**DESIGN A/E NOTE - GUIDE SPECIFICATION CONVENTIONS**

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**Red: Text updated in 1st quarter. April – June.**

**Strikethrough text and highlighting (not text) in previously issued quarters are deleted. Only 1st quarter highlighted updated text is indicated.**

**Turquoise: Text updated in 2nd quarter. July – September.**

**1st quarter updated text remains highlighted.**

**Pink: Text updated in 3rd quarter. October – December.**

**1st and 2nd quarter updated text remain highlighted.**

**Bright Green: Text updated in 4th quarter. January – March.**

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**Text Editing**

**Select options [in brackets] and edit <notes> before issuing specifications for distribution to Bidders/Contractors.**

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 **Click Replace tab, Replace All, OK, Close. Save.**

**Delete all highlighting of text from issue to be distributed to Bidders/Contractors.**

**Tip: To delete highlighting, locate cursor at beginning of Section and block all text in Section, press Shift + Control + End, click No Highlight icon on Formatting toolbar. Save.**

**IMPORTANT: Retain month and year under section title on first page indicating updated Guide Specification Section issue used.**

**Note: This** page **will not print when Hidden text is unchecked as indicated in Editor’s Notes Tip.**

IF THE HIDDEN GUIDE SPECIFICATION CONVENTIONS DO NOT APPEAR PRECEEDING THIS

NOTE, TURN THEM ON AS FOLLOWS.

**FOR MICROSOFT WORD 2000 and 2003**, CLICK ON SHOW/HIDE ICON IN MENU BAR OR CHOOSE

TOOLS IN MENU BAR. THEN CLICK OPTIONS, VIEW TAB, UNDER FORMATTING MARKS, CHECK

HIDDEN TEXT.

**FOR MICROSOFT WORD 2007,** CLICK ON MICROSOFT OFFICE ICON LOCATED IN UPPER LEFT

CORNER OF MENU BAR. CLICK ON WORD OPTIONS AT BOTTOM OF DROP DOWN. THEN CLICK

ON DISPLAY. CHECK THE HIDDEN TEXT BOX.

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THE GUIDE SPECIFICATION CONVENTIONS SHOULD NOW BE VISIBLE IN THE DOCUMENT.

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SECTION 23 09 16

REFRIGERATION MONITORING AND CONTROL SYSTEMS (RMCS)

(Edited from DeCA June 2022 Design Criteria)

1. A/E shall provide overall control design which clearly, completely, and concisely reflects all control requirements of the project. Edit this specification and DeCA standard details as necessary to achieve this. Notes to A/E are entered at "\*\*\*\*\*\*" throughout to assist A/E in editing this spec.
2. A/E shall edit at "\*\*\*\*\*\*" to indicate the drawing sheet numbers on which A/E will indicate the HVAC items to be controlled by the RMCS. (See Design Criteria section 23 05 00 for required HVAC items to be controlled by RMCS). If HVAC equipment is not being controlled by the RMCS, delete references to the equipment from this specification section.
3. A/E shall also edit at "\*\*\*\*\*\*" to indicate the drawing sheet numbers on which A/E will indicate the lighting to be controlled by the RMCS (See Design Criteria Division 26 for lighting to be controlled by RMCS). (Note: Design shall always call for New Display Case Lighting control by RMCS).
4. A/E shall provide all necessary additional control specifications to insure that all control requirements are clearly indicated.
5. A/E shall provide his own comprehensive control design review.
	1. Review complete design to insure that HVAC control requirements stated in 23 09 16 are consistent and cohesive with those indicated in Division 23 construction specifications and the construction drawings.
	2. Review complete design to insure that Product Refrigeration control requirements stated in 23 09 16 are consistent and cohesive with those indicated in Division 23 construction specifications and the construction drawings.
	3. Review complete design to insure that Lighting control requirements stated 23 09 16, are consistent and cohesive with those indicated in Division 26 construction specifications and the construction drawings.
6. A/E include 23 91 00 as part of the complete refrigeration specification.
7. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Refrigeration monitoring and control system.

* + - * 1. Related Sections:

\*\*\*\*\* A/E shall edit section names and numbers as necessary for design numerical and name consistency.

Division 01 Section Mechanical, Refrigeration, Food Service Equipment and Electrical Coordination.

Division 01 Section Environmental procedures for Refrigerants.

Division 01 Section Quality Control.

Division 01 Section Closeout Procedures.

Division 23 Section Product Refrigeration Systems.

Division 23 Section Packaged, Outdoor, Air-Handling Units.

Division 23 Section Mechanical Dehumidification Units.

Division 23 Section Convection Heating and Cooling Units.

Division 23 Section Instrumentation and Control Devices for HVAC.

Division 26 Electrical.

* + - 1. SCOPE OF WORK
				1. General

Refer to Division 23 Common Work Results for HVAC for information on demolishing existing refrigeration monitoring and control systems (RMCS).

Provide a monitoring and control system (RMCS) to monitor and control product refrigeration and HVAC equipment designated for control by RMCS in the specifications and the contract drawings. Items controlled by the RMCS include.

Product Refrigeration System:

\*\*\*\*\* A/E shall edit by adding the words existing if control of existing equipment is required on an ADD/ALTER PROJECT.

Compressors: Each new multiplex compressor system compressor indicated in the Contract Drawings.

Condensers: Each new multiplex compressor system condenser fan indicated in the Contract Drawings.

Defrost Contactors: Each new refrigeration defrost contactor.

Solenoid Valves: Each new refrigeration liquid/suction solenoid.

Case Controllers: Each new RMCS case controller.

Heat Reclaim: Each new heat reclaim 3-way valve.

Display Case Lighting: New display case lights.

\*\*\*\*\*California install actions only

\*\*\*\*\* A/E shall edit and delete reference to items, which are not indicated for control by RMCS. Also, A/E shall enter the appropriate drawing numbers at the question marks.

Heating Ventilation and Air Conditioning (HVAC):

All HVAC devices indicated for control by RMCS on Contract Drawings **<insert sheet number>** thru **<insert sheet number>**

Sales Area and Outside Lighting:

All lights indicated for control by RMCS on Contract Drawings **<insert sheet number>** thru **<insert sheet number>**

Warranty: Provide warranty service specified in paragraph 3.6 "Warranty".

Close-Out Items: Provide close out items specified in paragraph 3.5 "Close-Out Items".

Training: Provide training of Commissary personnel as specified in paragraph 3.1 "General Requirement, Training".

Parts and Labor: All labor and equipment necessary for Contractor to meet the requirements stated herein this Section shall be Contractor Furnished and Contractor Installed.

Coordination: The refrigeration monitoring and control system and its installation shall be approved by and coordinated with the display case manufacturer and the RMCS manufacturer.

The RMCS system must be capable to do the following:

Communicate via serial and Ethernet connectivity.

Remote-based connectivity through any web based browser (no software needed)

Provide centralized access to all devices from a single location.

Provide remote broadband access via cellular communication device.

Be capable of future remote accessibility via http using public infrastructure.

Provide graphical display of store information including all temperatures, alarms and data points managed by RMCS.

Provide secure logged authentication for all users. Provide multiple levels of password protected access to include view only, Lighting Schedule override, setpoint changes, and programming changes.

* + - 1. SUBMITTAL
				1. Furnish under the provisions of Division 01 Section Quality Control.
				2. Furnish a RMCS construction submittal for review and approval as herein indicated.

Distribution:

One (1) copy of RMCS construction submittal to the Contracting Officer’s technical representative.

One (1) copy of submittal to Jacobs’s DeCA core team support, 2250 Foulois Ave, Lackland AFB TX 78236-1039.

Date Required: Within 90 days after receipt of Notice to Proceed.

Equipment Cut Sheets: Provide manufacturer's cut sheets indicating Contract compliance of the following system components:

Thermistors, transducers, and dewpoint sensors.

ICU (Individual Control Units).

Phase loss protector.

Pulse meters.

Cellular modem.

Lighting control hardware

Refrigerated case controllers.

Installation Manuals: Provide system installation manual and instructions.

Drawings: Provide Drawings showing components locations in the commissary and required wiring between components.

User Manuals: Provide user's manual on system describing how to use the system and the software.

RMCS Manufacturer's Resume: Provide resume of control system manufacturer's experience in supermarket refrigeration. A minimum of ten successful installations using hardware model being provided.

Startup/Install Technician's Resume: Provide resume of Startup/Install Technician(s) indicating participation in startup of a least 5 systems using the same hardware as that being provided. This technician will be onsite during all aspects of the field installation.

RMCS Manufacturer Approval of Startup/Install Technician: Provide letter from RMCS manufacturer indicating their approval of the proposed Startup Technician(s), or, their intent to provide their own startup technician for startup and certification of the RMCS.

Display Case/Compressor Manufacturer Coordination: Provide a letter from the manufacturer of the display cases and the manufacturer of the compressor systems, verifying their approval of the RMCS equipment selection and indicating their intent to review all operating setpoints for the RMCS.

* + - * 1. Operation and Maintenance data.
1. REQUIRED EQUIPMENT AND STRATEGIES
	* + 1. REQUIRED RMCS HARDWARE QUANTITIES
				1. Cellular Modem: Quantity required: One.
				2. Laptop Computer with Padded Carrying Case: Quantity required (1).
				3. Desktop Computer: Quantity required (1).
				4. Refrigeration Alarm Annunciator: Quantity required (1).
				5. Phase Loss Protector: Quantity required (1).
				6. Individual Control Unit(s): See paragraph 3.2 for quantity required.
				7. Sensors
			2. RMCS HARDWARE DESCRIPTIONS
				1. Cellular broadband modem: Raven-X, with built in security layers.
				2. Laptop Computer: Laptop shall be compatible to communicate with RMCS and shall have the following minimum features: 14” color display, Wi-Fi enabled, at least 256 GB solid state drive (SSD), latest version of Microsoft Windows, and a wireless mouse.

Provide and install remote management software capable of commissioning and servicing the RMCS. Minimum features of software to include full offline programming and simulation of RMCS databases, custom graphics, and remotely connect, load, and access data files and data points via an industrially accepted standard file transfer protocol.

Provide and install web browser and software capable of managing the RMCS. Minimum features of software to include viewing data files, manipulating controlled data points, logging and generating data reports, viewing energy meters, and data in real time. Data should be passed via tcp/ip over a dedicated host control network.

Provide and install remote management software capable of commissioning and servicing the RMCS. Minimum features of the software to include full offline programming and simulation of RMCS databases, custom graphics, and remotely connect, load, and access data files and data points via an industrially accepted standard file transfer protocol.

* + - * 1. Refrigeration Alarm Annunciator: Audible alarm and reset button (sound only).
				2. Phase Loss Protector:

Phase Unbalance Trip: Adjustable 5 percent to 10 percent.

Under Voltage Trip: Adjustable 10 percent to 20 percent of normal voltage.

Phase Loss Trip: Trip within 50 msec.

Phase Reversal: Trip within 50 msec.

Restart: Automatic restart upon return to normal.

Product Reference: Time Mark Corp. Model 2644 or approved equal.

* + - * 1. Unit Controllers:

The RMCS is composed of Individual Control Units (ICUs), application specific controllers, and input devices (i.e. sensors, transducers, etc.) to form a complete networked control system. Provide devices that will retain all setpoints during a “power down” or “power up” and automatically reboot and commence operation. Create a host network to support multiple controllers as needed to control refrigeration, HVAC, store lighting, and energy monitoring functions. Mount subsequent controllers to network, if needed, and diversify refrigeration systems to prevent entire low or medium temperature systems running in default if communication is lost with controller.

Individual Control Units (ICUs):

Full color LCD user interface allowing local operators to interface directly with hardware without use of secondary hardware.

Control refrigeration equipment for efficient load shedding and suction pressure optimization.

Host multiple, user editable, building schedules.

Voltage/Surge Protection: RMCS and all controllers in system to operate from 100V to 130V AC at 60 Hz power. \*\*\*\*\* A/E edit for site condition Protect the power supply to the RMCS surge protection which meets the following.

EMI/RFI filtering.

Meets Government and military specs for fire panel applications.

User replaceable fusing

LEDs to indicate protection status, ground presence, ground fault indication, fuse status.

Tested to meet UL 1449 approved.

120/240 VAC, 20 amp continuous rating

Capable of communicating with all devices provided under this contract via BACnet or Modbus communication protocols. Devices include but are not limited to variable frequency/speed drives, refrigeration equipment, RTU’s, power monitoring equipment, and lighting control panels.

Support role-based passwords for parameter changes with various permission levels as well as individual passwords. They must allow customization of write authorizations. DeCA shall have the option of setting unlimited individual passwords.

Utilize non-volatile memory to host system program and other controller data stores so that data will remain unaffected by power failure.

Capable of sending alarm and incident events to multiple locations including a central monitoring facility.

Utilize an audit log to capture all system log-on attempts. Log the username, method of log-on, time/duration of log-on, and any system edits, changes, and/or overrides performed during the session.

Make accessible via IP address and require no software other than a web-browser, to access the information in the RMCS locally or remotely. Install cellular modem to gain remote access. The RMCS vendor is responsible for connectivity charges until system is turned over to DeCA.

Each ICU is to operate independently of the other ICUs. If any ICU is taken out of operation, the other ICUs are to continue normal operation. The ICU is to retain all setpoints during a power fluctuation or failure and automatically reboot and return to normal operation once restored to normal power.

Each ICU is to be capable of disseminating its program to attached I/O controllers that control individual devices such as racks, HVAC, exhaust fans, etc. Communication protocol between ICU and I/O shall be IP, BACnet, or Modbus.

Memory Storage: System configuration shall be stored in internal memory and shall be retained for up to 1 year by battery. No mechanical storage (i.e. hard drives) are permissible.

ICUs shall allow for descriptive aliasing of each device, so DeCA can name their devices to make the name most relevant to its users.

Basis of Design:

Danfoss AK-SM 800A

Resource Data Management PR0510

Approved equal, Refer to Division 01 Section Administrative Requirements for procedures.

Application Specific Controllers / Input Output (IO) Modules:

If communications fail between IO module and ICU, the controlled equipment will continue to operate with its last instruction set.

A variety of IO modules from the same ICU manufacturer are to be available for specific items such as compressor racks, condensers, HVAC equipment, refrigeration cases, etc. as well as user programmable controllers for specialized control strategies.

Inputs may be analog and/or digital. Capable of reading PT1000 and 10K Type 2 temperature sensors, as well as 4-20mA or 0-10VDC (as well as other variations) sensors.

Outputs may be digital or analog. Individually fuse all digital outputs to protect the IO controller. At a minimum each output shall be capable of a 4 Amp rating.

Each Digital Output shall have Normally Open (NO) and Normally Closed (NC) termination point.

Analog control points shall be capable of driving a 4-20mA signal as well as a DC signal. From a DC perspective, the IO controller shall be capable of driving a 0-10VDC, 0-4.5VDC, and/or 0-1VDC.

Individually fuse each power supply to an IO controller to protect it from overloading.

Case Controllers for Electronic Expansion Valves:

A case controller is intended to regulate the evaporator of a refrigerated appliance or room in the most energy efficient way.

Each controller shall have the capability of controlling:

Liquid Line / Solenoid Valves

Pulse Width Modulated (PWM) EEVs through a solid state relay

Case Lighting

Case Anti-Sweat Heaters

Defrosts

Each controller shall have the capability of monitoring (inclusively)

The refrigerant coil inlet and outlet temperatures

The air inlet and outlet temperatures to monitor the efficiency of the system

The defrost termination temperature

The suction pressure of the case

Dual temperature switch position

Status monitor (Digital Input) for case switch, door alarm, or man-trap switch.

Provide a remote display installed within 10’ of the controller. Mount above the case doors or in the cornice of the case by the refrigeration case equipment manufacturer.

* + - * 1. Sensors: Furnish RMCS sensors/inputs that meet or exceed the following required features:

Analog Inputs:

Temperature sensors shall be consistent throughout the installation and be resistive thermistors.

The thermistor temperature probes shall be interchangeable in the field with no required calibration.

Thermistor temperature accuracy (+ or -) 1 deg F. [ACI - +/- 0.36 deg F, RDM +/- 0.7 deg F] at a range of -25 deg F to 150 deg F.

Analog dewpoint temperatures shall be measured from -30 deg F to 79 deg F with an accuracy of 2deg F.

Pressure sensors shall be transducers.

The range for the compressor low pressure side shall be 0 psig to 200 psig with +or - 1 psig.

The range for the compressor high pressure side shall be 0 psig to 500 psig with accuracy of + or - 5 psig.

Dewpoint sensor measurement method is through temperature and humidity, where the RMCS derives the dewpoint. For outside dewpoint the outside temperature and humidity shall be used. For indoor dewpoint, a dedicated room temperature and humidity sensor shall be used. As an option, a dewpoint sensor can be used; Basis of Design: HEW D0117.

Refrigerant vapor detection sensors shall meet or exceed the following minimum requirements:

Shall measure 0 to 1000 parts per million of all refrigerants provided in this project. Shall operate from 0 deg F to 120 deg F.

Shall not require maintenance more often than every 6 months in order to operate properly.

Outdoor temperature sensor installed under condenser; weatherproof and equip with a sunshield.

Outdoor relative humidity sensor.

Outdoor light sensor module.

Indoor light sensor module where day lighting is used.

* + - * 1. Limit Switches: Provide magnetic switches to monitor walk-in freezer doors. Provide a RMCS ~~local~~ audible near Administration/Sales Floor and a local visual alarm at the door which will alarm after 30 minutes of open time.
				2. Utility Monitoring: Monitor gas, water, electrical, and/or other utility use through the RMCS and calibrate and verify correct reporting upon installation.

Monitor buildings electrical usage via an application specific meter and not through pulse meters. All three phases of the incoming power shall be monitored with CTs tied around all leads of each phase. The use of multipliers is not permitted. The meter, at a minimum, is to monitor consumption (kwh), demand (kW), true Voltage per phase, true power per phase, current per phase, and power factor.

Sub meter/monitor the following:

Sales floor lighting

Exterior lighting

Staging and shipping lights.

Each dual path HVAC unit

Refrigeration power, single point inclusive of:

Compressor racks and condensers

Case lighting

Defrost

Monitor gas consumption via a pulse meter where a multiplier is used to match the consumption per pulse.

Monitor water consumption via a pulse meter where a multiplier is used to match the consumption per pulse. Mount water meter in an accessible portion of a horizontal section of building’s main domestic water pipe.

* + - 1. RMCS FUNCTIONALITY
				1. General: Furnish, install, test, and debug system applications to provide control functions described herein. Utilize a unique URL for remote access to RMCS’s system setpoints, data logs, alarms, etc. Setpoints shall be selectable by user via local and remote user interfaces. Application software to reside on site at RMCS ICU's and be protected from loss during power failure.
				2. Software Configuration: RMCS shall allow user to add/remove digital outputs/inputs, analog inputs, schedules, and programs, based on user-rights assigned by DeCA.
				3. Database Features: Database features of system software shall provide the following features:

Downloading Capability: Database software capable of downloading on-site database to an offside location via broadband cellular modem. Format database to contain; setpoints, names, tables, etc.

Database shall be accessible through any web browser connected to the internet. No special software shall be needed to monitor trending.

* + - * 1. Phase Loss Protector Features: When a phase loss/unbalance occurs, all RMCS controlled 3 phase loads shall be shut down until power is restored. Systems shall automatically restart upon return of all three phases. Monitor power at panel "CP" on dedicated breaker.
				2. ~~Manual Ventilation Stop Station~~ Emergency Air Distribution Shutoff

~~In case of emergency, manual ventilation stop stations are provided to stop the ventilation process to reduce the feeding of oxygen to possible fires in the building. The RMCS shall be capable of shutting down all fresh air sources in the event of a Fire~~. Using the RMCS system, provide an emergency air distribution shutoff in accordance with (UFC 4-24-01 3-5.1.2). The RMCS shall be capable of shutting down all fresh air sources.

Provide a manual push button 1” to 2” in diameter with a 4” x 4” back plate flush mounted in the wall. The back plate shall be yellow in color with a 1/2” high black engraved lettering reading: “IN THE EVENT OF A VENTILATION HAZARD PRESS TO STOP VENTILATION”.

Mount air distribution shutoff ~~ventilation stop~~ stations 48” above finished floor.

Locate the shutoff ~~switch~~ station to be easily accessible by building employees in the proximity of Administration Area or near the building’s mass notification systems ~~local operating consoles~~.

~~Provide additional manual ventilation stop stations such that the travel distance to the nearest shutoff switch will not be in excess of 200 feet.~~

The ~~manual ventilation stop~~ emergency air distribution shutoff station is to immediately shut down the air distribution and exhaust systems throughout the building and close all dampers leading to the outside even if a local hand/off/auto switch is in the hand position.

Exceptions:

Exhaust systems that are required to run to maintain safe conditions. E.g. exhaust fans serving grease laden air, refrigerant leak evacuation.

Fans and dampers where interior pressure and airflow control would more efficiently prevent the spread of airborne contaminants and/or ensure the safety of egress pathways. E.g. smoke evacuation fans.

Systems without duct connections to the outside (intake, exhaust, or pressure relief).

Local air handling units serving critical areas where cooling and/or heating must be maintained to prevent mission failure, loss of data or unsafe conditions can continue to recirculate air, but outside air, relief air and exhaust must be closed with low leakage isolation dampers.

* + - * 1. History Logging Features: RMCS software is to collect data from the controllers and provide the following features:

Alarm History: At a minimum, log last 100 alerts and last 100 alarms

User Configuration: Allow user (via keyboard) to, select items to: log, select logging interval (seconds or minutes), select number of samples. The items logged in this manner are either analog inputs (AI), analog outputs (AO), digital outputs (DO), or digital inputs (DI).

Compressor Runtime: The compressor cycles per day and total run time per day logged for a period of not less than 30 days.

Condenser Runtime: The condenser fan cycles per day and total run time per day logged for a period of not less than 30 days.

Refrigeration Runtime: The refrigeration circuits defrost cycles per day and total run time per day; logged for a period of not less than 30 days.

Log history of data points at two minute intervals. Provide capacity to retain a minimum of six months data point.

* + - * 1. Security Access Features: Require a username/password(s) in order to access the control parameters of the system. Password shall be for user identification and shall not be echoed on printer or terminal. The system shall be capable of using a password of 4 or more characters.

Provide at least four levels of access.

 A non password protected level of access to view data/setpoints locally

A password protected level to view data/setpoints remotely.

One level to allow one password that will only permit lighting override and lighting schedule changes.

Password protected level for remote or local access to change setpoints and system programs.

* + - 1. EQUIPMENT CONTROL AND STRATEGIES
				1. Compressor Rack Control Strategy:

The ICU will have evaporator’s mapped to their corresponding suction group. The ICU will utilize the rack I/O and be factory programmed to optimize the system’s suction pressure using floating suction pressure control. Factory floating suction pressure control schemes will keep the required suction pressure as high as possible while still maintaining evaporator temperatures at setpoint. Compressors on/off time will be set to factory minimums to prevent short cycling.

The controller/ICU shall be capable of controlling the following rack components:

Compressors.

Digital Scroll Compressors (via solid state relays).

Unloaders.

Inverters.

Condenser Fans.

Defrost

Heat reclaim.

The controller/ICU shall be capable of the following control:

Fuzzy logic and/or staged control of compressors

Operation of up to 3 suction pressure group per rack

Direct control of digital scroll with or without IDCM Module…

Instituting equal compressor run time.

Setting different store open and store closed pressure control setpoints

Monitoring of individual compressor amperage.

User Access: Software shall allow the user to select and adjust all setpoints.

* + - * 1. Subcooler Control Features: Utilize the RMCS to control subcooling. Control consists of automatically adjusting two normally closed liquid line solenoids, one sized for 25% subcooler operation, the other sized for 75% operation, and when both open will provide 100% subcooling operation. Mount a temperature sensor on the subcooled liquid outlet to maintain the subcooled liquid at manufacturer’s recommended temperature. Monitor the superheat and automatically close subcooling valves as necessary to prevent liquid flooding back to the compressors.

It is acceptable to use one EEV valve if the deployed RMCS controller is capable of both summer and winter conditions.

* + - * 1. Condenser Control Strategy: Map the condenser fans through the rack I/O. The condenser control will stage fans and modulate the lead fan’s speed via ECM or VFD to maintain the target condensing pressure. Optimize the condensing fan power/speed using a factory designed floating head pressure control strategy that adjusts the required head pressure based on the minimum condensing temperature required to maintain 100% refrigerant liquid at the evaporators’ expansion valves. Condenser fans on/off time will be set to factory minimums to prevent short cycling.

For refrigerants with glide, when converting the temperature into pressure, the mid-point is preferred.

The minimum condenser saturation setpoint (TCmin) should be 70 degrees for low-temp racks and 80 degrees for medium-temp racks.

The TD value and TCmin setpoint should be field adjusted for optimal operation.

The discharge pressure should be the dropleg pressure (after condenser).

The outside air temperature sensor should be from a weather station installed in the store or a sensor under the condenser close to the header fan, protected from any roof heat or condenser coil heat to represent the true outside air temperature.

The maximum speed of the ECM or VFD speed should be locked at 90%.

50 percent / 50 percent Split: Control split condenser valves through the RMCS for condensers provided with such valves.

Control lockout shall be based on the following:

Outdoor ambient setpoint of less than 40 degrees Fahrenheit and reset deadband 10 degrees.

If the head pressure of the refrigeration system goes above a pressure equivalent of 75 degrees Fahrenheit, the valve shall be un-split. The valve shall split again at a pressure equivalent of 70 degrees Fahrenheit, with minimum un-split to split delay of minimum 2 min.

The control algorithm for the ECM motors should be programmed so that 0V from the RMCS output causes the fans run at maximum speed and 10V from the RMCS output runs the fans at minimum speed. The ambient air temperature sensor value is subtracted from the value of the refrigerant dropleg pressure, converted to a temperature. The result is the **temperature differential**. It is this differential value that is compared to the PID setpoint for the purpose of determining the amount of total fan capacity to activate.

Control Point: Control ECM fan speed to meet target condenser pressure. All fans should be in parallel fan operation:

Control parallel condenser fans from the RMCS via a variable analog signal of either 4-20mA or 1-10VDC.

 “ON” “OFF” Delays: Pre-delays and post-delays shall be provided for each stage.

* + - * 1. Case Control Strategy: Case controllers are to adjust the electronic expansion valve to maintain the programmed case supply, return, and product temperature while producing minimal superheat. Set the case controller’s initial superheat value as recommended by the case manufacturer. Include a factory control sequence to determine individual case and/or rail defrost needs. The sequence will optimize defrost start, duration, and termination required to maintain product temperature while minimizing defrost energy penalties. Scheduled case lighting is to be made at the ICU and passed to the case controllers.

For low temp cases the superheat shall be between 3-7 deg F.

For medium temp cases the superheat shall be between 6-10 deg F.

The case controller is to run in a standalone manner if the communication link is disrupted for any reason.

Factory install case controllers, all temperature sensors, and pressure transducers in all remote cases and evaporators. Field install the case controllers at walk-in coolers and freezers in a serviceable location. .

Case controllers at a minimum are to be able to control:

Pulse Width Modulated Electronic Expansion Valves (PWM EEV), with a solid-state relay, controlled within a 6-second window

Evaporator Fans

Case lighting

Case anti-sweats if applicable.

Defrosts

Case controllers at a minimum are to be able to monitor:

Case-Clean Switch.

Dual-Temp Switch.

Door Open Switch (for monitoring purpose only).

A variety of temperature inputs: Utilize a single type of sensor throughout the installation of either PT1000 or 10K Type 2 for continuity.

Pipe mounted suction temperature sensor that measures the temperature of the gas leaving the evaporator coil.

Pipe mounted refrigerant inlet temperature measuring the temperature of the gas at the coldest point in the coil.

Grille mounted return air temperature to the temperature of the air going into the coil.

Duct or grille mounted supply air temperature to measure the temperature of the air leaving the coil.

Where detailed, provide a product temperature to monitor the product temperature in the case.

Pipe mounted defrost termination sensor, when cases are equipped with electric or hot gas bypass.

Suction pressure transducer for measuring superheat.

Each case or lineup of like cases (i.e. 4 cases of ICGD) shall be equipped with a suction pressure transducer, for measuring superheat.

Provide all cases equipped from the equipment manufacturer with a pre-wired PWM EEV.

Defrost Control Features: The RMCS shall initiate control the defrost termination of all refrigerate cases equipped with electric or hot gas defrost, through defrost termination sensors mounted on the evaporators by the OEM.

All cases in any circuit (i.e. 4 x ICGD-4) shall defrost at the same time, through a RMCS group defrost schedule. No case shall begin refrigerating until all defrost terminations have been achieve or the maximum defrost time is reached and the drip time has expired.

On any defrost cycle with electric heat or hot gas:

De-energize the evaporator fans and close the EEV.

Set controller to follow a drip period after the defrost is terminated per any manufacturer’s requirements before allowing the EEV to operate.

Case controller shall be capable of skipping a defrost if the scheduled defrost is not needed

The case controller shall have a programmable fan to allow the fan to either run or not run during any defrost.

Alarming will be suppressed during all defrost cycles and recovery periods. This includes defrosts manually implemented. The recovery time is 30 minutes, which starts after the drip time has concluded.

A manual defrost can be initiated at the case controller or remotely through the RMCS, should one be required

The case controller shall have a remote display that can be installed within 10’ of the controller when not readily accessible. Factory mount the display above the case doors or in the cornice of the case.

At a minimum, the RMCS is to log the following points:

EEV opening.

Superheat.

Discharge air temperature.

Return and discharge air temperatures

Defrost temperature (when sensor is available).

Defrost times.

* + - * 1. Walk-in Case Control Strategy: The strategy for controlling a walk-in cooler or freezer is to follow the Case Controller strategy with the following exceptions:

At each ~~latchable~~ freezer door install a RMCS door switch and ~~an audible/~~visual alarm device (amber strobe) mounted above the door.

If the door is left open for more than ~~20~~ 30 minutes, initiate an audible RMCS alarm, the visual alarm device at the door, and alert staff that a door has been left open.

The RMCS silence button, if pressed, will turn off the audible alarm, but leave the visual alarm run until reset and a history log is created.

Equip walk-in freezer with a man trap switch to deactivate fans and refrigeration in case a person is trapped inside the freezer

If the switch is tripped, initiate ~~an~~ a local audible alarm to alert staff and activate a green strobe mounted above the door.

Equip each walk-in, prep room, enclosed space, or compressor room with an appropriate leak detection device for the refrigerant used in the refrigeration system.

Install an audio/visual annunciator with blue strobe above the entry of the walk-in, inside and outside of the refrigerated space, to alert someone of a leak in the space they are entering.

Install the leak detection device 48” above the floor in a location suitable to protection from damage due to operations.

Equip the annunciator with a silencer button to stop the audio alarm. Continue the visual alarm until the leak dissipates.

Initiate the alarm when detecting 500ppm of the refrigerant for more than 1 minute.

Once the alarm is initiated, the RMCS shall:

Send an alarm message to the alarm center notifying them of an alarm.

Trigger the visual alarm at the office area.

Shut the refrigeration valves of the space where the leak occurred.

* + - * 1. Dual-Path Air handling Unit Control Strategy.

General Design Concept

The RMCS’s ICU is used to monitor and provide control inputs to the DHU/AHU’s unit controller. The ICU monitors the outdoor and space temperature and humidity, maintains the store’s scheduled hours including shutdowns and setback, and monitors storewide alarms and phase loss. The ICU and DHU/AHU application specific controller are to pass I/O between the controllers for communication. Configure the ICU to read and logically display the DHU/AHU’s controller’s data points including damper positions, compressor stage, status, and speed (for variable speed), evaporator and condensing fan status and speed (for variable speed), measured airflows, measured temperatures in each section, heat reclaim status and contribution, hot gas reheat status and contribution, filter status, and all alarm conditions detailed.

When not detailed elsewhere: control space temperature and humidity by a minimum of three individual cooling stages utilizing two air paths. The outside air path will process all of the outside air (no bypass) and house an outdoor air precooling coil and dehumidification coil. The return air path will house a sensible cooling coil. Some return air may be bypassed. The air paths will then mix and a hot gas reheating coil and primary heating section will follow before discharging unit. Hot gas re-heat will utilize waste heat from the unit’s compressors and maintain a supply air temperature of 75 deg F when appropriate. The primary heating section will be utilized if additional capacity is required.

Fan operation shall be continuous

Utilize a variable frequency drive (VFD) to control the fan speed.

Run at no more than 95% speed in occupied mode.

Run at 50 percent during night set-back.

Run fan at full speed on any call during night set-back.

Optimize condenser fan operation for energy efficiency.

Condenser fans are controlled based on discharge pressure transducers directly from the internal unit controls.

Control outside air motorized dampers with independent linkage and actuator, set position during test and balance.

Control return air and bypass dampers with independent linkage and actuator, set position during test and balance. .

Control Design:

Control the auxiliary gas heating section from space temperature. Auxiliary heat shall be used for reheat control provided the hot gas reheat is insufficient.

Mount a temperature probe on the discharge air side of each hot gas reheat coil inside of the AHU for proof of hot gas reheat operation.

Utilize a factory optimization strategy to stage 1, 2, 3 to maintain space temperature and dewpoint.

Factory install temperature and pressure ports throughout the unit for test and balance to finalize damper positions in the field.

Factory mount a differential pressure switch to monitor the operation of the main blower

Factory mount a differential pressure switch to monitor dirty filters. .

Setpoints: The temperature and humidity setpoints shall be:

Heating Setpoint

Occupied: 70 deg F

Unoccupied: 68 deg F

Stage 1 has a deadband of plus or minus 1 deg F during occupied periods.

Auxiliary Heat

Stage one shall turn on 2 degrees from heating setpoint with a 1-degree deadband.

Stage two shall turn on 3 degrees from heating setpoint with a 1-degree deadband.

Cooling Setpoint

Occupied: 75 deg F

Unoccupied: 75 deg F

Cooling stage 1 comes on at 75 deg F and shuts off at 73 deg F.

Cooling stage 2 comes on at 76 deg F and shuts off at 74 deg F.

Lock out cooling operation below 45 deg F ambient.

Humidity Setpoint

Occupied: 52 deg F dew point.

Unoccupied: 52 deg F dew point.

Dehumidification mode on at 52.5 deg F dewpoint and off at 51 deg. F dewpoint.

OSA Operation

Occupied: Open.

Unoccupied: Closed.

Equipment Manufacturer to provide unit controller with the following input and output points from RMCS.

Space Temperature Sensor: Utilize to enable cooling, hot gas reheat, and auxiliary heat.

Space humidity/Dewpoint Sensor: Utilize to enable dehumidification sequence.

Outdoor Temperature Sensor: Utilize to lockout cooling and heating based on outside temperature setpoints. (Factory installed in the outdoor section).

Outdoor Humidity/Dewpoint Sensor: Utilize to enable dehumidification. (Factory installed in the outdoor section).

Discharge Air Temperature Sensor: Factory installed for operation, monitoring, and troubleshooting.

Discharge pressure transducers for each cooling circuit: Factory installed for operation, monitoring, and troubleshooting.

The following are for monitoring and troubleshooting:

Return Temperature (Factory installed).

Entering Air Temperature of pre-cooling coil (Factory installed).

Leaving Air Temperature of each heating coil (Factory installed).

Suction Temperature of each cooling circuit (Factory installed).

CTs on each compressor for on/off proof (Factory installed).

OA damper position feedback (voltage signal). (Wired by factory).

The following sensors and devices are for alarm purposes:

Airflow Switch (Provided and installed by the factory and wired to a Digital Input).

* + - * 1. Packaged HVAC Unit Control Strategy: Refer to Section 23 74 13 - HVAC Systems indicated on Contract Drawings <**insert sheet number>** through **<insert sheet number>** are to be controlled with an application specific controller to monitor and provide control inputs to the unit’s controller. The ICU monitors the space temperature, maintains the store’s scheduled hours including shutdowns and setback, and monitors storewide alarms and phase loss. The ICU and HVAC unit’s application specific controller are to pass I/O between the controllers for communication. Configure the ICU to read and logically display the unit controller’s data points including damper positions, compressor stage and status, evaporator and condensing fan status, measured discharge and return temperatures, hot gas reheat status and contribution when applicable, filter status, and all alarm conditions through the RMCS.

Provide RTU unit controllers programmed to provide the most economical method of operating while following the RTU’s sequence of operation. Correct any deficiencies and verify proper operation.

Fan Operation:

Evaporators with fractional horsepower fans may cycle with demand but allow local users to override unit with fan only modes.

Fans greater than 1 horsepower are to operate continuously during occupied modes and cycle on demand during un-occupied modes.

Monitor fans for proof of run utilizing a pressure differential switch and a current sensor.

Close outdoor air dampers in unoccupied modes.

The RMCS is to, at minimum, monitor the operation and inputs of the HVAC unit:

Zone temperature sensor – minimum of one per unit unless detailed elsewhere.

Discharge air temperature

Return air temperature

Fan status

Damper position

Alarm conditions

User shall be able to schedule the occupied periods of each unit individually or as a group through the RMCS.

Default space setpoints: For night setbacks adjust space 2 deg F down/up for the heating/cooling during unoccupied hours

Bakery

Cooling setpoint is 75 deg F with a 2-degree deadband.

Include a minimum 10-minute delay between 1st and 2nd stage compressor startup when applicable.

Include a 5 minute delay between compressor restarts.

Heating setpoint is 67 deg F with a 2-degree deadband

Include a minimum of a 10-minute delay between 1st and 2nd stage heat exchanger startup when applicable.

Administrative Offices

Cooling setpoint is 75 deg F with a 2-degree deadband.

Include a minimum 10-minute delay between 1st and 2nd stage compressor startup when applicable.

Include a 5 minute delay between compressor restarts.

Heating setpoint is 72 deg F with a 2-degree deadband

Include a minimum of a 10-minute delay between 1st and 2nd stage heat exchanger startup when applicable.

* + - * 1. Refrigeration and Equipment Room Exhaust Fans Control Strategy: Exhaust fans (EF) **<insert EF number>** in the refrigeration equipment rooms and indicated on Contract Drawings **<insert sheet number>** thru **<insert sheet number>,** shall be temperature controlled by the RMCS from their respective zone temperature.

Interlock any actuated exhaust dampers and/or inlet dampers with their respective exhaust fan(s).

The compressor room exhaust fans are staged. The first stage will energize when the temperature in the compressor room exceeds 75 deg F and the second above 80 deg F.

RMCS shall generate an alarm upon failure of any fan as sensed by a current transformer and sail switch.

When the refrigerant vapor sensor in the Mechanical Room senses an elevated vapor level of 500 ppm for more than 1 minute:

Both fans will energize.

An audio/visual alarm device shall sound in the room. Install, at minimum, two devices, one in the mechanical room and the other above the mechanical room entry door. Others may be needed on the exterior of rooms with secondary exits.

The RMCS shall generate an alarm.

Exhaust fans are to continue to operate even with the ~~Manual Ventilation Stop~~ emergency air distribution shutoff switch activated with an elevated vapor condition.

Alarm the RMCS if temperature in compressor room drops below 32 deg F if room houses any sprinkler or other pipes conveying water.

* + - * 1. Staging Area and Receiving Area Exhaust/Supply Fan Control Strategy: Exhaust Fans (EF) **<insert EF number>** in these areas shall be temperature controlled by the RMCS from their respective zone temperatures. Should the temperatures in these areas rise above 80 deg F, the exhaust fans shall run, bringing in fresh air through their supply fans.

Interlock any actuated dampers with their respective exhaust fan(s).

The staging area and receiving area fans are staged. The first stage will energize when the temperature in the room exceeds 70 deg F and the second above 75 deg F.

Deadband is plus/minus 2.5 deg F.

RMCS shall generate an alarm upon failure of any fan as sensed by a current transformer and sail switch.

~~When the Manual Ventilation Stop switch has been activated, the exhaust fans are to run and any supply fans are to remain off .~~

* + - * 1. Staging Area Unit Heaters and Radiant Heater Control Strategy: Heaters are to be temperature controlled by the RMCS from their respective zone temperatures. Energize heaters below 65 deg F with a 5 degree deadband.

Install one zone temperature sensor for every heater. If the zone is shared by a temperature-controlled exhaust, a zone temperature sensor may be shared.

* + - * 1. Miscellaneous Exhaust Fans Control Strategy:

Control exhaust fans serving janitor’s closets, storerooms, or other occupancies which need continuous ventilation and indicated on Contract Drawings **<insert sheet number>** thru **<insert sheet number>,** through the RMCS based on time of day scheduling. These exhaust fans do not require proof monitoring.

Control exhaust fans serving single toilet rooms locally with occupancy sensors or light switches to determine occupancy.

Where two or more rooms are served by one exhaust fan, the sensor in any room shall turn on the exhaust fan.

Toilet room exhaust fans do not require proof monitoring

Control exhaust fans serving multiple occupancy toilet room through the RMCS based on time of day scheduling with an occupancy sensor override timed for 15 minutes.

Toilet room exhaust fans do not require proof monitoring

Control freezer floor ventilation fan through the RMCS with a 24/7 time of day schedule.

RMCS shall generate an alarm upon failure of any fan as sensed by a current transformer and sail switch

* + - * 1. Lighting Controls: RMCS shall control the lighting in the Commissary building either through contact closures or through dimming:

The following lighting circuits are to be controlled by the RMCS

Sales Area Lighting

For on/off control, contactors are to be provided such that the lights can be all on (100%), half on for stocking and cleaning use (50%) and all off, except for security lights when no one is scheduled to be in the stores (0%).

For stores with daylight harvesting through windows or sky lights via dimmable ballasts or LED lighting, set a default lighting level in the store of 80-foot candles during the sales hours and 40-foot candles during stocking and cleaning hours. Install interior light meters in the store area where shown in contract documents in the daylight harvesting areas.

Case lighting shall be controlled through the RMCS utilizing time of day scheduling and disseminated to individual case controllers. Control case lights to match occupied store hours.

Exterior lighting shall be broken up into 3 different groups.

Patron Parking: Turn on at dusk and remain on until 1 hour after the store has closed. Parking lot lights will turn on 30 minutes before the store opens and stay on until it is sufficiently light outside.

Employee Parking: Turn on at dusk and remain on until restocking and cleaning are done. Employee parking lot lights will turn on 30 minutes before the store opens and stay on until it is sufficiently light outside.

Receiving Pole Lighting: Turn on at dusk and off at dawn.

Staging and Receiving lights shall stay on 24/7 and shall be equipped with individual motion detectors. Lights will turn on when motion is detected in its zone and shall stay on for 15 minutes after no motion is detected. Not RMCS controlled.

Install a three-wall switch gang box in **<an area accessible to night manager>**, cover plate, and conduit to the RMCS. Install three momentary contact override switches and control wiring to connect to the digital inputs for the Sales Area, Product Cases, and Exterior lighting control zones. Program overrides through the RMCS to carry out the following functions:

Turn the circuited lights on when the momentary switch is depressed for 6 seconds. Lights shall remain on for 120 minutes / 2 hours

When the same button is pressed for another 6 seconds the overridden lights will revert to the normal schedule

Label all switches with lighting control function, i.e. “Sales & Checkout”, “Case and Supplementary Lighting” and “Outside Lighting”.

When Outside lighting is running in hand, the RMCS will poll all outdoor photocells and if the average determines there is sufficient daylight, the RMCS will put the Outside lighting mode back into auto.

* + - 1. ALARM FEATURES:

Types of RMCS Alarms: RMCS shall provide for the following types of alarms:

Critical Alarms: Critical alarms are those that predict food loss, enhance human safety and anything that could prevent the commissary to open. Critical alarms include:

Over temperature alarms.

Under temperature alarms.

Sensor/transducer failure.

Alarm shall be displayed on the RMCS and anyone logged into it.

Main store alarm audio visual alarm shall turn on.

Alarm is sent to the alarm center.

It will be logged by the RMCS.

Phase loss alarms.

High and low-pressure rack alarms.

Leak detection.

Loss of communication with any refrigeration control device.

Once a critical alarm is recognized by the RMCS:

Central store alarm shall activate the A/V device.

Alarm message is sent to alarm center reporting said alarm.

Alarm shall be displayed on RMCS and anyone logged into it

Will be logged by the RMCS.

Non-Critical Alarms are all other alarms: These alarms include:

HVAC over temperatures.

Communications failure alarms (only non-refrigeration).

High and low liquid level alarms in racks.

Rack oil failure alarm.

Status faults.

Door open alarm.

Alarm Logs (N): These are events that are recorded in the system and do not produce remote reporting or audible alarm.

Communications faults (only for non-refrigeration faults)

HVAC alarms

Exhaust fan proof alarms

Alarm Remote Reporting Sequence: RMCS shall execute the following external reporting actions upon each Alarm (A) event:

Alarm to: Remote 3rd party alarm monitoring center via broadband cellular modem of all alarms.

Alarm to trigger in-house alarm light to alert store staff of any over-temperature alarm condition in any case, walk-in or prep room (Critical alarms).

Message description to monitoring center: Master controller shall send an out-bound message with store name, date, time, sensor name, and sensor number that caused alarm.

User Selection/Configuration of Alarm Dial Out Actions: RMCS software shall provide user with the following alarm dial out configuration options:

Phone Numbers to Be Called: Allow user (via keyboard) to enter a minimum of four separate phone numbers/addressees which shall be called during Alarm Dial Out Sequence.

Type of Devices to Be Called: Allow user to select which devices (pager, fax, printer) are at phone addresses selected in "PHONE NUMBERS TO BE CALLED."

Pauses During Dialing: Allow user to be able to select time delays to be entered into phone address selected in "PHONE NUMBERS TO BE CALLED."

Attempts to Reach a Number: Allow user to select number (1 to 4) of times the Master Controller shall dial phone number of each pager.

Alarm Test Time: Allow user to select time of day that Master controller shall dial out a test refrigerant alarm.

Email/Cellular Modem: Able to email at least four (4) separate email addresses.

1. EXECUTION AND INSTALLATION REQUIREMENTS
	* + 1. GENERAL INSTALLATION REQUIREMENTS
				1. Guide Lines: The entire system shall be installed in accordance with RMCS manufacturers' recommendations and the requirements of these specifications. Where the Contract requirements are in conflict with those of the manufacturer, the more stringent requirement shall be followed.
				2. Entire system shall be installed in accordance with current National Electric Code (N.E.C.) and requirements of these Specifications.
				3. Lead Technician: Lead technician shall be on site during the majority of the installation to supervise installation and supervise all aspects of RMCS field installation. When not on-site, Lead technician shall have remote connectivity to RMCS to assure continual support. Lead technician experience shall have installed a minimum of 3 control systems of same brand and model as the one being installed in this Project, along with being capable of programming and starting up the equipment.
				4. Inspection/Certification of Installation: Startup Technician’s responsibilities include the following:

Manufacturer approved Startup Technician shall personally be on site at the Commissary for at least 3 days to perform operational checkouts of system.

Startup Technician shall personally inspect installation of system to ensure that RMCS system is installed in accordance with RMCS manufacturer recommended methods.

The Startup Technician shall provide a "Startup Inspection Report" listing all incomplete work and incorrectly installed equipment. This list shall be provided to Contracting Officer, RMCS manufacturer, and display case manufacturer.

* + - * 1. Certification of Installation: The following installation certifications shall be provided:

Startup Technician Certification: Startup Technician shall provide a letter certifying that all items indicated in "Startup Inspection Report" have been corrected. This letter shall be provided to DeCA/CCND 2250 Foulois Ave, Lackland AFB TX 78236-1039, RMCS manufacturer, and display case manufacturer.

RMCS Manufacturer Certification: Contractor shall submit a letter from RMCS manufacturer certifying that installation meets manufacturer's recommendations. Letter shall be addressed to the Contracting Officer with a copy to DeCA/LEED, 2250 Foulois Ave, Lackland AFB TX 78236-1039.

Display Case Manufacturer Certification: The Contractor shall submit a letter from the Display Case Manufacturer certifying that the installation is correct. The letter shall be addressed to the Contracting Officer with a copy to DeCA/CCND, 2250 Foulois Ave, Lackland AFB TX 78236-1039.

* + - 1. HARDWARE INSTALLATION REQUIREMENTS
				1. Individual Control Units (ICU's) shall be provided for the following equipment:

Refrigeration Compressor Systems: Provide one individual control unit (ICU) for each multiplex refrigeration compressor system.

HVAC: Provide at least one individual control unit (ICU) for the HVAC systems.

\*\*\*\*\* A/E shall edit as necessary.

Installation/Testing individual control units shall be installed, programmed, and tested at the respective factory of the compressor system manufacturer for stand-alone operation.

* + - * 1. Refrigerated Case Controller shall be provided for the following equipment:

Refrigerated Display Case: Provide one controller for each case.

Refrigerated Walk-in Box: Provide one controller for each unit cooler.

* + - * 1. Analog Temperature Sensors: Analog temperature sensors shall be furnished and installed as described in Equipment Control and Strategies.
				2. Analog Pressure Sensors: Analog pressure sensors shall be furnished and installed as described in Equipment Control and Strategies.
				3. Analog Receiver Level Sensors: Connect to and monitor refrigeration equipment OEM supplied liquid level sensors. Calibrate and validate that readings are correct.
				4. Digital Sensors: Digital inputs shall be furnished and installed to monitor the following electrical loads:

Compressors: On each refrigeration compressor monitoring the compressor operation.

Freezer Doors: On each walk-in freezer door.

Condenser Fans: On each condenser fan motor monitoring the fan motor operation.

AHU Fans: On each Sales Area, air handler and Desiccant supply fan motors being controlled.

\*\*\* Select (5) or (8)(g). (8)(g) Preferred for remodels where meter is existing\*\*\*

Phase Loss Protector: Provide dedicated breaker in panel "CP". Connect protector sensor inputs to breaker. Connect N.C. output contacts in protector to RMCS input.

Electrical Energy Consumption: Provide Veris power meter E50C2, or equivalent, with H681, or equivalent, split core current transformers with monitoring interface equipment and wiring to monitor each of the following via pulse output:

Refrigeration: Monitor feeder circuit at panel CP.

Total building power: Monitor building electrical service.

* + - * 1. Digital sensors: Digital inputs shall be furnished and installed to monitor the following utility consumption:

Domestic “Electric” Water heater operation for status of ON/OFF.

* + - * 1. Refrigeration Alarm Annunciator and Computer Terminal: Furnish and install the computer terminal in the Store Manager's Office. The Alarm Annunciator will be installed in the front area of the Sales floor 7’-0” above finished floor. Silencer shall be installed at 6’-0” above finished floor.
				2. Wiring: All RMCS wiring shall as a minimum meet the following requirements.

Routing: All factory and field-installed wiring shall be in EMT (except in wet locations use alternate approved product).

Analog input (AI) and Analog output (AO) wiring shall not be routed in conduits with conductors which carry alternating current.

The wiring and EMT for space sensors shall be routed and concealed inside of stud walls.

Wire Size: All field wiring sizes shall be of different sizes. Refer to the RMCS drawings for wiring sizes and requirements for each part of the installation.

Connections: All splices/connections shall be made in junction boxes and shall utilize either terminal strips or Silicone filled connectors, such as 3M-314 connectors or approved equal. NO splices are allowed within the communication loop(s).

Labeling: Control cables shall be labeled at all junction boxes and at the origination and termination of each cable. The Cable number/letter indicated on the submittal drawings shall be specified on this label.

* + - * 1. Cellular Modem: When RMCS is being installed, and before refrigeration system is tested, Contractor shall have a commercial broadband data modem installed for use with RMCS system. Coordination for installation of modem is as follows:

Installation: Identify a broadband cellular provider with clear strong signal at local area.

Identify physical location for cellular modem with good signal reception. If signal is hampered by structure surrounding it, utilize a remote antenna mounted outside building to establish stable signal.

Contractor is responsible for maintaining broadband cellular modem until 90 days beyond Beneficial Occupancy Date (BOD).

Contractor is responsible for all costs to maintain broadband cellular modem until 90 days beyond BOD.

Transfer of Billing: Upon final acceptance of system (BOD), the Contractor shall notify Contracting Officer that the billing for cellular modem is to be transferred to Commissary not less than 90 days after date of final acceptance.

* + - 1. INITIAL SETPOINTS
				1. Refrigerated Cases, Walk-in Boxes, and Prep Rooms: The below noted temperature setpoints all refer to the discharge air temperatures off the coils, into the case. These are initial setpoints that are to be set at time of completion.
				2. Walk-In Boxes: Walk-in boxes shall be initially adjusted to maintain temperatures indicated on refrigeration schedule of Contract Drawings.
				3. Prep Rooms: Prep rooms shall be initially adjusted to maintain temperatures indicated on refrigeration schedule of Contract Drawings.
				4. Display Case Temperatures: Display case discharge temperatures shall be initially adjusted to maintain the following or case manufactures recommended discharge temperature settings:

\*\*\*\*\* A/E shall edit as necessary.

Alarm Setpoints: RMCS temperature alarm setpoints shall be initially set as follows with alarm inhibited during defrost:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Setpoint Range | Alarm Settings from fixture setpoint |
| **Cases:** | Abrev. | MinºF | Max ºF | Over Temp ºF | Under Temp ºF | Delay minutes |
| Bakery Display – Fresh | CAKE | 36 | 40 | +10 | -10 | 90 |
| Bakery Freezer | BAKE | -10 | 0 | +10 | -15 | 90 |
| Dairy, Multi Deck | DYCS | 30 | 36 | +10 | -10 | 90 |
| Deli, Multi Deck, Self Service | DELI | 32 | 35 | +10 | -10 | 90 |
| Multi Deck Deli Case | MDDI | 32 | 35 | +10 | -10 | 90 |
| Service Deli | SVDL | 32 | 35 | +10 | -10 | 90 |
| Deli, Glass Door | DLGD | 28 | 32 | +10 | -10 | 90 |
| Fish/Seafood Case | FISH | 28 | 34 | +10 | -10 | 90 |
| Frozen Food, Single Deck | SDFF | -8 | -3 | +10 | -10 | 90 |
| Frozen Food, Glass Door | FZGD | -6 | -1 | +10 | -10 | 90 |
| Ice Cream, Glass Door | ICGD | -15 | -10 | +10 | -10 | 90 |
| Meat, Fresh, Single Deck | MTCS | 22 | 26 | +10 | -10 | 90 |
| Meat, Fresh, Multi Deck | MDCS | 24 | 28 | +10 | -10 | 90 |
| Meat, Pre-Pack, Multi Deck | MDMT | 28 | 32 | +10 | -10 | 90 |
| Dairy, Glass Door | DYGD | 30 | 36 | +10 | -10 | 90 |
| Produce | PRCS | 36 | 40 | +10 | -10 | 90 |
| Produce Glass Door | PRGD | 36 | 40 | +10 | -10 | 90 |
| Grab N Go | GRGO | 32 | 35 | +10 | -10 | 90 |
| Sandwhich Self Service | SAND | 32 | 35 | +10 | -10 | 90 |
| Sushi Cooler | SUSH | 32 | 35 | +10 | -10 | 90 |
| Medium Temp Reach-In |  | 36 | 40 | +10 | -10 | 90 |
|  |  |  |  |  |  |  |
| **Walk-Ins:** |  |  |  |  |  |  |
| Bakery Cooler | BKBX | 34 | 37 | +10 | -10 | 90 |
| Bakery Freezer | BKFZ | -10 | 0 | +10 | -10 | 90 |
| Controlled Temp Storage | CTBX | 34 | 37 | +10 | -10 | 90 |
| Dairy Cooler | DYBX | 34 | 37 | +10 | -10 | 90 |
| Deli Cooler | DLBX | 34 | 37 | +10 | -10 | 90 |
| Fish/Seafood Cooler | FIBX | 28 | 32 | +10 | -10 | 90 |
| Frozen Seafood Freezer | FSBX | -10 | 0 | +10 | -10 | 90 |
| Ice Cream Storage | ICBX | -15 | -10 | +10 | -10 | 90 |
| Meat Cooler | MTBX | 28 | 32 | +10 | -10 | 90 |
| Meat Holding | HDBX | 28 | 32 | +10 | -10 | 90 |
| Meat Prep Room | MTPR | 46 | 50 | +10 | -10 | 90 |
| Meat Wrapping | MTWR | 46 | 50 | +10 | -10 | 90 |
| Poultry Storage | POBX | 28 | 32 | +10 | -10 | 90 |
| Produce Cooler  | PRPX | 34 | 40 | +10 | -10 | 90 |
| Produce Prep Room | PRPR | 55 | 68 | +10 | -10 | 90 |

Table above is required for all walk-in coolers. Follow manufacturer’s guidance for all display cases if available.

Defrost times, durations, and terminations are to be set according to case manufacturing specifications.

Leak alarm setpoints are to trigger A/V alarm when leak sensor exceeds 500 ppm. When leak gets down below 50 ppm, it can shut off alarm.

* + - 1. NAMING CONVENTIONS
				1. RMCS sensors shall be identified as follows:

Names: "Standard RMCS Point Names" shall be used/indicated in system software.

Inputs: All analog inputs shall have identification tag at input sensor/transducer to identify input. Except for pressure transducers, tags shall be secured with fasteners (screws or rivets). On pressure transducers, tags can be secured with wire. Identification tags shall be metal or laminated plastic (minimum thickness of 1/16 inch) and letters on tag shall be 1/4 to 3/8 inch in height. Typical identification tags shall reflect "Standard RMCS Point Names", input example; MDFF , for Analog Input on Multideck frozen food case # . On display cases, identification tags shall be mounted at locations shown on Drawings.

Probe Layout Sheet: Probe layout sheet shall indicate "Standard RMCS Point Names" which shall match software and analog input identification tags.

Cabinets: All system panel/cabinets that contain microprocessor units or circuit boards shall have a tag on outside of panel/cabinet to identify panel/cabinet number.

All wire shall be labeled on either side of their termination indicating what it is connected to.

The "STANDARD RMCS POINT NAMES" shall be as follows:

**Refrigeration**

For all cases and walk-in boxes, refer to the above table showing control setpoints and alarm settings:

Compressor Systems SYS##X (where ## is the system number and X is the compressor letter.)

Defrost DEF## .XX (where ## is system numbered XX designates refr. circuit number.)

Air Cooled Condensers ACC##X (where ## is the condenser number and X is the stage number on the condenser.)

Liquid Line Solenoid LLSV ## (where ## is the refr circuit number).

Heating, Ventilating and Air-Conditioning (HVAC) Names:

Names Abbreviations

Main Air Handler AHU ## (where ## is Air Handler 1, 2, etc. the AHU number)

Cooling Stages Cool# (where # designates the stage number. When more than one AHU is present, designate as COOL### where ## is for AHU and the 2nd # is for stage.)

Heat Reclaim Stages (HR) HR### (where ## is AHU number and # is the stag number.)

Auxiliary Duct Heat (AH) AHEH### (electric) AHGH### (gas) AHOH### (oil) AHSH### (steam) AHWH### (water) (where ## is AHU number and # is stage number.)

Dehumidification DHUM.## (where ## is the desiccant sys#)

Humidity HUMD## (where ## is the AHU number.)

Dewpoint DEWPT## (where ## is the AHU number.)

Condensing Water Temp COND WTR

Mezzanine Room Temp MEZ TMP

Outside Air Temperature OTSD TMP

Pan Water Temperature PAN WTR

Stock Room Temperature STCK TMP

Store Temperature INSD TMP (when only one zone) INSIDE X (where X =zone when more than one.)

Supply Air Temperature SP## AIR (where X is AHU number)

Compressor Suction SYS##ST# or SYS##DT## (where ## is system number and Discharge Temperature # is compressor letter.)

Oil Pressure Monitor OPMXXX (where ## is system number and # is compressor letter.)

Refrigerant Level SYSXXLQD (where XX is the system number.)

Chill Water Supply CWSTMP

Chill Water Return CWRTMP

System Suction Pressure SYS##SP (where ## is the system number.)

System Discharge Press SYS##DP (where ## is the SYS number.)

System Condenser Press SYS##CP (where ## is the SYS number.)

* + - 1. CLOSE OUT ITEMS
				1. O & M MANUALS: Contractor shall furnish O&M manuals and information as herein indicated.

Distribution:

Provide two (2) CD ROM copies to DeCA / LEED, 2250 Foulois Ave, Lackland AFB, TX 78236-1039.

Provide one CD ROM copy to the Contracting Officer’s technical representative (to be forwarded to Commissary).

Date Required: Prior to final acceptance.

Table of Contents: Each set shall have a table of contents identifying the contents.

Contents: Each shall contain hardware and software information indicating the following:

Names, addresses, and telephone numbers of manufacturer of the system and nearest service representatives for the system.

Shall describe the specifications and capabilities of all equipment provided including:

General description and specification.

Installation and checkout procedures.

Descriptions of maintenance and repair of defective components (temperature probes, humidity or dewpoint sensors, control relays, digital input sensors, power supplies, etc.).

Installation drawings and sketches indicating locations of analog inputs, control relays, digital outputs, digital inputs, and panels.

Computer specifications and peripherals.

Use of system and applications software.

Use of alarm system.

* + - * 1. CADD Files: Provide CADD files (DWG and DXE format) on CD ROM indicating analog probe locations and point to point electrical interface drawings between RMCS connections and other equipment.

Distribution of CADD CD: CD shall be mailed to HQ DeCA/LEED 2250 Foulois Ave, Lackland AFB, TX 78236-1039.

* + - * 1. Control Task Manual: Provide booklet attached by chain to each ICU and one attached to Desk Top Computer. Each manual shall contain the following:

Wiring Diagram: Provide half sized As-Built drawing that folds into booklet, indicating physical location in store of all relays, relay boards, and sensors. Provide one full sized As-Built with same information and mount on equipment room wall with other As-Built drawings.

* + - * 1. Training: Manufacturer’s Authorized Representative shall give the following training sessions each of which shall be coordinated with the commissary, scheduled during week days, scheduled at a minimum of 14 days in advance, and coordinated through the Contracting Officer. During these sessions, Commissary Store Personnel shall be instructed on accessing RMCS temperatures and alarms using RMCS computer.

First Training Session: Four-hour training session (to a minimum of four Commissary Store Personnel) within 14 days after final acceptance and all RMCS final inspection punch list items are resolved. This training session should be considered in conjunction with 3 day commissioning start up visit.

Second Training Session: Four-hour training session (to a minimum of four Commissary Store Personnel) at least 30 days after but no more than 45 days after final acceptance.

* + - * 1. Videos: Provide each video described below:

User Video: Video should be tailored to equipment installed on this project and will explain to commissary management how to determine what causes a refrigeration alarm and how to change lighting schedules using the Desktop Computer. Video length should be from 15 to 25 minutes.

Service Video: Video training on "Basic Service Procedure" tailored to repairing equipment (ICUs and sensors) installed on this project. Video should be on level that would enable a journeyman refrigeration mechanic to make most repairs to the system. Video length shall be 45 to 70 minutes.

Distribution of Videos: Provide one copy of each DVD video to: HQ DeCA/LEED 2250 Foulois Ave, Lackland AFB, TX 78236-1039.

* + - * 1. Database Software: Provide the following items:

Drive: Database downloading software USB Flash Drive described in 2.3-d (1) **[if needed to operate the RMCS].**

Authorization of Use: Letter granting Government rights to use this software [**if software is needed to operate the RMCS].**

Distribution: Mail to DeCA/CCND, 2250 Foulois Ave, Lackland AFB, TX 78236-1039.

* + - * 1. Data Backup: Provide the following items:

USB Flash Drive or Database File containing backup of all RMCS names and setpoints for site.

Distribution: Mail to DeCA/CCND, 2250 Foulois Ave, Lackland AFB, TX 78236-1039.

* + - * 1. Spare Parts: The following spare parts shall be provided at least 30 days prior to final acceptance.

Probes: Four temperature sensing probes for each type used in the project.

Transducers: One pressure transducer for each type used in the project.

Controllers: One controller board of each type; DI, AI, RO, AO, communication.

Gateways: One gateway of each type used in the project.

Fuses: Twenty fuses of each type.

ICU: One spare individual control unit (ICU) complete with all printed circuit cards, circuit chips, and power supply, install any updates to match store’s installed ICUs. .

Location for parts: These parts shall be located in the mechanical equipment room in a Contractor furnished cabinet with a non-lockable door.

* + - * 1. Final Acceptance: Prior to final acceptance, the following shall be accomplished.

Temperatures Maintained: RMCS equipment shall be maintaining Contract specified control.

Punch List Complete: Pre final and final punch list items shall have been corrected by Contractor and their correction approved by DeCA/LEED Lackland AFB TX.

O&M Info Received: O&M information shall have been received by the Government.

Warranty Received: Warranty letters from RMCS and Display case manufacturers shall have been received by Government.

Certification of Installation Received: Certification of installation letters from RMCS and Display Case Manufacturers shall have been received by Government (see 3.1.2-b).

Transfer of Billing for cellular modem: (See 3.2-H (2)).

Alarm Monitoring and Notification: Alarm monitoring and notifications service shall be activated.

Submit all testing and verification forms provided at the end of this section:

Refrigeration Piping Test and Evacuation Verification.

Refrigeration Startup Checklist.

Refrigeration Defrost Schedule.

Refrigerant Leak Detection.

Refrigeration Policy.

Work Authorization Procedures for OEM Warranty.

* + - * 1. Alarm Monitoring and Notification: Contractor shall provide a 24 hour a day Alarm monitoring and notification service as soon as product is in the cases up to the first 90 days of the warranty after final acceptance. See 3.6 Warranty.

General: RMCS shall dial out alarms to a monitoring service using a toll free (1-800) phone number. Monitoring company shall evaluate all alarms and shall notify designated Commissary personnel as necessary to inform them of refrigeration problems which warrant the store's attention.

* + - 1. WARRANTY
				1. Provide Warranty Guarantees and Services as follows:

The Authorized Representative of the RMCS manufacturer shall guarantee that RMCS equipment/software, shall operate and provide specified control without failure for periods indicated below beginning on the date of final acceptance.

First 90 Days: During the first 90 days of warranty, Contractor shall provide 24 hours a day, 7 days per week (including holidays), service to Commissary. A technician shall arrive at Commissary within 2 hours of receipt of telephone call for warranty service. All parts and labor shall be provided by Manufacturer at no cost to Government during this period. Additionally, manufacturer shall provide a 24 hour a day Alarm Monitoring and Notification service.

91 to 365 Day: During the 91st day through the 365 day of the warranty, the Manufacturer shall provide free exchange of parts within 24 hours of notification. Shipping costs shall be paid by the Manufacturer. These parts will be installed by a Maintenance Contractor whose services are provided for under a separate Contract. No installation cost shall be paid by RMCS Manufacturer for replacement of these parts.

First Five Years: Additionally, during the 91st day through the first five years of warranty, manufacturer of RMCS shall provide assistance (via telecon at no cost to the Government nor Government Contractor) in helping Government or Contractor personnel locate any problem with RMCS system. During this warranty period, manufacture of RMCS shall unconditionally provide software maintenance at no cost to Government or Government Contractor.

**END OF SECTION**