall be _____. The accent color shall be _____.

## 2.2 Filters

For Downflow units, the filter chamber shall be located within the cabinet, and filters shall be removable from the top of the unit. Filters shall be arranged in a flat bank configuration.

For Upflow units with front return, the filters shall be located within the cabinet and removed from the front of the unit. On Upflow units with rear return, the filters are removed from the side of the unit and are located in the rear return filter box.

### 2.2.1 Filters, 4-Inch Merv8 or Merv11

Filters shall be deep pleated 4-inch filters with an ASHRAE 52.2-2007 MERV8 or ASHRAE 52.2-2007 MERV11.

### 2.2.2 Filters, 2-Inch Merv8 Pre-Filter With 2-Inch Filter Merv11

Filters shall be 2-inch ASHRAE 52.2-2007 MERV8 pre-filter, with 2-inch ASHRAE 52.2-2007 MERV11 efficiency filter.

### 2.2.3 Extra Filter Set

_____extra set(s) of filters shall be provided per system.

## 2.3 Locking Disconnect Switch

The electrical panel shall provide at least 65,000A SCCR (60 hz).

Short circuit current rating (SCCR) is the maximum short circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

## 2.4 Short Circuit Current Rating (SCCR)

The electrical panel shall provide at least 65,000A SCCR (60 hz).

Short circuit current rating (SCCR) is the maximum short circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

## 2.5 Fan Section

### 2.5.1 Electronically Commutated (EC) Fan

The blower section shall be designed for _____ CFM (CMH) at an external static pressure of _____ in. w.g. (Pa).

The fans shall be plug/plenum type, single inlet and shall be dynamically balanced. The drive package shall be direct drive, electronically commutated, and variable speed. The fans shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.

- EC fans shall be available on downflow (fans may be lowered into a raised floor with a minimum height of 24-inches (610 mm) or upflow models. EC fans may operate within the Vertiv™ Liebert® DS cabinet, instead of under the floor.
- EC fans shall be available on upflow models and fans shall operate outside the unit in a factory provided plenum with a minimum height of 24-inches (610 mm).
- DS/VS035 fan motor(s) shall be nominal 3.75 hp (2.8 kW) each with a maximum operating speed of 1,230 rpm. Quantity: 1.
- DS/VS042 air- or water-cooled unit fan motor(s) shall be nominal 3.75 hp (2.8 kW) each with a maximum operating speed of 1,230 rpm. Quantity: 1.
- DS042 Dual Cool Air, Dual Cool Water and GLYCOOL unit fan motor(s) shall be nominal 5.36 hp (4.0 kW) fan for 380-480V (maximum 1,370 rpm).

- VS042 Dual Cool Air, Dual Cool Water and GLYCOOL unit fan motor(s) shall be nominal 3.75 hp (2.8 kW) each with a maximum operating speed of 1,230 rpm. Quantity: 1.
- DS/VS053, DS/VS070, and DS/VS077 fan motors shall be nominal 4.15 hp (3.1 kW) each with a maximum operating speed of 1,520 rpm; quantity, two.
- DS/VS105 fan motors shall be nominal 3.6 hp (2.7 kW) each, with a maximum operating speed of 1,700 rpm. Quantity: 3.

### 2.5.2 Forward Curved Blower—Optional

The blower section shall be designed for CFM (CMH) at an external static pressure of in. wg. (Pa).

The fans shall be the centrifugal type, double width and double inlet, and shall be dynamically balanced as a completed assembly. The shaft shall be heavy duty steel with self-aligning, permanently sealed, pillow block bearings with a minimum L3 life of 200,000 hours.

The fans shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.

The fan motor shall be an open drip-proof, premium efficiency_____ hp (kW) at 1,750 rpm at 60 Hz, mounted to an automatic, spring tensioning base. The motor shall be removable from the front of the cabinet. The drive package shall be two belt, variable speed, sized for 200% of the fan motor horsepower. (Forward curved blower only available on upflow units.)

## 2.6 Infrared Humidifier—Optional

A humidifier shall be factory installed inside the unit. The humidifier shall be of the infrared type, consisting of high intensity quartz lamps mounted above and out of the water supply. The humidifier pan shall be stainless steel and arranged to be removable without disconnecting high voltage electrical connections. The complete humidifier section shall be pre-piped, ready for field connection to the water supply. The humidifier shall be equipped with an automatic water supply system and shall have an adjustable water overfeed to prevent mineral precipitation. A high water detector shall shut down the humidifier to prevent overflowing. A 1-inch (24 mm) airgap in compliance with ASME A112.1.2 section 2.4.2 (backsiphonage testing) shall prevent backflow of the humidifier supply water. The humidifier capacity shall be _____ lb./hr (_____ kg/hr). The humidifier shall be removable from the front of the cabinet.

## 2.7 Three-Stage Reheat—Optional

The Thermal Management unit shall include a factory installed reheat to control temperature during dehumidification.

The electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches, shall be _____ kW (_____ BTUH) controlled in three stages. The reheat elements shall be removable from the front of the cabinet.

## 2.8 Refrigeration System

### 2.8.1 Evaporator Coil

The evaporator coil shall be A-frame design for downflow units and V-frame design for upflow units and have _____sq. ft. (m2) face area, _____ rows deep.

It shall be constructed of rifled copper tubes and aluminum fins and shall have a maximum face velocity of _____ ft. per minute (m/s) at _____ CFM (CMH). A stainless steel condensate drain pan shall be provided.

### 2.8.2 Compressorized Systems

1. Dual Refrigeration System

Each unit shall include two independent refrigeration circuits and shall include hot gas mufflers (semi-hermetic compressor units only), liquid line filter driers, and refrigerant sight glasses with moisture indicator, externally equalized expansion valves, and liquid line solenoid valves. Compressors shall be located outside the air stream and shall be removable and serviceable from the front of the unit.

2. Scroll Compressors

The compressors shall be scroll type. The compressors shall include a suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, low pressure transducer, and a maximum operating speed of 3,500 RPM.

3. Digital Scroll Compressors

The compressor shall be scroll type with a variable capacity operation capability. The compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, low pressure transducer, and a maximum operating speed of 3,500 rpm. Consult factory for 575 V availability. Not available on DS077 and DS105 units.

4. Semi-Hermetic Compressors with Four Step Unloaders Control

The compressor shall be semi-hermetic with a suction gas cooled motor, vibration isolators, thermal overloads, oil sight glass, automatic reset high pressure switch with control lockout after three failures, low pressure transducer, service valves, reversible oil pumps for forced feed lubrication, a maximum operating speed of 1,750 rpm. The system shall include cylinder unloaders on the semi-hermetic compressors. The unloaders shall be activated by solenoid valves which are controlled from the microprocessor control. In response to the return air temperature, the microprocessor control shall activate the unloader solenoids and the liquid line solenoids such that four stages of refrigeration cooling are obtained. The stages shall be: 1) one compressor, partially loaded, 2) two compressors partially loaded, 3) one compressor partially loaded, one compressor fully loaded, 4) two compressors fully loaded. On a call for dehumidification, the microprocessor control shall ensure that at least one compressor is on full for proper humidity control. Only available on DS077 and DS105 units.

### 2.8.3 Expansion Valve

#### Thermostatic Expansion Valve (TXV)

A manual adjustable externally equalized expansion valve thermostatic expansion valve (TXV) shall control the flow of liquid refrigerant entering the direct expansion coil. The TXV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The TXV shall prevent liquid refrigerant from returning to the compressor.

### 2.8.4 Crankcase Heaters

The compressors shall include crankcase heaters, powered from the indoor unit electric panel.

### 2.8.5 R-407C Refrigerant

The system shall be designed for use with R-407C refrigerant, which meets the EPA clean air act for phase-out of HCFC refrigerants.

## 2.9 Cooling System

### 2.9.1 Air Cooled System

**System Description**

The indoor evaporator refrigerant piping shall be filled with an inert gas holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system. Evaporator unit shall be matched with a Vertiv™ Liebert® MC condenser.

### 2.9.2 Dual Cool: Chilled Water and Air Cooled Refrigeration

**1. System Description**

The dual cooling source system shall consist of an air cooled compressorized system with the addition of a chilled water coil, a modulating control valve, and a comparative temperature sensor. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or a combination of both. The primary mode of cooling shall be chilled water. Switchover between the two cooling modes shall be performed automatically by the microprocessor control.

**2. Dual Cooling Source**

The dual cooling source coil shall be constructed with copper tubes and aluminum fins. It shall be located in the return air, before the evaporator coil. The dual cooling source coil shall be rated at BTU/HR (kW) sensible cooling capacity with 45°F (7.2°C) entering water temperature. The dual cooling source coil shall require GPM (l/s) of chilled water and the pressure drop shall not exceed psi (kPa). A Cu-Ni coil must be specified whenever a GLYCOOL or Dual Cooling Source system is applied to a cooling tower loop or other open water system.

**3. Dual Cool: Free Cooling Control Valve**

- Three-Way Modulating Valve

The water circuit shall include a 3-way modulating valve. The Vertiv™ Liebert® iCOM™ control positions the valve in response to room conditions. Cooling capacity will be controlled by bypassing chilled water around the coil. The modulating valve travel for dehumidification shall be proportional.

- Two-Way Modulating Valve—Optional

The water circuit shall include a pre-piped two-way modulating valve. The Liebert® iCOM™ control shall manage valve movement to maintain desired room conditions. The modulating valve travel for dehumidification shall be proportional.

**4. Chilled Water System Design Pressure**

- Standard Pressure

The chilled water circuit shall be designed for a pressure of 150 PSI (1,034 kPa).

- High Pressure Rating—Optional

The chilled water circuit shall be designed for a pressure of 400 psi (2,758 kPa).

**5. Comparator Sensor**

The system shall be equipped with a Liebert® iCOM™ microprocessor-controlled comparator sensor that permits free cooling operation whenever entering chilled water temperature is below return air temperature. The comparator sensor shall be factory installed on a free cooling three-way valve and field installed on a free cooling two-way valve.

**6. Cu-Ni Vertiv™ Liebert® Econ-o-Coil—Optional**

A 70/30 Cu-Ni Liebert® Econ-o-Coil shall be provided when the Liebert® Econ-o-Coil is applied to a cooling tower loop or other open water system.

### 2.9.3 Water/Glycol Cooled System

#### 1. System Description

The system includes a Vertiv™ Liebert® Paradenser™ and water regulating valve. The refrigeration system is factory charged with refrigerant. The water piping shall be filled with an inert gas holding charge and spun shut. Field relief of the Schrader valve on the water piping shall indicate a leak-free system.

#### 2. Vertiv™ Liebert® Paradenser™ Condenser

The Liebert® Paradenser™ water cooled condensers for each circuit shall be cleanable, shell and tube, counterflow type. The heads shall be removable to allow for cleaning of the water tubes. Condensers shall be rated for a maximum refrigerant pressure of 400 psi at 200°F (2,758 kPa at 93.3°C). The condenser shall be capable of operating with R-407C refrigerant. The unit shall require GPM (l/m) of °F (°C) water and have a maximum pressure drop of psi (kPa).

#### 3. Water/Glycol Regulating Valve for Units with Scroll Compressor or Semi-Hermetic Compressor

The condenser shall be pre-piped with a two-way regulating valve with bypass ball valve.

#### 4. Water/Glycol Regulating Valve for Units with Digital Scroll Compressor

The condenser shall be pre-piped with a two-way motorized ball valve.

#### 5. Water/Glycol Regulating Valve, Three-Way

The condenser shall be pre-piped with a three-way regulating valve.

#### 6. Water/Glycol System Design Pressure

- Standard Pressure

The condenser water circuit shall be designed for a pressure of 150 psi (1,034 kPa).

- High Pressure Rating—Optional

The condenser water circuit shall be designed for a pressure of 350 psi (2,413 kPa).

### 2.9.4 Dual Cooling Source System: Water/Glycol Cooled and Vertiv™ Liebert® Econ-o-Coil

#### 1. Dual Cooling Source

The dual cooling source system shall consist of a water cooled compressorized system with the addition of a chilled water coil (Liebert® Econ-o-Coil), a modulating control valve and a comparative temperature sensor. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or a combination of both. The primary cooling mode shall be chilled water. Switchover between the two cooling modes shall be performed automatically by the microprocessor control. Four pipes shall be included on water/glycol systems: Liebert® Econ-o-Coil supply, Liebert® Econ-o-Coil return, condenser supply and condenser return.

### 2. Dual Cooling Liebert® Econ-o-Coil Control Valve

- Three-Way Modulating Valve

The water circuit shall include a three-way modulating valve. The Vertiv™ Liebert® iCOM™ control shall manage valve movement to maintain desired room conditions. Cooling capacity will be controlled by bypassing chilled water around the coil. The modulating valve travel for dehumidification shall be proportional.

- Two-Way Modulating Valve—Optional

The water circuit shall include a pre-piped two-way modulating valve. The Vertiv™ Liebert® iCOM™ control shall manage valve movement to maintain desired room conditions. The modulating valve travel for dehumidification shall be proportional.

### 3. Liebert® Econ-o-Coil System Design Pressure

- Standard Pressure

The Liebert® Econ-o-Coil (chilled water) circuit shall be designed for a pressure of 150 psi (1,034 kPa).

- High Pressure Rating—Optional

The Liebert® Econ-o-Coil (chilled water) circuit shall be designed for a pressure of 400 psi (2,758 kPa).

### 4. Comparator Sensor

The system shall be equipped with a Liebert® iCOM™ microprocessor-controlled comparator sensor that permits free cooling operation whenever entering chilled water/glycol temperature is below return air temperature.

The comparator sensor shall be factory installed on a free cooling three-way valve unit and field installed on a continuous flowing pipe for a unit with a free cooling two-way valve.

### 5. Cu-Ni Vertiv™ Liebert® Econ-o-Coil—Optional

A 70/30 Cu-Ni Liebert® Econ-o-Coil shall be provided for when the Liebert® Econ-o-Coil is cooling tower loop or other open water system.

### 6. Vertiv™ Liebert® Paradenser™ Condenser

The water-cooled condensers for each circuit shall be cleanable, shell and tube, counterflow type. The heads shall be removable to allow for cleaning of the water tubes. Condensers shall be rated for a maximum refrigerant pressure of 400 psi at 200°F (2,758 kPa at 93.3°C). The condenser shall be capable of operating with R-22 or R 407C refrigerant. The unit shall require GPM (l/m) of °F (°C) water and have a maximum pressure drop of psi (kPa).

### 7. Water/Glycol Regulating Valve

The condenser shall be pre-piped with a two-way regulating valve.

### 8. Water/Glycol Regulating Valve, Three-Way

The condenser shall be pre-piped with a three-way regulating valve.

### 9. Water/Glycol System Design Pressure

- Standard Unit Pressure

The condenser water circuit shall be designed for a pressure of 150 psi (1,034 kPa).

- Standard Unit High Pressure Rating—Optional

  The condenser water circuit shall be designed for a pressure of 350 psi (2,413 kPa).

### 2.9.5 GLYCOOL: Fluid Cooled Economizer and DX Refrigeration System

#### 1. System Description

GLYCOOL - The GLYCOOL unit shall have two independent cooling coils. The first cooling coil shall be a part of a chilled glycol circuit and shall be strategically located in the return air stream to either pre-cool or totally cool the air before entering the refrigeration coil. The second cooling coil shall be part of a direct expansion refrigeration circuit and shall include a compressor, Liebert® Paradenser™, pressure safety switches, and a factory refrigerant charge. Liebert® iCOM™ shall control the activation/deactivation and modulation of the two cooling circuits allowing the system to function either as a modulating glycol economizer, a glycol refrigeration system, or a combination of both.

This shall be a two pipe system and shall require closed loop water/glycol heat rejection, such as Vertiv™ Liebert® Drycooler/pump or customer water tower using properly treated glycol solutions. Field relief of the Schrader valve shall indicate a leak-free system.

#### 2. GLYCOOL Coil

The GLYCOOL (Liebert® Econ-o-Coil) shall be constructed of copper tubes and aluminum fins. The coil shall be A-frame or V-frame to minimize air pressure drop and shall be nested with the DX coil. The Liebert® Econ-o-Coil shall be upstream of the DX coil to enable pre-cooling of the air.

The Liebert® Econ-o-Coil shall have a net sensible cooling capacity of BTUH (kW) with 45°F (7.2°C) entering glycol solution temperature. The system shall require GPM (l/s) and the total unit pressure drop shall not exceed feet of water (kPa), when in the Liebert® Econ-o-Coil mode of operation.

#### 3. GLYCOOL Three-Way Control Valve

The GLYCOOL coil shall be equipped with a fully proportional three-way control valve. This motorized control valve shall control the amount of flow to the GLYCOOL (Liebert® Econ-o-Coil) coil to control room temperature and relative humidity.

#### 4. Vertiv™ Liebert® Paradenser™ Condenser

The water cooled condensers for each circuit shall be cleanable, shell and tube, counterflow type. The heads shall be removable to allow for cleaning of the water tubes. Condensers shall be rated for a maximum refrigerant pressure of 400 psi at 200°F (2,758 kPa at 93.3°C). The condenser shall be capable of operating with R-22 or R 407C refrigerant. The unit shall require GPM (l/m) of °F (°C) water and have a maximum pressure drop of ____psi (kPa).

#### 5. Water/Glycol Regulating Valve, Three-Way

The condenser shall be pre-piped with a three-way regulating valve.

#### 6. GLYCOOL System Design Pressure

- Standard Pressure

The GLYCOOL system shall be designed for a pressure of 150 psi (1,034 kPa).

- High Pressure Rating—Optional

The GLYCOOL system shall be designed for a pressure of 350 psi (2,413 kPa).

#### 7. Cu-Ni Liebert® Econ-o-Coil—Optional

A 70/30 Cu-Ni Liebert® Econ-o-Coil shall be provided for when the Liebert® Econ-o-Coil is cooling tower loop or other open water system.

# 3.0 CONTROLS

## 3.1 Vertiv™ Liebert® iCOM™ Microprocessor Control With 7-Inch Color Touchscreen

The Liebert® iCOM™ shall be microprocessor based with a 7-inch, high definition, capacitive, color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the front panel is open or closed. The controls shall be menu driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup, and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards, and diagnostics/service mode. The Liebert® iCOM™ control shall provide Ethernet/RS-485 ports dedicated for BMS connectivity (i.e., Base-Comms).

- Password Protection – The Liebert® iCOM™ shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.
- Unit Backup/Restore – The user shall be able to create safe copies of important control parameters. The Liebert® iCOM™ shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
- Parameter Download – The Liebert® iCOM™ shall enable the user to download a report that lists parameter names, factory default settings, and user programmed settings in .csv format for remote reference.
- Parameter Search – The Liebert® iCOM™ shall have search fields for efficient navigation and parameter lookup.
- Parameter Directory – The Liebert® iCOM™ shall provide a directory that lists all parameters in the control. The list shall provide Line ID numbers, parameter labels, and current parameter values.
- Context Sensitive Help – The Liebert® iCOM™ shall have an on-board help database. The database shall provide context sensitive help to assist with setup and navigation of the menus.
- Display Setup – The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, backlight timer and the hide/show of certain readouts shall be configurable through the display.
- Additional Readouts – The display shall enable the user to configure custom widgets on the main screen. Widget options will include items such as fan speed, call for cooling, call for free cooling, maintenance status, call for hot water reheat, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate, and cooling capacity.
- Status LEDs – The Liebert® iCOM™ shall show the unit's operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
- Event Log – The Liebert® iCOM™ shall automatically store the last 400 unit only events (messages, warnings, and alarms).
- Service Contact Information – The Liebert® iCOM™ shall be able to store the local service or sales contact information.

- Upgradeable – Vertiv™ Liebert® iCOM™ firmware upgrades shall be performed through a USB connection.
- Timers/Sleep Mode – The menus shall allow various customer settings for turning the unit on or off.
- Menu Layout – The menus shall be divided into two main menus: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personnel and shall provide access to advanced control setup features and diagnostic information.
- Sensor Calibration – The menus shall allow unit sensors to be calibrated with external sensors.
- Maintenance/Wellness Settings – The menus shall allow reporting of potential component problems before they occur.
- Options Setup – The menus shall provide operation settings for the installed components.
- Auxiliary Boards – The menus shall allow setup of optional expansion boards.
- Various Sensors – The menus shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5 VDC or 0 to 10 VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display. When configuring the analog inputs, the selectable items to choose from shall include air pressure, fluid pressure, temperature, percentage, general amperage, condenser amps, compressor amps, reheat amps, humidifier amps, unit amps, fan amps factory standard, and not used.
- Diagnostics/Service Mode – The Liebert® iCOM™ control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.
- Base-Comms for BMS Connectivity – The Liebert® iCOM™ controller shall provide one Ethernet Port and RS-485 Port dedicated for BMS Connectivity. Provides ground fault isolated RS-485 Modbus, BACnet IP and Modbus IP network connectivity to Building Management Systems for unit monitoring and management. Also, provides ground fault isolated 10/100 baseT Ethernet connectivity for unit monitoring and management. The supported management interfaces include SNMP for Network Management Systems, HTTP for web page viewing, SMTP for email, and SMS for mobile messaging. The Liebert® iCOM™ controller can support dual IP on one network and one 485 protocol simultaneously.

## 3.2 Alarms

All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customer's Building Management System/Building Automation System. The Liebert® iCOM™ control shall activate an audible and visual alarm in event of any of the following conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- EC Fan Fault

- Change Filters
- Loss of Air Flow
- Loss of Power
- Compressor Overload (Optional)
- Humidifier Problem
- High Head Pressure
- Low Suction Pressure
- Custom Alarms

Custom alarm inputs shall be provided to indicate facility specific events. Custom alarms can be identified with programmable labels. Frequently used alarm inputs include:

- Leak Under Floor
- Smoke Detected
- Standby Unit On

Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a time delay of 0 to 255 seconds.

## 3.3 Vertiv™ Liebert® iCOM™ Control Methods and Options

The Liebert® iCOM™ shall be factory set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity-based control sensors installed. Proportional and Tunable PID shall also be user selectable options.

### 3.3.1 Controlling Sensor Options

Liebert® iCOM™ shall be flexible in the sense that it shall allow for controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:

1. Cooling Capacity
   - Supply
   - Remote
   - Return
2. Fan Speed
   - Supply
   - Remote
   - Return
   - Manual (for diagnostic or to receive a signal from the BMS through the Liebert® remote monitoring devices or analog input)
   - Static Pressure

### 3.3.2 Temperature Compensation

The Vertiv™ Liebert® iCOM™ shall be able to adjust the capacity output based on supply and return temperature conditions to meet SLA guidelines while operating to highest efficiency.

### 3.3.3 Humidity Control

Dew point and relative humidity control methods shall be available (based on user preference) for humidity control within the conditioned space.

## 3.4 Multi-Unit Coordination

Vertiv™ Liebert® iCOM™ teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected cooling units equipped with Liebert® iCOM™ using the U2U (Unit to Unit) network. There shall be three modes of teamwork operation:

- Teamwork Mode 1 (Parallel): Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan on) are collected to be used for an average or worst case sensor reading (user selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan, and humidity) is divided and shared among the units in the group. Each unit will receive instructions on how to operate from the Master unit based on how far the system deviates from the setpoints. Evaporator fans and cooling capacity are ramped in parallel.
- Teamwork Mode 2 (Independent): The Liebert® iCOM™ calculates the worst case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning that the unit may respond to the thermal load and humidity conditions based on the unit's controlling sensors.

All sensor readings are shared.

- Teamwork Mode 3 (Optimized Aisle): May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors or Economizer) is controlled through unit supply air conditions. Liebert® iCOM™ calculates the average or worst case sensor reading (user selectable) for heating, cooling humidification, and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied. This is the best form of control for a room with an unbalanced load.

## 3.5 Standby Lead-Lag

The Liebert® iCOM™ shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

## 3.6 Standby Unit Cascading

The Liebert® iCOM™ cascade option shall allow the units to turn On and Off based on heat load when utilizing Teamwork Mode 1, Independent mode or Teamwork Mode 3, Optimized Aisle mode with remote temperature sensors. In Teamwork Mode 1, Cascade mode will stage units on based on the temperature and humidity readings and their deviation from setpoint. In Teamwork 3 Mode, Cascade mode dynamically coordinates the fan speed to save energy and to meet the cooling demands. For instance, with a Liebert® iCOM™ group of six units and only 50% of the heat load, the Liebert® iCOM™ shall operate only four units at 80% fan speed and leave the other two units in standby.

As the heat load increases, the Liebert® iCOM™ shall automatically respond to the additional load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them into standby.

## 3.7 Wired Supply Sensor

Each Vertiv™ Liebert® iCOM™ shall have one factory supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

## 3.8 Virtual Master

As part of the robust architecture of the Vertiv™ Liebert® iCOM™ control, it shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the Liebert® iCOM™ shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

## 3.9 Virtual Back Draft Damper

The Vertiv™ Liebert® iCOM™ shall allow the use of a virtual back draft damper, eliminating the need for a mechanical damper. This shall allow the fans to spin slower (15% or less) to act as a damper.

## 3.10 Compressor Short Cycle Control

To help maximize the life of the compressor(s), there shall be start-to-next start delay for each single compressor. The control shall monitor the number of compressor starts in an hour. If the compressor starts more than 10 times in 60 minutes, the local display and remote monitoring shall notify the user through a Compressor 1 or 2 Short Cycle event.

## 3.11 Vertiv™ Liebert® MC Condenser Communication

The Vertiv™ Liebert® iCOM™ shall communicate directly with the Liebert® MC condenser via field supplied CANbus communication wires and via field supplied, low voltage interlock wires. This shall provide enhanced monitoring, alarming, diagnostics, low noise mode, and condenser fan reversal for cleaning mode.

## 3.12 System Auto Restart

The auto restart feature shall automatically restart the system after a power failure. Time delay shall be programmable. An optional capacitive buffer may be provided for continuous control operation through a power failure.

## 3.13 Sequential Load Activation

On initial start-up or restart after power failure, each operational load shall be sequenced with a minimum delay of one second to minimize total inrush current.

## 3.14 Low Pressure Monitoring

Units shall ship standard with low pressure transducers for monitoring individual compressor suction pressure. If the pressure falls due to loss of charge or other mechanical cause, the corresponding circuit shall shut down to prevent equipment damage. The user shall be notified of the low pressure condition through the local display and remote monitoring.

## 3.15 Winter Start Time Delay—Air Cooled Models

An adjustable software timer shall be provided to assist with compressor starting during cold weather. When the compressor starts, the low pressure input shall be ignored for the period set in the user adjustable timer. Once the time period has elapsed after the compressor start, the low pressure input should remain in the normal state. If the low pressure input does not remain in the normal state when the time delay has elapsed, the circuit shall lock out on low pressure. The low pressure alarm shall be announced on the local display and communicated to remote monitoring systems.

## 3.16 Advanced Freeze Protection

Units shall ship standard with advanced freeze protection enabled. The advanced freeze protection shall monitor the pressure of each circuit using a transducer. The control shall interact with the fan and compressor to prevent the unit coil from freezing if circuit suction pressure drops. Applying fan speed to direct expansion systems requires limitations to avoid freezing condensate on the coil when the unit operates below 100% fan speed. Vertiv™ Liebert® iCOM™ advanced freeze protection provides the ability to predict freeze conditions and correct this condition automatically by adjusting fan speed and compressor capacity. If a freeze condition is detected, the user shall be notified through the local display and remote monitoring systems.

## 3.17 Advanced High-Pressure Protection—Water/Glycol Cooled Models with Variable Capacity Compressors

When the compressor is initially activated, the system shall be monitored for high pressure. When high pressure is detected, the control shall alter the compressor operation and the condenser fans speed to reduce the system discharge pressure, preventing circuit shut down. If the unit is unsuccessful in correcting the problem through this interaction, an alarm shall occur, and the affected compressor shall be immediately locked off. The control shall re-enable the compressor when the pressure returns to a safe level. This feature is standard on units equipped with liquid line transducers and these compressor types:

- 4 Step
- Digital Scroll

## 3.18 Refrigerant Pressure Transducer Failure

The control shall monitor the high side and low side refrigerant pressure transducers. If the control senses the transducer has failed, has been disconnected, has shorted or the reading has gone out of range, the user shall be notified through an event on the local display and remote monitoring. The corresponding circuit that the failure has occurred on shall be disabled to prevent unit damage.

## 3.19 Oil Return Protection

The control shall monitor compressor operation and staging to ensure that liquid and hot gas velocity are maintained for proper oil return to the compressor.

## 3.20 Digital Scroll High Temperature Protection

The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out for 30 minutes and an alarm shall be annunciated on the local display and through monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off cycle and re-enable the circuit once a safe operating temperature is reached and the 30 minutes has elapsed. The control shall store the number of high temperature trips. The number of trips shall be accessible through the local display.

## 3.21 Digital Scroll Sensor Failure

The control shall monitor the status of the digital scroll sensor(s). If the control senses that the thermistor is disconnected, shorted or the reading goes out of range, the user shall be notified through an event on the local display and remote monitoring.

## 3.22 Compressor Sequencing

A user selectable compressor sequencing parameter shall be provided and shall be accessible through the local display. This sequencing parameter shall present the user with three choices:

1. Always use Compressor 1 as the lead compressor.
2. Always use Compressor 2 as the lead compressor.
3. Auto: The unit shall automatically stage compressors to keep each unit's run time within eight hours of the other's run time. NOTE: The Auto setting attempts to maintain equal run times between compressors. However, the control will not turn Off a compressor to equalize run time when it is needed to control the space.
    - First priority: If the safety timings are acceptable for only one compressor, then it is the next to be started/stopped.
    - Second priority: If both compressors are off: The compressor with fewer working hours is the next to start.
    - Third priority: If both compressors are in operation: the compressor that has been operating longer since the last start is the next to be stopped.

## 3.23 Compressor High and Low Temperature Limit Protection

The control shall monitor the return air to ensure that the compressor(s) are operated within the manufacturer's defined window of operation. If the return air temperature deviates from the manufacturer's window of operation, the Vertiv™ Liebert® iCOM™ shall automatically adjust to prevent damage to the cooling unit or reduction in its reliability.

## 3.24 Compressor Run Time Monitoring

The control shall log these compressor statistics:

- Number of compressors starts
- Run hours
- Average run time
- Starts per day
- Starts per day worst
- Number of high-pressure alarms
- Operating phase in which the high-pressure alarm occurred
- Number of low pressure alarms
- Operating phase in which the low pressure alarm occurred
- Number of compressor overloads
- Number of high temperature alarms (scroll compressors)

The user shall have the ability to monitor compressor operating temperature and pressure from the local display to be used as a diagnostic tool.

## 3.25 Manual Compressor Disablement

The user shall have the ability to disable compressor operation using a set of either normally open or normally closed dry contacts tied directly to the control or through remote monitoring. An additional enable/disable feature shall be provided to allow the user to permanently disable an individual compressor circuit for maintenance using the local display.

## 3.26 Manual Compressor Operation

The user shall be able to operate each compressor(s) manually from the local display. The user shall be able to energize refrigeration components including liquid line solenoid valves, compressor contactors, electronic expansion valves, and adjust capacity for troubleshooting or repair. The control shall monitor the compressor during manual operation and shall shut the compressor down if needed to prevent electrical or mechanical damage.

## 3.27 Flooded Start Protection

The control shall isolate each compressor through a dedicated circuit liquid line solenoid valve and/or electronic expansion valve. These devices, combined with an integral compressor check valve (all models) and crankcase heater (air cooled models), shall help ensure refrigerant does not migrate/carry oil out of the compressor case during the off cycle.

## 3.28 Compressor Dehumidification

The control shall permit the user to specify which compressor is used for dehumidification. The choices shall be 1st compressor, 2nd compressor, 1 or 2, or BOTH.

# 4.0 MISCELLANEOUS OPTION

## 4.1 High Temperature Sensor—Optional

The high temperature sensor shall immediately shut down the environmental control system when activated. The high temperature sensor shall be mounted in the electrical panel with the sensing element in the return air.

## 4.2 Smoke Sensor—Optional

The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

## 4.3 Condensate Pump, Dual Float—Optional

The condensate pump shall have a minimum capacity of GPH (l/h) at ft. (kPa) head. It shall be complete with integral dual float switches, pump and motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shall shut down the unit upon high water condition.

## 4.4 Low Voltage Terminal Package—Optional

Factory installed and factory wired terminals shall be provided.

- Remote Shutdown Terminals – Two additional pairs of terminals provide the customer with additional locations to remotely shut down the unit by field installed devices or controls.
- Extra Common Alarm Contacts – Two additional pairs of terminals provide the customer with normally open contacts for remote indication of unit alarms.
- Main Fan Auxiliary Switch – One set of normally open contacts wired to the EC fan motor contactor will close when EC fan operation is required. This set of dry contacts could also be used to initiate air economizer operation. Air economizer and associated devices by others.
- Vertiv™ Liebert® Liqui-tect™ Shutdown – One pair of dry contacts for the Liebert® Liqui-tect™ sensor signal will provide unit shut down. (Liebert® Liqui-tect™ sensor is not included.)

## 4.5 Remote Humidifier Contact—Optional

A pair of N/O contacts provided for connection to a remote humidifier that allows the unit's humidity controller to control a humidifier outside the unit. Power to operate the remote humidifier does not come from the unit.

## 4.6 Main Fan Overload—Optional

A pair of normally open contacts shall be factory installed and wired to indicate Main Fan Overload.

## 4.7 Compressor Overload—Optional

A pair of normally open contacts shall be factory installed and factory wired to each compressor to indicate Compressor Overload.

## 4.8 Wired Remote Sensor(s)—Optional

Each Vertiv™ Liebert® iCOM™ shall have up to ten 2T sensors (20 sensor readings total) for control or reference. As part of the U2U network, those sensors shall be shared and used to control the units and provide greater flexibility, visibility, and control using that to respond to changes in the data center. When the sensors are used for control, the user may set the control to be based off a maximum or average of a select highest temperature reading.

## 4.9 Vertiv™ Liebert® Liqui-tect™ Sensors

Provide _____(quantity) solid state water sensors under the raised floor.

## 4.10 Floor Stand—Optional

The floor stand shall be constructed of a welded steel frame. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand shall be _____inches (mm) high.

## 4.11 Return Air Plenum for Downflow Units-Optional

The air plenum shall be constructed of 20-gauge steel, powder coated to match unit color. The plenum shall be_____inches (mm) high. A door shall be included in the front of the plenum to enable front filter access. Air shall enter the plenum from the top.

## 4.12 Discharge Air Plenum for Upflow Units, With Discharge Grille(s)—Optional

The air plenum shall be constructed of 20-gauge steel, powder coated to match unit color. The plenum shall be inches (mm) high. Discharge air grilles shall be painted black and shall be included on the (front), (rear), (left side) or (right side) of the plenum.

## 4.13 Discharge Air Plenum for Upflow Units, Without Discharge Grille(s)—Optional

The air plenum shall be constructed of 20-gauge steel, powder coated to match unit color. The plenum shall be_____inches (mm) high. Air shall discharge from the top of the plenum.

## 4.14 Vertiv™ Liebert® vNSA Network Switch-Optional

The Liebert® vNSA network switch is designed for networking multiple Vertiv™ Liebert® iCOM™ unit level controllers together. There shall be two different styles of the vNSA14 panel available:

- Liebert® vNSA14 – enclosure with network switches only
- Liebert® vNSA14-iCOM™-H – enclosure with network switches and 9 inch Liebert® iCOM™ color touchscreen display. Each offering shall be housed inside a steel enclosure secured with a key lock and contain two network switches, providing a total of 14 Ethernet ports available for Liebert® iCOM™ controller unit to unit networking. The Liebert® vNSA requires field supplied, hard wiring, 16AWG, 100-240 VAC universal (12 V, 1.5A) single phase input power supply for 120 V or 230 V operation with factory supplied power connector.

# 5.0 HEAT REJECTION

## 5.1 Options—Air Cooled Vertiv™ Liebert® MC Condenser

### 5.1.1 Vertiv™ Liebert® MC Summary

These specifications describe requirements for a Liebert® air cooled condenser for a Liebert® Thermal Management system. The condenser shall be designed to reject waste heat to outdoor air and to control refrigerant head pressure as indoor equipment loading and outdoor ambient conditions change.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

Standard 60-Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and shall be marked with the CSA c-us logo.

### 5.1.2 Vertiv™ Liebert® MC Design Requirements

The air cooled condenser shall be a factory assembled unit, complete with integral electrical panel, designed for outdoor installation. The condenser shall be a draw through design.

### 5.1.3 Vertiv™ Liebert® MC Standard Features

Condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct driven by individual fan motor(s), electrical controls, housing, and mounting legs. The Vertiv™ Liebert® air cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity.

Microchannel coils shall provide superior heat transfer, reduce air side pressure drop, increase energy efficiency, and significantly reduce the system refrigerant volume required. EC fans and fan operating techniques shall reduce sound levels. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.

### 5.1.4 Vertiv™ Liebert® MC Coil

Liebert® MC coils shall be constructed of aluminum microchannel tubes, fins, and manifolds. Tubes shall be flat and contain multiple, parallel flow microchannels and span between aluminum headers. Full depth louvered aluminum fins shall fill spaces between the tubes. Tubes, fins and aluminum headers shall be oven brazed to form a complete refrigerant to air heat exchanger coil. Copper stub pipes shall be electric resistance welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Coil assemblies shall be factory leak tested at a minimum of 300 psig (2,068 kPag). Hot gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun closed ends for customer piping connections. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.

#### Aluminum Microchannel Coil with E-Coat—Optional

Aluminum microchannel coil with E-coat shall be epoxy coated for extended coil life in corrosive environments, such as coastal areas. Factory applied E-coat using immersion and baking process shall provide a flexible epoxy coating to all coil surfaces. Coil color shall be black and shall be protected from solar UV ray degradation with a factory applied UV topcoat. E-coat shall increase coil corrosion protection and shall reduce heat rejection capacity degradation to less than 10% after a severe 2,000-hour, 5% neutral salt spray test (ref. ASTM B117). The coating process shall ensure complete coil encapsulation.

### 5.1.5 Vertiv™ Liebert® MC Fan Motor/Blade Assembly

The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass reinforced polymeric material. Fan guards shall be heavy gauge, close meshed steel wire, coated with a black, corrosion resistant finish. Fan terminal blocks shall be in an IP54 enclosure on the top of the fan motor. Fan assemblies shall be factory balanced, tested before shipment, and mounted securely to the condenser structure.

#### Liebert® MC Condenser EC Fan Motor

The EC fan motors shall be electronically commutated for variable speed operation and shall have ball bearings. The EC fans shall provide internal overload protection through built-in electronics. Each EC fan motor shall have a built-in controller and communication module linked via RS485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed inputs from the Premium Control Board.

### 5.1.6 Vertiv™ Liebert® MC Electrical Controls

Electrical controls and service connection terminals shall be provided, and factory wired inside the attached control panel section. Only high voltage supply wiring and low voltage indoor unit communication/interlock wiring are required at condenser installation.

#### 1. EC Fan Speed and Premium Control

The EC fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors and refrigerant pressure transducers. The Premium Control Board shall communicate directly with the indoor unit's Vertiv™ Liebert® iCOM™ control via field supplied CANbus communication wires and via field supplied low voltage interlock wires. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed. The Premium Control Board shall be rated to a temperature of -30°F to 125°F (-34.4°C to 51.7°C). The premium control shall be factory set for (fan speed) (fan speed with Liebert® Lee-Temp) control.

#### 2. Locking Disconnect Switch

A locking type disconnect switch shall be factory mounted and wired to the electrical panel and be capable of disrupting the flow of power to the unit and controlled via an externally mounted locking and lockable door handle. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

#### 3. Short Circuit Current Rating

The electrical panel shall provide at least 65,000A SCCR.

#### 4. Liebert® MC 575 Volt—Optional

The condenser cabinet shall include a secondary, factory mounted, NEMA 3R weatherproof electrical enclosure. The secondary enclosure shall contain a 575 V transformer and protective fuses. All wiring between main and secondary electrical enclosures shall be factory provided. All field electrical connections shall be made in the main electrical enclosure.

### 5.1.7 Cabinet

The condenser cabinet shall be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles. Internal structural support members, including coil support frame, shall be galvanized steel for strength and corrosion resistance. Panel doors shall be provided on two sides of each coil/fan section to permit coil cleaning. An electrical panel shall be contained inside a factory mounted NEMA 3R weatherproof electrical enclosure. Units with the 575 V option shall include a second, factory mounted, NEMA 3R weatherproof electrical enclosure opposite the main electrical enclosure.

### 5.1.8 Vertiv™ Liebert® MC Mounting Legs Standard

Legs shall be provided to mount unit for vertical air discharge with rigging holes for hoisting the unit into position. Standard height is 18-inches (457 mm).

#### Optional Galvanized Steel Legs with Bracing

Condensers shall be shipped with (36-inch, 914 mm) (48-inch, 1,219 mm) (60-inch, 1,524 mm) mounting legs with stabilization bracing. Legs, bracing, and hardware shall be galvanized steel.

### 5.1.9 Vertiv™ Liebert® MC Condenser Accessories

#### Vertiv™ Liebert® Lee-Temp System—Optional

Liebert® Lee-Temp Receiver Kit shall contain an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure relief valve, rota-lock valve for refrigerant charge isolation, and piping assembly with head pressure operated 3-way valve and check valve. Components shall be field assembled to the condenser. The three-way valve shall sense refrigerant head pressure and adjust the flooding charge in the condenser coil to adjust the condenser heat rejection capacity. The Liebert® Lee-Temp heater shall be 150 W, shall include an integral thermostat to maintain refrigerant temperature at a minimum of 85°F (29°C), and shall require a separate power supply of (208/230 V, 1 phase, 60 Hz) (120 V, 1 phase, 60 Hz).

The Liebert® Lee-Temp Kit shall function with Liebert® MC variable speed fan motors and electronic controls that lower fan speed in lower outdoor ambient temperatures for maximum energy efficiency. This system shall allow system start-up and positive head pressure control with ambient temperatures as low as -30°F (-34.4°C).

### 5.1.10 Fusible Plug Kit—Optional

A fusible plug kit shall be field installed on the liquid line for compliance with building codes requiring refrigerant relief during high temperature and building fire conditions.

### 5.1.11 IBC/OSHPD Seismic Certification and IBC Wind/Snow Load Compliant—Optional

IBC/OSHPD Seismic Certification and IBC Wind/Snow Load Compliant condensers shall be provided with any applicable bracing and field installation instructions. Condensers shall bear a label certifying compliance with IBC/OSHPD requirements.

## 5.2 OPTIONS— Vertiv™ Liebert® Drycooler

### 5.2.1 Vertiv™ Liebert® Drycooler Summary

These specifications describe requirements for an air cooled Liebert® Drycooler for a Liebert® Thermal Management system. The Liebert® Drycooler shall be designed to reject waste heat to outdoor air and to control glycol temperature as pumped glycol rates and outdoor ambient conditions change.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

Standard 60-Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and shall be marked with the CSA c-us logo.

### 5.2.2 Liebert® Design Requirements

The Vertiv® Liebert® Drycooler shall be a factory assembled unit, complete with integral electrical panel, designed for outdoor installation and vertical air flow only. The Liebert® Drycooler shall be a draw through design.

### 5.2.3 Vertiv® Liebert® Drycooler Standard Features—All Liebert® Drycoolers

The Liebert® Drycooler shall consist of Liebert® Drycooler coil(s), housing, propeller fan(s) direct driven by individual fan motor(s), electrical controls, and mounting legs. The air cooled Liebert® Drycooler shall provide glycol temperature control to the indoor cooling unit by adjusting heat rejection capacity. Various methods shall be available to match indoor unit type, minimum outdoor design ambient, and maximum sound requirements.

#### 1. Housing

The Liebert® Drycooler housing shall be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles. Structural support members, including coil support frame, motor, and drive support, shall be galvanized steel for strength and corrosion resistance. Aluminum legs shall be provided to mount unit for vertical air discharge and shall have rigging holes for hoisting the unit into position. An electrical panel shall be inside an integral NEMA 3R weatherproof section of the housing. The electrical panel shall provide at least 5,000A SCCR.

#### 2. Liebert® Drycooler Coil

The Liebert® manufactured coil shall be constructed of copper tubes in a staggered tube pattern. Tubes shall be expanded into continuous, corrugated aluminum fins. The fins shall have full depth fin collars completely covering the copper tubes, which are connected to heavy wall Type “L” headers. Inlet coil connector tubes pass through relieved holes in the tube sheet for maximum resistance to piping strain and vibration. Coil shall be split flow into multiple coil circuits, combined to yield a Liebert® Drycooler with _____ internal circuits. The supply and return lines shall be (spun shut [1-4 fan models]), (brazed with a cap [6 or 8 fan models]) and shall include a factory installed Schrader valve. Coils shall be factory leak tested at a minimum of 300 psig (2,068 kPag), dehydrated, then filled and sealed with an inert gas holding charge for shipment. Field relief of the Schrader valve shall indicate a leak free coil.

#### 3. Propeller Fan

The propeller fan shall have aluminum blades secured to a corrosion protected steel hub. Fans shall be secured to the fan motor shaft by means of a keyed hub and dual setscrews. Fan diameter shall be 26-inches (660 mm) or less. Fans shall be factory balanced and run before shipment. Fan guards shall be heavy gauge, close mesh steel wire with corrosion resistant polyester paint finish that shall be rated to pass a 1,000-hour salt spray test.

#### 4. Fan Motor

The fan motor shall be continuous air over design and shall be equipped with a rain shield and permanently sealed bearing. Motors shall be rigidly mounted on die formed galvanized steel supports.

#### 5. Electrical Control

Electrical controls, overload protection devices and service connection terminals shall be provided, and factory wired inside the integral electrical panel section of the housing. A locking disconnect switch shall be factory mounted and wired to the electrical panel and controlled via an externally mounted locking door handle. An indoor unit interlock circuit shall enable Liebert® Drycooler operation whenever indoor unit compressors are active. Only supply wiring, indoor unit interlock wiring and high voltage wiring to pumps when controlled by the Liebert® Drycooler shall be required at Liebert® Drycooler installation.

### 5.2.4 Specific Features by Vertiv™ Liebert® Drycooler Type

#### 1. Fan Speed Control (DSF/DDF) Liebert® Drycooler (1 Fan) with Integral Pump Control

The DSF/DDF Liebert® Drycooler shall have a fan speed controller that senses the leaving glycol temperature and varying the speed of an FSC duty motor in direct proportion to the heat rejection needs of the system. Fan speed controller shall be factory set to range of 70 to 100°F (21 to 38°C) for glycol cooled applications. The fan speed control shall be field adjustable to a range of 30 to 60°F (-1 to 16°C) for free cooling applications. The motor shall be single phase and include built-in overload protection.

The motor shall have an ODP enclosure and a full speed of 1,100 rpm at 60 Hz (920 rpm at 50 Hz). The DSF/DDF Vertiv™ Liebert® Drycooler shall control operation of glycol pump(s) powered from the electrical panel. The air cooled Liebert® Drycooler shall have a ____V, 1 phase, ____ Hz power supply.

### 2. Fan Cycling Control (DSO/DDO) Liebert® Drycooler with Integral Pump Control (All Fan Quantities)

The DSO/DDO Liebert® Drycooler shall sense the leaving glycol temperature and cycle fixed speed fans to maintain glycol temperatures. Aquastats shall have field adjustable setpoints. The fixed speed motors shall be three phase and have individual internal overload protection. Fixed speed motors shall have a TEAO enclosure and a full speed of 1,140 rpm at 60 Hz (950 rpm at 50 Hz). The DSO/DDO Liebert® Drycooler shall control operation of glycol pump(s) powered from the electrical panel. The air cooled Liebert® Drycooler shall have a ____V, 3 phase, ____ Hz power supply.

### 3. Fan Cycling Control DDNT Liebert® Drycooler (All Fan Quantities)

The DDNT Liebert® Drycooler shall sense the leaving glycol temperature and cycle fixed speed fans to maintain glycol temperatures. Aquastats shall have field adjustable setpoints. The fixed speed motors shall be three-phase and have individual internal overload protection. Fixed speed motors shall have a TEAO enclosure and a full speed of 1,140 rpm at 60 Hz (950 rpm at 50 Hz). The air cooled Liebert® Drycooler shall have a ____ V, 3 phase, ____ Hz power supply.

### 4. Main Fan Control DDNL Liebert® Drycooler (All Fan Quantities)

The DDNL Liebert® Drycooler shall control fixed speed fans when an external contact closure completes the internal 24 VAC circuit. The fixed speed motors shall be three-phase and have individual internal overload protection. Fixed speed motors shall have a TEAO enclosure and a full speed of 1,140 rpm at 60 Hz (950 rpm at 50 Hz). The air cooled Liebert® Drycooler shall have a ____V, 3 phase, ____ Hz power supply.

### 5. No Fan Control DDNC Liebert® Drycooler (All Fan Quantities)

The DDNC Liebert® Drycooler shall activate all fixed speed fans when supply power is applied to the Liebert® Drycooler. The fixed speed motors shall be three-phase and have individual internal overload protection. Fixed speed motors shall have a TEAO enclosure and a full speed of 1,140 rpm at 60 Hz (950 rpm at 50 Hz). The air cooled Liebert® Drycooler shall have a ____ V, 3 phases, ____ Hz power supply.

### 6. Vertiv™ Liebert® Quiet-Line Drycooler (All Fan Quantities)

Liebert® Quiet-Line Drycoolers shall be available for DSO, DDO, DDNT, DDNL, and DDNC control types. The fixed speed fan motor(s) shall have a TEAO enclosure, provide individual overload protection and have a full speed of 570 rpm at 60 Hz (475 rpm at 50 Hz) for quiet operation.

### 7. Pump Controls

The control for pump(s) up to 7.5 hp shall be incorporated into the Liebert® Drycooler electrical panel and shall be available on all fan speed and fan cycling control Liebert® Drycoolers. The pump fuses, overload heaters and flow switch (dual pump control models) for the Liebert® Drycooler electrical panel shall be included with the Liebert® pump packages or shall be field supplied for field supplied pumps.

The dual pump control option shall provide controls for primary and standby pump operation. A flow switch shall be field installed into glycol piping and wired into the Liebert® Drycooler electrical panel. A loss of glycol flow shall be sensed by the flow switch and the pump controls shall energize the standby pump and de-energize the primary pump. An internal switch shall allow manual selection of the lead/lag pump for the balance of run time.

### 5.2.5 Ancillary Items

An expansion tank shall be provided for expansion and contraction of the glycol fluid due to temperature change in the closed system. The tank and air vents shall be field installed at the system's highest elevation to allow venting of trapped air. A fluid pressure relief valve shall be provided for system safety. The system shall include (tank steel [expansion, compression, diaphragm, bladder], air separator, air vent, fluid pressure relief valve, pressure gauges, flow switches, tempering valves, [primary, primary and standby] pumps, supply and return piping).

### 5.2.6 Fan Motor

The fan motor shall be continuous air over design and shall be equipped with a rain shield and permanently sealed bearings. Motors shall be rigidly mounted on die formed galvanized steel supports.

### 5.2.7 Electrical Controls

Electrical controls, overload protection devices and service connection terminals shall be provided, and factory wired inside the integral electrical panel section of the housing. A locking disconnect switch shall be factory mounted and wired to the electrical panel and controlled via an externally mounted, locking door handle. An indoor unit interlock circuit shall enable Liebert® Drycooler operation whenever indoor unit compressors are active. Only supply wiring, indoor unit interlock wiring and high voltage wiring to pumps when controlled by the Liebert® Drycooler shall be required at Liebert® Drycooler installation.

### 5.2.8 Specific Features by Vertiv™ Liebert® Drycooler Type

#### 1. Fan Cycling Control (DSO, DDO) Liebert® Drycooler (All Fan Quantities) with Integral Pump Control

The DSO/DDO Liebert® Drycooler shall sense the leaving glycol temperature and cycle fixed speed fans to maintain glycol temperatures. Aquastats shall have field adjustable setpoints. The fixed speed motors shall be three-phase and have individual, internal overload protection. Fixed speed motors shall have a TEAO enclosure. The DSO/DDO Liebert® Drycooler shall control operation of glycol pumps powered from the electrical panel. The air cooled Liebert® Drycooler shall have a V, 3 phase, _____Hz power supply.

#### 2. Fan Cycling Control (DDNT) Liebert® Drycooler (All Fan Quantities)

The DDNT Liebert® Drycooler shall sense the leaving glycol temperature and cycle fixed speed fans to maintain glycol temperatures. Aquastats shall have field adjustable setpoints. The fixed speed motors shall be three-phase and have individual, internal overload protection. Fixed speed motors shall have a TEAO enclosure. The air cooled drycooler shall have a _____V, 3 phases, _____Hz power supply.

#### 3. Main Fan Control (DDNL) Liebert® Drycooler (All Fan Quantities)

The DDNL Liebert® Drycooler shall control fixed speed fans when an external contact closure completes the internal 24 VAC circuit. The fixed speed motors shall be three-phase and have individual, internal overload protection. Fixed speed motors shall have a TEAO enclosure. The air cooled Liebert® Drycooler shall have a _____V, 3 phase,_____ Hz power supply.

#### 4. No Fan Control (DDNC) Liebert® Drycooler (All Fan Quantities)

The DDNC Liebert® Drycooler shall activate all fixed speed fans when supply power is applied to the Liebert® Drycooler. The fixed speed motors shall be three-phase and have individual, internal overload protection. Fixed speed motors shall have a TEAO enclosure. The air cooled Liebert® Drycooler shall have a _____ V, 3 phase, _____ Hz power supply.

#### 5. Vertiv™ Liebert® Quiet-Line Drycooler (All Fan Quantities)

Liebert® Quiet-Line Drycoolers shall be available for DSO, DDO, DDNT, DDNL, and DDNC control types. The fan motor(s) shall have a TEAO enclosure and provide individual overload protection for quiet operation.

### 5.2.9 Pump Controls within Vertiv™ Liebert® Drycooler

#### 1. Single Pump Option

Pump controls for a single glycol pump up to 7.5 hp (5.6 kW) shall be incorporated into the same integral electrical panel as the Liebert® Drycooler fan controls and may include fuses or circuit breakers as required for the pump motor. Pump voltage, phase, and frequency shall be the same as Liebert® Drycooler voltage, phase, and frequency.

#### 2. Dual Pump Option

Pump controls for a dual glycol pump system up to 7.5 hp (5.6 kW) shall operate one pump as primary and the second pump shall operate as a standby pump. Pump controls shall be incorporated into the same integral electrical panel controlling Liebert® Drycooler fans. A factory supplied, field installed flow switch shall sense loss of flow and switch to the standby pump for continuous system operation. An internal switch shall allow manual selection of the primary (lead) pump.

### 5.2.10 Pump Package

#### 1. Single Pump Package

This system shall be provided with a centrifugal pump mounted in a weatherproof and vented enclosure. The pump shall be rated for ____GPM (  l/m) at ft. (___kPa) of head and operate on volt, three-phase, ______Hz and operate on____ V, 3 phase, ________Hz.

#### 2. Dual Pump Package

The dual pump package shall include pumps, enclosure, and field mounted flow switch. The standby pump shall automatically start up on failure of the lead pump by Liebert® Drycooler pump controls or by a separate, factory wired control box and shall include a lead/lag switch for the pumps. Each pump shall be rated for GPM ( ____l/s) at __ft. ( ____kPa) of head and operate on ____V, 3 phase, _________ Hz.

### 5.2.11 Ancillary Items

#### Expansion Tanks, Fluid Relief Valves, Air Management, and Other Devices

An expansion tank shall be provided for expansion and contraction of the glycol fluid due to temperature change in the closed system. The tank and air vents shall be field installed at the system's highest elevation to allow venting of trapped air. A fluid pressure relief valve shall be provided for system safety. The system shall include (tank steel [expansion, compression, diaphragm, bladder], air separator, air vent, fluid pressure relief valve, pressure gages, flow switches, tempering valves, [primary, primary and standby] pumps, supply, and return piping).

# 6.0 EXECUTION

## 6.1 Installation of Thermal Management Units

### 6.1.1 General

Install thermal management units in accordance with manufacturer’s installation instructions. Install units’ plumb and level, firmly anchored in locations indicated and maintain manufacturer’s recommended clearances.

### 6.1.2 Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to electrical contractor.

### 6.1.3 Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer’s piping connection diagram submittal to piping contractor.

#### Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Provide pitch and trap as manufacturer's instructions and local codes require.

## 6.2 Field Quality Control

Start the system in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements.

## 6.3 Warranty Start-Up and Control Programming

Engage manufacturer's field service technician to provide warranty start-up supervision and assist in programming of unit(s) controls and ancillary panels supplied by them.