SECTION 236333 - EVAPORATIVE REFRIGERANT CONDENSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Factory-assembled and -tested, [forced] [induced]-draft evaporative refrigerant condensers.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design evaporative refrigerant condenser support structure, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Evaporative refrigerant condenser support structure shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

C. Wind-Restraint Performance:

1. Basic Wind Speed: <Insert value>.
2. Building Classification Category: [I] [II] [III] [IV].
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

D. Seismic Performance: Evaporative refrigerant condenser shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, installation instructions, furnished specialties, and accessories.

B. Shop Drawings: For evaporative refrigerant condensers. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field piping and wiring connection.
2. Wiring Diagrams: Power, signal, and control wiring.
C. Delegated-Design Submittal: For evaporative refrigerant condensers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind and Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include handrails, ladders, and equipment mounting frame.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For evaporative refrigerant condensers, accessories, and components, from manufacturer.
B. Warranties.

1.5 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

1.6 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
C. Comply with NFPA 70.
D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning" and Section 10 - "Other Equipment."

1.7 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of evaporative refrigerant condensers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Fan, motor, drive shaft, bearings, and motor supports.
   b. Tube bundle.
   c. External-circuit circulating pump.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FORCED-DRAFT EVAPORATIVE REFRIGERANT CONDENSERS

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Baltimore Aircoil Company; Series V.
   2. EVAPCO, Inc.; Models LSCB.
   3. Recold; Series JC.

B. Fabricate evaporative refrigerant condenser mounting base with reinforcement strong enough to resist evaporative refrigerant condenser movement during a seismic event when evaporative refrigerant condenser is anchored to field support structure.

C. Evaporative refrigerant condenser designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:
   2. Fasteners: [Galvanized] [Stainless] steel.

E. Collection Basin:
   1. Material: [FRP with UV inhibitors] [Galvanized steel, ASTM A 653/A 653M, G210 coating] [Galvanized steel, ASTM A 653/A 653M, G235 coating] [Polymer-coated galvanized steel] [Stainless steel].
   2. Strainer: Removable strainer with openings smaller than nozzle orifices.
   3. Overflow and drain connections.

F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

G. Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat exchanger coil throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.
   1. Pipe Material: PVC
2. Spray Nozzle Material: [Plastic] [Polypropylene] [PVC].
3. Piping Supports: Corrosion-resistant hangers and supports designed to resist movement during operation and shipment.

H. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer and flow balancing valve, and mechanical seal suitable for outdoor service.

1. General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

I. Heat-Exchanger Coils:

1. Tube and Tube Sheet Materials: [Copper tube with stainless-steel sheet] [Stainless-steel tube and sheet]
2. Heat-Exchanger Arrangement: [Serpentine tubes] [Serpentine tubes with removable cover plate on inlet and outlet headers] [Straight tubes with removable header cover plate on both ends of heat exchanger for straight-through access to each tube]; and sloped for complete drainage of fluid by gravity.
3. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.

J. [Removable] Drift Eliminator:

1. Material: [FRP] [PVC] [FRP or PVC]; with maximum flame-spread index of [5] [25] according to ASTM E 84.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

K. [Removable] Air-Intake Screens: [Polymer-coated, galvanized] [Stainless]-steel wire mesh.

L. Centrifugal Fan: Double-width, double-inlet fan with forward-curved blades; and statically and dynamically balanced at the factory after assembly.

M. Belt Drive:

1. Service Factor: 1.5 based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
4. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
5. Belt-Drive Guard: Comply with OSHA regulations.
N. Fan Motor:

1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

O. Discharge Hoods:

1. Hood Configuration: [Tapered] [Straight]: totally surrounding drift eliminators and constructed of same material as casing; and having factory-installed access doors.
2. Discharge Dampers: Positive-closure, automatic, isolation dampers with electric actuators.
   a. Provide field power and controls to open dampers when pump is energized and close dampers when pump is de-energized.

P. Capacity-Control Dampers: [Galvanized-steel] [Stainless-steel] dampers, with linkages, electric operator, controller, limit switches, transformer, and weatherproof enclosure.

Q. Vibration Switch: For each fan drive.

1. Enclosure: NEMA 250, [Type 4].
2. Provide switch with manual-reset button for hardwired connection to fan motor electrical circuit.
3. Switch shall, on sensing excessive vibration, shut down the fan.

R. Controls: Comply with requirements in Section 230900 "Instrumentation and Control for HVAC."

S. Control Package: Factory installed and wired, and functionally tested at factory before shipment.

1. NEMA 250, Type 4 enclosure with removable internally mounted backplate.
2. Control-circuit transformer with primary and secondary side fuses.
3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
4. Microprocessor-based controller for automatic control of fan and spray pump based on evaporative refrigerant condenser leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
5. Fan motor sequencer for multiple-cell and two-speed applications with automatic lead-stage rotation.
7. Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph.
8. Controls and wiring for "two-motor, single-fan drives" shall be same as two-speed, two-winding motor.
9. Power and controls to open discharge hood dampers when pump is energized and close dampers when pump is de-energized.
10. Single-point, field-power connection to a fused disconnect switch
   a. Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch or circuit breaker.
   b. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
11. Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquidtight conduit.
12. Visual indication of status and alarm for each motor.
13. Audible alarm and silence switch.
14. Visual indication of elapsed run time, graduated in hours for each motor.

T. Personnel Access Components:
1. Doors: Large enough for personnel to access evaporative refrigerant condenser internal components from evaporative refrigerant condenser end walls.
2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of evaporative refrigerant condenser from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at evaporative refrigerant condenser access doors when evaporative refrigerant condensers are elevated and not accessible from grade.

U. Capacities and Characteristics:
1. Number of Cells: <Insert quantity>.
2. Maximum Drift Loss: $0.005 <Insert number> percent of design water flow.
3. Heat-Exchanger Coil(s):
   a. Refrigerant Type [R-407C] [R-410A] [HFC-134a].
   c. Condensing Temperature: <Insert deg F>.
   d. Entering-Air Wet-Bulb Temperature: <Insert deg F>.
4. Fan Location: [Bottom] [Side].
5. Fan Motor:
a. Type: [Single speed] [Two speed, single winding] [Two speed, two winding] [Variable speed].

6. Spray Pump and Motor:

c. Full-Load Ampacity: <Insert value>.
d. Minimum Circuit Ampacity: <Insert value>.
e. Maximum Overcurrent Protection Device: <Insert amperage>.
f. Electrical Characteristics: [120] [208] [240] [277] [480] <Insert value>-V ac, [single] [3] phase, 60 Hz.

7. Sound Pressure Level: <Insert dBA> at <Insert distance in feet> [when measured according to CTI ATC 128].

2.2 EVAPORATIVE REFRIGERANT CONDENSERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Baltimore Aircoil Company; Series CXV.
2. EVAPCO, Inc.; Models ATC.
3. Recold; Series MC.

B. Fabricate evaporative refrigerant condenser mounting base with reinforcement strong enough to resist evaporative refrigerant condenser movement during a seismic event when evaporative refrigerant condenser is anchored to field support structure.

C. Evaporative refrigerant condenser designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:

2. Fasteners: [Galvanized] [Stainless] steel.

E. Collection Basin:

2. Overflow and drain connections.

F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.
G. Retain first paragraph below to require basin heaters for projects subject to freezing conditions. See Evaluations.

H. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

1. Pipe Material: [Fiberglass] [PVC] [Galvanized steel] <Insert material>.
2. Spray Nozzle Material: [Plastic] [Polypropylene] [PVC] <Insert material>.
3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

I. Recirculating Piping: PVC.

J. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer and flow balancing valve, and mechanical seal suitable for outdoor service.

1. General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

K. Heat-Exchanger Coils:

1. Tube and Tube Sheet Materials: [Copper tube with stainless-steel sheet] [Stainless-steel tube and sheet] [Prime-coated steel tube and sheet with outer surface of tube and sheet hot-dip galvanized after fabrication].
2. Heat-Exchanger Arrangement: [Serpentine tubes] [Serpentine tubes with removable cover plate on inlet and outlet headers] [Straight tubes with removable header cover plate on both ends of heat exchanger for straight-through access to each tube]; and sloped for complete drainage of fluid by gravity.
3. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.

L. [Removable] Drift Eliminator:

1. Material: [FRP] [PVC] [FRP or PVC] <Insert material>; with maximum flame-spread index of 25 according to ASTM E 84.
2. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

M. Air-Intake Louvers:

1. Material: [FRP] [PVC] [Matching casing].
2. Louver Blades: Arranged to uniformly direct air into evaporative refrigerant condenser, to minimize air resistance, and to prevent water from splashing out during all modes of operation including operation with fans off.

N. Axial Fan: Balanced at the factory after assembly.
1. Blade Material: [Aluminum] [FRP] [Galvanized steel].
5. Fan Shaft Bearings: Self-aligning, grease-lubricated ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of [40,000] [50,000] \(<\text{Insert value}\) hours.
6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

O. Belt Drive:
1. Service Factor: \([1.5] <\text{Insert value}\) based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
4. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
5. Belt-Drive Guard: Comply with OSHA regulations.

P. Fan Motor:
1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.
5. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

Q. Fan Discharge Stack: Material shall match casing.
1. Stack Extension: Fabricated to extend above fan deck \(<\text{Insert distance}\) unless otherwise indicated.
2. Stack Termination: Wire-mesh, galvanized-steel screens; complying with OSHA regulations.

R. Vibration Switch: For each fan drive.
1. Enclosure: NEMA 250, Type 4.
2. Provide switch with manual-reset button for hardwired connection to fan motor electrical circuit.
3. Switch shall, on sensing excessive vibration, shut down the fan.

S. Controls: Comply with requirements in Section 230900 "Instrumentation and Control for HVAC."

T. Control Package: Factory installed and wired, and functionally tested at factory before shipment.

1. NEMA 250, Type 4 enclosure with removable internally mount backplate.
2. Control-circuit transformer with primary and secondary side fuses.
3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
4. Microprocessor-based controller for automatic control of fan and spray pump based on evaporative refrigerant condenser leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
5. Fan motor sequencer for multiple-cell and two-speed applications with automatic lead-stage rotation.
7. Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph.
8. Single-point, field-power connection to a fused disconnect switch.
9. Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquidtight conduit.
10. Visual indication of status and alarm for each motor.
11. Audible alarm and silence switch.
12. Visual indication of elapsed run time, graduated in hours for each motor.

U. Personnel Access Components:

1. Doors: Large enough for personnel to access evaporative refrigerant condenser internal components from both evaporative refrigerant condenser end walls. Doors shall be operable from both sides of the door.
2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of evaporative refrigerant condenser from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at evaporative refrigerant condenser access doors when evaporative refrigerant condensers are elevated and not accessible from grade.

V. Capacities and Characteristics:

1. Number of Cells: <Insert quantity>.
2. Maximum Drift Loss: [0.005] <Insert number> percent of design water flow.
3. Heat-Exchanger Coil:
   a. Refrigerant Type [R-407C] [R-410A] [HFC-134a]
   b. Refrigerant Type: R-407C, R-410A, or HFC-134a.
   d. Condensing Temperature: <Insert deg F>.
   e. Entering-Air Wet-Bulb Temperature: <Insert deg F>.

4. Fan Motor:
   a. Type: [Single speed] [Two speed, single winding] [Two speed, two winding] [Variable speed].

5. Spray Pump and Motor:
   c. Full-Load Ampacity: <Insert value>.
   d. Minimum Circuit Ampacity: <Insert value>.
   e. Maximum Overcurrent Protection Device: <Insert amperage>.
   f. Electrical Characteristics: [120] [208] [240] [277] [480] <Insert value>-V ac, [single] [3] phase, 60 Hz.

6. Sound Pressure Level: <Insert dBA> at <Insert distance in feet> [when measured according to CTI ATC 128].

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Install evaporative refrigerant condensers on concrete base(s). Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete"

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Loose Equipment: Install electrical components, devices, and accessories that are not factory mounted.

D. Install piping adjacent to evaporative refrigerant condensers to allow service and maintenance.

E. Install flexible pipe connectors at final connection of evaporative refrigerant condensers mounted on vibration isolators.

F. Run overflow, drain, and bleed lines to sanitary sewage system.

G. Domestic Water Piping: Comply with requirements in Section 221116 "Domestic Water Piping." Connect to water-level control with shutoff valve and union or flange at each connection.
H. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping." Connect to evaporative refrigerant condenser coil with isolation valves at each connection.

I. Ducts: Comply with requirements in Section 233113 "Metal Ducts." Connect ducts to evaporative refrigerant condenser inlet and outlet, full size of outlet, with flexible duct connection.

3.2 STARTUP SERVICE

A. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

B. Obtain performance tables from manufacturer.

C. Engage a factory-authorized service representative to perform installation check and startup service.

3.3 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain evaporative refrigerant condensers.

END OF SECTION