CRAC UNIT SPECIFICATION
For MAHG20-1053, Repair HVAC Data Center, B1101
(based upon UFGS Sect. 23.81.23.00 20)

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 55	(2010) Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B31.1	(2018) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME BPVC	(2010) Boiler and Pressure Vessels Code

ASTM INTERNATIONAL (ASTM)

ASTM B280	(2020) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2018) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL Elec Equip Dir	(2011) Electrical Appliance and Utilization Equipment Directory

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1.2 SYSTEM DESCRIPTION

Provide and install 4 new NIPR CRAC units complete, ready for operation. Retrofit 1 existing SIPR CRAC unit with VFD controller & fan motor, 2WAY CHW & HW control valves, and a new I-COM control display. Provide and install these retrofit kits for 1 existing SIPR CRAC unit complete and ready for operation.

NIPR CRAC units shall run in a (3+1) RUN/STANDBY configuration. A network switch installed in NIPR CRAC unit #242 allow this configuration to run in a local network.

All 5 NIPR & SIPR CRAC units shall be wired to BAS (Metasys) via BACNet protocol. BAS will allow EMCS to monitor the operation of all CRAC units receiving data and alarms, noted.

1.3 SUBMITTALS

Submit per the AF 66HAZ document provided with contract.

1.4 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Air filters shall meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2. Thermal comfort shall meet or exceed ASHRAE 55.

PART 2 PRODUCTS

2.1 COMPUTER ROOM AIR CONDITIONING UNITS (CRACU)

Provide (4) self-contained units, designed, and factory assembled, and factory tested. Unit shall be listed in UL Elec Equip Dir or ETL DLP for computer room application. Equipment shall have a minimum net sensible coefficient of performance (SCOP-127) of 2.67 @ 85degF DB / 52degF DP per ASHRAE 90.1, Table 6.8.1-10 and AHRI 1360. Unit shall include room cabinet and frame, floor stand, fan section, filter section, CHW cooling coil, HW reheat coil, CFW humidifier, controls, and interconnecting internal piping.

CRAC units shall be per **Liebert CW084DC1A1-H208H-ILO-BF** or approved equal with SAME FOOTPRINT, as existing/new floorstand combinations will be used for CRAC unit installation.

Dimensions: 99L x 35W x 72H, 106H with plenum
Weight: 1540#
With floorstand for 24” raised floor
With HI-TEMP STAT, SMOKE & LIQUID SENSORs, and FLOW SWITCH
With Liebert iCOM display, UNIT to UNIT network switch
With UNITY interface card for BACNet MSTP protocols with BAS.
With Variable Speed Electrically Commutated (EC) fans
ELEC SVCE @ 480VAC/3ph/60Hz, MCA=19.6A, MOP=30A with integral locking disconnect switch and 65kA SCCA
Cooling Capacity: 297.2 kBTUH @ 63gpm, 18ftHD, 11,900cfm
per CHW @ 45degF EWT & 10degF temp rise
with CHW system 45psi WP & 150psi DP
per 75degF DB, 61degF WB (46%RH) return air

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Re-Heat Capacity: 125.2 kBTUH @ 8gpm, 3.7ftHD, 11,900cfm
per HW @ 180degF EWT & 75degF EAT
with HW RH system 45psi WP & 150psi DP
2WAY control valves for both CHW and HW Reheat piping.
Infrared humidifier: 22.1 #/hr, 9.6kW
Gravity condensate drain with internal P-trap.

Provide for (1) existing Liebert BF068 unit 246, a replacement CHW 2-WAY inlet valve replacement set. Liebert field representative shall remove the existing CHW 3-WAY inlet, and install new CHW 2-WAY inlet valve set.

Provide for same (1) existing Liebert BF068 unit 246, a NEW replacement "Liebert iCOM" display, controller. Leibert field representative shall remove the existing display, controller; and, install new "iCOM" unit.

Provide for (1) existing Liebert BF068 unit 246, a replacement VFD fan controller. Liebert field representative shall remove the existing fan controller, and install new VFD controller.

2.1.1 Cabinet and Frame

2.1.1.1 Unit Cabinet

Unit frame shall be minimum 14 gage welded steel tubes or steel angles and shall be mill-galvanized or coated with an epoxy finish, or an approved manufacturer's standard finish, if equivalent.

Exterior panels shall be furniture grade steel sheet, minimum of 20 gage, mill-galvanized or coated with a corrosion-inhibiting epoxy finish, or an approved equivalent finish. Mill galvanized sheet metal shall be coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Mill rolled structural steel shall be hot-dip galvanized or primed and painted. Cut edges, burns and scratches in hot-dip galvanized surfaces shall be coated with galvanizing repair coating.

Provide removable panel for access to controls without interrupting airflow. Panels shall be gasketed to prevent air leakage under system operating pressure and shall be removable for service access without the use of special tools. Condensate pans shall be minimum 22 gage Type 304 stainless steel, double-sloped, and shall be piped to drain.

Exterior surfaces of cabinets constructed of mill-galvanized steel shall be finished by the manufacturer's standard enamel finish, color.

CRACU manufacturer's standard cabinet materials and finishes will be acceptable if considered equivalent to the above requirements by the Contracting Officer.

2.1.2 Fan Section

The supply air fan shall be AMCA certified. Fans shall be single inlet, plug type or plenum type, direct drive, variable speed electronically commutated fans. The supply air fan shall be statically and dynamically balanced. Fans shall draw air over the cooling coil to ensure even air distribution and maximum coil performance. Unit shall be of down-flow configuration with fans contained within cabinet.
The fan motor shall be drip-proof with NEMA rated frame, inherent overload protection. Two fan motors shall be 4.0hp (3.0kW)_at 1520 rpm.

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2.1.3 Cooling Coil

Provide AHRI 410 coils and slope for drainage. Coil shall be constructed of seamless copper tubes with plate aluminum fins. Use a low sensible heat ratio for more moisture removal. Each coil, in the production process, shall be individually tested at 320 psi with compressed air under water and verified to be air tight. The CHW coil, system shall be factory equipped with 2WAY motorized control valve. Provide hydronic coils complete with drain and vent connections. Provide condensate drain pan of stainless steel construction with nonferrous connections and internal trap.

2.1.4 Filters

Provide UL listed two inches thick deep pleated fiberglass throwaway type filters. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2.
Provide and additional set of filters, as initial replacement filters.

2.1.5 Reheat Coil

Provide AHRI 410 reheat coils and slope for drainage. Provide coil constructed of seamless copper tubes with plate aluminum fins. Each coil, in the production process, shall be individually tested at 320 psi with compressed air under water and verified to be air tight. The control system shall be factory equipped with 2WAY motorized control valve, and a cleanable Y-strainer installed in HW supply line.

2.1.6 Humidifier

Provide infrared type humidifier, including high intensity quartz lamps mounted above and out of water supply. The infrared humidification system shall use bypass air to prevent over-humidification. An auto-flush system shall flush deposits from the humidifier pan. The system shall be field adjustable to change the cycle time to suit local water conditions. A minimum air gap of 1” within piping assembly to comply with ASME A112.1.2 (back-siphonage testing) to prevent back-flow of the humidifier supply water. Section should be factory pre-piped for final connection. Provide stainless steel evaporator pan with water high-level and low-level alarms. Arrange system to be cleanable and serviceable, without disconnection of water, drain, or electrical service.

2.1.6 Space Temperature Control System
See Appendix 1, LIEBERT ICOM™ MICROPROCESSOR CONTROL & ALARMS

Provide microprocessor control system integral with unit including electronic control center, control valves, sensors, wiring, and other appurtenances for workable system. Provide access panel or door in front of unit.

Isolate electronic control center from conditioned airstream to allow service while system is in operation. Provide control sensors in unit for cooling, dehumidifying, and humidifying. High-voltage circuits in system shall have individual leg overload protection. Starters, contactors, and relays shall be controlled by 24 volt control circuit.

High-voltage circuit components shall be protected by safety lock, dead-front panel. Mount non-automatic, molded-case circuit breaker in

high-voltage section of electrical panel. Operating mechanism shall prevent access to high-voltage electrical components until switched to "OFF" position.

Include the following control capabilities:

a. Capable of changing the set points and sensitivity of the space and humidity along with their low and high alarm points.

b. Logging capability of the last 10 alarms and run time.

c. Diagnostics

Provide a controls interface on CRACU to enable the DDC system to monitor the following operating parameters and alarm conditions: high and low computer room temperature, relative humidity, CRACU status.

2.1.7 Alarm Panel System
See Appendix 1, LIEBERT ICOM™ MICROPROCESSOR CONTROL & ALARMS

Provide unit with cabinet-mounted alarm panel which shall monitor high and low space temperature, high and low space humidity, dirty filters, loss of airflow, loss of chilled water flow, loss of hot water reheat flow, and humidifier problems. Provide underfloor water detector.
Provide field accessible local audible alarm with silence pushbutton.
Provide push-to-test lamps or all-lamp test pushbutton. CRACUs shall have local devices which provide signals for remote audible and visual alarming capability for the above specified alarm conditions.

2.1.9 Air Return and Delivery Orientation

Computer room air conditioning units shall be downflow discharge, top return, draw-thru cooling coil, and shall discharge air into a 24” raised floor plenum.

2.1.10 Floorstand

Unit shall be provided with elevating 24 inches high floorstand. Floorstand shall elevate the unit to the height of the raised floor and shall allow for leveling and locking at the desired height. Floorstand shall be removable. Unit shall be fully gasketed (rubber or neoprene) to prevent air leakage at the raised floor penetration.

2.2 ELECTRICAL

Requirements for ELECTRICAL service are noted within this CRAC unit Specification, MAHG201053, B1101 Data Center, DWG, rev 1.
See DWG sheet M1.0 ELECTRICAL NOTES.

2.3 HVAC PIPING

Requirements for CHW, HW ReHeat, CFW humidifier, and Condensate drain piping are specified in a separate MAHG2—1053, B1101 Data Center HVAC, PIPING SPECIFICATION document.

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2.4 FIRE PROTECTION and OTHER DEVICES

Provide Smoke detector, HI-Temp detector, Liquid detector in raised floor, and CHW FLO-Switch with each CRACU.

2.5 SOURCE QUALITY CONTROL

2.5.1 Manufacturer's Factory Test Plans & Reports

Provide factory test plan for all of the CRACUs.
Provide factory test report for each of the CRACUs.

Submit a factory test plan which when followed during factory testing shall verify that the performance scheduled on the drawings is met by the produced CRACU models.

The manufacturer shall perform factory tests on the actual CRACU[s] produced for this project. The test reports shall document the performance tests conducted on the factory assembled computer room air conditioning units. Performance testing on the individual computer room air conditioning unit components, not factory assembled, is not acceptable.

Submit factory test plan per AF66 document. (with submittal)
Submit the required test reports per AF66 document. (at end of contract)

2.5.2 Manufacturer's Field (Start-Up) Test Plans & Reports

Submit start-up manufacturer’s test plan for a single CRACU.
A start-up test will be conducted for each CRACU.
Submit a start-up test report for each CRACU per AF66 document.

Manufacturer’s start up test must be accomplished to prove the manufacturer’s warranty acceptable.

Field test plans developed by the installing Contractor will not be acceptable.

Furnish a factory trained field test representative authorized by the CRACU manufacturer to oversee the complete execution of the field testing. This test representative shall also review, approve, and sign the completed field test report. Signed test report shall indicate a manufacturer’s warranty agreement.

Field test must occur after CHW & HW RH system hydrostatic tests are accomplished, satisfactory. And after condensate drain “plugged” gravity test is witnessed. CFW humidifier “visual inspection” check will occur during manufacturer’s field testing.

Conduct the test for each CRACU for a continuous 24-hour test period. A CRACU shutdown before the continuous 24-hour test period is completed shall result in the 24-hour test period being started again and run for the required duration.

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APPENDIX 1

LIEBERT ICOM™ MICROPROCESSOR CONTROL WITH 7-IN. 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 a report that lists parameter names, factory default settings and user-programmed settings in .csv format for remote reference.
- Parameter Search - The Liebert iCOM shall have search fields for efficient navigation and parameter lookup.
- Parameter Directory - The Liebert iCOM shall provide a directory that lists all parameters in the control. The list shall provide Line ID numbers, parameter labels, and current parameter values.
- Context Sensitive Help - The Liebert iCOM™ will 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 will be configurable through the display.
- Additional Readouts - The Liebert iCOM shall enable the user to configure custom widgets on the main screen. Widget options shall 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.

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- Status LED's - The Liebert iCOM shall provide the user with 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 have the capacity to store the local service or sales contact information.
- Upgradeable - Liebert iCOM firmware upgrades shall be performed through a USB connection.
- Timers/Sleep Mode - Menu shall allow various customer settings for turning on/Off unit.
- Menu Layout –
  The menus will be broken out into two main menu screens:
  The User screen contains the menus to access parameters required for basic unit control and setup.
  The Service screen is designed for service personnel and provides access to advanced control setup features and diagnostic information.
- Sensor Calibration – The menus shall allow unit sensors to be calibrated with external sensors.
- Maintenance/Wellness Settings - The menus shall allow reporting of potential component problems before they occur.
- Options Setup - The menus shall provide operation settings for the installed components.
- Auxiliary Boards - The menus shall allow setup of optional expansion boards.
- Various Sensors - The menus shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 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 iCOM controller can support dual IP on a single network and one 485 protocol simultaneously.

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LIEBERT ICOM™ MICROPROCESSOR ALARMS

All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customer's Building Management System/Building Automation System.

The Liebert iCOM control shall activate an audible and visual alarm in event of any of the following conditions:

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

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

LIEBERT ICOM™ CONTROL METHODS

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.

Controlling Sensor Options

The Liebert iCOM shall be flexible in the sense that it shall allow 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

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

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

LIEBERT ICOM™ MULTI-UNIT COORDINATION
Liebert iCOM™ teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork shall allow 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): Is best applied in large rooms with unbalanced heat loads. The Liebert iCOM calculates the worse-case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning 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 the inlet rack temperature is being met. Cooling (Chilled Water Valve or Economizer) is controlled through unit supply air conditions. The Liebert iCOM calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied. This is the best form of control for a room with an unbalanced load.

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STANDBY LEAD-LAG
The Liebert iCOM shall allow planned rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

STANDBY 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 new 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 need by cascading units On or putting them into standby.

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 provides 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 automatically assigns a virtual master. The virtual master assumes the same responsibilities as the master until communication is restored.