SECTION 15681A
PACKAGED WATER CHILLER UNIT

PART I GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. **(Air, Water, Evaporative)** cooled **(reciprocating, scroll, rotary screw)** chiller
B. Chilled water pump
C. Accessories and trim
D. Charge of refrigerant and oil
E. Controls and control connections
F. Chilled glycol connections
G. Starters
H. Electrical power connections

1.02 REFERENCES

A. ANSI/ARI 590 - Standard for Reciprocating Water Chilling Packages
B. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration
D. ANSI/UL 465 - Central Cooling Air Conditioners
E. ANSI/UL 779 - Motor-Operated Water Pumps

1.03 SUBMITTALS

A. Submit shop drawings indicating components, assembly, dimensions, weights, and loadings, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required for complete system.

B. Submit product data indicating rated capacities, weights, and all accessories. Also, submit complete wiring diagrams specifically for the unit being submitted. The wiring diagrams shall include all rated loads and recommended component sizes. No item that is not being submitted with the equipment shall appear on the diagram. Also, submit refrigerant piping diagram showing all components and connection sizes.

C. If a pump package is included with the equipment, submit a complete hydronic piping schematic showing all components and connection sizes. Also include a pump curve showing performance.

D. Submit manufacturer's installation instructions.

1.04 OPERATION AND MAINTENANCE DATA

A. Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

B. Submit maintenance data.

1.05 QUALITY ASSURANCE

A. Warranty: Includes coverage for complete assembly including materials and workmanship for a period of **12 months (24 months)** from start-up or **18 months (30 months)** from shipping**. (and an additional four years warranty for parts on the compressor only.)**

(B. Select pumps to operate at or near their point of peak efficiency. Maximum impeller size shall not exceed 85% of the differences between the maximum and minimum impeller diameter.)

PART 2 PRODUCTS

2.01 CHILLER MANUFACTURER

A. Technical Systems, Division of RAE Corporation
B. Edwards Engineering
C. Filtrine
D. Owner approved equal

2.02 MANUFACTURED UNITS

A. Provide factory assembled and tested liquid chillers consisting of **(semi-hermetic reciprocating, scroll, hermetic rotary screw)** compressors, evaporator, thermal expansion valve, refrigeration accessories, **(chilled water pump, expansion tank, air separator, interconnecting chiller water piping and valves,)** and control panel housing all power and control components. Construction and rating shall be in accordance with ANSI/AIR 590.

B. Provide an **(air-cooled, water-cooled, evaporative cooled)** water chiller package **(with integral chilled water pump package)** having minimum capacity as scheduled herein for a**(water, ethylene glycol, propylene glycol)** solution, including all features described in the specification and/or noted on drawings.

2.03 HOUSING AND INTERCONNECTING PIPING

A. The frame shall be heavy duty **(G-90 galvanized sheet metal 12 Ga. minimum, epoxy coated structural carbon steel)**. The housing shall be fabricated from **(heavy gauge G-90 galvanized steel with factory applied (epoxy, enamel) corrosion resistant finish, 304 stainless steel, 316 stainless steel with 304 SS hardware)** removable panels.

B. The interconnecting piping shall be **(Type L hard copper [*through 4" pipe size*], all ferrous Schedule 40 black piping with welded joints, schedule 80 PVC)** (see attached piping diagram.)

[The following compressor sections are set up for recips and scrolls. Screw compressor specs are to follow. The compressor section should be analyzed and the correct style of compressor should be included]

2.04 COMPRESSORS (semi hermetic reciprocating)

A. Construct semi-hermetic reciprocating compressors with heat-treated forged steel or ductile iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, suction and discharge valves, and sealing surface immersed in oil. Compressors shall be designed for use with **(R-22, R-404a, R-134a).**

B. Provide reversible, positive displacement, oil pump lubrication system with oil charging valve, oil level sight glass, oil filter and magnetic plug on strainer, arranged to ensure adequate lubrication during starting, stopping and normal operation. When compressors are multiplexed on the same circuit, provide an oil equalization system composed of an oil strainer, oil separator and an oil reservoir. Capillary tube systems will not be accepted.

C. Provide compressor with automatic capacity reduction with electronic unloading solenoid valves operated by **(an electronic signal based on return water temperature, refrigerant suction pressure.)**. Provide for unloaded compressor start.

D. Provide constant speed 1800 RPM compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for across the line starting. Furnish with starter.

E. Provide crankcase heater to evaporate refrigerant returning to crankcase during shutdown. Energize heater during off time, once compressor is energized, disengage heater.

2.4 COMPRESSORS (alternate scroll type)

A. Compressors shall be direct driven full hermetic, fixed compression scroll compressors with cast iron frame and cast iron scrolls; one fixed and one orbiting.

B. Compressors shall have all Teflon impregnated bronze drive bearings, crankcase heaters, rotary dirt trap, rotolock fittings for discharge and suction connections. Each fitting shall have a Schrader pressure tap. The suction inlet shall be equipped with a suction screen.

C. Compressor shall have large internal volume capable of handling a minimum 22 lbs. Of refrigerant. Compressor shall also have inherent dynamic discharge valve to prevent backflow, and solenoid valve to prevent shutdown noise.

D. Lubrication System

1. Compressor shall have inherent centrifugal oil pump, oil filter, oil level sight glass, oil level adjustment Schraeder fitting.

2. Oil shall have an initial charge of 140 oz. Of mineral oil Sontex 200-LT or Witco LP-200 only.

E. Performance

1. Compressor shall be designed to operate at suction temperatures of 10°F to 55°F for 65°F return gas, 0°F subcooling and 95°F ambient.

2. Compressor shall have minimum EER of 11.1 at standard conditions, and also operate at maximum sound power levels of 80 db(A) without discharge mufflers.

3. Compressor vibration of maximum 1.3 mills peak to peak at 60 Hz discharge pulse 3.0 psi peak to peak is required.

4. Compressor scroll members shall separate in the event of liquid or debris contamination. Tip seals are not allowed.

F. Controls

1. Compressor to have four (4) individual motor winding sensors wired to a solid state module connected to 4 pin fusite. In addition, an inherent discharge temperature sensor shall be wired in series with the motor sensors for compressor self-protection.

G. Installation

1. Factory install an external check valve in discharge to guarantee protection against back flow in case of inherent valve failure. Install factory mounted high and low pressure cut-outs. Compressors to be mounted on neoprene rubber mounts.

2.04 COMPRESSORS (semi hermetic rotary screw)

A. Construct semi-hermetic rotary screw compressor with double structure cast iron casing. Compressor shall have two asymmetrical profile screw rotors composed of ductile cast iron, or spheroidal graphite cast iron. Compressors shall be designed for use with **(R-22, R-134a).**

B. Provide compressor with radial roller bearings to support radial loads from rotors. At the discharge end of the compressor, the male rotor shall have a triple angular contact ball bearings, and the female screw rotor shall have double ball bearings. Each bearing shall be lubricated by the oil from the oil separator. Liquid refrigerant may not be used as a lubricant for the rotors.

C. Provide compressor with an inherent oil separator and oil reservoir. Oil shall be fed through the oil strainer into the bearings and the capacity control system by differential pressure between the discharge and suction sides of the compressor. Oil passages from the reservoir shall be cast into the compressor body to prevent choking and oil leakage. Capillary tubes shall not be allowed. An oil strainer shall be installed with a 150 mesh reinforced steel filter with a side screen area. Oil strainer shall be installed with a replaceable flange for service.

D. Provide compressor with automatic proportional control slide valve. Capacity shall be able to be modulated down to **(33% *[for the 40 hp compressor]*, 25% *[for the 50 hp & 60 hp compressors]*)** of full load capacity. The slide valve shall be located on the topside of the rotors and allows refrigerant gas to bypass from the suction side to the discharge side. The slide valve shall be controlled by a series of oil solenoid valves that allow oil to flow to and from the rotor side of the piston. The solenoid valves shall be controlled by a proportional integral controller that stages compressors based on return water temperature, and modulates the slide valve based on supply water temperature.

E. Provide constant speed 1800 RPM compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for across the line starting. Furnish with starter.

F. Provide crankcase heater to evaporate refrigerant returning to crankcase during shutdown. Energize heater during off time, once compressor is energized, disengage heater.

G. Install check valve on the discharge port of the compressor to protect against liquid migration back to the compressor during off cycles.

[Following sections pertain to a shell and tube heat exchanger and should be modified to fit your application]

2.05 EVAPORATOR *[SHELL & TUBE]*

A. Provide evaporator of **(shell and tube type, brazed plate heat exchanger (copper or nickel bronze brazing), gasketed (304, 316) SS plate and frame heat exchanger)**, seamless or welded steel construction with cast iron or fabricated steel heads, seamless 5/8" copper tubes or red brass tubes with integral aluminum fins, rolled or silver brazed into tube sheets. Provide multiple refrigerant circuits.

B. Design, test and stamp cooler verifying that the refrigerant side has be rated for 225 PSIG working pressure and water side for **(250 psig *[up to 30 ton loads]*, 150 psig *[over 30 ton loads]*)** working pressure in accordance with ANSI/ASME SEC 8.

C. Provide cooler heater cable wired to provide low ambient freeze protection during off cycle.

D. Insulate with 0.75 inch minimum thick flexible expanded polyvinyl chloride insulation with maximum K value of 0.26.

E. Provide water drain connection and thermometer wells for temperature controller and low temperature cutout.

2.05 EVAPORATOR *[BRAZED PLATE HEAT EXCHANGER]*

A. Provide as shown on attached drawings, a brazed plate heat exchanger as manufactured by Alfa Laval. Heat exchangers shall be both UL and ETL listed.

B. Heat exchanger shall consist of pressed Type 316L stainless steel plates as necessary to provide the required heat transfer area to meet the specified operating conditions.

C. Heat exchangers shall be constructed to prevent any external moisture from being trapped between plate surfaces and possibly freezing.

D. Copper brazing material shall be 99.9% pure copper.

E. Construction of the brazed plate heat exchanger shall allow the two heat transfer mediums to flow in a counter current direction.

F. Heat exchangers shall have a minimum design pressure of vacuum and a maximum design pressure of 435 psi. They shall also be rated for a minimum design temperature of -256 F and a maximum design temperature of 435 F.

[Following sections describe both air cooled and water cooled condenser. Evaporative condenser specification soon to follow]

2.06 CONDENSER (Air-cooled)

A. Provide condenser of ½" copper tubes with **(aluminum, copper, phenolic coated)** plate fins. Fins shall be formed with tube collars and mechanically expanded with fin collars for full contact for optimum heat transfer. Condenser coils shall be tested to 425 psig air pressure.

B. Casings and tube sheets shall be heavy gauge **(galvanized steel, 304 stainless steel, 316 stainless steel)**. Tube sheets shall be die formed and full collared for tube support. Headers to be constructed of heavy wall seamless copper tubing. Copper tubing to be **(.017", .025", .035")** wall thickness. Fin thickness to be **(.006", .008", .010").**

C. Condenser shall be provided with a separate sub-cooling circuit integral with the main circuit for each refrigerant circuit. Liquid seal shall be maintained by a trap between main header and sub-cooling circuit header.

2.06 CONDENSER (WATER-COOLED)

A. Condensers shall be shell & tube type with condensing water running through the tubes and the refrigerant contained in the shell. Tubing shall be rated to 225 psi. Tubing shall be seamless rolled copper tubes. Condensers shall be rated and stamped in accordance with ANSI/ASME Section VIII.

B. Condensers shall have pressure actuated water regulating valves. Valves shall be mounted on the water outlet to maintain turbulent flow through the condenser.

2.06 CONDENSER (Evap-cooled)

A. The manufacturer of the evaporative condenser shall have been involved with the production of this equipment of this size for over 5 years. In addition, the manufacturer of the condenser shall have current installations in within 50 miles of jobsite installation.

B. Condenser pan and casing shall be constructed of G-235 hot-dip galvanized steel for long life and durability. During fabrication, all panel edges shall be coated with a 95% pure zinc-rich compound. The heat transfer section shall be removable from the pan to provide easy handling and rigging. Pan/fan section shall include fans, motors, and drives mounted and aligned at the factory. These items shall be located in the dry entering air stream to provide maximum service life and easy maintenance. Pan accessories shall include circular access doors, stainless steel strainers, wastewater bleed line with adjustable valve and brass makeup valve, with an unsinkable foam filled plastic float.

C. Fans shall be forward curved centrifugal type of hot-dip galvanized construction. The fans shall be factory installed into the pan/fan section, and statically and dynamically balanced for vibration free operation. Fans shall be mounted don either a solid steel shaft or a hollow steel shaft with forged bearing journals. The fan shaft shall be supported by heavy-duty, self-aligning bearings with cast-iron housings and lubrication fittings for maintenance. The fan drive shall be V-belt type with taper lock sheaves designed for 150% of the motor nameplate horsepower. Drives are to be mounted and aligned at the factory.

D. The condenser shall be equipped with modulating dampers on the discharge of the fans in order to control head pressure. The motor actuators shall be based on refrigerant pressure.

E. Fan motor shall be totally enclosed fan cooled motor with 1.15 service factor and furnished suitable for outdoor service. Open drip proof motors and enclosed air over motors are not allowed. Motors shall be mounted on an adjustable base.

F. The condenser coil shall be prime surface steel, encased in steel framework with the entire assembly hot-dip galvanized after fabrication. Coil shall have staggered elliptical tubes for more heat transfer surface area and lower static. Coil shall be designed with sloping tubes for free drainage of liquid refrigerant and tested to 350 PSIG air pressure under water.

G. The water distribution system shall provide a water flow rate of not less than 6 GPM over each square foot of unit face area to ensure proper flooding of the coil. The spray header shall be constructed of schedule 40 PVC pipe for corrosion resistance. All spray branches shall be removable and include a threaded end plug for cleaning. The water shall be distributed over the entire coil surface by precision molded ABS spray nozzles (1" x ½" orifice) with internal anti-sludge rings to eliminate clogging. Nozzles shall be threaded into spray header to provide easy removal for maintenance.

H. Water recirculation pump shall be a close-coupled, bronze fitted, centrifugal type with mechanical seal, installed vertically at the factory to allow free drainage on shut down. The pump motor shall be totally enclosed furnished suitable for outdoor service.

I. The mist eliminators shall be constructed entirely of PVC that has been specially treated to resist ultra-violet light. Assembled in easily handled sections, the eliminator blades shall be spaced on 1-inch centers and shall incorporate three changes in air direction to assure removal of entrained moisture from the discharge air stream. They shall have a hooked leaving edge to direct the discharge air away from the fans to minimize recirculation.

J. The following provisions shall be factory installed as part of the water treatment system:

1. A 115V power receptacle shall be provided for a water treatment controller. The power shall be interlocked with the cooling so that chemicals are not pumped when cooling is off.
2. A ¾" stub out line shall be installed so as to provide a means to connect the water system with the chemicals.

K. Acceptable manufacturers of the evaporative condenser are Evapco, Baltimore Air Coil, and Spectrum. No other manufacturer's will be considered.

2.07 CONDENSER FANS

A. Provide direct drive propeller type with zinc plated chromate dipped blades. Air shall discharge vertically to minimize noise generation and air recirculation.

B. Fans shall be located within a formed venturi and be provided with a polyvinyl covered fan guard.

C. Fan motors shall be 3 phase, 1140 RPM, vertical, direct drive motors with permanently lubricated ball bearings and overload protection.

2.08 REFRIGERANT CIRCUIT

A. Provide complete refrigerant circuits, factory supplied and piped.

B. Provide for each refrigerant circuit:

1. Liquid line solenoid valve.
2. Filter drier **(replaceable core type, with 3-valve bypass)**.
3. Liquid line sight glass and moisture indicator.
4. Thermal expansion valve for maximum operating pressure.
5. Charging valve.
6. Insulated suction line.
7. Discharge line check valve.
8. Compressor service valves.
9. **(Pressure relief device)**
10. **(Suction accumulators *[Low temp applications]***

[The following sections are for special applications. If a corrosive environment, acoustic requirements, low ambient are needed, be sure to include these sections in the specifications]

2.?? Corrosion Resistant Features

A. All cabinetry and structural base shall be of **(304 stainless, 316 stainless, epoxy coated inside and out)**

B. Condenser shall be treated for corrosive environment**. (Construct condensers with (304 stainless steel, epoxy coated)** casings **and (copper, Acrycoat) fins)** *or* **(Entire condenser assembly shall be coated with a corrosive resistant coating, Technicote. Coating shall be applied by immersion process. Air dried spray applied phenolic coating will not be accepted. Coating shall be a minimum of 1.5 mils dry film thickness.)**

C. All wiring shall be run in liquid tight conduit with liquid tight connections.

D. Control enclosure shall be **(NEMA 7, NEMA 4X with purge system with external air system provided by others).**

E. All piping shall be finished with an air dried phenolic coating after the piping assembly is complete.

2.?? Acoustic Treatment

A. Provide compressors with **(heavy duty sound attenuating compressor wraps. Wraps shall be made of industrial vinyl and shall have industrial grade Velcro for easier service access., *or* sheet metal enclosures lined with acoustic lining.)**

B. Provide **(850 rpm condenser fans to minimize air discharge noise without reducing condenser capacity. Install (18" acoustic shroud around entire perimeter of unit, individual 30" acoustic stacks on each fan venturi).**

C. To minimize vibration noise, install compressors on spring isolators. Install suction and discharge vibration isolators at the piping connections to the compressors to allow for free movement in the piping.

2.?? LOW AMBIENT OPERATION

A. Provide unit with low ambient operation down to **(20 F, 0F)** by cycling fans based on refrigerant temperature. Cycling fans based on ambient temperature will not be allowed.

B. Provide unit with low ambient operation down to -20 F by a flooded condenser control. Provide liquid receivers with pressure relief device with the flood control. Install a flow restricting valve in the main liquid line between the main condenser to the receiver. This valve shall restrict the flow and back up refrigerant liquid in the condenser based on refrigerant pressure. Install a bypass line between the hot gas line and the main liquid line to the condenser to bypass hot gas into the receiver when the refrigerant pressure continues to decrease.

2.09 END SUCTION PUMP

A. General Requirements:

1. Balance: Rotating parts, statically dynamically.

2. Construction: To permit servicing without breaking piping or motor connections.

3. Pump Motors: Operate at 1750 RPM unless specified otherwise.

4. Pump Connections: Flanged

B. Furnish and install pumps with capacities as specified herein. Pumps shall be end suction type, single-stage, close coupled for installation in horizontal position, and capable of being serviced without distributing piping connections.

C. Pump volute shall be Class 30 cast iron with integrally cast pedestal support. The impeller shall be cast bronze, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking cap screw.

D. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat of at least 98 percent alumna oxide content and carbon seal ring, suitable for continuous operation at 225°F. A replaceable bronze shaft sleeve shall completely cover the wetted area under the seal.

E. Pumps shall be rated for minimum of 175 PSI working pressure. Casing shall have gauge ports at nozzles and vent and drain ports at top and bottom of casing.

F. Baseplate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends with securely welded cross members. A flexible type coupler, capable of absorbing torsional vibration shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required.

G. Pump bearing housing assembly shall have heavy-duty regreasable ball bearings, replaceable without disturbing piping connections and have foot support at coupling end.

H. The motor shall meet NEMA specifications and shall be the size, voltage, and enclosure called for on the plans. Pump and motor shall be factory aligned.

I. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

J. Provide access space around pumps for service. provide no less than minimum as recommended by pump manufacturer.

K. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

L. Pumps shall be manufactured by **(ITT Bell and Gossett, Burkes, MEPCO,)** or approved equal.

2.10 TRIPLE DUTY VALVE

A. Furnish and install as specified, a valve designed to performs the functions of a non-slam check valve, throttling valve, shutoff valve, and calibrated balancing valve.

B. The valve shall be of heavy-duty cast iron construction with NPT connections per ANSI B1.20.1-83 suitable for 1745 psi working pressure for operating temperatures up to 250°F. The valve shall be fitted with a bronze seat, replaceable bronze disc with EPDM seat insert, brass stem, and chatter preventing stainless steel spring. The valve design shall permit re-packing under full system pressure.

C. Each valve shall be equipped with brass readout valves (with integral check valve) to facilitate taking differential pressure readings across the orifice for accurate system balance.

D. Manufacturer: The manufacturer shall be ITT Bell and Gossett.

2.11 HYDRAULIC TRIM

A. On the suction side of the pump, install a **(basket, wye)** strainer, and a **(ball valve, through 2 1/2" pipe size, butterfly valve, 3" pipe size and larger)** for shut-off.

B. Manufacturer: The manufacturer shall be ITT Bell Gossett, Armstrong, Watts, Josam, or Owner approved equal.

2.12 AIR SEPARATOR

A. Horizontal in-line air separator designed to effectively separate free air in hydronic cooling system. The air separator shall be heavy duty cast iron designed to function satisfactorily at working pressures up to 175 psi and liquid temperatures up to 300°F. The air separator shall have an integral weir designed to decelerate system flow to maximize air separation.

B. The in-line air separator shall also assist in eliminating free air from the system by directing the air to an ancillary air vent attached to the air separator while reduced oxygenated water is circulated to the system.

C. Manufacturer: ITT Bell and Gossett.

2.13 AIR VENT

A. Non-modulating, high capacity, automatic type designed to purge free air from the system and provide positive shutoff at pressures up to 150 psig at a maximum temperature of 250°F.

B. Vent shall be constructed of cast iron body and bonnet with stainless steel, brass, EPDM, and silicon rubber internal components.

2.14 EXPANSION TANK

A. Size tank to be suitable for the total water volume of the entire system using normal engineering standards and practices.

B. Tank shall be constructed of UV-stabilized, high density polyethylene with inlet and outlet bulkhead fittings. Tank shall be suitable for outdoor installations.

C. Acceptable Manufacturer's: ITT Bell & Gossett, Ventrite, or approved equal.

2.15 CONTROLS

A. Provide provisions for local control as specified herein, and provisions for remote start/stop capabilities and run status light as provided by other(Div.16). Locate on chiller, mount steel control panel with hinged access, containing starters, power and control wiring, **(molded case disconnect switch)**, factory wired with **(single-point power connection.)**

B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer. Provide manual reset current overload protection.

C. Provide the following devices on a NEMA 3R**(NEMA 4X, NEMA 7)** control panel face:

1. Compressor run lights.
2. System start-stop switch.
3. Control power fuse of circuit breaker.
4. Compressor lead-lag switch.
5. Anti-short cycle timer
6. Auto Lead/Lag
7. Phase monitor to monitor over/under voltage and phasing.

D. Provide the following safety controls with indicating lights arranged so that operating any one will shut down machine and require manual reset:

1. Low chilled water temperature switch.
2. High discharge pressure switch for each compressor.
3. Low suction pressure switch for each compressor.
4. Oil pressure switch.
5. Flow switch in chilled water line.
6. Relay for remote mounted emergency shutdown.

E. Provide the following operating controls:

1. Multi-step chilled water temperature controller which cycles compressor and activated cylinder unloaders.
2. Five minute off timer prevents compressor from short cycling.
3. Periodic pumpout timer to pump down on chilled water flow and high evaporator refrigerant pressure.
4. Hot gas bypass sized for minimum compressor loading on one compressor only, bypasses hot refrigerant gas to evaporator.
5. Flooding head pressure control for low ambient operation.
6. Automatic start/stop controls for chilled water pump.

F. Provide pre-piped gauge board with pressure gauges for suction and discharge refrigerant pressures and oil pressures.

G. Provide alarm package with test button and indicating lights for each circuit which indicate control circuit is energized and compressor is running and will sound an audible alarm and light an indicating light upon detection of compressor malfunction, low chilled water temperature, or evaporator water flow failure.

[As an option, we can provide a Johnson DX-9100 or an Allen-Bradley SLC controller for a microprocessor. The DX-9100 is much cheaper, but the Allen-Bradley has more capabilities. The following items can be accomplished by either controller. Keep in mind, different options require different hardware, if you use one of these, please contact the factory to discuss the possibilities and the costs.

C. Provide a microprocessor based DDC controller with a programmable face. The controller shall be capable of adjusting the setpoint at the face of the controller. Any other programming changes shall require the use of a security key and must utilize manufacturer certified software to access the program and make revisions. Provide the following devices on a NEMA 3R**(NEMA 4X, NEMA 7)** control panel face:

1. Compressor run lights.
2. System start-stop switch.
3. Control power fuse of circuit breaker.
4. Phase monitor to monitor over/under voltage and single and reverse phasing.

D. The controller shall have all internal programming time sequences. Off-time sequences after compressors cycle off and time delays between compressor starts to limit in rush current.

E. The controller shall also control lead/lag capabilities by **(equal run time *[on screws and scrolls, and recips without unloaders],* automatic cycling *[on recip compressors with unloaders]***. With the equal run time, on a call for cooling, the controller shall assess which compressor has had the least amount of run time and energize that machine. For each additional call for cooling, the controller will do the same analysis for the remaining compressors. As the cooling cycles off, the controller will assess which compressor has the most run time and cycle that one off first.

F. The controller shall also monitor unit amperage draw. When the amperage increases above the determined setpoint for maximum draw, the controller will unload the slide valve until the amperage falls to a level below the setpoint. If necessary, the controller will shut a compressor off to maintain amp draw. After 5 minutes, the controller will try to load the compressors up to meet the load and maintain correct amp draw.

F. The controller shall display the following information on the face of the controller:
1. Supply and return water temperatures.
2. Current setpoints of the water temperatures.

2.16 Waterside Economizer

A. Unit shall be equipped with an integral waterside economizer. Unit shall be constructed and controlled in order to take advantage of ambient air to perform free cooling of the glycol solution. The condenser coil on the unit shall be built with an integral economizer coil circuited for water flow with ½" tubes, .017" tube thickness minimum with .025" return bend thickness, and .006" fin thickness.

B. Unit shall be equipped with a 3-way modulating valve and ambient stat that will redirect the glycol solution flow when the ambient falls to a point that it can be used for free cooling. At ambients beginning at 5°F below the leaving solution temperature, the modulating valve shall redirect the flow through the economizer coil. At this point, the economizer coils shall serve as a pre-cooler coil to the chiller. The chiller will still be capable of mechanical cooling, but the heat removed in the economizer coil will allow the compressors to unload and stage off until the ambient falls to a point where the entire load is satisfied with the economizer coil.

C. Fan cycle control shall be utilized to maintain the glycol temperature. Fans shall be cycled by an electronic controller monitoring the leaving solution temperature of the economizer coil.

2.16 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems.

B. Supply service of factory-trained representative for a period of one day to supervise testing, dehydration and charging of machine, start-up, and instruction on operation and maintenance to Owner.

C. Supply initial charge of refrigerant and oil.

2.17 EQUIPMENT SCHEDULE

A. CHILLERS

Equipment Tab:
Manufacturer:
Model:
GPM:
Tons:
Entering Water Temp:
Leaving Water Temp:
Ambient Air Temperature:
Maximum Pressure Drop:
Number of Compressors:
Volts/Phase:
Percent Ethylene Glycol:

B. PUMP

Dynamic Head:
RPM:
Motor
Equipment Tag:
GPM:
Total HP:
Volts/Phase:
Manufacturer:
Model: