1.0 Cooling Tower

1.1 General: Furnish and install _____ factory-assembled, induced draft, crossflow cooling tower(s) with vertical air discharge conforming in all aspects to the specifications, schedules and as shown on the plans. Overall dimensions shall not exceed approximately _____ ft (mm) long x _____ ft (mm) wide x _____ ft (mm) high. The total connected fan horsepower shall not exceed _____ HP (kW). The cooling tower(s) shall be Baltimore Aircoil Company Model ____________________.

1.2 Thermal Capacity: The cooling tower(s) shall be warranted by the manufacturer to cool _____ USGPM (l/s) of water from ___ °F(°C) to ___ °F(°C) at ___ °F(°C) entering wet bulb temperature. Additionally, the thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105, by the Cooling Technology Institute or other qualified independent third party testing agency. Manufacturer’s performance guarantees or performance bonds without CTI Certification or independent field thermal performance test shall not be accepted. The cooling tower shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.

1.3 Corrosion Resistant Construction: Unless otherwise noted in this specification, all steel panels and structural members shall be constructed of heavy-gauge G-235 (Z700 metric) galvanized steel with all edges given a protective coating of zinc-rich compound.

(Alternate) 1.3 Corrosion Resistant Construction: Unless otherwise noted in this specification, all steel panels and structural members must be protected with the BALTIBOND® Corrosion Protection System. The system shall consist of G-235 (Z700 metric) hot-dip galvanized steel prepared in a four-step (clean, pretreat, rinse, dry) process with an electrostatically sprayed, thermosetting hybrid polymer fuse-bonded to the substrate during a thermally activated curing stage and monitored by a 23-step quality assurance program. Coatings other than the BALTIBOND® Corrosion Protection System must be submitted to the engineer for pre-approval. Approved equals must have undergone testing, resulting in the following results as a minimum:

1. When X-scribed to the steel substrate it shall be able to withstand 6000 hours of 5% salt spray per ASTM B117 without blistering, chipping, or loss of adhesion;

2. When X-scribed to the steel substrate it shall be able to withstand 6000 hours of exposure to acidic (pH=4.0) and alkaline (pH=11.0) water solutions at 95°F (35°C) without signs of chemical attack;

3. Shall withstand impact of 160 in-lbs per ASTM D2794 without fracture or delamination of the polymer layer;
4. Shall withstand 6000 hours of ultraviolet radiation equivalent to 120,000 hours of noontime sun exposure without loss of functional properties;

5. Shall withstand 200 thermal shock cycles between -25°F and +180°F (-32°C and 82°C) and without loss of adhesion or other deterioration;

6. Shall withstand 6000 hours of exposure to 60 psi (42184.2 kg/m²) water jet without signs of wear or erosion.

(Alternate) 1.3 Type 304 Stainless Steel Construction: All steel panels and structural members, including the casing panels, hot and cold water basins, distribution covers, fan deck and fan cylinder shall be constructed of Type 304 stainless steel and assembled with Type 304 stainless steel nut and bolt fasteners. All factory seams in the cold water basin shall be welded to ensure watertight assembly and shall be unconditionally warranted against leaks for five (5) years from date of shipment.

1.4 Quality Assurance: The cooling tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001:2000 to ensure consistent quality of products and services.

1.5 Wind and Seismic Forces: When supported as recommended, the unit shall be suitable for applications requiring equipment anchorage to resist wind loads up to 30 psf (146.6 kg/m²) acting on the full vertical projected area with 16 psf (78.1 kg/m²) acting simultaneously on the full horizontal projected area or seismic forces of 161% of the operating weight acting in the horizontal direction, and 24% of the operating weight acting in the vertical direction applied at the center of gravity. Loads are appropriate for Seismic Zone 4 assuming an Importance factor of 1.0, and soil profile SD, and rigid mounting to the supporting structure per the 1997 Uniform Building Code.

2.0 Construction Details

2.1 Cold Water Basin: The cold water basin shall be constructed of heavy-gauge steel panels and structural members. Basin shall include a depressed section with drain/clean-out connection. The basin area under the fill shall be sloped toward the depressed section to facilitate cleaning. Standard basin accessories shall include a corrosion resistant make-up valve with a large diameter plastic float for easy adjustment of operating water level.

(Alternate) 2.1 Cold Water Basin: The cold water basin shall be constructed of heavy-gauge Type 304 stainless steel panels and structural members. All factory seams shall be welded to ensure watertight construction and welded seams shall be warranted against leaks for a period of five (5) years from date of shipment. Stainless steel basins with bolted seams are not acceptable. Basin shall include a depressed section with drain/clean-out connection. The basin area under the fill shall be sloped toward the depressed center section to facilitate cleaning. Standard basin accessories shall include a corrosion resistant make-up valve with large diameter plastic float for easy adjustment of the operating water level.
(Alternate) 2.1 Cold Water Basin: Protected with TriArmor™ Corrosion Protection System: The cold water basin shall be protected with the TriArmor™ Corrosion Protection System. The system shall consist of G-235 galvanized steel encapsulated with a thermosetting hybrid polymer further protected by a polyurethane liner factory applied to all submerged surfaces. The polyurethane barrier shall seal all factory seams in the cold water basin to ensure a corrosion resistant and water tight construction, and shall be warranted against leaks and corrosion for five (5) years. Field applied polyurethane or polyurethane applied directly to galvanized steel is not an acceptable alternative. Standard basin accessories shall include: a corrosion resistant make-up valve with large diameter polystyrene filled plastic float for easy adjustment of the operating water level, removable anti-vortexing device to prevent air entrainment, and large area lift out strainers with perforated openings sized smaller than the water distribution system nozzles. The strainer and anti-vortexing device shall be constructed from Type 304 stainless steel to prevent corrosion. A welded type 304 or 316 stainless steel basin shall be an acceptable alternative; provided the basin is warranted against leaks and corrosion for a period of at least 5 years. A bolted Type 304 basin shall not be an acceptable alternative.

2.2 Water Outlet: The water outlet connection shall be beveled for welding and grooved for mechanical coupling or bolt hole circle designed to accept an ASME Class 150 flat face flange. The outlet shall be provided with large area lift out strainers with perforated openings sized smaller than the water nozzles and an anti-vortexing device to prevent air entrainment. The strainer and vortex device shall be constructed of the same materials as the cold water basin to prevent dissimilar metal corrosion.

2.3 Water Distribution System: The distribution system shall be furnished with a single water inlet. The pipe stub connection shall be beveled for welding and grooved for mechanical coupling. The hot water distribution system shall consist of an integral strainer that feeds to an open gravity type basin, for easy cleaning, and constructed of heavy-gauge G-235 (Z700 metric) hot-dip galvanized steel. The basins must be accessible from outside the unit and serviceable during tower operation. Basin weirs and plastic metering orifices shall be provided to assure even distribution of the water over the fill. Lift-off distribution covers shall be constructed of heavy-gauge G-235 (Z700) hot-dip galvanized steel. Gravity flow nozzles shall be snap-in type for easy removal. Should pressurized nozzles be used, they shall utilize grommets, which ensure easy removal.

(Alternate) 2.3 Water Distribution System: The distribution system shall be furnished with a single water inlet. The pipe stub connection shall be beveled for welding and grooved for mechanical coupling. The hot water distribution system shall consist of an integral strainer that feeds to an open gravity type basin, for easy cleaning, and constructed of heavy-gauge, Type 304 stainless steel. The basins must be accessible from outside of the unit and serviceable during tower operation. Basin weirs and plastic metering orifices shall be provided to assure even distribution of the water over the fill. Lift-off distribution covers shall be constructed of heavy-gauge, Type 304 stainless steel.
Gravity flow nozzles shall be snap-in type for easy removal. Should pressurized nozzles be used, they shall utilize grommets, which ensure easy removal.

3.0 Mechanical Equipment

3.1 Fan(s): Fan(s) shall be axial flow with aluminum alloy blades selected to provide optimum cooling tower thermal performance with minimal sound levels. Air shall discharge through a fan cylinder designed for streamlined air entry and minimum tip clearance for maximum fan efficiency. The top of the fan cylinder shall be equipped with a conical, non-sagging removable fan guard.

3.2 Bearings: Fan(s) and shaft(s) shall be supported by heavy-duty, self-aligning, grease packed ball bearings with moisture proof seals and integral slinger collars, designed for a minimum L10 life of 40,000 hours (280,000 Hr. Avg. Life).

3.3 Fan Drive: The fan(s) shall be driven by a one-piece, multi-groove, solid back V-type powerband with taper lock sheaves designed for 150% of the motor nameplate horsepower. The powerband shall be constructed of neoprene reinforced polyester cord and be specifically designed for cooling tower service.

3.4 Sheaves: Fan and motor sheave(s) shall be fabricated from corrosion-resistant materials to minimize maintenance and ensure maximum drive and powerband operating life.

3.5 Fan Motor: Fan motor(s) shall be totally enclosed air over (TEAO), reversible, squirrel cage, ball bearing type designed specifically for cooling tower service. The motor shall be furnished with special moisture protection on winding, shafts, and bearings and appropriately labeled for “cooling tower duty.”

(Alternate) 3.5 Fan Motor: Fan motor(s) shall be totally enclosed air over (TEAO), reversible, squirrel cage, ball bearing type designed specifically for cooling tower service. The motor shall be furnished with special moisture protection on winding, shafts, and bearings and appropriately labeled for “cooling tower duty.” Fan motors shall be inverter duty type designed per NEMA Standard MG1, Section IV Part 31.

3.6 Mechanical Equipment Warranty: The fan(s), fan shaft(s), bearings, mechanical equipment support, and fan motor shall be warranted against defects in materials and workmanship for a period of five (5) years from date of shipment.

3.7 ENERGY-MISER® Fan System (optional): Two single-speed fan motors, one sized for full speed and load, the other sized for 2/3 speed and approximately 1/3 the full load horsepower, shall be provided for capacity control and stand-by protection from drive or motor failure. Two-speed motor(s) are not an acceptable alternative.

(Alternate) 3.4 BALTIGUARD PLUS™ Fan System: Two single speed fan motors, one sized for load, the other sized for 1/3 of the full load horsepower shall be provided in
each cell for capacity control and standby protection from drive or motor failure. The manufacturer of the equipment shall supply controls for the larger motor, a VFD for the smaller motor and factory programmed logic controller to maximize energy saving for off-peak load and wet-bulb conditions.

4.0 Fill and Drift Eliminators

4.1 Fill and Drift Eliminators: The fill and integral drift eliminators shall be formed from self-extinguishing (per ASTM-568) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and shall be impervious to rot, decay, fungus and biological attack. The fill shall be suitable for entering water temperatures up to and including 120°F (48.8°C). The fill shall be manufactured, tested and rated by the cooling tower manufacturer and shall be elevated above the cold water basin to facilitate cleaning.

(Alternate) 4.1 Fill and Drift Eliminators: The high temperature fill and integral drift eliminators shall be formed from self-extinguishing (per ASTM-568) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and shall be impervious to rot, decay, fungus and biological attack. The high temperature fill shall be suitable for entering water temperatures up to and including 135°F (57.2°C). The fill shall be manufactured, tested and rated by the cooling tower manufacturer and shall be elevated above the cold water basin to facilitate cleaning.

5.0 Air Inlet Louvers

5.1 Air Inlet Louvers: Air inlet louvers shall be separate from the fill and be removable to provide easy access for inspection of the air/water interface at the louver surface. Louvers shall prevent water splash-out during fan cycling and be constructed of maintenance free, corrosion resistant, UV protected, fiberglass reinforced polyester (FRP).

(Alternate) 5.1 FM Approval (Multi-cell): The cooling towers shall be constructed with galvanized steel casing panels and louvers that shall meet the requirements of FM.

(Alternate) 5.1 FM Approval (Multi-cell): The cooling towers shall be constructed with Type 304 stainless steel casing panels and louvers that shall meet the requirements of FM.

6.0 Access

6.1 Plenum Access: Hinged access doors shall be provided on two sides of the tower for access into plenum section.

7.0 Sound
7.1 **Sound Level**: To maintain the quality of the local environment, the maximum sound pressure levels (dB) measured 50 ft (15240 mm) from the cooling tower operating at full fan speed shall not exceed the sound levels detailed below. If the tower exceeds these conditions the tower must be either oversized and reduced in horsepower, provided with a low sound fan, or provided with sound attenuation.

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<th>Location</th>
<th>63</th>
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**(Alternate) 7.1 Sound Level**: To maintain the quality of the local environment, the cooling tower shall be furnished with a low sound fan. The thermal performance of the cooling tower when furnished with the low sound fan shall be certified by the Cooling Technology Institute in accordance with paragraph 1.2 of this specification. Maximum sound pressure levels (dB) measured 50 ft (15240 mm) from the cooling tower operating at full fan speed shall not exceed the sound levels detailed below.

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8.0 **Accessories**

8.1 **Vibration Isolation Rails**: Spring-type vibration isolation rails, constructed of steel channels and base plates, painted with a rust-resistant primer shall be provided to minimize vibration transmission from the tower to the building structure. The isolators shall be designed for a static deflection of 1” (25.4 mm) and a maximum wind speed of 50 mph (80 km/h).

**(Alternate) 8.1 Vibration Isolation Rails**: Spring-type vibration isolation rails, constructed of steel channels and base plates, coated with a 0.003” (.076 mm) layer of zinc after fabrication shall be provided to minimize vibration transmission from the tower to the building structure. The isolators shall be designed for a static deflection of 1” (25.4 mm) and a maximum wind speed of 50 mph (80 km/h).

8.2 **Basin Heater(s)**: The cooling tower cold water basin shall be provided with electric heater(s) to prevent freezing in low ambient conditions. The heater(s) shall be selected to maintain 40°F (4.4°C) basin water temperatures at _____°F (°C) ambient. The heater(s) shall be ______V/____phase/___Hz electric and shall be provided with low water cutout and thermostat.

**(Alternate) 8.2 Basin Heaters**: A steam coil shall be factory installed in the depressed section of the cold water basin to prevent freezing during cold water shutdown. The
steam coil shall be capable of maintaining 40°F (4.4°C) basin water temperature at a –20°F (-28.8°C) ambient temperature given 5 psig (34 Kpa) at the coil inlet connection.

(Alternate) 8.2 Basin Heaters: A steam injector shall be factory installed in the cold water basin section to prevent freezing during cold water shutdown. Steam injector shall be capable of maintaining 40°F (4.4°C) basin water temperature at a ___°F (°C) ambient temperature given 10 psig (68 Kpa) at the inlet connection.

8.3 Basin Water Level Control: The cooling tower manufacturer shall provide an electric water level control (EWLC) system. The system shall consist of water level sensing and control units in quantities and locations as indicated on the drawings. Each water level sensing and control unit shall consist of the following: NEMA 4 enclosure with gasketed access cover; solid state controls including all necessary relays and contacts to achieve the specified sequence of operation; stainless steel water level sensing electrodes with brass holder; Schedule 40 PVC standpipe assembly with vent holes, and all necessary stainless steel mounting hardware. Provide PVC union directly below the control enclosure to facilitate the removal and access of electrodes and control enclosure.

The number and position of water level sensing electrodes shall be provided to sense the following: high water level, low water level, high water alarm level, low water alarm, and heater safety cutout.

8.4 Vibration Cutout Switch: Provide mechanical local reset vibration switch. The mechanical vibration cut out switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g’s.

(Alternate) 8.4 Vibration Cutout Switch: Provide electronic remote reset vibration switch with contact for BAS monitoring. Wiring shall be by the installing contractor. The electronic vibration cut out switch shall be set to trip at a point so as not to cause damage to the cooling tower. The trip point will be 0.45 in/sec (0.0114 m/sec).

8.5 Basin Sweeper Piping: The cold water basin of the cooling tower shall be equipped with PVC basin sweeper piping with plastic eductor nozzles. The piping should create a grid under the fill section and force all dirt and debris to the depressed section of the cold water basin.

8.6 Air Intake Option: Provide removable hot dip galvanized steel 1”x1” (25.4 mm x 25.4 mm) mesh air intake screens.

(Alternate) 8.6 Air Intake Option: Provide removable hot dip galvanized steel 1”x1” (25.4 mm x 25.4 mm) mesh air intake screens protected with the BALTIBOND® Corrosion Protection system or Type 304 stainless steel.

(Alternate) 8.6 Air intake Option: Provide removable Series300 stainless steel 1”x1” (25.4 mm x 25.4 mm) mesh air intake screens.
8.7 **Access Door Platform**: A galvanized steel platform and aluminum ladder to grade shall be provided at an access door to access the plenum section of the cooling tower. All working surfaces shall be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load.

8.8 **Louver Face Platform**: Easy access to the hot water basins for inspection and maintenance of the basins, even during tower operation, shall be provided by louver face platforms. Fan deck ladders and handrails, which add to the overall height of the tower, are not acceptable.

8.9 **Internal Platform**: An internal platform shall be provided in the plenum section to provide for inspection and maintenance. All working surfaces shall be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load. Other components of the cooling tower, i.e. basin floor and fill/drift eliminators, shall not be considered an internal working surface. Cooling tower manufacturers that require that these surfaces be used as a working platform shall provide a 5-year extended warranty to the Owner to repair any damage to these surfaces caused by routine maintenance.

8.10 **Fan Cylinder Extension**: To extend the height of the tower equal to the surrounding enclosure, the cooling tower shall be provided with ____ ft (mm) of fan cylinder extension. The fan cylinder extension shall match the construction of the fan deck.

9.0 **Equipment Controls (Optional)**

9.1 **Variable Frequency Drive(s)**: A variable frequency drive (VFD) shall be provided for each fan motor. The supplier of the VFD shall be the manufacturer of the evaporative cooling equipment. The VFD shall have a 3-contactor bypass, 3% input line reactor, a removable keypad, an RS232 terminal for PC connection, and a circuit breaker disconnect. Fuse protection will not be accepted. Control voltage shall be 24V to minimize the size of the enclosure which should not exceed ____ ft x ____ ft x ____ ft and the weight should not exceed ____ lbs. VFD shall be provided in a NEMA (1)(3R)(12) enclosure. The VFD shall be compatible with a (ModBus) (LonWorks) (Johnson N2) Building Automation System.

OR

9.1 **Enclosed Controls**: An enclosed control panel shall be provided for each cell of the evaporative cooling equipment. The panel shall include full voltage, non-reversing (FVNR) fan motor and pump motor (if applicable) starters in a common enclosure. The panel shall be provided with a main a circuit breaker disconnect and a separate circuit breaker for each motor or speed. Fuse protection will not be accepted. Panels containing basin heaters shall have an Earth Leakage Breaker containing ground fault protection. Starters above 25 A shall be NEMA rated. IEC starters will be accepted for motors below 25 A. Panel shall include a 120V/60Hz control power transformer, Hand-Off-Auto
switches for each starter or contactor, and pilot lights for each component. Enclosed controls shall be provided in a NEMA (1) (3R) (4) (4X) (12) enclosure.

Optional enclosed control features: (A temperature sensor shall be provided with the enclosed controls.) (A temperature controller shall be provided with the enclosed controls.) (A basin heater contactor with circuit breaker shall be provided.) (A vibration cutout switch input shall be provided.)

9.2 Safety Switch(es): A heavy-duty, non-fusible safety disconnect switch shall be provided by the manufacturer of the evaporative cooling equipment. Switch shall be single throw, 3-pole design, rated up to 600 VAC. Switch shall have triple padlocking capability, a visible double break rotary blade mechanism, a clearly visible On/Off handle, an interlocking mechanism to prevent door opening with handle in On position, and a clear line shield. Safety switch shall be provided in a NEMA (1) (3R) (12) enclosure.