SECTION 23 64 01 – AIR COOLED WATER CHILLERS (LESS THAN 150 TONS)

PART 1: GENERAL

1.1 GENERAL

A. This standard is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. The responsibility of the engineer is to apply the principles of this section such that the University of Texas at Dallas may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be justified through LCC analysis and submitted to UT Dallas for approval.

B. Flow Characteristics: Variable primary flow should be strongly considered for these chiller systems. Variable primary flow reduces pump energy consumption, reduces first cost, eliminates low Delta T staging issues, and increases mechanical room space with the deletion of the primary only pumps. When designing variable flow systems the designer must ensure the basis of design chiller can allow for at the least 40% reduction in flow and 60% or greater is preferred. IFM Efector chiller flow switches must be specified with the chiller. The system must be designed with programmable slow acting isolation valves, a high quality flow meter, and a wide ranging linear flow globe type bypass valves.

1. Engineer must ensure his specification and design meet all of the scheduled manufacturers recommended clearances. A minimum of 4" housekeeping pad must be utilized. Roof mounted installations shall utilize spring isolators sized and provided from the manufacturers factory. Extra care should be taken to ensure the top of the condenser fans are at or above the screen wall height (except on one side if against building).

C. Manufacturers:

1. York YVAA or YCIV or YCAV (Preferred Scheduled Basis of Design)
2. Trane RTAC High Efficiency Models only
3. Carrier Aquaforce
4. McQuay AWS with VFD

1.2 SCOPE

A. Provide Microprocessor controlled, multiple-screw compressor, air-cooled, liquid chillers of the scheduled capacities as shown and indicated on the Drawings, including but not limited to:

1. Chiller package
2. Charge of refrigerant and oil
3. Electrical power and control connections
4. Chilled fluid connections
5. Manufacturer start-up

1.3 QUALITY ASSURANCE

A. Products shall be Designed, Tested, Rated and Certified in accordance with, and Installed in compliance with applicable sections of the following Standards and Codes:

1. AHRI 550/590 – Water Chilling Packages Using the Vapor Compression Cycle
2. AHRI 370 – Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment
3. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration
4. ANSI/ASHRAE 34 – Number Designation and Safety Classification of Refrigerants
5. ASHRAE 90.1 – Energy Standard for Buildings except Low-Rise Residential Buildings
6. ANSI/NFPA 70 – National Electrical Code (N.E.C.)
7. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1
8. OSHA – Occupational Safety and Health Act

9. Manufactured in facility registered to ISO 9001
10. Conform to Intertek Testing Services for construction of chillers and provide ETL/cETL Listed Mark

B. Factory Run Test: Chiller shall be pressure tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessel.

C. Chiller manufacturer shall have a factory trained and supported service organization.

D. Warranty: Manufacturer shall Warrant all equipment and material of its manufacture against defects in workmanship and material for a period of 66 months from date of shipment or 60 months from date of start-up, whichever occurs first. Warranty must include parts, labor, and refrigerant for entire period of warranty.

1.4 DELIVERY AND HANDLING

A. Unit shall be delivered to job site fully assembled with all interconnecting refrigerant piping and internal wiring ready for field installation and charged with refrigerant and oil by the Manufacturer.

B. Provide protective covering over vulnerable components for unit protection during shipment. Fit nozzles and open ends with plastic enclosures.

C. Unit shall be stored and handled per Manufacturer's instructions.

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. York YVAA or YCIV or YCAV (Preferred Scheduled Basis of Design)

1. Trane RTAC High Efficiency only
2. Carrier Aquaforce
3. McQuay AWS with VFD

2.2 GENERAL

A. Description: Furnish, Install, and Commission factory assembled charged, and operational run tested air-cooled screw compressor chiller as specified herein and shown on the Drawings. Chiller shall include, but is not limited to: a complete system with multiple independent refrigerant circuits, semi hermetic twin screw compressors, shell and tube hybrid falling film type evaporator, air-cooled condenser, R134a refrigerant, lubrication system, interconnecting wiring, safety and operating controls including capacity controller, control center, motor starting components, and special features as specified herein or required for safe, automatic operation.

B. Operating Characteristics:

1. Provide low and high ambient temperature control options as required to ensure unit is capable of operation from 0° F to 125° F (-18°C to 52°C) ambient temperature.

2. Provide capacity control system capable of reducing unit capacity to 10% of full load for 2 compressor units. Compressor shall start in unloaded condition.

C. Cabinet: Unit panels, structural elements, control boxes and heavy gauge structural base shall be constructed of painted galvanized steel. All exposed sheet steel shall be coated with baked on powder paint to meet 500-hour salt spray test in accordance with the ASTM B117 standard.

D. Shipping: Unit shall ship in one piece and shall require installer to provide only a single evaporator inlet and outlet pipe connection.

If providing chiller model that ships in multiple pieces, bid shall include all the material and field labor costs for factory authorized personnel to install a trim kit to connect the pieces as well as all interconnecting piping and wiring.

2.3 COMPRESSORS

A. Compressors: Shall be semi hermetic, rotary twin-screw type, including: muffler, temperature actuated 'off-cycle' heater, rain-tight terminal box, discharge shut-off service valve, suction shut-off service valve for each compressor, and precision machined cast iron housing. Design working pressure of entire compressor, suction to discharge, shall be 350 psig (24 barg) or higher. Compressor shall be U.L. Recognized.

B. Compressor Motors: Refrigerant suction-gas cooled accessible hermetic compressor motor, full suction gas flow through 0.006" (0.1524 mm) maximum mesh screen, with inherent internal thermal overload protection and external current overload on all 3 phases.

C. Balancing Requirements: All rotating parts shall be statically and dynamically balanced.

D. Lubrication System: External oil separators with no moving parts, 450 psig (31 barg) design working pressure, and ETL listing shall be provided on the chiller. Refrigerant system differential pressure shall provide oil flow through service replaceable, 0.5 micron, full flow, cartridge type oil filter.

E. Capacity Control: Compressors shall start at minimum load. Provide microprocessor control to command compressor capacity to balance compressor capacity with cooling load.

2.4 REFRIGERANT CIRCUIT COMPONENTS

A. Refrigerant: R-134a Classified as Safety Group A1 according to ASHRAE 34.

B. Equipment supplied shall comply with LEED Energy & Atmosphere Credit 4, Enhanced Refrigerant Management. (If LEED Project).

C. Each independent refrigerant circuit shall incorporate all components necessary for the designed operation including: liquid line shut-off valve with charging port, low side pressure relief device, removable core filter-drier and sight glass with moisture indicator.

D. Chiller manufacturer shall provide an independent circuit for each compressor to provide maximum redundancy during chiller operation. If equipment does not have independent circuits per compressor, manufacturer shall provide owner one spare compressor of each unique size.

E. Discharge lines shall be provided with manual compressor shut-off service valves.

2.5 HEAT EXCHANGERS

A. Evaporator:

1. Evaporator shall be shell and tube type with 2 or 3 pass arrangements to optimize efficiency and refrigerant charge. Tubes shall be high-efficiency, internally and externally enhanced type copper tubes with 0.035" (0.89 mm) minimum wall thickness at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube shall be roller expanded into the tube sheets providing a leak proof seal, and be individually replaceable. Independent refrigerant circuits shall be provided per compressor (preferred not required).

2. Constructed, tested, and stamped in accordance with applicable sections of ASME pressure vessel code for minimum 235 psig (16 barg) refrigerant side design working pressure and 150 psig (10 barg) liquid side design working pressure.

3. Water boxes shall be removable to permit tube cleaning and replacement. Water boxes shall include liquid nozzle connections suitable for ANSI/AWWA C-606 couplings, welding, or flanges.

4. Provide vent and drain fittings, and thermostatically controlled heaters to protect to -20° F (-28°C) ambient temperature in off-cycle. A separate power connection for evaporator heaters is required and shall be provided by the Contractor. If strainers are required by the manufacturer they must be provided by the manufacturer.

B. Air-cooled Condenser:

1. Condenser coils shall be micro-channel type or aluminum fin with black fin coating and copper tube. Condenser coils can be made of a single material to avoid galvanic corrosion due to dissimilar metals. Tube and fin type condenser coils are an acceptable alternate when tubes and fins are fabricated of the same metal material to avoid galvanic corrosion due to dissimilar metals. *[OPTIONAL when no screen is present]: Unit shall include Louvered Panels (Full Unit): Painted steel to match unit panels, over internal components. [OPTIONAL when screened by walls, privacy fence, vegetation, etc.]: Unit shall include Louvered Panels (Condenser only): Painted steel to match unit panels, over internal components. Wire guards shall be included to protect lower part of chiller.*

2. *[Preferred OPTIONAL]:* Low Sound Fans with Variable Speed Drives. All fans shall be powered by VSDs. Fans shall provide vertical air discharge from extended orifices. Fans shall be composed of corrosion resistant aluminum hub and glass-fiber-reinforced polypropylene composite blades molded into a low-noise airfoil section. Fan impeller shall be dynamically balanced for vibration-free operation. Fan guards of heavy gauge, PVC (polyvinyl chloride) coated or galvanized steel.

3. Fan Motors: High efficiency, direct drive, 3-phase, insulation class "F", current protected, Totally Enclosed Air-Over (TEAO), with double sealed, permanently-lubricated ball bearings. Open Drip Proof (ODP) fan motors will not be acceptable**.**

2.6 INSULATION

A. Material: Closed-cell, flexible, UV protected, thermal insulation complying with ASTM C 534 Type 2 (Sheet) for preformed flexible elastomeric cellular thermal insulation in sheet and tubular form.

B. Thickness: ¾" (19mm.)

C. Thermal conductivity: 0.26 (BTU/HR-Ft2-° F/in) maximum at 75° F mean temperature.

D. Factory-applied insulation over cold surfaces of liquid chiller components including evaporator shell, water boxes, and suction line. Liquid nozzles shall be insulated by Contractor after pipe installation.

E. Adhesive: As recommended by insulation manufacturer and applied to 100% of insulation contact surface including all seams and joints.

2.7 ACOUSTICAL DATA

A. Provide acoustical sound power or sound pressure level data in decibels (dB) at the scheduled 8 octave band center frequencies. A weighted sound data alone is not acceptable.

B. Provide all sound power or sound pressure level data at 100%, 75%, 50%, and 25% load.

C. Supplied equipment shall not exceed scheduled sound power or sound pressure level data at any load point. The mechanical Contractor shall be responsible for any additional costs associated with equipment deviation.

D. Acoustical performance ratings shall be in accordance with AHRI Standard 370.

2.8 POWER AND ELECTRICAL REQUIREMENTS

A. Power/Control Panel:

1. Factory installed and wired NEMA 3R, powder painted steel cabinets with tool lockable, hinged, latched, and gasket sealed outer doors equipped with wind struts for safer servicing. Provide main power connection(s), compressor starters and fan motor contactors, current overloads, and factory wiring.

2. Panel shall include control display access door.

B. Single Point Power:

1. Provide single point power connection to chiller, shall be 3-phase of scheduled voltage.

2. Single Point Circuit Breaker or fused disconnect: A circuit breaker/fused disconnect and lockable external handle shall be provided at the point of incoming single point connection for field connection, interconnecting wiring to the compressors, and isolating the unit power voltage for servicing. Separate external fusing must be supplied, by others, in the incoming power wiring which must comply with local codes.

C. Control Transformer: Power panel shall be supplied with a factory mounted and wired control transformer that will supply all unit control voltage from the main unit power supply. Transformer shall utilize scheduled line voltage on the primary side and provide 115V/1Ø on secondary.

D. Short Circuit Withstand Ratings of the chiller electrical enclosure shall be (380, 400, & 460V: 50,000 Amps.). Rating shall be published in accordance with UL508.

E. Motor Starters: Motor starters shall be Variable Frequency Drive type with zero electrical inrush current. Wye-Delta and Solid State, type starters are acceptable. Across the Line type starters will not be acceptable.

F. Power Factor:

1. Provide equipment with power factor correction capacitors as required to maintain a displacement power factor of 95% at all load conditions.

2. The installing contractor is responsible for additional cost to furnish and install power factor correction capacitors if they are not factory mounted and wired.

G. All exposed power wiring shall be routed through liquid-tight, UV-stabilized, non-metallic conduit.

H. Supplied equipment shall not exceed scheduled MOCP. The mechanical Contractor shall be responsible for any additional costs associated with equipment deviation.

2.9 CONTROLS

A. General:

1. Provide automatic control of chiller operation including compressor start/stop and load/unload anti-recycle timers, condenser fans, evaporator pump, evaporator heater, unit alarm contacts and run signal contacts.

2. Chiller shall automatically reset to normal chiller operation after power failure.

3. Unit operating software shall be stored in non-volatile memory. Field programmed set points shall be retained in lithium battery backed regulated time clock (RTC) memory for minimum 5 years.

4. Alarm contacts shall be provided to remote alert for any unit or system safety fault.

B. Display and Keypad:

1. Provide minimum 80 character liquid crystal display that is both viewable in direct sunlight and has LED backlighting for nighttime viewing. Provide one keypad and display panel per chiller.

2. Display and keypad shall be accessible through display access door without opening main control/electrical cabinet doors.

3. Display shall provide a minimum of unit set-points, status, electrical data, temperature data, pressures, safety lockouts and diagnostics.

4. Descriptions in English (or available language options), numeric data in English (or Metric) units.

5. Sealed keypad shall include unit On/Off switch.

C. Programmable Set-points (within Manufacturer limits): Display language, chilled liquid cooling mode, local/remote control mode, display units mode, system lead/lag control mode, remote temperature reset, remote current limit, low ambient temperature cutout enable/disable, leaving chilled liquid set-point and range, maximum remote temperature reset.

D. Display Data: Chilled liquid leaving and entering temperatures; outside ambient air temperature; lead system; evaporator pump status; active remote control; compressor suction, discharge, and; compressor discharge; saturation temperatures per refrigerant circuit; compressor speed; condenser fan status; condenser sub-cooling temperature; compressor capacity in percentage of Full Load Amps; compressor number of starts; run time; operating hours; evaporator heater status; history data for last ten shutdown faults; history data for last 20 normal (non-fault) shutdowns.

E. Predictive Control Points: Unit controls shall avoid safety shutdown when operating outside design conditions by optimizing the chiller controls and cooling load output to stay online and avoid safety limits being reached. The system shall monitor the following parameters and maintain the maximum cooling output possible without shutdown of the equipment: motor current, suction pressure, discharge pressure.

F. Unit Safeties: Manufacturers standard but to include phase monitor protection.

G. Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system.

2.10 ACCESSORIES

A. Controls:

1. Gateway: Provides communication for Building Automation Systems, including Modbus. **(Field Commissioned by BAS Manufacturer)**

B. General:

1. IFM Efector IR flow switch

PART 3: EXECUTION

3.1 INSTALLATION

A. General: Rig and Install in full accordance with Manufacturer's requirements, Project drawings, and Contract documents. General Contractor is ultimately responsible for installation of equipment with all trades. General Contractor must review requirements for equipment and ensure all requirements are met.

B. Location: Locate chiller as indicated on drawings, including cleaning and service maintenance clearance per manufacturer instructions. Adjust and level chiller on support structure.

C. Components: Installing Contractor shall provide and install all auxiliary devices and accessories for fully operational chiller.

D. Electrical: Coordinate electrical requirements and connections for all power feeds with Electrical Contractor.

E. Controls: Manufacturer to coordinate all control requirements and connections with Controls Contractor.

F. Finish: Installing Contractor shall paint damaged and abraded factory finish with touch-up paint matching factory finish.

END OF SECTION 23 64 01