# Vertiv™ CoolPhase CDU

## Split Indoor Chiller for High Density Applications
## Guide Specifications

# 1.0 GENERAL

## 1.1 Summary

These specifications describe requirements for a thermal management system. The system shall be designed to control supply fluid temperature to rear door heat exchangers or cabinets containing fluid cooled electronic equipment. The manufacturer shall design and furnish all equipment to be fully compatible with the heat dissipation requirements of the rear door heat exchanger or fluid cooled electronic equipment cabinet.

## 1.2 Vertiv™ CoolPhase CDU System

The Vertiv™ CoolPhase CDU is available in the following model: XDM300. Each XDM300 module contains its own pump, power supply, Vertiv™ Liebert® iCOM™ display, and dual refrigeration circuit.

## 1.3 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 US and Canadian product safety standard, CSA C22.2 No. 60335-2-40/UL 60335-2-40 and marked with the CSA c-us logo.

## 1.4 Submittals

Submittals shall be provided with the proposal and shall include: single line diagrams; dimensional, electrical, and capacity data; piping and electrical connection drawings.

## 1.5 Acceptable Alternatives

Acceptable alternatives shall be permitted with engineer's prior approval only. Contractor to submit a detailed summary form listing all variations to include size deviations, electrical load differences, functional and component changes, and savings to end user.

## 1.6 Quality Assurance

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 (VERTIV™ COOLPHASE CDU)

## 2.1 Cooling System

The content in this section describes details of a Vertiv™ CoolPhase CDU system.

### 2.1.1 Secondary Fluid Circuit

The fluid circuit shall be factory piped with heat exchanger (brazed plate evaporator), pump, sensors and fittings, insulated to prevent condensation.

The water piping shall be filled with a nitrogen holding charge and closed connections.

### 2.1.2 Pump

#### 2.1.2.1 Dual Pump

The unit shall be equipped with two pumps. The pump speed shall be variable and automatically regulated by the Vertiv™ Liebert® iCOM™. Flow is monitored by the flow meter.

Pump shall be rated for _____ GPM (___ l/s) at ___ ft. (___ kPa) of head.

### 2.1.3 Heat Exchanger

#### 2.1.3.1 Brazed Heat Exchanger

The heat exchanger shall be brazed-plate type, constructed of 316 stainless-steel plates. The primary side shall be piped to the refrigerant circuit. The secondary side shall be piped to cooling module(s) in the Vertiv™ CoolPhase CDU and cooling devices in the Data-Hall space.

## 2.2 Refrigeration System

### 2.2.1 System Description

A single refrigeration circuit shall include a compressor, liquid line filter drier, and a refrigerant sight glass with moisture indicator, an expansion valve, a brazed plate evaporator, and pressure safety switches.

### 2.2.2 Dual Circuit

Unit shall include two independent refrigerant circuits.

Compressors shall be located inside the cabinet, removable and serviceable from the front of the unit. Paired compressor circuits shall be connected to a common evaporator (per cooling module), with alternating plates to affect every water channel of that heat exchanger.

## 2.3 Compressors

### 2.3.1 Tandem Digital Scroll Compressors

The compressors shall be tandem, scroll type with a variable capacity operation capability of one compressor of the pair. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall have vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, suction line strainer, and a maximum operating speed of 3,500 rpm. The compressor motor shall be suction gas cooled.

## 2.4 Crankcase Heaters

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

## 2.5 R-410A Refrigerant

The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants. Refrigerant shall be field supplied and field charged by the installing contractor.

## 2.6 Air Cooled Systems

The indoor evaporator unit shall include refrigerant piping and shall have a factory holding charge of nitrogen. The hot gas and liquid lines shall be spun shut and each shall include a factory installed Schrader valve. Field relief of the Schrader valve shall indicate a leak free system from the factory. The installing contractor shall cut the evaporator piping and shall evacuate and charge the system. Refrigerant shall be supplied by the installing contractor.

## 2.7 Cabinet Construction and Accessibility

### 2.7.1 Cabinet Construction (Vertiv™ Liebert® XDM300)

The exterior panels shall be 20-gauge steel and powder coated with charcoal color paint to protect against corrosion. The base is closed to prevent air bypass from the underfloor space. The top is open for cabinet ventilation.

The Liebert® XDM300 unit frame shall be welded construction, with formed sheet metal and steel tubing, having removable plates where required for access. The frame weldment shall be protected against corrosion using the autophoretic coating process.

The Liebert® XDM300 top module frame shall be welded construction, with formed sheet metal and steel tubing, having removable plates where required for access. The frame weldment shall be protected against corrosion using the autophoretic coating process.

### 2.7.2 Exterior Panels

The exterior panels shall be uninsulated. Panels shall have captive quarter-turn fasteners. The main unit color shall be RAL 7021 (gray-black).

### 2.7.3 Serviceability

The cabinet shall be designed so all components are easily accessible for service and maintenance through either the front or top of the unit. Units that are not fully accessible from front and top or not serviceable in place shall be unacceptable.

## 2.8 Locking Disconnect Switch

A manual disconnect switch shall be mounted in the electrical panel and be capable of disrupting the flow of power to the unit. The electric panel compartment shall be accessible only with the switch in the Off position. It shall be located behind the Vertiv™ Liebert® iCOM™ display door for quick access.

## 2.9 Short Circuit Current Rating (SCCR)

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

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.

# 3.0 CONTROL

## 3.1 Vertiv™ Liebert® iCOM™ Microprocessor Control with 7-inch Color Touchscreen

The Vertiv™ CoolPhase CDU XDM300 system shall utilize the Liebert® iCOM™ controller with Embedded Unity functionality. 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, and 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 and 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 back up unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup. An analysis.csv file shall be provided via the backup which allows the end user to download and view unit level settings, parameter names, default values, and newly adjusted values.
- **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.
- **Context Sensitive Help** - The Liebert® iCOM™ shall have an onboard 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** - Liebert® iCOM™ 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 field supplied sensors. 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.
- **Diagnostics/Service Mode** - The Vertiv™ 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 base-T 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 shall support dual IP on a single network and one 485 protocol simultaneously.

## 3.2 User Main Menu

All unit main menu clearly displays on the screen the current operating conditions and communicates to the customer's building management system/building automation system. Information displayed on the main menu may be changed by the user to suit site requirements. The Vertiv™ Liebert® iCOM® main menu factory configuration displays the following conditions:

- Status Dial – Display of unit fluid control temperature, supply/return fluid temperatures, supply/return fluid pressure, flow rate, differential pressure, and dew point.
- Event Log – Display of unit status, alarms, warnings, and messages.
- Unit Function – Entering and leaving fluid temperatures, heat exchanger liquid temperature, indoor pump speed (%), load (watts), pump differential pressure, pump suction/discharge pressure, pump differential pressure, refrigerant liquid temperature.

### 3.2.1 User Setpoints

Available end user defined Vertiv™ CoolPhase CDU setpoints shall include, Supply Fluid Temperature, Return Fluid Temperature Limit (Return Compensation), Pump Flow, Differential Pressure, Supply Fluid Pressure Limit, Manual Pump Speed (BMS), and Dewpoint Margin.

## 3.3 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 Vertiv™ Liebert® iCOM™ shall activate an audible and visual alarm in the event of any of the following conditions:

- High/Low Supply Fluid Temperature
- High/Low Fluid Differential Pressure
- Low System Flow
- Loss of Flow
- Pump Op w/No Flow
- XD Flow Blocked
- Low XD Pump Inlet Pressure
- High Supply Fluid Pressure
- XDM Pump Inverter Failure
- High/Low Room Temperature
- High/Low Dew Point
- Supply/Return Fluid Temp Sensor Failure
- Supply/Return XD Fluid Pressure Sensor Failure
- Flow Sensor Failure
- 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 10 to 9,999 seconds.

## 3.4 Monitoring Points

Vertiv™ CoolPhase CDU shall have monitoring points available for temperatures, pressures, pump control, fluid flow, differential pressure, pump information, unit cooling information, and alarm events.

## 3.5 Control Method

The Vertiv™ Liebert® iCOM™ shall be factory set to allow precise monitoring and control of the fluid temperature leaving the unit.

Fluid flow rate is manually set from the Liebert® iCOM™ control based on the server equipment manufacturer's configuration specifications. Once set, the Liebert® iCOM™ control precisely monitors and controls the pump speed to maintain the flow rate at all times.

## 3.6 Supply Fluid Temperature Control

Supply Fluid Temperature Control shall be influenced by the Supply Fluid Temperature Sensor. This sensor shall influence the refrigerant-side cooling components (compressor/PRE).

### 3.6.1 Return Fluid Temperature Compensation

Vertiv™ CoolPhase CDU shall provide a routine for instances where higher than desired fluid temperatures are witnessed at the return of the CoolPhase CDU. The Return Fluid Temperature Compensation routine shall allow the adjustment of a high return threshold which defines the allowable return fluid temperature. As temperature increases above the desired threshold, corresponding PI settings will be adjusted to compensate for the high return fluid temperatures. This routine can be utilized for pump speed control or for supply fluid temperature control.

## 3.7 Quick Start Operation

In the event of a power failure, the Vertiv™ Liebert® iCOM™ controller shall provide the option for Quick Start operation which permits the Vertiv™ CoolPhase CDU to start compressors/PRE and indoor pump(s) within ~10 seconds after power restoration. While the Liebert® iCOM™ controller is booting the application, the system shall operate compressors/PRE and indoor pump(s) at a fixed speed/capacity. Once Liebert® iCOM™ has fully booted, the system operation shall return to normal.

## 3.8 Pump Control

The Vertiv™ Liebert® XDM system shall contain two variable speed pumps that is used to circulate cooling liquid to the source requiring cooling. The circulated liquid shall absorb heat from the source requiring cooling and reject it to the plate heat exchanger. Each variable speed pump is connected to a VFD and shall provide the required maximum flow rate. A flow meter and pressure transducers shall monitor actual system flow rate on the discharge of the system and determine the speed of the pump. Pump speed is monitored to determine the health of the fluid system.

The Liebert® XDM shall contain supply and return pressure sensors installed on the supply and return fluid lines to monitor the health of the system.

### 3.8.1 Indoor Pump Speed Control

Indoor pump speed control or call for pump (CFP) shall be based on five possible means of control:

- Flow Rate: A flow meter shall monitor the actual system flow rate. A signal from the flow meter is used to control the pump speed to match the flow rate setpoint and/or alarm on adjustable minimum/maximum values. Each pump flow rate and total flow rate from all pumps shall be displayed via the Vertiv™ Liebert® iCOM™ display. This is the default means of control.
- Differential Pressure: The pressure from the Vertiv™ Liebert® XDM supply and return shall be monitored at the customer connection point. The difference in pressure at the customer connection point is used to control the speed of the pump to match a differential pressure setpoint, and/or alarm on adjustable minimum/maximum values.
- Flow w/ Differential Pressure Limit: Primary means of control is specified by end user and expressed as an LPM/GPM setting.
    - Primary loop controls flow rate.
    - Secondary loop controls to differential pressure (If differential pressure gets too low, pump speed shall increase.)

- Differential Pressure w/Flow Limit: Primary means of control is specified by end user and expressed as a differential pressure setting.
  - Primary loop controls differential pressure.
  - Secondary loop controls flow rate (If flow rate gets too low, pump speed shall increase.)
- Manual: Pump speed shall be set to a manual value via the local display or via BMS.

### 3.8.2 Indoor Pump Staging

Vertiv™ Liebert® XDM pumps shall be staged ON/OFF as required to achieve the desired flow rate, reduce corrosion, and maintain the wetted, sealed surfaces of the lag pump. Vertiv™ Liebert® iCOM™ ensures that during pump staging there shall be no interruption of flow due to the connected load. Indoor pumps that have been inactive for seven days must run for a minimum of two minutes at predetermined fluid flow rate and shall be monitored by the flow meter. By default, inactive pumps shall automatically be staged ON/OFF.

## 3.9 Dew Point Margin Control

Vertiv™ CoolPhase CDU shall provide dew point margin control to assist with preventing condensation from forming on uninsulated field piping or critical surfaces within the space being served. Condensation shall take place in the event the Vertiv™ CoolPhase CDU supply fluid temperature is cooler than the room air dew point temperature. The dew point air temperature shall be monitored/calculated by remote temperature/humidity sensors. A dew point margin setpoint is established to provide a safety margin between the fluid temperature and room air dew point. As the system dew point increases the supply fluid temperature setpoint is increased proportionally above the user setpoint to maintain the dew point margin temperature delta.

## 3.10 Heat Exchanger Maximum Operating Pressure

The Vertiv™ CoolPhase CDU shall utilize an EEV to prevent excessive compressor suction pressures and temperatures due to high secondary fluid temperatures. The EEV shall determine the maximum allowable operating pressure.

## 3.11 Vertiv™ CoolPhase Teamwork Operation

Vertiv™ CoolPhase CDU by default shall come with Teamwork Mode 3 enabled. In instances where multiple CoolPhase systems are networked together into a single group, cooling capacity controlling the leaving fluid temperature shall be independently controlled at each system based off the PI settings determined by the end user and pump speed (%) shall operate in parallel i.e., each CoolPhase system shall provide identical flow rates.

### 3.11.1 Cascade on Vertiv™ Liebert® XDM Pump Speed

Liebert® XDM shall allow for the configuring of staging or cascading ON/OFF standby units in a group configuration to assist with fluid flow requirements.

## 3.12 Fluid Pressure Sensor Configuration and Calibration

Each unit shall be provided with seven internal pressure sensors; fluid supply, fluid return, pump discharge, filter outlet, and pump inlet. Each sensor can be calibrated using the Vertiv™ Liebert® iCOM™ display.

## 3.13 Wired Remote Temperature/Humidity Sensor

Each Vertiv™ Liebert® iCOM™ shall have one factory supplied and connected remote temperature/humidity sensor that may be used as a controlling sensor or for reference.

## 3.14 Wired Entering/Leaving Fluid Sensor

Each Vertiv™ Liebert® iCOM™ shall have one factory supplied and connected thermistor monitoring the fluid temperature entering the unit and one thermistor monitoring the fluid temperature leaving the unit.

## 3.15 Fluid Flow Meter

Each Vertiv™ Liebert® iCOM™ shall have one fluid flow meter monitoring the gallons per minute (GPM) provided at the discharge of the system. Flow meter shall determine the speed of the operating pump if flow control is selected.

## 3.16 Liebert® XDM BMS Setup and Operation

The Vertiv™ Liebert® iCOM™ controller shall allow for the control of the Vertiv™ Liebert® XDM unit from a building monitoring system (BMS) which includes standard unit level settings used for the control of supply fluid temperature setpoint, manual pump speed %, pump speed control type, fluid flow and fluid pressure differential setpoints. Liebert® iCOM™ may be configured to provide backup settings that may be used for control in the event of a BMS disconnect.

## 3.17 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 outage.

## 3.18 Sequential Load Activation

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

## 3.19 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.

## 3.20 Winter Start Time Delay

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 delay after the compressor start has elapsed, the low pressure input should remain in the normal state. If the low pressure input does not remain in the normal state after the 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.

## 3.21 Advanced High Pressure Protection

When the compressor is initially activated, the system shall be monitored for a high pressure. When high pressure is detected, the control shall reduce the system discharge pressure by altering the compressor loading and the condenser fan speed, 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 automatically re-enable the compressor when pressure returns to a safe level.

## 3.22 Refrigerant Pressure Transducer Failure

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

## 3.23 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.

## 3.24 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.

## 3.25 Digital Scroll Sensor Failure

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

## 3.26 Compressor Sequencing

A user selectable compressor sequencing parameter shall be provided and accessed through the local control. This sequencing parameter presents the user with three choices:

- Always use Compressor 1 as lead compressor.
- Always use Compressor 2 as lead compressor.
- Auto: The unit shall automatically stage compressors to keep each unit's run time within eight hours of the other unit'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 cooling load.
    - First priority: If the safety timings are acceptable for only one compressor, that compressor shall be the next to be started/stopped.
    - Second priority: If both compressors are Off, the one with fewer working hours shall be the next to start.
    - Third priority: If both compressors are in operation, the one that has been operating longer since the last start shall be the next to be stopped.

## 3.27 Compressor Run Time Monitoring

The control shall log these compressor statistics:

- Number of compressor 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.

## 3.28 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.

## 3.29 Manual Compressor Operation

The user shall be able to operate each compressor 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.

# 4.0 MISCELLANEOUS OPTIONS

## 4.1 Communication Interfaces

## 4.2 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. The remote shutdown terminal shall provide a location to remotely shut down the unit, complying with the National Fire Code.
- **Extra Common Alarm Contacts** - Two additional pairs of terminals provide the customer with normally open contacts for remote indication of unit alarms.
- **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.)

## 4.3 Compressor Overload—Standard

A pair of N/O contacts shall be factory installed and wired to each compressor to indicate compressor overload.

## 4.4 Quick Restart Function—Optional

Unit restart time for full cooling shall be 40 seconds or less after power to the unit has been restored, with fans starting within 15 seconds. The unit shall be equipped with an optional capacitive buffer to provide the Vertiv™ Liebert® iCOM™ with a minimum of three minutes of ride-through power. The UPS or capacitive buffer shall provide power to the Vertiv™ Liebert® IS-UNITY-DP card for continuous connectivity to building management system/building automation systems (where applicable). For unit with dual disconnect option this feature provides power from the Vertiv™ Liebert® XDM unit to the outdoor units (Vertiv™ Liebert® MCV and PRE).

## 4.5 Backup UPS Power and Condenser Subfeed Function—Optional

Dual disconnect with UPS, still has a reversing starter, the condenser subfeed, but no capacitance buffer since the controls are powered by the UPS feed. The UPS shall provide power to the unit controls and pumps for continuous connectivity to building management system/building automation systems (where applicable).

## 4.6 Wired Remote Sensor(s)—Optional

Each Vertiv™ Liebert® iCOM™ can have up to 10 2T sensors (20 sensor readings total) for reference only.

### 4.6.1 Vertiv™ Liebert® Liqui-tect™ 460 Zone Leak Detection Module with Cable Kit for Remote Mounting

A total of _____ (quantity) zone water sensor cables with no moving parts and hermetically sealed to keep out dust and dirt shall be provided. The Liebert® Liqui-tect™ 460 (LT460) shall provide a zone detection of leaks. The LT460 shall constantly monitor points for leaks, internal faults and power failures and warn of any abnormal conditions. LED's shall provide status indication and also ensure the cable is properly installed and operational under raised floors. The LT460 shall provide two independent outputs that provide a signal to a local alarm panel, Liebert® environmental unit, remote building management system, or external equipment.

Liebert® Liqui-tect™ 460 Module

The LT460 shall consist of a metal enclosure with a hinged top door providing access to the internal circuit board for wiring termination and configuration of DIP switches. The LT460 shall monitor up to 100 feet (30 m) of connected LT500Y leak detection cable. The LT460 shall be rated for 24 VAC, 50/60 Hz and 0.12 A.

## 4.7 Dew Point Margin Sensor(s)

Vertiv™ Liebert® iCOM™ for Vertiv™ Liebert® XDM supports the use of additional remote sensors for Dew Point Margin Control. Up to two additional sensors may be used for Dew Point Aggregation (Sensor A, Sensor B).

## 4.8 Floor Stand—Optional for Raised Floor Applications

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 ____ in. (_____mm) high

## 4.9 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 Liebert® 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, 16 AWG, 100-240 VAC universal (12 V, 1.5 A) single phase input power supply for 120 V or 230 V operation with factory supplied power connector.

## 4.10 Power Monitoring—Optional

The unit shall be equipped with factory-programmed/installed power meters to monitor power characteristics for either individual component or total unit. These meters allow the user to monitor meter connection status, input under voltage, input RMS voltage leg-to-leg and leg-to ground, input current for each phase, energy consumption in kilowatt hours and instantaneous power in watts. In multi-unit applications, a phase loss protection routine shall place a unit into standby mode in the event that phase loss is detected.

## 4.11 Secondary Filter

The unit can be equipped with two large capacity, removeable, and washable secondary filter assemblies providing filtration to either 25 microns (µm), 50 microns (µm) or 500 microns (µm). The filters shall be concurrently maintainable.

The filter shall be designed with sufficient face area to enable a filter media velocity of <0.5 m/s (1.6 ft/s) and in such a way that enables zero filter media bypass. The filters shall be fitted with differential pressure monitoring to report state of cleanliness and indicate an alarm when cleaning is required.

# 5.0 HEAT REJECTION

## 5.1 Vertiv™ Liebert® MCV Condenser

### 5.1.1 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 are 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 condenser model number shall be: _____

### 5.1.2 Condenser Design Requirements

The air cooled condenser shall be a factory assembled unit, complete with integral electrical panel, Vertiv™ Liebert® EconoPhase pump package, and designed for outdoor installation. The condenser shall be a draw through design.

The unit is to be supplied for operation using a _____volt/3 phase/60 Hz power supply.

### 5.1.3 Standard Features – All Condensers

Condenser shall consist of all aluminum microchannel condenser coil configured in V-banks, propeller fans direct driven by individual EC fan motors, mounting base, and electrical controls, suitable for mounting outdoors. The Liebert® air cooled condenser shall provide the heat rejection of two refrigeration circuits, matching heat rejection capacity varying with the outdoor ambient temperatures and compressor or Vertiv™ Liebert® EconoPhase pump heat rejection requirements. 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 provide reduced maximum sound levels.

### 5.1.4 Condenser Coil

#### 5.1.4.1 Aluminum Microchannel Coil

Microchannel 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.

### 5.1.5 Condenser Fan

The fan motor/blade assembly shall have an external rotor motor, fan blades, fan/finger guard, and integral orifice plate. 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. Orifice plate shall be coated with a corrosion resistant finish. Fan terminal blocks shall be located in an IP54 enclosure located on the top of the fan motor. Fan assemblies shall be factory balanced, tested before shipment, and mounted securely to the condenser structure.

#### 5.1.5.1 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 Electrical Controls

Electrical controls and service connection terminals shall be provided and factory wired inside the attached control panel section. A locking disconnect switch shall be factory mounted and wired to the electrical panel and controlled via an externally mounted locking and lockable door handle. High voltage supply wiring and low voltage indoor unit communication/interlock wiring shall be factory wired to customer connection boxes mounted on the base.

#### 5.1.6.1 Premium Efficiency Fan Control

The Vertiv™ Liebert® MCV 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 control system provides refrigerant head pressure and system starting for outdoor ambient temperature as low as -30°F (-35°C), provided the total temperature range (from minimum design ambient to maximum design ambient) is 125°F (70°C) or less.

The mode of the Liebert® MCV shall be controlled by the Liebert® iCOM™ control and shall be in either DX, EconoPhase, or Idle Mode by each refrigerant circuit. Dual circuit condensers shall operate fans to meet airflow needs and mode of each circuit independent of the other. Fan(s) on common refrigerant circuit shall operate in synchronous speed when that circuit is active.

#### 5.1.6.2 High Voltage Supply Connection Box

A high voltage customer connection box shall be provided for each Vertiv™ Liebert® MCV and matching Vertiv™ Liebert® EconoPhase to provide a single high voltage connection. The connection box shall be factory mounted to the condenser base and wired to the electrical panels of the Liebert® MCV and the Liebert® EconoPhase units. A locking type disconnect switch shall be accessible from the outside of the unit with the door closed and shall prevent access to the high voltage electrical components until switched to the Off position. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

#### 5.1.6.3 Low Voltage Connection Box

A low voltage connection box shall be provided for each Vertiv™ Liebert® MCV and matching Vertiv™ Liebert® EconoPhase unit to provide a single, low voltage connection from the indoor Vertiv™ Liebert® XDM unit. The connection box shall be factory mounted to the condenser base and wired to the electrical panels of the Liebert® MCV and the Liebert® EconoPhase units.

#### 5.1.6.4 Short Circuit Current Rating

The high voltage electrical configuration shall provide at least 65,000 A SCCR and shall be labeled to speed site approvals by AHJs.

#### 5.1.6.5 575-Volt Option

A secondary electrical enclosure shall be mounted to the condenser base and shall contain a factory wired transformer and fusing to support 575-V input power to the Vertiv™ Liebert® MCV and Vertiv™ Liebert® EconoPhase units. Liebert® MCV and Liebert® EconoPhase units shall be 460-V units. All internal wiring shall be provided to connect the connection box transformer to Liebert® MCV and Liebert® EconoPhase electrical enclosures. High voltage supply connections from the building shall be made in the high voltage connection box.

### 5.1.7 Condenser Cabinet

The condenser cabinet shall be divided into multiple fan/coil sections by configuring two coils into a V-bank arrangement for each variable speed EC fan. Fan/coil sections shall be created and protected by galvanized panels on each V-bank end. Internal structural support members, including coil support frame, shall be painted or galvanized steel for strength and corrosion resistance. Panel doors are provided on the outside of each coil/fan section to provide for coil cleaning. An electrical panel shall be contained inside a factory mounted NEMA 3R weatherproof electrical enclosure.

### 5.1.8 Vertiv™ Liebert® EconoPhase

The Liebert® EconoPhase has two variable speed refrigerant pumps controlled by individual VFDs, factory wired electrical panel, factory piped and tested refrigerant piping all housed within a bright aluminum NEMA 3R enclosure. The Liebert® EconoPhase is mounted, wired, and piped into the Vertiv™ Liebert® MCV Condenser Skid to provide significant jobsite installation savings. The Liebert® EconoPhase refrigerant pumps are individually activated and speed controlled during cooler outdoor ambient, coordinated with Liebert® compressors idled and refrigerant bypassed around them. Cool temperatures, such as mild weather and at night, partial economization and power savings is provided with one pump activated and one compressor idled. Colder temperatures, such as winter weather, allow both Vertiv™ Liebert® XDM compressors to be idled and Liebert® EconoPhase pumps to be controlled independently to provide full economization.

### 5.1.9 Vertiv™ Liebert® MCV Single Skid Assembly

The Liebert® MCV single skid assembly shall consist of a galvanized steel base with the Liebert® MCV condenser, Vertiv™ Liebert® EconoPhase, and Liebert® receivers mounted to provide a single, high density heat rejection unit to support one Vertiv™ Liebert® XDM unit. All components shall be factory wired to a centralized connection location for high voltage connection and low voltage connection boxes. Refrigeration components shall be factory piped, insulated, secured to a common location on the base, and sealed with an inert gas for shipment. Field relief of the Schrader valve shall indicate a leak free system. Jobsite transportation, rigging, anchorage, and connections shall be simplified for fast deployment.

### 5.1.10 Vertiv™ Liebert® MCV Double Skid Assembly—Optional

The Liebert® MCV double skid assembly shall consist of two independent single skid assemblies that are bolted together, creating a common assembly for ease of transportation and jobsite rigging. The double skid assembly shall support two Vertiv™ CoolPhase CDU units. All components shall be factory wired to a centralized connection location on one end of the double skid for high voltage connection and low voltage connection boxes.

Refrigeration components shall be factory piped, insulated, and secured to a common location on the same end of the double skid as electrical connections. Piping shall be sealed with an inert gas for shipment, and field relief of the Schrader valve shall indicate a leak free system. Jobsite transportation, rigging, anchorage and connections shall be simplified for fast deployment.

# 6.0 EXECUTION

## 6.1 Installation of Thermal Management Units

### 6.1.1 General

Install cooling 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 a copy of manufacturer’s electrical connection diagram submittal to the electrical contractor.

### 6.1.3 Piping Connections

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

### 6.1.4 Field Quality Control

Start up cooling units 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 flow and temperature conditions for fluid cooled electronic equipment.

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

## 6.2 Warranty Start-up and Control Programming

Install the indoor unit in accordance with manufacturer's installation instructions provided with seismic option. Firmly anchor maintaining manufacturer's recommended clearances. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, special inspection, and attachment to non-building structures must be outlined and approved by the engineer of record for the projection or building. Electrical, pipe, and duct connections must permit movement in three dimensions and isolate the unit from field connections. Electrical conduit shall be flexible, having at least one bend between the rigid connection at the unit cabinet and the connection to rigid conduit or foundation. The piping flexible connection or loop must be suitable for the operation pressure and temperature of the system. Furnish a copy of the manufacturer's piping connection diagram submittal to the piping contractor.

Engage the 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.