SECTION 23 68 00 - COOLING TOWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment, and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTALS

A. Submittals shall be job specific and include the following:
   1. Tower Performance Analysis showing Flow (GPM), Tower Inlet/Outlet Temperatures (°F), Wet Bulb Temperature (°F), required Motor Horsepower, and kW/Ton at design conditions and part load conditions as specified by Engineer.
   2. Drawings showing plan and elevation views with all critical dimensions, tower weight (dry & operating), design operating conditions, and motor data.
   3. Dimensioned fabrication drawings of tower support structure accompanied by all manufacturers engineering load calculations confirming design.
   4. All necessary wiring diagrams showing internal tower wiring and all required field connections by others.
   5. Drawing of tower “Lift Rigging” recommendations showing proper sizing of spreader bar, locations of pre-installed lifting brackets, and final leveling instructions.
   6. Wiring diagrams and Installation drawings shall also be provided for all optional equipment (Tower Control Panel, VFD) when applicable.
   7. Copy of manufacturers’ written warranty regarding materials and labor, along with the conditions under which warranty is subject.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Cooling Tower module “where possible” shall arrive as single, fully assembled and wired component, on a flatbed trailer.

B. Upon arrival of tower module(s) (prior to any lifting operation), the tower shall be inspected on the truck by the owner’s representative for general acceptance. Any items of concern related to damage or lifting operations shall be documented and reported (in writing) to the manufacturer’s representative. The owner’s representative or his crane operator shall inspect all corner lifting brackets and their bolting to the tower.

C. Prior to lifting tower, all excess water should be removed from basin.

D. Should tower need to be temporarily placed on the ground prior to its final positioning, the tower shall be stored on sound and level surface in accordance with manufacturer’s recommendations.

1.4 WARRANTY

A. Cooling Tower manufacturer shall provide material and labor warranty, in accordance with conditions specified within written warranty, as follows:
   1. External Shell – Fifteen (15) years from date of shipment from factory. Excludes cosmetic or superficial damage/wear.
   2. Internal Components – Five (5) years from date of shipment from factory.
   3. Mechanical Components – Five (5) years from date of shipment from factory.
   4. Labor – Three (3) year from date of shipment from factory.

1.5 ACCEPTABLE MANUFACTURERS

A. The following manufacturers, in compliance with specifications and thermal performance contained herein, are considered acceptable:
   1. Tower Tech Inc.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Tower shall be a factory assembled, forced draft, counter-flow, modular cooling tower. Tower shall include 6' sub-structure leg supports. The tower's principal construction shall be of pultruded Fiberglass Reinforced Polyester (FRP) and must have a flame spread rating less than 25 or a flammability coefficient of 94-V0. Towers constructed of metal shall have all steel panels and structural members, including structural frame, hot and cold water basins, distribution covers, fan deck, and fan cylinder manufactured from 316 or 304 Stainless Steel and assembled with type 304 stainless steel nut and bolt fasteners as further specified in this specification. The modules must be capable of operating independently or in combination with future modules.

2.2 THERMAL PERFORMANCE

A. The tower shall be capable of requirements per schedule. The manufacturer shall guarantee the tower(s) supplied will meet the specified performance conditions when the tower(s) is (are) installed according to plan and per the guidelines established in the tower manufacturers current Installation, Operation and Maintenance Manual.

B. Cooling tower must be Cooling Technology Institute (CTI) Certified as set forth in the CTI Certification Standard STD-201(04). Towers claiming to be CTI "listed" or "designed" to CTI specifications shall not be acceptable.

2.3 DESIGN LOADING

A. Tower shell and substructure (support legs) shall be designed to withstand a sustained wind load of 150 MPH and seismic force factor of Cs = 0.4 x weight, category D (Ss = 200, S1 = 150, soil class E) as referenced in the International Building Code.

2.4 CONSTRUCTION

A. The cold water basin and the tower casing for the basis of design unit shall be constructed of pultruded Fiberglass Reinforced Polyester (FRP) with UV inhibitors. FRP shall have a minimum thickness of ¼" and a minimum density of 0.7 oz./cu.in. Specially placed reinforcement and a UV veil layer will ensure the structural strength and longevity. If a metal tower is provided, the cold-water basin, hot water basin and casing shall be constructed of 316 Stainless Steel. The structural members shall be constructed of minimum 304 Stainless Steel.

B. PERIMETER BASIN (External Shell)

1. The basis of design unit shell or casing shall have an integral perimeter basin. Its elevated basin shall reduce operational pump head requirements. Its high velocity water flow (5 to 7 fps) during operation shall minimize accumulation of sediment. Perimeter basin shall be equipped with one inspection port, at each corner support member, on the front and rear surfaces.
2. Basin shall be equipped with stainless steel basin heater elements. Heater shall have corrosion and liquid proof enclosure. The basin heater package shall include a combination controller and probe (temperature and level sensor) preset at 45°F. This sensor probe is stainless steel with a ½" NPT mounting fitting. The control panel contains the electronic temperature/flow liquid level control, control voltage transformer, and the magnetic contactor used to energize and de-energize the heaters. Heaters must be interlocked with pump control to deactivate heaters when cooling tower pumps are operating. Control panel is NEMA 4X, UL rated. Control panel door includes standard lockout disconnect. Panel and probes shipped loose for field install. A separate 3-Phase power source must be supplied to the control unit. Interlock with pump control completed in the field by others.

C. SUMP (Mechanical Component)

1. Tower shall be equipped with an end wall mounted sump with a bottom outlet providing a flanged (150 lbs bolt pattern) discharge connection for simplified piping. As an alternate a depressed 304 SS center section design with drain and clean out connection can be provided.
2. Standard equipment shall include a manufacturer supplied and mounted brass float valve with brass or stainless steel components. Connection size shall be 2" NPT. Also included are a flanged overflow/equalization connection, and a corrosion-free, easily removable debris screen. Sump shall be covered by a five (5) year warranty.
3. Towers with basins that do not provide a min 5-7fps of basin velocity shall include a "Sweeper" piping system to prevent sediment buildup and/or stagnant water areas that permit algae and other biological growth. Sweeper piping system shall include all necessary "Eductor" nozzles, piping, pump, sediment separator, and electronic controllers for a completely automatic system.

D. FILL AND DRIFT ELIMINATORS (Internal Component)

1. Fill shall be Polyvinyl Chloride (PVC) of cross-fluted design, minimum 10 mil (after forming), impervious to decay, fungus and biological attack. Fill sheets shall be self-spacing, supported on maximum spans of 12". Each fill sheet shall have a microstructure to improve heat transfer. The flute opening of the fill pack shall not be less than 1900mm (3/4"). Fill packs or blocks shall be placed in the tower so as to provide the tightest fit possible without damage to the fill.
2. Drift eliminators shall be minimum three-pass Polyvinyl Chloride (PVC) material of cellular design impervious to decay, fungus and biological attack. Drift losses shall not exceed 0.0004% of the design circulating flow rate at full fan speed. Fill and drift eliminators shall be covered by a five (5) year warranty.

E. WATER DISTRIBUTION SYSTEM (Internal Component)

1. The basis of design unit distribution system shall be comprised of a single inlet, enclosed, low pressure, non-corrosive Polyvinyl Chloride (PVC) Schedule 40 piping system. Water will be distributed further using 4" Schedule 40 PVC lateral(s). Water shall be evenly sprayed over the fill media by evenly spaced and sized High Density Polyethylene (HDPE) rotary spray nozzles. The nozzles shall have a four (4) inch NPT connection and rotating disk for clog free operation, produce a square pattern, and shall be located no more than three inches above the fill media. The nozzles must operate between a minimum of ½ PSI and a maximum of 1½ PSI pressure drop. Nozzles shall be capable of a variable flow of 100 GPM to 300 GPM while maintaining full fill media coverage.
2. Alternative distribution system shall include minimum 316 stainless steel hot water basins, which shall receive hot water piped to each cell of the tower. Distribution system shall be designed so that a single hot water inlet connection is provided. Basins shall be sealed at the factory and shall be equipped with removable, stainless steel covers capable of withstanding a minimum of 60 psf live load or a 200 lb concentrated load. All components of the hot water basin shall be 316 stainless steel with the exception of the nozzles and hardware. Each basin shall include an inlet hole and bolt circle to accept a 125# flange. Removable polypropylene nozzles shall provide coverage of the fill by gravity flow. The water distribution system shall be covered by a five (5) year warranty.

F. WATER COLLECTION SYSTEM (Internal Component)

1. The basis of design tower shall utilize a water collection system positioned beneath the fill media and above the air inlet. The water collection system shall collect cold water as it falls from the fill media and channel the water into the tower's elevated perimeter basin permitting the mechanical equipment to be mounted in the dry entering air stream beneath the tower. The water collectors shall be made of extruded flame retardant Acrylonitrile Butadiene Styrene copolymer (ABS) material and shall contain an integral damper system that opens mechanically with airflow. The damper system will prevent entry of airborne debris when the fan below it is off. The water collection system shall be covered by a five (5) year warranty.

G. MOTORS (Mechanical Component)

1. The motors shall be Totally Enclosed Air Over (TEAO) with a service factor of 1.15 and must be suitable for 460-Volt, 3-phase, 60-Hz service. Motors shall be nominal 860 RPM and be rated for inverter duty. All motors shall be factory pre-wired using oil resistant, VFD compatible, Double Shielded Cable to J-box. Motors shall be covered by a five (5) year warranty.

H. FANS (Mechanical Component)

1. Fans shall be of an axial, airfoil design positioned within an aerodynamically streamlined fiberglass or 316 stainless steel shrouds and installed with a minimum tip clearance for maximum efficiency. Fan blades shall be manufactured of Fiberglass-Reinforced Polypropylene or aluminum alloy and be pitch-adjustable. Fan hubs shall be manufactured of high strength, low weight aluminum alloy to minimize stress and wear on motor bearings. The tower shall have a minimum of 2 fans to handle the design conditions. The basis of design tower shall have 4 direct drive fans per module. The basis of design tower shall have the fan assembly and motor located outside the hot moist exiting air stream.
2. Towers utilizing gear reducers or belt drive units positioned in the moist exiting air stream must provide one replacement spare of each mechanical component.
3. Tower utilizing gearboxes or belt drive units shall provide a single pole, double-throw vibration limit switch in a NEMA 4 housing. Unit shall be installed on the mechanical equipment support for wiring into the fan motor shutdown circuit.
4. All major mechanical components, including fans, drive trains, fan motors, and fan motor/drive train supports are covered by a five (5) year mechanical warranty. Towers not covered by a warranty of this scope will not be accepted.

I. Pan Heater: Provide pan heater to project tower from freezing with 10ºF outside air temperature.

2.5 TOWER CONTROLS

A. The motor control panels shall be equipped with a cover mounted lockable main disconnect and individual HAND-OFF-AUTO controls for each fan motor. Each internally mounted motor overload protector shall be an integral lockable circuit breaker to enable individual motor isolation with lock out/tag out capability. The control panel shall be completely pre-wired. Terminal blocks are provided for the main power feed and the individual fan motor connections, and any externally mounted control input and outputs. The enclosure for the motor control panel shall be a NEMA-4 rated, powder coated hinged steel box with full back plate and gasket door.

B. The motor control panel shall have a preprogrammed PLC and temperature input device to control a remote variable-frequency drive. Each motor overload protector is equipped with an auxiliary relay. Should a motor overload trip a dry contact signal shall be available to the Building Automation System (BAS) for notification.

C. Provide with HMI touch screen equipped with a protective panel door that is lockable.

D. The PLC shall supply an intermittent 4-20 milliamp signal to control an external variable-frequency drive (VFD). See Section 23 05 00 for Drive.

E. Provide tower control panel with BACnet/MSTP Interface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with project engineering drawings and manufacturer's installation, operation, and maintenance manuals.

B. Provide all required supports, attachments devices, and accessories needed to insure quiet operation.

C. Contractor shall be responsible for all design, engineering, and installation involving changes or adjustments to the specified cooling tower to the satisfaction of the engineer at no cost to the owner.

D. Provide representative of manufacturer for installation supervision and start up.

3.2 HVAC EQUIPMENT INSTALLATION

A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

B. Engage a factory authorized service representative to perform startup service. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

C. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain cooling tower(s) and controls including:
   1. Starting and Stopping of Fan Motors
   2. Sequence of Operation
   3. Troubleshooting & Servicing
   4. Routine Maintenance
   5. Schedule training with Owner, through Engineer or Construction Manager

END OF SECTION