Liebert® CRV™

Row-based Environmental Control System
Guide Specifications

1.0 GENERAL

1.1 SUMMARY

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

1.2 DESIGN REQUIREMENTS

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

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

1.2.1 Submittals

Submittals shall be provided with the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical, and Capacity Data; Piping and Electrical Connection Drawings.

2.0 PRODUCT

2.1 COOLING SYSTEM

2.1.1 Air-Cooled Refrigeration System

2.1.1.1 Refrigeration System

The single refrigeration circuit shall include a liquid-line filter drier, a refrigerant sight glass with moisture indicator, an adjustable, externally-equalized expansion valve, and a liquid-line solenoid valve. The indoor evaporator refrigerant piping shall be spun shut with a nitrogen holding charge. Field relief of the Schrader valve shall indicate a leak-free system.

2.1.1.2 Hydrophilic-Coated Evaporator Coil

Models CR020, CR035

The direct expansion, tilted-slab cooling coil shall have 7.25 ft^2 (0.674 m^2) face area, four or five rows deep. It shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. Two stainless steel condensate drain pans shall be provided.

Model CR019

The direct expansion, slab cooling coil shall have 6.2ft^2 (0.576 m^2) face area, three rows deep. It shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

2.1.1.3 Compressor

The compressor shall be scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the compressor to provide variable capacity operation. The compressor shall have a suction gas-cooled motor, vibration isolators, internal thermal overloads, manual reset high-pressure switch, rotalock service valves, low-pressure and high-pressure transducer, crankcase heater, internal centrifugal oil pump and an operating speed of 3500 rpm at 60Hz (2900rpm @ 50Hz). The compressor shall be located outside the air stream and shall be removable and serviceable from the rear of the unit.

2.1.1.4 R410A Refrigerant

The system shall be designed for use with R410A refrigerant, which meets the U.S. Clean Air Act for phaseout of HCFC refrigerants.

2.1.1.5 Low Noise Package

The Low Noise Package shall reduce the level of sound emitted from the compressor. The package shall consist of a 3/8 inch, closed-cell polymeric 4.5 - 8.5 lb/ft^3 density compressor sound jacket that encloses the compressor. Additional half-inch, closed-cell polymeric 3 - 8 lb/ft^3 density sound-deadening material shall be affixed to the underside of the Superior Service Access Panel located above the compressor and attached to the inner side of the compressor compartment panels that face the hot and cold aisles. All sound deadening material shall be non-shedding and located outside the air stream.

2.1.2 Water/Glycol-Cooled Refrigeration System

2.1.2.1 Refrigeration System

The single refrigeration circuit shall include a liquid-line filter drier, an adjustable externally equalized expansion valve and a liquid-line solenoid valve. The water/glycol circuit shall be equipped with an insulated, brazed-plate heat exchanger having a total pressure drop of _____ ft. (kPa) of water at a flow rate of _____ GPM (l/s) with _____°F (°C) entering water/glycol temperature. The water piping shall be threaded closed with a nitrogen holding charge. Field-relief of the Schrader valve shall indicate a leak-free system.

2.1.2.2 Hydrophilic-Coated Evaporator Coil

Models CR020, CR035

The direct-expansion, tilted-slab cooling coil shall have 7.25 ft^2 (0.674 m^2) face area, four or five rows deep. It shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. Two stainless steel condensate drain pans shall be provided.

Model CR019

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2.1.2.3 Compressor

The compressor shall be scroll-type with variable capacity operation from 20-100%; commonly known as a digital scroll. Compressor solenoid valve shall unload the compressor to provide variable capacity operation. The compressor shall have a suction gas-cooled motor, vibration isolators, internal thermal overloads, manual reset high-pressure switch, rotalock service valves, low-pressure and high-pressure transducer, crankcase heater, internal centrifugal oil pump and an operating speed of 3500 rpm at 60Hz (2900rpm @ 50Hz). The compressor shall be located outside the air stream and shall be removable and serviceable from the rear of the unit.

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2.1.2.6 Modulating Valve

Two-Way

A two-way modulating valve shall control the water/glycol flow through the insulated, brazed-plate condenser. The Liebert iCOM™ shall manage the valve actuator movement to maintain the desired condensing temperature for various entering water temperatures. The maximum differential pressure across the closed valve shall be 43.5 PSI (300 kPa). Maximum system pressure shall be 230PSI (1,586 kPa).

Three-Way

A three-way modulating valve shall control the water/glycol flow through the insulated, brazed-plate condenser. The Liebert iCOM™ shall manage the valve actuator movement to maintain the desired condensing temperature for various entering water temperatures. The maximum differential pressure across the closed valve shall be 43.5 PSI (300 kPa). Maximum system pressure shall be 230PSI (1586 kPa).

2.1.2.7 Brazed-Plate Heat Exchanger

The heat exchanger shall be an insulated, brazed-plate type. The primary side shall be piped to a chilled water source, and the secondary side shall be connected to the refrigeration system. A strainer must be installed upstream of the Liebert CRV, on the primary (building) chilled water side.

2.1.3 Chilled Water System

The water circuit shall be designed to distribute water into the entire coil face area.

2.1.3.1 Hydrophilic-Coated Evaporator Coil

Model CR040

The chilled water tilted-slab cooling coil shall be 7.25 ft^2 (0.674m^2) face area, six rows deep. It shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. Two stainless steel condensate drain pans shall be provided. The water circuit shall be threaded shut with a nitrogen holding charge. Field-relief of the Schrader valve shall indicate a leak-free system.

Model CR032

The chilled water, rotated-slab cooling coil shall be 7.8ft^2 (0.72m^2) face area, three rows deep. It shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. A stainless-steel condensate drain pan shall be provided. The water circuit shall be threaded shut with a nitrogen holding charge. Field-relief of the Schrader valve shall indicate a leak-free system.

2.1.3.2 Modulating Valve

Two-Way Valve

A two-way modulating valve shall control the chilled water flow through the cooling coil. The Liebert iCOM™ shall manage the valve actuator movement to provide the desired amount of cooling for various entering water temperatures. Cooling capacity shall be regulated by varying the chilled water flow. The maximum differential pressure across the closed valve shall be 200 PSI (1379 kPa). Maximum system pressure shall be 325PSI (2,241kPa).

Three-Way Valve

A three-way modulating valve shall control the chilled water flow passing through the cooling coil. The Liebert iCOM™ shall manage the valve actuator movement in order to provide the desired amount of cooling for various entering water temperatures. Cooling capacity shall be regulated by varying the chilled water flow. The maximum differential pressure across the closed valve shall be 200 PSI (1,379 kPa). Maximum system pressure shall be 325PSI (2,241 kPa).

2.2 FAN SECTION

Models CR020, CR035, CR040

The unit shall be equipped with two plug fans: direct-driven centrifugal fans with backward-curved blades and electronically-commutated DC motors; commonly referred to as EC plug fans. The fan speed shall be variable and automatically regulated by the Liebert iCOM™ through all modes of operation. Each fan shall have a dedicated motor, fault monitoring circuitry and speed controller which provides a level of redundancy. The impellers shall be made of steel and balanced. The EC plug fans shall be mounted on the rear door. The entire fan assembly shall be capable of swinging out of the unit for accessibility. The fans shall be located to blow air through the filters and tilted-slab cooling coil to ensure even air distribution and maximum coil performance.

Model CR019

The unit shall be equipped with five plug fans: direct-driven centrifugal fans with backward-curved blades and electronically commutated DC motors; commonly referred to as EC plug fans. The fan speed shall be variable and automatically regulated by the Liebert iCOM through all modes of operation. Each fan shall have a dedicated motor, fault monitoring circuitry and speed controller, which provides a level of redundancy. The impellers shall be made of steel and balanced. The EC plug fans shall be mounted in the front of the unit and draw air through the coil.

Model CR032

The unit shall be equipped with six plug fans: direct-driven centrifugal fans with backward-curved blades and electronically commutated DC motors; commonly referred to as EC plug fans. The fan speed shall be variable and automatically regulated by the Liebert iCOM through all modes of operation. Each fan shall have a dedicated motor, fault monitoring circuitry and speed controller, which provides a level of redundancy. The impellers shall be made of steel and balanced. The EC plug fans shall be mounted in the front of the unit and draw air through the coil.

2.3 ADVANCED AIRFLOW MANAGEMENT

2.3.1 Supply Air Baffle System

Models CR020, CR035, CR040

A field-adjustable, modular, supply-air baffle system shall be located in the discharge air stream on the front of the cabinet to direct air toward the equipment racks and balance air-flow requirements within the row. The six modular baffle segments shall be easily reconfigurable to redirect air flow as cooling requirements change. Controlling the air flow prevents hot spots and maintains high return-air temperatures by not blowing cold air over racks or out the ends of aisles. By focusing the cold air where it is needed and meeting the servers' requirements, the need for excessive air flow and energy consumption is eliminated.

Models CR019, CR032

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2.4 CABINET CONSTRUCTION AND ACCESSIBILITY

2.4.1 Cabinet Construction

Models CR020, CR035, CR040

The exterior panels shall be 20-gauge steel and powder-coated with charcoal color paint to protect against corrosion. The double-wall side panels separate the half-inch, 2.0 lb./ft^3 insulation from the air stream and increase unit rigidity. The unit shall be mounted on casters for quick installation and provided with leveling feet. The perforated inlet and outlet panels shall have 81% open area. The rear door shall utilize a Knurr™ rack style handle and hinges to mirror the appearance of neighboring server racks.

Model CR019, CR032

The exterior panels of the unit shall be 20=gauge steel and powder-coated with charcoal color paint to protect against corrosion and follow Knürr rack appearance guidelines to mirror the style of neighboring equipment racks. The cabinet shall be mounted on casters for quick installation and provided with leveling feet. Both doors shall have a powder-coated sheet-metal frame with hexagonal perforations leaving 81% of the door open to air flow for efficient cooling. The front and rear doors shall swing 170 degrees open, shall be removable, and shall feature a two-point latch. The powder-coat painted steel side panels shall be lined with half-inch closed-cell polymeric insulation and secured using quarter-turn fasteners.

2.4.2 Serviceability

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

Models CR020, CR035, CR040

The Superior Service Access Panel shall provide additional access to the top of the system components. Side access shall not be required.

The variable-speed EC plug fans shall be mounted on the rear door to provide access to all sides when swung out of the unit. Units with a compressor, dual-float condensate pump, and canister humidifier shall have components conveniently mounted near the edge of the unit.

Model CR019, CR032

Side access shall not be required. Each of the variable-speed fans shall be individually replaceable through the front door of the unit. Units with a compressor and/or a condensate pump shall be conveniently mounted near the edge of the unit.

2.4.3 Supply Air Baffle System

Models CR020, CR035, CR040

A field-adjustable, modular, supply-air baffle system shall be located in the discharge air stream on the front of the cabinet to direct air toward the server racks and balance air-flow requirements within the row. The six modular baffle segments shall be easily reconfigurable to redirect air flow as cooling requirements change. Controlling the air flow prevents hot spots and maintains high return-air temperatures by not blowing cold air over racks or out the ends of aisles. By focusing the cold air where it is needed and meeting the rack equipment's cooling requirements, the need for excessive air flow and energy consumption is eliminated.

Models CR019, CR032

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2.5 LOCKING DISCONNECT SWITCH

Models CR020, CR035, CR040

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 Liebert iCOM™ display door for quick access.

Models CR019, CR032

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 rear door for quick access.

2.6 SHORT CIRCUIT CURRENT RATING (SCCR)

Models CR019, CR020, CR035, CR040

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

Model CR032 120V/1/60Hz

The electrical panel shall provide at least 5000A SCCR.

Model CR032 208-230/1/60Hz

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

Model CR032 208-230/3/60Hz

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

Model CR032 460/3/60Hz

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

2.7 FILTRATION

Models CR020, CR035, CR040

MERV 8

The filter channel shall be an integral part of the system, located within the cabinet and serviceable from the rear. The two filters shall be deep-pleated, 4 inches thick with an ASHRAE 52.2 MERV8 rating (30% ASHRAE 52.1). A filter clog alarm shall be included. Mesh type, cleanable filters shall be unacceptable.

MERV 11

The filter channel shall be an integral part of the system, located within the cabinet and serviceable from the rear. The two filters shall be deep-pleated, 4 inches thick with an ASHRAE 52.2 MERV11 rating (60-65% ASHRAE 52.1). A filter clog alarm shall be included. Mesh type, cleanable filters shall be unacceptable.

Models CR019, CR032

MERV 1

The two filters shall be an integral part of the system, located within the cabinet and serviceable from the rear. The filters shall be washable, half-inch thick with an ASHRAE 52.2 MERV1 rating. A filter clog alarm shall be included.

MERV 8

The two filters shall be an integral part of the system, located within the cabinet and serviceable from the rear. The filters shall be washable, half-inch thick with an ASHRAE 52.2 MERV8 rating. A filter clog alarm shall be included.

2.7.1 Extra Filter Set (Optional)

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

2.8 ELECTRIC REHEAT

The low-watt density, 304/304, stainless-steel, finned-tubular electric reheat coils shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include UL/CSA recognized safety switches to protect the system from overheating. The capacity of the reheat coils shall be controlled in one stage. The reheat elements shall be accessible from the front of the cabinet.

2.9 STEAM GENERATING CANISTER HUMIDIFIER

A canister-type steam-generating humidifier shall be factory-installed in the cooling unit and operated by the Liebert iCOM™. It shall be complete with disposable cylinder, all supply and drain valves, steam distributor and electronic controls. The need to change the canister shall be indicated on the Liebert iCOM. The humidifier shall be designed to operate with water conductivity from 330 to 670 (60Hz) microS/cm. The system shall automatically fill and drain as well as maintain the required water level based on conductivity. An air gap within the humidifier assembly shall prevent back-flow of the humidifier supply water. The humidifier canister shall be removable from the rear of the cabinet.

2.10 CONDENSATE PUMP—MODELS CR020, CR035, CR040

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

2.10 CONDENSATE PUMP—MODELS CR019

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

2.10 CONDENSATE PUMP—MODELS CR032

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

2.11 IBC/OSHPD SEISMIC CERTIFICATION - CRV600MM (24 IN.) AND CRV300MM(12 IN.)

IBC/OSHPD Seismic Certification shall be provided with applicable bracing and field installation instructions. Liebert CRV units shall bear a label certifying compliance with IBC/OSHPD requirements.

3.0 CONTROL

3.1 LIEBERT ICOM™ MICROPROCESSOR CONTROL WITH 9 INCH COLOR TOUCHSCREEN

The Liebert iCOM shall be microprocessor-based with a 9" color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The controls shall be menu driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date, and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards, and diagnostics/service mode.

- 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 backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more stream-lined unit startup.
- Parameter Download - The Liebert iCOM shall enable the user to download a report that lists parameter names, factory default settings and user programmed settings in .csv format for remote reference.
- Parameter Search - The Liebert iCOM shall have search fields for efficient navigation and parameter lookup.
- Setup Wizards - The Liebert iCOM shall contain step-by-step tutorials or wizards to provide easy setup of the control.
- Context-Sensitive Help - The Liebert iCOM shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.
- Display Setup - The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, back-light 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 LED's - 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 de-signed 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.
- Diagnostics/Service Mode - The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

3.2 ALARMS

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

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- EC Fan Fault
- Change Filters
- Loss of Air Flow
- Loss of Power
- Humidifier Problem
- High Head Pressure
- Low Suction Pressure
- Custom Alarms

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

- Leak Under Floor
- Smoke Detected
- Standby Unit On

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

3.3 LIEBERT ICOM™ CONTROL METHODS AND OPTIONS

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

3.4 CONTROLLING SENSOR OPTIONS

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

Cooling Capacity

- Supply
- Remote
- Return

Fan Speed

- Supply
- Remote
- Return
- Manual (for diagnostic or to receive a signal from the BMS through the Liebert remote monitoring devices or analog input)

3.4.1 Temperature Compensation

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

3.4.2 Humidity Control

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

3.5 MULTI-UNIT COORDINATION

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

- **Teamwork Mode 1**: Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan on) are collected to be used for an average or worst-case sensor reading (user selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan, and humidity) is divided and shared among the units in the group.
- **Teamwork Mode 2**: 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 that the unit may respond to the thermal load and humidity conditions based on the unit's controlling sensors.
- **Teamwork Mode 3** - Optimized Aisle: May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors) is controlled through unit supply-air conditions. Liebert iCOM calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification, and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied.

3.6 STANDBY LEAD-LAG

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

3.7 STANDBY UNIT CASCADING

The Liebert iCOM cascade option shall allow the units to turn On and Off based on heat load when utilizing Optimized Aisle, Teamwork Mode 3 and remote temperature sensors. Cascade mode dynamically coordinates the fan speed to save energy and to meet the cooling demands. For instance, with a Liebert iCOM group of six units and only 50% of the heat load, the Liebert iCOM shall operate only four units at 80% fan speed and leave the other two units in standby. As the heat load increases, the Liebert iCOM shall automatically respond to the additional load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them into standby.

3.8 WIRED SUPPLY SENSOR

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

3.9 VIRTUAL MASTER

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

3.10 COMPRESSOR SHORT CYCLE CONTROL

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

3.11 LIEBERT MC™

Units may be matched to a premium efficiency condenser control with enhanced monitoring, alarming, and diagnostics. The condenser control shall have an automated, low-noise mode and fan reversal for cleaning mode.

3.12 SYSTEM AUTO RESTART

The auto restart feature shall automatically restart the system after a power failure. Time delay shall be programmable.

3.13 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.

3.14 LOW-PRESSURE MONITORING

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

3.15 WINTER START TIME DELAY-AIR-COOLED MODELS

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

3.16 ADVANCED FREEZE PROTECTION

Units shall ship standard with advanced freeze protection enabled. The advanced freeze protection shall monitor the pressure of the circuit using a transducer. The control shall interact with the fan and compressor to prevent the unit coil from freezing if circuit suction pressure drops. If a freeze condition is detected, the user shall be notified through the local display and remote monitoring systems

3.17 ADVANCED HIGH-PRESSURE PROTECTION- WATER/GLYCOL-COOLED MODELS WITH DIGITAL SCROLL COMPRESSORS

When the compressor is initially activated, the system shall be monitored for high pressure. When high pressure is detected, the control shall alter the compressor operation to reduce the system discharge pressure, preventing circuit shut down. If the unit is unsuccessful in correcting the problem through this interaction, an alarm shall occur, and the affected compressor shall be immediately locked off. The control shall re-enable the compressor when the pressure returns to a safe level.

3.18 REFRIGERANT PRESSURE TRANSDUCER FAILURE

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

3.19 OIL RETURN PROTECTION

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

3.20 DIGITAL SCROLL HIGH-TEMPERATURE PROTECTION

The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out 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. The control shall store the number of high temperature trips. The number of trips shall be accessible through the local display.

3.21 DIGITAL SCROLL SENSOR FAILURE

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

3.22 COMPRESSOR HIGH- AND LOW-TEMPERATURE LIMIT PROTECTION

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

3.23 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

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

3.24 RACK TEMPERATURE SENSORS

The Liebert CRV shall be provided with three 2T rack temperature sensors, each consisting of a vented case with two temperature probes. The sensors shall provide real-time, direct feedback to the cooling unit to optimize the amount of cooling and airflow provided. The sensor data shall be available to remote BMS and monitoring systems. The sensor network shall consist of one CAN wire leaving the cooling unit and connecting to a 2T sensor. Each remaining 2T sensor is connected to the previous sensor.

3.24.1 Additional Rack Temperature Sensor(s)

_____ additional 2T rack temperature sensors shall be provided.

3.24.2 Additional CAN Cables for Rack Sensors

_____ additional ____ feet long CAN cables shall be provided.

3.25 LIEBERT vNSA™ NETWORK SWITCH-OPTIONAL

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

- vNSA14 – enclosure with network switches only
- vNSA14-iCOM-H – enclosure with network switches and 9” 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 iCOM controller unit-to-unit networking. The Liebert vNSA requires field supplied, hard wiring, 16AWG, 100-240VAC universal (12V, 1.5A) single-phase input power supply for 120V or 230V operation with factory supplied power connector.

3.26 COMMUNICATION INTERFACES

3.26.1 Remote Shutdown Terminal

The remote shutdown terminal shall provide a location to remotely shut down the unit, complying with the National Fire Code.

3.26.2 Common Alarm Contact

The common alarm contact shall provide a set of normally open contacts for remote indication of unit alarms.

3.26.3 Liebert CRV 600mm Cabinet Reheat / Humidifier Lockout

The reheat and humidifier lockout shall include the necessary relays to disable the reheat and humidifier from an external 24V signal while on emergency power.

3.26.4 Liebert CRV 600mm Cabinet (Model 20, 35 and 40) One Extra Common Alarm Contact

One additional contact (total of two sets) of normally open (n/o) contacts for remote indication of unit alarms shall be provided.

3.26.5 Liebert IntelliSlot™ Unity-DP™ Card

The Liebert IntelliSlot Unity Card (IS-UNITY-DP) shall provide ground fault isolated RS-485 Modbus, BACnet IP and Modbus IP network connectivity to Building Management Systems for unit monitoring and management. Also, it shall provide ground fault isolated 10/100 baseT Ethernet connectivity for unit monitoring and management. The supported management interfaces include SNMP for Network Management Systems, HTTP for Web page viewing, SMTP for e-mail and SMS for mobile messaging. The card shall support IP and 485 protocols simultaneously.

3.26.6 Liebert IntelliSlot™ SiteLink-E™ Card

The Liebert IntelliSlot SiteLink-E Card shall provide ground fault isolated connection to a Liebert SiteLink-E for monitoring and management. Liebert SiteLink-E supports Vertiv interfaces as a BACnet router that provides the communication link between Liebert units and other protocols and modules. The Liebert SiteLink-E is designed to communicate with Liebert equipment—cooling units, UPSs and PDUs—and route the information over a BACnet, Modbus or LONWorks™ network to a Building Automation System (BAS) workstation. This shall be required for communication with Liebert SiteScan™ Web 4.0 or newer.

3.26.7 Liebert Nform™ (Optional Advanced Monitoring)

The Critical Infrastructure Management software shall centrally monitor and manage distributed equipment using the customer's existing network infrastructure. The system shall provide the Critical Infrastructure Management and Monitoring for air conditioning (CRAC) systems, uninterruptible power supply (UPS) systems, power distribution units (PDUs), static transfer switches (STS), direct current power systems (DC), power distribution strips (PDUs), Alber™ battery monitoring, rack enclosure monitoring, leak detection systems and other critical infrastructure systems as specified. The system shall have an architecture that allows up to 10,000 managed devices, including Liebert and third-party devices, in a single-server installation.

3.26.7.1 System Requirements

All material and equipment used shall be standard components, regularly manufactured and available and not custom-designed especially for this project. All systems and components shall have previously been thoroughly tested and proven in actual use before installation on this project.

The manufacturer will furnish or supply a site-specific Critical Infrastructure Management software system based on customer requirements. The system must be a software-only solution; no substitutions shall be accepted.

The system architecture shall consist of network interface cards that shall be installed in all critical infrastructures that, at a minimum, support HTTP and SNMP simultaneously.

The system shall receive SNMP traps from managed equipment and display the alarm notification in a graphical user interface.

The system shall be based on SNMP open protocols and shall integrate seamlessly with Vertiv, Aperture™ software suite and Network Management Systems.

Open protocol support shall include:

- HTTP(s)
- TCP/IP/v4, TCP/IP/v6
- SNMPv1, SNMPv2

The system shall have the capability of being remotely monitored and managed 24 hours a day, 7 days a week by the manufacturer.

The system shall have the ability to be deployed worldwide.

The system shall operate as a client-to-server application.

The Web interface of each managed device shall integrate directly into the system.

The system shall support enterprise-level databases including Microsoft® SQL™.

The system shall support exporting of all recorded parametric trend data.

The system shall operate on a server determined by the customer. Specific server brand or function is not permissible.

The system shall support virtual server environments by default.

The system shall include, at no additional cost, one (1) year of Software Assurance.

3.26.7.2 Approved Products

The Critical Infrastructure Monitoring System shall be Liebert® Nform™ as manufactured by Vertiv™. No substitutions shall be accepted.

3.26.7.3 Scope of Work

Owner-Supplied Items

The owner shall furnish the following system components:

- Network (LAN) hardware and software required to provide an Ethernet backbone to be used for transport of IP data packets from network interface cards installed in all equipment to the Critical Infrastructure server and to the Liebert Nform workstations. These components may include hubs, routers, cabling, network operating systems, firewalls, IP addresses, virtual private network (VPN) and other components as required. The owner shall supply network drops for the Critical Infrastructure server, workstation clients and all network-interfaced equipment.
- Dedicated Critical Infrastructure server meeting the following minimum requirements:
  - Microsoft® Windows® 7, XP, 2003, Windows Vista® or Windows Server® 2008 operating system
  - Pentium™ 3.0GHz single processor or better (1.8GHz dual processor or better recommended)
  - 4 GB of RAM (memory) or better
  - 40 GB hard drive (SCSI recommended)
  - 10/100 BaseT network port or better
  - Monitor / keyboard and mouse port as required for setup
  - Standard USB ports
  - CD or DVD-ROM drive for software installation (CD/DVD-RW suggested for installation and backup)
  - Critical Infrastructure server may be Virtual Environment compatible

- Critical Infrastructure Workstation PCs meeting the following minimum requirements:
  - System should meet the minimum requirements for Microsoft Windows 7, XP, 2003, Vista or Server 2008 operating systems.
  - Microsoft Internet Explorer® v6.0 or higher
  - 1 GB RAM
  - Hard disk with 10GB free space

The owner shall supply the following to facilitate system implementation:

- IP addresses and subnet masks and other information as required to configure network devices
- A person as the nominated system owner for administrator purposes
- Secure location for hardware and server

Critical Infrastructure System Vendor Responsibilities

Provide hardware and software as listed.

- Critical Infrastructure software and licenses for server and workstation installations.
- Software Assurance for the first year at no additional cost.
- 7 x 24 system application and service support through a toll-free telephone number.
- Warranty (parts and labor) per the manufacturer's warranty statement.
- Vendor shall be ISO 9001 listed for design and manufacture of environmental control systems for Critical Monitoring and Control applications.

3.26.8 Liebert Liqui-tect™ 410 Point Leak Detection Sensor for Remote Mounting

A total of _____ (quantity) solid-state water sensor(s) with no moving parts and hermetically sealed to keep out dust and dirt shall be provided. The Liebert Liqui-tect 410 (LT410) shall provide a single-point detection of leaks. The point detection sensor shall have two gold-plated sensing probes to prevent corrosion resistance and to provide accurate readings. The LT410 shall constantly monitor points for leaks, internal faults and power failures and warn of any abnormal conditions. Mounting brackets shall allow for sensor height adjustment and leveling. The LT410 shall provide two independent outputs to signal both a local alarm panel and a remote building management system or external equipment. The LT410 shall be rated for 24VAC, 50/60Hz and 0.10 amp.

3.26.9 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 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 (30m) of connected LT500Y leak detection cable. The LT460 shall be rated for 24VAC, 50/60Hz and 0.12A.

LT500Y Leak Detection Cable

The cable material and construction shall allow the cable to lie flat when used with hold-down clips. The LT500Y shall be plenum-rated and UL-listed for safe operation. Cables shall be available in lengths of 20, 25, 30, 35 and 45 feet (6, 7.6, 9, 10.6 and 13.7m).

4.0 HEAT REJECTION

4.1 OPTIONS—AIR COOLED LIEBERT MC CONDENSER

4.1.1 Standard Features

The condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct driven by individual fan motor(s), electrical controls, housing, and mounting legs. The Liebert air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity. Microchannel coils shall provide superior heat transfer, reduce air side pressure drop, increase energy efficiency, and shall significantly reduce the system refrigerant volume required. EC fans and fan operating techniques shall provide reduced maximum sound levels. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.

4.1.2 Condenser Coil

4.1.2.1 Aluminum Microchannel Coil

Liebert 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 environ-mental elements. Coil assemblies shall be factory leak tested at a minimum of 300 psig (2068kPag). Hot gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun-closed ends for customer piping connections. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.

4.1.2.2 Aluminum Microchannel Coil with E-Coat

Aluminum microchannel coil with E-coat shall be epoxy-coated for extended coil life in corrosive environments, such as coastal areas. Factory-applied E-coat using immersion and baking process shall provide a flexible epoxy-coating to all coil surfaces. Coil color shall be black and shall be protected from solar UV ray degradation with a factory-applied UV topcoat. E-coat shall increase coil corrosion protection and shall reduce heat rejection capacity degradation to less than 10% after a severe 2000-hour 5% neutral salt spray test (ref. ASTM B117). The coating process shall ensure complete coil encapsulation.

4.1.3 Fan Motor/Blade Assembly

The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards shall be heavy gauge, close-meshed steel wire, coated with a black, corrosion-resistant finish. Fan terminal blocks shall be 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.

4.1.3.1 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 RS-485 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

4.1.4 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. Only high-voltage supply wiring and low-voltage indoor unit communication/interlock wiring shall be required at condenser installation.

4.1.4.1 Premium Control

The EC fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors, and refrigerant pressure transducers. The control board shall receive an indoor unit run signal via field-supplied low voltage interlock wires to the compressor side switch via field-supplied CANbus communication wires from the indoor unit's Liebert iCOM™ or via both. 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.

4.1.4.2 Locking Disconnect

A locking-type disconnect switch shall be factory-mounted and wired to the electrical panel. The 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/tag-out safety programs.

4.1.4.3 Short Circuit Current Rating

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

4.1.4.4 575V Option

The secondary electrical enclosure shall contain a factory wired transformer and fusing to support 575V input power. All internal wiring shall be provided to connect main and secondary electrical enclosures. High-voltage supply and low voltage indoor unit communication/interlock connections shall be made in the main electrical enclosure.

4.1.5 Cabinet

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

4.1.6 Mounting Legs

4.1.6.1 Standard Aluminum Legs

Aluminum legs shall be provided to mount the unit for vertical air discharge with rigging holes for hoisting the unit into position. Standard height shall be 18in. (457mm).

Condensers shall be shipped with 36in. (914mm), 48in. (1219mm), or 60in. (1524mm) mounting legs with stabilization bracing. Legs, bracing and hardware shall be galvanized steel.

4.1.7 Condenser Accessories

4.1.7.1 Liebert Lee-Temp™ Receiver Kit

Liebert Lee-Temp Receiver Kit shall contain an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure relief valve, rotalock valve for refrigerant charge isolation and piping assembly with head pressure operated three-way valve and check valve. Components shall be field assembled to the condenser. The three-way valve shall sense refrigerant head pressure and adjust the flooding charge in the condenser coil to adjust the condenser heat rejection capacity.

4.1.7.2 Fusible Plug Kit

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

4.1.7.3 IBC/OSHPD Seismic Certification and IBC Wind/Snow Load Compliant

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

4.2 OPTIONAL—LIEBERT DRYCOOLER

4.2.1 Liebert Drycooler Summary

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

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

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

4.2.2 Liebert Design Requirements

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

4.2.3 Liebert Drycooler Standard Features—All Drycoolers

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

4.2.4 Liebert Drycooler Coil

The Liebert-manufactured coil shall be constructed of copper tubes in a staggered tube pattern. Tubes shall be expanded into continuous, corrugated aluminum fins. The fins shall have full-depth fin collars completely covering the copper tubes, which shall be connected to heavy wall Type "L" headers. Inlet-coil connector tubes shall pass through relieved holes in the tube sheet for maximum resistance to piping strain and vibration. Coil shall be split-flow into multiple coil circuits, combined to yield a drycooler with _____ internal circuits. The supply and return lines shall be (spun shut [1 to 4 fan models]), (brazed with a cap [6 or 8-fan models]) and shall include a factory-installed Schrader valve. Coils shall be factory leak-tested at a minimum of 300 psig (2068 kPag), dehydrated, then filled and sealed with an inert-gas holding charge for shipment. Field relief of the Schrader valve shall indicate a leak-free coil.

4.2.5 Housing

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

4.2.6 Propeller Fan

The propeller fan shall have aluminum blades secured to a corrosion-protected steel hub. Fans shall be secured to the fan-motor shaft by means of a keyed hub and dual set screws. Fan diameter shall be 26 in. (660 mm) or less. Fans shall be factory-balanced and run before shipment. Fan guards shall be heavy gauge, close-mesh steel wire with corrosion-resistant polyester-paint finish that shall be rated to pass a 1000-hour salt spray test.

4.2.7 Fan Motor

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

4.2.8 Electrical Controls

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

4.2.9 Pump Controls Control within Drycooler

4.2.9.1 Single Pump Option

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

4.2.9.2 Dual Pump Option

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

4.2.10 Pump Package

4.2.10.1 Single Pump Package

This system shall be provided with a centrifugal pump mounted in a weatherproof and vented enclosure. The pump shall be rated for ___ GPM (___ l/m) at ___ ft. (___ kPa) of head and operate on ___ volt, 3-phase, ___ Hz.

4.2.10.2 Dual Pump Package

The dual pump package shall include pumps, enclosure, and field-mounted flow switch. The standby pump shall automatically start up on failure of the lead pump by drycooler pump controls or by a separate factory-wired control box and shall include a lead/ lag switch for the pumps. Each pump shall be rated for _____ GPM (___ l/s) at ___ ft. (___ kPa) of head.

4.2.11 Ancillary Items

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

5.0 EXECUTION

5.1 INSTALLATION OF THERMAL MANAGEMENT UNITS

5.1.1 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.

5.1.2 Electrical Wiring

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

5.1.3 Piping Connections

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

5.1.4 Refrigerant Charging

Charge completed cooling system in accordance with manufacturer's refrigerant charging instructions.

5.1.5 Field Quality Control

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

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

5.1.6 Supply and Drain Water Piping

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

5.2 SEISMIC IBC/OSHPD

5.2.1 Liebert CRV

Install 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. Wiring and piping 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 copy of manufacturer's piping connection diagram submittal to piping contractor.

5.2.2 Liebert MC

Install condenser 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. Wiring and piping 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 copy of manufacturer's piping connection diagram submittal to piping contractor.