Vertiv™ Liebert® PCW
Nominal 035-170 kW Thermal Management System
Guide Specifications

1.0 GENERAL

1.1 Summary

This specification describes the requirements for a perimeter chilled water system. The system shall be designed to control air flow, temperature, and humidity conditions in rooms containing electronic equipment, with an effective insulation and vapor barrier.

1.2 Design Requirements

The Thermal Management system shall be a Vertiv™ Liebert® PCW factory-assembled unit. Standard 60 Hz units shall be CSA-certified and adhere to the U.S. and Canadian product safety standard, “CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment” and marked with the CSA c-us logo. Units shall be specifically designed for service from the front of the unit. The system shall be designed for draw-through air arrangement to ensure even air distribution to the entire face area of the coil.

The Liebert® PCW system performance shall be AHRI Certified™, the trusted mark of performance assurance for heating, ventilation, air conditioning, and commercial refrigeration equipment, using AHRI Standard 1360. To find AHRI Certified products, go to www.ahridirectory.org.

1.3 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.

1.4 Operating Limits

The unit shall be designed to operate within the following working ranges.

Room air conditions:

- Temperature: from 64°F to 105°F (18°C to 41°C)
- Humidity ratio: from 0.0055 lbs/lbs to 0.011 lbs/lbs (5.5 g/kg to 11 g/kg)
- Relative humidity: from 20% to 60%

Chilled water circuit:

- Inlet water temperature: min. 41°F (5°C)
- Water pressure: max. 400 psig (27.6 bar)

1.5 Installation/Serviceability

The unit is designed to be moved and set in place using a forklift. The cabinet shall be designed so that serviceable components are easily accessible for maintenance and service through the front of the unit. Internal components cannot be accessed from the sides of the unit. Fans, valves, and filters can be replaced without removing any other internal components. Electrical panel shall have power and signal quick connectors for fans to reduce installation time and unit downtime in case of failure.

1.6 Submittals

Submittals shall be provided after the agreement of the proposal and shall include: single-line chilled water diagram, unit dimensions and weight, electrical and capacity data (net sensible cooling capacity, unit power consumptions including microprocessor controller and the unit SCOP); piping, and electrical connection drawing.

1.7 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.

2.0 PRODUCT

2.1 Frame

The cabinet is manufactured from hot-dipped galvanized steel sheet.

The unit frame section and fan plenum frame shall be welded, formed sheet metal. They shall be protected against corrosion using the autophoretic coating process. The unit section and the fan plenum shall be shipped as two separate sections. The fan plenum shall be field mounted on top of the unit frame section.

2.2 Exterior Panels

The exterior panels shall be insulated with a minimum 1 in. (25mm), 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 black RAL 7021. The fan plenum shall be painted to match the color of the main unit.

The external panels are carbon steel painted with black RAL 7021 color epoxy polyester powder paint and assembled using stainless steel and galvanized screws and high tensile rivets.

The rear and the fans section panels are double skinned, with a minimum in. (25 mm), 1.5 lb. (0.68 kg) density fiber insulation sandwiched between the skins to reduce noise emission and heat loss.

The side panels, which are isolated from the inside of the unit to form a complete double-skinned cabinet, and the small service panel for electrical heaters are also lined with fiber insulation.

The front panel(s) are supported by hinges for easier access; this panel can be opened with the fast closing lock. The rear and side panels are screwed to the supports. The rear panel(s) are screwed directly to the frame.

2.3 Airflow Configurations

2.3.1 Downflow Air, EC Fans Operating in the Unit (Digit 6 = D)

The unit takes the air from the top and delivers from the bottom, with fans running in the unit.

2.3.2 Upflow Air, Top Discharge (Digit 6 =U)

The unit takes the air from the front and delivers from the top. The unit is suited for ducted applications. The unit can be installed with and without a raised floor. The bottom of the unit is closed.

2.3.2.1 Floor Stand or Pedestal - Required for Upflow Unit

The upflow unit must be elevated to allow for condensate drainage. A floor stand or pedestal must be ordered with each unit.

2.3.3 Downflow Air, Front Discharge (Digit 6 = H)

The unit takes the air from the top and delivers from the front through a grill on the front panel(s). The unit shall be installed directly on the floor, the bottom of the unit is closed.

2.3.4 Downflow Air, EC Fans Operating Underfloor (Digit 6 = E)

The unit takes the air from the top and delivers from the bottom, with fans running in the raised floor. Delivering the air from all directions optimizes unit efficiency. The unit is suited for raised floor air delivery.

2.4 Air Filtration

2.4.1 MERV 8/MERV 11

The standard filtration grade is ASHRAE 52.2-2007 MERV 8 or MERV 11 standard filters. They are easily accessed/replaced by opening the front panel(s). Filters are installed on the coil surface to maximize the filtering surface to reduce air pressure drop.

2.4.2 Filter Clog

The filter clog shall sound an alarm when filters need to be changed.

2.5 Fan Section

The unit is fitted with variable speed, high efficiency, single inlet, backward curved, centrifugal plug type innovating EC fan(s). The fan(s) have an impeller with curved blades corrosion resistant. The fan motors are Electronically Commutated, IP54, with internal protections, continuous speed regulation via controller signal.

The motor is three-phase with IP54 protection; provided with internal thermal protection. The fan wheel is statically and dynamically balanced of degree G6.3 according to ISO 21940-11:2016; the bearings are self-lubricating.

A separator shall be installed between the fans to eliminate turbulence effects of one fan to the others; it shall also be designed to increase efficiency compared to simple plate separators.

2.5.1 Downflow

PW035 and PW040 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, one.

PW045 and 060 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity one for PW045 or quantity two for PW060.

PW070 and 080 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, two.

PW095 and 110 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, three.

PW145 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, three.

PW170 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, four.

2.5.2 Upflow

PW035 and PW040 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, one.

PW045 and 060 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity one for PW045 or quantity two for PW060.

PW070 and 080 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, two.

PW095 and 110 fan motors shall be nominal 4.7 hp (3.5 kW) each, with a maximum operating speed of 1800 rpm; quantity, three.

2.6 Electrical Panel

The electrical panel shall provide a minimum of 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.

Electric panel high voltage is covered with a safety panel. The front facing electrical panel (isolated from the air stream), contains fuses, contactors, transformers, controller, and other miscellaneous electrical components. Each high voltage system component includes fuses for an over-current protective device. Once open, the low voltage electrical section can be rotated to the right to allow for an easier installation/maintenance procedure.

2.7 Power Supply

Electrical power supply options are 460 V (±10%)/3 Ph/60 Hz (±2 Hz) or 575 V (±10%)/3 Ph/60 Hz (±2 Hz), if unit is supplied with an external THD filter, voltage tolerance is (+5,-10%), and includes a disconnect switch, mechanically interlocked with the electrical panel cover.

2.7.1 Standard Power Supply with Locking Disconnect Switch (Digit 17 = D)

The manual disconnect switch shall be mounted in the high-voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed and prevent access to the high-voltage electrical components until switched to the “OFF” position.

2.7.2 Dual Power Supply with ATS (Digit 17 = A)

Dual power supply unit is fitted with Dual Power Supply Alternate Version. The unit is fed by two separate power supplies: each power supply can independently feed the unit. In the case of main line failure, the Automatic Transfer Switch (ATS) switches to the second power supply. This feature provides full power supply and cooling redundancy in the case of an emergency power outage scenario.

Available on model sizes PW045 through PW170 with 460 V/3 Ph/60 Hz requirements.

2.7.3 Dual Power Supply with ATS and Capacitive Buffer (Digit 17 = G)

Dual power supply alternative option with Ultracap. The unit is fed by two separate power supplies: each power supply can independently feed the unit. In the case of power supply failure, the ATS switches to the secondary power supply This allows for full power supply redundancy during a power failure. The unit includes a simplified ATS (Automatic Transfer Switch) functionality: in the case of line I failure, it can be used for operating the interlocked contactors to the line II, if line II is operational. When fully charged, the ultracapacitor is capable of maintaining controls, the BMS card and the passive sensors for one minute.

Available on model sizes PW045 through PW170 with 460 V/3 Ph/60 Hz requirements.

2.7.4 Standard Power Supply with Capacitive Buffer (Digit 17 = U)

The capacitive buffer is powered by a 24 VAC input and outputs 18.4 VDC to the control when power is lost. The capacitive buffer takes four minutes to fully charge, and it will power the controller and display for up to one minute when power is lost.

2.8 Chilled Water Coil

The internal coil is manufactured from copper tubes and mechanically bonded to hydrophilic painted aluminium fins and is pressure tested to 500 psig (34.5 bar). The large face area, low velocity coil allows precise control of temperature and humidity during cooling and dehumidification and is designed to optimize fluid velocity while minimizing pressure drop, achieving the highest SHR (Sensible Heat Ratio) value. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

One chilled water circuit including copper pipes, a motorized modulating valve, air relief valve, and drain plug.

2.9 Chilled Water Valve

2.9.1 2-Way Modulating Valve

The unit is equipped with a chilled water circuit with a 2-way modulating valve, and electronic actuator to the control water flow to the coil. The actuator is suitable for up to 200 psig (1379 kPa) closing pressure. The valve shall be designed for up to 400 psig (2758 kPa) water pressure.

2.9.2 3-Way Modulating Valve

The unit is equipped with a chilled water circuit with a 3-way modulating valve, and electronic actuator to control water flow to the coil. The actuator is suitable for up to 200 psig (1379 kPa) closing pressure. The valve shall be designed for up to 400 psig (2758 kPa) water pressure.

2.10 Customer Piping Connections

2.10.1 Piping Out the Bottom of Cabinet (Digit 15 = H)

The unit is provided with bottom left piping connections. Only available in Downflow configurations.

2.10.2 Piping out the Top of Cabinet (Digit 15 = T)

The unit is provided with top left piping connections. Only available in Upflow configurations for model sizes PW035 through PW080.

2.10.3 Piping out the Left Side of Cabinet (Digit 15 = S)

The unit is provided with left side piping connections. Only available in Upflow configurations.

2.11 Humidifier

The unit controls the humidity of the environment at the requested setpoint through humidification and dehumidification functions; the dehumidification function is embedded when the humidifier is installed.

2.11.1 Infrared Humidifier - Optional

The unit is fitted with an infrared humidifier suitable for use with water of varying degrees of hardness. The humidifier is complete with a water inlet valve and a maximum water level sensor. The humidifier includes high-intensity quartz lamp, creating instantaneous moisture for nearly any water quality. The cleanable, stainless steel humidifier pan is removable from front of the unit.

The auto-flush system shall automatically flush deposits from the humidifier pan. The system shall be field adjustable to change the cycle time to suit local water conditions.

A minimum 1-in. (25-mm) air gap within the humidifier piping assembly, in compliance with ASME A112.1.2 section 2.4.2 (backsiphonage testing), shall prevent back-flow of the humidifier supply water.

2.12 Reheat

2.12.1 Electric Reheat - Optional

Electrical reheating/heating. The heating resistors have a rigid design for extended operational life and are normally utilized to control room dry-bulb conditions during a system call for dehumidification. Each stage of the heaters is made of finned armored stainless steel AISI 304 to maintain a low surface power density. Ionization effects are mitigated due to the low heater surface temperature. Heating control is of the ON-OFF type. The heaters are phase balanced and include a high air temperature safety that measures the air temperature at the unit outlet and switches off the heater if the air temperature is higher than the alarm threshold. Heaters are provided with a manual reset safety thermostat to disable them in the event of a high temperature.

The heating system also includes fuses which protect the heater(s) from short circuits, should the harness be damaged. Reheat section shall include a UL/CSA-listed safety switch to protect the system from overheating. A ground current detector shall be factory installed to shut-down the entire unit if a ground fault in the reheat system is detected.

2.13 Packaging

2.13.1 Domestic Packaging

Units are fully packed before shipping and are installed on an ISPM15 fumigated wooden pallet. Standard packaging consists of honeycomb cardboard corners, with side walls protected by honeycomb sheets and covered by a corrugated cardboard lid. The unit is then wrapped with a polyethylene stretch film.

2.13.2 Export Packaging

In addition to the standard cardboard packing, desiccant bags are added and the whole unit is wrapped in VCI foil and enclosed within a seaworthy wooden box.

3.0 CONTROLS

3.1 Microprocessor Control and Display

The Vertiv™ Liebert® iCOM™ is a microprocessor-based controller with a 7-inch, high definition, resistive, color touchscreen display and is mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable when the front panel is open or closed. The controls shall be menu driven. The system shall display user menus for active alarms, event log, graphical data, unit status overview (including the monitoring of room conditions, operational status in percentage of each function, date, and time), total run hours, various sensors, and 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, maintenance/wellness settings, options setup, system/network setup, auxiliary boards, and diagnostics/service modes. The Liebert® iCOM™ control by default shall provide Ethernet dedicated for BMS connectivity (BACnet IP, Modbus TCP/IP, SNMP v1, v2c, SMTP, DHCP, Telnet, IPv4, HTTP, HTTPS, SSL Certificates, NTP Time Service, DNS) as standard. Additional hardware is required to support BACnet MSTP, Modbus RTU.

- Password Protection – The Liebert® iCOM™ shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature allows the user to see applicable information based on the login used.
- Configuration Backup and Restore – The user shall be able to create safe copy of the unit configuration. 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.
- Display Setup – The user shall have the ability to configure the Liebert® iCOM™ information based on the user's preference. Language, units of measure, screen contrast, home screen layout, back-light timer and the hide/show of certain readouts shall be configurable through the display.
- Event Log – The Liebert® iCOM™ shall automatically store the last 240 unit-only events (messages, warnings, and alarms).
- Service Contact Information – The Liebert® iCOM™ shall have the ability to store the local service or sales contact information.
- Upgradeable – Liebert® iCOM™ firmware upgrades shall be performed through a USB connection or direct connection to laptop PC.
- Timers/Sleep Mode – The menu shall allow various customer settings for turning the unit on/off.
- Menu Layout – The menus shall be divided into two main menu screens: 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 provides access to advanced control setup features and diagnostic information.
- 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-provided 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 can be monitored from the front display.

- Diagnostics/Service Mode – The Vertiv™ Liebert® iCOM™ shall be provided with self-diagnostics for troubleshooting. Control inputs shall be listed as On or Off at the front display. Control outputs can be turned On or Off from the front display without using jumpers or a service terminal. Each control output is indicated by an LED on a circuit board.
- Embedded BMS Monitoring – The Liebert® iCOM™ controller shall provide one Ethernet Port dedicated for BMS connectivity. Supported protocols for network connectivity to building management systems for unit monitoring and management include BACnet IP, Modbus TCP/IP, SNMP v1, v2c for network management systems, SMTP for email, DHCP, Telnet, IPv4, HTTP, HTTPS for web page viewing, SSL Certificates, NTP Time Service, and DNS. The Liebert® iCOM™ controller provides ground fault isolated 10/100 baseT Ethernet connectivity for unit monitoring and management. The Liebert® iCOM™ controller can support dual IP on a single network and one 485 protocol simultaneously. Additional hardware required to support BACnet MSTP, Modbus RTU.
- Remote Connectivity to unit-level display – via PC with proper network credentials, access the unit-level Liebert® iCOM™ controller user interface via web browser. Gain access to all unit-level Liebert® iCOM™ controller settings, full read/write access.

Terminals are provided for remote start/stop control plus Volt-free 'Common Alarm', 'Common Warning'. Full list of microprocessor features includes:

- Up to seven configurable digital inputs (for example condensate pump alarm, heater alarm, fire alarm, water alarm, no power, etc.)
- One digital input for remote ON/OFF
- Two digital outputs to report general warning and general alarm
- One Ethernet port

The application shall be menu-driven and shall include two menus.

- User Menu: The application shall display submenus for basic setpoints, temperature and humidity alarms (limits), run hours for each device, timer bands, event log, unit overview, and system overview.
- The Service Menu is designed for service personnel and provides access to advanced control setup features and diagnostic information.

3.2 Alarms

More than 240 types of warnings/alarms/messages are displayed including:

- High temperature (return/remote/supply)
- Low temperature (return/remote/supply)
- High relative humidity (return/remote)
- Low relative humidity (return/remote)
- Fan failure
- Electrical heater high temperature
- Sensor failure

Unit can store up to 100 events in memory. Each unit shall have one factory mounted return temperature and humidity sensor. The control as standard allows for the following:

- A return temperature and humidity sensor
- A supply temperature sensor
- Up to 10 active remote temperature and humidity sensors
- Up to three read-only temperature and humidity reference sensors

3.3 Vertiv™ Liebert® iCOM™ Control Methods and Options

3.3.1 Controlling Sensor Options

3.3.1.1 Return T/H Sensor

The return sensor provides a single temperature and humidity reading. Each Liebert® iCOM™ shall support one factory-supplied/mounted Return Temperature-Humidity sensor that may be used for control or reference. The Return T/H sensor also acts as a safety device, monitoring the return air conditions entering the Liebert® cooling unit. The Return T/H sensor may be assigned to temperature (cooling capacity) control, fan speed control or humidity control.

3.3.1.2 Supply Air Temperature Sensor

The supply sensor provides a single temperature reading. Each Liebert® iCOM™ shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. In a unit-to-unit (U2U) network configuration, when multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

3.3.1.3 Remote Temperature Sensor - Optional Accessory

The remote sensor provides a single temperature reading and single humidity reading. Each Liebert® iCOM™ controller shall support up to 10 additional remote T/H sensors that may be used for control or for reference-only. In a unit-to-unit (U2U) network configuration, these remote sensor values shall be shared to the Master controller and may be used to control the Liebert® cooling units and provide greater visibility and flexibility as the cooling units respond to changes within the conditioned space. Having sensors shared across the network of units provides sensor redundancy in the event of a failure. When remote sensors are used for control, the end-user may configure Liebert® iCOM™ to create an average reading or operate based on maximum (worst case) temperature reading of all connected remote sensors. Three additional remote T/H sensors may be used for reference-only along with the additional remote sensors being used for control.

3.3.2 Control Modes

Liebert® iCOM™ shall control the cooling capacity and fan speed from a single sensor or from multiple sensors. The Liebert® iCOM™ controller shall provide tunable PID settings used to fine-tune the cooling capacity, fan speed, and humidification output. The user can adjust the desired setpoint settings for PID tuning for Temperature, Fan Speed, and Humidity Control modes. Specific PID settings can be adjusted by service personnel during commissioning if necessary; cooling capacity and fan speed PIDs can be decoupled if needed (i.e., using separate sensor types for control).

3.3.2.1 Temperature Control Mode

Temperature control mode determines which sensor the cooling capacity will be driven from. In the case of a control sensor failure, the unit automatically adapts to maintain cooling/airflow continuity. The following three sensor options are available for control:

- Return
- Supply
- Remote

3.3.2.2 Fan Speed Control Mode

Fan speed control mode determines how the outlet airflow is controlled. The following six options are available:

- Return Sensor
- Remote T/H Sensor
- Delta T between Return temperature and Supply temperature
- Static Pressure
- Return CW Priority
- Fixed Speed

3.3.2.3 Humidity Control Sensor Mode

Humidity control sensor mode defines which sensor shall be used to control humidification and dehumidification. The following options are available:

- Return Sensor
- Remote Sensor

Humidification/dehumidification PI control types available are:

- Relative
- Relative Compensated
- Absolute
- Dew Point

3.4 Unit-to-Unit (U2U) Communication

A U2U (unit to unit) communication between multiple units via Ethernet network (up to 32 units) allows for advanced control functionality: teamwork modes, sharing sensor data, standby rotation, lead-lag, cascade operation, auto restart delay and rotating master function; without the need of a dedicated sequencing panel.

3.5 Virtual Master

As part of the robust architecture of the Vertiv™ Liebert® iCOM™ control U2U network, Liebert® iCOM™ shall support virtual master functionality. The Virtual Master function provides smooth control operation if the network group's communication is compromised. When the lead unit (U2U #1) in charge of component/unit staging and standby rotation becomes disconnected from the network (i.e., no longer visible on the network), the Liebert® iCOM™ controller shall automatically assign a 'virtual master' or rotate to the next available U2U address. This controller shall assume the duties and responsibilities of the Master controller (U2U #1) for the time being until the original unit once again becomes visible on the network.

3.6 Teamwork Modes

Vertiv™ Liebert® iCOM™ teamwork saves 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.

Four teamwork modes can be adopted.

- No Teamwork (Default)

  The units work independently on the cooling control. Sensor values and setpoints are not shared. The control drives cooling, heating, ventilation, humidification, and dehumidification based on the local requests. Standby function and unit rotation are possible once units have been networked together and placed into a single group.

- Teamwork Mode 1 (Parallel)

  This mode is ideal for small rooms with balanced heat loads. The 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 for system control). 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 system setpoint deviations. Evaporator fans and cooling capacity are ramped in parallel.

- Teamwork Mode 2 (Independent)

  This mode is ideal for large rooms with unbalanced heat loads. The Liebert® iCOM™ calculates the worse-case demand for heating, cooling humidification, and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning each 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)

  Typically employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows each 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 the inlet rack temperature is being met. Cooling (Chilled Water Valve or Economizer) is controlled through unit supply air conditions. The 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.

3.7 Standby/Lead-Lag Unit Rotation

Vertiv™ Liebert® iCOM™ controller shall support the ability to operate individual thermal units within a standby/lead-lag fashion. Liebert® iCOM™ shall allow end-users to place redundant units within 'standby' operation and rotate units based on a daily/weekly/monthly schedule at a specific time of day or rotate units every 12 hours or 24 hours. In the event of a currently operating unit receiving an 'alarm' type notification, Liebert® iCOM™ shall automatically bring on a Standby system to operate in place of the current unit with an alarm-event. Liebert® iCOM™ also provides the capability for the end-user to start all standby units due to a high temperature event, to which this threshold may be defined by the end-user.

3.8 Cascade

The Liebert® iCOM™ cascade option shall allow the units to turn On and Off based on heat load when utilizing **Teamwork Mode 1 - Independent** or **Teamwork Mode 3 - Optimized Aisle** 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 Mode 3**, 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 new load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control responds by cascading units ON or putting them into standby. The Liebert® iCOM™ shall allow planned rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

Standby Units will start in case of an alarm of one of the Duty Units. Cascaded Units will also start in order to help the Duty Unit based on the cooling request **Teamwork Mode 1 - Independent** or for Airflow request **Teamwork Mode 3 – Optimized Aisle**. In this case the system optimizes the Standby Units in the case of an alarm/failure.

3.9 Auto-Restart Delay

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.

3.10 Unit Power Consumption Calculator

Unit power consumptions can be calculated using the direct communication between the control and the EC fan motor(s). This specific algorithm provides an estimate of each unit's instantaneous power consumption with an accuracy of ± 5% at the nominal conditions. The power consumption value shall only be shown if the Liebert® unit is in cooling-only and fan speed is 30% or greater. This feature is available for cooling only units.

3.11 CW Quick Start

Each Liebert® iCOM™ controller shall have the option to enable Chilled Water Quick-Start. After a loss of power, the unit normally requires approximately 60 seconds to reboot prior to the unit providing airflow and cooling output. With CW Quick-Start enabled, the end-user may configure a specific airflow output % and cooling capacity output % as desired. The unit shall operate at these configured values within approximately 10 seconds after a power restoration during the reboot process. After Liebert® iCOM™ has fully booted, the unit will continue normal operation.

3.12 Remote Connectivity

Vertiv™ Liebert® iCOM™ shall provide the capability to allow remote connectivity to the unit-level controller user interface via a PC on a secured network which supports a single web user-interface instance.

Table 3-1 Supported Connected Client Count

Unit Display	No Display on Unit/System Display Only	No Physical Displays/Web UI Only	iCOM-S/iCOM-S GW (RDU301) Single Connection Only	iCOM-S Dual/Redundant iCOM-S GW (RDU301) Connections	Max Recommended Unit Remote Web UI Sessions
X					2
	X				2
		X			3
X			X		1
	X		X		1
		X	X		2
X				X	0
	X			X	0
		X		X	1
NOTE: Maximum of three connected clients recommended. No impact to BMS connectivity if this limit exceeded.					

4.0 MISCELLANEOUS OPTIONS

4.1 Monitoring

The unit features a website link that can be accessed via HTTP using a common browser. The unit also includes an input for remote on-off and volt-free contacts for simple remote monitoring of alarms.

The unit can communicate with Building Management Systems and Network Management Systems supporting third-party protocols: Modbus TCP/IP, BACnet IP v1.14, SNMP v2c, and HTTP. More than 600 different parameters/events are available to BMS.

4.1.1 BACnet Router – Optional, field-Installed

When BACnet MSTP protocol is required for BMS monitoring, the BACnet router can support BACnet IP and BACnet MSTP protocols for BMS monitoring purposes. This device is BTL (BACnet Testing Laboratories) Certified. This device provides two RS485 ports and one Ethernet port. Multiple BACnet protocols may be used simultaneously.

4.1.2 Modbus Gateway – Optional, Field-Installed

When Modbus RTU protocol is required, the Modbus gateway can support Modbus TCP/IP and Modbus RTU protocols for BMS monitoring purposes. Modbus Gateway provides one Ethernet port and four RS-232/422/485 ports.

4.2 Power Meter - Optional

The unit is equipped with factory-programmed/installed power meter to monitor power characteristics for individual components or the entire unit. The power meter allows 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 safety will place a unit into standby mode in the event that a phase loss is detected.

4.3 Low Voltage Options

4.3.1 Low Voltage Terminal Package

- 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.

4.3.2 Remote Humidifier Contact

- Remote Humidifier Contact - A pair of normally open contacts are 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.

4.4 Sensors - Optional

4.4.1 High Temp Stat

The high temperature sensor will immediately shut down the unit when activated. The sensor is mounted with the sensing element in the return air. This sensor is not meant to replace any fire detection system that may be required by local or national codes.

4.4.2 Smoke Sensor

The smoke sensor will immediately shut-down the unit 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.

4.5 Condensate Pump - Optional

The pump has a capacity 0.22 gpm at 5.2 psi head. The pump includes a dual-float switch, pump, motor assembly, and reservoir. The secondary float shall send a signal to the local alarm and shut-down the unit upon a high-water condition. The pump is shipped inside the unit for field installation outside of the unit. Field installation of the pump by others.

4.6 Static Pressure Control - Optional

Pressure control transducer controls fan speed to keep static pressure constant. If multiple units are connected in teamwork, they share pressure sensor data to provide greater flexibility, visibility, and control. User can decide to control the fans on the average reading collected in the U2U network. In the case of a failure, the system can operate with a minimum of one sensor.

4.7 Ethernet Switch – Optional

Ethernet Switch with five RJ45 ports installed in the electrical panel with individual LED indicators.

4.8 Leak Detector – Vertiv™ Liebert® Liqui-tect™

This feature detects the presence of water or of any other conductive liquid and activates an alarm. It is made up of a corrosion-proof metal covering, with access to the two terminals for wiring.

4.8.1 Leak Detector – LT410

The Liebert® Liqui-tect™ 410 (LT410) shall provide a single-point detection of leaks. The point detection sensor includes two gold-plated sensing probes for corrosion resistance and to improved accuracy readings. The LT410 constantly monitors for leaks, internal faults, power failures and alarms with any abnormal condition. Mounting brackets allow for sensor height adjustment and leveling. The LT410 provides two independent outputs to signal both a local alarm panel and a remote building management system or external equipment. The LT410 is rated for 24 VAC, 50/60 Hz and 0.10 amps. Liebert® Liqui-tect™ sensor shall be field mounted and wired.

4.8.2 Leak Detector – LT460

This feature detects the presence of water or of any other conductive frontal area, it is possible to lift some footboards, moving them on the lower level, creating a service volume in the raised floor. The footboards are designed to support a maximum vertical distributed load of 600 kg/m2 and a maximum concentrated load of 150 kg.

4.9 Mounting Options

4.9.1 Floor Stand – Upflow Intended

Base frame can be supplied on request to support the unit when installed with a raised floor. The legs are fixed with the unit frame and support the unit at different heights. The height of the legs can be modified by cutting them in the field and can be adjusted from 4.7 - 31.5 in.

4.9.2 Legs Kit – Downflow Only

The legs are fixed with the unit frame and allow supporting the unit at different heights. Three kits are available with different heights, fully adjustable in the range: H1 1.2 - 14.5 in.; H2 14.5 - 22.4 in., H3 22.4 - 31.5 in. An extended height leg kit is available for heights from 31.5 in. to 48.0 in.

The legs are designed to allow an adjustment of the height without the need of cutting or brazing.

4.9.3 Pedestal - Upflow Only

The pedestal matches the same aesthetic design as the main unit and exterior panels and shall have a fixed height of 7.9 inches.

4.10 Ducted Plenum

An extension hood can be supplied on request and can be installed on top of the unit. It is available with different height: 19.6 in.; 23.6 in.; 31.5 in.; 35.4 in.

It shall be the same design as the unit and consists of insulated panels with a minimum of 1 in. (25 mm), and 1.5 lb. (0.68 kg) density fiber insulation.

Shipped with duct collar.

4.11 Grilled Front Discharge Plenum – Upflow Only

A supply plenum with horizontal air flow can be installed on top of the unit. The 23.6 in. high plenum shall be the same design as the unit and consist of insulated panels with a minimum of 1 in. (25 mm), and 1.5 lb. (0.68 kg) density fiber insulation. It shall be equipped with a double deflection grill.

5.0 EXECUTION

5.1 Installation of Thermal Management Units

5.1.1 General

The user shall install Thermal Management units in accordance with manufacturer's installation instructions.

The units shall be installed plumb and level, firmly anchored in locations indicated and shall maintain manufacturer's recommended clearances.

5.1.2 Electrical Wiring

The user shall install and connect electrical devices furnished by the manufacturer but not specified to be factory mounted. The manufacturer shall furnish a copy of wiring diagram and submittal(s) to electrical contractor.

5.2 Piping Connections

The user shall install and connect devices furnished by the manufacturer but not specified to be factory-mounted. The manufacturer shall furnish a copy of piping connection diagram and submittal(s) to the piping contractor.

5.2.1 Supply and Drain Water Piping

The user shall startup the unit(s) in accordance with the manufacturer's start-up instructions.

The manufacturer shall test controls and demonstrate compliance with requirements.

5.3 Field Quality Control

The user shall start cooling units in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. These specifications describe the 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.

5.4 Warranty Start-Up and Control Programming

The user is responsible for installing the indoor unit in accordance with manufacturer's installation instructions provided with seismic option.

The unit shall be firmly anchored while maintaining manufacturer's recommended clearances. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, and special inspection and attachment to non-building structures must be outlined and approved by the Engineer of Record for the project 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 flexible connection or loop must be suitable for the operation pressure and temperature of the system. The manufacturer shall provide a copy of the piping connection diagram and submittals to piping contractor.