SECTION 236500 – PACKAGED COOLING TOWERS

PART 1 – GENERAL

1.1. Any deviance from the following instructions must be approved during design by WVU Facilities Management project manager.

1.2. All cooling towers shall be certified by the Cooling Tower Institute, (CTI). These towers shall have been tested, rated, and certified in accordance with CTI Standards, and shall bear the CTI certification label, and shall be listed in the CTI directory of certified cooling towers.

1.3. List of acceptable manufacturers:

A. Baltimore Air Coil
B. Delta Cooling Towers
C. Marley
E. Trane

1.4. Variable speed drive and indoor sumps shall be analyzed on all systems.

1.5. WVU utilizes third party term contractor to treat the cooling systems. The contractor shall be involved during the project design phase for their input. Their equipment must also be purchased and installed by the contractor during the construction phase.

PART 2 – PRODUCTS

2.1. Materials

A. Fiberglass Reinforced Polyester (FRP): This material is used in applications where there are components in the water that are highly corrosive to metal. FRP with maximum flame spread rating of five according to ASTM E84.

B. Metal: Galvanized Steel: Hot-dip galvanized steel complying with ASTM A653/A653M, and having G235 (Z700) coating. Stainless Steel: ASTM A666, Type 304 or 316.

C. Polyvinyl Chloride (PVC): Polyvinyl chloride (PVC) is used in applications where there are corrosive materials in the water.

D. The choice between FRP or Metal or PVC shall be approved by the owner based on the application. Fasteners: Zinc or cadmium coated bolts or tapping screws for assembly. Use stainless steel washers with neoprene backing where required for preventing leaks. Joints: Sealed watertight.

2.2. Framing: Rolled structural steel shapes, hot-dip galvanized after fabrication or structural shapes cold formed from galvanized steel sheets or plates, complying with ASTM A653/A653M, and having G235 (Z700) coating.

2.3. Louvers: Minimum splash out type. Material for the louvers shall be similar to the casing or may be FRP or PVC if formed integral with the fill material. 25 mm (1 inch) inlet screen, hot dipped / galvanized steel or copper / stainless steel. / Attach the screen securely to air intakes.

2.4. Fill: PVC / FRP / resistant to rot, decay and biological attack; with a maximum flame spread rating of five per ASTM E84 and fabricated, formed and installed by manufacturer to ensure that water breaks up into droplets.

2.5. Drift Eliminators: Same as fill material. Eliminators shall ensure a maximum drift rate of 0.001 percent of recirculated water. Eliminate the combustible materials when cooling tower is located 40 feet or closer to hazards such as chimneys, and incinerators or when roof mounted.

2.6. Hot Water Distribution System: Open basin, flume and troughs, or a pipe system with nozzles spaced for even distribution of water over fill material. Provide access door. System shall be self-draining and non-clogging. Spray nozzles, if used, shall be cleanable stainless steel, bronze or high impact plastic, non-clog, removable type properly spaced for even distribution. Provide cover for entire nozzle area or flume/trough area. Provide manufacturer's standard pre-strainer assembly and butterfly or globe valve, for cross flow tower, to balance the water flow to each basin.

2.7. Collecting Basin: Material same as the unit casing or concrete in accordance with manufacturer's standard details. Outlet pump may also be of heavy glass-reinforced polyester (GRP) for depressed side outlet type. Provide a bronze make-up water float valve, overflow, drain not less than 2 inches suction connections, and outlet sump of size and depth to prevent cavitation and air entrapment in pump.

Provide the following accessories:

A. Manufacturer's standard bronze make up water float valve with an adjustable linkage / Electric float switch and a solenoid operated make-up valve.
B. Removable basin strainer, constructed of 304 stainless steel, shall have openings smaller than nozzle orifices.
C. Make-up water, overflow and drain connections.
D. Equalizer connection (multiple cooling tower systems).
E. Flume plate between adjacent cells (multi-cell units only).
F. Stainless steel basins shall be welded and include a 5 year leak warranty.

2.8. Fans, Motors and Drives: Centrifugal or propeller type constructed of hot-dip galvanized steel, cast aluminum or aluminum alloy, glass fiber reinforced polyester or glass reinforced epoxy, statically and dynamically balanced at factory for quiet and efficient operation. Forced-draft towers shall be centrifugal type only. Fans for induced-draft towers of 350 kW (100 tons) and less, and for forced-draft towers shall be belt driven.

A. For induced draft towers larger than 350 kW (100 tons), fan shall be driven through a gear reducer, or driven by a special V belt.
B. Gear reducer drive: Specially designed for cooling tower operation, with dynamically balanced drive shaft assembly or shock absorbent flexible coupling requiring no lubrication, cast iron case with readily accessible oil drum and fill, and self-contained oil reservoir sealed against water entrance.
C. Fan shall be driven by a one-piece, multi-groove, neoprene/polyester belt.
D. The alignment and balancing of the fans, motors and drive shaft as installed shall operate within the vibration tolerance.
E. Motors and Motor Controllers: Evaluate variable speed motors and controllers.

2.9. Belt Drive:

A. Type: ANSI standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
B. Dimensions, rating and selection standards: ANSI IP-20 and IP-21.

C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI service factor (not less than 20 percent) in addition to the ANSI allowances for pitch diameter, center distance, and arc of contact.
D. Maximum Speed: 25 m/s (5000 feet per minute).
E. Adjustment Provisions: For alignment and ANSI standard allowances for installation and take-up.
F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.
G. Multiple Belts: Matched to ANSI specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.
H. Sheaves and Pulleys:
   1. Material: Pressed steel, or close grained cast iron. Induced draft units shall use aluminum sheaves due to corrosion potential.
   2. Bore: Fixed or bushing type for securing to shaft with keys.
   3. Balanced: Statically and dynamically.
   4. Groove spacing for driving and driven pulleys shall be the same.
   5. Minimum Diameter of V-Belt Sheaves (ANSI recommendations) in millimeters and inches:

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. OD mm (in)	Cross Section	Min. OD mm (in)	Cross Section	Min. OD mm (in)
2L	20 (0.8)	A	83 (3.25)	3V	67 (2.65)
3L	38 (1.5)	B	146 (5.75)	4V	180 (7.10)
4L	64 (2.5)	C	239 (9.40)	5V	318 (12.50)
5L	89 (3.5)	D	345 (13.60)		
		E	554 (21.80)		

I. Drive Types, Based on ARI 435:
   1. Provide adjustable-pitch or fixed-pitch drive as follows:
      a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
      b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
   2. Provide fixed-pitch drives for drives larger than those listed above.
   3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

2.10. Drive Guard:

A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor.
B. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
C. Access for Speed Measurement: 25-mm (One-inch) diameter hole at each shaft center.

2.11. Electric Motors:

A. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.
B. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).
C. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.
D. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.
E. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.12. Variable Speed Motor Controllers:

A. The combination of controller and motor shall be sized as per the respective manufacturer's recommendations, and shall be rated for 100 percent output performance.
B. Variable Frequency Drives shall have a bypass function (preferred manufacturer: ABB)
C. Motors shall be energy efficient type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch C. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system. In addition to the requirements, the following shall apply:
    1. Motors: Totally enclosed, epoxy encapsulated or totally enclosed fan cooled (TEFC) conforming to NEMA 250.
    2. No remote lubrication fittings are allowed.
    3. Fans over 60 inches in diameter shall include a vibration cutout switch located in a protected position to effectively monitor fan vibration. Vibration switch shall be solid-state with adjustable time delay in NEMA 250, Type 4 enclosure. It shall stop fan motor under excessive fan vibration. The switch shall be accessible from the exterior of the tower.

2.13. Safety: Provide fan guards, ladders, handrails and platform in conformance with the ANSI A10.18 as follows:

A. Fan Guard: Removable fan discharge with a rigid framed screen guard, installed over the fan cylinder.
B. Ladders: Vertical hot-dip galvanized steel or aluminum ladder for each tower located outdoors. Ladders higher than 12 feet shall have safety cage. Ladders shall extend to within one foot of the grade or the roof deck surface.

C. Hand Railing: Steel or aluminum hand railings not less than 42 inches high around perimeter of each fan-deck, or working surface 12 feet or more above ground, roof or other supporting construction. Handrails shall meet OSHA Standards.
D. Platform: Galvanized steel with a bar-grating floor. The platform shall be continuous and on all sides of the tower.
E. Catwalk: There shall be a galvanized catwalk inside of the cooling tower. It shall be located in such a location to ease access to service bearings, belts, motors.

2.14. Electric Basin Heater: Provide electric immersion heater with water-tight junction boxes mounted in the basin with sufficient capacity to maintain 40 degrees F water in the basin. Heater shall be complete with control thermostat, control circuit transformer, contactor, and low water level heater protection.

2.15. Electric Heat: Tracing during winter operation shall be provided by either manufacturer or installer. This shall include all outdoor piping and valves.

PART 3 – EXECUTION

3.1. Provide permanent rigging, hoist beams, rollers, cranes, and similar devices as necessary to help facilitate future maintenance. This is important in such areas as motor and fan blade removal. If mounted outdoors such equipment shall be galvanized.

3.2. Install cooling tower according to equipment manufacturer's written instruction.

3.3. Install cooling towers plumb, level and anchored on structure provided. Coordinate steel structure with cooling tower-mounting requirements.

3.4. Install vibration controls according to manufacturer's recommendations.

3.5. Maintain recommended clearances for service and maintenance.

3.6. Piping:
1. Install piping, including flanges or union adjacent to cooling towers to allow for service and maintenance.
2. Install flexible pipe connectors at connections to cooling towers mounted on vibration isolators.
3. Install shutoff/balancing valves at cooling tower inlet connections.
4. Connect overflow drain and blow down lines to sanitary sewage system. Blow-down valves shall be full-port ball valves, and shall be heat traced with self-regulating heat tape.
5. Connect sheet metal ducts to inlet and outlet of liquid coolers if installed indoors.

3.7. Start-up and Testing:

A. Provide the services of a factory-authorized and qualified representative to perform start up service. Proper start-up procedure for water treatment and basin conditioning shall be detailed in the Contract Specifications and Contract Drawings.
B. Inspect field-assembled components and equipment installation, including piping and electrical connections.
C. Obtain and review performance curves and tables.
D. Perform startup checks, according to manufacturer's written instructions, and as noted below:
   1. Check clearances for airflow and tower servicing.

2. Check for vibration isolation and structural support.
3. Verify fan rotation for correct direction. Correct rotation if needed.
4. Adjust belts to proper alignment and tension.
5. Lubricate rotating parts.
6. Operate equipment controls and safeties.
7. Verify that tower discharge is high enough and it does not recirculate into air intake. Recommend corrective action.

E. Adjust water level for proper operating level and balance condenser water flow to each tower inlet.
F. Check water treatment water system, including blow down for proper operation of the tower.
G. Start cooling tower, including condenser water pumps and verify the tower operation.

END OF SECTION 236500