

DESIGN CRITERIA – PRODUCT REFRIGERATION SYSTEMS

GENERAL

1.01 Related Sections

- A. See Division 13 Section Cold Storage Rooms and Division 23 Section Refrigeration Monitoring and Control Systems (RMCS) for additional information.
- B. See Division 23 Product Refrigeration Micro-Distributed Systems for projects utilizing micro-distributed system.

1.02 Summary

- A. Product refrigeration includes all display cases, compressors, condensers, heat recovery coils, evaporators (unit coolers for insulated cold storage rooms), refrigerant piping, refrigerant controls, monitoring systems or Refrigeration Monitoring and Control System (RMCS), associated controls, and all wiring including that not indicated on Drawings required for a complete, functional and usable system. Refrigeration compressor units with all controls, heat recovery coils, heat reclaim hot water heaters, diverting valves for heat recovery, condensers, unit coolers, display cases and RMCS shall be furnished by a single display case or compressor system manufacturer. The only exception to this is that the self-contained display cases can be a different manufacturer than the other cases.

1.03 Design, Furnishing and Installation

- A. The Product System Refrigeration System Provider (Provider) shall be either the primary compressor system manufacturer or the primary display case manufacturer. The entire refrigeration system shall be furnished by the Provider who shall be singly responsible for the design, furnishing, installation, testing, and satisfactory operation of the total system, including both high and low side components. The installation shall be supervised by a field engineer employed by the compressor system manufacturer or display case manufacturer, as the case may be. The design shall use the most energy efficient combination and arrangement of compressors for the compressor systems, consistent with operational reliability. Prior to acceptance, the manufacturer shall submit a letter stating that the total refrigeration system has been inspected and approved by the manufacturer and that it meets the manufacturer's installation requirements. Provide registered engineering seal and signature on each Drawing. All contractor design and installation not specifically addressed in this RFP shall meet or exceed ASHRAE recommendations/guidelines and recommendations of the equipment manufacturer(s).

1.04 Coordination

- A. The Provider shall coordinate the installation of the total refrigeration systems as delineated, and shall prepare complete shop Drawings, submittals, and design analysis of the entire refrigeration system.

PRODUCTS

2.01 Compressor Systems

- A. The designer shall large, central evaluate Parallel Rack Compressor systems vs. smaller, point of use packaged Outdoor Distributed Refrigeration System options. A life cycle cost analysis (LCCA) shall be done to justify the system selection.
- B. The designer shall evaluate the use of adiabatic condensers in desert or hot climates. A life cycle cost analysis (LCCA) shall be done to justify the system selection.
- C. Parallel Rack Compressor System
 - 1. Parallel Rack Compressor systems shall be installed in mechanical center(s) which shall be installed either at grade or on the roof. Air cooled condensers shall be installed on the

roof of the mechanical center when centers are at grade. When centers are on the roof, use horizontal receivers and elevate condensers above roof sufficiently to drain to the receivers by gravity. The centers shall also contain water heaters, electrical equipment and such other equipment as required by Section Product Refrigeration Systems. The centers shall be located so as to minimize the length of suction and liquid piping to the various cases and coolers as well as the length of hot gas piping to the air handling unit coil.

D. Outdoor Distributed Package Refrigeration System

1. Distributed Package Systems shall be installed on the roof and shall be zone to minimize pipe runs and maximize efficiency. These units shall be located so as to minimize the length of the suction and liquid piping to the various cases and coolers. These units shall not have integrated air cooled condensing units. Air cooled condensers shall be stand alone.

2.02 Unit Coolers

- A. General: Size unit coolers in the preparation areas to meet or exceed the load upon the room at suction temperatures no greater than 20 deg F below room temperatures. Size unit coolers in all other storage rooms to meet or exceed the load upon the room at suction temperatures no greater than 10 deg F below room temperatures. Size unit coolers in frozen food storage rooms to meet or exceed the load upon the room at a suction temperature no greater than 8 deg F below room temperatures. Unit coolers operating in rooms at or below 28 deg F shall have maximum fin spacings of 4 fins per inch. Unit coolers operating in rooms above 28 deg F shall have maximum fin spacings of 6-8 fins per inch. Condensate drain lines in rooms operating at or below 32 deg F shall have 1" unicellular insulation and heat tape. Run refrigerant piping to compressor units in located in mechanical centers.
- B. Suspension: Suspend unit coolers located in insulated cold storage rooms. Do not use ceiling support columns within the cooler panels. Suspension system shall consist of all members, including fasteners and attachments, required to support unit coolers. Suspension system shall be of steel materials. Design of suspension system shall be in accordance with AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.
- C. Provide unit cooler fans with motors.
- D. Required product temperatures to be maintained in walk in boxes and freezers is:

Unit	Temperature Range
Dairy Storage	34 to 37 deg F
Ice Cream Storage	-10 deg F or below
Freezer Vestibule	46 to 50 deg F
Frozen Food Storage	-6 to 0 deg F
Meat Storage	28 to 32 deg F
Meat Holding	28 to 32 deg F
Meat Processing/Wrapping	46 to 50 deg F
Deli Storage	34 to 37 deg F
Ambient Produce Storage	60 to 65 deg F
Produce Storage	38 to 42 deg F
Produce Processing	60 to 65 deg F
Fish Storage	28 to 32 deg F
Poultry Storage	28 to 32 deg F
Frozen Bakery	-6 to 0 deg F
Bakery Storage	34 to 37 deg F
Pre Pak Meat Storage	34 to 37 deg F

- E. See Design Standard Plates for Division 23 Product Refrigeration Systems.
- F. Walk-in Coil Control Requirement: All walk-in coils will require a field installed control panel which will house the case controller (controlling an EEV for temperature control) and all electrical distribution blocks. All temperature sensors required for operation (discharge air, return air, suction temperature) will be field installed and wired. Each refrigeration 'circuit' will get a single electrical feed each for fans/lights/anti-sweats and a single electrical feed for defrost (as required). Specify case controller location on plans and include mounting height requirement of no less than 60" and no more than 70".

2.03 Refrigerated Display Cases

- A. Locate refrigerated display cases in sales area per the [**Concept**] Floor Plan.
- B. Commissary Refrigerated Display Case Equipment Descriptions for the types of equipment currently used in DeCA commissaries will be provided in the DeCA Guide Spec.
- C. Required product temperatures, corresponding suction temperatures, coil types and defrost method for all types of display cases shall be as follows: **[NOTE TO SPECIFIER: Check against Commissary Equipment List in Appendix A and edit out any inapplicable pieces of equipment.]**
- D. Self contained cases require excessive maintenance and energy. The advantage of self contained cases is flexibility of movement, no need to tear up floor slabs to install piping or to have pipe risers at the case visible on the sales floor, and requirement for drains. Avoid use of self contained cases when it is reasonable to place a case on a remote rack. Placing piping under floor is as long as it is not cost prohibitive to do so. If there is any question of remote or self contained the designer should seek guidance from the DeCA project manager.
- E. Display case item descriptions. Refer to Equipment Descriptions for specific requirements.
- F. Refrigerant line layout:
 - 1. Consolidate refrigerant line risers into shafts at column where they can be run overhead, above the sales area ceiling, to the mechanical center(s) and/or distributed package systems.
 - 2. Refrigerant piping must be routed above sales area, where possible, route above shopping aisles, and not above soffits. This will allow for easier access for maintenance of the piping, electrical and condensate pans.
 - 3. Consider placement of chases to avoid obtrusive views or interference with overall sales area decor and appearance.
 - 4. Condensate pans under refrigerant piping:
 - a. For piping routed: Provide condensate pans under piping operation at 0 deg SST and lower if store is located where 2.5% design wet bulb exceeds 74 deg F.
 - b. For piping routed above Walk-in Storage or Processing Rooms and overhead in Warehouse: Provide condensate pans under piping operation at 0 deg SST and lower if store is located where 2.5% design wet bulb exceeds 78 deg F.
 - c. Slope drain pans to drain fitting. Pipe drain fitting to floor drain.
 - 5. Under floor tunnels shall not be used without express direction from DeCA/END.
- G. Refrigerated Case / Walk-in Coil Control Requirement: All refrigerated cases will be provided with factory installed case controllers (one per case), which will control an EEV (electronic expansion valve) for temperature control. All temperature sensors required for operation (discharge air, return air, suction temperature) will be factory installed and wired. Each

refrigeration 'circuit' will get a single electrical feed each for fans/lights/anti-sweats and a single electrical feed for defrost (as required).

2.04 Product Refrigeration System

- A. Comply with requirements of refrigeration system Design Standards Plates.
- B. The product refrigeration system includes compressors, condensers, recovery systems, evaporators (unit coolers for insulated cold storage rooms), refrigerant piping, refrigerant controls, head pressure controls, defrost systems, and a refrigeration monitoring and control system (RMCS). When parallel rack compressor systems are utilized provide two low temperature system and three medium temperature systems in stores larger than 80,000 SF. On projects less than 80,000 SF in size, provide with two separate low temperature systems and two separate medium temperature systems. On projects 30,000 SF in size, provide with one low temperature system and one medium temperature systems. When distributed package refrigeration systems are utilized provide a zoned approach locating each system near the cases served to minimize refrigerant charge and maximize efficiency. Each system shall be a multiplex compressor system. Remote condensers shall be air cooled types. Summer design ambient temperature shall be the 1% ASHRAE dry bulb design temperature for the area. Condenser capacity shall meet or exceed compressor heat of rejection at a condensing temperature 10 deg F above design entering air temperature for low temperature systems and 15 deg F above the design entering air temperature for medium temperature systems. Use refrigerant R-407A on all systems.
- C. Refrigeration Defrost Methods.
 - 1. On display cases with operating discharge air temperature (DAT) at greater than 32 deg F, the defrost shall be off cycle, or as required in the Equipment Descriptions.
 - 2. On walk-in boxes with operating discharge air temperature (DAT) greater than 32 deg F, the defrost shall be off cycle.
 - 3. Off cycle defrost shall be time-initiated and time-terminated.
 - 4. All other refrigeration defrost shall be electric. Electric defrost shall be time-initiated and temperature-terminated with time fail safe.
 - 5. Defrost shall be controlled through the RMCS.
- D. Compressor Systems. Locate multiplex compressor systems **[in mezzanine] [or] [in mechanical centers [or] distributed package units]** with refrigerant to cases, coolers, heat reclaim, and remote condensers. Install an evaporator pressure regulator at each circuit to provide temperature control of fixtures and rooms. For each compressor provide replaceable core suction filter/drier, crankcase heater, high pressure safety switch with manual reset and low pressure cut in/out with automatic reset, braided steel lines to controls, electronic oil pressure safety control, and compressor isolation valves. When parallel rack compressor systems are utilized compressors shall be high efficiency, semi-hermetic, "Copeland discus" or approved equal. When distributed package refrigeration systems are utilized provide high efficiency scroll or semi-hermetic compressors. Each compressor system shall have an oil separator, replaceable core liquid line filter drier and liquid receiver with visual and RMCS level indication. Compressors shall be staged on and off through the RMCS.
- E. Condensers. Roof Condensers shall be air cooled type with fan motors shall be direct drive type. Control shall be through the RMCS and shall provide for staging of each parallel fan set to control condensing pressure. **[SITE SPECIFIC: Include following sentence if condensers will be installed within 30 miles of salt water:]** [Provide VFD control VFD panel in **[mezzanine] [mechanical center]**].

2.05 Heat Reclaim Water Heaters

- A. Provide domestic water heating for the building with heat rejection of product refrigeration system.

2.06 Prefabricated Walk-in Refrigerators and Freezers

- A. Refer to Division 13 Section Cold Storage Rooms.

2.07 Electrical.

- A. Provide grounding conductors in all refrigeration electrical conduit runs.
- B. Provide duplex receptacles in the kick plates, 3' from the end of each side of each island case lineup. See Design Standard Plate Product Refrigeration Systems-50.
- C. Provide electrical panel schedules and refrigeration electrical drawings showing wiring requirements for refrigeration circuits.
- D. Show location of all walk-in cooler / freezer case controller enclosures. Add a keyed note on plan to indicate mounting height of no less than 60" and no more than 70" A.F.F.

EXECUTION

3.01 Refrigerant Handling and Recovery

- A. Division 01 Section Environmental Procedures for Refrigerants applies.

3.02 Display Cases

- A. Seal as required to floor, walls and to each other with sheet metal parts and caulking per Design Standards Division 23 Sections Common Work Results for HVAC and Product Refrigeration Systems.
- B. Include details of case sealing on construction Drawings.

3.03 Electrical

- A. Show on the Refrigeration Drawings:
 - 1. Provide a weatherproof disconnect and enclosure for a permanent plug-in receptacle for power to a temporary refrigeration trailer. The trailer provider will provide a receptacle to match the NEMA configuration of the trailer plug. Provide conductors and circuit breaker for 208V/3Ø/7060 ampere load receptacle.
 - 2. Provide a duplex outlet at each end and each side of the island case runs. Locate the receptacle in the toe/space of the cases 5' ± from each end of each case run except that it shall not be below doors at glass door cases.
 - 3. Provide electrical panel schedules and refrigeration electrical drawings showing wiring requirements for refrigeration circuits.

3.04 Compressor Systems Locations

- A. Mechanical mezzanines shall only be used if existing.
- B. In smaller stores, Mechanical Centers may be located on Grade. If line lengths exceed practical limits (300'), locate centers on the roof.
- C. Locate Roof mounted Mechanical Centers above walk-in coolers to minimize noise in the Sales Area.
- D. Locate the air cooled condensers no more than 75 feet from the mechanical systems to facilitate heat recovery.
- E. Located distributed package systems near to cases being served.

3.05 Contract Documents Check List

- A. Layout unit cooler drain lines on Drawings, such that lines do not cross door openings.
- B. In add / alter projects insure continuous availability of refrigerated cases and walk-ins by providing a location for new equipment separated from the old equipment location so that new and existing refrigerated cases and walk-ins can be operated simultaneously.
- C. Verify that space and structural support are adequate for replacement equipment.
- D. Show location of condensate piping and floor drains for all condensate producing equipment.
- E. Gas fired equipment located in refrigeration equipment rooms, occupied spaces, or in equipment spaces other than properly ventilated and protected boiler rooms shall be of the separated combustion type with combustion air ducted from out of doors.
- F. Work with the Structural Engineer to determine whether seismic restraint or wind restraint is needed for items of mechanical equipment based on ASCE 7-02.
- G. All unit heaters in machinery rooms shall be sealed combustion type.
- H. Show a detector in the refrigeration machinery room(s) or mechanical center(s).

END OF SECTION