SECTION 236424 – GEOTHERMAL HEAT RECOVERY CHILLER/HEATER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. This Section includes geothermal, heat recovery chiller, electric-motor-driven, scroll compressors.

1.3 DEFINITIONS

A. EER: Energy-efficiency ratio.

B. IPLV: Integrated part-load value.

1.4 SUBMITTALS

A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Instrumentation and Control for HVAC". The meeting shall be held in a location chosen by the contractor. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

B. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

C. Shop Drawings: Complete set of manufacturer's certified prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Operating weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: Power, signal, and control wiring.

D. Certificates: For certification required in "Quality Assurance" Article.

E. Source quality-control test reports.

F. Startup service reports.

G. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

1. Provide bound, indexed operation and maintenance (O&M) manuals. Manuals shall be organized by systems and fully indexed by equipment type. Must contain original manufacturer's bulletins and manuals. Copies are not acceptable.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. ASHRAE Certification: Signed by manufacturer certifying compliance with ASHRAE 15 for safety code for mechanical refrigeration. Comply with ASHRAE Guideline 3 for refrigerant leaks, recovery, and handling and storage requirements.

B. Comply with UL 1995.

C. ARI 550/590-1998 - Standard for Water Chilling Package using the Vapor Compression Cycle.

D. ANSI/ASHRAE 90.1 - Energy Efficient Design of New Buildings.

E. UL 984 - Safety Standards for Hermetic Motor Compressors.

F. ARI STANDARD 575-87 - Method of Measuring Machinery Sound within Equipment Rooms.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant.

1.7 COORDINATION

A. Coordinate size and location of steel rails.

1.8 WARRANTY

A. Warranty: One year warranty in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship.

B. Special Warranty: Five year compressor warranty in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Geothermal Heat Pump Water Chillers:
   - **a. Multistack VME II (Basis of Design) (*AD 07)**
   - **b. Trane Artic (*AD 07)**
   - c. ClimaCool
   - d. Water Furnace (Model: WC)

2.2 GEOTHERMAL HEAT PUMP WATER CHILLERS

A. System Description: The geothermal heat recovery water chiller/heater is a single packaged unit that will provide chilled water and hot water, where it uses source geothermal water for heat absorbing and heat rejection as needed. This unit include six (6) piping connections, chilled water supply, chilled water return, hot water supply, hot water return, source water supply and source water return. This packaged unit can provide simultaneous chilled water and hot water at full capacities listed, where it can main both loops at design set points (44°F leaving chilled water, 120°F leaving hot water with 90 to 45°F source water). Source water will be from a geothermal well field, sized to provide a maximum entering water of 90°F during the cooling season and minimum entering water of 49°F during the heating season to geothermal heat recovery water chiller/heater.

The entire unit shall include factory controls with BAS interface to remotely monitor and control. The factory controls shall control unit leaving chilled and hot water temperature and control integral primary pumps. In addition, the factory controls shall control the external source (geothermal pumps) as variable speed, where the factory controls will vary source pumps (duty and standby arrangement) as needed for heat absorption and rejection, where at a minimum they will modulate to 50% speed to reduce pumping energy. The factory controls shall vary duty and standby pumps to equalize their run time. The controls shall stage all compressors. See Section 2.5 - Chiller Manufacturer Central Plant Control Section for additional requirements

B. Description: Factory-assembled and performance-tested heat recovery chiller complete with base and frame, scroll compressors, brazed plate evaporator, brazed plate condenser, brazed plate geothermal heat exchanger, water pumps, electrical power, controls, and accessories.

The unit is capable of operating in 3 distinct modes, per circuit:

1. PRODUCTION OF CHILLED WATER ONLY: The multipurpose unit acts as a classical chiller producing cold water at a system water side plate heat exchanger acting as an evaporator. Heat is disposed through the geothermal heat exchanger.

2. PRODUCTION OF HOT WATER ONLY: The multipurpose unit acts as a heater producing hot water at a system water side plate heat exchanger acting as a condenser. Chiller/Heater must be able to satisfy heating dominant load by extracting heat from the source/sink. Heating dominant modules must be capable of running at optimal suction pressure to minimize power consumption.
   Note: The main difference from traditional cycle reverse heat pumps is that the heated water is produced in a different heat exchanger from the one used to produce cold water improving efficiency.

3. COMBINED PRODUCTION (HEAT RECOVERY): If the utility requires simultaneous hot and cold water, the unit acts as a heat recovery chiller, controlling condensation and evaporation across the two distinct plate heat exchangers associated to circulation of cold and hot water in the system. It automatically changes from one configuration to another (managed by on-board microprocessor) to optimize the spent energy depending on the demand by the utility. The system is capable of modulating the percentage of heat recovery and heat rejection, providing a 0 to 100 percent range of recovery. The unit must be able to manage all types of unbalanced loads; it must be able to produce more cooling than heating and more heating than cooling. The multi-circuit unit provides maximum efficiency both with full load and partial loads, guaranteeing operating continuity should one of the circuits stop to facilitate maintenance.

C. Cabinet:
   1. Base and Support Structure: Made up from hot galvanized sheet steel elements with suitable thickness.
   2. Designed in a way to allow total accessibility to all the internal components. Isolation valves shall be installed between the heat exchangers and water supply mains for heat exchanger isolation and removal without the requirement to remove a module or shut down the entire chiller allowing for total access to all serviceable components
   3. Each module shall be supplied with a light weight aluminum frame with sound reduction panels. Panels are powder coated 20 gauge steel with 1” of fiberglass insulation to reduce sound levels. Optional sound package will reduce sound pressure levels measured at 1 meter at a minimum of 12 dBA.

D. Compressors:
   1. Description: High efficiency scroll hermetic compressors activated by a 2-pole electric motor with internal heat protection.
   2. Two compressors per module independently circuited

   3. Capacity Control: On-off compressor cycling.
   4. Vibration Isolation: Mount individual compressors on vibration isolators.
   5. Compressors must be enclosed in acoustically insulated compartment.

E. Refrigeration:

   1. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.
   2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
   3. The unit shall have minimum two independent refrigerant circuits with single compressor per circuit for optimal staging and load control. Single circuited units will not be accepted.
   4. Each Refrigerant Circuit shall include:
      a. Electronic expansion valve (thermal expansion valve not acceptable), isolation valves;
      b. high pressure switch (manual reset);
      c. high pressure transducer;
      d. low pressure transducer;

F. Heat Exchangers (Evaporator and Condenser)
   1. Brazed Plate:
      a. Type 316 stainless-steel construction.
      b. Externally insulated with closed cell material to reduce thermal dispersions.
      c. Heat exchangers shall be equipped with motorized modulating butterfly type valves driven independently by signals from the module controller and powered from the main power feed. The motorized actuators shall be modulating NEMA 4X rated Valves shall be fast acting type with a maximum stroke time (full closed to full open) of 15 seconds
      d. The isolation valves are required for variable primary flow application.
      e. Load side valves shall modulate to maintain modular leaving load temperatures. When heat exchangers are using sink/source due to unequal heating/cooling duty, master controller shall modulate valve to provide minimum required head pressure control in order to maximize efficiency of those Chiller/Heater modules and to provide equipment protection. All valves must be installed such that proper piping practices are observed, including proper distances before and after elbows.

G. Noise level:

1. Sound Power level from the unit, in accordance with EN ISO 9614-2, shall be less than 90.0 dB(A).

H. Electrical Power:
1. Factory installed and wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to each unit.
2. Electric control board access door with interlock system.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Factory wiring must be supplied with the unit.
5. Unit shall be supplied with factory installed non-fused disconnect.
6. Provide each motor with overcurrent protection.
7. Phase-Failure and Undervoltage protection.

I. Electronic adjustment:
1. Each unit shall be provided with a control panel and display. Transducers, sensors and all the safety components are connected to the board.
2. The software and parameters are memorized permanently on FLASH memory, allowing their storage even in case of lack of power supply.
3. The microprocessor has the following functions:
    a. local or remote ON/OFF with digital inlet (external contact without voltage);
    b. Proportional+integral control based on the outlet water temperature, complete with “Switching Hysteresis” self-adapting work differential to always ensure the correct work schedule, even with low water flow rate.
    c. Management of operating times: stand-by between peaks, stand-by between switch off and switch on, minimum operation time, etc;
    d. Management of alarms;
    e. Autostart after blackout
    f. Flow switch management;
    g. Display of all main parameters (temperatures, pressures) regarding the operation of the machine;
    h. Double set-point for the temperature of the water produced, pre-set at the menu;
    i. Automatic compensation of set points on the basis of an external probe;
    j. Compatible with Modbus protocol (or Bacnet protocol)

J. Insulation:
1. Material: Closed-cell, flexible elastomeric, thermal insulation
2. Factory-applied insulation over cold surfaces of water chiller components.

a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.

3. Apply protective coating to exposed surfaces of insulation.

K. Operating limits:

1. The machine shall be able to produce chilled water with evaporator outlet temperature from 44°F to 64.4°F, with condenser water outlet temperature from 77°F to 131°F.

L. Module Valve Packages:

1. The chiller shall contain fast-acting motorized butterfly valves that open/close on a command from the central control system. The isolation valves shall be between the chiller modules as required to repurpose modules for Cooling/Heating /Heat recovery modes. The motorized actuators shall be modulating NEMA 4X rated with easily visible position indicators and internal thermal motor overload protection. Valves shall be fast acting type with a maximum stroke time (full closed to full open) of 30 seconds. Valve modules shall be built into pre-engineered headers and powered by the Chiller/Heaters buss bar.

2.3 MOTORS

A. Refer to Division 23 Section "Common Motor Requirements for HVAC" for general requirements.

B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

A. Chillers shall be ARI certified .

B. Each unit shall be performance tested, full load efficiency and full load capacity. Test reports shall be made available upon request.

2.5 CENTRALPLANT CHILLER CONTROL BY CHILLER MANUFACTURER

A. Chiller manufacturer to provide chiller plant control and optimization package.

B. Multistack MultiPRO (Basis of Design)

Scope as follows:

1. Coordination / Operation of the Ground Source Heat Pump and all Pumps, Valves, and Sensors Associated with the Central Plant System.

The controller shall also control the remote bypass valves to maintain chiller minimum flow at all times.

2. Touch screen / panel PC
   a. Power Options
      1) Powered via Separate Control Electrical Power Feed
3. Open Protocol (Bacnet as Std others available) Comms between the CPC and :
   Water Cooled Dedicated Heat Recovery Modules – Standard DHRC Master Controller
   Pump Variable Frequency Drives
4. Display of Operating Status & Alarms for Chiller and Pumps
5. Enabling the Plant (coordinating the timing of the start and stop of chillers and pumps) fr om a single “Enable Command” from either the CPC touch screen or from the Building Automation System via the CPC
6. Display of KW Metering for Chiller, DHRC, Free Cooling, Pumps
7. Providing Flow Meters for Tie In and Display of Flow Values (including calculation of C apacity – Tons)
8. The system will actively control chillers, pumps, and other ancillary equipment that makes up a complete chilled water system in a “best practice” highly efficient manner.
9. Calculation, Display, and Comms to BAS of Kw; Kwh; Kw/Ton (or COP)
10. The plant is configured to operate in local control mode where all of the chillers and pumps can be operated by their local controllers
    a. Pumps are placed in Local Mode
       1) Local Timed Rotation of Pumps is used when Pumps are in Local Mode
       2) CPC Timer and Rotation Schedule (Adjustable from BAS) is used when Pumps are in BAS Model

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, piping, and electrical to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

   1. Final water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Two 4” to 6” rails (provided by Division 23) and vibration isolation pads are required for ease of installation. A level floor and base rails are minimum requirements.

B. Vibration Isolation: Mount water chiller on vibration isolation equipment base as specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Charge water chiller with refrigerant if not factory charged.

E. Chiller to be provided with thermal dispersion flow switches

F. Install flange connections at chillers.

G. Install flexible pipe connections for chillers mounted on vibration isolators.

H. Install water strainers as required to the evaporator and condenser water systems.

3.3 CONNECTIONS

A. Chilled and condenser-water piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Connections: Connect inlet to evaporator with controller-bulb well, shutoff valve, thermometer, strainer, pressure gage, and union or flange. Connect outlet to evaporator with shutoff valve, flow switch, balancing valve, thermometer, pressure gage, and union or flange.

D. Condenser Connections: Connect inlet to condenser with shutoff valve, thermometer, plugged tee, and pressure gage. Connect outlet to condenser with shutoff valve, thermometer, drain line and shutoff valve, strainer, and plugged tee.

E. Ground water chillers according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

G. Install all necessary electrical wiring devices and services such as fused disconnect switches or circuit breakers to power each module, phase loss monitors. All wiring is done in the field and shall be according to local and national electrical codes where applicable.

H. Install and connect remote flow switches and remote chiller control panel.

I. Tighten electrical connectors and terminals, including grounding connections, according to manufacturers published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period according to manufacturer's written instructions.
5. Verify that refrigerant pressure relief is vented outside (for water-cooled water chillers).
6. Verify proper motor rotation.
7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
8. Verify and record performance of chilled-and condenser-water flow and low-temperature interlocks.
9. Verify and record performance of water chiller protection devices.
10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

E. Engage a factory-authorized service representative to review installation and make necessary modifications to system 60 days after substantial completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Refer to Division 1 Section "Closeout Procedures." Training shall coincide with start-up visit or during on of the occupancy adjustment visits.

END OF SECTION 236424