SECTION 23 65 00 - COOLING TOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Open-circuit, induced-draft, counterflow cooling towers.
2. Basin water level controls.
3. Closed circuit fluid coolers and/or condensers are also acceptable, subject to meeting the capacity requirements.

B. Cooling towers are specified herein for reference only and will be for temporary use.

C. Cooling tower shall operate in a manner that no visible plume is produced. If necessary provide gas fired heaters or HW coils for cooling tower discharge for plume abatement.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME).

1. Boiler and Pressure Vessel Code, Section VIII, Division 1, “Rules for Construction of Pressure Vessels”.
2. Performance Test Code PTC 23, “Atmospheric Water Cooling Equipment”.

B. Cooling Technology Institute (CTI).

C. Standard 201, “Standard for the Certification of Water-Cooling Tower Thermal Performance”.

D. Acceptance Test Code ATC 105, “Acceptance Test Code for Water Cooling Towers”.

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

E. Standard 90.1, “Energy Standard for Building Except Low-Rise Residential Buildings”.

1. National Fire Protection Association (NFPA).

F. Standard 70, “National Electrical Code”.

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Institute of Electrical and Electronics Engineers (IEEE).
4. National Electrical Manufacturers Association (NEMA).

G. Factory Mutual (FM).

H. Underwriters Laboratories (UL).

1.3 SUBMITTALS

A. Product Data: Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, materials of construction, furnished specialties, and accessories.

1. Maximum flow rate.
2. Minimum flow rate.
3. Drift loss as percent of design flow rate.
4. Volume of water in suspension for purposes of sizing a remote storage tank.
5. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
6. Performance curves for the following:
    a. Varying entering-water temperatures from design to minimum.
    b. Varying ambient wet-bulb temperatures from design to minimum.
    c. Varying water flow rates from design to minimum.
    d. Varying fan operation (off, minimum, and design speed).
7. Fan airflow, brake horsepower, and drive losses.
8. Pump flow rate, head, brake horsepower, and efficiency.
9. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
10. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Sizes and locations of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For cooling tower support structure 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 fabrication and assembly of support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

D. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

E. Certificates: Provide certificate from manufacturer.

F. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Source quality-control reports.

H. Field quality-control reports.

I. Startup service reports.

J. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals. Include start-up instructions, maintenance data, parts lists, controls, accessories, and trouble-shooting guide.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. Fan assembly including fan, drive, and motor.
2. All components of cooling tower.
3. Warranty Period: Five (5) years.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories.

PART 2 - PRODUCTS

2.1 OPEN-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

A. Manufacturers: Subject to compliance with requirements, provide one of the following:
   1. **Baltimore Aircoil Company.**
   2. **Delta Cooling Towers.**
   3. **Evapco.**

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

C. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:
   1. Casing and Frame Material: Stainless steel, Type 304.

E. Collection Basin:
   1. Material: Stainless steel, Type 304.
   2. Strainer: Removable stainless-steel strainer with openings smaller than nozzle orifices.
   3. Overflow and drain connections.
   4. Makeup water connection.
   5. Outlet Connection: ASME B16.5, Class 150 flange.
   6. Removable equalization flume plate between adjacent cells of multiple-cell towers.
   7. Equalizer connection for field-installed equalizer piping.
   8. Basin Sweeper Distribution Piping and Nozzles:
      a. Pipe Material: PVC.
      b. Nozzle Material: Plastic.
      c. Configure piping and nozzles to minimize sediment from collecting in the collection basin.

F. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:
   1. Enclosure: NEMA 250, Type 4.
   2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide control of water makeup valve, low- and high-level alarms, and output for shutoff of pump on low level.
   3. Electrode Probes: Stainless steel.
   4. Water Stilling Chamber: Corrosion-resistant material.

5. Solenoid Valve: Slow closing with stainless-steel body; controlled and powered through level controller in response to water-level set point.

6. Electrical Connection Requirements: 120V, single phase, 60 Hz.

G. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill 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: PVC.

3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

H. Fill:

1. Materials: PVC, resistant to rot, decay, and biological attack; with maximum flame-spread index of 5 according to ASTM E 84.

2. Minimum Thickness: 15 mils before forming.

3. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.

4. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F.

I. Removable Drift Eliminator:

1. Material: Fiberglass reinforced plastic; resistant to rot, decay, and biological attack; with maximum flame-spread index of 5 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.

J. Air-Intake Louvers:

1. Material: Matching casing.

2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.

3. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

K. Removable Air-Intake Screens: Stainless-steel wire mesh.

L. Axial Fan: Balanced at the factory after assembly.

1. Blade Material: Aluminum.

2. Hub Material: Aluminum.

3. Blade Pitch: Field adjustable.

4. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens, complying with OSHA regulations.
5. Fan Shaft Bearings: Self-aligning 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 50,000 hours.
6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

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.
    a. Belt: Multiple V-belt design with a matched set of cogged belts.
    b. Belt: One-piece, multigrooved, solid-back belt.
    c. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
    d. Belt-Drive Guard: Comply with OSHA regulations.

N. Direct Drive: Fan hub directly connected, and properly secured, to motor shaft.

O. Fan Motor:

1. Motor Enclosure: Totally enclosed fan cooled (TEFC).
2. Service Factor: 1.15.
3. Insulation: Class F.
4. Variable-Speed Motors.

P. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower 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 cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Stainless-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
4. Handrail: Stainless steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.
5. Internal Platforms: Stainless-steel bar grating.
    a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall

be elevated so that all parts are above the high water level of the collection basin.

b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.2 CONNECTIONS

A. Install piping adjacent to cooling towers to allow service and maintenance.

B. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

C. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

D. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

E. Domestic Water Piping: Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

F. Supply and Return Piping: Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union, flange, or mechanical coupling.

G. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform field tests and inspections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections: Comply with ASME PTC 23, "ASME Performance Test Codes - Code on Atmospheric Water Cooling Equipment."

E. Cooling towers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

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

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Clean entire unit including basins.

b. Verify that accessories are properly installed.

c. Verify clearances for airflow and for cooling tower servicing.

d. Check for vibration isolation and structural support.

e. Lubricate bearings.

f. Verify fan rotation for correct direction and for vibration or binding and correct problems.

g. Adjust belts to proper alignment and tension.

h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.

i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.

j. Check vibration switch setting. Verify operation.

k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.

l. Verify operation of basin heater and control.

m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.

n. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.5 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to adjust, operate, and maintain cooling towers. Training to include minimum of 15 personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands-on training.

END OF SECTION 23 65 00