ATTACHMENT "C"

PACKAGED AIR-COOLED AND LIQUID CHILLERS

1.0 GENERAL

1.1 SCOPE

This specification establishes minimum requirements for the design, fabrication and assembly of two (2) outdoor packaged air-cooled and three (3) indoor reciprocating liquid chiller utilizing 134A refrigerant. All materials, equipment, fabrication techniques and design incorporated into this packaged system shall be the manufacturer's responsibility. The chiller system shall be designed for unattended automatic operation.

2.0 APPLICABLE CODES AND STANDARDS

Except as modified by this specification, the reciprocating compressors, heat exchangers, vessels, auxiliaries, motors, starters and control components, materials and test methods shall conform to the applicable requirements established by the latest editions of the following Codes and Standards.

ANSI	American National Standards Institute
ANSI Std. S.5.1	Test code for measurement of Sound from Pneumatic Equipment.
ANSI Std B.31.5	Refrigeration Piping
ANSI Std B.16.5	Steel Pipe Flanges and Flanged Valves and Fittings
ARI-590	Air Conditioning and Refrigeration Standard
ASHRAE 15	Safety Code for Refrigeration
ASME	Boiler and Pressure Vessel Code, by American Society of Mechanical Engineers
ASME Section V	Nondestructive Examination
ASME Section VIII	Unfired Pressure Vessels
OSHA Part 1910.219	Mechanical Power Transmission Apparatus, by Occupational Safety and Health Administration

NEC	National Electrical Code, by NFPA-70
NEMA	National Electrical Manufacturer's Association
NEMA Std MG1	Motors and Generators
NEMA Std AB1	Molded Case Circuit Breakers
UL	Underwriters Laboratories Control Equipment
ICS	Industrial Controls and Systems

Uniform Mechanical Code

All applicable state, city and local codes at the installation site.

The applicable standards and codes referred to shall have full force and effect as though printed in this specification. If there is any overlapping of, or conflict between the requirements of these standards or codes and this specification, then that requirement which is more stringent shall take precedence.

All items used in the manufacture of these products shall comply with the product manufacturer's installation instructions and recommendations, except where more stringent requirements are indicated either in applicable codes and standards or in this specification.

3.0 ENGINEERING DESIGN AND PERFORMANCE REQUIREMENTS

3.1 GENERAL

The Manufacturer shall be responsible for all engineering design in regard to the selection of compressor capacity, equipment performance and performance of controls and instrumentation including refrigerant head pressure control.

The package will be completely factory assembled on a structural steel base. The packaged system shall be complete with compressors, motor, DX chiller, air-cooled condenser, suction accumulator, oil separator, control panel, all necessary valving, instrumentation, insulation, required process flanges and piping. All components of the package shall be painted for corrosion protection. The packaged chiller shall be factory-assembled, tested and shall be furnished complete with the required charge of refrigerant and oil.

3.2 FOUNDATIONS/UTILITIES

Proposer shall provide foundation, external piping, interconnecting wiring and all necessary utility services for installation of the chillers.

3.3 PERFORMANCE REQUIREMENTS

The chiller system, operating at design conditions, shall be capable of providing the refrigerant capacity as follows:

Evaporator

Recirculating solution:	30% Ethylene Glycol and 70% Water (EG/W) by weight
EG/W Entering Temperature:	30 °F
EG/W Leaving Temperature:	20.0 °F
Flow Rate:	256 GPM
Refrigeration Capacity:	575 TONS AT ABOVE CONDITIONS*
Pressure Drop:	10 FT WC*
Fouling Factor:	.00025

Condenser Air-Cooled

Design Ambient Air Temp	94.0 °F
Altitude:	1,117 FT

* Manufacturer to confirm

The air-cooled chiller package shall also be capable of providing proper capacity control at start-up when the EG/W solution temperature entering the chiller could reach as high as 100 °F.

4.0 EQUIPMENT DESIGN REQUIREMENTS

4.1 GENERAL

The chiller shall be run-tested as a complete unit prior to shipment. Capacity, power draw, control and operation shall be monitored and recorded. A copy of the run test report shall be available upon request. The unit shall be shipped with a full operating charge of refrigerant and oil. The unit shall have a minimum of two (2) compressors with each having its completely independent refrigerant circuit.

4.2 HERMETIC MOTOR-COMPRESSOR

The compressor shall be accessible hermetic reciprocating type with all rotating parts statically and dynamically balanced. The compressors shall include ring type, stainless steel, suction and discharge valves and removable cylinder liners. Motor cover and cylinder heads (with integral muffling devises) shall be removable.

The compressor lubrication is force-fed by a reversible positive displacement type oil pump to all crankshaft and bearing surfaces through a fine mesh stainless steel strainer. The compressor shall also include a suction strainer, oil strainer, crankcase oil sight glasses, crankcase oil heater, and backseating seal cap suction and discharge stop valves. The compressors shall be mounted on isolators.

The hermetic motor shall be high torque part winding start, 1750 RPM refrigerant gas-cooled and shall be equipped with overload protection. The motor shall be operated on 460 volts ±10%, 3-phase, 60 Hz electrical power. The raintight motor terminal box shall be located above the crankcase oil level.

4.3 CAPACITY MODULATION AND TEMPERATURE CONTROL

Each compressor shall have minimum three-step unit capacity control. The capacity control shall be in response to leaving EG/W temperature. The chiller shall be capable of shedding load from 100% to 6% in 5 minutes and maintain the 6% load without faulting off. Compressor unloaders shall be electric solenoid actuated and oil pressure operated.

4.4 EVAPORATOR

The evaporator shall be direct expansion shell and tube type with refrigerant in the tubes and liquid to be chilled in the shell. The design working pressure of the evaporator shell (liquid) side shall be 150 psig, and 235 psig for the tube (refrigerant) side. Refrigerant heads shall be removable. As a standard feature, the evaporator is equipped with a heater cable, covered with 3/4” flexible closed cell foam insulation for freeze-up protection to -20 °F ambient. The evaporator shall be constructed and tested in accordance with ASME code requirements. Vent and drain connections shall be included. The EG/W inlet and outlet connections shall be flanged type and fully accessible.

4.5 CONDENSER

The condenser coil shall be constructed of seamless copper tubes, arranged in staggered rows, mechanically expanded into aluminum fins. The design working pressure of the condenser coil shall be 450 psig. The condenser fans shall be propeller type, providing vertical air discharge. Fan blades shall be statically and dynamically balanced, protected above by nonrusting, vinyl coated fan blade guards. Each fan shall be driven directly by a permanently lubricated individual motor.

4.6 REFRIGERANT CIRCUIT

Independent refrigerant circuits shall be furnished with each unit. The refrigerant circuit(s) shall be constructed of copper tubing with brazed joints, and shall include: shut-off valve with charging connection, sight glass moisture-liquid indicator, direct acting maximum operating pressure thermal expansion valve, solenoid valve and filter-drier. The entire suction line and liquid line between the expansion valve and the cooler shall be insulated with flexible closed cell insulation.

4.7 CONTROL PANEL

All controls, meters, alarms, lights, manual controls shall be mounted in a weather-tight enclosure. Separate sections shall be provided for the refrigeration and electrical controls starter section. The starter section shall consist of the main unit single point power connection, starting controls for part winding to start, noncycling compressor overloads and oil pressure cutouts. The refrigeration section shall contain the reset relay, compressor service switches, motor protector, differential oil pressure control, high and low pressure controls central unit microprocessor.

The microprocessor controls the compressor antirecycle function, automatic compressor lead-lag, low water temperature cutout, loss of charge protection, leaving chilled water temperature control, load limiting, with control capability for unit low ambient start logic, timed periodic pumpout, and hot gas bypass logic.

The control panel shall be provided with an interface terminal to wire in customer “Enable” signal (n.o. dry contacts) to enable chiller system for automatic operation. The control panel shall be provided with a set of signal dry contacts for indicating chiller status (n.o.: closes to indicate chiller is running).

4.8 HOT GAS BYPASS

Hot gas bypass with seven step control shall allow unit operation below the minimum step of unit unloading. The regulator valve along with all the associated refrigerant piping and electrical wiring shall be factory installed and tested. If unit operates in the bypass mode for a period of 30 minutes without a call for cooling, the unit will pump down and stop. Unit will be allowed to start immediately on a call for cooling. Regulator valves shall be provided on both refrigerant circuits for lead-lag sequencing of compressors.

4.9 CHILLED WATER FLOW SENSOR

A flow sensor (flow switch or pressure differential switch) used in conjunction with a customer enable signal (dry contact) interlocked with the chiller control circuit shall be provided in the chiller control circuit. Terminals for customer interface for enable signal, flow sensor dry contact and chiller run status signal shall be provided on the refrigerant control part of control panel.

5.0 POWER PANEL(S)

The power panel(s) shall contain the compressor power terminals, compressor motor starting contactors, current transformer sensing for each compressor power source, for protection against under voltage, over voltage, imbalanced voltage, single phasing compressor stall and voltage spikes, and control power supply (115-1-60) from the unit mounted control power transformer.

5.1 ACCESSORIES

Manufacturer shall include the following items as also specified under other paragraphs in this specification.

Permit stable operation to as low as 6% of the capacity (factory-mounted).

Flow switch - (field mounted).

Fused Control Power transformer - To reduce unit power voltages to 115-1-60 for operation of control panel (factory mounted).

Single point power connection - (factory-mounted).

Wire/Louvered enclosure - (factory mounted)

EG/W inlet outlet flanges - 150 lb R.F. (factory mounted)

Leaving water temperature control - Unit modified at factory to provide control from EG/W leaving instead of EG/W return side.

Summary alarm dry contacts (N.O.: closes on alarm): one set of contacts for each compressor circuit.

High Ambient kit to meet maximum ambient temperature of 130°F.

Customer Enable signal dry contacts (n.o.: closes to enable chiller system) remote chiller operation

A set of signal dry contacts for indicating chiller status (n.o.: closes to indicate chiller is running).

6.0 ADDITIONAL SERVICES

6.1 START-UP, TESTING AND INSPECTION

Proposer shall supply a serviceman for start-up of the chiller system at the Houston Hobby Airport. The start-up technician shall remain available until the equipment is operating in accordance with these specifications. This condition

shall be deemed to have been met when the Director accepts the equipment as being satisfactorily operational.

The start-up technician shall be required to test all electrical systems for starting, loading, unloading alarms and shutdowns.

6.2 DRAWINGS AND VENDOR INFORMATION

Manufacturer shall supply six (6) each of the following within four (4) weeks of award of Contract.

A. Electrical control wring and schematic diagram.

B. Skid general arrangement drawings showing overall dimensions, weight and service access requirements.

C. Compressor motor data sheet.

D. Complete installation, operation and maintenance manuals including microprocessor control ladder diagram.

E. Complete parts list with priced recommended spare parts list.