

Specifications
Chiller 2 Replacement at the Canada Centre for Inland Waters
September 3rd 2020

Contents

PART 1: SUMMARY OF WORK - SECTION 01 11 00 3

PART 2: WORK RESTRICTIONS - SECTION 01 14 00 4

PART 3: DESIGNATED SUBSTANCES REPORT - SECTION 01 14 25 5

PART 4: SUBMITTAL PROCEDURES - SECTION 01 33 00 6

PART 5: HEALTH AND SAFETY REQUIREMENTS - SECTION 01 35 29 8

PART 6: CLEANING - SECTION 01 74 00 9

PART 7: WASTE MANAGEMENT AND DISPOSAL - SECTION 01 74 19 10

PART 8: COMMON WORK RESULTS FOR HVAC - SECTION 23 05 00 12

PART 9: SELECTIVE DEMOLITION FOR HVAC - SECTION 23 05 05 13

PART 10: COMMON INSTALLATION REQUIREMENTS FOR HVAC PIPEWORK - SECTION 23 05 15 15

PART 11: PIPE WELDING - SECTION 23 05 17 17

PART 12: HVAC EQUIPMENT INSULATION - SECTION 23 07 16 18

PART 13: HVAC PIPING INSULATION - SECTION 23 07 19 20

PART 14: CENTRIFUGAL WATER CHILLERS - SECTION 23 64 16 22

PART 15: COMMON WORK RESULTS FOR ELECTRICAL - SECTION 26 05 00 28

PART 16: SELECTIVE DEMOLITION FOR ELECTRICAL - SECTION 26 05 05 30

PART 17: WIRE AND BOX CONNECTORS - SECTION 26 05 20 32

PART 18: WIRES AND CABLES (0-1000 V) - SECTION 26 05 21 33

PART 19: CONNECTORS AND TERMINATIONS - SECTION 26 05 22 34

PART 20: HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS - SECTION 26 05 29 35

PART 21: SPLITTERS, JUNCTION, PULL BOXES AND CABINETS - SECTION 26 05 31 36

PART 22: CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS - SECTION 26 05 34 37

PART 23: ELECTRICAL CABINETS AND ENCLOSURES - SECTION 26 27 16 38

PART 1: SUMMARY OF WORK - SECTION 01 11 00

1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1. Work of this Contract comprises the replacement of Chiller 2 at the Canada Centre for Inland Waters (867 Lakeshore Rd Burlington On L7S 1A1. The existing chiller gets removed and the new one goes in it's place. The new chiller is integrated with the existing closed circuit fluid cooler. New 600V variable speed drives are installed and integrated with both 75hp chilled water and condenser water pumps.

1.2 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from the owner.
- .2 Co-ordinate work with other contractors. If any part of work under this Contract depends for its proper execution or result upon work of another contractor, report promptly to the owner in writing, any defects which may interfere with proper execution of Work.

1.3 WORK SEQUENCE

1. Work shall be done November to March. The new chiller shall be operational by April 1 2021.
2. The existing chiller will be removed on the same flatbed trailer that delivers the new chiller.

1.4 CONTRACTOR USE OF PREMISES

1. Work on site shall occur during normal occupied hours, 7:00-18:00 weekdays.
2. Work outside these hours will require a commissioner stationed in the boiler room.
3. Contractors may use the boiler room washroom
4. Contractor may use the cafeteria at CCIW.

1.5 EXISTING SERVICES

1. Where work involves breaking into or connecting to existing services, give owner 24 hours notice for necessary interruption of mechanical or electrical service and hold off until owner approval.
2. Minimize duration of interruptions.
3. Provide alternative routes for pedestrian and vehicular traffic during chiller removal/arrival.
4. Where unknown services are encountered, immediately advise the owner and confirm findings in writing.
5. Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by owner.

END OF SECTION

PART 2: WORK RESTRICTIONS - SECTION 01 14 00

1 GENERAL

1.1 ACCESS AND EGRESS

1. All contractors shall sign in and out daily at the front desk. Once signed in, contractors may access the area of work (CCIW Boiler room) by driving around back or accessing through the building.
2. Work under this contract shall take during normal occupied hours, Monday - Friday 7:00-18:00. Any work done outside of this window must be approved by the owner.

1.2 USE OF SITE AND FACILITIES

1. Do not leave vehicles in the boiler room driveway. Contractors may use the driveway to unload, then they shall park in the south parking lot.
2. Contractors may use the washroom in the boiler room
3. Contractors may use the CCIW cafeteria

1.3 EXISTING SERVICES

- .1 Notify the owner of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give the owner 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions to a minimum. Carry out interruptions outside of normal occupied hours. The owner must approve any work outside of normal working hours

1.4 SPECIAL REQUIREMENTS

1. All material deliveries shall occur during normal working hours unless otherwise approved by the owner. Coordinate all special deliveries with the owner.

1.5 SECURITY

- .1 Any work done outside normal occupied hours shall require a commissionaire. Coordinate any work outside normal occupied hours with the owner.
- .2 Security clearances:
 - a) Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - b) Obtain requisite clearance, as instructed, for each individual required to enter premises.
 - c) Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
 - d) Contractor's personnel will require satisfactory RCMP initiated security screening in order to complete Work in premises and on site.

END OF SECTION

PART 3: DESIGNATED SUBSTANCES REPORT - SECTION 01 14 25**1.1 SECTION INCLUDES**

This Section clarifies Contractor's responsibilities and obligations to review the information provided in the "Designated Substances Report (DSR)", pertaining to the Site located at the Canada Centre for Inland Waters, 867 Lakeshore Rd Burlington On L7S 1A1. This Section is to be read in conjunction with the Site specific DSR

- a) A copy of the Site specific DSR is attached under a separate cover forming part of bid and tender documents.

1.2 REFERENCE STANDARDS

- a) Refer to current laws, by laws, ordinances, rules, regulations and orders of authority having jurisdictions, and other legally enforceable requirements applicable to Work at that area; or become in force during Work performance.
- b) Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.
 - .1 Canadian Environmental Protection Act, 1999 (CEPA 1999)
 - .2 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
 - .3 Province of Ontario Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. [1990, c.0.1, as amended and O. Reg. 213/91 as amended] - Updated [2016].

1.3 DEFINITIONS

- a) Designated Substances: Are those substances designated as hazardous by the Ministry of Labour under the Occupational Health and Safety Act.
- b) Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities, and hazardous products, including but not limited to: corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

1.4 RESPONSIBILITY

- a) Contractor shall be responsible for reading and evaluating the information provided in DSR for the Site.
- b) Contractor shall incorporate any recommendations in the Site DSR as they pertain to the health and safety of workers on Site, in accordance with Section 01 35 29.06 - Health and Safety Requirements, and in compliance with authority having jurisdictions for that area.
- c) Contractor shall ask the Owner should they have any questions related to the Site specific DSR.
- d) Contractor shall exercise every reasonable precaution for the protection of each worker on Site.
- e) Contractor shall furnish the Site specific DSR to all subcontractors who will be performing work on Site.

END OF SECTION

PART 4: SUBMITTAL PROCEDURES – SECTION 01 33 00**1 GENERAL****1.1 ADMINISTRATIVE**

- a) Submit to the Owner submittals listed for review in this section. 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.
- b) Each submittal shall include, at a minimum, the following:
 - a) Project Name (Chiller 2 Replacement)
 - b) Date and revision
 - c) Supplier
 - d) Manufacturer
 - e) General Contractor Name
 - f) Subcontractor Name (if applicable)
- c) Do not proceed with Work affected by submittal until review is complete.
- d) Present shop drawings and product data in **SI Metric units**. Where items or information is not produced in SI Metric units converted values are acceptable.
- e) Review submittals prior to submission to the Owner. 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 specific to this project will be returned without being examined and considered rejected.
- f) Notify the Owner in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- g) Verify field measurements and affected adjacent Work are co-ordinated.
- h) Contractor's responsibility for errors and omissions in submission is not relieved by Owner's review of submittals.
- i) Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by owner review.
- j) Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1. The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
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 design drawings and specifications.
3. Allow 5 business days for the owner to review of each submission.
4. Make changes in shop drawings as Owner may require, consistent with Contract Documents. When resubmitting, notify Owner in writing of revisions other than those requested.
5. Shop Drawings required to be submitted include:
 - a) Centrifugal Water Chiller
 - i. Performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant entering condenser water temperature
 - ii. Compressor and product data in table form indicating impeller speed (RPM), number of bearings, type of bearings, high speed impeller shaft RPM, sound pressure level per AHRI 575-2008 (dB), number of stages, number of sets of inlet guide vanes, amount of refrigerant charge (lb), and amount of oil required (gal)
 - iii. Submit product data indicating options and specialties, electrical requirements, and wiring diagrams and connections. Indicate accessories, valves, strainers, and thermostatic valves required for the complete system.
 - iv. Submit drawings indicating assembled dimensions, operating weight, load distribution, and required service and access clearances
 - v. Submit rigging, installation, and startup procedures. Include operations and maintenance data for both the chiller and variable-speed drive. Include location, size, and type of field piping connections.
 - b) Condenser Variable Speed Drive
 - c) Evaporator Variable Speed Drive
 - d) Isolation Valves

1.3 CLOSEOUT SUBMITTALS

The contractor shall provide 2 binders which shall contain:

- a) All approved shop drawings
 - b) The operation and maintenance manual for the Chiller and both variable speed drives
 - c) A section indicating warranty dates for all items applicable to this installation
 - d) Photographic documentation
 - e) All submitted contemplated change orders and approved change orders
 - f) The construction contract and any addenda
 - g) Certificates and Transcripts
2. The close out binders shall contain tabs and a table of contents.
 3. The owner has the right to reject the close out binder
 4. All documents in the binder shall be printed double sided where applicable

1.4 PHOTOGRAPHIC CLOSEOUT SUBMITTALS

The contractor shall photographic documentation and include it in the close out binder. At a minimum, this shall be comprised of:

- a) Photos of the demolition
 - b) The New chiller on the flatbed trailer on site
 - c) The old chiller on the flatbed on site
 - d) Photos of each circumferential pipe weld on the condenser and evaporator pipework
 - e) A group photo at the end of the project which shall have all workers on the mechanical & electrical trades as well as the owners and chiller manufacturer
2. Photos in this sections shall be 4 per letter sized page, with each photo having a caption which shall include the date of photo was taken

END OF SECTION

PART 5: HEALTH AND SAFETY REQUIREMENTS - SECTION 01 35 29

1 GENERAL

1.1 REFERENCE STANDARDS

- a) Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- b) Province of Ontario - Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. [1990, c.0.1, as amended and O. Reg. 213/91 as amended] .

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- a) Submit in accordance with Section 01 33 00 - Submittal Procedures.
- b) Submit site-specific Health and Safety Plan: Within 21 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation
- c) Be ready to submit a copy of Contractor's authorized representative's work site health and safety inspection reports to the owner at any time the owner asks.
- d) Submit copies of reports or directions issued by Federal, health and safety inspectors.
- e) Submit copies of incident and accident reports.

1.3 MEETINGS

Schedule and administer Health and Safety meeting with the entire work crew daily before work starts for 15 minutes minimum.

1.4 RESPONSIBILITY

- a) Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- b) Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

END OF SECTION

PART 6: CLEANING - SECTION 01 74 00

1 GENERAL

1.1 PROJECT CLEANLINESS

- a) Maintain Work in tidy condition, free from accumulation of waste products and debris.
- b) Remove waste materials from site at the end of each day of work. Do not burn waste materials on site.
- c) Dispose of waste materials and debris off site.
- d) Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- e) Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- f) Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

- a) Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- b) Prior to final review remove surplus products, tools, construction machinery and equipment.
- c) Remove waste products and debris [other than][including] that caused by Owner or other Contractors.
- d) Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- e) Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.3 WASTE MANAGEMENT AND DISPOSAL

Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

PART 7: WASTE MANAGEMENT AND DISPOSAL – SECTION 01 74 19

1 GENERAL

1.1 SUMMARY

- a) This Section includes requirements for management of construction waste and disposal, which forms the contractor's commitment to reduce and divert waste materials from landfill and includes the following:
- b) Preparation of a Construction Waste Management Plan that provides guidance on a logical progression of tasks and procedures to be followed in a pollution prevention program to reduce or eliminate the generation of waste, the loss of natural resources, and process emissions through source reduction, reuse, recycling, and reclamation.
- c) Preparation of a Construction Waste Management Report containing detailed information indicating total waste produced by the project, types of waste material and quantity of each material, and total waste diverted and diversion rates indicated as a percentage of the total waste produced.

1.2 DEFINITIONS

- a) Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- b) Construction [and Demolition] Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, [re modeling],[repair and demolition] operations.
- c) Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- d) Non hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- e) Non toxic: Not poisonous to humans either immediately or after a long period of exposure.
- f) Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- g) Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- h) Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.
- i) Return: To give back reusable items or unused products to vendors for credit.
- j) Reuse: To reuse a construction waste material in some manner on the project site.
- k) Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- l) Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- m) Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- n) Toxic: Poisonous to humans either immediately or after a long period of exposure.
- o) Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- p) Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.3 ADMINISTRATIVE REQUIREMENTS

- a) Coordination: Coordinate waste management requirements with all Divisions of the Work for the project, and ensure that requirements of the Construction Waste Management Plan are followed.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- a) Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- b) Construction Waste Management Plan - Submit to the owner a preliminary analysis of anticipated site generated waste by listing a minimum of five (5) construction or demolition waste streams that have potential to generate the most volume of material indicating methods that will be used to divert construction waste from landfill and source reduction strategies; The Owner will provide commentary before development of Contractor's Construction Waste Management Plan.

1.5 PROJECT CLOSEOUT SUBMISSIONS

- a) Accounting: Submit information indicating total waste produced by the project.
- b) Composition: Submit information indicating types of waste material and quantity of each material.
- c) Diversion Rate: Submit information indicating total waste diverted from landfill as a percentage of the total waste

produced by the project.

- d) Transportation Documentation: Submit copies of transportation documents or shipping manifests indicating weights of materials, and other evidence of disposal indicating final location of waste diverted from landfill and waste sent to landfill.

1.9 DELIVERY, STORAGE AND HANDLING

- a) Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the project waste and the available recycling and reuse programs in the project area.
 - b) Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:
 - c) Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
 - d) Arrange for collection by or delivery to the appropriate recycling or reuse facility.
 - e) Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.
 - f)

2 PRODUCTS

2.01 NOT USED

3 EXECUTION

3.1 IMPLEMENTATION

- a) Contractor is responsible for designating an on site party or parties responsible for instructing workers and overseeing and documenting results of the waste management plan for the project.
- b) Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, composting and return methods being used for the project to [Subcontractor]'s at appropriate stages of the project.
- c) Separation Facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting and return:
- d) Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
- e) Hazardous wastes shall be separated, stored, and disposed of in accordance with local regulations.
- f) Progressive Documentation: Submit a monthly summary of waste generated by the project to ensure that waste diversion goals are on track with project requirements:
 - .1 Submission of waste summary can coincide with application for progress payment, or similar milestone event as agreed upon between the Owner, [Contractor] and the Owner.
 - .2 Monthly waste summary shall contain the following information:
 - .1 The amount in tonnes or m³ and location of material landfilled,
 - .2 The amount in tonnes or m³ and location of materials diverted from landfill, and
 - .3 Indication of progress based on total waste generated by the project with materials diverted from landfill as a percentage.

PART 8: COMMON WORK RESULTS FOR HVAC – SECTION 23 05 00**1 GENERAL****1.1 REFERENCE STANDARDS**

- a) National Building Code
- b) National Plumbing Code
- c) ASHRAE 15 – Safety Standard for Refrigeration Systems
 - d) .1 CSA Group (CSA)
 - e) .1 [CSA S350](#) M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
 - f) .3 CSA Group (CSA)
 - g) .1 [CAN/CSA B139-\[04\]](#), Installation Code for Oil Burning Equipment.
 - h) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 **ANSI/ASHRAE 90.1-[04]-SI** Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - i) Canadian General Standards Board (CGSB)
 - .1 [CGSB 51-GP-52MA-\[89\]](#), Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 [CAN/CGSB 51.53-\[95\]](#), Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

1. Submit in accordance with 01 33 00 - Submittal Procedures.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.5 DELIVERY, STORAGE AND HANDLING

1. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
2. Chiller Removal & Arrival Scheduling – The existing chiller to be demolished shall be removed from the site on the same flat bed trailer that brings the new chiller.
3. Storage and Handling Requirements:
 - a) New Chiller – On the delivery date of the new chiller, it shall go directly from the flatbed to the house-keeping pad. Keep all manufactures packaging on the new chiller until directed by the owner. Once the new chiller is placed on the house keeping pad, the old chiller shall be placed on the same flat bed and removed from site.
 - b) All other equipment & accessories – shall be stored inside the boiler room as directed by the owner.

2 PRODUCTS**2.1 MATERIALS**

- .1 HVAC and R Equipment:
 - .1 Refrigerant: R-514A

3 EXECUTION**3.1 PROTECTION**

1. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

PART 9: SELECTIVE DEMOLITION FOR HVAC – SECTION 23 05 05

1 GENERAL

1.1 SUMMARY

This Section includes requirements for selective demolition and removal of heating, ventilation and air conditioning systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section [ready for new construction].

1.2 RELATED REQUIREMENTS

Section 26 05 05 - Selective Demolition for Electrical

1.3 SITE CONDITIONS

- a) Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- b) Hazardous substances will be removed by a hazardous abatement specialist engaged by the Owner before start of the Work.

1.4 SALVAGE AND DEBRIS MATERIALS

- a) Demolished items become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain by the owner.
- b) Purge Unit – Delicately remove the existing purge unit for Chiller 2 and set aside for the owner. This will be used as a future spare.
- c) Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials.

2 PRODUCTS

2.1 MATERIAL

- a) HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- b) Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

3 EXECUTION

3.1 EXAMINATION

- a) Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; neither the owner nor PSPC will consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- a) Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify the Owner and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- b) Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Owner] and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify the Owner and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- a) Do not disrupt active or energized utilities without approval of the Owner.

A-NMS230505++

CANADIAN NATIONAL	SELECTIVE DEMOLITION FOR	SECTION 23 05 05
MASTER CONSTRUCTION	HEATING, VENTILATING, AND	PAGE 14
SPECIFICATION	AIR CONDITIONING (HVAC)	2018-01-30

- b) At end of each day's work, leave worksite in safe condition.
- c) Perform demolition work in a neat and workmanlike manner:
- d) Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
- e) Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

END OF SECTION

CANADIAN NATIONAL	COMMON INSTALLATION	SECTION 23 05 15
MASTER CONSTRUCTION	REQUIREMENTS FOR HVAC	PAGE 15
SPECIFICATION	PIPEWORK	2018-01-29

PART 10: COMMON INSTALLATION REQUIREMENTS FOR HVAC PIPEWORK – SECTION 23 05 15

1 GENERAL

1.1 REFERENCE STANDARDS

CSA Group (CSA) - [CAN/CSA B139-\[04\]](#), Installation Code for Oil Burning Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

a) Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

2 PRODUCTS

2.1 MATERIAL

a) Paint: Condenser Water Paint to match existing. zinc-rich to [CAN/CGSB-1.181](#).

b) Primers & Paints][Coating]: in accordance with manufacturer's recommendations for surface conditions.

3 EXECUTION

3.1 APPLICATION

a) Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 CONNECTIONS TO EQUIPMENT

a) In accordance with manufacturer's instructions unless otherwise indicated.

b) Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

c) Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

a) Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

3.4 PIPEWORK INSTALLATION

a) Install pipework to [CAN/CSA B139](#).

b) Connections to new chiller are Victaulic. All other condenser and chilled water pipework over 250Ømm are flanged and welded.

c) Protect openings against entry of foreign material.

d) Route chilled water and condenser water pipework to allow for 2" thick insulation c/w PVC wrap.

e) Install, except where indicated, to permit separate thermal insulation of each pipe.

f) Use concentric reducers at pipe size changes to ensure positive drainage and venting.

g) Provide for thermal expansion as indicated.

3.5 Valves

a) Install in accessible locations. Obtain owner approval of isolation valve locations before installing

b) Butterfly Valves NPS 2"-12" shall have cast iron full lug bodies, one-piece design, powder coated for maximum corrosion resistance

c) Valve bodies in compliance with ANSI 125/150 drillings and face to face dimensions shall conform to MSS-SP-67.

d) Disc shall be **316 Stainless Steel**, through shaft broach design, for maximum wear and corrosion resistance.

e) Use chain operators on valves installed more than 2400] mm above floor.

3.6 FLUSHING OUT OF PIPING SYSTEMS

a) Flush system in accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

3.7 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

a) Advise the Owner 48 hours minimum prior to performance of pressure tests.

b) Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

c) Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

d) Conduct tests in presence of the owner.

- e) Pay costs for repairs or replacement, retesting, and making good. The owner to determine whether repair or replacement is appropriate.
- f) Insulate or conceal work only after approval and certification of tests by the Owner.

3.8 EXISTING SYSTEMS

- a) Connect into existing piping systems at times approved by the Owner.
- b) Request written approval by the Owner 10days minimum, prior to commencement of work.
- c) Be responsible for damage to existing plant by this work.

3.9 CLEANING

- a) Clean in accordance with Section 01 74 00 - Cleaning.
- b) Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 11: PIPE WELDING - SECTION 23 05 17

1 GENERAL

1.1 REFERENCE STANDARDS

- a) American Welding Society (AWS)
 - 1. **AWS C1.1M/C1.1-[2000(R2006)]**, Recommended Practices for Resistance Welding.
 - 2. **AWS Z49.1-[2005]**, Safety in Welding, Cutting and Allied Process.
 - 3. **AWS W1-[2000]**, Welding Inspection Handbook..
- b) CSA Group (CSA)
 - 1. [CSA W48-\[06\]](#), Filler Metals and Allied Materials for Metal Arc Welding.
 - 2. [CSA-W117.2-\[2006\]](#), Safety in Welding, Cutting and Allied Processes.
- c) The Welders Handbook

1.2 QUALITY ASSURANCE

- a) Welding qualifications in accordance with [CSA B51](#).
- b) Use qualified and licensed welders possessing certificate licenced to weld pipes in the province of Ontario.
- c) Submit welder's qualifications to the Owner. Always have a copy of welder certification on site.
- d) Weld Inspections – All welds shall be approved by the owner. The owner reserves the right to reject welds and the contractor shall redo when directed

2 PRODUCTS

3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- a) All pipes of 2"Ø diameter or less are threaded. All pipes over 2"Ø diameter shall be flanged or welded. The exception is the Victaulic connections to new Chiller 2

3.2 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- a) Review weld quality requirements and defect limits of reference standards listed with the Owner before work is started.
- b) Formulate "Inspection and Test Plan" in co-operation with the Owner.
- c) Do not conceal welds until they have been inspected, tested and approved by the Owner.
- d) Provide for the owner notification to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by the Owner.

3.3 CLEANING

- Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 12: HVAC EQUIPMENT INSULATION - SECTION 23 07 16**1 GENERAL****1.1 REFERENCE STANDARDS**

- a) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 **ANSI/ASHRAE 90.1-[04]-SI** Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- b) Canadian General Standards Board (CGSB)
 - .1 [CGSB 51-GP-52MA-\[89\]](#), Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 [CAN/CGSB 51.53-\[95\]](#), Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- a) Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- b) Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.
- c) Provide chiller 2 manufacturers' recommended insulation materials and installation methods
- d) Qualifications: Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

2 PRODUCTS**2.1 INSULATION**

- a) Insulate new Chiller 2 in accordance with chiller manufacturers recommended material and best practices for installation.
- b) TIAC Code C-4: rigid mineral fibre board faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: [ASTM C 612](#).
 - .2 Jacket: to [CGSB 51-GP-52MA](#).
 - .3 Maximum "k" factor: [ASTM C 612](#).
- .7 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: [ASTM C 553](#).
 - .2 Jacket: to [CGSB 51-GP-52MA](#).
 - .3 Maximum "k" factor: [ASTM C 553](#).

2.2 CEMENT

- a) Thermal insulating and finish
 - .1 To: [ASTM C 449/C 449M](#).
 - .2 Air drying on mineral wool, to [ASTM C 449](#).

2.3 JACKETS

Polyvinyl Chloride (PVC):

- a) One-piece moulded type [and sheet] to [CAN/CGSB 51.53](#) with pre-formed shapes as required.
- b) Colours: White

2.4 INSULATION SECUREMENTS

- a) Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- b) Contact adhesive: quick setting.

2.07 VAPOUR RETARDER LAP ADHESIVE

- a) Water based, fire retardant type, compatible with insulation.

3 EXECUTION**3.1 APPLICATION**

- a) Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE- INSTALLATION REQUIREMENTS

- a) Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.
- b) Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- a) Install in accordance with TIAC National Standards. Cold equipment: to TIAC code 1503-C.
- b) Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- c) Provide vapour retarder as recommended by manufacturer.
- d) Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- e) Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- f) Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

3.4 CLEANING

- a) Clean in accordance with Section 01 74 00 - Cleaning.
- b) .Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 13: HVAC PIPING INSULATION – SECTION 23 07 19**1 GENERAL****1.1 SUMMARY**

Section Includes: Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 ASTM International (ASTM)
 - .1 [ASTM C 335-\[04\]](#), Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 449/C 449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 [ASTM C 547-\[2003\]](#), Mineral Fiber Pipe Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 [CGSB 51-GP-52Ma-\[89\]](#), Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 [CAN/CGSB-51.53-\[95\]](#), Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- a) Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- b) Shop Drawings: Submit shop drawings of pipe insulation and jacketing.

1.4 QUALITY ASSURANCE

- a) Qualifications: Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project.

1.5 DELIVERY, STORAGE AND HANDLING

- a) Deliver, store and handle materials in accordance with manufacturer's written instructions. Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- b) Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- c) Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Divert unused metal materials from landfill to metal recycling facility approved by the Owner.
 - .3 Dispose of unused adhesive material at official hazardous material collections site approved by the Owner.

2 PRODUCTS**2.1 FIRE AND SMOKE RATING**

- a) In accordance with [CAN/ULC-S102](#). Maximum flame spread rating: 25.

2.2 INSULATION

- a) Mineral fibre specified includes glass fibre, rock wool, slag wool.
- b) Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with [ASTM C 335](#).
- c) TIAC Code C-2: mineral fibre blanket faced [with][without] factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to **CAN/ULC-S702**.
 - .2 Jacket: to [CGSB 51-GP-52Ma](#).
 - .3 Maximum "k" factor: to **CAN/ULC-S702**.

2.3 INSULATION SECUREMENT

- a) Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- b) Contact adhesive: quick setting.
- c) Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

- a) Thermal insulating and finishing cement: Air drying on mineral wool, to **ASTM C 449/C 449M**.

2.5 VAPOUR RETARDER LAP ADHESIVE

- a) Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- a) Vinyl emulsion type acrylic, compatible with insulation.

2.7 JACKETS

Polyvinyl Chloride (PVC):

- a) One-piece moulded type [and sheet] to [CAN/CGSB-51.53](#) with pre-formed shapes as required.
- b) Colours: White
- c) Minimum service temperatures: -20 degrees C.
- d) Maximum service temperature: 65 degrees C.
- e) Moisture vapour transmission: 0.02 perm.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- a) Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

- a) Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- b) Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- a) Install in accordance with TIAC National Standards.
- b) Apply materials in accordance with manufacturers instructions and this specification.
- c) Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- d) Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- e) Install hangers, supports outside vapour retarder jacket.
- f) Supports, Hangers: Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 CLEANING

- a) Proceed in accordance with Section 01 74 00 - Cleaning.
- b) Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 14: CENTRIFUGAL WATER CHILLERS – SECTION 23 64 16**1.0 GENERAL****1.1 REFERENCE STANDARDS**

- a) Air-Conditioning, Heating and Refrigeration Institute (AHRI) - AHRI-550/590-[03], Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
- b) ASTM International (ASTM) - [ASTM C 547-\[07e1\]](#), Standard Specification for Mineral Fiber Pipe Insulation.
- c) CSA Group (CSA) - [CSA B52-\[05 SMART\]](#), Mechanical Refrigeration Code.
- d) Environment Canada/Environmental Protection Services (EPS) - EPS 1/RA/2-[1996], Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
- e) Conform to AHRI Standard 550/590 code for rating and testing of water chillers.
- f) Conform to UL 1995 for Safety for Heating and Cooling Equipment.
- g) Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.
- h) Conform to latest revision of ANSI/ASHRAE STANDARD 15 code for construction and operation of centrifugal chillers.
- i) Unit shall bear the AHRI Certification Label for the specific type of water chiller as applicable.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- a) Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- b) Submit drawings indicating assembled dimensions, operating weight, load distribution, and required service and access clearances.
- c) Submit product data indicating options and specialties, electrical requirements, and wiring diagrams and connections.
- d) Submit rigging, installation, and startup procedures. Include operations and maintenance data for both new chiller 2 and new chiller 2 variable-speed drive.
- e) Submit performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant entering condenser water temperature.
- f) Submit compressor and product data in table form indicating impeller speed (RPM), number of bearings, type of bearings, high speed impeller shaft RPM, sound pressure level per AHRI 575-2008 (dB), number of stages, number of sets of inlet guide vanes, amount of refrigerant charge (lb), and amount of oil required (gal).
- g) Acceptable refrigerants on which chiller performance is based are HFO-514A. All proposals for chiller performance must include an AHRI approved selection method for the specified refrigerants.

1.3 CLOSEOUT SUBMITTALS

- a) Submit in accordance with Section 01 33 00 - Submittal Procedures.
- b) Operation and Maintenance Data: submit operation and maintenance data for centrifugal water chillers for incorporation into manual. Data to include:
 1. Description of equipment giving manufacturers name, model type and, capacity and serial numbers.
 2. Submit part load performance curves.
 3. Details on operation servicing and maintenance.
 4. Recommended spare parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

- a) Comply with manufacturer's installation instructions for rigging, chiller loading, local transportation requirements, unloading, storage, and final setting.
- b) Protect chiller and controls from physical damage. Leave factory shipping covers in place until installation. The entire unit must be shrink wrapped with an environmentally recyclable material standard. The material shall include an imbedded desiccant to minimize/eliminate internal moisture.
- c) The chiller shall ship with a dry nitrogen charge to eliminate potential charge loss during delivery and construction. The refrigerant must be shipped separately from the chiller. **The refrigerant monitoring system shall be active at the job site prior to the charging of the chiller.**
- d) The chiller should ship with a full charge of oil.
- e) Follow minimum standards for refrigeration systems as required by the latest revision of ANSI/ASHRAE Standard 15, paying special attention to requirements for air monitoring, ventilation, self-contained breathing apparatus, and leak detection to assure the safety of chiller plant operating personnel.
- f) Install proper outside exhaust of chiller refrigerant relief device(s), discharge header(s), and purge unit(s). Route exhaust

outside.

- g) Per ASHRAE Std 147, medium pressure units with relief valves only shall have rupture discs in series with relief valves to minimize refrigerant leakage.
- h) Install a refrigerant monitor that can be calibrated for appropriate refrigerant(s), capable of detecting concentrations of minimum ppm for low-level leak detection to assure the safety of chiller plant operating personnel.
- i) Install suitable audible and visual alarms that activate well below the Acceptable Exposure Level (AEL) of the specific refrigerant(s) to alert persons inside and outside of the equipment room that a refrigerant leak condition exists.
- j) Storage: Per ASHRAE Std 147, positive pressure units must have a pumpdown capability that isolates the refrigerant charge for storage in a suitable vessel. If pump down capability does not exist, then the charge must be removed during long idle periods.

2.0 PRODUCTS

2.1 GENERAL

- a) Description: Factory-assembled and tested water chiller complete with compressor, evaporator, condenser, controls, and variable speed drive, interconnecting unit piping and wiring, indicating accessories, and mounting frame...
- b) The contractor shall furnish and install centrifugal water chillers as shown and scheduled in the plans and specifications. The units shall produce the specified tonnage per the scheduled data in accordance with the latest revision of AHRI 550/590. The unit shall bear the AHRI certification label as applicable.

2.2 CAPACITY

Certified ratings based on AHRI 550:

- a) 708 tons when cooling 157.7 L/s of water from 11.0°C to 7.2°C rejecting heat to a condenser water flow rate of 142.0 L/s of water entering the condenser at 29.4°C and leaving at 34.3°C.
- b) Fullload Efficiency of 0.4988 kW/ton. Partload Efficiency of 0.3115 kW/ton
- c) Fouling resistance coefficient: 0.000045 m² K/W
- d) Refrigerant: R-514-A

2.3 COMPRESSOR and MOTOR

- a) The compressor shall be centrifugal with multiple stages using low pressure refrigerant
- b) Chiller should be able to unload to 15% of design tonnage with constant entering water temperature. The minimum unloading point shall be demonstrated at the time of the factory performance test. The machine shall be modified to include hot gas bypass if the minimum load cannot be met.
- c) Compressor assembly shall be vibration tested at the factory. Vibration shall not exceed 0.15 inches per second at full load design compressor speed as measured on the motor housing. The test data shall be recorded and provided to the customer for approval. The motor shall be hermetic and either suction or liquid refrigerant cooled. Hot gas motor cooling is not acceptable.
- d) If an open motor design is used, then the manufacturer shall provide and install a complete chilled water AHU with a capacity equal to 0.9% of the chiller's tonnage to serve the chiller area, which must be completely operational and include all wiring and automatic temperature controls. The open motor chiller manufacturer must also increase chiller size by an equivalent tonnage with no increase in specified full load kW, and shall list, on the submittal, additional maintenance requirements due to alignment, refrigerant shaft seal, coupling and bearings. Additionally, if an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided with the following inclusions:
 - e) An oil reservoir shall collect any oil and refrigerant that leaks past the seal.
 - f) A float device shall be provided to open when the reservoir is full, directing the refrigerant/oil mixture back into the compressor housing.
 - g) Manufacturer shall warrant the shaft seal, reservoir, and float valve system against leakage of oil and refrigerant to the outside of the chiller for a period of 10 years from initial start-up, including parts and labor to replace a defective seal and any refrigerant required to trim the charge to original specifications. Inspections shall be performed a minimum of once a year. See Section 1.05 for more information in warranty.
- h) Motors shall have winding 100 ohm platinum RTD's for temperature sensing on each phase. Thermistors and thermal overloads are not acceptable. These temperatures shall be furnished to the unit control panel for monitoring and alarm.
- i) Manufacturers with speed increasing transmissions shall not exceed 10,000 RPM compressor speeds and shall annually inspect the gears and all bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.

- j) The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

2.4 EVAPORATOR

- a) The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable.
- b) Evaporator tubes shall be internally and externally enhanced with a [0.75"] [1"] outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets. The evaporator tubes must also be removable from both ends to provide easy access for tube cleaning. The minimum evaporator tube wall thickness, root-to-root across the entire tube length shall be 0.025". It is unacceptable to provide this thickness at the intermediate supports only.
- c) The evaporator water piping connections shall be [grooved] [welded flange-raised face] [flanged (adapter)].
- d) The evaporator waterboxes shall be standard non-marine type with connections per the schedule.
- e) Supply and return head waterboxes shall be designed for a working pressure of [150] [300] and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.
- f) Insulation will be 3/4" insulation and cover all low-temperature surfaces to include the evaporator, waterboxes, and suction elbow. Economizer, if applicable, is insulated with 3/8" insulation.
- g) Hinges shall be factory supplied on the ends of the evaporator to facilitate waterbox removal without external rigging.
- h) Units with multi-stage compressors shall incorporate an interstage flash vessel "economizer". All units with single stage compressors shall have the condensers circuited for liquid subcooling and be provided with a thermometer well to monitor the amount of subcooling.
- i) Adjustable or float type refrigerant metering devices and thermal expansion valves shall be inspected and adjusted by the manufacturer at the end of each year for the first five years of operation to assure equivalent reliability and maintenance to a fixed orifice system. A written report shall be forwarded to the owner each year to confirm completion.
- j) Evaporator condenser and water boxes shall be designed for 1 1/2 times working pressure but not less than [1] MPa on water side.
- k) Fouling resistance coefficient: 0.000045 m² K/W

2.5 CONDENSER

- a) The condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable.
- b) Condenser tubes shall be internally and externally enhanced with a [0.75"] [1"] outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends. The condenser tubes must also be removable from both ends to provide easy access for tube changeouts or tube cleaning. The minimum condenser tube wall thickness, root-to-root across the entire tube length shall be [0.025"] [0.028"] [0.035"]. It is unacceptable to provide this thickness at the intermediate supports only.
- c) The condenser water piping connections shall be [grooved] [welded flange-raised face] [flanged (adapter)].
- d) The condenser waterboxes shall be standard non-marine type with connections per schedule.
- e) Supply and return head waterboxes shall be designed for a working pressure of 150 psi and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.
- f) Hinges shall be factory supplied on the ends of the condenser to facilitate waterbox removal without external rigging.

2.6 REFRIGERANT & PURGE UNIT

- a) New Chiller 2 comes with a new purge unit.
- b) Acceptable Refrigerants on which chiller performance is based are low-GWP, next generation refrigerants such as R-513A or R-514A.
- c) Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from the chiller to remote systems.
- d) Refrigerant Flow Control: Fixed orifice plates at the entrance and exit of the economizer shall be used to control refrigerant flow.
- e) Factory install check or manual isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of the full refrigerant charge in the chiller condenser shell. In addition, provide isolation valve on the suction side of compressor from evaporator to allow for isolation and storage of full refrigerant charge in the chiller evaporator shell.

- f) Chillers that operate at low pressures must have a high efficiency purge system to ensure that any potential non-condensable leakage into the vessel is immediately eliminated. The purge run time shall be monitored by the main unit controller to act as a leak detector if required, and must have the following specifications:
- g) The manufacturers of low pressure machines must provide a purge system. Acceptable purges are the Trane EarthWise Purge.
- h) The purge efficiency must meet ASHRAE Standard 147-2002.
- i) The purge shall be capable of operating when the chiller is idle in accordance with ASHRAE Standard 147-2002.
- j) Vent purge in accordance with CSA B52

2.7 REFRIGERANT PIPING

Refrigerant piping, valves, fittings and related parts: to [CSA B52](#) include:

- a) Thermal expansion valve.
- b) Suction and discharge regulators.
- c) Combination filter/dryer [complete with replaceable core].
- d) Solenoid stop valves.
- e) Liquid sight glasses [complete with moisture indicator].
- f) High side pressure relief device.
- g) Suction line insulation: 20 mm of flexible elastomeric, unicellular insulation to [ASTM C 547](#).
- h) Provide 2 sight glasses for monitoring refrigerant change level, and oil change level and compressor rotation.

2.8 FREQUENCY DRIVES AND STARTERS

- a) The centrifugal water chiller shall be furnished with an air cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be remote free standing in areas shown on drawings and shipped completely factory assembled, wired and tested.
- b) The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.
- c) The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.
- d) The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
- e) Power semi-conductor and capacitor cooling shall be from a liquid or air cooled heatsink.
- f) The VSDs shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
- g) Enclosure shall include a padlockable, door-mounted circuit breaker with a minimum AIC rating of 65,000 amps.
- h) The entire chiller package shall be UL/CUL listed.
- i) The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
- j) Compliance to recommendations for harmonic mitigation.
- k) The VSD design shall include a DC link reactor on positive and negative rails to minimize power line harmonics and protect the VSD from power line transients.
- l) Input shall be nominal [460] [480] [575] [600] volts, three phase, 60 Hertz AC power, +/- 10 percent of nominal voltage.
- m) Frequency range 38-60 hertz.
- n) The VSD shall include the following features:
 - o) All control circuit voltages are physically and electrically isolated from power circuit voltage.
 - p) 150% instantaneous torque available for improved surge control.
 - q) Soft start, adjustable linear acceleration, coast-to-stop.
 - r) Insensitivity to incoming power phase sequence.
 - s) Adjustable current limiting and U.L. approved electronic motor overload protection.
 - t) Output line-to-line short circuit protection.
 - u) Line-to-ground short circuit protection.

- v) Protection from phase loss at AFD input.
- w) Protection from phase reversal/imbalance.
- x) Protection from over/under-voltage.
- y) Protection from over-temperature.
- z) The following VSD status indicators shall be available to the unit controller to facilitate startup and maintenance:
 - a . Input line voltage.
 - b . Output/load amps.
 - c . Fault.

2.9 FREE COOLING

- a) A free cooling cycle shall be provided for the centrifugal chiller. The proposed chiller shall provide required material (including controls, valves, piping, and additional storage vessels) to allow cooling of chilled water by transferring heat to cold condenser water without operating the compressor. This shall be a factory installed option on the centrifugal chiller. The following details shall apply:
 - b) Changeover from free cooling to mechanical cooling shall be initiated by manual operation of a switch on the machine control panel.
 - c) Interlock between free cooling cycle and normal operational cycle shall be provided to prevent compressor start-up or operation during unsafe conditions.
 - d) Manufacturers with systems requiring spray pumps shall be responsible for any special foundations required to provide adequate pump Net Positive Suction Head (NPSH). When pump is used, provide necessary pump starter, disconnect and wiring.
 - e) Where spray nozzles are used, provide access provision for removal and cleaning of nozzles.
 - f) The contractor can, as an option, provide a plate frame heat exchanger with all the necessary piping, pumps, and controls to meet this performance. Operation must be automatic and provide for switching from chiller to heat exchanger and back.

2.10 ELECTRICAL

- a) Chiller shall be installed, wired, and functionally tested at the factory before being shipped. Single point power connection - A control power transformer internal to the motor controller/frequency drive and of sufficient size to power all chiller mounted auxiliary loads shall be supplied.
- b) No separate power connection shall be required for chiller mounted equipment. The CPT shall tap from the main power connection.
- c) Terminal blocks with numbered and color coded wiring to match the wiring diagram must be included.

2.11 CONTROL PANEL

- a) To EEMAC standard and include Safety controls with cutout, indicator lights and manual reset [and contacts for an alarm] to include:
 - a) High condenser pressure
 - b) Low oil pressure
 - c) High oil temperature
 - d) [High hermetic motor temperature]
 - e) High discharge temperature
 - f) Motor over current
 - g) Low evaporator temperature.
- b) Operating controls with in-operation indicator lights to include:
 - a) Start-stop switch
 - b) Anti-recycle [30] minute time delay
 - c) Low chilled water temperature cutout and automatic reset
 - d) Excess purge signal light and reset switch
 - e) Manual/automatic oil pump operating switch and signal light.
 - f) Oil heater signal light; manual reset power failure and signal light.
 - g) Chilled water flow interruption light [meter to indicate number of compressor starts and elapsed running time]
 - h) Adjustable water temperature set point on controller.
 - i) Demand limit switch permitting selection of maximum motor load between 40 and 100% of full load.
 - j) 90 mm dial pressure gauges for condenser, evaporator, oil pressure, purge.

- k) Interlock terminals.
- l) Alarm for refrigerant leakage.

3 EXECUTION**3.1 INSTALLATION**

- a) Install in accordance with manufacturer's instructions.
- b) Provide for connection to electrical service. Include for connection of oil pump if required.
- c) Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.
- d) Furnish and install necessary auxiliary water piping for oil cooling units if required.
- e) Arrange piping for easy dismantling to permit tube cleaning.
- f) Provide piping from chiller relief device to outdoors. Size as recommended by manufacturer.
- g) Chiller vibration isolation and the base type (i.e. floor pad) will be in accordance with ASHRAE Handbook, 1995, HVAC Applications, Chapter 43 Table 42.

3.2 MANUFACTURER'S FIELD SERVICES

- a) All Startup, maintenance and monitoring functions shall be performed by a manufacturer's commercial agent to confirm, (in writing), that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty.
 - b) Applied chiller manufacturers shall maintain service capabilities no more than 80km from the facility.
 - c) EXECUTIVE COORDINATION - Prestart instructions and coordination is to be provided by senior lead technician or supervisor to:
 - a) Review installation checklist with installing contractor.
 - b) Review startup procedures and required support.
 - c) Review training requirements, timing and logistics with the installing contractor.
 - d) STARTUP - Provide all labor and materials to perform the startup. This shall be done in strict accordance with manufacturer's specifications and requirements.
 - e) Provide a complete log of all operating parameters.
 - f) TRAINING - Provide a minimum of 2 one hour sessions hours of training.
 - g) INSPECTIONS - For the duration of the warranty, during operation, there shall be inspections in 3 month intervals, to perform the following:
 - a) Check the general operation of the unit.
 - b) Provide a complete log as in item 2 above.
 - c) Check operation of the control circuit.
 - d) Check operation of the lubrication system.
 - e) Check operation of the motor and starter.
 - f) Analyze the record data. Compare the data to the original design conditions.
 - g) Review operating procedures with operating personnel.
 - h) Do one oil analysis and submit the written report. Change the oil and filter as required in the published manufacturer's literature.
 - i) Complete all recommended maintenance and tests as documented in the manufacturer's published literature.
 - j) Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies.
 - k) At the final inspection (performed within 30 days of warranty expiration), assure that the chillers are functioning correctly and that all warranty items are resolved to the customer's satisfaction.
13. CENTRAL MONITORING - Provide remote monitoring through the building EMCS system as follows:
- a) Critical alarm monitoring.
 - b) Automated alarm routing and notification of local Trane field office service personnel.
 - c) Routine verification of communications link.
 - d) Archived documentation of critical events history.

END OF SECTION

PART 15: COMMON WORK RESULTS FOR ELECTRICAL - SECTION 26 05 00**1 GENERAL****1.1 REFERENCE STANDARDS**

- .1 CSA Group
 - a) [CSA C22.1-\[12\]](#), Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - b) [CSA C22.2 No.41-\[13\]](#), Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and [UL 467](#)).
 - c) [CSA C22.2 No.65-\[13\]](#), Wire connectors (Tri-National Standard, with [UL 486A-486B](#) NMX-J-543-ANCE).
 - d) [CAN/CSA-C22.2 No.18-\[98\(R2003\)\]](#), Outlet Boxes, Conduit Boxes and Fittings.
 - e) [CAN/CSA-C22.2 No.65-\[03\(R2008\)\]](#), Wire Connectors (Tri-National Standard with [UL 486A-486B](#) and NMX-J-543-ANCE-03).
 - f) [CSA C22.2 No. 45-\[M1981\(R2003\)\]](#), Rigid Metal Conduit.
 - g) [CSA C22.2 No. 56-\[04\]](#), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - h) [CSA C22.2 No. 83-\[M1985\(R2003\)\]](#), Electrical Metallic Tubing.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC) - IEEE SP1122-[2000], The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

- a) Submit in accordance with Section 01 78 00 - Closeout Submittals.
- b) Operation and Maintenance Data: submit operation and maintenance data for new Chiller 2, Chiller 2 variable speed drive, and all condenser & chilled water variable frequency drives for incorporation into manual.
- c) Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

2 PRODUCTS**2.1 DESIGN REQUIREMENTS**

- a) Operating voltages: to [CAN3-C235](#).
- b) Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- c) Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- d) Language operating requirements: provide identification nameplates and labels for control items in English.

2.2 MATERIALS AND EQUIPMENT

- a) Material and equipment to be CSA certified.
- b) Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- a) Verify installation and co-ordination responsibilities related to motors, equipment and controls with the Owner prior to installation.

2.4 WIRING TERMINATIONS

- a) .Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

Identify electrical equipment with nameplates and labels as follows:

- a) Nameplates: lamicaid 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
- b) Sizes to be approved by Owner prior to manufacture.

- c) Wording on nameplates and labels to be approved by the Owner prior to manufacture.
- d) Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- e) Disconnects, starters and contactors: indicate equipment being controlled, voltage and source of power.

2.6 WIRING IDENTIFICATION

- a) Identify wiring with permanent indelible identifying markings, numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- b) Maintain phase sequence and colour coding throughout.
- c) Colour coding: to [CSA C22.1](#).
- d) Use colour coded wires in communication cables, matched throughout system.

3 EXECUTION**3.1 INSTALLATION**

- a) Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- a) Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- a) Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50mm.
- b) Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 MOUNTING HEIGHTS

- a) Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- b) If mounting height of equipment is not specified or indicated, verify with Owner before proceeding with installation.

3.5 FIELD QUALITY CONTROL

- a) Load Balance: - Measure phase current to panelboards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- b) Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- c) Carry out tests in presence of the Owner.
- d) Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- e) Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Report.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.6 SYSTEM STARTUP

- a) Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- b) Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.7 CLEANING

- Progress Cleaning and Final Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 16: SELECTIVE DEMOLITION FOR ELECTRICAL – SECTION 26 05 05

1 GENERAL

1.1 SUMMARY

This Section includes requirements for selective demolition and removal of electrical components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete work described in this Section.

1.2 REFERENCE STANDARDS

CSA Group (CSA) - [CSA S350](#) M1980 [(R2003)], Code of Practice for Safety in Demolition of Structures

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- a) Action Submittals: Provide in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:
- b) Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.
- c) Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.4 SITE CONDITIONS

- a) Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- b) Existing Hazardous Substances: the Owner performed a hazardous substances assessment and is a part of this specification. Everyone must read that.
- c) Hazardous substances will be removed by a hazardous abatement specialist engaged by the owner before start of Work.

1.5 SALVAGE AND DEBRIS MATERIALS

Demolished items become Contractor's property and will be removed from Project site; except for items indicated by the owner.

2 PRODUCTS

2.1 MATERIALS

- a) Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.
- b) Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

3 EXECUTION

3.1 EXAMINATION

Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; the Owner will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- a) Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations
- b) Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
- c) Prevent debris from blocking drainage inlets.

3.3 EXECUTION

Demolition and Removal:

- a) Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.

- b) Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
- c) Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
- d) Perform demolition work in a neat and workmanlike manner: Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
- e) Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
- f) Remove existing conduits, boxes, cabling and wiring associated with removed electrical devices and equipment.
- g) Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- h) Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.04 CLOSEOUT ACTIVITIES

Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle center) except where explicitly noted otherwise for materials being salvaged for re use in new construction.

END OF SECTION

PART 17: WIRE AND BOX CONNECTORS - SECTION 26 05 20

1 PRODUCTS

1.1 MATERIALS

- a) Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- b) Fixture type splicing connectors to: [CAN/CSA-C22.2 No.65](#), with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- c) Bushing stud connectors: to **EEMAC 1Y-2** and NEMA to consist of:
 - .1 Connector body and stud clamp for stranded conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- d) Clamps or connectors for armoured cable, TECK cable, flexible conduit, and non-metallic sheathed cable as required to: [CAN/CSA-C22.2 No.18](#).

2 EXECUTION

2.1 EXAMINATION

- a) Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
- b) Visually inspect substrate in presence of the Owner.
- c) Inform the Owner of unacceptable conditions immediately upon discovery.
- d) Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner.

2.2 INSTALLATION

- a) Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with [CAN/CSA-C22.2 No.65](#).
- b) Install fixture type connectors and tighten to [CAN/CSA-C22.2 No.65](#). Replace insulating cap.
- c) Install bushing stud connectors in accordance with **EEMAC 1Y-2** and NEMA.
- d) Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 18: WIRES AND CABLES (0-1000 V) - SECTION 26 05 21**1 GENERAL****1.1 PRODUCT DATA**

Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

2 PRODUCTS**2.1 BUILDING WIRES**

- a) Conductors: stranded for 12 AWG and larger. Minimum size: 18 AWG.
- b) Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Non Jacketed.
- c) Copper conductors: size as indicated, with thermoplastic insulation type T90 Nylon rated at 600 V.

2.2 TECK 90 CABLE

- a) Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- b) Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- c) Insulation:
 - .1 Ethylene propylene rubber EP.
 - .2 Cross-linked polyethylene XLPE.
 - .3 Rating: 1000 V.
- d) Inner jacket: polyvinyl chloride material.
- e) Armour: interlocking aluminum.
- f) Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- g) Connectors: Watertight, approved for TECK cable.

2.3 CONTROL CABLES

Owner will supply all control cables for this installation.

3 EXECUTION**3.1 FIELD QUALITY CONTROL**

- a) Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- b) Perform insulation tests using method appropriate to site conditions and to approval of the Owner and local authority having jurisdiction over installation.
- c) Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- a) Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- b) Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- c) Conductor length for parallel feeders to be identical.
- d) Lace or clip groups of feeder cables at distribution centers, pull boxes, and termination points.
- e) Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- a) Group cables wherever possible on channels.
- b) Install cable exposed, securely supported by straps or hangers.

3.4 INSTALLATION OF CONTROL CABLES

- a) Install control cables in conduit
- b) Ground control cable shield.

END OF SECTION

PART 19: CONNECTORS AND TERMINATIONS - SECTION 26 05 22

1 PRODUCTS

1.1 CONNECTORS AND TERMINATIONS

2 EXECUTION

2.1 EXAMINATION

Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of the Owner.
- .2 Inform the Owner of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner.

2.2 INSTALLATION

- a) Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- b) Bond and ground as required to CSA C22.2 No.41.

2.3 CLEANING

Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 20: HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS – SECTION 26 05 29**1 PRODUCTS****1.1 SUPPORT CHANNELS**

U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

2 EXECUTION**2.1 EXAMINATION**

Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of the Owner.
- .2 Inform the Owner of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner.

2.2 INSTALLATION

- a) Secure equipment to hollow and solid masonry surfaces with lead anchors or nylon shields.
- b) Secure equipment to poured concrete with expandable inserts.
- c) Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- d) Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- e) Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- f) For surface mounting of two or more conduits use channels at 50mm on center spacing.
- g) Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- h) Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- i) Do not use wire lashing or perforated strap to support or secure raceways or cables.
- j) Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Owner.
- k) Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 21: SPLITTERS, JUNCTION, PULL BOXES AND CABINETS - SECTION 26 05 31

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- a) Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- b) Submit shop drawings cabinets including new Chiller 2 Variable speed drive and all four new 75hp 600V variable frequency drives for the chilled water and condenser water pumps.
- c) Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

2 PRODUCTS

2.1 JUNCTION AND PULL BOXES

- a) Construction:welded steel enclosure.
- b) Covers Flush Mounted: 25 mm minimum extension all around.
- c) Covers Surface Mounted: screw-on flat or turned edge covers.

2.02 CABINETS

- a) Construction: welded sheet steel or aluminum with hinged door, handle, and catch.
- b) Type E Empty: surface return flange mounting as indicated.
- c) Type T Terminal: surface return flange mounting as indicated containing 2.5 mm sheet steel backboard.

3 EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- a) Install pull boxes in inconspicuous but accessible locations.
- b) Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- c) Install terminal block as indicated in Type T cabinets.
- d) Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.02 IDENTIFICATION

- a) Equipment Identification: to Section 26 05 00- Common Work Results for Electrical.
- b) Identification Labels: indicating system name, voltage and phase or as indicated.

END OF SECTION

PART 22: CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS - SECTION 26 05 34

1 PRODUCTS

1.1 CONDUITS

- a) Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- b) Electrical metallic tubing (EMT): to **CSA C22.2 No. 83**, with couplings.
- c) Rigid pvc conduit: to **CSA C22.2 No. 211.2**.
- d) Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

1.2 CONDUIT FASTENINGS

- a) One hole steel straps to secure surface conduits 50 mm and smaller.
- b) Two hole steel straps for conduits larger than 50 mm.
- c) Beam clamps to secure conduits to exposed steel work.
- d) Channel type supports for two or more conduits at 50mm on center.
- e) Threaded rods, 6 mm diameter, to support suspended channels.

1.3 CONDUIT FITTINGS

- a) Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- b) Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

1.4 FISH CORD

- .1 Polypropylene.

2 EXECUTION

2.1 MANUFACTURER'S INSTRUCTIONS

Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

2.2 INSTALLATION

- a) Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- b) Use rigid galvanized steel threaded conduit except where specified otherwise.]
- c) Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury].
- d) Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- e) Dry conduits out before installing wire.

2.3 SURFACE CONDUITS

- a) Run parallel or perpendicular to building lines.
- b) Run conduits in flanged portion of structural steel.
- c) Group conduits wherever possible on suspended or surface channels.
- d) Do not pass conduits through structural members.
- e) Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

2.4 CLEANING

Proceed in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 23: ELECTRICAL CABINETS AND ENCLOSURES - SECTION 26 27 16

1 GENERAL

1.1 REFERENCE STANDARDS

- a) CSA Group (CSA) - CAN/CSA C22.2 No.94.1-1-[07], Enclosures for Electrical Equipment, Non Environment Considerations.
- b) National Electrical Manufacturers Association (NEMA) - NEMA 250-[2008], Enclosures for Electrical Equipment (1000 Volts Maximum).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- a) Submit in accordance with Section 01 33 00 -
- b) Submit shop drawings cabinets including new Chiller 2 Variable speed drive and all four new 75hp 600V variable frequency drives for the chilled water and condenser water pumps.
- c) Provide shop drawings for each type of starter to indicate:
 - 1. Mounting method and dimensions.
 - 2. Starter size and type.
 - 3. Layout and components.
 - 4. Enclosure types.
 - 5. Wiring diagram.

2 PRODUCTS

2.1 MATERIALS

- a) Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to NEMA 250, CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- b) Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m² area without rupture of material.
- c) Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- d) Cover: tamperproof, bolt-on, domed to shed water.
- e) Door: 3 point latching, with padlocking means.
- f) Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- g) Starters: to IEC 947-4 with AC4 utilization category.

2.2 FULL VOLTAGE MAGNETIC STARTERS

- a) Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- b) Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- c) Accessories:
 - .1 Selector switches: heavy duty labelled as indicated.
 - .2 Indicating lights: heavy duty type and Colour as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3 CONTROL TRANSFORMER

- a) Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- b) Size control transformer for control circuit load plus 20% spare capacity.

2.4 ACCESSORIES

- a) Pushbutton: heavy duty, oil tight as required.
- b) Selector switches: heavy duty, oil tight as required.
- c) Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.05 FINISHES

Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.06 EQUIPMENT IDENTIFICATION

- a) Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- b) Magnetic starter designation label, white plate, black letters, engraved as indicated

3 EXECUTION

3.1 EXAMINATION

- a) Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electrical cabinet and enclosure installation in accordance with manufacturer's written instructions.
- b) Visually inspect substrate in presence of the Owner.
- c) Inform the Owner of unacceptable conditions immediately upon discovery.
- d) Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from the Owner.

3.2 INSTALLATION

- a) Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- b) Mount equipment in enclosure.
- c) Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.
- d) Install starters and control devices in accordance with manufacturer's instructions.
- e) Install and wire, starters and controls as indicated.
- f) Ensure correct fuses installed.
- g) Confirm motor nameplate and adjust overload device to suit.

3.3 FIELD QUALITY CONTROL

- a) Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- b) Operate switches and contactors to verify correct functioning.
- c) Perform starting and stopping sequences of contactors and relays.
- d) Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.03 CLEANING

Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION