Vertiv™ Liebert® PDX and Vertiv™ Liebert® PCW
Nominal 11, 17, 18, 23 or 29 kW Thermal Management System
Guide Specifications

1.0 GENERAL

1.1 Summary

These specifications describe requirements for a mission critical 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 precision Thermal Management system shall be a Liebert® PDX or Liebert® PCW factory-assembled unit. Standard 60Hz 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. It shall be specifically designed for service from the front and right side of the unit. The system shall be designed for draw-through air arrangement to insure even air distribution to the entire face area of the coil.
- The system shall be AHRI Certified, the trusted mark of performance assurance for heating, ventilation, air conditioning and commercial refrigeration equipment, using AHRI Standard 1360.

1.3 Submittals

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

1.4 Serviceability/Access

The cabinet shall be designed so all components are easily accessible for service and maintenance through the front and right sides of the unit.

1.5 Acceptable Alternatives

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

1.6 Quality Assurance

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

2.0 PRODUCT

2.1 Cooling System

2.1.1 Air-Cooled Refrigeration System (Model 011, 018, 023 and 029)

1. **System Description**

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

2. **Hydrophilic-Coated Evaporator Coil**

   - Vertiv™ Liebert® PDX

     The direct-expansion, tilted-slab cooling coil 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.

3. **R-410A Refrigerant**

   The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

4. **Compressor**

   - Digital Scroll Compressor

     The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

   - Compressor Sound Jacket - Optional

     The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8-inch closed cell polymeric 4.5 - 8.5 lb/ft^3 density jacket that encloses the compressor.

   - Standard Scroll Compressor

     The compressor shall be an R-410A scroll-type with a suction gas-cooled motor; EPDM vibration isolators, internal thermal overloads, and automatic reset high-pressure switch with lockout after three failure occurrences, rota-lock service valves, low-pressure transducer, and crankcase heater. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles. The compressor shall be serviceable and removable from the front of the unit.

5. **Expansion Valve**

   - Thermostatic Expansion Valve (TXV)

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

   - Electronic Expansion Valve (Optional for Digital Scroll Compressors)

     An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The valve shall be controlled by a separate electronic controller. Superheat shall be determined through the suction-pressure-temperature method.

2.1.2 Dual Cool: Chilled Water + Air-Cooled Refrigeration (Model 011, 018, 023 and 029)

1. **System Description**

   Two independent circuits shall be included. The dual-cooling source system shall consist of an air cooled system with the addition of a free-cooling chilled water coil or free-cooling chilled glycol coil (Vertiv™ Liebert® Econ-O-Coil), a modulating control valve, and a comparative temperature sensor. The system shall be able to function as a modulating chilled-water system, as a compressorized system or as a combination of both. The primary cooling mode shall be chilled water. The secondary refrigeration circuit shall include a liquid-line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, pressure safety switch and a liquid line solenoid valve. The indoor evaporator refrigerant piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system. Switchover between the two cooling modes shall be performed automatically by the microprocessor control.

2. **Hydrophilic-Coated Evaporator Coil**

   The direct-expansion, tilted-slab cooling coil and the free-cooling chilled water coil 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.

3. **R-410A Refrigerant**

   The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

4. **Compressor**

   - Digital Scroll Compressor

     The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

- Compressor Sound Jacket—Optional

  The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft^3 density jacket that encloses the compressor.

- Standard Scroll Compressor

  The compressor shall be an R-410A scroll-type with a suction gas-cooled motor; EPDM vibration isolators, internal thermal overloads, and automatic reset high-pressure switch with lockout after three failure occurrences, rota-lock service valves, low-pressure transducer, and crankcase heater. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles. The compressor shall be serviceable and removable from the front of the unit.

5. **Expansion Valve**

   - Thermostatic Expansion Valve (TXV)

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

   - Electronic Expansion Valve (Optional for Digital Scroll Compressors)

     An electronically-controlled expansion valve (EEV) shall precisely control the flow of liquid refrigerant entering the direct-expansion coil. The EEV shall be of stepper-motor type. The EEV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The valve shall be controlled by a separate electronic controller. Superheat shall be determined through the suction-pressure-temperature method.

6. **Dual-Cool: Free-Cooling Control Valve**

   - Three-Way Motorized Ball Valve

     The water circuit shall include a pre-piped three-way motorized ball valve. The Vertiv™ Liebert® iCOM™ control shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. Cooling capacity will be controlled by bypassing chilled water around the coil.

   - Two-Way Motorized Ball Valve—Optional

     The water circuit shall include a pre-piped two-way motorized ball valve. The Liebert® iCOM™ shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. The motorized ball valve travel for dehumidification shall be proportional.

7. **Comparator Sensor**

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

8. **System Design Pressure**

   - Standard Pressure

     The water circuit shall be designed for a pressure of 150PSI (1034kPa).

   - High Pressure—Optional

     The water circuit shall be designed for a pressure of 400PSI (2758kPa).

2.1.3 Water/Glycol-cooled Refrigeration System (Model 011, 018, 023, and 029)

1. **System Description**

   Single refrigeration circuit shall include a compressor, liquid line filter drier, and a refrigerant sight glass with moisture indicator, an expansion valve, a brazed-plate condenser, pressure safety switches, and a factory refrigerant charge. The water piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve on the water piping shall indicate a leak-free system.

2. **Hydrophilic-Coated Evaporator Coil**

   The direct-expansion, tilted-slab cooling coil 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.

3. **R-410A Refrigerant**

   The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

4. **Compressor**

   - Digital Scroll Compressor

     The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

   - Compressor Sound Jacket - Optional

     The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft^3 density jacket that encloses the compressor.

   - Standard Scroll Compressor

     The compressor shall be an R-410A scroll-type with a suction gas-cooled motor; EPDM vibration isolators, internal thermal overloads, and automatic reset high-pressure switch with lockout after three failure occurrences, rota-lock service valves, low-pressure transducer, and crankcase heater. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles. The compressor shall be serviceable and removable from the front of the unit.

5. **Expansion Valve**

   - Thermostatic Expansion Valve (TXV)

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

6. **Brazed-Plate Condenser**

   The condenser shall be an insulated, brazed-plate type. The plates are to be stainless steel material. The primary side shall be piped to a condenser water source, and the secondary side shall be connected to the refrigeration system. A factory-supplied strainer is to be field-installed upstream of the Vertiv™ Liebert® PDX, on the condenser water supply line. Water pressure rating of the condenser shall be 600 psig (4136kPa) design working pressure.

7. **Condenser Motorized Ball Valve**

   - Three-Way Valve

     A pre-piped three-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The Vertiv™ Liebert® iCOM™ control shall manage the non-spring return valve actuator movement to maintain the desired condensing temperature for various entering water temperatures.

   - Two-Way Valve—Optional

     A pre-piped two-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The Liebert® iCOM™ control shall manage the non-spring return valve actuator movement to maintain the desired condensing temperature for various entering water temperatures. The maximum differential pressure across the closed valve shall be 200 PSI (1379kPa).

8. **System Design Pressure**

   - Standard Pressure

     The water/glycol circuit shall be designed for a pressure of 150PSI (1034kPa).

   - High Pressure—Optional

     The water/glycol circuit shall be designed for a pressure of 400PSI (2758kPa).

2.1.4 Dual Cooling Source System: Water/ Glycol Cooled + Vertiv™ Liebert® Econ-O-Coil (Models 011, 018, 023 and 029)

1. **System Description**

   - Two independent circuits shall be included. The dual-cooling source system shall consist of a water/glycol-cooled system with the addition of a free-cooling chilled water coil or free-cooling chilled glycol coil (Liebert® Econ-O-Coil), a modulating control valve, and a comparative temperature sensor. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or as a combination of the two. The primary cooling mode shall be chilled water. The secondary refrigeration circuit shall include a compressor, liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, a brazed-plate condenser, pressure safety switches, and a factory refrigerant charge.

- The Vertiv™ Liebert® Econ-O-Coil piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system. Switchover between the two cooling modes shall be performed automatically by the microprocessor control. Four (4) pipe connections shall be included on water/glycol systems: Econ-O-Coil supply, Econ-O-Coil return, condenser supply and condenser return.

2. **Hydrophilic-Coated Evaporator Coil**

   The direct-expansion, tilted-slab cooling coil and the Liebert® Econ-O-Coil coil 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.

3. **R-410A Refrigerant**

   The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

4. **Compressor**

   - Digital Scroll Compressor

     The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

   - Compressor Sound Jacket—Optional

     The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft^3 density jacket that encloses the compressor.

   - Standard Scroll Compressor

     The compressor shall be an R-410A scroll-type with a suction gas-cooled motor; EPDM vibration isolators, internal thermal overloads, and automatic reset high-pressure switch with lockout after three failure occurrences, rota-lock service valves, low-pressure transducer, and crankcase heater. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles. The compressor shall be serviceable and removable from the front of the unit.

5. **Expansion Valve**

   - Thermostatic Expansion Valve

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

6. **Brazed-Plate Condenser**

   The condenser shall be an insulated, brazed-plate type. The plates are to be stainless steel material. The primary side shall be piped to a condenser water/glycol source, and the secondary side shall be connected to the refrigeration system. A factory-supplied strainer is to be field-installed upstream of the Vertiv™ Liebert® PDX, on the condenser water supply line. Water pressure rating of the condenser shall be 600 psig (4136kPa) design working pressure.

7. **Condenser Motorized Ball Valve**

   - Three-Way Valve

     A pre-piped three-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The Vertiv™ Liebert® iCOM™ shall manage the non-spring return valve actuator movement to maintain the desired condensing temperature for various entering water temperatures.

   - Two-Way Valve—Optional

     A pre-piped two-way motorized ball valve shall control the water/glycol flow passing through the insulated, brazed-plate condenser. The Liebert® iCOM™ control shall manage the non-spring return valve actuator movement to maintain the desired condensing temperatures for various entering water temperatures. The maximum differential pressure across the closed valve shall be 200 PSI (1379kPa).

8. **Dual-Cool: Econ-O-Coil Control Valve**

   - Three-Way Motorized Ball Valve

     The water circuit shall include a pre-piped three-way motorized ball valve. The Liebert® iCOM™ shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. Cooling capacity shall be controlled by bypassing chilled water around the coil.

   - Two-Way Motorized Ball Valve—Optional

     The water circuit shall include a pre-piped two-way motorized ball valve. The Liebert® iCOM™ shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. The motorized ball valve travel for dehumidification shall be proportional.

9. **Comparator Sensor**

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

10. **Design Pressure**

    - Standard Pressure

      The water circuit shall be designed for a pressure of 150 PSI (1034 kPa).

    - High Pressure—Optional

      The water circuit shall be designed for a pressure of 400 PSI (2758 kPa).

2.1.5 Vertiv™ Liebert® Glycool: Fluid-cooled Economizer and DX Refrigeration System (Model 011, 018, 023 and 029)

1. **System Description**

   Glycool - The Liebert® Glycool unit shall have two independent cooling coils. The first cooling coil shall be a part of a chilled glycol circuit and shall be strategically located in the return-air stream to either pre-cool or totally cool the air before entering the refrigeration coil. The second cooling coil shall be part of a direct-expansion refrigeration circuit and shall include a compressor, liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, a brazed-plate condenser, pressure safety switches, and a factory refrigerant charge. Vertiv™ Liebert® iCOM™ shall control the activation/deactivation and modulation of the two cooling circuits allowing the system to function either as a modulating glycol economizer, a glycol refrigeration system, or a combination of both. This shall be a two-pipe system and shall require closed-loop water/glycol heat rejection, such as drycooler/pump or customer water tower using properly treated glycol solutions. Field relief of the Schrader valve shall indicate a leak-free system.

2. **Hydrophilic-coated Evaporator Coil**

   The Liebert® Glycool unit shall have two independent cooling circuits, constructed of copper tubes with hydrophilic-coated aluminum fins. The first cooling circuit shall be a chilled glycol circuit and designed for closed-loop applications using properly treated glycol solutions. The second cooling circuit shall be a direct expansion refrigeration circuit. The coil shall be constructed into the tilted slab. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. The coil shall be provided with a stainless steel drain pan.

   - Cu-Ni Coil—Optional

     A 70/30 Cu-Ni Vertiv™ Liebert® Econ-O-Coil shall be provided on dual-cooling units that are connected to a cooling tower loop or other open water system. This option shall be required on open cooling tower applications.

3. **R-410A Refrigerant**

   The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

4. **Compressor**

   - Digital Scroll Compressor

     The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

   - Compressor Sound Jacket—Optional

     The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft^3 density jacket that encloses the compressor.

- Standard Scroll Compressor

  The compressor shall be an R-410A scroll-type with a suction gas-cooled motor; EPDM vibration isolators, internal thermal overloads, and automatic reset high-pressure switch with lockout after three failure occurrences, rota-lock service valves, low-pressure transducer, and crankcase heater. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles. The compressor shall be serviceable and removable from the front of the unit.

5. **Expansion Valve**

   - Thermostatic Expansion Valve

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

6. **Brazed-Plate Heat Condensers**

   The condenser shall be an insulated, brazed-plate type. The plates are to be stainless steel material. The primary side shall be piped to a condenser glycol source, and the secondary side shall be connected to the refrigeration system. A factory-supplied strainer shall be field-installed upstream of the Vertiv™ Liebert® PDX, on the water/glycol supply line. Water pressure rating of the condenser shall be 600 psig (4136kPa) design working pressure.

7. **Three-Way Vertiv™ Liebert® Glycool Valve**

   The Liebert® Glycool coil shall include a pre-piped, three-way motorized ball valve. The Vertiv™ Liebert® iCOM™ shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures.

8. **Condenser Motorized Ball Valve**

   - Three-Way Valve

     A pre-piped three-way motorized ball valve shall control the water/glycol flow passing 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.

9. **Comparator Sensor**

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

10. **System Design Pressure**

    - Standard Pressure

      The Liebert® Glycool circuit shall be designed for a maximum system pressure of 150 PSI (1034 kPa).

    - High Pressure—Optional

      The Liebert® Glycool circuit shall be designed for a maximum system pressure of 400 PSI (2758 kPa).

2.1.6 Chilled Water System (Models 011, 017 and 029)

1. **System Description**

   The system shall function as a modulating chilled-water system consisting of a modulating chilled-water valve and a coil designed to distribute water into the entire coil-face area.

2. **Hydrophilic-Coated Evaporator Coil**

   The chilled-water tilted-slab cooling coil 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. The water circuit shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system.

3. **Control Valve**

   - Three-Way Motorized Ball Valve

     A pre-piped three-way motorized ball valve controls the chilled water flow passing through the cooling coil. The Vertiv™ Liebert® iCOM™ control shall manage the non-spring return valve actuator movement to maintain the desired room conditions for various entering water temperatures. Cooling capacity shall be regulated by varying the chilled water flow.

   - Two-Way Motorized Ball Valve - Optional

     A two-way pre-piped way motorized ball valve shall control the chilled water flow through the cooling coil. The Liebert® iCOM™ control shall manage non-spring return the valve actuator movement to maintain the desired room conditions 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 (1379kPa).

4. **System Design Pressure**

   - Standard Pressure

     The chilled water circuit shall be designed for a maximum system pressure of 150 PSI (1034 kPa).

   - High Pressure—Optional

     The chilled water circuit shall be designed for a maximum system pressure of 400 PSI (2758 kPa).

2.2 Fan Section

2.2.1 Fan and Motor

The unit shall be equipped with one plug fan: integral direct driven fan with backward-curved blades and electronically commutated DC motor; commonly referred to as EC fan. The fan speed shall be variable and automatically regulated by the Liebert® iCOM™ through all modes of operation. The fan shall have a dedicated motor, fault monitoring circuitry, and speed controller, which shall provide a level of redundancy. The impeller shall be made of aluminum and dynamically balanced. The EC fan shall be located within the unit. The EC fan shall also provide greater energy savings than forward curved centrifugal fan and variable speed drives.

2.2.2 Air Flow Configuration

1. Upflow Supply

- Upflow Supply with Front Air Return

  The supply air shall exit from the top of the cabinet. The return air shall be through the front factory installed grilles. The EC fan shall be factory mounted in the upper portion of the unit. The fan shall be located to pull air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

- Upflow Supply with Rear Air Return

  The supply air shall exit from the top of the cabinet. The return air shall be through the rear of the factory-supplied, 24" rear return, skirted floor stand assembly with air filters. The EC fan shall be factory mounted in the upper portion of the unit. The fan shall be located to pull air through the filter and cooling coil to ensure even air distribution and maximum coil performance.

2. Downflow Configurations

- Downflow Supply with Front Air Discharge

  The supply air shall exit from the front of the cabinet opening. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

- Downflow Supply with Front and Right Side Air Discharge

  The supply air shall exit from the front and right side cabinet openings. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

- Downflow Supply with Front Air and Left Side Air Discharge

  The supply air shall exit from the front and left side cabinet openings. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

- Downflow Supply with Front, Right and Left Side Air Discharge

  The supply air shall exit from the front, right and left side cabinet openings. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

- Downflow Supply with Discharge into Raised Floor

  The supply air shall exit from the bottom of the unit directly into the raised floor. The EC fan shall be mounted in the bottom of the unit. The fan shall be located to draw air through the filter and cooling coil to ensure even air distribution and maximum coil performance.

2.3 Cabinet Construction and Accessibility

2.3.1 Cabinet Construction

The exterior panels shall be 20 gauge steel and powder-coated with RAL 7021 black color paint to protect against corrosion. The exterior panels shall be insulated with 1/2” to 1" (12.7 to 25.4mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners. The cabinet shall be designed so that all components are serviceable and removable using the front and right sides of the unit.

2.3.2 Double-Skin Panels—Optional

The exterior panels shall be internally lined with 20 gauge galvanized steel, sandwiching the insulation between the panels for easy cleaning.

2.4 Locking Disconnect Switch

A locking-type fused disconnect switch shall be mounted in the electrical panel and shall be capable of disrupting the flow of power to the unit. The locking type shall consist of a main unit switch operational from outside the unit. The electric panel compartment shall be accessible only with the switch in the Off position. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

2.5 Short-Circuit Current Rating (Sccr)

- The electrical panel shall provide at least 65,000A SCCR.
- Short-circuit current rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

2.6 Filtration

2.6.1 MERV 8 Filters

The filter shall be an integral part of the system and located within the cabinet. The filter shall be deep-pleated, 2 in. (51mm) thick with a MERV 8 rating efficiency based on ASHRAE 52.2-2007. A filter clog switch shall be included. Mesh type, cleanable filters shall be unacceptable.

2.6.2 MERV 11 Filters

The filter shall be an integral part of the system and located within the cabinet. The filter shall be deep-pleated, 2 in (51mm) thick with a MERV 11 rating efficiency based on ASHRAE 52.2-2007. A filter clog switch shall be included. Mesh type, cleanable filters shall be unacceptable.

2.6.3 Extra Filter Set—Optional

_____ extra set(s) of [(MERV 8) (MERV 11)] filters shall be provided per system.

2.7 Electric Reheat—Optional

The reheat shall be a low-watt density 304/304 stainless steel finned-tubular electric reheat. The reheat section shall include UL/CSA recognized safety switches to protect the system from overheating. The electric reheat shall be controlled in two stages. The reheat elements shall be accessible from the right side of the cabinet.

2.8 Scr Reheat—Optional On Px011 Units Only

The SCR (Silicon Controlled Rectifier) controller shall proportionally control the stainless steel reheats to maintain the selected room temperature. The SCR controller shall provide precise temperature control, and the lower element temperature shall improve heater life. Available only on air-cooled or water/glycol-cooled PX011 units using digital scroll compressors.

2.9 Hot Water Reheat—Optional On Chilled Water Units Only

The hot water reheat coil shall have copper tubes and aluminum fins. The control system shall be factory pre-piped with a two-way motorized control valve. A cleanable Y-strainer should be field supplied and installed on the hot water supply line.

2.10 Infrared Humidifier

The humidifier shall be of the infrared type, consisting of high intensity quartz lamps mounted above and out of the water supply. The evaporator pan shall be stainless steel and arranged to be serviceable without disconnecting water supply lines, drain lines, or electrical connections. The complete humidifier section shall be pre-piped ready for final connection. The infrared humidification system shall use bypass air to prevent over humidification of the controlled space. 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. (25.4 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.

2.11 Steam Generating Canister Humidifier—Optional

A canister-type steam generating humidifier shall be factory-installed in the cooling unit and operated by the Vertiv™ 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™ display. The humidifier is designed to operate with water conductivity from 330 to 670 microS/cm. System shall automatically fill and drain as well as maintain the required water level based on conductivity. A minimum 1 in. (25.4 mm) air-gap within the humidifier assembly shall prevent back flow of the humidifier supply water.

2.12 Condensate Pump—Optional

The pump shall have a capacity of _____ GPM (_____ l/m) at _____ ft head (_____ kPa). The dual-float condensate 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. The condensate pump shall be factory-installed on upflow units and field-installed on downflow units.

3.0 CONTROLS

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

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

- **Password Protection** - The Liebert® iCOM™ shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.
- **Unit Backup 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 streamlined unit startup.
- **Parameter Download** - The Liebert® iCOM™ shall enable the user to download an Liebert® iCOM™ parameter file that lists parameter names, factory default settings and user-programmed settings in .csv format for remote reference.
- **Parameter Search** - The Liebert® iCOM™ shall have search fields for efficient navigation and parameter lookup.
- **Parameter Directory** - The Liebert® iCOM™ shall provide a directory that lists all parameters in the control. The list shall provide Line ID numbers, parameter labels, and current parameter values.
- **Context-Sensitive Help** - The Liebert® iCOM™ shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.
- **Display Setup** - The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, 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 LEDs** - The Liebert® iCOM™ shall show the unit's operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
- **Event Log** - The Liebert® iCOM™ shall automatically store the last 400 unit-only events (messages, warnings, and alarms).
- **Service Contact Information** - The Liebert® iCOM™ shall be able to store the local service or sales contact information.

- **Upgradeable** - Vertiv™ Liebert® iCOM™ 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.
- **Various Sensors:** The menus shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for field-supplied sensors. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.
- **Diagnostics/Service Mode** - The Liebert® iCOM™ control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.
- **Base-Comms for BMS Connectivity** – The Liebert® iCOM™ controller shall provide one Ethernet Port and RS-485 Port dedicated for BMS Connectivity. Provides ground fault isolated RS-485 Modbus, BACnet IP & Modbus IP network connectivity to Building Management Systems for unit monitoring and management. Also, provides ground fault isolated 10/100 baseT Ethernet connectivity for unit monitoring and management. The supported management interfaces include: SNMP for Network Management Systems, HTTP for web page viewing, SMTP for email, and SMS for mobile messaging. The Liebert® iCOM™ controller shall support dual IP on a single network and one 485 protocol simultaneously.

3.2 Alarms

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

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- EC Fan Fault
- Change Filters
- Loss of Air Flow

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

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

- Leak Under Floor
- Smoke Detected
- Standby Unit On

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

3.3 Vertiv™ Liebert® iCOM™ Control Methods and Options

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

3.3.1 Controlling Sensor Options

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

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)
- Static Pressure

3.3.2 Temperature Compensation

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

3.3.3 Humidity Control

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

3.4 Multi-Unit Coordination

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

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

3.5 Standby Lead-Lag

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

3.6 Standby Unit Cascading

The Liebert® iCOM™ cascade option shall allow the units to turn On and Off based on heat load when utilizing Teamwork Mode 1, Independent mode or Teamwork Mode 3, Optimized Aisle mode with remote temperature sensors. In Teamwork Mode 1, Cascade mode will stage units On based on the temperature and humidity readings and their deviation from setpoint. In Teamwork 3 Mode, Cascade mode dynamically coordinates the fan speed to save energy and to meet the cooling demands. For instance, with a Liebert® iCOM™ group of six units and only 50% of the heat load, the Liebert® iCOM™ shall operate only four units at 80% fan speed and leave the other two units in standby. As the heat load increases, the Liebert® iCOM™ shall automatically respond to the additional load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them into standby.

3.7 Wired Supply Sensor

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

3.8 Virtual Master

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

3.9 Virtual Back-Draft Damper

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

3.10 Compressor Short Cycle Control

To help maximize the life of the compressor, there shall be start-to-next start delay for each 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 Short Cycle event.

3.11 Vertiv™ Liebert® MC Condenser Communication

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

3.12 System Auto Restart

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

3.13 Sequential Load Activation

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

3.17 Advanced High-Pressure Protection—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 and the condenser fan speed to reduce the system discharge pressure, preventing circuit shut down. If the unit is unsuccessful in correcting the problem through this interaction, an alarm shall occur and the affected compressor shall be immediately locked off. The control shall re-enable the compressor when the pressure returns to a safe level. This feature is standard on units equipped with liquid line transducers and digital scroll.

3.18 Refrigerant Pressure Transducer Failure

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

3.19 Oil Return Protection

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

3.20 Digital Scroll High-Temperature Protection

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

3.21 Digital Scroll Sensor Failure

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

3.22 Compressor High- and Low-Temperature Limit Protection

The control shall monitor the return air to ensure that the compressor is 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 (scroll compressors)

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

3.24 Flooded Start Protection

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

4.0 MISCELLANEOUS OPTIONS

4.1 High Temperature Sensor—Optional

This sensor shall be factory-installed in the unit and shall be factory-set to 125ºF (52ºC). It shall immediately shut down the environmental control system when activated. The sensor shall be 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.

4.2 Smoke Sensor—Optional

The smoke sensor samples the return air, shuts down the unit upon activation, and sends visual and audible alarms. Dry contacts are available for a remote customer alarm. The smoke sensor includes a “supervision” contact closure. This smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes.

4.3 Remote Temperature/Humidity Sensor—Optional

This sensor shall allow the control of the unit based on temperature/humidity conditions remote to the unit. This sensor shall be field-mounted and wired to the Vertiv™ Liebert® iCOM™ control board and the unit shall not have a return-air temperature/humidity sensor mounted inside the unit.

4.4 Low-Voltage Terminal Package—Optional

Factory-installed and factory-wired terminals shall be provided for customer connection:

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

4.5 Remote Humidifier Contact—Optional

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

4.6 Compressor Overload—Optional

A factory-installed sensor designed to detect high compressor currents and provide Liebert® iCOM™ input to shut down the compressor as a compressor protection feature.

4.7 Floor Stand—Optional

4.7.1 Supply Air Floor Stand - Optional

Downflow Raised Floor (Upflow, Not Rear Return)

The floor stand shall be constructed of galvanized steel. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand shall be: (6in. [15cm]), (9 in. [23cm]), (12 in. [30cm]), (15 in. [38cm]), (18 in. [46cm]), (21 in. [53cm]), (24 in. [61cm]) high.

4.7.2 Return Air Floor Stand Assembly - Optional

The upflow unit with rear returns air configuration shall be supplied with a skirted-floor stand assembly. The floor stand assembly shall be constructed of galvanized steel with powder-coated panels and supplied with air filter. The floor stand assembly shall be 24-1/8 in. (613mm) high and have adjustable legs with vibration isolation pads. It shall provide a rear return duct flange and removable panel for filter access.

4.8 Plenum - Optional

4.8.1 Plenum Construction

The exterior panels shall be 20 gauge steel and powder-coated with black color paint to protect against corrosion. The exterior panels are insulated with 1/2” to 1" (12.7 to 25.4mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners.

4.8.2 Air Flow Configuration

- **Ducted**

  The unit shall be supplied with a ducted air discharge plenum. The plenum shall be (18 in. [457mm]), (24 in. [609mm]), (30 in. [762mm]), (36 in. [914mm]), (42 in. [1066mm]) or (48 in. [1219]mm) with top duct connection.

- **Two-way Grille**

  The unit shall be supplied with a two-way air discharge plenum. The plenum shall be 18 in. (457mm) high.

- **Three-way Grille**

  The unit shall be supplied with a three-way air discharge plenum. The plenum shall be 18 in. (457mm) high.

- **Four-way Grille**

  The unit shall be supplied with a four-way air discharge plenum. The plenum shall be 18 in. (457mm) high.

4.9 Vertiv™ Liebert® vNSA Network Switch-Optional

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

- Liebert® vNSA14: enclosure with network switches only
- Liebert® vNSA14 - Liebert® iCOM™ - H: enclosure with network switches and 9” Liebert® iCOM™ color touchscreen display

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

4.10 Vertiv™ Liebert® Nform Advanced Monitoring - Optional

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), Vertiv™ Liebert® Alber™ battery monitoring, rack enclosure intrusion 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.

4.10.1 Liebert® Nform 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.

4.10.2 Approved Products

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

4.10.3 Liebert® Nform 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, Windows 8/8.1 Enterprise, Windows Server 2003, Windows Server 2008 (R2) or Windows Server 2012 (R2) 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, Windows Vista, Windows 8/8.1 Enterprise, Windows Server 2008 (R2) or Windows Server 2012 (R2) operating system.
  - Microsoft Internet Explorer v9.0 or better
  - 2 GB RAM (or the minimum operating system requirement)
  - 20 GB hard disk (or the minimum operating system requirement)
  - 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.

4.11 Vertiv™ Liebert® Liqui-Tect™ 410 Point Leak Detection Sensor For Remote Mounting- Optional

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 amps.

4.12 Liebert® Liqui-Tect™ 460 Zone Leak Detection Module with Cable Kit For Remote Mounting - Optional

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).

5.0 HEAT REJECTION - VERTIV™ LIEBERT® MC CONDENSER

5.1 Liebert® MC Condenser Summary

- These specifications describe requirements for a Liebert air-cooled condenser for a Liebert Thermal Management system. The condenser shall be designed to reject waste heat to outdoor air and to control refrigerant head pressure as indoor equipment loading and outdoor ambient conditions change.
- The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.
- Standard 60Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard “CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment” and shall be marked with the CSA c-us logo.

5.2 Liebert® MC Condenser Design Requirements

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

5.3 Liebert® MC Condenser Standard Features

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

5.4 Liebert® MC Condenser 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 environmental 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.

Aluminum Microchannel Coil with E-Coat—Optional

Aluminum microchannel coil with E-coat shall provide a flexible epoxy coating to all coil surface areas without material bridging between fins. 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, and the color shall be black. A UV topcoat shall be applied to prevent UV degradation of E-coat.

5.5 Vertiv™ Liebert® MC Condenser 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-mesh steel wire, coated with a black corrosion resistant finish. Fan terminal blocks shall be in an IP54 enclosure on the top of the fan motor. Fan assemblies shall be factory-balanced, tested before shipment and mounted securely to the condenser structure.

Liebert® MC Condenser EC Fan Motor

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

5.6 Liebert® MC Condenser Electrical Controls

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

EC Fan Speed and Premium Control

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

Locking Disconnect Switch

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

Short Circuit Current Rating

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

Cabinet

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

5.7 Vertiv™ Liebert® MC Condenser Mounting Legs

Standard Aluminum Legs

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

Optional Galvanized Steel Legs with Bracing

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

5.8 Liebert® MC Condenser Accessories

Vertiv™ Liebert® Lee-Temp System—Optional

- Liebert® Lee-Temp Receiver Kit shall contain an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure relief valve, rota-lock valve for refrigerant charge isolation and piping assembly with head pressure operated 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. The Liebert® Lee-Temp heater shall be 150W, shall include an integral thermostat to maintain refrigerant temperature at a minimum of 85°F (29°C) and shall require a separate power supply of (208/230V-1ph-60Hz) (120V-1ph-60Hz).
- The Liebert® Lee-Temp Kit shall function with Liebert® MC variable speed fan motors and electronic controls that lower fan speed in lower outdoor ambient temperatures for maximum energy efficiency. This system shall allow system startup and positive head pressure control with ambient temperatures as low as -30°F (-34.4°C).

Vertiv™ Liebert® PDX-EEV Receiver Kit - Optional

Liebert® PDX-EEV Receiver Kit shall contain a painted, un-insulated receiver with integral fusible plug, formed copper pipe for ease of connecting condenser liquid line to receiver and mounting bracket. Additional full-length leg is shipped with condenser (18 in., 36 in. and 48 in.) or with 60 in. leg kit and should be secured to the mounting surface. One receiver kit shall be field installed per refrigerant circuit.

Liebert® MC 575 Volt - Optional

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

5.9 Fusible Plug Kit - Optional

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

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

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

6.0 HEAT REJECTION - VERTIV™ LIEBERT® DRYCOOLERS

6.1 Liebert® Drycooler Summary

- These specifications describe requirements for a Liebert® air-cooled drycooler for a Liebert® Thermal Management system. The Liebert® Drycooler shall be designed to reject waste heat to outdoor air and to control glycol temperature as pumped glycol rates and outdoor ambient conditions change.
- The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.
- Standard 60Hz 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.

6.2 Liebert® Drycooler Design Requirements

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

6.3 Liebert® Drycooler Standard Features

The Liebert® 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.

6.4 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 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 [1-4 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 (2068kPag), 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.

6.5 Liebert® Drycooler Housing

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

6.6 Liebert® Drycooler Propeller Fan

The propeller fan shall have aluminum blades secured to a corrosion protected steel hub. Fans shall be secured to the fan motor shaft by means of a keyed hub and dual setscrews. Fan diameter shall be 26" (660mm) 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.

6.7 Vertiv™ Liebert® Drycooler Fan Motor

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

6.8 Liebert® Drycooler Electrical Controls

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

6.9 Specific Features By Drycooler Type

6.9.1 Fan Speed Control (DSF/DDF) Liebert® Drycooler (1 Fan) with Integral pump control

The DSF/DDF Liebert® Drycooler shall have a fan speed controller that senses the leaving glycol temperature and varying the speed of a FSC duty motor in direct proportion to the heat rejection needs of the system. Fan speed controller shall be factory set to range of 70 to 100°F (21 to 38°C) for glycol-cooled applications. The fan speed control shall be field adjustable to a range of 30 to 60°F (2 to 7°C) for free-cooling applications. The motor shall be single-phase and include built-in overload protection. The motor shall have an ODP enclosure. The DSF/DDF Liebert® Drycooler shall control operation of glycol pumps powered from the electrical panel. The Liebert® air-cooled drycooler shall have a ____ volt, ____ ph, ____ Hz power supply.

6.9.2 Fan Cycling Control FAN(DSO, DDO) Liebert® Drycooler (All Fan Quantities) with Integral Pump Control

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

6.9.3 Fan Cycling Control (DDNT) Liebert® Drycooler (All Fan Quantities)

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

6.9.4 Main Fan Control (DDNL) Liebert® Drycooler (All Fan Quantities)

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

6.9.5 No Fan Control (DDNC) Liebert® Drycooler (All Fan Quantities)

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

6.9.6 Vertiv™ Liebert® QuietLine Drycooler (All Fan Quantities)

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

6.10 Pump Controls Within Liebert® QuietLine Drycooler

6.10.1 Single Pump Option

Pump controls for a single glycol pump up to 7.5 hp (5.6kW) 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.

6.10.2 Dual Pump Option

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

6.11 Pump Package

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.

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.

6.12 Ancillary Items

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

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

7.0 HEAT REJECTION - VERTIV™ LIEBERT® PIGGYBACK DRYCOOLERS

7.1 Liebert® Piggyback Coil

Coil is constructed of copper tubes in a staggered tube pattern. Tubes are expanded into aluminum plate type fins. The fins have full depth fin collars that bond to the seamless copper tubes. Coils are installed to provide horizontal air inlet.

7.2 Liebert® Piggyback Fans

Quiet, low speed centrifugal type, double width, double inlet, dynamically balanced to a vibration tolerance of two mils in any plane with lifetime lubricated self-aligning ball bearings rated at 100,000 hours. The open drip-proof fan motor operates at 1750 RPM for 60 HZ and is mounted on an adjustable slide base. A top or rear discharge location enables the draw-through design to provide even air distribution across the coil.

7.3 Liebert® Piggyback Drives

Drives Consist of one fixed pitch sheave keyed to the fan shaft and a variable pitch sheave keyed to the motor shaft. The sheaves are machined cast iron, double grooved, and are statically balanced. Dual V-belts, standard for extra protection, are super-grip or grip-notched type.

7.4 Liebert® Piggyback CABINET AND FRAME

Custom painted steel panels with 1" (25.4mm), 1 1/2 lb. (.68 kg) insulation. A hinged left end access panel opens to a second dead front panel which is a protection enclosure for all high voltage components. Frame is constructed of 14 gauge heliarc welded tubular steel.

7.5 Liebert® Piggyback SINGLE GLYCOL PUMP

Glycol pump is a single staged, end suction, close coupled, with ball bearing motors, bronze fitted construction, stainless steel pump shaft, high efficiency impellers, and designed for continuous service.

7.6 Liebert® Piggyback Options

7.6.1 Filter Chamber

Deep pleated with a minimum efficiency rating of MERV8 (based on ASHRAE 52.2-2007) located within the cabinet inside the optional filter chamber positioned in front of the condenser coil, and serviceable from either end of the unit.

7.6.2 Unit Disconnect Switch

Two types of switches are available. The “Non-Locking-Type” consists of a non-automatic molded case circuit breaker operational from the outside of the unit. Access to the high voltage electric panel can be obtained with the breaker in either the “on” or “off” position. The “Locking Type” is identical except access to the high voltage electric panel compartment can be obtained only while the breaker is in the “off” position.

7.6.3 Floor Stand

Floor stand is constructed of heliarc welded tubular steel and available in heights from 9" to 24" with vibration isolation pads provided on the adjustable legs.

7.6.4 Oversized Blower & Pump Motors

Oversized blower and pump motors are available for higher than normal pressure applications.

7.6.5 Dual Glycol Pumps with Automatic Changeover Control

Dual glycol pumps with automatic changeover control provide 100% redundancy of the glycol pump.

7.6.6 No Glycol Pump

Option is available for field supplied pump applications.

8.0 EXECUTION

8.1 Installation Of Precision Cooling Units

8.1.1 General

Install precision 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.

8.1.2 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.

8.1.3 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.

8.1.4 Field Quality Control

Start the system 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.

8.1.5 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.

8.2 Warranty Start-Up And Control Programming

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