FXV3 Closed Circuit Cooling Tower Specification

1.0 Closed Circuit Cooling Tower

1.1 General: Furnish and install, as shown on the plans, ___ factory-assembled closed circuit cooling tower(s) of induced draft design with vertical air discharge. Overall dimensions shall not exceed approximately ___ ft (mm) x ___ ft (mm), with an overall height not exceeding approximately ___ ft (mm). The closed circuit cooling tower shall be Baltimore Aircoil Company Model FXV3-___.

1.2 Thermal Capacity (water as heat transfer fluid): The closed circuit cooling tower shall be warranted by the manufacturer to have capacity to cool _____ USGPM (l/s) of water from _____°F (°C) to _____°F (°C) at _____°F (°C) entering wet-bulb temperature. Coil pressure drop shall not exceed _____ psi (kPa). The performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201 or, 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. Manufacturers' performance guarantees or performance bonds without CTI Certification of water ratings shall not be accepted.

(Alternate) 1.2 Thermal Capacity (aqueous glycol solution as heat transfer fluid): The closed circuit cooling tower(s) shall be warranted by the manufacturer to cool _____USGPM (l/s) of _____% by volume ethylene/propylene glycol solution from _____°F (°C) to _____°F (°C) at _____°F (°C) entering wet-bulb temperature. Coil pressure drop shall not exceed _____ psi (kPa). The performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201 or, 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. Manufacturers' performance guarantees or performance bonds without CTI Certification of water ratings shall not be accepted.

1.3 Energy Efficiency Requirements: The closed circuit cooling tower(s) shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.

1.4 Quality Assurance: The closed circuit 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 Warranty: Unless otherwise noted, the manufacturer's standard equipment warranty shall be for a period of not less than one year from date of startup or eighteen months from date of shipment, whichever occurs first. In addition, the manufacturer shall warrant the rotating mechanical equipment, including fans, fan motors, fan shafts, bearings, sheaves and associated supports for not less than five (5) years from date of shipment.

1.6 Seismic Certification: The closed circuit cooling tower shall be designed in accordance with the 2012 IBC and ASCE/SEI 7-10. The unit shall be suitable for applications with Design Spectral Acceleration at Short Period (S_{DS}) for z/h = 1.0 up to ___ g with a Component Importance Factor (I_p) of 1.0.

1.7 Wind Certification: The closed circuit cooling tower shall be designed in accordance with the 2012 IBC and ASCE/SEI 7-10. The unit shall be suitable for applications with a design horizontal wind pressure up to __ psf. Design wind pressure shall be calculated in accordance with Chapter 29 as applicable, of ASCE/SEI 7-10. A concurrent uplift pressure equivalent to the horizontal pressure shall be considered in the unit design. Unit resistance shall be determined in accordance with the material design specifications referenced in the 2012 IBC.

2.0 Construction Details

2.1 Corrosion Resistant Construction (standard): All steel panels and structural elements shall be constructed from heavy-gauge, G-235 (Z700 metric), hot-dip galvanized steel, with cut edges given a protective coating of zinc-rich compound. Casing panels shall be constructed of corrosion resistant, fiberglass, reinforced polyester (FRP).

(Alternate) 2.1 EVERTOUGH™ Construction: Unless otherwise noted in this specification, all steel panels and structural members shall be protected with a thermosetting hybrid polymer. The process shall consist of G-235 (Z700 metric) hot-dip galvanized steel prepared in a four-step (clean, pre-treat, 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 thermosetting hybrid polymer 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 95ºF (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 - 25ºF and +180ºF (-32˚C and 82˚C) without loss of adhesion or other deterioration;

6. Shall withstand 6000 hours of exposure to 60 psi (42,184 kg/m2) water jet without signs of wear or erosion.

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 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 stainless steel basin shall not be an acceptable alternative.

(Alternate) 2.1 Optional Stainless Steel Construction: All steel panels and structural elements shall be constructed from heavy-gauge, Type 304 stainless steel.

2.2 Coil Section: The heat transfer section of the closed circuit cooling tower shall be encased with removable corrosion resistant, fiberglass reinforced polyester (FRP). The coil shall be constructed of continuous serpentine all prime surface steel, be pneumatically tested at 375 psig (2,685 kPa), and be

hot-dip galvanized after fabrication. The coil shall be designed for free drainage of fluid and shall be ASME B31.5 compliant. Maximum allowable working pressure shall be 300 psig (280 psig for coils supplied with a CRN).

(Alternate) 2.2 Optional Cleanable Header Coil: Coil(s) to be constructed of continuous serpentine prime surface carbon steel, with a hot-dip galvanized (after fabrication) outside surface. Inlet and outlet headers have removable cover plates, and elbowed fluid inlet and outlet connections to allow removal of the cover plates without disturbing fluid piping. Coil(s) shall be pneumatically tested at 125 psig (895 kPa).

(Alternate) 2.2 Optional Cleanable Tube Coil: Coil(s) to be constructed with straight full-length tubes, pitched in the direction of fluid flow for free drainage, and pneumatically tested at 125 psig (895 kPa). Full-height box headers and removable cover plates allow access to all tubes at both ends. The entire assembly is hot-dip galvanized after fabrication, inside and out.

(Alternate) 2.2 Optional ASME Coil: Coil(s) shall be designed and constructed to meet the requirements of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and bear the U stamp.

(Alternate) 2.2 Optional Stainless Steel Coil: Coil(s) shall be constructed of type 304 stainless steel serpentine tube. Tubes shall be sloped for free drainage and coil assembly shall be pneumatically tested at 375 psig (2,685 kPa). Coil(s) shall be ASME B31.5 compliant. **Maximum allowable working pressure shall be 300 psig (280 psig for coils supplied with a CRN).**

(Alternate) 2.2 Optional Extended Surface Coil for Half the Rows: The coil shall be constructed of continuous serpentine all prime surface steel with half the rows finned at 5 fins per inch for seasonal wet/dry operation. The coils shall be pneumatically tested at 375 psig (2,685 kPa), and be hot-dip galvanized after fabrication. The coil shall be designed for free drainage of fluid and shall be ASME B31.5 compliant. Maximum allowable working pressure shall be 300 psig (280 psig for coils supplied with a CRN).

(Alternate) 2.2 Optional Extended Surface Coil for All the Rows: The coil shall be constructed of continuous serpentine all prime surface steel with all the rows finned at 5 fins per inch for seasonal wet/dry operation. The coils shall be pneumatically tested at 375 psig (2,685 kPa), and be hot-dip galvanized after fabrication. The coil shall be designed for free drainage of fluid and shall be ASME B31.5 compliant. Maximum allowable working pressure shall be 300 psig (280 psig for coils supplied with a CRN).

2.3 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/cleanout connection. The basin area under the fill surface shall be sloped toward the depressed section to facilitate cleaning. Standard accessories shall include large area, lift-out steel strainers with perforated openings sized smaller than water distribution nozzle orifices, an integral anti-vortexing hood to prevent air entrainment, waste water bleed line, and brass make-up valve with large diameter plastic float arranged for easy adjustment.

(Alternate) 2.3 Cold Water Basin: 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 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 stainless steel basin shall not be an acceptable alternative.

(Alternate) 2.3 Optional Stainless Steel Cold Water Basin: The cold water basin shall be made of type 304 stainless steel. All factory seams in the cold water basin shall be welded, leak tested at the factory to ensure watertight assembly and shall be warranted against leaks for 5 years.

2.4 Casing Panels: Casing panels shall be constructed of corrosion resistant, fiberglass reinforced polyester (FRP).

3.0 Spray Water System
3.1 Spray Water Pump(s): The closed circuit cooling tower shall include an appropriate number of close coupled, bronze-fitted centrifugal pump and motor assemblies equipped with mechanical seal, mounted in the basin and piped from the suction connection to the water distribution system. The pump motor(s) shall be the totally enclosed fan cooled (TEFC) type, premium efficiency suitable for _____ volts, ___ phase, and ____ hertz electrical service. The pump assembly shall include an integral metering valve and bleed line to control the bleed rate from the pump discharge to the overflow connection.

3.2 Water Distribution System: Water shall be distributed evenly over the coil at a flow rate sufficient to ensure complete wetting of the coil at all times. Large diameter, non-clog, 360° plastic distribution nozzles shall utilize a two stage diffusion pattern to provide overlapping, umbrella spray patterns that create multiple intersection points with adjacent nozzles. The branches and spray nozzles shall be held in place by snap-in rubber grommets, allowing quick removal of individual nozzles or complete branches for cleaning or flushing.

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 manufactured and performance tested by the closed circuit cooling tower manufacturer to provide single source responsibility and assure control of the final product. A separate set of drift eliminators shall be removable in easily handled sections for quick access to the coil. Eliminators shall have a minimum of three changes in air direction.

(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 140°F (60.0˚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

The air inlet louvers shall be manufactured of wave-formed, fiberglass-reinforced polyester (FRP) widely spaced to minimize air resistance and prevent water splash-out.

6.0 Mechanical Equipment
6.1 Fan(s): Fan(s) shall be heavy-duty, axial flow, with aluminum alloy blades. Air shall discharge through a fan cylinder designed for streamlined air entry and minimum fan blade tip clearance for maximum fan efficiency. Fan(s) and shaft(s) shall be supported by heavy-duty, self aligning, grease-packed ball bearings with moisture-proof seals and integral slinger rings, designed for minimum L10 life of 80,000 hours. Fan(s) shall be drive by a one-piece, multi-groove neoprene/polyester belt designed

specifically for evaporative cooling service. Fan and motor sheave(s) shall be fabricated from cast aluminum.

6.2 Fan Motor: Fan motor(s) shall be totally enclosed air over (TEAO), reversible, squirrel cage, ball bearing type designed specifically for evaporative cooling duty on ____ volt/ ___ hertz/ ____ phase electrical service. The motor shall be furnished with special moisture protection on windings, shafts, and bearings. Fan motors shall be premium efficient/inverter duty type designed per NEMA Standard MG1, Section IV, Part 31.

(Alternate for ENDURADRIVE™ Fan System): Fan(s) shall be driven by direct drive TEAO motor(s) with an IP66 NEMA enclosure rating. Fan system shall be capable of operating at any speed with no minimum requirement. Motor insulation type shall be Class H and shall be rated at 1850 volts peak. Bearings shall be designed for a minimum L10 life of 100,000 hours. Motor paint shall be capable of passing a 1000 hour salt fog test. Motor shall be provided with normally closed thermostats. Space heater shall be included if drive system does not include automatic protection from moisture for motor windings. If oil is required, an extended oil fill line, electric oil heater, low oil level switch, and oil level sight glass shall be included.

Variable frequency drive(s) shall be provided by the manufacturer and designed specifically for the cooling tower motor(s); refer to VFD specification for details. The drive enclosure shall be provided in (NEMA 1 indoor-rated) (NEMA 12 indoor-rated) (NEMA 3R outdoor-rated) enclosure(s).

(Alternate for ENDURADRIVE™ Fan System) Mechanical Equipment Warranty: The motor shall be warranted against defects in materials and workmanship for a period of seven (7) years from date of shipment. The fan(s), fan shaft(s), sheaves, bearings, and mechanical equipment support shall be warranted against defects in materials and workmanship for a period of five (5) years from date of shipment.

6.3 BALTIGUARD™ 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.

7.0 Access

7.1 Plenum Access: A large, hinged access door shall be provided on each end wall for access to the coil, drift eliminators, and fan plenum section. The water make-up valve, float ball, and suction strainer shall be easily accessible. On single side air inlet units, the access door shall open to a standard internal walkway.

8.0 Sound

8.1 Sound Level: To maintain the quality of the local environment, the maximum sound pressure levels (dB) measured 50 ft (15,240 mm) from the closed circuit cooling tower operating at full fan speed shall not exceed the sound levels detailed below.

(Alternate) 8.1 Sound Level: To maintain the quality of the local environment, the closed circuit cooling tower shall be furnished with a low sound fan. The thermal performance of the closed circuit cooling tower shall be certified by the Cooling Technology Institute in accordance with paragraph 1.2 of this specification when furnished with the low sound fan. Maximum sound pressure levels (dB) measured 50 ft (15,240 mm) from the closed circuit cooling tower operating at full fan speed shall not exceed the sound levels detailed below.

9.0 Accessories

9.1 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) pan 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.

9.2 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.

9.3 Vibration Cutout Switch: Provide mechanical local reset vibration switch. The mechanical vibration cutout 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) 9.3 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).

9.4 Basin Sweeper Piping: The cold water basin of the cooling tower shall be equipped with PVC sump sweeper piping for a separator (supplied by others).

9.5 Intake Sound Attenuation: The unit shall be equipped with intake sound attenuators consisting of fiberglass acoustical baffles encased in steel to further reduce sound levels.

9.6 Sound Attenuation: The unit shall be equipped with a straight hood lined with sound absorbing fiberglass acoustical baffles to reduce sound levels from the top of the unit.

9.7 Heat loss: The heat loss for the FXV shall be equal to or less than _____ BTUH using either a standard unit, a unit with a hood, positive closure dampers, insulation or a combination.

9.7 Heat loss: The heat loss for the FXV with a hood and positive closure dampers shall be equal to or less than _____ BTUH. The linkages in the PCD hood shall be stainless steel.

9.8 External platform with ladder: A pre-assembled galvanized steel platform and aluminum ladder to grade shall be provided to access the distribution system. The maintenance personal shall be able to inspect the distribution system while the unit is operational. All working surfaces shall be able to withstand 50 psf live load or 200 pound concentrated load

(Alternate) 9.8 Ladder: An aluminum ladder (with galvanized steel safety cage) shall be provided for access to the fan deck. Access door or service platforms shall not be accepted as equal.

(Alternate) 9.8 Handrails: 1-1/4" galvanized steel pipe handrail shall be proved around the perimeter of the cooling tower cells. The handrails shall be provided with knee and toe rails and shall conform to the requirements of OSHA.

9.9 An internal walkway shall be provided in the plenum section to provide for inspection and maintenance. All working surfaces shall be able to withstand 50 psf (244 g/m2) live load or 200 pound (90.7 Kg) concentrated load. Other components of the cooling tower, i.e. basin and fill/drift eliminators,

shall not be considered an internal working surface. Manufacturers that require that these surfaces be used as a working platform shall provide a two-year extended warranty to the Owner to repair any damage to these surfaces caused by routine maintenance.

9.10 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 live load or 200 pound concentrated load. Other components of the cooling tower, i.e. basin floor and fill/drift eliminators, shall not be considered an internal working surface. Manufacturers that require that these surfaces be used as a working platform shall provide a two-year extended warranty to the Owner to repair any damage to these surfaces caused by routine maintenance.

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

9.12 Motor Removal System: The unit shall be equipped with a mechanical equipment removal davit. The motor shall be lowered from the mechanical equipment supports down to grade. Davit shall attach to the unit without the need for tools. If tools are required for davit installation or removal, provide (1) davit for each motor provided.

9.13 Externally Mounted Pre-wired Terminal Box: The cooling tower shall ship from the factory with the fan motor(s) (and vibration cutout switch) wired to terminal blocks encased in a 304 stainless steel NEMA 3R enclosure, mounted on the outside of the tower. No casing penetrations shall be permitted in the field.

9.14: Top Mounted Combined Inlet Shields: The air inlet on the top of the unit shall be supplied with combined inlet shields. These blockers shall be UV resistant PVC and shall minimize sunlight exposure on the coil to reduce the potential for algae growth.