

1. GENERAL

1.1 ADMINISTRATIVE

- .1 Submit to Contract Administrator submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples, and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
- .10 Keep one reviewed copy of each submission on site.

1.2 Shop Drawings and Product Data

- .1 Where requested, submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to Contract Drawings and Specifications.
- .3 Allow 10 Business Days for Contract Administrator's review of each submission.
- .4 Adjustments made on Shop Drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.

- .5 Make changes in Shop Drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter containing:
 - .1 Date.
 - .2 City Tender title and Tender number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each Shop Drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions include:
 - .1 Date and revision dates.
 - .2 City Tender title and Tender number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.

- .10 Relationship to adjacent work.
- .8 After Contract Administrator 's review, distribute copies.
- .9 Submit electronic copies of Shop Drawings for each requirement requested in specification Sections and as Contract Administrator may reasonably request.
- .10 Submit electronic copies of product data sheets or brochures for requirements requested in Specification sections and as requested by Contract Administrator where Shop Drawings will not be prepared due to standardized manufacture of product.
- .11 Submit electronic copies of test reports for requirements requested in Specification sections and as requested by Contract Administrator.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .12 Submit electronic copies of certificates for requirements requested in Specification sections and as requested by Contract Administrator.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit electronic copies of manufacturer's instructions for requirements requested in Specification sections and as requested by Contract Administrator.
 - .1 Pre-printed material describing installation of product, system, or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit electronic copies of Manufacturer's field reports for requirements requested in Specification sections and as requested by Contract Administrator.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit PDF electronic copy of Operation and Maintenance Data for requirements requested in Specification sections and as requested by Contract Administrator.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, electronic copy will be returned, and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and resubmission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

- .20 The review of Shop Drawings by the Contract Administrator is for the sole purpose of ascertaining conformance with the general design concept.
 - .1 This review shall not mean that Contract Administrator approves detail design inherent in Shop Drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in Shop Drawings or of responsibility for meeting requirements of the Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective Specification sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Contract Administrator's business address.
- .3 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
- .6 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 PHOTOGRAPHIC DOCUMENTATION

- .1 In addition to the photographs taken by the Contract Administrator's Resident Engineer submit electronic copy of colour digital photography in jpg format, standard resolution as directed by Contract Administrator.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints:
 - .1 Viewpoints and their location as determined by the Contract Administrator.
- .4 Frequency of photographic documentation: as directed by the Contract Administrator.

2. PRODUCTS

2.1 NOT USED

.1 Not Used.

3. EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 REFERENCE STANDARDS

- .1 Conform to the reference standards, in whole or in part as specifically requested in the Specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, the City reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be borne by the City in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Materials incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout the site.
- .3 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the City and/or Contract Administrator of such, in order that remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify the City and/or Contract Administrator at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the City reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .7 Remove and replace damaged products at the Contractor's expense and to satisfaction of the City.

- .8 Touch-up damaged factory finished surfaces to the City's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay costs of freight and cartage of Materials required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in Specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Contract Administrator in writing, of conflicts between Specifications and manufacturer's instructions, so that Contract Administrator will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties.

1.8 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

- .1 Conceal conduits, and wiring below grade and within the pole structure, except where indicated otherwise.
- .2 Before installation inform Contract Administrator if there is interference. Install as directed by Contract Administrator.

1.10 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and electrical items indicated as approximate.
- .2 Inform Contract Administrator of conflicting installation. Install as directed.

1.12 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.

- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected Specification section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Contract Administrator.

1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

2. PRODUCTS

2.1 NOT USED

- .1 Not Used.

3. EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1. GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit four (4) final copies of operating and maintenance manuals in English to Contract Administrator two (2) weeks prior to Substantial Performance of Work.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.2 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm (8.5" x 11") with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide a tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text. Fold larger drawings to size of text pages.
- .9 Provide digital PDF copies of all documentation organized same as the binder.
- .10 Provide digital PDF copies of all As-Built drawings along with hardcopy.

1.3 Contents – Operation and Maintenance Manuals

- .1 Table of Contents for each volume:
 - .1 Provide title of project.
 - .2 Date of submission.

- .3 Name addresses and telephone numbers of Consultant and Contractor with name of responsible parties.
- .4 Schedule of products and systems indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
 - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems to show control and flow diagrams.
 - .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.4 Maintenance Materials

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site, place, and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Contract Administrator.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site, place, and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Contract Administrator.
 - .2 Include approved listings in Operation and Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

.3 Special Tools:

.1 Provide special tools, in quantities specified in individual specification sections.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to location as directed, place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Operation and Maintenance Manual.

1.5 Delivery, Storage and Handling

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and for review by Contract Administrator.

2. PRODUCTS

.1 Not Used.

3. EXECUTION

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 Reference Standards

- .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI)
 - .1 AHRI-550/590-03, Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
- .2 ASTM International (ASTM)
 - .1 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
- .3 CSA Group (CSA)
 - .1 CSA B52-05 SMART, Mechanical Refrigeration Code.
- .4 Environment Canada/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for centrifugal water chillers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit factory shop drawings that indicate:
 - .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematics.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Space requirements for operation and maintenance.
 - .5 Type of refrigerant used.

1.3 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for centrifugal water chillers for incorporation into the Operation and Maintenance Manual by the Installation Contractor.
- .3 Data to include:
 - .1 Description of equipment giving manufacturers name, model type and, capacity and serial numbers. Include full description of system, operation and control as well as providing "as programmed/commissioned" parameter list
 - .2 Submit part load performance curves.
 - .3 Details on operation servicing and maintenance.
 - .4 Parts book that illustrate and list all assemblies, sub-assemblies and components. Bill of material to include manufacturer's part number with matching reference numbers to illustrations. Recommended spare parts list and special tools list shall be provided.
- .4 Special tools as described in 2.1.3.4

1.4 Delivery, Storage and Handling

- .1 Chillers shall be delivered to the job site completely assembled (unless otherwise specified).
- .2 Comply with the manufacturer's instructions for transporting and rigging.
- .3 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .4 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .5 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect centrifugal water chillers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Packaged Outdoor Air-Cooled Chiller (CHLR-M630)

- .1 Product Description
 - .1 Provide a factory assembled air cooled packaged chiller.
 - .2 The chiller shall include multiple Turbocor, magnetic bearing, and variable-speed centrifugal compressors. Integrated variable frequency drive shall operate with inlet guide vanes.
 - .3 The chiller shall operate with HFO-1234ZE refrigerant.

- .1 Refrigerant to be supplied by the City up to an amount of 545 kg. Quantities of refrigerant exceeding this amount to be supplied by Contractor and included as an additional price.
 - .4 The evaporator, condenser, and expansion valve shall be configured to operate as dual refrigerant circuits. The chiller unit compressors shall be designed for mechanical and electrical isolation to facilitate service and removal.
- .2 Warranty and Maintenance
- .1 The chiller manufacturer's warranty shall be for a period of two years from the date of Total Performance.
 - .2 The warranty shall apply if the failure is as a result of defective parts, materials or workmanship as provided by the equipment manufacturer or the Contractor's delivery. The warranty shall cover the following:
 - .1 Parts,
 - .2 Any rentals associated with the repairs,
 - .3 Software upgrades,
 - .4 Replacement of refrigerant lost, and
 - .5 Labour costs for the repair or replacement of parts.
 - .3 Maintenance of the chiller and condenser equipment, while under warranty, is mandatory and shall be the responsibility of the City unless supplied by the manufacturer.
 - .4 One of each specialty tool that is required for the maintenance of the equipment shall be provided to the City for the maintenance of the equipment.
- .3 Design Requirements
- .1 Unit shall consist of 2 magnetic bearing, oil-free centrifugal compressors with integrated variable frequency drive, refrigerant flooded evaporator, air cooled condenser and operating controls with equipment protection.
 - .2 Performance:
 - .1 Nominal capacity: 130 Tons.
 - .2 The chiller shall be capable of stable operation down to 35 Tons.
 - .3 Refrigerant: HFO-1234ZE.
 - .4 Voltage/phase/hertz: 575/3/60.
 - .5 Evaporator fluid: 30% Propylene glycol.
 - .6 Evaporator fluid design flow rate: 21 L/s.

- .7 Evaporator fluid supply temperature (Full load): 5.5°C.
- .8 Evaporator fluid return temperature (Full load): 11°C.
- .9 Maximum fluid pressure drop: 34.5 kPa.
- .10 Maximum footprint dimensions (L x W): 3400mm x 2400mm.
- .11 Maximum operating weight: 5200 kg.
- .3 Acoustics: Sound pressure for the unit shall not exceed the following specified levels, and be less than 74 dBA, measured a 1 meter (3.28 feet). Sound data shall be measured according to AHRI Standard 370-2011.
- .4 Chiller shall be equipped for single-point power connection.
- .5 Evaporator shall be designed to allow for the flow rate to be reduced to the rate of 0.063 L/s (1 GPM) per ton without entering laminar flow to allow for variable chilled water flow and facilitate chilled water pump energy savings. The chiller shall be able to operate in a stable fashion at this condition for at least 8 hours continuously.
- .6 Each compressor shall be electrically isolated. The chiller shall be able to operate with the remaining compressors with (1) or more compressors electrically isolated.
- .7 All chillers shall be equipped with a load balancing valve for capacity control and supply chilled temperature stability.
- .8 All chillers equipped with (2) or more compressors shall be equipped with individual compressors staging valves to channel discharge gas from the outlet of the compressor to the evaporator for the ramp up during a high-pressure ratio application.
- .4 Compressors
 - .1 Compressors shall be of semi-hermetic centrifugal design and operate oil-free with two-stages of compression, magnetic bearings, movable inlet guide vanes and integrated variable frequency drive system.
 - .2 Automatically positioned and controlled inlet guide vanes shall operate with compressor speed controls.
 - .3 The compressor shall be capable of coming to a controlled stop in the event of a power failure. The unit shall be capable of initializing an automatic restart in the case of power failure.
 - .4 Each compressor shall have integrated microprocessor control capable of capacity and safety control.
 - .5 Each compressor shall be installed with individual suction, discharge and motor cooling refrigerant line isolation valves. Chillers without discharge line isolation valves that rely on non return valves in discharge line for compressor removal shall not be accepted.
 - .6 Refrigerant Discharge line shall have a combination of shut off and check valve, Blank seal are not acceptable.

- .7 Guide Vanes: Modulating with factory mounted electric operator, suitable for capacity reduction down to fifteen (15) percent of specified load without hot gas bypass.
- .5 Prime Mover
 - .1 Permanent-magnet, synchronous hermetically sealed motor of sufficient size to effectively provide compressor horsepower requirements. Motor shall include soft-start capabilities with an inrush current of no more than 2 amps. Motor shall be liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase.
 - .2 Compressor motor and chiller unit shall include variable-frequency speed controls to match cooling load demand to compressor speed and inlet guide vane position.
 - .3 Each compressor shall be equipped with a 5% impedance AC line reactor and individual disconnect or circuit breaker
- .6 Evaporator
 - .1 Evaporator shall be shell-and-tube type and have separate shells. Heat exchangers shall be designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII Code Case 1518-5. They shall have a copper wall of 0.635 mm (0.025 in.) wall thickness. In the evaporator, refrigerant shall be in the shell and water inside the tubes. The water sides shall be designed for a minimum of 1034 kPa (150 PSIG). Evaporator shall be designed for 30%Turn down ratio on flow rate. The water connections for the evaporator and condenser shall be grooved suitable for Victaulic couplings or flanged. Vents and drains shall be provided. The refrigerant side of each vessel shall bear the ASME Code stamp, code case section VII. Vessels shall pass a test pressure of 1.1 times the working pressure but not less than 690 kPa (100 psig). Provide intermediate tube supports spaced to enable equal liquid and gas flow across multiple compressor suction ports. The evaporator water connections shall also be equipped with right-hand or left-hand connection, interchangeable.
 - .2 The evaporator shall be provided with spring loaded reseating-type pressure relief valves according to ASHRAE-15. Rupture disks are not acceptable.
 - .3 Tubes shall be individually replaceable and have internally and externally enhanced surfaces designed for refrigeration duty. Tubes shall have smooth full tube wall landings at the tube-sheet ends and at intermediate tube supports. Tubes shall be mechanically roller expanded into steel tube sheets containing a minimum of three concentric grooves. The use of sealants to provide a proper seal is not be acceptable for this application.
 - .4 Provide factory-mounted and wired, thermal dispersion switches water flow switches on evaporator to prevent unit operation with no water flow.
- .7 Air-Cooled Condenser
 - .1 1. Air cooled packaged chillers and controls shall be capable of reliable operation between 0°C (32°F) and 41°C (105°F) ambient air temperature.
 - .2 Air-cooled condensers microchannel coils shall meet ASTM B117 1000hr salt spray test resistance.
 - .3 TUBE: aluminum construction. Copper inlet and outlet.

- .4 FIN: aluminum construction, louvred fins.
 - .5 END CAP: The end cap and the main body of the heat exchanger shall be brazed together to form one leak-free stable unit. The whole heat exchanger assembly including the end cap shall be resistant to galvanic corrosion.
 - .6 Condenser coils frame shall be made of galvanized steel.
 - .7 Condenser coils and fans shall be arranged such that one fan operates with one coil section so that the failure of a fan will not affect the airflow across any coil beyond that fan.
 - .8 Condenser shall be equipped with an oversized liquid line and mechanical float to assure liquid sub-cooling necessary for effective cooling of the compressor.
 - .9 Condenser shall be equipped with packaged variable speed fans capable of delivering minimum of 6607 L/s (14,000 CFM) and maximum 890 rpm. The fans shall have a minimum diameter of 910 mm in order to provide higher air flow at lower speed and lower noise level. The sound pressure level at highest speed shall not exceed 68dB(A) in the inlet side.
 - .10 Condenser fan motors shall be ECM type high efficiency, direct drive, 3-phase, insulation class "F", current protected, Totally Enclosed Air Over (TEAO), double sealed and with permanently lubricated ball bearings.
 - .11 The fans shall balance dynamically and statically and direct drive. Also, the blades shall be corrosion resistant designed for low noise, full airfoil cross section, providing vertical air discharge from extended orifices. The fans guards shall be constructed of heavy duty 14-gauge steel and painted.
 - .12 Condenser coils shall be positioned in such a manner as to resist damaged from without the use of hail guards. If this cannot be accomplished, hail guards must be provided and manufacturer to provide documentation demonstrating that the coil guards do not affect the performance of the fans.
 - .13 All V-bank coils must include a plastic cover to protect the coils from damage and all refrigerant piping must be with the unit framing.
 - .14 Provide standard rough grade finish 304 Stainless steel Base frame and galvanized G-14 sheet metal for the V-bank
- .8 Liquid level controls
- .1 Control of refrigerant flow shall utilize a single or multiple 6,000 step electronic expansion valve (EXV), to operate within the full range from full load to the lowest loading capacity for the chiller. Fixed orifice metering devices or float controls using hot gas bypass are not acceptable. The EXV liquid line shall have a sight glass with moisture indicator and temperature sensor connected to control system for validation of sub-cooling.
 - .2 The EXV valve shall be controlled by evaporator level float control. EXV superheat control shall not be acceptable as a primary control method, however, shall be included as a redundant feature.

- .3 Evaporator shall be provided with a capacitive type liquid level transducer with a resolution of not less than 1024 discrete steps. Transducer shall be wired to chiller control system. Evaporator liquid level measurement shall be used in electronic expansion valve control algorithm with a minimum level set point to ensure adequate liquid seal is maintained in condenser to provide compressor motor cooling during operation. Evaporator liquid level shall be clearly displayed on graphical operator interface in a minimum of two screens. Chillers without direct level measurement are prohibited due to possible over heating damage that may occur in compressors when liquid seal is lost.

.9 Chiller Controls

- .1 The controller fitted to the oil-free centrifugal chiller package shall be an embedded real time microprocessor device that utilizes control software written specifically for chiller applications. User operation shall be accomplished using a panel mounted color touch-screen interface. The status of the compressors and all system parameters including compressor alarms and temperature trends shall be viewable.
- .2 Chiller control system shall have the capability to store one year of operational data. No less than 60 points of information shall be sampled at a maximum of 15 minute intervals.
- .3 Chiller control system shall have full web based remote control capability including the capability for remote operation and software updates.
- .4 There shall be a backup superheat control on inlet of the compressor in order to control the EXV in the event of a failure of the primary level sensing device.
- .5 A cover is to be included to protect the touch screen interface from environmental conditions. The cover shall be hinged with stoppers and opaque.
- .6 Controller features:
 - .1 Selectable control mode – leaving chilled water, entering chilled water or suction pressure control.
 - .2 305 mm (12 inch), touch panel (with Kiltech Controller)
 - .3 Operator interface shall be capable of connecting directly to compressors via serial communication protocol and display compressor information using Turbocor compressor monitoring/ commissioning software.
 - .4 Chiller control panel shall contain a minimum of three processors; all control functionality shall be carried out on a dedicated real time processor and data served to a remote graphical user interface via an open Ethernet protocol. Proprietary protocols between any pc based or micro based processor strictly prohibited.
 - .5 Bacnet MS/TP, Bacnet IP, or Lon capable.
 - .6 Chiller control shall be capable of controlling up to eight Turbocor compressors on up to eight individual refrigerant circuits serving the same chilled water stream.
 - .7 Chiller control panel user interface shall be capable of remote control via an internet connection without the use of any third-party gateway device or additional hardware or software.

- .8 Ability to place all outputs in a manual state (hand, off, auto) via graphical user interface.
 - .9 Alarm screen shall be capable of filtering faults into specific categories such as compressor, chiller and system faults in order to provide rapid diagnosis and separation of failure modes.
 - .10 Multiple compressors staging algorithm shall operate at the optimized power curves of each compressor simultaneously and shall reset automatically every second during operation. Compressor staging methods that operates using simple incremental percent of demand shall not be accepted.
 - .11 Continuous data logging for operational trending and bin analysis shall be exportable to "CSV" format. (12 months data stored).
 - .12 Embedded Web to enable remote encrypted control, log download, software version upload and operational monitoring.
 - .13 Built-in stepper motor controls for EXVs
 - .14 Controls lockup protection
 - .15 Ramp rate control - Peak energy demand limiting algorithms.
 - .16 Chiller control software shall employ an active fault avoidance algorithm to reduce chiller capacity and/or power level in the case the chiller approaches within 10% of any trip limit value such as suction pressure, discharge pressure, chiller amp limit, leaving chilled water temperature limit etc.
 - .17 Store up to 32,000 alarm and fault events stored with date / time stamp.
 - .18 Real time data trending viewable via Touch panel.
 - .19 Chiller load profile charts viewable via Touch panel.
 - .20 Chiller control graphical user interface shall be capable of displaying data in SI or I-P units without affecting control or BAS protocol units.
 - .21 Controls shall identify within 60 seconds a compressor that is not starting or ramping properly. Upon this identification, the compressor shall be disabled, the remaining compressors shall be operated in an optimized fashion and an alarm shall be sent to alert the operator.
 - .22 Chiller faults (14) possible conditions.
 - .23 Each compressor alarm (9) possible conditions.
 - .24 Each compressor fault (13) possible conditions.
 - .25 Each compressor bearing fault (16) possible conditions.
 - .26 Each compressor IGV position.
- .7 Data on Main Display Screen shall include:

- .1 Entering and leaving chilled water temperatures
 - .2 Ambient air temperature
 - .3 (7) states available
 - .4 Active timers
 - .5 Chiller enable status
 - .6 Chiller water flow proof status
 - .7 Indication of compressor readiness
 - .8 Indication of clearance to run
 - .9 Chiller set point
 - .10 Total chiller kW
 - .11 Total chiller current input
 - .12 Three pages of data trends with zoom functionality
 - .13 Graphical dial indicators that clearly indicate safe and unsafe operating values
 - .14 Graphical representation of evaporator and condenser showing gas movement when chiller is running
 - .15 Current alarms (announce and manual reset provision)
 - .16 Compressor actual rpm, maximum rpm, minimum rpm
 - .17 Compressor alarm description & fault description
 - .18 Compressor percentage motor demand
 - .19 Compressor safety interlock status
 - .20 Compressor Modbus communication health status
 - .21 Compressor suction and discharge pressures
 - .22 Compressor suction and discharge temperatures
 - .23 Compressor internal cooling system temperatures and status
 - .24 Compressor motor kW and amps
 - .25 Compressor pressure ratio.
- .10 Acceptable manufacturer shall be Smardt Inc. or approved equal in accordance with B7.

- .1 Where a manufacturer is approved as equal in accordance with B7, the following additional spare parts shall be provided:
 - .1 magnetic bearing compressor assembly with motor,
 - .2 thermostatic expansion valves,
 - .3 safety relief valves,
 - .4 fuse plugs,
 - .5 filters, driers and shells,
 - .6 air filters,
 - .7 pressure switches,
 - .8 fan motor,
 - .9 electrical contactors and accessories,
 - .10 auxiliary contact relays,
 - .11 starters,
 - .12 breakers,
 - .13 fuses/switch disconnects,
 - .14 transformers,
 - .15 relays,
 - .16 capacitors,
 - .17 damper actuator,
 - .18 spring return actuator,
 - .19 user interface,
 - .20 displays,
 - .21 controllers boards, and
 - .22 miscellaneous electronics boards.

3. EXECUTION

3.1 Factory Performance Testing Services

- .1 Chiller manufacturer shall be responsible for the factory run test and submitting test reports for approval by the Contract Administrator prior to chiller shipment.

3.2 Post-Delivery Inspection Services

- .1 Visually inspect product upon delivery.
- .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
- .3 Proceed with receipt of product only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.3 Site Installation Support and Inspection of Chiller Installation

- .1 Provide a manufacturer's factory-trained service engineer without additional charge to perform chiller start-up and on-site commissioning, including controls and flow verification. Provide leak testing, evacuation, dehydration, and charging of the chillers.
- .2 The manufacturer or its approved representative will participate in and coordinate with the Contract Administrator, the City, the Contractor, controls sub-contractor and other trades to ensure proper application and integration of the chiller in the PLC control system. The proposed person should have experience in similar projects.
- .3 Manufacturer to approve installation, to supervise start up and to instruct operators.
 - .1 Include 3 days minimum per unit.

3.4 Start-Up and Commissioning by Factory Technician

- .1 Units shall be field charged with HFO-R1234ZE refrigerant (City supplied – see 2.1.1.3.1).
- .2 Factory Start-Up Services: Provide factory supervised start-up on-site for a minimum of two working days ensure proper operation of the equipment.
- .3 During the period of start-up, the factory authorized technician shall instruct the City's personnel in proper care and operation of the equipment.

3.5 Training Services

- .1 Provide one 4-hour training session on complete operations and maintenance of the system.
- .2 Provide a copy of training booklet / information for future employee use.
- .3 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
- .4 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .5 Instruct personnel on control and maintenance of sensory equipment and operational equipment associated with maintaining energy efficiency and longevity of service.
- .6 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .7 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

- .8 Provide sufficient amount of time required to instruct maintenance staff on the proper operation of all equipment

END OF SECTION