PART 1 GENERAL

1.1 Related Work Specified Elsewhere

.1	General Provisions	Section 01000
.2	Mechanical General Provisions	Section 15010
.3	Insulation	Section 15180
.4	Chemical Treatment	Section 15300
.5	Plumbing	Section 15400
.6	Controls	Section 15900
.7	Testing and Balancing	Section 15990

1.2 Description of Systems

.1 For the systems listed below (but not limited to) complete piping systems including all necessary equipment such as piping, valves, hangers, controls, and insulation.

.1 Replacement of existing central chilled water plant and associated pumps, piping modifications.

.2 Replacement of existing cooling tower and associated piping modifications.

1.3 Reference

.1 Conform with the requirements of the plans and specifications, the local authorities having jurisdiction and the National Building Code. In the case of conflicting requirements, be governed by the most severe regulations.

.2 Use latest edition of all referenced codes, standards, regulations, etc.

1.4 Requirements of Regulatory Agencies

.1 Conform to ASME requirement for pressure vessels where applicable.

.2 Electrical equipment shall bear CSA and ULC labels attesting to have met test standards of agencies and having been listed.

.3 Tanks shall bear approval of Manitoba Department of Labour, and when applicable, shall bear label of Underwriters' Laboratories of Canada.

1.5 Sample

.1 Submit all samples requested by the Contract Administrator.

1.6 Shop Drawings

.1 Submit shop drawings in accordance with Section 01000.

.2 Shop drawings are required for:

.1 Chillers.

.2 Cooling tower.

.3 Pumps.

.4 Pipe hangers and anchors.

.5 Valves and piping specialties.

.6 Equipment supports, saddles and bases.

.7 All miscellaneous equipment.

.8 Control and control diagrams.

1.7 Maintenance Data

.1 Provide maintenance data for incorporation into maintenance manual.

1.8 HVAC Equipment and Systems Components

.1 In the case of a discrepancy between any tender documents as to number, type or location of HVAC equipment and systems components, obtain written ruling during tender call.

PART 2 PRODUCTS

2.1 Pipe and Pipe Fittings

.1 Select from Table 1. (at end of this section)

.2 Black Steel Pipe and Fittings:

.1 For longitudinal seam, use butt welded design for sizes up to and including 65 mm (2 1/2") and lap welded design for sizes 75 mm (3") and over.

.2 Use screwed fittings for pipe sizes up to and including 50 mm (2"). Refer to Table 1.

.3 Use welded joints and fittings for pipe sizes 65 mm (2 1/2") and larger. Refer to Table 1.

.4 Use welded joints and fittings for all gas pipe sizes where required by Manitoba Department of Labour, Gas Notices.

.5 Provide coupling of malleable iron 150 psi banded type,welded or flanged with gasket to suit service.

.6 Provide welded fittings and malleable iron 150 PSL.

.7 Provide unions for 50 mm (2") size and smaller, malleable iron, two bronze seats, ground joint 150 psi standard.

.8 Provide unions for 65 mm (2 1/2") size and larger, cast iron flange with gasket to suit service. Fasten with bolts, square or hex head, and heavy hex nuts to ASTM A307, Class B.

.9 Use long radius elbows.

.10 Standard of Acceptance for welding fittings; Tube-Turn.

.3 Copper Pipe and Fittings.

.1 Use standard pipe couplings of same material and strength as adjoining pipe.

.2 Provide wrought copper fittings with solder recess to ANSI B16-18.

.3 Use unions all brass or bronze, 150 psi service with ground joint seat.

.4 Solder: (use either .1 or .2)

.1 Use 95/5 tin antimony. Solder metal to CSA B67064. Use non-corrosive flux.

.2 Use "Silfos".

2.2 Valves

.1 Select from Table 2. Standard of Acceptance: Toyo Valve unless otherwise noted.

.2 Standard of Acceptance for all valves listed in above shall include listed manufacturer or

approved equal as manufactured by McAvity, Jenkins , Grinnell, Keystone, Milwaukee, BB-FF, Crane, Nordstrom, Walworth, Lunkenheimer, Check-Rite or Monotight.

.3 Except where otherwise acceptable to the Contract Administrator, provide all valves of same type by one manufacturer, ie. cast iron valves by one manufacturer; bronze valves by one manufacturer.

.4 Unless otherwise specified or noted, valves to be NASI Class 200 wog, or 150/200 wog non-shock screwed or soldered ends, malleable iron handle. In equipment room and in boiler rooms, provide butterfly shut-off and throttling valves.

2.3 Piping Specialities

.1 Backflow Preventers:

.1 Backflow preventers on potable water systems are provided under Section 15400. Provide all required information to Section 15400.

.2 Provide all backflow prevention assemblies that are required to protect integrity of HVAC systems. Use items specified in Section 15400.

.2 Drain Valves:

.1 Drain Valves on domestic water lines shall be complete with Watts 8A vacuum breaker or equal.

.3 Strainers:

.1 Minimum service rating of 150 psig or system pressure, whichever is greater.

.2 Strainers: Iron bodied except use non-ferrous on non-ferrous lines, and on domestic water service.

.3 Type: Cleanable Y Pattern or cylindrical (suction diffuser).

.4 Screens: Removable and made from type 304 stainless steel with 0.045" perforation (233 per square inch).

.5 50 mm (2") and under (screwed):

.1 Provide valved blowdown connection with hose end.

.2 Standard of Acceptance: Armstrong Model AISC or equal as manufactured by Sarco, Crane, or Toyo.

.6 63 mm (2 1/2") and over (flanged):

.1 Provide valved blowdown line run to discharge to nearest acceptable point of disharge. Line and valve to be same size as strainer blowdown connection.

.2 Standard of Acceptance: Armstrong Model A IFL-125 or equal as manufactured by Sarco, Crane or Toyo.

.7 Dielectric couplings: Provide dielectric union between dissimilar metals.

.4 System Air Vents:

.1 Provide automatic float type air vents on all air purgers at heat generation source of liquid cooling systems.

.1 Provide shut off valve in piping to air vent.

.2 Provide indirect drain line from air vent to discharge to nearest acceptable point of discharge.

.3 Standard of Acceptance: Armstrong 1-AV 3/4" with test cock or equal as manufactured by Taco, Maid-o-Mist, Amtrol, Vent-Rite or Sarco.

.2 Provide manual type air vents of all high points liquid cooling systems.

.1 Standard of Acceptance: Toyo 5046.

2.4 Water Chiller

.1 Provide semi-hermetic rotary screw direct drive water chiller, c/w semi-hermetic compressor-motor assembly, evaporator, condenser, electrical disconnect, starter, three way condenser motor valve, and control package capable of controlling entire chilled water system and must be capable of interfacing with existing Johnson Controls Metasys The intent is to provide two stand alone chiller, pump, and tower systems.

.2 Chillers evaporators must be capable of operating with two chillers in parallel.

.3 Manufacturer must have local representation and must have local serviceperson capable of servicing this type of equipment. Manufacturer to demonstrate stability of machine when operating at 25% capacity, 100 deg F (40.6 deg C) condenser water discharge temperature, and 40 deg F (4.4 deg C) evaporator discharge. Submit head versus capacity curves, showing surge envelope.

.4 Chiller package must have a written 5 year parts and labor warranty provided by the manufacturer.

.5 Chiller to be shipped in skids and be shrink wrapped. Storage of unit will be the responsibility of the contractor. Units must be stored inside.

.6 Compressor-Motor Assembly:

.1 Compressor shall be direct-drive rotary screw statically and dynamically balanced and over-speed tested.

.2 Motor to be semi-hermetic assembled and functionally tested at manufacturer*s plant, suction gas or liquid refrigerant cooled, to have inherent high temperature protection in each phase of stator windings.

.3 Motor to be capable of operating continuously without damage, at voltages within plus or minus 10 percent of the specified voltage. Motor enclosures designed with access covers for inspection and removal of two mainshaft bearings. Motor protected against drawing more than rated full load amperes.

.4 Motor shall be 575 Volts, 3 phase, 60 Hertz, with service factor of 105% and a minimum .90 power factor at full load.

.5 Compressor to be provided with an automatic capacity control system, and shall provide continuously variable capacity from 10 to 100% of full load. Unit shall be designed to start under no—load condition. This control system to include automatic stopping when load falls below 10% and shall have automatic restarting. Manufacturer to supply chilled water reset controller to allow chilled water leaving temperature to be reset from 40 deg F (4.4 deg C) to 54 deg F (12.2 deg C).

.6 Provide load limiting relay on semi-hermetic machine, set at 95% of service factor X F.L.A. or 110% of F.L.A., whichever is the greater.

.7 Cooler and Condenser:

.1 Water box to be designed for 150 psi (1034 kPa) maximum working pressure and shall be designed to ASME Code for Unfired Pressure Vessels and CSA B52.

.2 Relief devices to ANSI B9.l Safety Provincial and Local Codes.

.3 To be of horizontal shell and tube type, fabricated so each tube may be individually replaced.

.4 Evaporator and Condenser tubes shall be internally enhanced and externally finned to achieve maximum efficiency. The nominal tube wall thickness shall be 0.025 inches (0.64 mm) for the evaporator and 0.028 inches (0.71 mm) for the condenser.

.5 Evaporator and condenser shall be flanged and gasketed water boxes with drains and covers that will permit easy tube cleaning. Suitable tappings provided in water boxes for thermometers, control bulbs, and gauges.

.6 In condenser, provide baffles to ensure even distribution of incoming gas and to concentrate non-condensable gases.

.7 Removable water heads.

.8 Manufacturer to provide a three-way valve on the condenser to control the condenser pressure/temperature, especially on start-up with a cold condenser loop.

.9 Water connections shall be flanged.

.10 Mount supporting base on suitable composition vibration isolation pads provided by manufacturer.

.8 Control Panel:

.1 Provide microprocessor-based central panel stand-alone direct digital control (DDC) to control chiller. A dedicated chiller control panel with an LCD touchscreen with clear language display is to be supplied with each chiller. Factory mounted package including full complement of controls to safely and efficiently operate water chiller including three phase solid state overload protection. Include comprehensive status and diagnostic monitoring controls.

.2 Provide automatic safety shutdown for:

.1 Low evaporator refrigerant temperature.

.2 High refrigerant condenser pressure.

.3 Low oil pressure

.4 High oil temperature

.5 High motor current

.6 High motor temperature

.7 Starter function fault

.3 Devices shall be of latching tripout type requiring manual reset.

.4 Provide non-latching safety tripouts for operating conditions external to chiller to automatically permit unit to resume normal operation when condition is corrected.

.5 Provide Motor Protection Package to monitor 3—phase current to provide protection from adverse affects of phase failure, phase unbalance, phase reversal and electrical distribution fault by instantaneous tripout of motor.

.6 Provide surge protection to detect surge and act to provide for head relief through lowering cooling tower water temperature. If not corrected within 15 minutes, chiller shall shut down.

.7 Momentary power loss protection with auto restart consisting of three- phase current sensing devices that monitor the status of the current.

.9 Standard Control Capabilities:

.1 DDC to constantly monitor evaporator refrigerant temp. As temperature approaches safety trip point, corrective control action is taken to help keep chiller on line.

.2 DDC panel to provide comprehensive status and diagnostic accessibility at front panel for:

.1 Current chiller operating mode.

.2 Status indicator lights.

.3 Setpoints and water temperature display.

.4 Separate starts counter and running hours meter for both compressor and purge unit.

.5 Dial type pressure gauges.

.6 Operating switches.

.7 Diagnostic codes.

.10 Provide Condenser Limit Control to protect against shutdown at high refrigerant pressure by energizing relay to initiate head relief.

.11 Safeties - the chiller control panels shall monitor the following safeties: start and running time between compressor/motor starts, low chilled water temperature, low evaporator refrigerant temperature or pressure, high condenser refrigerant pressure, evaporator and condenser water flow status, low oil pressure, low oil temperature, high oil temperature, sensor faults, and proper operation of unit controls.

.12 The following feature will help prevent shut down from problems frequently encountered with chillers. The chiller control panel shall utilize the following components to automatically take action to prevent unit shutdown due to abnormal operating conditions which will perform as follows:

.1 High pressure switch that is set 20 PSIG lower than factory pressure switch that will automatically unload the compressor to help prevent a high pressure condenser control trip. One switch is required for each compressor and indicating light shall also be provided.

.2 Motor surge protector that is set 95% of compressor RLA that will automatically unload the compressor to help prevent an overcurrent trip. One protector is required for each compressor and indicating light shall also be provided.

.3 Low pressure switch that is set at 5 PSIG above the factory low pressure switch that will automatically unload the compressor to help prevent a low evaporator temperature trip. One switch is required for each compressor and indicating light shall also be provided.

.4 In all of the above cases, the chiller will continue to run, in an unloaded state, and will continue to produce some chilled water in an attempt to meet the cooling load. However, if the chiller reaches the trip-out limits, the chiller controls will take the chiller off line for protection, and a manual reset is required. Once the "near trip" condition is corrected, the chiller will return to normal operation and can then produce full load cooling.

.13 The front of the chiller control panel shall be capable of displaying the following digital readouts in clear language as standard:

.1 Entering and leaving evaporator water temperatures

.2 Entering and leaving condenser water temperatures

.3 Saturated evaporator and condenser refrigerant temperatures

.4 Evaporator and condenser refrigerant pressures

.5 Oil Temperature

.6 Differential oil pressure

.7 Compressor motor starts and running hours

.8 Compressor motor current, by phase

.9 Compressor motor percent RLA

.10 Compressor motor voltage, by phase, kW, power factor (if selected with Under/Over voltage protection)

.11 Compressor discharge temperature

.12 Chilled water setpoint

.13 Electrical 3 phase current limit and percent RLA setpoint

.14 Electrical 3 phase amp draw

.15 Chiller operating mode

.16 Condenser refrigerant temperature

.17 Chiller compressor run status relay

.18 Outdoor air temperature

.19 Diagnostics with time and date stamp

.20 Last 10 diagnostics with time and date stamp

.14 The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output can be used to enable the cooling tower temperature controls.

.15 The chiller control panel shall provide a programmable soft load to prevent the chiller from achieving full capacity during the pulldown rate. Either can be adjusted to limit how fast the chiller can load after an initial startup.

.16 The chiller control panel shall provide a chilled water pump output relay that closes when the chiller is given a signal to start.

.17 The chiller control panel shall be capable of displaying system data in English or Metric units.

.18 With variation of +/- 10% of design flow per minute, chiller shall be able to maintain +/- 0.5F leaving water temperature control. The chiller must be able to withstand a +/- 30% change in flow rate per minute without unit trip. Variations in the primary flow allow for optimal system efficiency, but the chiller must be able to maintain temperature control to help ensure occupant comfort.

.19 The chiller control panel shall provide +/- 0.5F leaving water temperature control during normal operation. The chiller shall provide Eleven (11) or more steps leaving chilled water temperature controller to minimize part load energy use and optimize leaving chilled water temperature control.

.20 The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the panel will automatically indicate that the chiller is in adaptive mode and if the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.

.21 The chiller control panel shall provide anti-recycle timer to prevent compressors from short cycling.

.22 A central control package shall be provided by the chiller manufacturer to control the two chillers, the two chilled water pumps, the two condenser water pumps, and the two cell cooling tower. The chilled water control system shall be a stand alone system by the chiller manufacturer. The control logic of the chilled water system shall be done by the chiller manufacturer to insure the best and most efficient operation of the entire chilled water system. The system must be set up so that any part of the system can be operated manually if the main control system fails. System must allow for only one chiller to run if the other fails. Control system must allow the condenser to be circulated on cold nights to prevent tower freeze up. The control system must be capable of communication and control via the existing Johnson Controls Metasys The Metasys integrator will be provided by section 15900.

.23 Chilled water system Control Specification:

.1 The chiller shall be specified to come complete with a Unit Control Panel (UPC2) connected to a Tracer Summit Building Control Unit (BCU) with Tracer Summit Software Version 5.0 or Higher and with an open RS-232 Port at 9600 baud for connection to the Johnson Control Metasys Integrator Panel.

.2 The BCU and UPC2 are supplied, installed and commissioned by the chiller manufacturer. All data points such as compressor running hours, number of starts, bearing temperatures, currents, voltages, power factor, kW draw, pressures, expansion valve position, operating mode, all chiller temperatures, setpoints, current limit setpoints, etc., will be configured by the chiller manufacturer.

.3 The chiller manufacture will provide a hard copy of the configuration indicating device ID of the BCU containing the RS-232 port to connect to the Metasys Integrator, the first point number for each point type for each device, the BCU I/O object ID and the type along with the specific data names for every mapped object. BI9 on standard template and BI4 on the universal template must be programmed as UCM communication status in the BCU database.

.4 The chiller manufacture to provide sufficient training on the control system to satisfy the owner's selected control personnel.

.24 Motor Starter:

.1 Water chiller manufacturer to supply closed transition wye-delta compressor motor starters.

.2 Compressor motor starter to be factory assembled, wired and tested and shall be mounted on chiller. Installation to be CSA approved. Starter to include wired disconnect switch. Front access door interlocked with disconnect switch. Provide metal nameplate showing manufacturer, serial no., voltage, maximum locked motor amps and maximum overload trip setting. Permanent wiring diagram shall be affixed to inside of starter panel door.

.3 Contactor shall be air design to carry specified current (OLT) on continual basis without damage (normal condition). Design to break specified (LRA) current repeatedly without damage (abnormal condition).

.4 Control circuit shall have hand reset, inverse time magnetic overload relays set to hold to motor in during acceleration which may last as long as 45 seconds at 57.7% voltage at motor terminals, or 12 seconds at full voltage, and ultimately trip at 105% motor FLA rating. Trip setting shall be independent of one another.

.5 Starter shall be provided with solderless cable connectors for line and load sides. Connectors shall be copper cable sizes in accordance with applicable electric code wire sizing procedures.

.6 The starter / control shall be designed and able to operate in temperatures up to 122 deg F (50 deg C).

.7 All field suppled wires, bus bars, and fittings shall be copper only.

.25 Provide a minimum of following controls for machine protection:

.1 Emergency stop pushbutton for chiller on the control door.

.2 Current and potential transformer as required.

.3 An ammeter complete with selector switch. Provide volt-meter.

.4 Running time hour meter (mechanical type not effected by computer).

.5 Disconnect switch interlocked with enclosure door.

.6 All necessary contacts, relays, terminals and any control devices required for the automatic operation of the compressor motor by interconnection with the self contained controls on the refrigeration machine.

.26 Provide thermometer to sense refrigerant temperature, chilled water inlet and outlet temp.; condenser water inlet and outlet temp. Thermometers to conform to Clause, “Thermometers” noted in this section.

.27 Provide initial charge of oil and refrigerant. This section to provide further refrigerant and oil required during the five year extended warranty period after total performance acceptance of the system by the Contract Administrator.

.28 Manufacturer shall provide water chiller extended warranty to run for period of 60 months after total performance of the installation has been accepted by the Contract Administrator. The warranty is to cover all parts and labor required to operate the chillers. The owner would expect no other charges for the first five years.

.29 Installation

.1 Install in accordance with manufacturer’s instructions.

.2 Provide for connection to electrical service.

.3 Provide Neoprene Isolation Pads to reduce vibration transmission.

.4 Arrange piping for easy dismantling to permit tube cleaning.

.5 Provide piping from chiller relief valve to outdoors. Size as recommended by the manufacturer.

.30 Manufacturer's Field Services

.1 Manufacturer shall furnish a factory trained service engineer without additional charge to start the units. Representatives shall provide leak testing, evacuation, dehydration, and charging of the units as required. Chiller manufacturer shall maintain 24 hour service capabilities in Winnipeg

.2 A start-up log shall be furnished by the manufacturer to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

.3 Manufacturer to provide full services parts and labor and maintenance warranty for a period of five years.

.4 Manufacturer's representative shall furnish complete submittal wiring diagrams, control logic and source code of the chiller starters and associated components like cooling tower, pumps, interlocks, etc. as applicable.

.31 Each of the two water chillers shall meet following performance specifications:

.1 Design cooling load 300 tons for each chiller for a total of 600 tons.

.2 Design evaporator water flow 800 usgpm (50 l/s) through each unit.

.3 Minimum evaporator water flow of 454 gpm (28 l/s) or less.

.4 Maximum evaporator water flow of 1666 gpm (104 l/s) or more.

.5 Minimum water temp. entering evaporator 45 F (7.2 C).

.6 Minimum water temp. leaving evaporator 40 F (4.4 C).

.7 Water temp. entering condenser 85 F (29.4 C).

.8 Water temp. leaving condenser 95 F (35 C)

.9 Design flow for each condenser is 900 gpm (56 l/s) for a total of 1800 gpm (113 l/s)

.10 Minimum condenser water flow of 530 gpm (33 l/s) or less.

.11 Maximum condenser water flow of 1960 gpm (123 l/s) or more.

.12 Chilled water pressure drop through evaporator: Not to exceed 17 feet.

.13 Condenser cooling water pressure drop: Not to exceed 11 feet.

.14 Fouling factor evaporator: Not to exceed .00010 hr-sq ft-deg F / btu.

.15 Fouling factor condenser: Not to exceed .00025 hr-sq ft-deg F / btu.

.16 No. of passes (evaporator) 4 pass.

.17 No. of passes (condenser) 2 pass.

.18 Refrigerant R-134a. No more than 700 lbs (318 Kg).

.19 Running motor maximum KW input 185 KW 575/3/60.

.20 Maximum overcurent protection 480 amps 575/3/60.

.32 Water Chillers shall be Equal to: two (2) only Trane model RTHD, C2 Compressor 575/3/60, G1 four pass evaporator, G1 two pass condenser, Fisher 3-way full port condenser motor valve, Trane Tracer Summit chiller plant controller (BCU software version # 14) capable of controlling both chillers, two chilled water pumps, two condenser water pumps, two 2-speed cooling tower fans, and have full communication (inputs and outputs) to existing Johnson Controls Metasys.

.33 Obtain from manufacturer, following drawings and information for each refrigeration machine, motor starter and control system:

.1 General arrangement, giving outline dimensions.

.2 Assembly drawings providing construction details.

.3 Electrical schematics, wiring diagrams, interconnection and connection diagrams.

.4 Drawings of electrical equipment.

.5 Clearances required for maintenance purposes.

.6 Manufacturer, description and specifications of all purchased components.

.7 Manuals and programing information on the chiller controls and summit system. Owner is to obtain all source code programing so they can service or alter the system in the future if so desired.

2.5 Cooling Tower

.1 Provide separate pricing for the cooling tower and all associated replacement costs. Cooling tower may be replaced at a later date.

.2 Base:

.1 Provide a two cell induced-draft, cross flow type, factory-assembled, film-filled,

industrial-duty, galvanized steel cooling tower situated as shown on the plans. The limiting overall dimensions of the tower shall be 15.50 it wide, 16.08 ft long, and 11.94 ft high. Total operating power of all fans shall not exceed 30.0 HP, consisting of 2 - 15 HP motor(s). Cooling tower shall be similar and equal in all respects to Marley Model NC8303FL2 with the following options:

.2 Stainless Steel Hot Water Basins

.3 Stainless Steel Cold Water Basin

.4 Extended Lube Line

.5 Single Hot Water Inlet

.6 Equalizer Flume Weir Gates

.7 4 feet of fan cylinder extension section.

.8 Ladder and Handrail

.9 Ladder Extension

.10 Ladder Safety Cage

.11 Access Door Platform for one cell only.

.12 Control System

.13 Vibration Switch

.3 Thermal Performance:

.1 The tower shall be capable of cooling 1800 usgpm of water from 95 ^{0}F to 85 ^{0}F at a design entering air wet-bulb temperature of 75 ^{0}F, and its thermal rating shall be Certified by the Cooling Technology Institute.

.4 Performance Warranty:

.1 CTI Certification notwithstanding, the cooling tower manufacturer shall warranty that the tower supplied will meet the specified performance conditions when the tower is installed according to plan. If, because of a suspected thermal performance deficiency, the owner chooses to conduct an on-site thermal performance test under the supervision of a qualified, disinterested third party in accordance with CTI or ASME standards during the first year of operation; and if the tower fails to perform within the limits of test tolerance; then the cooling tower manufacturer will pay for the cost of the test and will make such corrections as are appropriate and agreeable to the Contract Administrator to compensate for the performance deficiency.

.5 Design Loading;

.1 The tower and all its components shall be designed to withstand a wind load of

30 psf (l.44kPa), as well as a 0.3g seismic load. It shall be designed to withstand shipping and hoisting loads of 2g horizontal and 3g vertical. The fan deck and hot water basin covers shall be designed for 50 psf (2.42 kPa) live load or a 200 lb. (91 kg) concentrated load. Handrails, where specified, shall be capable of withstanding a 200 lb. (890 N) concentrated live load in any direction, and shall be designed in accordance with OSHA guidelines.

.6 Construction:

.1 Except where otherwise specified, all components of the cooling tower shall be fabricated of heavy-gauge steel, protected against corrosion by G-235 galvanizing. The tower shall be capable of withstanding water having a pH of 6.5 to 8.0; a chloride content (NaCl) up to 500 ppm; a sulfate content (S04) up to 250 ppm; a calcium content (CaCO3) up to 500 ppm; silica (Si02) up to 150 ppm; and design hot water temperatures up to 125^0F (51.7^0C). The circulating water shall contain no oil, grease, fatty acids, or organic solvents.

.2 The specifications, as written, are intended to indicate those materials that will be capable of withstanding the above water quality in continuing service, as well as the loads described in paragraph 4.1. They are to be regarded as minimum requirements. Where component materials peculiar to individual tower designs are not specified, the manufacturers shall take the above water quality and load carrying capabilities into account in the selection of their materials of manufacture.

.3 The tower shall include all design and material modifications necessary to meet the fire rating requirements of Factory Mutual. The product proposed shall be listed in the FM Approval Guide, latest edition.

.7 Mechanical Equipment:

.1 Fan(s) shall be propeller-type, incorporating fiberglass-reinforced polypropylene or aluminum alloy blades and aluminum or electro-galvanized hubs. Blades shall be individually adjustable. Fan(s) shall be driven through a right angle, industrial duty, oil lubricated, geared speed reducer that requires no oil changes for the first five (5) years of operation. Speed reducers employing pulleys and belts will not be accepted.

.2 Motor(s) shall be 15 HP maximum, TEFC, 1.15 service factor, variable torque, and specially insulated for cooling tower duty. Speed and electrical characteristics shall be 1800/900 RPM, single-winding, 3 phase, 60 Hertz, 575 volts. Motor shall operate in the shalt-horizontal position, and nameplate horsepower shall not be exceeded at design operation.

.3 A neoprene and galvanized steel oil line shall extend from the gear reducer(s) to a point on the fan deck of each cell. The oil level in the gear reducer shall be readable at that point by means of a dip stick.

.4 The complete mechanical equipment assembly for each cell shall be supported by a rigid, welded, hot dip galvanized steel structural support that resists misalignment between the motor and the gear reducer. The mechanical

equipment assembly shall be warrantied against any failure caused by defects in materials and workmanship for no less than five (5) years following the date of tower shipment. This warranty shall cover the fan, speed reducer, drive shaft and couplings, and the mechanical equipment support. The electric motor shall carry a manufacturer*s warranty of at least one year.

.5 Each cell of the cooling tower shall be equipped with a field installed control system in a NEMA 3R raintight enclosure. This system shall control the operation of the fan motor. The panel shall include a fused disconnect switch with external operating handle, lockable in the off position a fused control-circuit transformer to provide 120 volt control power; an across-the-line magnetic contactor for each primary motor speed; and enclosure-mounted Hand-Off-Auto selector switch. Two speed control panels will have a High-Low selector switch. The control panel will have a factory wired, multiport tenninal block for the connection of alarms and auxiliary equipment. For automatic operation, the fan wall be controlled by a separately-enclosed thermostatic temperature controller. The temperature controller shall be adjustable for the required cold water temperature. Control panels shall be UL listed assemblies or shall bear a UL panel builders label on the assembly. Panels without a UL label for the entire assembly will not be accepted.

.6 A vibration limit switch shall be installed on the mechanical equipment support assembly and wired into the control panel. The purpose of this switch will be to interrupt power to the motor in the event of excessive vibration. It shall be adjustable for sensitivity, and shall require manual reset.

.8 Fill, Louvers and Drift Eliminators:

.1 Fill shall be film type, thermoformed of 15 mil (0.38 mm) thick PVC, with louvers formed as part of each fill sheet Fill shall be suspended from hot dip galvanized structural tubing supported from the tower structure, and shall be elevated above the floor of the cold water basin to facilitate cleaning. Air inlet faces of the tower shall be free of water splash-out.

.2 Drift eliminators shall be PVC, triple-pass, and shall limit drift losses to no more than 0.005% of the design GPM flow rate.

.9 Hot Water Distribution System:

.1 Two stainless steel open basins (one above each bank of fill) shall receive hot water piped to each cell of the tower. These basins shall be installed and sealed at the factory, and shall be equipped with removable, stainless steel covers capable of withstanding the loads described in paragraph 4.1. All components of these basins, with the exception of the nozzles, shall be stainless steel. The basin shall be warrantied to be free of leaks and corrosion for a period often (10) years from date of shipment to the job.

.2 Each cell of the tower shall include a single hot water PVC bottom inlet connection located as shown on the plans. An internal system of piping shall deliver water equally to the distribution basins without the need for balancing valves. This internal piping system shall require no scheduled maintenance, and

shall be located such that it does not interfere with normal maintenance access. Removable, interchangeable polypropylene nozzles installed in the floor of these basins shall provide full coverage of the fill by gravity flow. Include hot water basin dams to provide proper fill coverage during low flow conditions of 50-62% of design flow.

.10 Casing, Fan Deck, & Fan Cylinder

.1 The casing and fan deck shall be heavy-gauge galvanized steel, and shall be capable of withstanding the loads described in paragraph 4.1. The top of the fan cylinder shall be equipped with a conical, non-sagging, removable fan guard, fabricated of welded 5/16" (8 mm) and 7 gauge rods, and hot dip galvanized after fabrication. Fan cylinders 5*-0"in height and over shall not be required to have a fan guard.

.2 Supply a 4 foot fan cylinder extension on top of fan cylinder to insure that the cooling tower air is discharged over the building roof and not recirculated.

.11 Access:

.1 A large galvanized steel access door 30” (762mm) wide and a minimum of 33” (838mm) high shall be located on both endwalls for entry into the cold water basin and fan plenum area. Access doors shall be operable from inside as well as outside the tower.

.2 The top of the tower shall be equipped with a sturdy handrail, complete with kneerail and toeboard, designed according to OSHA guidelines. Handrails and kneerails shall consist of 1.66” (42mm) O.D. x 15 gauge galvanized structural tubing, the handrail of which shall be capable of withstanding a 200 pound (890N) concentrated live load in any direction. Posts are 2” x 2” (51mm x 51mm) square structrual tubing and shall be spaced on centers of 8*-O” (2438mm) or less. A 1*-6” (457nim) wide aluminum ladder with 3”(76mm) I-beam side rails and 1.25” (32mm) diameter rungs shall be permanently attached to the endwall casing of the tower, rising from the base of the tower to the top of the handrail.

.3 Provide a ladder extension for connection to the foot of the ladder attached to the tower casing. This extension shall be long enough to rise from the roof (grade) level to the base of the tower. The installing contractor shall be responsible for cutting the ladder to length; attaching it to the foot of the tower ladder; and anchoring it at its base.

.4 A heavy gauge galvanized steel safety cage shall surround the ladder, extending from a point approximately 7*-O” (2.134m) above the foot of the ladder to the top of the handrail surrounding the fan deck.

.5 There shall be an access platform at the base of the tower extending from the vertical ladder to the endwall access door. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a handrail, kneerail, and toeboard.

.12 Cold Water Collection Basin:

.1 The cold water basin shall be heavy-gauge Series 300 stainless steel, and shall include the number and type of suction connections required to accommodate the outflow piping system shown on the plans. A stainless steel sump outlet shall be provided in each cell c/w antivortex plate and trash screen. The sump is field installed by contractor. The hole and bolt circle conforms to Class 125 ANSI B16.1**.** A factory-installed, float-operated, mechanical make-up valve and a 4" (102mm) diameter PVC pipe overflow shall be provided in each cell of the tower. The basin shall include a depressed center section into which accumulated silt can be flushed and overflow standpipes shall be removable to permit flush-out cleaning of the basin. The basin floor adjacent to the depressed section shall slope toward the depressed section to prevent build-up of silt under the fill area. Include stainless steel flumes for flow and equalization between cells. All steel items which project into the basin (columns, diagonals, anchor clips, etc.) shall also be made of stainless steel.

.2 The interconnecting flume between cells shall be equipped with a removable cover plate to permit the shutdown of one cell for maintenance purposes, or to permit independent cell operation.

.3 The basin shall be warrantied to be free of leaks or corrosion for a period of ten (10) years from date of shipment to the job.

2.6 Double Suction Pumps

.1 Furnish and install as shown on plans, four (4) only double suction split case horizontal pumps. All pumps to be identical. Two chilled water pumps each capable of pumping 800 usgpm, 40 deg F water at 90 feet of head and two condenser water pumps each capable of pumping 900 usgpm 95 deg F water at 70 feet of head.

.2 Motor and pump to be mounted on a base plate fabricated from 1/4 " rigid steel plate and shall have an 1.5 " wide anchorage flanges down each side with integral drip pan. Motor risers shall be of the platform type with no motor blocks higher than 1". The coupling shall be the flexible type rated for full torque. A suitable removable coupling guard which covers all moving parts shall be included.

.3 Casing of extra heavy close—grain cast iron, split parallel to shaft. Both sections bolted and dowelled together. Bearing housing supports, suction and discharge flanges cast integral with lower half of casing. Flanges shall be standard 125 # ASA drilled flat face with 250 # OD and thickness. Removal of upper half and cartridge caps must allow rotating element to be removed without disconnecting suction or discharge flanges. The upper case shall be fitted with lifting lugs, 3/4" P.T vent, ½" drains and 1/4" P.T. gauge connections on the suction and discharge nozzles.

.4 Impeller shall be of one-piece vacuum cast bronze of the enclosed, Francis design double suction type, accurately machined, dynamically and hydraulically balanced to minimum thrust.

.5 Shaft shall be 316 stainless steel designed to limit maximum deflection at the seal cavities to .002 inches.

.6 Mount shaft in heavy duty grease lubricated ball bearings. The outboard bearing shall be locked in position by bearing lock nuts. The inboard bearing shall be free to move axially in the bearing housing. Removable bearing caps and bearing covers shall permit inspection or service of the bearings without disturbing the pump casing or piping. Bearing housing shall be designed for grease lubrication. Grease relief shall prevent over-lubrication.

.7 Provide mechanical seals with carbon rotating face, Ni—resist stationary seat, EPDM secondary seal and stainless steel spring. Seals to have lubrication and be suitable for use with fluid being pumped.

.8 Motor shall be 30 HP, 575/3/60, 1750 rpm TEFC premium efficiency for continuous operation and have a 1.15 service factor. Motor size shall be sufficient to prevent overloading at operating conditions or at the lowest listed head conditions whichever point requires greater horsepower. Following installation, grouting and connection of all piping, pump and motor must be checked for alignment in accordance with standards of the Hydraulic Institute. Acceptable motor manufactures are: CGE, Lincoln, WEG, or Westinghouse.

.9 Pumps shall be equal to Canada Pumps model NSL 6x5 x 10.5 inch impeller to pump 800 gpm of water at 40 F, 90 feet of head or 900 gpm of water at 95 F , 70 feet of head.

.10 Pump Accessories:

.1 Suction Diffuser, upstream of pump shall incorporate elbow, strainer and entry pipe into one unit, as manufactured by Mueller Steam Specialties or approved equal. Refer to drawings for details and sizing.

.2 Combination Valve, downstream of pump shall incorporate balancing, shut-off and check valve functions into one unit. Equal to Contol-Chek as manufactured by Mueller Steam Specialties or approved equal. Refer to drawings for details and sizing.

2.7 Flex Connectors

.1 Provide stainless steel flanged flex connectors on all supply and return lines to the chillers and pumps, (16 only 8" connectors required).

.2 Provide flex connectors on the pressure relief lines of both chiller evaporators and condensers.

.3 Connectors to be the bellows type c/w a bradded covering sheath and are to compensate for vibration, thermal expansion, misalignment, pressure stress, and noise reduction in the piping system.

.4 Connecters must be rated for a minimum of 150 psig at 70 F and a burst pressure of at least 800 psig.

.5 Connectors to be equal to SureFlow Type SPCF Stainless Steel Flanged flex connector model 0800 - SPCF - 012. Total of 16 required and SPCT threaded connectors on

pressure relief system .

2.8 Expansion Tank Units, Air Purgers, Air Vents

.1 Expansion tanks shall be pressurized diaphragm type.

.1 Construct for a maximum working pressure of 75 psi.

.2 Factory pre-charge with air to initial fill pressure of the system.

.3 Use sealed in elastomer EPDM diaphragm suitable for an operating temperature of 240^0F.

.4 Furnish with base mount or saddles as required.

.2 Air purger shall be constructed of cast iron for a maximum working pressure of 125 psi.

.1 Use threaded connections for sizes through 3" inclusive. Use flanged connections for sizes 4" and larger.

.3 Air vents shall be brass automatic float type air vent.

.1 Construction to be suitable for a maximum working pressure of 125 psi and temperature of 240^0F.

.2 Provide indirect drain line from air vent discharge to nearest approved point of discharge.

.4 Provide expansion tanks, air purgers, and air vents as indicated and required. Standard of Acceptance: Hamlett Garneau.

PART 3 EXECUTION

3.1 Piping Installation

.1 Examine areas where work is to be performed for:

.1 Anything that affects execution and quality of work.

.2 Piping clearances.

.3 Equipment access requirements.

.2 General:

.1 Conform to requirements of ANSI B31 code for pressure piping.

.2 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fitting for direction changes.

.3 Install groups of piping parallel to each other on trapeze hangers; space to permit application of insulation, identification and service access.

.4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.5 Where pipe sizes differ from connections sizes of equipment, install reducing fittings close to equipment. Reducing busings are not permitted.

.6 Install dielectric couplings wherever piping of dissimilar metals are joined.

.7 Install flanges or unions to permit removal of equipment without disturbing piping systems, as required by sizing standard.

.8 Install flanged, long radius, reducing elbows with base support on the inlet side of base mounted pumps.

.9 Use suction diffusers where specified and where space does not permit installation.

.10 Make all branch take-offs from top of main.

.11 Install system drains at all low points for complete system drainage.

.12 Install all hose end faucets and hose connections with vacuum breakers.

.13 Install pressure gauges on inlet and discharge side of each pump.

.14 Install piping without strain, distortion or buckling.

.15 Support piping so that no strain is imposed on the equipment by the piping system.

.16 Welding shall be done in accordance with ASME code and requirements of Provincial government. Welders shall be fully qualified and licensed by Provincial government. Proof of welders qualification shall be furnished to Architect upon request.

.17 Install control valves, sensors, gauges, etc. supplied under other sections.

.3 Expansion and Contraction

.1 Install expansion joints and compensators, flexible connections, pipe loops and offsets as required to allow for thermal expansion of pipe.

.2 Install flexible connections on the inlet and outlet of the chiller evaporator and condenser.

.3 Support piping to prevent any stress or strain.

3.2 Equipment Installation

.1 Examine areas where work is to be performed for:

.1 Anything that affects execution and quality of work.

.2 Clearances for equipment access (maintenance, inspection and removal).

.2 Install all equipment in accordance with manufacturer's recommendations.

.3 Make tests to demonstrate capabilities and general operating characteristics of all equipment, as instructed by the Architect.

3.3 Water Chiller

.1 Follow manufacturer*s detailed installation procedures.

.2 Water chiller manufacturer to install, program and commission the chilled water system control system including hard wiring to all related pumps and cooling tower starters.

.3 Water chiller manufacturer shall include services of factory trained representative for a period of five working days (37.5 hours) for each water chiller unit to provide the following services:

.1 Prepare system for start-up by having the manufacturer*s factory trained representative supervise evacuation, initial charging and testing of machines. Assist in start-up including co-ordination of start-up of cooling tower, condenser cooling water pumps, and chilled water pumps.

.2 Supervise initial start-up and assist in necessary adjustments to place the equipment in operation.

.3 Train Owner*s designated personnel to safely and properly operate and maintain equipment.

.4 Proceed step by step under advice of field service representative of manufacturer for field assembly of piping and wiring.

.5 Co-ordinate wiring work simultaneously with Division 16.

.6 Section 15400 to make water connections to oil cooler and other such water and drain connections as are required.

.7 Provide space around unit for servicing as recommended by unit manufacturer.

.8 Arrange piping so that it can be easily dismantled.

.9 Provide weights and points or areas of bearing, anchoring bolts and nuts and all the related hardware required, for placement of concrete pad and anchorage required. Pads shall not be loaded until 20 days after initial setting. Skid unit into place, level, and grout, providing shimming sheet and EMBECO grouting. Chiller units to be set on neoprene

pads as recommended by the manufacturer.

.10 Provide all piping with flexible or swing joint connections as shown to inlet and outlet of unit and related pumps, auxiliaries, oil cooler and purge condenser. Submit details of spring hanger and hangering systems for approval. Sum of Moments at Chiller and condenser connections = 0. Sum of Moments and Forces at pump flanges = 0.

.11 Co-ordinate the installation of the pressure differential switches across each evaporator section and each condenser section.

.12 Install relief piping from all rupture discs and other relief devices in CSA-B-52 Mech. Refrigeration Code. Provide flexible connection at relief device to prevent strain on safety device.

.13 Provide sufficient refrigeration and dry nitrogen for pressure testing under manufacturer*s supervision or to Contract Administrator*s directive. Provide equipment and personnel for double evacuation of the unit. Evacuate to wet bulb temperature equal to 3.9 deg C. Do not use vacuum gauge for evacuation check, use temperature.

.14 Prior to testing ensure that:

.1 All connections are complete and correct; do not put any piping stress on shell water boxes or flanged connections use suitable hangers to Contract Administrator*s direction.

.2 Draw up tight to flange connections.

.3 Relief pressure components must be protected (remove if necessary, plugged temporarily), test pressure may exceed components setting.

.4 Test purge unit separately, isolate from the rest of unit.

.5 Carry out performance test in the presence of the Contract Administrator to his satisfaction. Obtain acceptance certificate on approved standard forms agreed upon.

.15 Mount supporting base on suitable composition vibration isolation pads supplied with unit.

3.4 Cooling Tower

.1 Install in strict accordance published installation manual.

.2 Manufacturer responsible for field installation of all items required to be shipped loose.

.3 Mount vibration switches at each fan. Wire in with fan starter. Use manual reset.

.4 Include services of manufacturer*s competent factory trained serviceman*s time to start-up units. Also include for any adjustments required to provide satisfactory operation. Instruct Owner*s staff in maintenance and care of equipment. Instruction period to be fifteen (15) hours at job site.

3.5 Pumps

.1 Install all piping without strain or distortion.

.2 Support suction and discharge piping so that no strain is imposed on the pump by the piping system.

3.6 Clean-up

.1 Maintain all work areas in clean condition.

.2 Leave all systems operating with work areas clean to the satisfaction of the Contract Administrator.

.3 Remove all paper, marks and name tags (do not remove nameplates). Protect all equipment during construction. Cover equipment as required by the Contract Administrator at any and all times for protection.

3.7 Air Vents

.1 Provide manual air vents at high points of systems.

3.8 Strainers

.1 Provide pipe strainers in following locations and where shown on drawings.

.1 Pump suctions.

3.9 Thermometers

.1 Mount all thermometers in wells so that the thermometer can be changed without opening up the system.

.2 Care most be taken to ensure an accurate temperature reading. Well area may have to be insulated to insure an accurate reading.

.3 Capillary type (red alcohol) glass thermometer to be used for greater accuracy.

3.10 Pressure Gauges

.1 Use pressure gauges on inlet and outlet of the chiller condenser and evaporator, suctions and discharges of pumps and where noted.

.2 Gauges o be liquid filled.

.3 All pressure gauges to have a shut-off valve so they can be changed without opening the system.

.4 Refer also to section 15010.

3.11 Co-ordination with HVAC Balancing and Testing Agency

.1 Refer to Section 15990 Testing and Balancing.

.2 Balancing work shall not begin until system has been completed and in full working order. Heating, ventilation, and air conditioning systems and equipment shall be in full operation, as season would demand, and shall continue operation of same during each working day of testing and balancing. Co-ordinate work with Section 15990.

.3 As part of this contract, Section 15700 shall make any changes in pulleys and belts for correct balance as recommended by Section 15990, at no additional cost to Owner.

.4 Section 15700 responsible for initial alignment and tension of all fan pulleys and belts of equipment supplied by Section 15700.

3.12 Testing Of Systems

.1 Heating - test at 862 kPa 125 pressure, or to pressure 1½ times operating pressure, which ever is greater, for 12 hours.

.2 Piping to be tested prior to concealment. Tests to be witnessed by Contract Administrator's representative. Provide three (3) working days prior notice to Contract Administrator of such tests. Pressures to be registered at system highest point. When sections are being tested additional pressure developed by static head of remainder of system above, to be added to specified test pressure.

.3 Tests to be with water, unless noted otherwise, prior to insulation being applied.

.4 System tests to be with equipment connected. Trap diaphragms to be removed and systems flushed prior to the test.

.5 Make good leaks, replace defective parts, flush out defective section, re-test and adjust until system functions correctly.

.6 Prior to Owner's takeover, systems to be balance and ready for operation, with traps, strainers, drip legs, etc. cleaned.

Table 1 - Pipe and Pipe Fittings

SERVICE	PIPE	FITTINGS
Heating hot water, Chilled water, and Glycol	Sched. 40 Black Steel ASTM-A-53	Malleable Iron Screwed, Class 150 Welded fittings
Radiation	Same as HHW or type 'L' Hard copper	Same as HHW or Wrought copper Cast bronze
Condensate and Pumped Condensate	Sched. 80 Black steel ASTM-A53	Malleable Iron, Screwed, Class 150 or Welded fittings
Indirect drain line	Type 'L' Hard copper	Wrought copper, Cast bronze
Steam, Natural gas	Sched. 40 Black steel ASTM-A53	Malleable iron, Screwed, Class 150 or Welded fittings
Refrigerant	ACR hard copper	Wrought copper soldered

Table 2 - Valves

SERVICE	PIPE SIZES	HOT WATER, GLYCOL, CHILLED WATER	STEAM & CONDENSATE	DOMESTIC WATER
Shut-off Valves	Up to & incl. 2"	5044A/5049A or 293/299	293 (0 to 99 psi) 314 (100 psi & up) 280A, Kitz 27	5044A/5049A or 293/299 (For Hot Water - MAS G-2)
	2 1/2" to 4" Inclus.	421 JA or 917 BESL	421 (0 to 99 psi) Kitz K-300 (100 psi & up)	421 JA (For Hot Water - 150 UMAM)
	5" and up	421JA or 917 BESG	421JA (0 to 99 psi), Kitz K-300 SCLB (100 psi & up)	421 JA (For Hot Water - 150 UMAM)
Shut-off/throttling valves	Up to & incl. 2"	5044/5049A c/w balance plate	214, 5044A Kitz 68	5044A/5049A c/w balance plate
	2 1/2" to 4" Inclus.	Kitz 6122E-L	400 JA (0 to 99 psi), Kitz K-300 SCJ (100 psi & up)	Kitz 6122E-L
	5" & up	Kitz 6122E-G	400 JA (0 to 99 psi), Kitz K-300 SCJ (100 psi & up)	Kitz 6122E-G
Check Valves	Up to & incl. 2"	236/237	236/237	236/237
	2 1/2" to 4"	435JA	435JA	435JA
	5" & up	435JA, Kitz 78	435JA	435JA, Kitz 78
Strainers	All sizes	Mueller Steam Specialities Fig. 758		
Drain Valves	3/4"	5046	5046	5046

Notes: Re Butterfly Valves: to be Full Lug Type with gear drives as noted.