Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises general construction for the installation of a new outdoor air-cooled chiller system at the Hurst Regional Pump Station (RPS). Coordinate all Control and Electrical requirements with the City of Winnipeg (the City).

1.2 CONTRACT METHOD

.1 Construct Work under City of Winnipeg general conditions for construction.

1.3 SUBMITTALS

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

.2 Submit Project construction progress schedule in accordance with Supplemental Conditions.

.3 Submit site-specific Safe Work Plan in accordance with the Supplement Conditions and Section 01 35 29.06 - Health and Safety Requirements.

1.4 WORK BY OTHERS

.1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from the Contract Administrator.

.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 Contract Administrator, in writing, any defects which may interfere with proper execution of Work.

1.5 WORK SEQUENCE

.1 Construct Work in stages to accommodate the City's continued use of premises during construction.

.2 Co-ordinate Progress Schedule and co-ordinate with City Occupancy during construction.

.3 Maintain City operational access and fire access/control.

.4 Protect workers and public safety.

1.6 CONTRACTOR USE OF PREMISES

.1 All access shall be arranged through the City.

.2 Limit use of premises for Work, for storage, and for access, to allow:

.1 City occupancy.

.2 Work by other contractors.

.3 Co-ordinate use of premises under direction of the Contract Administrator.

.4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.5 Refer to Section 01 56 00 - Temporary Barriers and Enclosures, for temporary facilities, access roads and parking areas, traffic regulations, and utilities.

.6 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

.7 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by the City and/or Contract Administrator.

.8 Ensure that operations conditions of exiting work at completion are still the same, equal to or better than that which existed before new work started.

.9 Smoking and the use of E-cigarettes on the Site is only permitted in designated areas.

1.7 OWNER OCCUPANCY

.1 The City will occupy premises during entire construction period for execution of normal operations.

.2 Co-operate with the City in scheduling operations to minimize conflict and to facilitate City usage.

1.8 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible interference or disturbance to building operations occupants, and normal use of premises. Arrange with the Contract Administrator to facilitate execution of work.

1.9 EXISTING SERVICES

.1 Notify the City, Contract Administrator, and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give the City and Contract Administrator five Working Days notice for necessary interruption of mechanical, controls or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

.1 Submit a shutdown plan in accordance with Section 01 33 00 – Submittal Procedures for service disruptions. The shutdown plan shall include the following:

.1 City staff resources required;

.2 start and end time of the shutdown;

.3 show the temporary services that will be provided if required to maintain the Site's operation;

.4 the procedures and staging of the system shutdowns and re-activations;

.5 anticipated impacts to services as a result of the shutdown;

.6 time required to bring systems back on line;

.7 systems to be isolated and locked out, tagged out (LOTO); and

.8 backout plan if work is not successful or will extend beyond the time limits.

.2 The work associated with the shutdown shall not commence until the shutdown plan has been coordinated with the City and approved by the Contract Administrator.

.3 Provide alternative routes for personnel, pedestrian and vehicular traffic.

.4 Establish location and extent of service lines in area of work before starting Work in accordance with the shutdown plan. Notify the City and Contract Administrator of findings.

.5 Submit schedule in accordance with the shutdown plan for approval by the City and Contract Administrator for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.6 Provide temporary services in accordance with the shutdown plan when directed by the City to maintain critical building and tenant services.

.7 Where unknown services are encountered, immediately advise the City and Contract Administrator and confirm findings in writing.

.8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

.9 Record locations of maintained, re-routed and abandoned service lines.

.10 Construct barriers, as required, in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.10 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy of each document as follows:

.1 The Tender Document;

.2 Contract Drawings;

.3 Specifications;

.4 Addenda;

.5 Reviewed Shop Drawings;

.6 List of Outstanding Shop Drawings;

.7 Requests for Information;

.8 Field Instructions;

.9 Proposed Change Notices;

.10 Change Orders;

.11 Other Modifications to Contract;

.12 Field Test Report, Commissioning Verification Testing and Verification Documentation such as Forms and Check Sheets and Commissioning Issues/Resolution Log;

.13 Copy of Approved Current Work Schedule showing the current status/completion of each task;

.14 Safe Work Plan and Other Safety Related Documents; and

.15 Other documents as specified.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

1. GENERAL

1.1 ADMINISTRATIVE

.1 Submit to Contract Administrator submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator’s review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.

.10 Keep one reviewed copy of each submission on site.

1.2 Shop Drawings and Product Data

.1 Where requested, submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to Contract Drawings and Specifications.

.3 Allow 10 Business Days for Contract Administrator's review of each submission.

.4 Adjustments made on Shop Drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.

.5 Make changes in Shop Drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of revisions other than those requested.

.6 Accompany submissions with a Shop Drawing Submittal Title Sheet included in the supplements to this Section.

.7 Submissions include:

.1 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.2 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.3 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.8 Electrical and instrumentation and control system Shop Drawings to include additional details as follows:

.1 Elevation layouts, bill of materials (BOM), fuse charts, schematics, interconnections, point-to-point wiring diagrams, loop wiring diagrams, motor control diagrams, single line diagram, 3-line diagram, and CSA/cUL panel plates in addition to the other wiring and detail requirements of the Contract.

.1 Panel plates shall be included in submissions, to be affixed on the front exterior door of the enclosure. They shall contain all information required under CSA C22.1

and C22.2. At a bare minimum the short circuit current rating (SCCR) of panel plates shall be equal to the MCC or Panelboard from which they are fed from.

.2 Wiring diagrams shall mark conductor identification, field terminals, changes, etc.

.3 Detailed listing of all nameplates.

.4 Identification in accordance with the City of Winnipeg Water & Waste Identification Standard (https://winnipeg.ca/waterandwaste/pdfs/dept/IdentificationStandard.pdf)

.2 Instrument Loop Diagrams (ILDs) – detailed drawings showing typical interconnections for the specified instrumentation and control devices. The Contractor is to reproduce an ILD for each device and record all relevant notes and installation-specific information on each sheet. Update the ILDs as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.1 Loop wiring diagrams shall follow ISA 5.4 for standard drawing layout, symbols, and wiring depictions.

.3 Motor Control Schematics (MCS) – when these are included, they are detailed drawings showing typical interconnections of motor control equipment. The Contractor is to reproduce a MCS for each motor and record all relevant notes and installation-specific information on each sheet. Update the MCS as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.4 Equipment descriptive data and detailed information for the system hardware and software (i.e., cutsheets or product literature). Failure to provide product literature or cutsheets with drawing submissions is grounds for marking the submission “Revise and Resubmit” without review.

.1 High-light only relevant information for the products provided. The intent of the literature is a technical review of the products suitability, technical ratings and limitations, and the installation/application. Do not include sales literature, or custom-made sheets, or sales declarations. Only manufacturer issued technical literature will be accepted.

.2 Where products have configurable part numbers, the part number options shall be broken down and either circled in red or highlighted in yellow.

.3 All cutsheets and product literature shall be provided showing CSA or cUL markings either circled in red or highlighted in yellow.

.4 Where hazardous location products are required, they shall also be submitted with their CSA or cUL certificates, and CSA or cUL required wiring diagrams for hazardous installations. The control system wiring diagrams shall capture these requirements, provide intrinsically safe barriers and methods as required, and provide notes for the electrical installer.

.5 Drawings for cabling:

.1 Provide Termination drawings with complete list of materials and nameplate engraving list.

.2 Provide Interconnection wiring diagrams for the complete system showing every fibre in each cable.

.6 Records of as-built information for the complete instrumentation and control system.

.1 Provide Enclosure/Cabinet temperature control calculations for heating and cooling loads. Appropriate temperature control shall be provided whenever required and maintain the enclosures CSA/NEMA rating.

.1 Temperature calculations shall be provided whenever Variable Frequency Drives (VFD), Variable Speed Drives (VSD), internally mounted transformers, or other components/devices may produce sufficient heat within the enclosure, or as requested by the Contract Administrator.After Contract Administrator 's review, distribute copies.

.9 Submit electronic copies of Shop Drawings for each requirement requested in specification Sections and as Contract Administrator may reasonably request.

.10 Submit electronic copies of product data sheets or brochures for requirements requested in Specification sections and as requested by Contract Administrator where Shop Drawings will not be prepared due to standardized manufacture of product.

.11 Submit electronic copies of test reports for requirements requested in Specification sections and as requested by Contract Administrator.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.12 Submit electronic copies of certificates for requirements requested in Specification sections and as requested by Contract Administrator.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.13 Submit electronic copies of manufacturer’s instructions for requirements requested in Specification sections and as requested by Contract Administrator.

.1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.

.14 Submit electronic copies of Manufacturer's field reports for requirements requested in Specification sections and as requested by Contract Administrator.

.15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.16 Submit PDF electronic copy of Operation and Maintenance Data for requirements requested in Specification sections and as requested by Contract Administrator.

.17 Delete information not applicable to project.

.18 Supplement standard information to provide details applicable to project.

.19 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, electronic copy will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and resubmission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.20 The review of Shop Drawings by the Contract Administrator is for the sole purpose of ascertaining conformance with the general design concept.

.1 This review shall not mean that Contract Administrator approves detail design inherent in Shop Drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in Shop Drawings or of responsibility for meeting requirements of the Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

.1 Submit for review samples in duplicate as requested in respective Specification sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Contract Administrator's business address.

.3 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.

.6 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 REQUESTS FOR INFORMATION

.1 In the event that the Contractor or any Subcontractor involved in the Work, determines that some portion of the Drawings, Specifications, or other Contract documents requires

clarification or interpretation by the Contract Administrator, the Contractor shall submit a Request for Information (RFI) Form in writing to the Contract Administrator.

.2 Submission Procedure

.1 Submit RFI's to the Contract Administrator on the "Request for Information" form appended to this Section (Supplement – 2). The Contract Administrator shall not respond to a RFI except as submitted on this form. The link to the City's RFI form is provided below:

https://www.winnipeg.ca/infrastructure/templates/ExecutionControl/Request_for_Information_(RFI)_v2.0.docx

.2 Number RFI's consecutively in one sequence in order submitted, in a numbering system established by the Contract Administrator.

.3 Submit one (1) distinct subject per RFI request. Do not combine unrelated items on one (1) form.

.4 Where RFI form does not have sufficient space, attach additional sheets as required.

.5 Submit with RFI form all necessary supporting documentation.

.3 In the RFI, the Contractor shall clearly and concisely set forth:

.1 the issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator; and

.2 an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

.4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Contractor not having been reviewed with an explanation why it was deemed not valid.

.5 An RFI response shall be issued within ten (10) Business Days of receipt of the request from the Contractor unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Business Day. When the RFI submission is received by the Contract Administrator after noon, the review period commences on the subsequent Business Day.

.6 If, at any time, the Contractor submits a large number of RFI's or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFI's within ten (10) Business Days, the Contract Administrator shall confer with the Contractor within five (5) Business Days of receipt of such RFI's and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFI's submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

.7 If the Contractor submits a RFI on an activity with ten (10) Business Days or less of available time to the impacted activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Contractor Administrator to

respond to the request provided that the Contract Administrator responds within the ten (10) Business Days set forth above.

.8 An RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Contractor believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Contractor shall within ten (10) Business Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in a change to the Contract and the Contractor intends to submit a change request. Failure to give such written notice of ten (10) Business Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

1.5 DESCRIPTION OF CONSTRUCTION METHODS

.1 The Contractor shall, if required by the Contract Administrator, submit for the review of the Contract Administrator method statements which describe in detail, supplemented with Drawings where necessary, the methods to be adopted for executing any portion of Work.

.2 These statements shall also include details of constructional Plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

.3 Other Considerations:

.1 Fabrication, erection, installation, or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.

1.6 PHOTOGRAPHIC DOCUMENTATION

.1 In addition to the photographs taken by the Contract Administrator's Resident Engineer submit electronic copy of colour digital photography in jpg format, standard resolution as directed by Contract Administrator.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints:

.1 Viewpoints and their location as determined by the Contract Administrator.

.4 Frequency of photographic documentation: as directed by the Contract Administrator.

2. PRODUCTS

2.1 NOT USED

.1 Not Used.

3. EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

SHOP DRAWING SUBMITTAL TITLE SHEET
(ATTACH TO EACH SUBMITTAL)

DATE: _____

SUBMITTED TO: Contract Administrator: Claude Courchaine, P.Eng. Company: AECOM Consultant Reference No.: 60664207 **SUBMITTED BY**: Name: Title: Company:	SD No.:_____ ☐ New Submittal ☐ Resubmittal City File No.: W-938 Project ID: 20050014 Specification Section No.:_____ **(Cover only one section with each transmittal)** Schedule Date of Submittal: _____

SUBMITTAL TYPE:	☐ Shop Drawing	☐ Sample	☐ Informational

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing/ Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that:

(i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and

(ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized)

For details and instructions on how to complete this document, click the [¶] icon under the Home tab to display the hidden text.

RFI Title: _____ **RFI No.:** 0

Date RFI initiated: _____ **Date Response Requested by:** _____

Date Response Issued: _____

Project Name: _____

Submitted To:			
Contract Administrator (CA):	Claude Courchaine, P. Eng.	Consultant Ref. No.	60664207
Company/Dept.:	AECOM	Tender No.	^^^^-2022

Requested By:		***For CA Use***	
Name:		City File No.:	W-938
Title:		Project ID:	20050014
Company:		Project Record Index No.:	
Email::		Purchase Order No.:	

Request/Question: (to be completed by Contractor)

Answer/Response: (to be completed by Contract Administrator)

Attachment(s):

Distribution (to be completed by Contract Administrator)

- Contract Administrator
- Contractor
- City Project Manager
- Other:

Part 1 General

1.1 REFERENCE STANDARDS

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.2 Province of Manitoba

.1 The Workers Compensation Act RSM 1987 - Updated 2021.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit site-specific Safe Work Plan in accordance with the Supplemental Conditions.

.3 Include results of Site specific safety hazard assessment.

.4 Include results of safety and health risk or hazard analysis for Site tasks and operation found in work plan.

.5 Submit electronic copies of Contractor's authorized representative's work site health and safety inspection reports to Contract Administrator and/or authority having jurisdiction, daily, or at specified intervals by the Contract Administrator.

.6 Submit copies of reports or directions issued by Federal, Provincial health and safety inspectors.

.7 Submit copies of incident and accident reports.

.8 Submit WHMIS Safety Data Sheets (SDS) in accordance with Section 02 81 00 - Hazardous Materials.

.9 Contract Administrator will review Contractor's site-specific Safe Work Plan and provide comments to Contractor within 10 Business Days after receipt of plan. Revise plan as appropriate and resubmit plan to Contract Administrator within 10 Business Days after receipt of comments from Contract Administrator.

.10 Contract Administrator's review of Contractor's final Safe Work Plan shall not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.11 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Contract Administrator.

.12 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

.1 Note the Sites have chemical dosing processes that may release to the environment under unusual and extraordinary circumstances. The City will review with the Contractor the appropriate Safe Work Procedures for the incorporation into the document.

1.3 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work as required.

1.4 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

.1 Schedule and administer Health and Safety meeting with Contract Administrator prior to commencement of Work.

1.6 REGULATORY REQUIREMENTS

.1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.7 PROJECT/SITE CONDITIONS

.1 Hazards at the Site involve:

.1 Working at a Site which uses chemicals for disinfection of the treated water leaving the RPS. The chemical can pose as an immediate hazard to life and health.

1.8 GENERAL REQUIREMENTS

.1 Develop written site-specific Safe Work Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from Site. .

.2 Contract Administrator may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 RESPONSIBILITY

.1 Be responsible for health and safety of persons on the Sites, safety of property on Sites and for protection of persons adjacent to the Sites and environment to extent that they may be affected by conduct of the Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Safe Work Plan.

1.10 COMPLIANCE REQUIREMENTS

.1 Comply with The Workers Compensation Act, Workplace Safety Regulation, Manitoba Reg. C.C.S.M c. W210.

.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.11 UNFORSEEN HAZARDS

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Manitoba having jurisdiction and advise Contract Administrator verbally and in writing.

1.12 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator.

.2 Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities;

.2 Have working knowledge of occupational safety and health regulations;

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work;

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Safe Work Plan; and

.5 Be on site during execution of Work and report directly to and be under direction of Site supervisor.

1.13 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Manitoba having jurisdiction, and in consultation with Contract Administrator.

1.14 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction, Contract Administrator, of the City.

.2 Provide Contract Administrator with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Contract Administrator may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.16 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Contract Administrator.

1.17 WORK STOPPAGE

.1 Give precedence to safety and health of public and Site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit WHMIS Safety Data Sheets (SDS) in accordance with Section 02 81 00 - Hazardous Materials.

.2 Submit a site-specific Contaminant Prevention Plan (CPP) identifying the proper procedures and actions to be implemented to prevent potentially or expected hazardous substances due to the presence of any hazardous substances within the project site. The intent of the CPP is to:

.1 Prevent introduction of designated substances (DS) into air, water, or ground;

.2 Detail provisions for storage and handling of these materials in compliance with Federal, Provincial, and Municipal laws.

1.3 FIRES

.1 Fires and burning of rubbish on site is not permitted.

1.4 NOTIFICATION

.1 Contract Administrator will notify Contractor in writing of observed noncompliance with Federal, Provincial environmental laws and regulations or Municipal environmental bylaws, permits, and other elements of site-specific plans.

.2 Contractor after receipt of such notice, shall inform Contract Administrator of proposed corrective action and take such action to obtain the approval of Contract Administrator.

.1 Take action only after receipt of written approval by Contract Administrator.

.3 Contract Administrator will issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Bury rubbish and waste materials on site is nor permitted.

.3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

.4 Proceed with final cleaning upon completion and removal of surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

.1 Department of Justice Canada (Jus)

.1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.

.2 Perform Work in accordance with The Manitoba Building Code and the latest adopted National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.3 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code

.1 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.3 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: demolition of asbestos containing material (ACM) is hazardous to health. Stop work immediately when material encountered during demolition work has been noted as being ACM or may contain asbestos in the City asbestos database, see the Supplemental Material in Section 02^. Notify Contract Administrator.

.2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Contract Administrator.

.3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Contract Administrator.

1.4 BUILDING SMOKING ENVIRONMENT

.1 Smoking on Site is only permitted at designated locations.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Except as otherwise specified, Constructor shall apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:

.1 Regulatory requirements and fees in force on date of Bid submission, and

.2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 INSPECTION

.1 Allow Contract Administrator access to Work. If part of Work is in preparation at locations other than the Sites, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Contract Administrator instructions, or law of Place of Work.

.3 If Contractor covers or permits to be covered any Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 Contract Administrator will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such Work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

1.2 INDEPENDENT INSPECTION AGENCIES

.1 All material testing required to meet the Specifications is Quality Control (QC) Testing. All QC to be conducted by Contractor engaged certified material testing laboratory.

.2 Independent Inspection/Testing Agencies shall be engaged by the Contractor for purpose of inspecting and/or testing portions of Work as required by this Contract. Cost of such services and related items will be borne by the Contractor.

.3 Provide equipment required for executing inspection and testing by appointed agencies.

.4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.5 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Contract Administrator at no cost to the City. Pay costs for retesting and reinspection.

1.3 Access to Work

.1 Allow inspection/testing agencies access to Work.

.2 Co-operate to provide reasonable facilities for such access.

1.4 Procedures

.1 Notify appropriate agency and Contract Administrator 10 Business Days in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in Specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on Site. Provide sufficient space to store and cure test samples.

1.5 Rejected Work

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Contract Administrator as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Contract Administrator it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the City will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Contract Administrator in accordance with the General Conditions - Valuation of a Change in Work.

1.6 Reports

.1 Submit electronic copies of inspection and test reports to Contract Administrator.

.2 Provide copies to subcontractor, manufacturer, or fabricator of work or material being inspected or tested.

1.7 Tests and Mix Designs

.1 Furnish test results and mix designs as requested in Section 03 30 00 – Cast-In-Place Concrete.

.2 Furnish concrete mix designs as requested no less than 14 Calendar Days before pouring concrete.

.3 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Contract Administrator and may be authorized as recoverable.

1.8 Mill Tests

.1 Submit mill test certificates as requested.

2. PRODUCTS

2.1 Not Used

.1 Not Used.

3. EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 SUBMITTALS

.1 Submittals to be in accordance with Section 01 33 00 – Submittals.

.2 Submit Shop Drawings for hoarding structures and heating equipment.

.3 Shop drawing shall bear the stamp of qualified professional engineer registered in Manitoba as required.

1.2 INSTALLATION AND REMOVAL

.4 Provide temporary controls in order to execute Work expeditiously.

.5 Remove from site all such work after use.

1.3 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide as required by governing authorities and as indicated.

.3 Provide welding screens for on-site welding.

1.4 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

1.5 DUST TIGHT SCREENS

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers and finished areas of Work.

.2 Maintain and relocate protection until such work is complete.

1.6 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.7 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.8 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.10 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with the City and/or Contract Administrator locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

2. Products

2.1 Not Used

.1 Not Used.

3. Execution

.1 Not used.

END OF SECTION

1. GENERAL

1.1 REFERENCE STANDARDS

.1 Conform to the reference standards, in whole or in part as specifically requested in the Specifications.

.2 If there is question as to whether products or systems are in conformance with applicable standards, the City reserves right to have such products or systems tested to prove or disprove conformance.

.3 Cost for such testing will be borne by the City in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

.1 Materials incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout the site.

.3 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the City and/or Contract Administrator of such, in order that remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify the City and/or Contract Administrator at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the City reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.7 Remove and replace damaged products at the Contractor’s expense and to satisfaction of the City.

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

1.5 TRANSPORTATION

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

1.6 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in Specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Contract Administrator in writing, of conflicts between Specifications and manufacturer's instructions, so that Contract Administrator will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties.

1.8 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

.1 Conceal conduits, and wiring below grade and within the pole structure, except where indicated otherwise.

.2 Before installation inform Contract Administrator if there is interference. Install as directed by Contract Administrator.

1.10 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and electrical items indicated as approximate.

.2 Inform Contract Administrator of conflicting installation. Install as directed.

1.12 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected Specification section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

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

1.15 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

2. PRODUCTS

2.1 NOT USED

.1 Not Used.

3. EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste materials from Site at daily regularly scheduled times or as directed by Contract Administrator. Do not burn waste materials on Site.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 If required, provide on-site containers for collection of waste materials and debris. Do not allow waste material to accumulate on the Site.

.5 Dispose of waste materials and debris at designated dumping areas.

.6 Store volatile waste in covered metal containers and remove from premises at end of each working day.

.7 Provide adequate ventilation during use of volatile or noxious substances. Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.

1.2 Final Cleaning

.1 Upon attaining Substantial Performance, the Contractor shall remove any Plant and Material not required for the performance of the remaining Work. The Contractor shall also remove waste and debris other than that caused by the City or other contractors, and leave the Site and the Work clean and suitable for occupancy by the City unless otherwise specified. .

.2 Remove waste products and debris and leave the Site and the Work clean and suitable for occupancy.

.3 Total Performance shall not be considered to have been achieved until the Contractor has cleaned up the Site and has removed all Plant, surplus Material, waste and debris, other than that left by the City or other contractors..

.4 Remove stains, spots, marks, and dirt from electrical and mechanical fixtures.

.5 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.6 Remove debris and surplus materials from crawl areas and other accessible concealed space.

2. PRODUCTS

2.1 Not Used

.1 Not Used.

3. EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 SUBSTANTIAL PERFORMANCE

.1 Substantial Performance.in accordance with the Supplemental Conditions.

1.2 TOTAL PERFORMANCE

.1 Total Performance in accordance with the Supplemental Conditions.

1.3 WARRANTY

.1 Warranty in accordance with the Supplemental Conditions.

1.4 Final Cleaning

.1 Clean in accordance with Section 01 74 11- Cleaning.

2. PRODUCTS

.1 Not Used.

3. EXECUTION

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit four (4) final copies of operating and maintenance manuals in English to Contract Administrator two (2) weeks prior to Substantial Performance.

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.2 OPERATIONS AND MAINTENANCE MANUALS

.1 General

.1 Provide a complete set of Operation and Maintenance Manuals in accordance with this Section to furnish City staff with all the information required to operate and maintain the Work. The scope of the Operations and Maintenance Manuals shall address the complete Work.

.2 Ensure that all information is prepared in a cohesive manner.

.2 Coordination with the Training

.1 The training program shall be based on the Operation and Maintenance Manuals

.2 Prepare the Operations and Maintenance Manuals in conjunction with the training material.

.3 Incorporate lessons learned and feedback from the Training Program into the Operations and Maintenance Manual.

.3 Phasing

.1 The Operations and Maintenance Manual shall be prepared in draft and final submissions as follows:

.1 Draft Operations and Maintenance Manuals shall be provided prior to commencing commissioning activities.

.2 Provide electronic and two (2) hard copies of the draft complete set of each of the Operation and Maintenance Manuals. Electronic copies are to include the original format documents and the PDF format. Both in an editable format.

.3 Final Operations and Maintenance Manuals shall be provided prior to Substantial Performance.

.4 Provide the following for the following for the final copies:

.1 Two (2) electronic copies; and

.2 Four (4) hard copies of the complete set of each of the Operations and Maintenance Manuals

.4 Language

.1 Prepare all content in plain English.

.2 Write content assuming all the Work is complete. Do not refer to equipment as “new”, “existing” “old”, or other similar adjectives as they are not applicable from an operations and maintenance perspective.

.3 Prepare descriptive writing, which explains how something works, in the third person, active voice, indicative. For example: “The tank fills with water after the upstream valve is opened.”

.4 Prepare instructions, which command the reader to do something, in the second person, active voice and imperative. For example: ”After verifying the system pressure, open valve HV-M681A, located next to the pump.”

.5 Format

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm (8.5” x 11”) with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 The contents are to be printed as followed:

.1 configure all 219 x 279 mm (8.5” x 11”) pages to be double sided for printing;

.2 configure all 279 x 438 mm (11” x 17”) pages to be single sided for printing;

.3 begin each section on the front side of a page (odd-page number); and

.4 ensure electronic files are appropriately configured for double sided printing without manual intervention.

.7 Provide a tabbed fly-leaf for each separate systems, with typed description of the system and major component parts of equipment.

.8 Text: manufacturer's printed data or typewritten data.

.9 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text. Fold larger drawings to size of text pages.

.10 Provide digital PDF copies of all documentation organized same as the binder.

.11 Provide digital PDF copies of all As-Built drawings along with hardcopy.

.6 Contents

.1 The content of every manual shall include:

.1 cover and cover spine;

.2 title page;

.3 document revision and approval page;

.4 name, addresses and telephone numbers of Consultant and Contractor with name of responsible parties page;

.5 table of contents (covering the complete manual including all binders and appendices);

.6 table of tables;

.7 table of figures; and

.8 list of abbrevisions.

.9 Schedule of products and systems indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data.

.1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: refer to Section 01 79 00.13 - Demonstration and Training for Building Commissioning.

1.3 MARK UP DOCUMENTS AND SAMPLES

.1 Maintain record documents in clean, dry and legible condition.

.1 Do not use record documents for construction purposes.

.2 Keep record documents and samples available for inspection by Contract Administrator.

.3 For the mark-up documents record information on a set of Contract Drawings.

.4 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.5 Record information concurrently with construction progress.

.1 Do not conceal Work until required information is recorded.

.6 Contract Drawings and Shop Drawings: mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimensions and details.

.5 Changes made by Change Work Orders.

.6 Details not on original Contract Drawings.

.7 Referenced standards to related Shop Drawings and modifications.

.8 Routing and sizes of all pipes and wiring and conduit.

.9 Measure location of installed equipment

.7 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and Change Work Orders.

.8 Other Documents: maintain inspection certifications, field test records, manufacturer's certifications, required by individual specifications sections.

.9 Provide digital photos, if requested, for site records.

.10 Provide mark-up Documents to the Contract Administrator prior to Substantial Performance. Make changes to mark-up Documents as required by the Contract Adminstrator.

1.4 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's co-ordination drawings with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01 45 00- Quality Control and 01 91 13- General Commissioning (Cx) Requirements.

.15 Additional requirements: as specified in individual specification sections.

1.5 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

.1 Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional requirements: as specified in individual specifications sections.

1.6 MAINTENANCE MATERIALS

.1 Spare Parts:

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Maintenance Manual.

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

.2 Extra Stock Materials:

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Operation and Maintenance Manual.

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

.3 Special Tools:

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

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

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

.4 Receive and catalogue items.

.1 Submit inventory listing to Contract Administrator.

.2 Include approved listings in Operation and Maintenance Manual.

1.7 DELIVERY, STORAGE AND HANDLING

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

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

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

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

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

2. PRODUCTS

.1 Not Used.

3. EXECUTION

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 Administrative Requirements

.1 Complete the training for the operation and maintenance of equipment and systems to the City's personnel two weeks prior to date of Substantial Performance.

.2 The City: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Preparation:

.1 Verify conditions for demonstration and instructions comply with requirements.

.2 Verify designated personnel are present.

.3 Ensure equipment has been inspected and put into operation.

.4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning Requirements and equipment and systems are fully operational.

.4 Demonstration and Training:

.1 Demonstrate operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.

.2 Refer to Section 40 80 11 for Automation commissioning specification.

.3 Execute and provide the Training Plan to City personnel as outlined in this Section.

.4 Reference the Operations and Maintenance Manual during and throughout the training.

.5 Prepare and insert additional data in the Operations and Maintenance Manual when needed during instructions.

.5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:

.1 Outdoor air-cooled chiller, CHLR-M630 vendor package: 6 hours of instruction.

.2 Air handling units (AHU-M601 & AHU-M602), exhaust fans (EF-M6510, EF-M6520 & EF-M6530), associated devices, and associated automation: 4 hours of instruction.

.3 Outdoor air cooled chiller (CHLR-M630) and chilled water circulation pumps (P-M631 & P-M632) associated devices (FDR-M633, U-M634, V-M635) and automation: 4 hours of instruction.

.4 HVAC control panel (CP-M806): 4 hours of instruction.

.5 Electrical Upgrades: 4 hours.

1.2 Action and Informational Submittals

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

2. PRODUCTS

2.1 Not Used

.1 Not used.

3. EXECUTION

3.1 Training Program

.1 Scope

.1 The Contractor shall develop, implement, continuously update, and provide the City a training program for the upgrades to the HVAC system upgrades at the Hurst Regional Pumping Stations.

.2 The training program shall:

.1 be designed to comprehensively train plant staff;

.2 be carried out in accordance with standards, practices, methods and procedures that are to a good commercial standard, conforming to applicable law and exercising the standard of care, skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a qualified, skilled and experienced person supplying similar services for similar projects, in a timely, good and workmanlike manner such that plant staff may competently operate and maintain the systems;

.3 be tailored for the specific audience in each course;

.4 ensure that each course accommodates plant staff shift schedules by providing multiple sessions covering the same content if necessary;

.5 be designed to maximize the transfer of learning, utilizing appropriate training methodologies;

.6 contain both classroom and field training courses, organized in a format to most effectively train plant staff including the classroom portion should be 20 to 30 percent of training time and the field portion at least 70 to 80 percent of the training time, completed on the same day;

.7 include ample opportunities for participants to ask questions and have their questions answered;

.8 be based upon the Operation and Maintenance Manuals with complete consistency between the training and the Operation and Maintenance Manuals, including SOP (Safe Operating Procedures), SWP (Safe Work Procedures) and lock-out/tag-out procedures;

Note: SOPs and SWP to be completed on the City templates.

.9 incorporate feedback from the training into the Operation and Maintenance Manuals;

.10 include the provision of the services of factory trained specialists and equipment manufacturers to instruct plant staff in the operation and maintenance of all equipment and system components during classroom and field training;

.11 be scheduled and coordinated to not interfere with the operation and maintenance of the water treatment and distribution systems;

.12 ensure that all training sessions include demonstration of learning by the participants. Evaluation methods should reinforce learning, monitor progress, and provide feedback on progress. Assessment should be based on course objectives and implemented in accordance with item 3.1.11 - Training Feed Back Requirements; and

.13 ensure that all operations personnel and required plant staff have completed the required training, as set out in this Specification section prior to Total Performance.

.2 Training Plan

.1 The Contractor shall develop, implement, update, and provide a training plan document that will detail the implementation of the training program.

.2 The training plan will include for each course:

.1 course name;

.2 overall training strategies;

.3 detailed course description, including the specific Work components addressed in the course;

.4 planned duration;

.5 specific participant group to be trained;

.6 specific and measurable learning objectives that can be evaluated at the end of the session;

.7 format and implementation methodology; and

.8 participant evaluation methodology.

.3 The training plan will organize and sequence the courses.

.4 The training plan will include a training schedule forecasting the number, timing, and duration of each training session.

.5 The training participants shall complete classroom and field training for a given unit process prior to commencing training in a separate process area.

.6 The Contractor shall submit the training plan for review by the City's Training Coordinator, including all associated course lesson plans a minimum of 25 Business Days prior to the commencement of commissioning or training whichever is earlier.

.1 The City's Training coordinator has authority to determine if the training plan is adequate based the submitted documents and requirements for the operations and maintenance staff.

.3 Course Lesson Plans

.1 The Contractor shall develop for each course lesson plan a detailed description and plan of the training.

.2 Each course lesson plan shall be consistent with the training plant and provide a detailed description that includes:

.1 the requirements of item 3.1.2 – Training Plan, more fully developed and detailed;

.2 instructor(s), including the qualifications;

.3 recommended and minimum number of training sessions;

.4 recommended and maximum number of training participants within each training session;

.5 the training participant evaluation methodology;

.6 the requirements of item 3.1.12 – Training Material;

.7 identification of any applicable resources; and

.8 other supporting information as appropriate.

.3 For each training course, the Contractor shall submit the course lesson plan and have received comments from the Contract Administrator a minimum of 25 Business Days prior to the scheduled start of training.

.4 The Contractor shall:

.1 not proceed with a training course until the corresponding course lesson plan and been reviewed and accepted by the Contract Administrator, and

.2 ensure that the portions of the Operations and Maintenance Manuals applicable to each training course have been reviewed and accepted by the Contract Administrator prior to the associated course lesson plan being submitted.

.5 The Contract Administrator shall update each course lesson plan based upon the completed training and incorporate any changes made to the training. The revised course lesson plan shall be included with the training material.

.4 Training Schedule

.1 The Contractor shall prepare, provide, and update a schedule of all training activities.

.2 The training schedule shall include:

.1 course names;

.2 course session dates and duration, and

.3 participant groups to be trained.

.3 Integrate the training schedule with the Work Schedule.

.4 The training schedule shall be coordinated with the City to ensure the planned training session dates include sufficient flexibility to allow for availability of the plant staff. The Contractor shall plan for and acknowledge that the plant staff training will be interspersed between the plant staffs' regular daily duties.

.5 Each training session shall be a maximum duration of four (4) hours per day and limited to Business Days with following windows of time:

.1 8:00 a.m. to 12:00 p.m., with a 15 minute coffee break, and

.2 1:00 p.m. to 4:00 p.m., with a 15 minute coffee break.

.6 Regularly update the training schedule based on the availability of the plant staff.

.5 Training Participants and Groups

.1 The Contractor shall provide and implement the training program for the plant staff that will or may be required to operate and maintain the systems installed.

.2 The plant staff participants groups include:

.1 the mechanical maintenance group consisting of mechanics, millwrights, plumbers, and labourers;

.2 the electrical maintenance group;

.3 the instrumentation maintenance group; and

.4 the operations group which consists of day and shift operators and are responsible for the operations of the Regional Pump Stations.

.3 In addition, the following City personnel may attend and observe the training:

.1 W&W supervisors;

.2 W&W operations engineers;

.3 W&W SCADA analysts;

.4 W&W training coordinators; and

.5 the Project Manager and/or delegates of the Project Manager.

.6 Coordination with the City

.1 The Contractor shall coordinate with the Contract Administrator regarding dates and times for training sessions. All dates and times are subject to availability of plant staff.

.2 The Contractor shall provide all requests to schedule a training session a minimum of 15 Business Days prior to the planned session along with the course name and proposed Training Participant Groups such that the training session date can be confirmed 10 Business Days ahead of the planned session.

.3 All in class training sessions shall be held at the City of Winnipeg Drinking Water Treatment Plant's main boardroom, at the Hurst RPS, or both locations as determined by the City.

.4 Coordinate with the City as required to ensure all applicable plant staff are trained.

.5 Repeat the training session(s) for each group to allow for training of all plant staff. The minimum number of sessions for each group and associated constraints are identified in Table 1, with additional requirements as follows:

Training Participant Groups	Approximate Number of Personnel	Minimum Number of Classroom Sessions	Minimum Number of Field Sessions
Mechanical Maintenance	10	2	3
Electrical Maintenance	5	2	2
Instrumentation Maintenance	6	2	2
Operations Personnel	20	5	7

.7 Coordination between the Contract Administrator and the Contractor

.1 The Contract Administrator shall oversee the Contractor including suppliers, to ensure a comprehensive, cohesive training program is delivered.

.2 The training shall be provided by the Contractor, subcontractors and suppliers.

.8 Instructor Qualifications

.1 The Contractor shall provide instructor(s) for each course who:

.1 are experienced and qualified for the specific training course;

.2 have demonstrated prior experience in performing similar training; and

.3 have the appropriate instructional and articulate public speaking skills to communicate clearly to the Training Participants.

.2 The Contractor shall implement appropriate plans and procedures to address potential unavailability of an instructor while maintaining the quality of instruction.

.3 The Contractor shall ensure that instructors are familiar with the Work, including the Operation and Maintenance Manuals.

.9 Classroom Requirements

.1 The Contractor shall:

.1 use appropriate learning resource materials, including slides and drawings, to aid in training clarity and effectiveness;

.2 make available applicable reference materials where it will be beneficial for the training participants to reference the material covered during the training. For example, paper copies of SOPs and SWPs should be provided, if beneficial to the training objectives;

.3 ensure all practical components are provided to ensure that training participants are able to see and hear the training. Provide projectors and screens as required, that are easily viewable and readable by all training participants; and

.4 be responsible for any temporary networking or other associated computer and audio requirements to implement the training sessions.

.2 The Contractor shall structure the training to provide an interactive environment that promotes active participation. The instructor shall use discussion, questions, and activities as appropriate during each session to provide engagement, enhance learning and to verify that the information presented is being understood.

.10 Field Requirements

.1 Implement the training using the constructed systems, unless otherwise approved by the Contract Administrator;

.2 Provide field training sessions in a manner that all training participants can see and hear all demonstrations provided;

.3 Arrange for and require training participants to perform the demonstrated procedures, and

.4 Ensure all training is in accordance with SWPs and SOPs and include training on their application and use.

.11 Training Feedback Requirements

.1 At the end of each training session, provide each training participant with a “Training Participant Feedback Form”.

.2 Collect the forms and deliver to the City a copy of each Training Participant Feedback Form.

.3 Utilize feedback provided to update the training material and improve the training for subsequent sessions.

.12 Training Material

.1 The Contractor shall provide a copy of all training materials used in each classroom and field training course within the training program.

.2 The training material shall be provided in electronic native, editable file format and include the following:

.1 course lesson plans, refer to item 3.1.3;

.2 list of all course materials;

.3 classroom slide presentations in MS PowerPoint format;

.4 other audio/visual material;

.5 handouts; and

.6 speaking notes (as applicable).

.3 The training material shall be organized by course, with the material systematically arranged in a consistent manner.

.13 Training Records

.1 The Contractor shall provide to the Contract Administrator comprehensive training records indicating the specific training provided, along with the supporting documentation in accordance with the training program.

.2 The Contractor shall record all training participants for each training session on a training participant register.

.3 For each session the training record shall include:

.1 training participant registers; and

.2 training participant feedback forms.

.4 Organize the Training Records in a hierarchical manner by:

.1 area or general as applicable;

.2 training participant groups (e.g. Operations, Mechanical Maintenance, etc.) or general as applicable.

.5 The Contractor shall provide all training records in pdf file format.

.6 The Contractor shall submit all Training Records no later than 20 Business Days after commissioning or the completion of training whichever is later.

.14 Deliverables

.1 The Contractor shall provide all material used in the training to the City, including:

.1 the training plan in accordance with item 3.1.2;

.2 course lesson plans in accordance with item 3.1.3;

.3 training material in accordance with item 3.1.12; and

.4 training records in accordance with item 3.1.13.

.15 Completion of Training

.1 Upon completion of the requirements for each course in the Training Plan, the Contractor shall provide a completed and signed Declaration of Course Completion document to the Contract Administrator.

3.2 Training Content Requirements

.1 General

.1 The purpose of item 33.2 is to provide general guidance to the Contractor regarding the requirements of the Training Program. However, the indication of any specific training requirement in item 33.2 does not reduce or eliminate the requirement of the Contractor to provide comprehensive training in accordance with item 3.1.

.2 The training program shall address all aspects of the Work, including:

.1 overview of each process/utility and the process/utility flow diagrams;

.2 process/utility layout, including major equipment, including P&ID’s;

.3 process/mechanical equipment and systems;

.4 electrical equipment and systems;

.5 automation systems; and

.6 safety systems.

.3 The Contractor shall include the following in all training sessions as applicable:

.1 all activities covered by a SWP;

.2 all activities covered by a SOP;

.3 all activities covered by a lock-out/tag-out;

.4 changing the modes of operation of the systems;

.5 operating and/or monitoring the system remotely (from SCADA or an HMI); and

.6 operation of the system during fault/trouble/alarm conditions.

.4 Learning Requirements

.1 The trained personnel will be able to:

.1 operate the systems under occupied mode and emergency mode;

.2 restore the systems after an emergency event;

.3 troubleshoot and maintain all aspects of the mechanical/process, electrical, and automation systems; and

.4 place all components of the system in a safe, zero energy state.

.2 Specific Limitations

.1 Except as indicated elsewhere the following are not required to be included in the training program:

.1 civil maintenance, except any special considerations associated with working safely around electrical equipment;

.2 basic trade knowledge of a journeyman in the electrical group;

.3 basic trade knowledge of a journeyman in the mechanical group;

.4 basic calibration and maintenance procedures for instrumentation that are currently used within the water system facilities; and

.5 PLC programming other than specific application nuisances that would not be common knowledge to a programmer.

.3 Classroom Training

.1 The Contractor shall provide classroom training, which other than the overview course, shall be specific for each training participant group.

.2 The classroom training topics for all training participants shall at a minimum include:

.1 an overview of the process/utility/system, including the locations of equipment and alarms;

.2 the function of the process/utility/system in occupied mode and emergency mode;

.3 an overview of the SCADA interface and functionality in conjunction with the W&W SCADA Analysts;

.4 placing every component of the process/utilty/system in a safe, zero energy state with the appropriate safety provisions; and

.5 emergency procedures.

.3 For the operation personnel in addition to the requirements of item 3.2.3.2 include at a minimum:

.1 an overview of the Operations and Maintenance Manuals as they are applicable;

.2 the required equipment exercise procedures and intervals;

.3 the start-up, shutdown, occupancy operation, and emergency procedures; and

.4 any routine inspection procedures.

.4 For the mechanical maintenance personnel in addition to the requirements of item 3.2.3.2 include at a minimum:

.1 an overview of the Operations and Maintenance Manuals as they are applicable;

.2 the start-up, shutdown, occupancy operation, and emergency procedures, including system integration and interlocks, if any;

.3 any routine inspection and troubleshooting procedures of specific equipment trouble symptoms;

.4 routine inspection and troubleshooting procedures for the purposes of predictive maintenance;

.5 routine preventive maintenance, including applicable specific details on lubrication, maintenance of corrosion protection of the equipment, and ancillary components and the use of special tools;

.6 safety features and procedures related to the maintenance of the equipment, referencing and utilizing specific SWP;

.7 the required equipment exercise procedures and intervals; and

.8 disassembly and assembly of equipment, if applicable, for purposes such as routine inspection or maintenance of the equipment.

.5 For the electrical maintenance personnel in addition to the requirements of item 3.2.3.2 include at a minimum:

.1 an overview of the Operations and Maintenance Manuals as they are applicable;

.2 the configuration of the upgraded distribution system with a detailed understanding of the single line diagram;

.3 locations of all electrical equipment, as required;

.4 manual and automatic switching procedures, as they relate to electrical;

.5 routine preventative maintenance;

.6 identification and brief description of recommended predictive maintenance;

.7 any equipment and troubleshooting procedures,

.8 safety features and procedures related to the maintenance of the equipment, referencing and utilizing specific SWP;

.9 understanding of the arc flash mitigation systems, arc flash identification, and protective equipment selection;

.10 understanding and troubleshooting of electrical interlocks;

.11 the start-up, shutdown, occupancy operation, and emergency procedures, including system integration and interlocks, if any;

.12 black start procedures, if any; and

.13 the required equipment exercise procedures and intervals.

.6 For the automation maintenance personnel in addition to the requirements of item 3.2.3.2 include at a minimum (in conjunction with the Contract Administrator as applicable):

.1 an overview of the Operations and Maintenance Manuals as they are applicable;

.2 locations of all automation devices, including networking;

.3 overview of the configuration/reconfiguration of the PLC systems, including which component or PLC processes various functions;

.4 basic theory of the system, equipment and communication between the components;

.5 troubleshooting and identification of issues;

.6 identification of and general procedures for routine preventive maintenance;

.7 equipment inspection and troubleshooting procedures;

.8 safety features and procedures related to the maintenance of the equipment, referencing and utilizing specific SWP;

.9 overview of the configuration of the historian system, as applicable; and

.10 overview of the configuration of any HMI systems, in conjunction with the W&W SCADA Analysts.

.4 Field Training

.1 The Contractor shall provide field training, which shall be specific for each training participant group.

.2 The field training topics for all Training Participants, tailored specific to each training participant group, shall include at minimum the:

.1 overview of the systems, including locations of specific equipment;

.2 demonstration of routine inspections and round checks, including the reading of gauges;

.3 demonstration of SOPs;

.4 equipment / system operation including alarms;

.5 demonstration of start-up and shutdown procedures;

.6 demonstration of the required equipment exercise procedures;

.7 placing every component of the Work in a safe, zero energy state with appropriate safety provisions, including barriers and grounding and in accordance with the SWPs; and

.8 demonstration of the use of all special tools and equipment.

.3 In addition to the requirements of item 3.2.4.2, the field training topics for Operations personnel shall include at minimum the identifying and reviewing safety items and demonstration of SWPs applicable to Operations personnel;

.4 In addition to the requirements of item 3.2.4.2, the field training topics for mechanical Maintenance personnel shall include at minimum the:

.1 identification of all equipment and instrumentation, including discussing the purpose, basic operation, and interpretation of any indicators or readouts;

.2 demonstration of the required equipment exercise procedures;

.3 identification and review safety items and demonstration of SWPs applicable to Maintenance personnel;

.4 troubleshooting of equipment problems;

.5 performing of routine maintenance procedures, including the routine disassembly and assembly of equipment, as applicable; and

.6 performing of repair procedures.

.5 In addition to the requirements of item 3.2.4.4.2, the field training topics for electrical Maintenance personnel shall include at minimum the:

.1 identification of all equipment and instrumentation, including discussing the purpose, basic operation, and interpretation of any indicators or readouts;

.2 performing of switching procedures;

.3 identification and review of safety items and demonstration of SWP applicable to the electrical Maintenance personnel;

.4 racking of breakers (low voltage);

.5 key and electrical interlock systems, as applicable;

.6 performing of preventive maintenance activities;

.7 troubleshooting of equipment problems;

.8 detection, without test instruments, of specific equipment trouble symptoms utilizing senses, including visual, audible, smell and touch cues;

.9 adjustment of protection settings (but not programming);

.10 replacement of protection relays, including loading of protection settings;

.11 performing of maintenance procedures, including the routine disassembly and assembly of equipment, as applicable;

.12 routine predictive and preventive maintenance requirements; and

.13 performing of repair procedures.

.6 In addition to the requirements of item 3.2.4.4.2, the field training topics for the automation Maintenance personnel shall include at a minimum the:

.1 identification of all automation equipment, including discussing the purpose, basic operation, and interpretation of any indicators or readouts;

.2 identifying and reviewing of safety items and demonstration of SWPs applicable to the automation Maintenance personnel;

.3 calibration and maintenance of instrumentation that is new and unique to the installation;

.4 replacement of PLC modules and other automation components;

.5 software programming of PLC systems in conjunction with the Contract Administator; and

.6 setup and configuration of any HMI operator workstations or interfaces in conjunction with the W&W SCADA Analysts.

3.3 Training Completion

.1 General

.1 The Contractor shall perform the training in accordance with the training program and to the satisfaction of the Contract Administrator. The Contract Administrator and the City may provide feedback, which shall be incorporated into subsequent training sessions or require repeat of one or more training sessions to address training quality issues.

.2 All training criteria shall be interpreted in accordance with the Contract as determined by the Contract Administrator.

.2 Training Completion

.1 The training is considered complete if the following has been carried out to the satisfaction of the City.

.2 Plant staff have been fully trained, and such training is in accordance with the training plan, the course lesson plans and this Section.

.3 The Contract Administrator has issued correspondence that indicates the acceptance of all the final associated training material and training records that have been submitted by the Contractor.

END OF SECTION

1. GENERAL

1.1 SUMMARY

.1 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.

.2 BMM - Building Management Manual.

.3 Cx - Commissioning.

.4 EMCS - Energy Monitoring and Control Systems.

.5 O&M - Operation and Maintenance.

.6 PI - Product Information.

.7 PV - Performance Verification.

.8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

.1 The chiller and associated systems are highly essential to maintain the uninterrupted operation of the facility which forms part of the City's Critical Infrastructure. Parallel operating of the new installation with the existing chiller systems is not possible. After the shutdown of the existing chiller/cooling tower at the end of the cooling season the new chiller system shall be functional and able to operate under the full system load for the facility at the start of the next cooling season and prior to the completion of commissioning.

.2 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Work. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the O&M manuals.

.3 Effectively train the City O&M staff.

.3 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments to be made to enhance performance to meet environmental or City requirements.

.4 Design Criteria: as per City's requirements or determined by designer. To meet the functional and operational requirements and Contract Documents.

1.3 COMMISSIONING OVERVIEW

.1 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.

.2 Cx to be a line item of Contractor's cost breakdown on Form B: Prices.

.3 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the chilled water system is installed and proven to operate satisfactorily under various cooling load conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.5 Prior to Substantial Performance:

.1 Completed Cx documentation shall be reviewed and accepted by the Contract Administrator.

.2 Equipment, components and systems and integrated systems shall be fully commissioned and functional as per the design intent to meet project functional and operational requirements.

.3 O&M Training sessions shall be completed.

.4 Final O&M and Training Manual shall be reviewed and accepted by the Contract Administrator.

.5 Successfully complete integrated system tests, and meet all requirements of the Authority Having Jurisdiction.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Contract Administrator, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions.

1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review Contract Documents, confirm by writing to Contract Administrator.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Contract Administrator.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Contract Administrator for review and approval.

.10 Ensure "As-Built" system P&IDs are available.

.4 Inform Contract Administrator in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Contract Administrator before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit no later than 4 weeks after award of Contract:

.1 Draft Contractor Cx plan.

.2 Preliminary Cx schedule.

.2 Request in writing to Contract Administrator for changes to submittals and obtain written approval at least 40 Business Days prior to start of Cx.

.3 Submit proposed Cx procedures to Contract Administrator where not specified and obtain written approval at least 40 Business Days prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Contract Administrator.

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.

.2 Contract Administrator to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to the City.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

.3 The Cx schedule shall reflect Critical Dates indicated in the Tender's Section D – Supplemental Conditions.

1.10 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage, Contract Administrator to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Contract Administrator, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

.1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide 10 Business Days' notice prior to commencement.

.2 Contract Administrator to witness of start-up and testing.

.3 Contractor's Cx Representative to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

.1 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Contract Administrator

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.2 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

1.14 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual inspection of quality of installation.

.2 Start-up: follow accepted start-up procedures.

.3 Operational testing: document equipment performance.

.4 System PV: include repetition of tests after correcting deficiencies.

.5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from Contract Administrator after distinct phases have been completed and before commencing next phase.

.4 Document require tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Contract Administrator. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Contract Administrator.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Contract Administrator.

.3 If evaluation report concludes that major damage has occurred, Contract Administrator shall reject equipment.

.1 Rejected equipment to be remove from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Contract Administrator for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Pre-start-up inspection reports.

.2 Signed installation/start-up check lists.

.3 Start-up reports,

.4 Step-by-step description of complete start-up procedures, to permit the City to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit to Contract Administrator for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

.1 Notify the City and Contract Administrator at least 15 Business Days prior to start of Cx.

.2 Start Cx after performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Contract Administrator for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under normal operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

1.21 WITNESSING COMMISSIONING

.1 Contract Administrator to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to the Contract Administrator within 5 Business Days of test and with Cx report.

.4 Authority Having Jurisdiction includes, but is not limited to, Manitoba Hydro, Manitoba Office of the Fire Commissioner, the City Planning and Property Development.

1.23 COMMISSIONING CONSTRAINTS

.1 Test chiller and associated systems under design conditions or simulated design conditions.

.2 Commissioning activities shall be coordinated with the Contract Administrator’s PLC programmer and the City’s SCADA Analyst. All PLC programming and SCADA interfaces to be completed prior to the start of Cx activities. Coordinate all tests with the Automation subtrade.

1.24 EXTENT OF VERIFICATION

.1 Number and location to be at discretion of Contract Administrator.

.2 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.3 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.4 Perform additional commissioning until results are acceptable to the Contract Administrator.

1.25 REPEAT VERIFICATIONS

.1 Assume costs incurred by Contract Administrator for third and subsequent verifications where:

.1 Verification of reported results fail to receive Contract Administrator's approval.

.2 Repetition of second verification again fails to receive approval.

.3 Contract Administrator deems Contractor's request for second verification was premature.

1.26 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.27 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Contract Administrator.

.2 Report problems, faults or defects affecting Cx to Contract Administrator in writing. Stop Cx until problems are rectified. Proceed with written approval from Contract Administrator.

1.28 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to Substantial Performance.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by the Contract Administrator.

1.29 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated O&M manual documents and Cx form for affected item.

1.30 TRAINING

.1 In accordance with Section 01 79 00 - Demonstration and Training for Building Commissioning.

1.31 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.32 OCCUPANCY

.1 Cooperate fully with the City during stages of acceptance and occupancy of facility.

1.33 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Contract Administrator.

.2 Calibrated system sensors may be used to obtain performance data provided that sensor calibration has been completed within the timeframe indicated by the manufacturer and accepted by the Contract Administrator.

1.34 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.35 CITY'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by the City will not relieve Contractor from compliance with specified start-up and testing procedures.

2. PRODUCTS

2.1 NOT USED

.1 Not Used.

3. Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 Reference Standards

.1 CSA-Z320-11 – Building Commissioning Standard.

.2 ANSI/ASHRAE/IES Standard 202-2018 – Commissioning Process for Buildings and Systems.

1.2 General

.1 Provide new fully functional chiller system, automation system and upgrades to the associated systems for the W.D. Hurst Regional Pumping Station.

.1 Systems, equipment and components meet user's functional requirements before Substantial Performance and operate consistently.

.2 City O&M personnel have been fully trained in aspects of installed systems.

.3 Optimized for life cycle costs.

.4 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:

.1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.

.2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to O&M, process and administration of Cx.

.4 Describes process of verification of how built works meet the City’s design requirements.

.5 Produces a complete functional system prior to issuance of Substantial Performance.

.6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 Overview of Cx.

.2 General description of elements that make up Cx Plan.

.3 Process and methodology for successful Cx.

.4 Definitions:

.1 “**Cx**” means Commissioning.

.2 “**BMM**” means Building Management Manual.

.3 “**PLC System**” - Programmable Logic Control system used tomonitor and control the facility ambient cooling systems.

.4 “**SDS**” means WHMIS Safety Data Sheets.

.5 “**PI**” means - Product Information.

.6 "**PV**" means Performance Verification.

.7 "**TAB**" means Testing, Adjusting and Balancing.

.8 "**WHMIS**" means Workplace Hazardous Materials Information System.

.9 "**O&M**" means Operation and Maintenance.

.5 Commissioning terms used in this Section:

.1 Bumping: short term start-up to prove ability to start and prove correct rotation.

.2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.2 DEVELOPMENT OF 100% Cx PLAN

.1 Cx Plan to be 100% completed within 40 Business Days of award of Contract to take into account:

.1 Approved shop drawings and product data.

.2 Changes to the documents during the Tender.

.3 Contractor's Work schedule.

.4 Cx schedule.

.5 Contractor's, sub-contractor's, suppliers' requirements.

.6 Contract Administrator's requirements.

.2 Submit completed Cx Plan to Contract Administrator and obtain written approval.

1.3 REFINEMENT OF Cx PLAN

.1 During construction phase, revise, refine and update Cx Plan to include approved Contract changes.

.2 Revise, refine and update monthly by the seventh day of that month during construction phase. At each revision, indicate revision number and date.

.3 Each revised submission to be reviewed and accepted by the Contract Administrator. Revise the Cx Plan per the Contract Administrators requirements.

.4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.4 COMPOSITION, ROLES AND RESPONSIBILITIES OF Cx TEAM

.1 Contract Administrator to maintain overall responsibility for the Work and is sole point of contact between members of commissioning team.

.2 Contract Administrator will select Cx Team consisting of following members:

.1 Resident and non-resident contract administrators: during construction, will conduct periodic site reviews to observe general progress.

.2 Contract Administrator Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:

.1 Review of Cx documentation from operational perspective.

.2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.

.3 Protection of health, safety and comfort of occupants and O&M personnel.

.4 Monitoring of Cx activities, training, development of Cx documentation.

.5 Work closely with members of Cx Team.

.3 Contract Administrator is responsible for:

.1 Organizing Cx.

.2 Monitoring operations Cx activities.

.3 Witnessing, certifying accuracy of reported results.

.4 Witnessing and certifying TAB and other tests.

.5 Ensuring implementation of final Cx Plan.

.6 Performing verification of performance of installed systems and equipment.

.7 Automation systems PLC programming, documentation, and changes

.8 Review of Training Plan.

.4 Construction Team: contractor, subcontractors, suppliers and support disciplines, is responsible for construction/installation in accordance with Contract Documents, including:

.1 Testing.

.2 TAB.

.3 Performance of Cx activities.

.4 Delivery of training and Cx documentation.

.5 Developing BMM.

.6 Assigning one person as point of contact with Contract Administrator for administrative and coordination purposes.

.5 City Team: O&M staff:

.1 to support shutdowns.

.2 SCADA interface upgrades and operation.

1.5 CX PARTICIPANTS

.1 Employ the following Cx participants to verify performance of equipment and systems:

.1 Installation contractor/subcontractor:

.1 Equipment and systems except as noted.

.2 Ensure that Cx participant:

.1 Could complete work within scheduled time frame.

.2 Available for emergency and troubleshooting service in accordance with the warranty period for adjustments and modifications outside responsibility of O&M personnel.

.3 Provide names of participants to Contract Administrator and details of instruments and procedures to be followed for Cx within 60 Business Days prior to starting date of Cx for review and acceptance.

1.6 EXTENT OF CX

.1 Commission mechanical systems and equipment:

.1 New mechanical:

.1 Outdoor air-cooled chiller

.2 Chilled water circulation pumps

.3 Glycol fill station

.4 New piping (glycol, venting)

.5 Mechanical accessories (valve, thermometers)

.6 Air system upgrades

.2 Commission electrical systems and equipment:

.1 Connections to new mechanical systems.

.3 Commission automation systems and devices:

.1 For the integration of mechanical Work

1.7 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation.

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Standard Operating Procedures (SOP) using the City Water Services format.

.2 Preventative maintenance program.

.3 Contractor’s and Sub-Contractors’ as built drawings, including a site survey locating all installed equipment and buried electrical and automation conductors.

.4 Warranties.

.5 Project record documentation.

.6 Inventory of spare parts, special tools and maintenance materials.

.7 Maintenance Management System (MMS) identification system used.

.8 WHMIS information.

.9 SDS.

1.8 DELIVERABLES RELATING TO THE Cx PROCESS

.1 General:

.1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

.2 Definitions:

.1 Cx as used in this section includes:

.1 Cx of components, equipment, systems, subsystems, and integrated systems.

.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

.1 Startup, pre-Cx activities and documentation for systems, and equipment.

.2 Completed installation checklists (ICL).

.3 Completed product information (PI) report forms.

.4 Completed performance verification (PV) report forms.

.5 Results of Performance Verification Tests and Inspections.

.6 Description of Cx activities and documentation.

.7 Description of Cx of integrated systems and documentation.

.8 Tests witnessed by Contract Administrator

.9 Tests performed by City.

.10 Training Plans.

.11 Cx Reports.

.12 Prescribed activities during warranty period.

.4 Contract Administrator to witness and certify tests and reports of results provided to the City.

.5 Contract Administrator to participate.

1.9 PRE-Cx ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:

.1 Pre-Start-Up inspections: by Contract Administrator prior to permission to start up and rectification of deficiencies to Contract Administrator's satisfaction.

.2 Contract Administrator to use approved check lists.

.3 Contract Administrator will monitor some of these pre-start-up inspections.

.4 Include completed documentation with Cx report.

.5 Conduct pre-start-up tests. To be witnessed and certified by Contract Administrator and does not form part of Cx specifications.

.6 Contract Administrator will monitor some of these inspections and tests.

.7 Include completed documentation in Cx report.

.2 Pre-Cx activities - Mechanical:

.1 Pre-Start-Up inspections: by Contract Administrator prior to permission to start up and rectification of deficiencies to Contract Administrator's satisfaction.

.2 Contract Administrator will monitor some of these pre-start-up inspections.

.3 Include completed documentation with Cx report.

.4 Conduct pre-functional tests. Complete PV forms as pre-functional test prior to formal PVs.

.5 Contract Administrator will monitor some of these inspections and tests.

.6 Include completed documentation in Cx report.

.3 Pre-Cx activities – Electrical:

.1 Refer to Section 26 08 05.

.4 Pre-Cx activities – Automation:

.1 Refer to Section 40 80 11.

1.10 START-UP

.1 Startup components, equipment and systems.

.2 Installing contractor / sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:

.1 Outdoor air-cooled chiller, CHLR-M630.

.2 Chilled water circulation pumps, P-M631 & P-M632.

.3 Air Handling units: AHU-M601 & AHU-M602

.4 Exhaust fans: EF-M6510, EF-M6520 & EF-M6530

.5 Glycol fill station: FDR-M633

.6 HVAC control panel: CP-M806

.3 Contract Administrator to monitor some or all of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of Contract Administrator.

.4 Performance Verification (PV):

.1 Contractor to perform.

.1 Repeat when necessary until results are acceptable to Contract Administrator.

.2 Use procedures modified to suit project requirements.

.3 Contract Administrator to witness and certify reported results using approved PI and PV forms.

.4 Contract Administrator to approve completed PV reports and provide to the City.

.5 Contract Administrator reserves right to verify up to 30% of reported results at random.

.6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.11 Cx ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx using procedures developed by Contract Administrator and approved by Contract Administrator.

.2 Contract Administrator to monitor Cx activities.

.3 Contract Administrator to witness, certify reported results of, Cx activities and forward to the City.

.4 The Contract Administrator reserves right to verify a percentage of reported results at no cost to contract.

1.12 Cx OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed using procedures developed by Contract Administrator and approved by Contract Administrator.

.2 Tests to be witnessed by Contract Administrator and documented on approved report forms.

.3 Upon satisfactory completion, prepare Cx Report and submitted to Contract Administrator for review.

.4 The Contract Administrator reserves right to verify percentage of reported results.

.5 Integrated systems to include:

.1 Refer to Section 40 94 43 and 40 80 11.

1.13 INSTALLATION CHECK LISTS (ICL)

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.14 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.15 PERFORMANCE VERIFICATION (PV) REPORT

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.16 Cx SCHEDULES

.1 Prepare detailed critical path Cx Schedule and submit to Contract Administrator for review and approval same time as project Construction Schedule. Include:

.1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:

.1 Design criteria, design intents.

.2 Cx procedures: 60 Business Days after Contract award.

.3 Cx Report format: 60 Business Days after Contract award.

.4 Submission of list of Cx testing instrumentation with relevant certificates: 15 Business Days before start of Cx.

.5 Notification of intention to start Cx: 15 Business Days before start of Cx.

.6 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 10 Business Days before start of integrated system Cx.

.7 Identification of deferred Cx.

.8 Implementation of training plans.

.9 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to City.

.3 Cx schedule for verification of performance in all seasons and wear conditions.

.2 After approval, incorporate Cx Schedule into Work schedule.

.3 Contractor and Contract Administrator will monitor progress of Cx against this schedule.

1.17 Cx REPORTS

.1 Submit reports of tests, witnessed and certified by Contract Administrator to Contract Administrator who will verify reported results.

.2 Include completed and certified PV reports in properly formatted Cx Reports.

.3 Before reports are accepted, reported results to be subject to verification by Contract Administrator.

1.18 TESTS TO BE PERFORMED BY CITY

.1 SCADA interface testing will be completed by the City.

1.19 TRAINING PLANS

.1 Refer to Section 01 79 00.13 - Demonstration and Training for Building Commissioning.

1.20 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of the Contract Administrator, lock control devices in their final positions and document settings in Cx Reports.

2. PRODUCTS

2.1 NOT USED

.1 Not Used.

3. EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

1. GENERAL

1.1 SUBMITTALS

.1 Form 100: Certificate of Equipment Delivery

.2 Product Information Report Forms

.3 Form 102: Certificate of Satisfactory Installation

.4 Installation Start-up Checklists

.5 Form 103: Certificate of Equipment Satisfactory Performance

.6 Functional Test Results

.7 For 104: Certificate of Satisfactory Performance

.8 Performance Test Reports

1.2 EQUIPMENT DELIVERY

.1 The Contractor shall be responsible for receiving, off-loading, and placing into storage all equipment at the Site. Certificate of Equipment Delivery (Form 100), a copy of which is attached to this Section, shall be completed.

1.3 INSTALLATION/START-UP CHECK LISTS

.1 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Contract Administrator supplemental additional data lists will be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Contract Administrator with the Certificate of Satisfactory Installation (Form 102). Check lists will be required during Commissioning and will be included in the final commissioning report at completion of project.

1.4 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Contract Administrator’s approval.

1.5 PERFORMANCE VERIFICATION (PV) FORMS

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain Contract Administrator's approval.

1.6 SAMPLES OF COMMISSIONING FORMS

.1 Contract Administrator will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.

.2 Revise items on Commissioning forms to suit project requirements.

.3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.7 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required but are not available from Contract Administrator, develop appropriate verification forms and submit to Contract Administrator for approval prior to use.

.1 Additional commissioning forms to be in same format as provided by Contract Administrator.

1.8 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Contract Administrator provides Contractor project-specific Commissioning forms with Specification data included.

.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.3 Confirm operation as per design criteria and intent.

.4 Identify variances between design and operation and reasons for variances.

.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Verify reported results.

.8 Form to bear signatures of recording technician and reviewed and signed off by Contract Administrator.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Provide Contract Administrator with originals of completed forms.

.12 Maintain copy on site during start-up, testing and commissioning period.

.13 Forms to be both hard copy and electronic format with typed written results in Operations and Maintenance manuals and final commissioning report.

1.9 LANGUAGE

.1 To suit the language profile of the awarded contract.

2. PRODUCTS

2.1 NOT USED

.1 Not Used.

3. EXECUTION

3.1 SUPPLEMENTS

.1 The supplements listed below, following “End of Section”, are part of this Specification.

- .1 Form 100: Certificate of Equipment Delivery
- .2 Form 102: Certificate of Satisfactory Installation
- .3 Form 103: Certificate of Equipment Satisfactory Performance
- .4 Form 104: Certificate of Satisfactory Process Performance

END OF SECTION

Water and Waste Department • Service des eaux et des déchets

Form 100
CERTIFICATE OF EQUIPMENT DELIVERY

1. We certify that the equipment listed below has been delivered into the care and custody of the Installation Contractor. The equipment has been found to be in satisfactory condition. There is no visible evidence of exterior damage or defects.

Project: Chiller Replacement – Hurst Regional Pumping Station
Equipment Description:
Equipment Supply Tender No.:
Equipment Install Tender No.:
Equipment Tag No.:
Specification Reference:

Print Name	Signature	Date
(Authorized Representative of City)		
Print Name	Signature	Date
(Authorized Representative of Contractor)		
Print Name	Signature	Date
(Authorized Representative of Contract Administrator)		

Water and Waste Department • Service des eaux et des déchets

Form 102
CERTIFICATE OF SATISFACTORY INSTALLATION

We have completed our checks and inspection of the installation of our equipment as listed below and confirm that it is satisfactory and that any defects have been remedied except any as noted below.

Project: Chiller Replacement – Hurst Regional Pumping Station
Equipment Description:
Equipment Supply Tender No.:
Equipment Install Tender No.:
Equipment Tag No.:
Specification Reference:
Outstanding Defects:

Print Name	Signature	Date
(Authorized Representative of City)		

Print Name	Signature	Date
(Authorized Representative of Contractor)		

Water and Waste Department • Service des eaux et des déchets

Form 103
CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE

We certify that the equipment listed below has been continuously operated for a minimum of one (1) day and that the equipment operates satisfactorily and meets it's specified operating criteria. No defects in the equipment were found and as such are classified as "conforming".

Project: Chiller Replacement – Hurst Regional Pumping Station
Equipment Description:
Equipment Supply Tender No.:
Equipment Install Tender No.:
Equipment Tag No.:
Specification Reference:

Print Name	Signature	Date
(Authorized Representative of City)		
Print Name	Signature	Date
(Authorized Representative of Contractor)		
Print Name	Signature	Date
(Authorized Representative of Contract Administrator)		

Water and Waste Department • Service des eaux et des déchets

Form 104
CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE

We certify that the process/utility system listed below has been continuously operated and tested as per the Specifications and that the equipment meets its Performance Testing and Operating Criteria. No defects in the process system were found and as such are classified as "conforming".

Project:	Chiller Replacement – Hurst Regional Pumping Station
System Description:	Pump Station Chilled Water and Ventilation System
Equipment Supply Tender. No.:	
Equipment Install Tender No.:	
Equipment Tag No.:	
Specification Reference:	

Print Name _____ Signature _____ Date _____
(Authorized Representative of City)

Print Name _____ Signature _____ Date _____
(Authorized Representative of Contractor)

Print Name _____ Signature _____ Date _____
(Authorized Representative of Contract Administrator
i.e. Commissioning Lead or Design Discipline Lead)

Chiller Replacement Component Verification Form

Hurst Regional Pumping Station
City of Winnipeg

Unit Tag:
Equipment Type: Chiller (Air Cooled)
System:
Location:
Area Serviced:

This box for IDI use only.

Form Auditted? YES ☐ NO ☐

CxA reviewer: _____

Contractor (include company and print name)	Signature	Date
Mechanical:		
Electrical:		
Controls:		
General:		

IDI Audit Verification

Nameplate Data	Submitted	Installed *note any changes*	Installer Verify	IDI Audit Verification
Manufacturer			☐	☐
Model			☐	☐
Refrigerant Type			☐	☐
Number of Compressors			☐	☐
Capacity (tons)			☐	☐
Input Power (kW)			☐	☐
Efficiency, EER (Btu/W.h)			☐	☐
Electrical (V/Ph/Hz)			☐	☐

Details/Notes:

Inspection Items	Comments	Installer Verify	IDI Audit Verification
General Installation & Cleanliness			
Equipment is clean and free of debris		☐	☐
Equipment is properly mounted and vibration isolation equipment is installed		☐	☐
Service hatches are not hindered by surrounding equipment		☐	☐
Piping Installation			
Piping layout matches drawings and associated components such as flow switches, isolation valves, manual vents are installed per contract documents		☐	☐
Piping is properly supported		☐	☐
Electrical Installation			
Wiring complete and electrical connections are tight		☐	☐
Local disconnects are installed and labelled		☐	☐
Verify that overload breakers are installed and sized correctly		☐	☐
Controls Installation			
Controls wiring complete and electical connections are tight		☐	☐
Control actuator and sensor locations match contract documents		☐	☐
Control actuators and sensors labelled per contract documents		☐	☐
Insulation & Labelling			
Thermal Insulation complete as per contract documents		☐	☐
Equipment is labelled		☐	☐
Piping is labelled per contract documents and direction of flow is indicated		☐	☐

Chiller Replacement – Hurst Regional Pumping Station - City of Winnipeg - Commissioning Issue Tracking Log

2022-07-21

Item #	Report ID	Date	Item Description	Action	Responsibility	Action Taken	Status
ID_1.01	CxR#1						
ID_1.02	CxR#1						
ID_2.01	CxR#2						
ID_2.02	CxR#2						

1. GENERAL

1.1 Reference Standards

.1 Canadian Standards Association (CSA)

.1 CSA S350, Code of Practice for Safety in Demolition of Structures.

.2 CSA Z797, Code of Practice for Access Scaffold.

.3 ASTM C612, Standard Specification for Mineral Fibre Block and Board Thermal.

.2 Department of Justice (Jus)

.1 Canadian Environmental Assessment Act (CEAA).

.2 Canadian Environmental Protection Act (CEPA).

.3 National Fire Protection Association (NFPA)

.1 NFPA 241-13, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

.4 National Research Council Canada (NRC)

.1 National Building Code of Canada (NBC).

1.2 Submittals

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide the following submittals before start any work of this Section:

.1 Schedule of demolition activities.

.1 When preparing the schedule of demolition activities, the following shall be considered:

.1 Coordination with the City regarding ongoing Site operations. Limit the number of interruptions during regular business hours.

.2 Coordinate with the City for shutoff, capping, and continuation of utility services.

.3 Coordinate with the City regarding their continued occupancy of portions of the exiting building while demolition activities are taking place.

.2 The schedule of demolition activities shall indicate:

.1 Detailed sequence of demolition and removal work, with starting and ending dates for each activity.

.2 Interruption of utility services.

.2 Written demolition plan.

.1 The written demolition plan shall:

.1 Indicate the extend of temporary facilities and supports required. In the event where significant structural modifications are required, the demolition plan must be prepared by a qualified professional engineer registered and licensed in the province of Manitoba.

.2 Indicate the methods of removal and demolition.

.3 Indicate the locations of temporary partitions and means of egress to be used by all individuals.

1.3 Existing Conditions

.1 The City will occupy portions of the building immediately adjacent to selective demotion area:

.1 Conduct selective demolition to minimized disruptions to the City's operations.

.2 Obtain written approval from the Contact Administrator for any proposed disruptions.

.3 Provide not less than ten Calendar Days' notice to the Contractor Administrator of activities that will affect City operations.

.2 Maintain access to existing walkways, corridors, other adjacent occupied or used facilities, and as follows:

.1 Do not close or obstruct walkways, corridors, or other occupied or used facilities withouut written permission from the Contract Administrator.

.3 Should material resembling spray or trowel applied asbestos or any other designated substance be encountered in the course of demolition, stop the Work, take preventative measures, and notify the Contract Administrator immediately. Do not proceed until written instructions have been from the Contract Administrator.

.4 Salvage Materials identified by the Contract Administrator. Remove, protect, and store salvaged items as directed by the Contract Administrator. Deliver to the City as directed.

.5 Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

.6 Maintain fire protection, heating, ventilation, plumbing, and electrical in service during selective demolition operations.

2. PRODUCTS

2.1 Materials

.1 Design support components as required for demolition Work as necessary. In the event significant structural modifications are required, the Contractor shall provide demolition plans prepared by a qualified professional engineer registered and licensed in the province of Manitoba.

.1 Design, specifications, work procedures, or other records created for this Work to be submitted to the Contract Administrator for review prior to commencement of Work.

.2 Use repair Materials identical to existing materials:

.1 If identical Materials are unavailable or cannot be used for exposed surfaces, use Materials that visually match existing adjacent surfaces to the fullest extent possible.

.2 Use Materials whose installed performance equals or surpasses that of existing Materials.

.3 Comply with requirements specified in individual technical Specification sections.

3. EXECUTION

3.1 Examination

.1 Verify that utilities have been de-energized, disconnected, capped and locked-out-tagged-out.

.2 Survey existing conditions and correlate with requirements indicated to determine the extent of demolition required.

.3 Inventory and record the conditions of Material to be removed and reinstalled, and Materials to be removed and salvaged.

.4 When unanticipated mechanical, electrical, automation, or structural elements are encountered, investigate and measure the nature and extent of the element.

.5 Perform engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during demolition operations.

.6 Preform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 Utility Services

.1 Coordinate existing services to remain and protect them against damage during the selective demolition operations.

.2 Locate, identify, de-energize, disconnect, seal or cap off, and lock-out-tag-out utilities serving systems to be selectively demolished.

.1 Arrange to shut off affected utilities with utility companies or the City, as applicable.

.2 If utility services are required to be removed, relocated, or abandoned before proceeding with selective demolition, provide temporary utilities that bypass the selective demolition and that maintain continuity of service to other parts of building.

.3 Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

.4 Coordinate with associated subtrades for shutting off, disconnecting, removing, and sealing or capping utilities.

.5 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 Preparation

.1 Conduct selective demolition and debris removal operations to ensure minimum interference with roads, parking areas, walks, walkways, and other adjacent occupied and used facilities:

.1 Do not close or obstruct roads, parking areas, walks, walkways, or other adjacent occupied or used facilities without permission from the Contract Administrator. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

.2 Erect temporary protection such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

.3 Protect existing site improvements, appurtenances, and landscaping to remain.

.2 Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain in accordance with Specification Section 01 56 00 – Temporary Barriers and Enclosures, and as follows:

.1 Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

.2 Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

.3 Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

.4 Cover and protect furniture, furnishings, and equipment that have not been removed.

.3 Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities in accordance with Specification Section 01 56 00 - Temporary Barriers and Enclosures.

.1 Provide temporary weather tight enclosure for building exterior.

.2 Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures.

.3 Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

.4 Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

.5 Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

.6 Provide temporary power via genset or other temporary means for power requirements.

.7 Strengthen or add new supports when required during progress of selective demolition

3.4 Pollution Controls

.1 Provide temporary enclosures or other suitable methods reviewed and accepted by the Contract Administrator to limit spread of dust and dirt. Comply with governing environmental protection regulations and as limited below:

.1 Do not use water when it may damage existing construction or create hazardous or objectionable conditions such as ice, flooding, and pollution.

.2 Wet mop floors to eliminate tracking of dirt, wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

.2 Remove debris to prevent spillage on adjacent surfaces and areas.

.3 Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

.4 Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 Selective Demolition

.1 Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

.1 Proceed with selective demolition systematically.

.2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

.3 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

.4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain fire watch and portable fire suppression devices during flame cutting operations.

.1 A hot work permit is required to be completed by the Contractor and submitted to the Contract Administrator for review for hot works such as welding, cutting, or open flames or sparks, prior to the commencement of such work each day.

.5 Maintain adequate ventilation when using cutting torches.

.6 Remove decayed, vermin infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-Site.

.7 Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

.8 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

.9 Dispose of demolished items and materials promptly.

.10 Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

.2 Comply with the Contract Administrator's requirements for using and protecting stairs, walkways, facility unloading areas, building entries, and other building facilities during selective demolition operations.

.3 Existing Material to remain:

.1 Protect construction indicated to remain against damage and soiling during selective demolition.

.2 Materials may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

.4 Concrete:

.1 Demolish in small sections.

.2 Cut concrete full depth at junctures with construction to remain and at regular intervals, using power driven saw, then remove concrete between saw cuts.

.3 Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition.

.4 Neatly trim openings to dimensions indicated.

.5 Scanning, Cutting and Coring Concrete and Masonry:

.1 Locate location of reinforcing steel in concrete structures and masonry walls prior to cutting or coring using non destructive, non ionizing radio frequency locators.

.2 Core concrete and masonry surfaces to avoid reinforcing steel, electrical conduit, or water pipes; adjust core location and coordinate with the Contract Administrator where concrete and masonry features interfere with core drilling.

.3 Notify the Contract Administrator immediately for further instructions where coring or cutting will damage existing concrete and masonry features.

.6 Concrete Slabs on Grade: Saw cut perimeter of area to be demolished, then break up and remove.

.7 Masonry:

.1 Demolish in small sections.

.2 . Cut masonry at junctures with construction to remain, using power driven saw, then remove masonry between saw cuts.

.3 Provide new lintels as required in masonry openings in accordance with Section 05 50 00 – Metal Fabrications.

.8 Chiller and Cooling Tower: Removal of equipment to be coordinated with the City.

.1 Refrigerant to be turned over to the City.

3.6 Closeout Activates

.1 Promptly repair damage to adjacent construction caused by selective demolition operations and as follows:

.1 Patch to produce surfaces suitable for new materials where repairs to existing surfaces are required;

.2 Completely fill holes and depressions in remaining existing masonry walls remain with an approved masonry patching material applied according to manufacturer's written recommendations.

.3 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

.2 Arrange for legal disposal and remove demolished Materials to accredited landfill site or alternative disposal site (recycle centre):

.1 Promptly dispose of demolished Materials.

.2 Do not allow demolished materials to accumulate onsite.

.3 Do not burn demolished Materials.

END OF SECTION

1. GENERAL

1.1 REFERENCE STANDARDS

.1 Canadian Environmental Protection Act,1999 (CEPA 1999)

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Department of Justice Canada (Jus)

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1992, (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 WHMIS Safety Data Sheets (SDS).

.4 National Research Council Canada (NRC)

.1 National Fire Code of Canada 2015 (NFC).

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards.

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 DEFINITIONS

.1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into environment.

.3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment, or disposal.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish, and limitations.

.2 Submit two copies of WHMIS Safety Data Sheets (SDS) in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures to the Contract Administrator for each hazardous material required prior to bringing hazardous material on site.

.3 Hazardous waste classification: identify waste codes applicable to each hazardous waste material based on applicable federal and provincial acts, regulations, and guidelines. Waste profiles, analyses, and classification submitted to contract offices for review and approval.

.3 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.4 Delivery and Acceptance Requirements: deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.

.5 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.6 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with the Contract Administrator and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and waste in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada (NFC) requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene, and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Contract Administrator.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents: non-flammable or have flash point above 38 degrees C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 When hazardous waste is generated on site:

i. Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

ii. Report spills or accidents immediately to the Contract Administrator and the City. Submit a written spill report to the Contractor Administrator and the City within 24 hours of incident.

2. PRODUCTS

2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities hazardous material required to perform Work.

.2 Maintain WHMIS Safety Data Sheets (SDS) in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

.3 Spill Response Materials: provide spill response materials which can be used for absorbing/shoveling and containing hazardous materials.

.4 Provide personal protective equipment.

3. EXECUTION

3.1 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Both confirmed asbestos and presumed asbestos have been identified at the Hurst Regional Pumping Station which will or may be affected by the Work. Refer to the following Hazardous Materials Information Systems (HMIS) reports for further details:

.1 HMIS Confirmed Asbestos and Presumed Asbestos Report – W.D. Hurst Pumping Station, 2021-06-28;

.2 The presumed asbestos containing materials (ACMs) detailed in the appended HMIS reports shall be assumed to be ACM.

.3 The Contractor is responsible for the removal and disposal of all confirmed ACMs and presumed ACMs affected by the Work as indicated on the Drawings. This includes but is not limited to:

.1 the mastic and plaster on the ceramic tiles on the housekeeping pad and floor in the Hurst Regional Pumping Station affected by the installation of the new chilled water piping and equipment.

.4 Where penetrations through confirmed or presumed ACMs are required, the Contractor shall conduct the Work in accordance with this section.

.5 The Contractor shall put in place a removal / disposal work plan and shall remove all confirmed and presumed ACMs to perform the work as indicated on the Contract documents and as indicated in Appendix B which impact the Contractors activities, in a safe manner, as part of the required Work.

.6 Provide training for all workers, including but not limited to:

.1 Contractor’s workers

.2 Visitors

.3 Contract Administrator and his designated on-site staff

.7 Comply with requirements of this section when performing the following Work:

.1 Removing non-friable ACMs by breaking, cutting, drilling, abrading, grounding, sanding, or vibrating to accommodate work at locations indicated on the Drawings. If the Work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.

.2 Removing of all friable ACMs by wetting.

.3 Removing of ACM from a pipe, duct, or similar structure using a glove bag.

.8 The Contractor shall ensure that work does not impeded with the ongoing operations of the facility. The facility will continue to be operated by City staff.

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-94, Sealer for Application of Asbestos Fibre Releasing Materials.

.2 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS) 2015

.1 WHMIS Safety Data Sheets (SDS).

.4 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.5 Underwriters' Laboratories of Canada (ULC)

1.3 DEFINITIONS

.1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.2 Asbestos Containing Materials (ACMs): materials identified herein, and in the appended HMIS Confirmed Asbestos and Presumed Asbestos reports for each building.

.3 Asbestos Abatement Monitoring & Inspection Agent: a person qualified to provide asbestos abatement monitoring and inspection services in the jurisdiction where the services are to be provided. The Asbestos Abatement Monitoring & Inspection Agent shall be retained by the Contractor via the cash allowance included in the Contract.

.4 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.

.5 Authorized Visitors: Contract Administrator, or designated representative, and representative of regulatory agencies.

.6 Friable Materials: material that when dry can be crumbled, pulverized, or powdered by hand pressure and includes such material that is crumbled, pulverized, or powdered.

.7 Glove Bag: prefabricated glove bag as follows:

.1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.

.2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.

.3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.

.4 Straps for sealing ends around pipe.

.5 Must incorporate internal closure strip if it is to be moved or used in more than one specific location.

.8 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

.9 Minor Amounts of ACMs: less than or equal to 0.1 m^2 of friable material containing chrysotile asbestos.

.10 Non-Friable Material: material that when dry cannot be crumbled, pulverized, or powdered by hand pressure.

.11 Occupied Area: any area of building or work site that is outside the Asbestos Work Area.

.12 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.13 FR Polyethylene: fiber re-enforced polyethylene.

.14 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of Work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit proof satisfactory to Asbestos Abatement Monitoring & Inspection Agent that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.

.3 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.4 Submit proof of insurance in accordance with D11.2.

.5 Submit to Asbestos Abatement Monitoring & Inspection Agent and to the Contract Administrator necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.6 Submit proof satisfactory to Asbestos Abatement Monitoring & Inspection Agent and to the Contract Administrator that the Contractor's employees and all visitors to the area have had instruction on hazards of asbestos exposure, respirator use, dress, entry and exit from Asbestos Work Area, and aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning, and disposal of respirators and protective clothing.

.7 Submit proof that the Contractor's supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by the Asbestos Abatement & Inspection Agent and to the Contract Administrator.

.8 Submit documentation including test results, fire and flammability data, and WHMIS Safety Data Sheets (SDS) for chemicals or materials including:

.1 Encapsulants;

.2 Amended water;

.3 Slow drying sealer.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these Specifications more stringent requirement applies. Comply with regulations in effect at the time the Work is performed.

.2 Health and Safety:

.1 Safety Requirements: Provide all requirements for workers and Authorized Visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected, and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. Replace damaged or deteriorated respirator parts prior to the respirator being used by a worker and, when not in use, store respirators in a convenient, clean, and sanitary location. The Contractor to establish written procedures regarding the selection, use, and care of respirators and a copy of the procedures to be provided

to and reviewed with each worker who is required to wear a respirator. Do not assign a worker to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the Contractor for all of the Contractor's personnel and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker or Authorized Visitor must decontaminate his or her protective clothing prior to removing the protective clothing by using a vacuum equipped with a HEPA filter or by damp wiping. If the protective clothing will not be reused, decontamination is not required and place the protective clothing in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.4 Ensure workers and Authorized Visitors wash hands and face when leaving Asbestos Work Area.

.5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.6 Visitor and Contract Administrator Protection:

.1 Provide protective clothing and approved respirators to the Contract Administrator and Authorized Visitors to Asbestos Work Area.

.2 Instruct the Contract Administrator and Authorized Visitors in the use of protective clothing, respirators, and procedures.

.3 Instruct the Contract Administrator and Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, and Regional and Municipal regulations.

.3 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial/Territorial, and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 mils bags or leak proof drums. Label containers with appropriate warning labels.

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.7 EXISTING CONDITIONS

.1 Notify Contract Administrator of friable material discovered during Work and not apparent from Drawings, Specifications, or report pertaining to Work. Do not disturb such material until instructed by Contract Administrator.

1.8 SCHEDULING

.1 All Work will be carried out so as not to affect normal operations of the facility taking place at the time of the abatement.

.2 Co-ordinate Work schedule with the Asbestos Abatement Monitoring & Inspection Agent.

1.9 PERSONNEL TRAINING

.1 Before beginning Work, provide via the Asbestos Abatement Monitoring & Inspection Agent satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, at minimum:

.1 Fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 MATERIALS

.1 Drop and Enclosure Sheets:

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of ACM.

.3 Waste Containers: contain waste in two separate containers.

.1 Inner container: 0.15 mm thick sealable polyethylene bag or where glove bag method is used, glove bag itself.

.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.

.3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.

.4 Glove Bag:

.1 Acceptable materials: safe-T-Strip products in configuration suitable for Work or approved equal in accordance with B7.

.2 The glove bag to be equipped with:

.1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.

.2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct, or similar structure.

.3 A tool pouch with a drain.

.4 A seamless bottom and a means of sealing off the lower portion of the bag.

.5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

.5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

.6 Slow - Drying Sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 50.

.7 Encapsulant: Serpiflex Shield or approved equal in accordance with B7.

Part 3 Execution

3.1 SUPERVISION

.1 Minimum of one supervisor for every ten workers is required.

.2 Approved supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

.1 Before beginning Work at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.

.2 Before beginning Work, remove visible dust from surfaces in Asbestos Work Area where dust is likely to be disturbed during course of Work.

.1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.

.2 Do not use compressed air to clean up or remove dust from any surface.

.3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and work areas where dust or contamination cannot otherwise be safely contained.

.2 When removing ACM from piping or equipment where the "glove-bag" method is not used, erect enclosure of polyethylene sheeting around work area, shut off mechanical ventilation system serving work area, and seal ventilation ducts to and from work area.

.4 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.

.1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.

.2 Perform Work in a manner to reduce dust creation to lowest levels practicable.

.5 Pipe Insulation Removal Using Glove Bag:

.1 A glove bag is not to be used to remove insulation from a pipe, duct, or similar structure if:

.1 It may not be possible to maintain a proper seal for any reason including, without limitation:

.1 The condition of the insulation.

.2 The temperature of the pipe, duct, or similar structure.

.2 The bag could become damaged for any reason including, without limitation:

.1 The type of jacketing.

.2 The temperature of the pipe, duct, or similar structure.

.2 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag is to be inspected at regular intervals for damage and defects and repaired or replaced as appropriate. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be reused.

.3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.

.4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in the bag to obtain the full capacity of the bag.

.5 Insert nozzle of garden reservoir type sprayer into the bag through the valve and wash down the pipe and interior of bag thoroughly. Wet the surface of the insulation in the lower section of the bag.

.6 To remove the bag after completion of stripping, wash top section and tools thoroughly. Remove the air from the top section of the bag through the elasticized valve using a HEPA vacuum. Pull the polyethylene waste container over the glove bag before removing the bag from the pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove the second strap and zipper. Fold over into waste container and seal.

.7 After removal of the bag, ensure that the pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of the pipe and ends of insulation with slow drying sealer to seal in any residual fibres.

.8 Upon completion of the Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.

.6 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas. The costs of clean-up of affected surrounding areas due to

contamination shall be borne by the Contractor and no adjustments to the Contract price will be permitted.

.7 Cleanup:

.1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.

.2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.

.3 Immediately before their removal from Asbestos Work Area for disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

.4 Seal and remove double bagged waste from Site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.

.5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, the Asbestos Abatement Monitoring & Inspection Agent shall take air samples on a daily basis outside of the Asbestos Work Area enclosure in accordance with Health Canada recommendations.

.1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations.

.2 Submit daily air monitoring results and recommendations to the Contract Administrator.

.2 If air monitoring shows that areas outside Asbestos Work Area enclosure are contaminated, enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Area. The costs to enclose, maintain, and clean-up these areas shall be borne by the Contractor and no adjustments to the Contract price will be permitted.

.3 Ensure that respiratory safety factors are not exceeded.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.

.3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 CSA Group (CSA)

.1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16-14, Design of Steel Structures.

.4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.5 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric

.3 Environmental Choice Program (ECP)

.1 CCD-048-95(2006), Surface Coatings - Recycled Water-borne

.4 Green Seal Environmental Standards (GS)

.1 GS-11-2011, Paints and Coatings

.5 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition

.6 Underwriters Laboratories (UL)

.1 UL 2768-11, Architectural Surface Coatings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for sections plates pipe tubing bolts and include product characteristics, performance criteria, physical size, finish, and limitations.

.2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures.

.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W 350W.

.2 Steel pipe: to ASTM A53/A53M standard weight.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A307.

.6 Stainless steel tubing: to ASTM A269, Type 302 commercial grade seamless welded with AISI No. 4 finish.

.7 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Fabricate work square, true, straight, and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat round oval headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m2 to CAN/CSA-G164.

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: MPI-INT 5.1A in accordance with chemical component limits and restrictions requirements and VOC limits of UL 2768 CCD-048 GS-11.

.4 Zinc primer: zinc rich, ready mix to MPI-INT 5.2B in accordance with chemical component limits and restrictions requirements and VOC limits of UL 2768 CCD-048 GS-11.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar, and masonry.

.3 Wood.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GS-11 UL 2768 CCD-048.

.2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.6 ANGLE LINTELS

.1 Steel angles: galvanized prime painted, sizes indicated for openings. Provide 150 mm minimum bearing at ends.

.2 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: shop painted.

.1 Primer: VOC limit 250 g/L maximum to GS-11 when applied onsite.

2.7 CHANNEL FRAMES

.1 Fabricate frames from steel, sizes of channel and opening as indicated.

.2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.

.3 Finish: galvanized prime coat painted.

3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 ERECTION - GENERAL

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Contract Administrator such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16 or Weld field connection.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:

.1 Primer: maximum VOC limit 250 g/L to GS-11.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

.1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 CHANNEL FRAMES

.1 Install steel channel frames to openings as indicated.

3.4 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

1. GENERAL

1.1 SUMMARY

1. Provide all labour, methods, Products, equipment, and accessories for painting as shown on the Drawings, specified herein, and as required for the complete and proper execution of Work of this Section.

1.2 REFERENCES

1. Codes, standards, manuals, and maintenance documents shall be the latest published editions, unless otherwise stated:
    1. American Society for Testing and Materials International (ASTM):
        1. ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
    2. Master Painters Institute (MPI):
        1. MPI Painting Manual, The Master Painters Institute – Architectural Painting Specification Manual by PDCA.
        2. MPI Approved – The Master Painters Institute – Approved Products List (Includes United States, Canada and International Editions).
    3. Steel Structures Painting Council (SSPC):
        1. SSPC-SP 1, Solvent Cleaning.
        2. SSPC-SP 2, Hand Tool Cleaning.

1.3 SUBMITTALS

1. Submittals shall be in accordance with Division 1.

2. Product Data: Submit manufacturer's Product data, performance criteria and other documentation for each material specified in this Section proposed for use, including:
    1. Submit Product data and submit a Schedule of Finishes listing manufacturer's Product name, colour, textures, material safety data sheet (MSDS) and test reports requested for each paint system. Submit test reports for odourless, low or zero volatile organic compound (VOC) Products when specified.
    2. Provide the painting Subcontractor with written confirmation of specific surface preparation procedures and primers used for fabricated steel items from the fabricator/supplier to ensure appropriate and manufacturer-compatible finish coat materials prior to commencement of painting.
    3. Provide the painting Subcontractor with written Product data regarding chemical composition of coatings or treatments applied by others (pressure preservatives, admixtures, and sealers etc.) and their paintability.
    4. Submit Product data for concrete and concrete block primers.

3. Samples: Provide the following samples:
    1. Submit samples 30 Days before materials are required. Submit the following samples in the sizes indicated:

1. Three copies of brush outs minimum 200 mm x 250 mm of each finish including colour, sheen, and texture required at least 30 Days prior to commencement of application. Identify each sample with job, finish, colour name, number, sheen, and gloss values, substrate to be applied to, date and name of Subcontractor.

2. Sample panels of stain, varnish, lacquer, or other wood finish on each species of wood specified, minimum 300 mm square and of specified thickness.

4. Certificates:

1. Surface Preparation: Submit manufacturer's representative's written approval of surface preparation methods and any specific recommendations for alternative methods.

2. Materials: Submit list of proposed materials prepared by paint manufacturer, for approval at least 60 Days before materials are required. Ensure list bears manufacturer's official certification that materials listed meet or exceed requirements specified herein, are compatible with respective substrates and primer coats, including those applied by work of other Sections.

5. Closeout Submittals: Submit 4 copies of list of materials used, together with MSDS for each Product for incorporation into the Maintenance Manuals. Include maintenance information, such as cleaning and full pigment information, for future touch up.

1. Provide one (1) each hard copy and digital copy in PDF format issued to the Contract Administrator.

1.4 QUALITY ASSURANCE

1. Qualifications:

1. Applicators:

1. Execute work of this Section by a firm which has adequate plant, equipment, and skilled workers to perform the work expeditiously and which is known to have been responsible, during the immediate past 5 years, for installations similar to the work contained herein. Firm to be fully conversant with the applicable laws; bylaws; codes; fire, health and safety regulations; and other regulations that govern.

2. Provide work of this Section executed by competent applicators with membership in good standing in the provincial painting contractors association and have a minimum of 5 years of experience in the application of Products, systems, coatings, and assemblies specified and with approval and training of the Product manufacturers.

3. Ensure materials, preparation, and workmanship conform to the requirements of Master Painters Institute (MPI) Painting Manual.

2. Certifications: Ensure paint manufacturers and Products used are listed under the Approved Product List section of MPI Painting Manual.

3. Pre-Installation Meetings:

1. Review Drawings, details, and Schedules, determine intent, extent, materials, types of surfaces, and locations and be fully cognizant of the intent of the Work. Review Product literature, MSDS, related safety data, and proper disposal requirements and inform those involved in the Work of this Section.

2. Review Specifications and Drawings for work of other Sections regarding provisions for prime and finish coats and ensure compatibility with each other and substrate prior to application.

3. Prior to start of work, arrange for a Project site meeting of the parties associated with the Work of this Section. Include the Contract Administrator, Subcontractor, manufacturer's representative, any sub-trades whose work will be painted (including Mechanical and Electrical trades) or whose work is adjacent to, or whose work or schedule may be affected by work of this Section.

4. Review the Specification for the Work included under this Section and determine complete understanding of requirements and responsibilities relative to the work including, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas requiring painting, and other matters affecting construction, to permit compliance with the intent of this Section.

4. Scheduling:

1. Painting Schedule: Provide within 30 Days of award of Contract, together with the proposed manufacturer of materials to be used, a Schedule comprised of locations, types of surfaces, types of painting materials (and manufacturer's names), and number of coats to be used.

2. Schedule painting operations to prevent disruption of and by other trades. Ensure painting is completed for locations requiring application of finishes by other trades in a timely fashion to prevent delays.

3. Schedule painting operation in occupied facilities to prevent disruption of occupants in and about the Project Site. Carry out painting in accordance with the Construction Contractor's operation requirements. Schedule work such that painted surfaces will have dried before occupants are affected. Obtain written authorization from the Contract Administrator or Construction Contractor for changes in the work schedule.

4. Coordination: Coordinate material substrates with the appropriate Sections including correction of defects and deficiencies, other coating systems, exposed structural steel, and Mechanical and Electrical paint finishes.

1.5 DELIVERY, STORAGE AND HANDLING

1. Delivery and Acceptance Requirements:

1. Deliver to site, manufacturer's original materials, sealed and labelled containers bearing the manufacturer's name, brand name, type of paint or coating and colour designation, degree of gloss, batch number, standard compliance, materials content as well as mixing, reducing and application requirements.

2. The Manufacturer shall certify that the materials delivered to Site conform to the approved list and are of top quality Product range.

2. Storage and Handling Requirements:

1. Store on site, materials in manufacturer's sealed and labelled containers.

2. Comply with the applicable local fire and building code requirements during storage and application.

3. Store containers of paint, thinner, and other volatile materials in a secure, well ventilated location, heated to a minimum of 10°C, where they will not be exposed to excessive heat or direct solar radiation. Keep tightly closed when not in actual use.

4. Presence of any unauthorized materials or containers on Site is sufficient cause for rejection of paint materials on Site at that time.
5. Protect floor and wall surfaces in storage areas from paint drips and splatters.
6. Be totally responsible for the prevention of fire or explosion caused by improper storage of paints, solvents, rags, and similar items. Store fire hazardous materials in a location and manner approved by the local fire authority. Post "No Smoking" signs in areas of storage and mixing and strictly enforce this requirement. Provide and maintain CO_2 fire extinguishers of minimum 9 kg capacity. Repair damage to storage or surrounding area at no cost to the Construction Contractor.
7. Where toxic, volatile, explosive, flammable materials are used, provide adequate fireproof storage lockers, and take the necessary precautions and post adequate warnings (e.g., “No Smoking” signs), as required.

3. Packaging Waste Management: Leave storage areas clean and free from evidence of occupancy. Dispose of packaging in an appropriate method as required by the Authorities having Jurisdiction, and in an environmentally responsible manner in accordance with local requirements.

1.6 SITE CONDITIONS

1. Ambient Conditions:
    1. Paint and finish in clean, dust-free, properly ventilated, and adequately lit areas minimum 323 Lx on surfaces to be painted or decorated.
    2. Provide each paint material in accordance with the manufacturer's recommended tolerances for:
        1. Substrate Moisture Content: Perform tests with a properly calibrated electronic moisture meter to ensure compliance with the manufacturer’s recommendations. Without limitation, maximum moisture content shall be as follows:
            1. Concrete and Concrete Unit Masonry: Maximum 12–14% for solvent coatings and as recommended by the manufacturer for each water-based system.
            2. Gypsum Based Board: Maximum 12–14%.
            3. Wood: Maximum 15%.
    3. Temperature and Ventilation:
        1. Do not provide paint under ambient and surface temperatures, less those required below, in any instance for 24 hours before, during, and 7 Days after installation.
        2. Provide ventilation to remove odours, evaporating solvents, and moisture. Maintain adequate ventilation at all times to control excessive humidity.
        3. Ensure adequate temporary ventilation is provided for the protection of workers from toxic fumes.
        4. Interior Paint:
            1. Water-Based Paints: Maintain minimum interior surface and ambient air temperatures of between 18°C and 32°C during the application and drying of paint and maintain until building occupancy occurs.
            2. Solvent-Based Paints: Maintain minimum interior surface and ambient air temperatures of between 7°C and 35°C during the

application and drying of paint and maintain until building occupancy occurs.

3. Do not undertake interior painting on surfaces where condensation has or will form due to the presence of high humidity and lack of proper ventilation.

5. Exterior Paint:

1. Do not undertake exterior painting if air and surface temperatures are expected to fall below 10°C before coating has dried. Avoid painting during windy weather conditions which may affect paint application or following rain. Wait until frost, dew, or condensation has evaporated. Avoid painting surfaces exposed directly to hot summer sun.

2. Do not apply paint in snow, rain, fog, or mist or when relative humidity exceeds 85% or dew point is less than 3°C difference between air and surface temperatures, or damp or wet surfaces unless surface to be painted is enclosed and conditioned to the required temperatures and ambient conditions required for application.

3. Where required, suitable weatherproof covering and sufficient heating facilities are to be provided to enable required ambient and surface temperatures.

1.7 MAINTENANCE MATERIALS

1. Extra Stock Materials:

1. Supply, in addition to the quantities required for work, extra materials and Products to be stored by the Construction Contractor as follows:

1. Provide 1 L paint for each colour.

2. Deliver extra stock to the Construction Contractor as soon as permanent, locking storage facilities are available. Place extra stock in the designated storage area, where directed.

PART 2 - **PRODUCTS**

2.1 ACCEPTABLE MANUFACTURERS

1. Products of the following manufacturers are acceptable subject to conformance to the requirements of the Drawings, Schedules, and Specifications:

1. Benjamin-Moore & Co., Limited.
2. Pittsburgh Paints.
3. The Sico Inc. Company.
4. The Sherwin-Williams Company.
5. Or approved equivalent.

2.2 MATERIALS

1. Description:

1. Regulatory Requirements:

1. Conform to the latest edition of Industrial Health and Safety Regulations issued by the applicable Authorities having Jurisdiction in regard to site safety (ladders, scaffolding, ventilation, etc.)
2. Comply with the more stringent of applicable laws, bylaws, codes, fire regulations, health and safety regulations of Authorities having Jurisdiction or requirements of this Specification. Ensure standards used for work of this Section are considered a minimum.
3. Where required, ensure paints and coatings meet flame spread and smoke developed ratings designated by local code requirements or Authorities having Jurisdiction.
4. Comply with toxic trace limitations stipulated by Authorities having Jurisdiction.
5. Conform to the requirements of the local Authorities having Jurisdiction in regard to storage, mixing, application, and disposal of paint and related waste materials.

2. Material Performance Criteria:
   1. Provide best practices specified or recommended in MPI Painting Manual.
   2. The Contract Administrator reserves the right to refuse any paint or finishing material if in their opinion it is not suitable or adequate for its proposed use.
   3. Provide paint and finishing materials of the highest grade, top quality line of Products from manufacturer. Paint material containers not displaying manufacturer's Product identification will not be acceptable. Ensure paint is not diluted.
   4. Use the brand of paint chosen throughout the Work of this Section, except where specified otherwise. As far as practical, factory-mix paint for immediate application without thinning or alteration at site.
   5. Provide primers in the recommended dry film thickness (DFT) / coat.
   6. Only materials (primers, paints, coatings, varnishes, stains, lacquers, etc.) listed in MPI Approved Product List are acceptable for use on this Project.
   7. Provide other materials such as linseed oil, shellac, thinners, solvents, etc. of the highest quality Product of an MPI listed manufacturer; such materials shall be compatible with paint materials being used as required.
   8. Ensure materials used are lead and mercury free and have low VOC content, where possible.
   9. Where required, use only materials having a minimum MPI "Environmentally Friendly" E3 rating based on VOC (40 CFR 59, Subpart D, EPA Method 24) content levels.
   10. Where indoor air quality (odour) is an issue, use only MPI listed materials having a minimum E3 rating.
   11. Provide paint materials with good flowing and brushing properties and dry or cure free of blemishes, sags, air entrapment, etc.
   12. Paint materials which from time to time will become hot, such as convector covers and similar item, with a paint type approved by the paint manufacturer for that particular condition.

3. SRA: Aluminum oxide, rubber aggregate, clean/washed silica sand, or ground walnut chips (interior dry areas only) for use with or as a component part of paint (usually floor, porch, stair enamel) on horizontal surfaces as required to provide slip resistance. Where site applied, material shall either be mixed into paint (or mixed constantly to keep material in suspension) or broadcast into first or prime coat, as required.

4. Finishes:

    1. Colours: As indicated on the Drawings.

PART 3 - **EXECUTION**

3.1 EXAMINATION

1. Verification of Conditions:

    1. Do work only when surfaces and conditions are satisfactory for production of quality work. Report to the Contract Administrator in writing any surfaces which are found to be unsatisfactory.

    2. Ensure the temperature of surfaces to be finished is as required for the application of finish. Refer to “Temperature and Ventilation” section specified herein. Ensure surfaces are dry and free of dirt, grease, or other contaminants that may affect applied finish.

    3. Verify moisture content of surfaces with an electronic moisture meter. Do not proceed without written directions if moisture reading is higher than what is required for the application. Refer to “Ambient Conditions” section specified herein for substrate moisture content requirements.

    4. If substrate is steel, do not apply coatings over moisture or when surface temperature is within 3°C of dew point.

    5. If substrate is wood, do not stain or paint if moisture reading is higher than 15%. Inspect work to ensure that surfaces are smooth, free from machine marks and nail heads have been countersunk.

    6. If substrate is cast-in-place concrete, allow to cure for 60 to 90 Days before proceeding with priming.

    7. If substrate is new plaster or masonry, allow to cure for 30 to 90 Days. Ensure moisture content is between 12% and 14% and test for alkalinity and neutralize (pH of 6.5–7.5) before proceeding with priming.

    8. If substrate is gypsum board, inspect to ensure that joints are completely filled and sanded smooth. Inspect surfaces for "nail popping", screw heads not recessed and taped, breaks in surface, or other imperfections and have them repaired as required.

    9. Verify each substrate is dry and not frozen and free from tool and sandpaper marks, dust, rust, insects, grease, and other foreign matter liable to impair the finished work.

2. Evaluation and Assessment:

    1. Prior to commencement of work of this Section, thoroughly examine (and test as required) conditions and surfaces scheduled to be painted and report in writing to the Subcontractor and Contract Administrator any conditions or surfaces that will adversely affect work of this Section.

    2. Do not commence painting work until adverse conditions and defects have been corrected and surfaces and conditions are acceptable to the Subcontractor.

3. Commencement of work does not imply acceptance of surfaces except as qualified herein. Such surfaces as concrete, masonry, structural steel and miscellaneous metal, wood, gypsum board and plaster, is not the responsibility of the Subcontractor. Commencement of work implies acceptance of previously completed work.

3.2 PREPARATION

1. Protection of In-Place Conditions:
    1. Provide scaffolding, staging, platforms, and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with the *Occupational Health and Safety Act*.
    2. During work of this Section, provide drop cloths, plastic, plywood, or metal sheets to protect floors in areas assigned for storage and mixing of paints. Cover finished floors, walls, ceilings, and other work in vicinity and protect from paint and damage.
    3. Protect work of other trades against paint splattering and make good at own expense any such damage.
    4. Protect exterior surfaces and areas, including landscaping, walks, drives, adjacent building surfaces (including glass, aluminum surfaces, etc.) and equipment and any door and frame labels and signage from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
    5. Remove and securely store miscellaneous and finish hardware and surface fittings, electrical switch and outlet covers, receptacle plates, louvres, fittings, and fastenings, to protect from paint splatter. Mask items not removable. Use sufficient drop cloths and protective coverings for full protection of floors, furnishings, mechanical, electrical, and special equipment, other components of building which do not require painting or to be removed, from paint spotting and other soiling. Carefully clean and re-install items when paint is dry. Clean any components that are paint spotted or soiled. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g., lacquer finishes).
    6. Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured. Post “wet paint” or other warning signage during and on completion of work. Provide also warning signs at points of entry to areas where painting is applied and drying. Erect barriers or screens to warn of or limit or direct traffic away or around work area as required.

2. Surface Preparation:
    1. Prepare defective surfaces to obtain a satisfactory substrate and in accordance with paint manufacturer's instructions.
    2. Ensure exterior work is not performed during or immediately following rain, frost, or dew.
    3. Prior to painting, sweep areas dust-free.
    4. Clean soiled surfaces to be painted.
    5. Remove efflorescence, chalk, dust, dirt, oil, grease, rust, form oil, release agents, loose mill scale and other extraneous matter from surfaces (except rust occurring on items specified to be primed under other Sections be removed and work re-primed under those Sections). Vacuum (fibre acoustic tile and) insulation covering surfaces. Vacuum clean floors before painting; wipe clean adjacent surfaces and surfaces to be painted before work is commenced to prevent dust and debris damage to wet paint.

6. Remove mildew by scrubbing affected area with solution of 150 g TSP and 125 g bleach in 3.5 l water. Rinse well with clean water and allow to dry. If condition is serious, source out finishes with extra mildew resistance.

7. Be responsible for surface preparation to suit surface condition and conform to level of cleaning based on SSPC, recommended metal cleaning procedures most commonly used to suit site conditions.

8. Concrete and Masonry:

    1. Form Oil Removal: Remove with Xylol or TSP.

    2. Efflorescence Removal: Remove by dry brushing or washing with 1 part commercial muriatic acid to 20 parts water by volume and thoroughly rinse with clean water.

    3. Mildew Removal: Remove by scrubbing affected area with 1 part sodium hypochlorite to 3 parts water. Where dirt is also evident, add 1.36 kg TSP to 6.8 L of above solution.

    4. Concrete Floors: Verify moisture content is less than 12–14% before proceeding with painting. If concrete is less than 26 weeks old or has been previously painted, clean surface and etch with muriatic acid with extenders Conform to printed instructions for handling of acidic Products and hazardous substances without limitation, use approved gloves, aprons, boots, and eye protection in accordance with Occupational Health and Safety Act. Do not allow muriatic acid to come in contact with steel or electronic equipment. Rinse out etching compound with clean water and TSP to neutralize acidity of surface (pH 6–7.5). Rinse out with clean water 2 to 3 times and allow to dry.

    5. Concrete Vertical Surfaces: Use sand blasting, high pressure water blasting, high pressure water blasting with abrasives, vacuum blasting with abrasives or alternatively, needle guns or power grinders equipped with suitable grinding stone, to remove concrete, loose mortar, fins, projections, and surface contaminants. Vacuum or blow down and remove dust and loose particles from surface. Fill large cracks in consultation with Contract Administrator using either polyester, epoxy or acrylic resin, block filler or cement sand mixture in accordance with Contract Administrator's written instructions. Fill only flush to surface and allow to set.

    6. Concrete Block Masonry: Fill voids and cracks in masonry block wall to provide uniform surface for subsequent coats.

9. Metals:

    1. Ensure application of paint and coatings occurs within appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.

    2. Ferrous Metal: Clean to meet or exceed original surface preparation and paint application. Remove loose rust and prime bare metal with rust inhibitive steel primer. Touch-up damaged shop applied primer using compatible Product. Provide full coat primer only if damage is extensive. Treat weld areas with phosphoric acid (5% solution).

    3. Structural Steel / Miscellaneous Steel (previously painted and exposed by alterations work): Remove oil, grease, dirt, rust scale, loose mill scale, loose paint, or coating by brush-off blast as per original procedure for surface preparation. Cleaning to meet or exceed original surface preparation.

4. Metal Stacks, Breeching, Piping: Blast clean to 0.037 mm to 0.050 mm profile using grit abrasive to SSPC-SP 6.

5. Hot Dipped Galvanized Steel (Unweathered): Allow to weather minimum of 26 weeks and Xylene clean to SSPC-SP 1 specified herein prior to coating to remove dust, dirt, grease, oxides, and other foreign material. Remove silicates or similar surface treatments or any deposits of white rust by sanding or similar abrasive methods (bronze wool). Use of acetic acid to prepare galvanized surfaces is not acceptable.

6. Galvanized Steel (Weathered): Remove dust, dirt, grease, oxides, and other foreign material and clean to SSPC-SP 1 specified herein prior to coating.

7. Galvanized Steel (Pre-Treated) (Non-Crystal Appearance): Follow manufacturer's recommendations for preparation, priming and coating of pretreated galvanized steel.

8. Light Zinc Coated or Satin Coated Products (ZF075) mostly found in environmentally controlled areas. Follow manufacturer's recommendations for preparation, priming and coating.

9. Heavy Coated Zinc Z275 (G90) for high humidity areas and as specified. Follow manufacturer's recommendations for preparation, priming and coating.

10. Metal Doors: Remove doors before painting to paint bottom and top edges and re-hang once dry. Do not paint stainless steel or bronze door butts. Paint or finish top and bottom edges of doors. Touch-up or refinish tops and edges after fitting. Exterior doors to have tops, bottoms and side edges finished same as exterior faces to these doors. Paint elevator doors and frames where supplied primed by elevator manufacturer.

10. Hot-dipped galvanized steel:

    1. Provide surface preparation and coordination in accordance with ASTM D6386 and consisting of the following steps:

        1. Coordinate with galvanizer.

        2. Determine condition of coating.

        3. Clean surface using alkaline solution, acidic solution and/or solvent cleaning to achieve acceptable surface.

        4. Profile surface to provide anchor for paint coatings.

11. Woodwork:

    1. Verify and determine wood species, grain direction and structure, properties of finish, application method and exposure to elements. Check moisture content to avoid movement of wood caused by expansion and contraction due to changes in moisture content. Verify grain cut as it may interfere with adhesion of paint.

    2. Apply wood finishing Product in following order and as needed for specific appearance and application specified herein. Sanding sealer to control penetration of subsequent coats to create more uniform finish. Stain to colour wood and highlight grain for final finish. Filler to fill pores of wood and control penetration of subsequent coats. Apply filler across grain forcing it into pores followed with rubbing and sanding when dried. For staining requirements mix stain with filler before applying for uniform finish. Finish coats to provide protection to wood.

3. Woodwork for Opaque Coating: Seal knots and sapwood in surfaces to receive paint with alcohol-based primer-sealer. Seal door edges. Sand smooth rough surfaces of woodwork to be finished using 150 grit paper followed by a second sanding using 220 grit paper. Sand in direction of grain. Clean surfaces free of dust before applying first coat using brush, compressed air or tack rags. Fill nail holes, splits, and scratches with nonshrinking filler after first coat is dry. Remove salt deposits that may appear on wood surfaces treated with fire retarder.

4. Prepare plywood surface by removing dirt and debris. Fill screw and nail holes or minor imperfections with recommended filler and sand properly to receive finish coating. Ensure plywood requiring stained or painted finish is primed with top quality alkyd primer. Use only penetrating quality stain over plywood.

5. Woodwork for Clear Finish or Stain: Sand smooth woodwork to be finished using 150 grit paper followed by a second sanding using 220 grit paper and clean surfaces free of dust using brush, compressed air, or tack rags before applying first coat. Abrade surfaces with stiff brush to remove loose fibers and splinters. Fill nail holes, splits and scratches with non-shrinking filler tinted to match local grain condition after first coat is dry. Sand lightly between coats with No. 220 sandpaper and remove dust.

6. Remove salt deposits that may appear on wood surfaces treated with fire retarder.

7. Obtain inspection of glue laminated beams by assigned painting inspector to ensure shop sealer has been applied. Where non-specified shop sealer has been applied to beams or columns, remove, and refinish in accordance with manufacturer's written instructions.

8. Wood Doors: Remove doors before painting to paint bottom and top edges and re-hang once dry. Paint or finish top and bottom edges of doors to be painted or stained. Touch-up or refinish tops and edges after fitting.

12. Previously Finished Surfaces: Clean existing interior and exterior surfaces to be repainted or varnished to provide bond. Remove dirt, rust, loose paint, scale, oil, grease, mould, mildew, chemicals, mortar efflorescence, sealers, and other foreign matter which may impair proper bond of the new finish. Peeled, chipped, scratched or otherwise damaged surfaces shall be filled flush with suitable patching material. Clean off bubbled, cracked, peeling or otherwise defective paint by stripping with suitable environmental strippers or by burning. Do not burn off paints suspected of having lead content. Treat residue from stripping as Hazardous Waste. Flatten gloss paint and varnish with sandpaper to provide perfectly smooth and even surface, with surface texture matching surrounding area and wipe off dust. Check for compatibility by applying a test patch of the recommended paint system covering at lease 1 m^2. Allow to dry for one week before testing adhesion in accordance with ASTM D3359. If the previous paint system is incompatible, or if the previous coatings have failed so as to affect proper performance or appearance of coatings to be applied, remove previous coatings completely and prepare substrates properly and refinish as specified for new work. Leave entire surface suitable to receive designated finishes and in accordance with finish manufacturer's instructions.

3.3 APPLICATION

1. Safety Precautions: When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do not provide protection from vapours.

2. Material Compatibility: Provide primers and finish coat materials compatible with each other and substrate including fillers.

3. Mixing and Tinting:

    1. Unless otherwise specified herein or pre-approved, paint to be ready and factory tinted. Re-mix all paint in containers prior to and during application to ensure breakup of lumps, complete dispersion of settled pigment and colour and gloss uniformity.

    2. Mix and prepare paint materials including paste, powder, or catalyzed paint mixes in strict accordance with manufacturer's directions for particular material and coat to be applied to produce a mixture of uniform density. If reducing is required, do so in accordance with recommendations of manufacturer for particular material and coat.

    3. Where thinner is used, addition is not to exceed manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.

    4. Mix primer-sealer with a certain amount of colour coat in proportions recommended by manufacturer of material actually used. Tint undercoats and each finish coat with correct type colours, for identification of each succeeding coat.

    5. Thoroughly mix materials before application. Apply materials evenly, under adequate illumination, free from sags, runs and other defects. Do cutting-in neatly.

    6. Thin paint for spraying in accordance with manufacturer's instructions. Obtain instructions in writing from manufacturer and provide copy of instructions to Contract Administrator.

4. Obtain colour chart giving colour schemes and gloss value for various areas from Contract Administrator. Ensure colour chart gives final selection of colours and surface textures of finishes and whether finishes are transparent (natural) or opaque (paint).

5. Provide finish uniform in sheen, colour, and texture, free from streaks, shiners and brush or roller marks or other defects.

6. Apply materials in accordance with MPI requirements, manufacturer's directions and specifications paying particular attention to appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications. Do not use adulterants. Do any reduction of coating's viscosity in accordance with manufacturer's directions.

7. Use up paints within period of shelf life recommended by paint manufacturer.

8. Ensure successive coatings are harmonious chemical compositions and materials of same manufacturer.

9. Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1 m.

10. Ensure each coat is dry and hard before a following coat is applied.

11. Continue through paint finish behind wall-mounted items (e.g., chalk and tack boards).

12. Finish listed surfaces indicated on Room Finish Schedule(s) and/or noted on Drawing(s) and as specified. Refer to Finish Schedule for type, location and extent of finishes required and include all touch-ups and field painting necessary to complete work shown, scheduled, or specified.

13. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimum coverage and appearance. Some materials and colours may require additional coats and deeper colours may require use of manufacturers' special tinted primers. Unless otherwise specified, provide Premium Grade finish as defined by MPI as minimum finish.

14. Spray painting will be permitted only in specified areas. Upon receipt of written permission, equipment is to be airless type. Contract Administrator may revoke permission at any time for reasons such as carelessness during application, poor masking or other poor protective measures, drifting paint fog, disturbance to other trades, or failure to obtain a dense, even, opaque finish. Motors, fans, and mechanical ventilation system to be shut off during spray painting.

15. Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas which have been cut and patched. Patching is not acceptable. Vary each coat slightly in successively darker tones to permit supervision identity.

16. Do not paint baked paint surface, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint primed surfaces.

17. Advise Contract Administrator when each applied paint coat can be inspected. Do not recoat without inspection. Tint each coat slightly to differentiate between applied coats.

18. Apply additional paint coats, beyond number of coats specified for any surface, to completely cover and hide substrate and to produce a solid, uniform appearance.

19. Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.

20. Primer/Sealers: Apply primer-sealer coats by brush or roller. Permit to dry in accordance with manufacturer's recommendations before applying succeeding coats. Touch up suction spots and sand between coats with No. 120 sandpaper.

21. Metals: Apply primer coat to unprimed ferrous metal surfaces. Where sandblast preparation is specified, apply specified primer immediately after blast cleaning.

22. Woodwork:

    1. Fill open grain woods with filler tinted to match wood and work well into grain. Wipe excess from surface before filler sets.
    2. Sand smooth paint and varnish undercoats prior to recoating.
    3. Prime woodwork designated for painting as soon as possible after delivery to site and before installation. Prime cut surfaces, whether exposed or not, i.e., 6 edges of wood doors, before installation. Prime cut surfaces of woodwork to receive transparent finish with 1 coat of transparent finish reduced 25% or as directed by manufacturer.
    4. Apply final coats on smooth surfaces by roller or brush. Hand brush wood trim surfaces.

23. Allow each coat of paint to cure and become dry and hard before application of succeeding coats (unless manufacturer's directions require otherwise).

24. Before finishing paint coats are applied, inspect and touch-up shop coats of primers previously applied by other trades or fabricators.

25. Provide paint coating thicknesses indicated, measured as minimum DFT.

26. Apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.

27. Ledges: Finish projecting ledges, both above and below sight lines, as specified for adjacent surfaces.

28. Unless otherwise specified, DO NOT apply paint or finish to the following:
    1. Finish Hardware.
    2. Equipment nameplates and other such identification.
    3. Switch, receptacle, and other electrical device faceplates.
    4. Exposed copper, brass, plastic, acrylic and FRP unless otherwise specified.
    5. Lighting fixtures.
    6. Stainless steel.
    7. Chrome plated surfaces, and polished or lacquered brass or bronze surfaces.
    8. Surfaces factory coated with baked epoxy and enamel.
    9. Plastic Laminate surfaces.
    10. Recessed electrical boxes and similar recessed equipment.
    11. Exterior poured concrete.
    12. Circuit breakers, switches, receptacles, and similar electrical devices.
    13. Exterior sealant joints.

3.4 SITE QUALITY CONTROL

1. Site Tests and Inspections:
    1. Provide and coordinate site inspection service by manufacturer's representative in advance of work commencing and during progress of work to ensure correct use and application of each specified material. Manufacturer's representative to review and submit approval of surface preparation methods in specifications or obtain specific recommendations for alternative methods. Report such conditions to Contract Administrator.
    2. As work progresses and upon completion of work, submit written reports and manufacturers' confirmation that materials and application methods conform to manufacturers' requirements.
    3. Inspect surfaces, preparation, and paint applications.
    4. Inspections: Painting and decorating work will be inspected by Contract Administrator. Contractor and painting Subcontractor will be notified in writing of any defects or deficiencies after completion of prime coat.

2. Non-Conforming Work:
    1. Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction to Contract Administrator at no cost to Construction Contractor. Touch up small affected areas, repaint large affected areas or areas without sufficient DFT of paint. Remove runs, sags of damaged paint by scraper or by sanding prior to application of paint. Following are considered nonconforming qualities:
        1. Lack of Uniformity:

1. Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding, or shadowing by inefficient application methods, skipped or missed areas and foreign materials in paint coatings.
2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners, and re-entrant angles.
3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
4. Damage due to application on moist surfaces or caused by inadequate protection from weather.
5. Damage and/or contamination of paint due to blown contaminants(dust, spray paint, etc.)

2. Aesthetic Problems: If following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
   1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1 m.
   2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1 m.
   3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
   4. When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture and hiding across full surface area.

3. Manufacturer Services: Arrange for manufacturer's representative to visit site at intervals during surface preparation and paint coating application to ensure proper specified surface preparation is being performed, specified Product are being used, appropriate number of coats are being applied and specified finishing procedures are being carried out.

3.5 CLEANING

1. Keep waste rags in covered metal drums containing water and remove from building at end of each Day. Remove other combustible rubbish materials and empty paint cans each Day from site and safely dispose of same in accordance with requirements of Authorities having Jurisdiction.

2. Clean equipment and dispose of wash water/solvents as well as other cleaning and protective materials (e.g., rags, drop cloths and masking papers), paints, thinners, paint removers/strippers in accordance with safety requirements of Authorities having Jurisdiction.

3. Clean containers used for storage, mixing and application of materials free of foreign materials and residue.

4. Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials, and debris.

5. Clean adjacent surfaces which have been painted, soiled, or otherwise marred. Removes pilled, splashed, splattered, or sprayed paint as work progresses using means and materials that are not detrimental to affected surfaces.

6. Remove masking and other protection provided under this Section.

7. Remove temporary protective wrappings provided by others for protection of work after completion of painting operations unless instructed otherwise.

8. Painting work will not be considered complete until spatters, drippings, smears, and overspray have been cleaned and removed to satisfaction of Contract Administrator.

9. Make good any damage to structure building surfaces or furnishings resulting from painting operations at no cost to Construction Contractor.

10. Waste Management:

    1. Disposal of Paint Waste:

        1. Be responsible for removal and disposal of material and waste generated by this Section.

        2. Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are hazardous Products and are subject to regulations for disposal. Obtain information on these controls from applicable Authorities having Jurisdiction.

        3. Separate and recycle waste materials. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility. Treat materials that cannot be reused as hazardous waste and dispose of in an appropriate manner.

        4. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

        5. To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground adhere to following procedures:

            1. Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case clean equipment using free draining water.

            2. Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

            3. Return solvent and oil-soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

            4. Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

            5. Dry empty paint cans prior to disposal or recycling (where available).

            6. Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

            7. Set aside and protect surplus and uncontaminated finish materials not required by Construction Contractor and deliver or arrange collection for verifiable re-use or re-manufacturing.

END OF SECTION

1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for all equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Electrical date and wiring diagrams.

.6 Certification of compliance to applicable codes.

1.2 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for HVAC equipment and accessories for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.

.2 Make changes as required and re-submit as directed by Contract Administrator.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 Contractor will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built Drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of As-built Drawings.

.2 Identify each Drawing in lower right-hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Contract Administrator for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using As-built Drawings.

.5 Submit completed reproducible As-built Drawings with Operating and Maintenance Manuals.

.9 Submit copies of As-built Drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

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

.2 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect HVAC equipment and accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

1. Not Required

3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator 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 Contract Administrator.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork, and air handling units.

3.4 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.1 TAB Reports.

.2 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 Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

3.5 DEMONSTRATION

.1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment, and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Contract Administrator may request the Contractor record these demonstrations on video tape for future reference.

3.6 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.

3.7 PROTECTION

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

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-2015, 3.2 Edition, Environmental Standard for Paints, Coatings, Stains, and Sealers.

.2 National Research Council Canada (NRC)

.1 National Fire Code of Canada 2015 (NFC).

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2016, Architectural Coatings.

.2 SCAQMD Rule 1168-A2017, Adhesive and Sealant Applications.

.4 CSA Group (CSA)

.1 CSA B51-2019, 19th Edition, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 QUALITY ASSURANCE

.1 Sustainability Standards Certification:

.1 Low-Emitting Materials: provide listing of sealants / coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers / Paints / Coating: in accordance with manufacturer's recommendations for surface conditions.

3 EXECUTION

3.1 APPLICATION

.1 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

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation, ease of maintenance, and ease of assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and piping subject to movement, or to facilitate maintenance on the equipment.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by the manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

.3 Appropriate clearances shall be maintained to existing process and utility systems (e.g. large isolation valves, distribution pumps, electrical/control panels, etc.) for observation, inspection, servicing, removal, and maintenance. Review the clearance requirements with the Contact Administrator prior to commencement of Work.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each water only drain valve discharge separately to above floor drain.

.1 Discharge to be visible.

.2 Glycol solution drain valve outlets to be capped; no drainage piping is required.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install air vents at high points in piping systems.

.2 Install isolating ball valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Install pipework to CSA B51.9 – Building Services Piping.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to installing saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install pipework to minimize impact to crane travel in the facility.

.9 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.10 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

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

.12 Group piping wherever possible and as indicated.

.13 Ream pipes, remove scale and other foreign material before assembly.

.14 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.15 Provide for thermal expansion as indicated.

.16 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Install butterfly valves in the pipework with the disc positioned per the manufacturer's recommendations. Ensure pipework does not interfere with the operation of the disc.

.5 Valves accessible for maintenance without removing adjacent piping.

.6 Install globe valves in bypass around control valves.

.7 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.

.8 Install butterfly valves on chilled water and related condenser water systems only.

.9 Install butterfly valves between weld neck (steel) and socket weld (PVC/CPVC) flanges to ensure full compression of liner/seals as applicable.

.10 Install plug cocks or ball valves for glycol service.

.11 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.17 Check Valves:

.1 Install silent check valves on discharge of pumps where triple duty valves are not included, and in vertical pipes with downward flow and as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps where triple duty valves are not included, and as indicated.

3.8 SLEEVES

.1 General: install where coring is not possible for pipes passing through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for fire stopping.

.2 Maintain the fire-resistance rating integrity of the fire separation.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 FLUSHING OUT OF PIPING SYSTEMS

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

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 - Cleaning supplemented as specified in relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including cleaning of strainers and replacement of filters in piping systems.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

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

.4 Conduct tests in presence of Contract Administrator.

.5 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.6 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.11 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Contract Administrator.

.2 Request written approval by Contract Administrator 10 Business Days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.12 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A105/A105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Manufacturer, model number, line contents, pressure and temperature rating.

.2 Movement handled, axial, lateral, angular and the amounts of each.

.3 Nominal size and dimensions including details of construction and assembly.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

.1 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle in accordance manufacturer’s recommendations.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Ship, store and handle flexible connectors to prevent bending, deflecting, sagging, or otherwise extending beyond the rated capabilities.

2 PRODUCTS

2.1 FLEXIBLE CONNECTORS

.1 Application: to suit motion as indicated.

.2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.

.3 Material of construction: Stainless steel.

.4 The hose, braid and ferrule shall be integrally seal-welded using a 100% circumferential weld.

.5 The hose shall have the first “lip” removed to insure there are no sharp edges.

.6 All end fittings shall be must be attached using 100% circumferential weld.

.7 Operating temperatures range: minus 40 degrees Celsius up to plus 100 degrees Celsius.

.8 The rated working pressure of the hose must have a 4:1 safety factor.

.9 Each braided metal hose pump connector is to be individually leak tested.

.10 Supply with flat-face flanges with drilling and outside diameter to 150# ANSI.

.11 Ship using cut-to-length spacers, securely positioned between the flanges to prevent axial compression damage during shipment and to maintain the manufactured length.

.12 CSA standard B51 certified, inspected and tested.

.13 Diameter as indicated on the drawings.

.14 Acceptable material: Senior Flexonics, Flex-Hose Co. Inc, Metraflex, or approved equal in accordance with B7.

2.2 ANCHORS AND GUIDES

.1 Anchors:

.1 Provide as required.

.2 Alignment guides:

.1 Provide as required.

.2 To accommodate specified thickness of insulation.

.3 Vapour barriers, jackets to remain uninterrupted.

3 EXECUTION

3.1 APPLICATION

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

.2 Flexible connectors to be installed at glycol pipe connections to the circulation pumps and the chiller

3.2 INSTALLATION

.1 Install expansion joints with cold setting, as instructed by Contract Administrator. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as required and/or as indicated. Anchors to withstand 150 % of axial thrust.

.4 Do not twist the flexible connector assembly during installation when aligning the bolt holes in a flange.

.5 Install the flexible connector with neutral face-to-face dimension as shown on the submittal drawing. Do not install a braided metal hose assembly compressed (bagged braid).

.6 If the braided metal hose assembly must be installed with an initial offset then the maximum allowable movement is reduced by the amount of the initial deflection.

.7 Flexible connectors shall not be over bent. Any connectors determined to be over bent shall be determined to be defective.

.8 Verify that the movements of the system are within the design parameters of the flexible connector being installed.

.9 Prevent out-of-plane flexing in the installations.

.10 Support the piping to prevent excessive weight from compressing the hose and relaxing the braid tension.

.11 The shipping sticks for flanged units shall be kept in place during shipping and installation to maintain the flexible connector in a neutral end-to-end dimension. After installation, the shipping sticks shall be removed..

3.3 PIPE CLEANING AND START-UP

.1 In accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

3.4 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 13 - Performance Verification HVAC Systems.

3.5 CLEANING

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

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

.3 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 IPMVP 2007 Version.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.2 GS-36-11, Standard for Commercial Adhesives.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit a schedule listing all the thermometers and pressure gauges indicating the following:

.1 Pressure gauges: City tag number, City P&ID number, pressure range, connection sizes, dial size, and accuracy.

.2 Thermometers: City tag number, City P&ID number, temperature range, stem length, connection sizes, thermowell dimensions and material, dial size.

.3 Submit manufacturer’s printed product literature and SDS for thermally conductive paste.

.3 Test and Evaluation Reports:

.1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store thermometers and pressure gauges off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Ranges: as required by process.

2.2 DIRECT READING THERMOMETERS

.1	Type:	Bimetal
.2	Dial Size:	75 mm diameter
.3	Service:	Chilled fluid operating at plus 5 to plus 20 degrees Celsius
.4	Dry Stem Length:	To suit application
.5	Stem Diameter:	6 mm (1/4”)
.6	Stem Connection:	½ NPT
.7	Accuracy:	+/- 1% of span, ASME B40.200
.8	Material:	304 or 316 SS

.9 Enclosure: IP66, hermitically sealed

.10 Connection Location: variable angle type

.11 Acceptable Material: Ashcroft model EL Bimetal or approved equal in accordance with B7

2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter mercury-free, liquid filled or vapour activated dial type: to CAN/CGSB-14.5, ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass or stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

.1 Copper tubing: copper or bronze.

.2 Steel and PVC pipe: lead-free brass or stainless steel.

2.5 THERMALLY CONDUCTIVE PASTE

.1 Provide a suitable paste for chilled glycol applications.

2.6 PRESSURE GAUGES

.1 Dial Size: 112 mm diameter

.2 Service: 30% to 50% polypropylene glycol

.3 Process Connection: ¼ NPT

.4 Sensor: 316L stainless steel, length to suit pipe diameter..

.5 Range: submit range for approval by Contract Administrator

.6 Mounting: Bottom, stem mounted

.7 Enclosure Style: solid front with pressure relief back, IP54

.8 Accuracy: +/- 0.5% of span

.9 Dampening: liquid filled

.10 Acceptable Material: Ashcroft model 45-1259 or approved equal in accordance with B7.

3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator 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 Contract Administrator.

3.2 GENERAL

.1 Install thermometers and gauges at 1500mm AFF.

.1 If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

.1 Install in wells on piping. Include heat conductive paste inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Glycol cooling coils.

.2 Chiller evaporator glycol piping.

.3 Install thermowells for balancing purposes by TAB Firm. Coordinate with TAB Firm.

.4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Pumps: Upstream of suction diffuser, and at the suction and discharge of pumps.

.2 Upstream and downstream of PRV's.

.3 Upstream and downstream of control valves.

.4 Inlet and outlet of coils.

.5 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.5 NAMEPLATES

.1 Install engraved lamicoid nameplates in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment, identifying medium.

3.6 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.

.2 ASTM International (ASTM)

.1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

.5 D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.

.2 Complete catalog information, descriptive literature, specifications, identification of materials of construction, and cross-sectional details.

.3 Submit the following data complete, grouped together, and separated by divider, for each set of valves with the same combination of features and accessories:

.1 Dimensional outline drawing showing valve body, trim, actuator, and accessories.

.2 Identification of materials of construction, cross-sectional views and details; for valves, components, and accessories.

.3 Valve pressure and temperature ratings.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size. Minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.2 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.1 GENERAL

.1 All valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories, as required, for complete operation from the intended operating level.

.2 Valves to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

.3 Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements.

.4 Valve ends to suit adjoining piping.

.5 Valve to open by turning counterclockwise, unless otherwise specified.

2.2 BALL VALVES

.1 Type **V300** Ball Valve, 50 mm and Smaller: Two-piece end entry type, standard port, bronze body and end piece, hard chrome-plated bronze or brass ball, PTFE seats and stem packing, blowout-proof stem, zinc-coated steel hand lever operator with vinyl grip, rated 4140 kPa WOG/CWP, 1035 kPa SWP. Acceptable Material:

.1 NPT Threaded Ends: Crane; Series 9211, Watts; Series B6080, Kitz-58, M.A. Stewart B-3; or approved equal in accordance with B7.

.2 Soldered Ends: Crane; Series 9212, Watts; Series B6081, Kitz-59, M.A. Stewart B-2F, or approved equal in accordance with B7.

.2 Type **V330** PVC Ball Valve, 50 mm and Smaller: Rated minimum 1035 kPa at 22.8 degree C, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent weld socket ends, PTFE seat, Teflon O ring stem seals, to block flow in both directions. Acceptable Material: Chemline; Type 21 or approved equal in accordance with B7.

.3 Type **V331** PVC Ball Valve, 75 mm and 100 mm: Rated 1035 kPa at 22.8 degree C , with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, PTFE seat, Viton O ring stem, face and carrier seals, end entry design with dual union, solvent weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1. Acceptable Material: Chemline Type 21 or approved equal in accordance with B7.

.4 Type **V332** PVC Ball Valve, 150 mm: Rated 1035 kPa at 22.8 degree C, with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, PTFE seat, Viton O ring stem, face and carrier seals, end entry design with dual union, solvent weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1. Acceptable Material: Chemline High Capacity 150mm Ball 21 or approved equal in accordance with B7.

2.3 CHECK VALVES

.1 Type **V600** Check Valve, 50 mm and Smaller: All bronze, threaded cap, threaded or soldered ends, swing type replaceable bronze disc, rated 862 kPa SWP, 1380 kPa WOG/CWP. Acceptable Material:

.1 NPT Threaded Ends: Watts; Series CVY, Crane; Fig. 37, or approved equal in accordance with B7.

.2 Soldered Ends: Watts; Series CVYS or approved equal in accordance with B7.

.2 Type **V630** PVC Ball Check Valve 100 mm and Smaller: ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 1035 kPa at 22 degree C, and Viton seat and seal. Acceptable Material: Chemline Series BT-A-OXX-V-S or approved equal in accordance with B7.

.3 Type V633 PVC Wafer Check Valve 150 mm: ASTM D1784, Type I, Grade 1 polyvinyl chloride body, rated 1035 kPa at 20 degree C, and Viton seat and seal, 316 stainless steel spring. Acceptable Material: Chemline WP Series or approved equal in accordance with B7.

2.4 BUTTERFLY VALVES

.1 Type V230 PVC Butterfly Valve 75 mm and Larger Lug style, PVC body and disc, EPDM seat and seals, 403 stainless steel shaft. Acceptable Material: Chemline Type 57LIS or approved equal in accordance with B7.

2.5 OPERATORS

.1 General:

.1 Operator force not to exceed 18 kilograms under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 18 kilograms.

.2 Operator self locking type or equipped with self locking device.

.3 Position indicator on quarter turn valves.

.4 Worm and gear operators one piece design worm gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut.

.2 Exposed Operator:

.1 Galvanized and painted handwheels.

.2 Lever operators allowed on quarter turn valves 100 mm and smaller.

.3 Cranks on gear type operators.

.4 Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.

.5 Valve handles to take a padlock, and wheels a chain and padlock.

3 EXECUTION

3.1 INSTALLATION

.1 Confirmation of Dimensions:

.1 Confirm with the valve manufacturers, the face to face dimensions of all valves as well as the dimensions of the various valve operators.

.2 In the event that the face to face dimensions or other details vary from that shown on drawings or listed above, the Contractor shall be responsible to modify the connecting pipe lines to suit the valves supplied.

.3 Essentially, center-lines of shafts shall remain as show on the drawings provided operators have suitable clearance from all other equipment.

.2 Flange Ends:

.1 Flanged valve bolt holes shall straddle vertical centerline of pipe.

.2 Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

.3 Screwed Ends:

.1 Clean threads by wire brushing or swabbing.

.2 Apply joint compound.

.4 Soldered Ends:

.1 Remove internal parts before soldering.

.5 PVC and Valves: Install using solvents approved for valve service conditions.

.6 Valve Orientation:

.1 Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 1480 mm or less above finished floor, unless otherwise shown.

.2 Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 1480 mm and 2100 mm above finish floor, unless otherwise shown.

.7 Orientation of valve position Indication: Install valve operators whether manual or electric, to clearly indicate whether the valve is open, closed or partially open from a point no less than 3 m away and visible from a position compatible with normal plant operation.

.8 Install a line size ball valve and union upstream of each solenoid valve, in line flow switch, or other in line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

.9 Install safety isolation valves on pumps, tanks, compressed air, contactors and filter columns, as shown in the Contract Drawings.

.10 Locate valve to provide accessibility for control and maintenance.

.11 Install valve extensions where required for pipe insulation.

3.2 TESTS AND INSPECTION

.1 Valve may be either tested while testing pipelines, or as a separate step.

.2 Test that valves open and close smoothly under operating pressure conditions. Test that two way valves open and close smoothly under operating pressure conditions from both directions.

.3 Set, verify, and record set pressures for all relief and regulating valves.

.4 Automatic valves to be tested in conjunction with control system testing. Set all opening and closing speeds, limit switches, as required or recommended by the Contract Administrator.

3.3 SUPPLEMENTS

.1 Mechanical Manual Valve Schedule, following “End of Section,” is part of this Specification.

END OF SECTION

MECHANICAL MANUAL VALVE SCHEDULE

P&ID Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
1-0650M-P0021-002	Butterfly	V230	100 & 150	CHS/CHR	Exposed	
1-0650M-P0021-002	Ball	V330	12 & 20	CHS/CHR	Exposed	

General Notes:

The schedule provided is for the contractor convenience and shall not be taken as complete. The contractor shall review the project drawings and process and instrumentation drawings for work scope and valves not listed in this Table.

1 GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.9, Building Services Piping.

.2 ASTM International (ASTM)

.1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

.6 Underwriter's Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.9 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP58 and ANSI B31.1.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use electro-plating galvanizing process or hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.4 Where pipe or equipment is supported from floors or walls, utilize existing hangers where noted, or fabricate structural steel supports using Unistrut except where provision is required for adjustment. Where details of construction are not indicated, submit drawings to the Contract Administrator for approval before fabrication.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed / 13 mm FM approved.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed and/or FM approved to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, ULC listed and FM approved to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULC listed and FM approved.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies.

.2 Steel brackets.

.6 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 ULC listed and FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated or epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

.1 PVC/CPVC pipe: galvanized to MSS SP58, type 42, ULC listed and FM approved.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

.1 Reuse the existing chiller housekeeping pad for the installation of the glycol circulation pumps, City supplied glycol storage tank, and the expansion tank.

3 EXECUTION

3.1 GENERAL

.1 Hanger components shall not be used for purposes other than for which they were designed. Hanger components shall not be used for rigging and erection purposes.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps designed for use with PVC piping.

.2 Bolt-tightening torques to industry standards.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.4 HANGER SPACING

.1 Schedule 80 PVC Pipe

.1 Space in accordance with the more restrictive of the table below or the pipe manufacturers recommendations.

Temperature (degrees C)	Up to 19 mm	25 to 50 mm	65 to 75 mm	100 mm	150 mm
	Support Spacing in Metres for Sizes Shown Above*				
38	1.35	1.50	1.90	2.00	2.37

*Note: Spacing is for fluids with a specific gravity up to 1.35, but not for concentrated heavy loads.

.2 Copper Tubing:

13 mm	19 to 25 mm	32 to 50 mm
Support Spacing in Metres for Sizes Shown Above		
1.8	2.4	3.0

.3 Within 300 mm of each elbow.

3.5 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.6 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.7 VERTICAL MOVEMENT

.1 Where vertical movements are anticipated provide variable spring hangers sized based on the load and movement.

3.8 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.9 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCE STANDARDS

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS)

.2 National Fire Protection Association (NFPA)

.1 NFPA 13-[2002], Standard for the Installation of Sprinkler Systems.

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada [2015] (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.

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

.1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Provide system shop drawings complete with performance and product data.

.3 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Contract Administrator will make available [1] copy of systems supplier's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 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.

Part 2 Products

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Performance: as indicated.

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

.6 Performance: as indicated.

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy-duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to [9] mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.10 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.11 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled without need for sub-base.

.2 Lower member: continuous rectangular steel tube or extruded aluminum channel.

.3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.

.4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick [continuous gasket on top and bottom of complete assembly] [or] [pads on top and bottom of each spring]. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: [aluminum] [neoprene].

.7 Hardware: cadmium plated or galvanized.

2.12 SEISMIC CONTROL MEASURES

.1 General:

.1 Seismic control systems to work in every direction.

.2 Fasteners and attachment points to resist same maximum load as seismic restraint.

.3 Drilled or power-driven anchors and fasteners not permitted.

.4 No equipment, equipment supports or mounts to fail before failure of structure.

.5 Supports of cast iron or threaded pipe not permitted.

.6 Seismic control measures not to interfere with integrity of fire stopping. Coordinate with Section 07 84 00 - Fire Stopping.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment:

.1 Use one or more of following methods depending upon site conditions:

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.3 As indicated.

.4 Piping systems:

.1 Fire protection systems: to NFPA 13.

.2 Piping systems: hangers longer than 305 mm; brace at each hanger.

.3 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:

.1 Approved by Contract Administrator.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles, and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at 25% and 60% completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports Contract Administrator within 3 days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC system[s] after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.2 Take vibration measurements for equipment as indicated.

.3 Provide the Contract Administrator with notice 24 hours in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.5 Submit complete report of test results including sound curves.

.3 Verification requirements include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Certified wood.

.8 Low-emitting materials.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCE STANDARDS

.1 The City of Winnipeg, Water and Waste Department

.1 Identification Standard
https://winnipeg.ca/waterandwaste/pdfs/dept/IdentificationStandard.pdf

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare and submit a nameplate schedule identifying the nameplate size and text for each piece of equipment, pipeline device, valve, gauge supplied or referenced on the P&ID's for this Contract for the Contact Administrators review and acceptance. Indicate the colours of the nameplate and identify the applicable P&ID for the device.

.3 Samples:

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

.2 Samples lists of proposed legends.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Dispose of unused paint or coating material at official hazardous material collections site approved by Contract Administrator.

.2 Do not dispose of unused paint or coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: black letters, yellow background.

.2 Fire Protection: white letters, red background.

.3 Elsewhere: white letters, green background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners with the exception of size #10, letters accurately aligned, and machine engraved into core.

.3 Naming Convention

.1 Devices tagged for this Work will be identified in accordance with the City of Winnipeg, Water and Waste Identification Standard as follows:

FFFF	-	EEEE	-	A	NN(N)(N)	-	XX or S
Facility Code (not required)	-	Equipment Function Designation	-	Area Code	Equipment Number	-	Component Number (used if required) or Suffix Number for manual valves (no dash is applied between the equipment number and the sufffix

Where,

FFFF is the *Facility Code*, from Appendix A of the Identification Standard. It is not required on tags.

EEEE is the Equipment Functional Designation, which is comprised of 1 to 4 characters from Section 4.1.14.2 of the Identification Standard

A is the Area Code, which is based on Section 2.3 of the Identification Standard.

NN(N)(N) is the Equipment Number of the associated equipment. This will be three digits for the facility in this scope of Work.

XX Is the Component Numbers are suffixes to equipment numbers that are utilized to designate multiple components of a single system, not applicable to all tags.

S is the Suffix, a single letter to designate the specific valve. Always apply a suffix, regardless if there are one or more valves with the same equipment number.

Example:

P-M602 A pump in the M area.

HV-M602A A hand valve associated with the above pump.

.1 Sizes:

.2 Conform to following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20
10	35 diameter	1	5

.3 Use maximum of 25 letters/numbers per line.

.2 Locations:

.4 The lamacoid sizes for each piece of equipment supplied under this Contract or referenced as part of the Contract are shown in Appendix ? Equipment List.

.5 All valves, pipeline devices, thermometers, pressure gauges: use size #10.

2.3 IDENTIFICATION OF PIPE SYSTEMS

.3 General

.1 The labels to identify the contents of the system are to include a background colour, pipe/DUCT size, fluid commodity code, pipe specification code, and direction of flow by arrows.

.2 Colours:

.1 Hazardous: black letters, yellow background.

.2 Fire Protection: white letters, red background.

.3 Elsewhere: white letters, green background (except where required otherwise by applicable codes).

.4 Arrows showing direction of flow:

.4 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.5 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.6 Use double-headed arrows where flow is reversible.

.3 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate full length of legend and arrows.

.3 Ductwork: 100 mm wide label and length to to accommodate 50 mm tall letters and directional arrows 150 mm long x 50 mm tall

.4 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.5 Naming Convention

.3 Pipe and ductwork labels for this Work will be identified in accordance with the City of Winnipeg, Water and Waste Identification Standard as follows:

P	**-**	**CCC**	**-**	**MMNN**
Pipe Size Nominal (mm)	-	Fluid Commodity Code	-	Pipe Specification Code

Where,

P is the nominal pipe size and may be from 1 to 4 digits. For rectangular or flat ovals conduits and ducts, express the size as width x height.

CCC is the Fluid Commodity Code, which is 2 to 4 characters from Section 5.1.2 of the Identification Standard.

MMNN is the Pipe Specification Code, where MM is the material from Table 5.1.3, and NN is a number referencing the specific specification of the Identification Standard.

Example:

150-GS-PV80 A 150mm (6 inch) glycol supply pipe, with specification code PV80 (Schedule 80 PVC).

2.4 LANGUAGE

.1 Identification in English.

3 Execution

3.1 TIMING

.1 Provide identification only after painting has been completed.

3.2 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.3 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in process rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.4 VALVES

.1 Valves secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of the P&IDs and the valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1 DEFINITIONS

.1 When used in this Specification the following terms mean:

.1 "**AABC**" means Associated Air Balance Council;

.2 "**NEBB**" means National Environmental Balancing Bureau;

.3 "**SMACNA**" means Sheet Metal and Air Conditioning Contractors' National Association;

.4 "**TAB**" means the process and procedures for the testing, adjusting, and balancing the new and identified existing HVAC Materials relevant for this Work;

.5 "**TAB Firm**" means the company contracted through the Contract by the Contractor or the Contractor's subtrades to preform the Work of this Specification section;

.6 "**TAB Personnel**" means the TAB Specialist and the appropriate support personnel to complete the Work of this Section; and

.7 "**TAB Specialist**" means the individual certified by the referenced standards as:

.1 TAB Engineer by AABC;

.2 TAB Supervisor by NEBB; and

.3 TAB Supervisor by SMACNA;

.8 "**TAB Standard**" means the testing and balancing standard under which the TAB Personnel's qualifications and TAB Firm are approved to complete the Work of this Contract and include one of the following:

.1 AABC, National Standards for Total System Balance, MN-1-2002;

.2 NEBB, TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2015; or

.3 SMACNA, HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

1.2 SUBMITTALS

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

.2 Preconstruction Submittals:

.1 Submit the following qualification requirements within 90 Calendar Days of award of Contract but not less than 30 Calendar Days before the start of TAB on Site for review by the Contract Administrator:

.1 Names and qualifications of TAB Specialist(s) to perform TAB; and

.2 TAB Firm's registration/certificate number and the expiration date of the registration/certification number.

.2 TAB Firm or TAB Specialist(s) without a current registration or current certification are not to perform TAB on this Contract.

.3 Pre-TAB review.

.4 Pre-TAB checklist.

.5 Instrumentation to be used and the applicable calibration documents.

.3 Reports

.1 Preliminary TAB Report.

.2 Final TAB Report.

1.3 TAB STANDARDS

.1 Recommendations and suggested practices contained in the TAB Standard shall be mandatory.

.2 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.3 Use TAB Standard for TAB, including qualifications for TAB Firm and TAB Specialist and calibration of TAB instruments.

.4 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.5 TAB Standard quality assurance provisions such as performance guarantees form part of this contract. For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used, the requirements and recommendations contained in these procedures and requirements are considered mandatory

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.6 RESPONSIBILITIES

.1 Contractor

.1 Ensure that the TAB is accomplished by a TAB Firm meeting the requirements specified herein.

.2 Attend a pre-TAB meeting with the City, Contract Administrator, TAB Firm and ensure that a representative is present from the mechanical trade, sheet-metal trade, electrical trade, and automation trade.

.3 Furnish one complete set of the following HVAC-related documentation to the TAB Firm:

.1 Contract Drawings and Specifications;

.2 Approved submittal data for equipment;

.3 Construction Work schedule; and

.4 Up-to-date revisions and change orders for the previously listed items.

.4 Ensure that the schedule for submittals and work required by this Specification Section are met

.5 Provide the technical personnel, including but not limited to:

.1 factory representatives or automation subtrades required by the TAB Firm to support the TAB field measurement work.

.2 mechanics to operate HVAC equipment and sheet-metal trades to provide the field designated test ports to enable TAB Firm to accomplish TAB field measurement work.

.3 Ensure these support personnel are present at the times required by the TAB Firm, and cause no delay in the TAB field work.

.6 Conversely, ensure that the Contract Administrator, City, and automation subtrade has required support from the TAB Firm to complete the control checks.

.7 Ensure that the TAB Firm noted design/construction deficiency are submitted to the Contract Administrator within three (3) Business Days after the deficiency is encountered. Further, ensure that all such submissions are complete with explanation, including documentation, detailing deficiencies.

.8 Complete check out and startup of systems and Materials prior to the TAB Firm arriving at Site to begin the TAB. Check out and startup includes searching for and eliminating malfunctioning elements in the system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB Firm.

.9 The TAB Firm shall not commence TAB field work until the system installations are fully completed, the pre-TAB checklist is completed by the Contractor and reviewed by the Contract Administrator, and air filters in the ductwork are clean for TAB field work.

.10 Provide five (5) Business Day written notice to the Contract Administrator of the commencement of TAB field work.

.11 The Contractor in conjunction with the Contract Administrator are responsible for ensuring the automation system responds to the TAB requirements.

.2 TAB Firm

.1 Provide the services of TAB Personnel which complies with the requirements of this Specification Section. The Work to be performed by the TAB Firm is limited to the TAB of the Pump Floor air systems (supply, return and exhaust) and the chiller systems.

.3 TAB Specialist

.1 Supervise and manage the overall TAB Personnel work effort, including preliminary and technical TAB procedures and TAB Personnel field work.

.2 Pre-TAB meeting: Attend the meeting with the Contractor.

.3 Pre-TAB review: Conduct the pre-TAB review as detailed in this Specification Section.

.4 Specify the technical support personnel required from the Contractor and the Contract Administrator. Inform the Contractor in writing of the support personnel needed and when they are needed.

.5 Provide the Contractor a pre-TAB checklist for the Contractor to complete. The pre-TAB checklist shall address the Work that needs to be completed prior to the start of TAB.

.6 Prepare the certified TAB report. This report includes the following work:

.1 Review the TAB field data and formalize into a report for submission to the Contract Administrator for review. Verify the adherence by the TAB Personnel to the TAB procedures specified herein.

.2 Prepare a preliminary TAB report for review and comment by the Contract Administrator.

.3 Update the TAB report based on the Contract Administrator's comments.

.4 Coordinate any revalidation of TAB field data as requested by the Contract Administrator and as specified herein.

.7 Within three (3) Working Days after the TAB Firm has encountered any design or construction deficiencies, the TAB Specialist must submit written notification to the Contractor of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB.

.8 Do not bring the TAB Personnel to the Site until a copy of the prerequisite pre-TAB Checklist, with all work items certified by the Contractor to be working as designed, has been accepted by the Contract Administrator.

1.7 SCHEDULING

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

.3 Coordinate with the City Controls Contractor and the City to ensure all control items are in place and operational prior to starting of TAB.

1.8 PRE-TAB CHECKLIST

.1 Prepare and submit a list itemizing the inspections and work items which shall be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted to the Contract Administrator for review and acceptance prior to the TAB Personnel coming to the Contract Site

1.9 PRE-TAB REVIEW

.1 Review Contract Documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard. TAB procedures used to complete the Work referencing the TAB Standard procedure and the applicable system or component (e.g. AABC Item 2.2 – Electrical Power Measurements, for the testing of electric motors, etc.).

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.10 START-UP AND OPERATION OF SYSTEMS DURING TAB

.1 Coordinate with the Contractor for the start-up and operation of the systems during TAB.

1.11 START OF TAB

.1 Notify Contract Administrator 7 days prior to start of TAB.

.2 Confirm that all items outside the scope of this project that are required for the TAB have been completed with the Contract Administrator.

.3 Provisions for TAB installed and operational.

1.12 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of system requirement values:

SYSTEM	TOLERANCE OF SYSTEM REQUIREMENTS	REMARKS
Air handling units, fans	minus 5% to plus 10%.	Systems with filters must be tested at dirty conditions
Outdoor air	0 to plus 10%.	To obtain this accuracy requires ductwork that can be traversed otherwise calculated.
Grilles, registers and diffusers	plus or minus 10 %	If the design is ≤ 47 l/s will be ± 4.7 l/s
Positive pressurized room	supply air 0% to plus 5%, return/exhaust air minus 5% to 0%	Room offset tolerance to system requirements 100% to +110%
Negative pressurized room	supply air minus 5% to 0%, return/exhaust air 0% to plus 5%	Room offset tolerance to system requirements 100% to +110%
Coils, Heat Exchangers, Pumps, Evaporators, Condensers	plus or minus 5%.	Coils requirements ≤ 0.61 l/s shall be set for ± 10%

1.13 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2 % of actual values.

1.14 INSTRUMENTS

.1 Prior to TAB, submit to Contract Administrator list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Contract Administrator.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.16 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 3 paper copies of TAB Report to Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.

.4 Submit a digital PDF copy of the TAB Report to the Contract Administrator prior to Total Performance.

.5 Submit additional copies to the Contractor for inclusion in the Operations and Maintenance Manuals.

1.17 VERIFICATION

.1 Reported results subject to verification by Contract Administrator.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Contract Administrator.

.4 Pay costs to repeat TAB as required to satisfaction of the City and Contract Administrator.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of the City and Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by the City and Contract Administrator.

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

1.21 POST-OCCUPANCY TAB

.1 Participate in systems checks once during Warranty Period.

2 PRODUCTS

2.1 NOT USED

.1 Not used.

3 EXECUTION

3.1 PRE-TAB MEETING

.1 Meet with the Contractor, Contract Administrator and designated others to develop a mutual understanding relative to the details of the TAB requirements. Ensure that the TAB specialist is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.2 TAB PROCEDURES

.1 TAB field work

.1 Test, adjust, and balance the HVAC systems until measured fluid flow rates are within the system requirement flow rates.

.2 Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

.2 TAB Air Distribution Systems

.1 Report the cooling performance of the air handling units cooling coils for the purpose the coils meet the system requirements. Conduct capacity tests in accordance with AABC MN-4, procedure 3.5, “Coil Capacity Test” or the equivalent procedures for NEBB and SMACNA. Determine the entering and leaving wet and dry bulb temperatures by the average of multiple readings. Submit part-load coil performance data from the coil manufacturer converting test conditions to system required conditions.

.2 Air handling unit systems including fans, coils, ducts, plenums, mixing boxes, air distribution devices for supply air, return air, outside air, and mixed air.

.3 Exhaust fans include fans, ducts, plenums, and grilles.

.3 TAB Hydronic Systems

.1 Chilled Glycol Systems including the air cooled chiller, pumps, coils, system balancing valves, and flow measuring devices.

.4 Workmanship

.1 Conduct TAB work on the systems until measured flow rates are within the applicable tolerances and rates specified in the Contract Documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, notify the Contract Administrator.

.5 Deficiencies

.1 Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of values specified provide written notice as soon as possible to the Contractor and the Contract Administrator describing the deficiency and recommended correction.

.6 TAB Reports

.1 After completion of the TAB work, prepare a preliminary TAB report using the reporting forms accepted by the Contract Administrator. Data required by those approved data report forms is to be furnished by the TAB Personnel form the Site TAB work. Except as approved otherwise in writing by the Contract Administrator, the TAB work and the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the Contract Documents.

.2 Prepare the report neatly and legibly; the preliminary TAB report is the final TAB report minus the Contract Administrator’s review and acceptance and the TAB Specialist’s and TAB Firm’s certification.

3.3 HYDRONIC SYSTEMS

.1 Prepare test reports for all pumps, coils and chiller associated with the final upgraded HVAC system. Obtain relevant documentation to determine TAB procedures or requirements for the installed system. The City will endeavor to supply Shop Drawings and equipment data for existing equipment, however if no information is available, the Contractor shall contact the manufacturers to obtain said information.

.2 Crosscheck the summation of required coil and chiller flow rates with pump design flow rate.

.3 Verify that hydronic systems are ready for testing and balancing:

.1 Check air pressure in expansion tank.

.2 Check that glycol makeup system has adequate pressure pump to the highest vent in the system.

.3 Check that control valves are in their proper position.

.4 Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

.5 Verify that motor starters are equipped with properly sized thermal protection.

.6 Check that air has been purged from the system.

.4 Chilled Glycol Loop

.1 Adjustment of the hydronic pumps to deliver total design flow rate

.1 Position valves for full flow through the coils.

.2 Determine the flow of the pump through the installed triple duty valve.

.2 Measurement of the pump’s total dynamic head

.1 Measure the discharge pressure of the pump directly at the pump outlet flange or in the discharge pipe prior to any valves.

.2 Measure the inlet pressure of the pump directly at the pump inlet flange or in the suction pipe prior to any valves or strainers.

.3 Convert the pressure to pump head and correct for any differences in gauge heights.

.4 Verify the pump impeller size by measuring the total dynamic head with the discharge valve closed. Note the point on the manufacturer's pump curve at zero flow and verify that the pump has the specified impeller size.

.5 With all the valves open, read the pump's total dynamic head. Adjust the triple duty valve on the pump discharge until design water flow is achieved.

.3 Monitor motor performance during procedures and do not operate motor in an overload condition.

.4 Verify final system conditions as follows:

.1 Re-measure and confirm that the total glycol flow is within design tolerances.

.2 Re-measure all the final operating data, total dynamic head, electric parameters and static profile of the pumps.

.3 Mark all final settings.

.4 Verify that all memory stops have been set.

.5 Motors

.1 Motors, 373 W and Larger: Test the motors at the final balanced conditions and record the following data:

.1 Manufacturer's name, model number, and serial number.

.2 Motor horsepower or watts rating.

.3 Motor rpm.

.4 Phase/Hertz

.5 The nameplate and measured voltage at each phase

.6 The nameplate and measured amperage at each phase

.7 Starter size and thermal-protection-element rating

.8 Service factor and frame size

.2 For motors driven by a variable frequency drive, test the manual bypass of the controller to prove proper operation.

.6 Chiller

.1 Balance water flow through the evaporators to within specified tolerances with the pump operating per design sequence. Record the following data with the chiller operating at design conditions:

.1 Evaporator-glycol entering and leaving temperatures, pressure drop, and flow rate.

.2 Power factor on the chiller display panel.

.3 Kilowatt input on the chiller display panel.

.4 Capacity: Calculate in tons of cooling.

.5 Verify condenser fan rotation and record fan and motor data including number of fans and entering and leaving air temperatures

3.4 AIR SYSTEMS

.1 Prepare test reports for both fans and outlets associated with the final upgraded HVAC system. Obtain relevant documentation to determine TAB procedures or requirements for the installed system. The City will endeavor to supply Shop Drawings and equipment data for existing equipment, however if no information is available, the Contractor shall contact the manufacturers to obtain said information.

.2 Crosscheck the summation of required outlet volumes with required fan volumes.

.3 Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

.4 Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

.5 Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

.6 Verify that motor starters are equipped with properly sized thermal protection.

.7 Check condensate drains for proper connections and functioning.

.8 Check for proper sealing of air-handling-unit components.

.9 Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

.1 Measure total airflow.

.1 Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.

.2 Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

.3 Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

.4 If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

.2 Measure fan static pressures as follows:

.1 Measure static pressure directly at the fan outlet or through the flexible connection.

.2 Measure static pressure directly at the fan inlet or through the flexible connection.

.3 Measure static pressure across each component that makes up the air-handling system.

.4 Report any artificial loading of filters at the time static pressures are measured.

.3 Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

.10 Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

.1 Measure airflow of submain and branch ducts.

.2 Adjust sub-main and branch duct volume dampers for specified airflow.

.3 Re-measure each sub-main and branch duct after all have been adjusted.

.11 Verify final system conditions.

.1 Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

.2 Re-measure and confirm total airflow is within design.

.3 Re-measure all final fan operating data, rpms, volts, amps, static profile.

.4 Mark all final settings.

.5 Test system in economizer mode. Verify proper operation and adjust, if necessary.

.6 Measure and record all operating data.

.7 Record final fan-performance data.

3.5 EXISTING SYSTEMS

.1 Perform a preconstruction inspection of existing equipment that is to remain and be reused.

.1 Obtain manufacturer’s Shop Drawings and equipment data where not available from the City.

.2 Measure and record the operating speed, airflow, and static pressure of each fan

.3 Measure motor voltage and amperage. Compare the values to motor nameplate information

.4 Check the condition of filters

.5 Check the condition of coils

.6 Report on the operating condition of the equipment and the results of the measurements taken include any deficiencies to the Contract Administrator.

.2 Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

.1 New filters are installed

.2 Coils are cleaned and the fins are combed

.3 Condensate drain pans are clean

.4 Fans are clean

.5 Deficiencies noted in the preconstruction report are corrected.

.3 Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

.1 Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed.

.2 Verify that the indicated airflows of the renovated work result in fan speeds that are within the acceptable limits defined by equipment manufacturer.

.3 Adjust fan speeds within the limits of the installed sheaves and belts to achieve design airflow.

.4 Balance system to design airflows indicated.

3.6 MARKING OF SETTINGS

.1 Upon the final approval of the TAB work permanently mark the settings of system adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 The standards, guidelines, codes shall be the latest adopted standards.

.2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.3 National Research Council of Canada

.1 National Energy Code of Canada

.4 ASTM International (ASTM)

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.4 ASTM C547, Mineral Fiber Pipe Insulation.

.5 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.6 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.5 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.6 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA).

.2 Canadian Environmental Protection Act (CEPA)

.3 Transportation of Dangerous Goods Act (TDGA).

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.8 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.9 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S1023, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for pipe insulation and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 SDS:

.1 Provide all applicable SDS for products used in the Specification section.

.4 Manufacturers’ Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations and special handling criteria, installation sequence, and cleaning procedures .

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Contractor will make available 1 copy of systems supplier's installation instructions.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: must be a specialist in performing work of this section, have at least 3 years successful experience in this size and type of project, and be a member of Thermal Insulation Association of Canada (TIAC).

.2 Submit the qualifications of the installers upon request by the Contract Administrator.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 General

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.2 Indoor pipe assemblies including new and existing glycol systems and new domestic cold water assemblies shall be insulated with mineral fiber standard pipe insulation with an all service lap jacket. Insulation shall be 25 mm (1") thickness for pipe sizes up to 100 mm (4") pipe size and 35 mm (1-1/2") thickness for pipe sizes 100 mm (4") and larger and air separator.

.3 Outdoor pipe assemblies including new and existing glycol systems shall be insulated with 12 mm (1/2”) thick flexible closed-cell elastomeric insulation preformed to match pipe O.D. Sealed at all joints with the insulation manufacturer's adhesive and finished with two coats of finishing coat

2.3 JACKETS

.1 Indoor: polyvinyl chloride (PVC) jacket, one piece moulded type c/w preformed shapes as required. Use solvent weld adhesive compatible with insulation to seal pipes and joints.

.2 Outdooor: sheet aluminium jacket secured with 12 mm (1/2”) stainless steel bands.

2.4 VAPOUR BARRIER ADHESIVE

.1 Vapour barrier adhesive shall be Benjamin Foster 30 36, Bakelite 120 09 or approved equal in accordance with B7.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 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

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards as indicated in this Specification Section.

.2 Apply materials in accordance with manufacturer’s instructions and this specification.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.4 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

.5 Indoor Assemblies (TIAC 1501-C)

.1 Pipe: Apply pipe insulation with integral vapour retarder jacket to piping and hold in place by securing the jacket flap. Seal all flaps and butt strips with vapour retarder adhesive or alternately secure with staples on 75 mm centers and cover with vapour retarder tape. Pipe insulation with integral self-sealing vapour retarder jacket will not require additional fastening.

.2 Fittings: Insulate fittings with section of the pipe insulation mitered to fit tightly. All seams shall be sealed using vapour retarder tape.

.3 Valves and Strainers: Insulate valve bodies, bonnets and strainers with fitted pipe insulation or mitered blocks all to thickness of adjacent pipe insulation, then seal all seams of vapour retarder with vapour retarder tape.

.4 Flanges: Insulate with oversized pipe insulation or mitered blocks to the thickness of the adjacent pipe insulation, then seal all seams of vapour retarder jacket with vapour retarder tape.

.5 Air Separator: use either insulation with an integral vapour retarder or field apply a vapour retarder treatment. Apply insulation block board segments or pipe and tank insulation and secure firmly with mechanical fasteners, wire or banding .All openings, joints and seams shall be sealed with self-adhesive vapour retardant tape. Insulation shall be fitted neatly to all contours without voids.

.6 Outdoor Assemblies (TIAC 1501-CA)

.1 In accordance with the manufacturer's instructions.

3.4 JACKETING

.1 Indoor PVC Jacket (TIAC CPF/4)

.1 Over the pipe insulation apply PVC jacketing using necessary fastenings on approximately 300mm centers, or bond using an adhesive recommended by the manufacturer to provide continuous seal. Overlap each section a minimum 75 mm. Cover longitudinal and circumferential joints with finishing tape neatly applied.

.2 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges if specified) apply PVC jacket or preformed PVC fitting covers to provide a complete jacket system. Secure with appropriate fastenings and jacket finishing tape.

.2 Outdoor Metal Jacket (TIAC CPF/3)

.1 Over the pipe insulation apply metal jacketing with a 60mm overlap at 3 o’clock using necessary fastenings on approximately 150mm centers.

.2 Over insulated fittings, (valve bodies, valve bonnets, strainers and flanges if specified) apply metal jacket or preformed metal fitting covers to provide a complete jacket system. Secure with necessary fastenings.

.3 Air Separator (TIAC CEF/1)

.1 Over the insulation, apply aluminum jacket secured with stainless steel self-tapping screws or pop rivets with all joints caulked or flashed to prevent water infiltration.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 SEQUENCING AND SCHEDULING

.1 Complete the following prior to starting Functional Performance Tests of mechanical systems:

.1 All equipment and systems completed, cleaned, flushed, disinfected, calibrated, tested, and operate in accordance with Contract documents.

.2 Final TAB report has been accepted by the Contract Administrator in accordance with Specification Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

.3 Instrument Test Reports and Loop Check Reports of control systems have been completed and accepted by the Contract Administrator in accordance with Specification Section the Performance Verification Test Report has been submitted in accordance with Specification Section 29 05 00.

1.3 ACCESSIBILITY REQUIREMENTS

.1 Equipment, systems, and devices for commissioned systems must be accessible. Make necessary modifications if systems and devices are not accessible for inspections and testing.

.2 Assist commissioning team in testing by removing equipment covers, opening access panels, and other required activities that assist with visual oversight. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

1.4 COORDINATION

.1 Refer to Specification Section 01 91 13 – General Commissioning Requirements for requirements pertaining to coordination during the commissioning process. Coordinate with the Contract Administrator in accordance with Section Specification 01 91 13.13 – Commissioning Planning to schedule inspections as required to support the commissioning process. Furnish additional information requested by Contract Administrator. Coordinate scheduling of Functional Performance Testing with the Contract Administrator.

1.5 PIPE FLUSING, TESTING, AND WATER TREATMENT REPORTS

.1 Test requirements are specified in Specification Section 23 08 16 – Cleaning and Start Up of HVAC Piping Systems. Prepare a pipe system cleaning, flushing, and hydrostatic testing log. Provide cleaning, flushing, testing, and glycol treatment log and final reports.

.2 Include the following in the pipe system cleaning, flushing, and hydrostatic testing log:

.1 Minimum flushing water velocity;

.2 Glycol treatment reports; and

.3 Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

1.6 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Control pressure failure.

.3 Maximum cooling demand.

.4 Chiller failure.

1.7 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of glycol circulation pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Contract Administrator to provide the calculated system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system glycol solution to approved testing agency to determine if chemical treatment is correct.

.6 Chilled water system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Operating all available internal building and process heat rejection that would normally or otherwise be contributing to the cooling load.

.2 Test procedures:

.1 Open fully cooling coil control valves.

.2 Override the space temperature sensors for maximum cooling.

.3 Set AHU's for design maximum air flow rates.

.4 Set load or demand limiters on chillers to 100%.

.5 After system has stabilized, record glycol flow rates, supply and return temperatures of the glycol solution simultaneously.

1.8 GLYCOL SYSTEMS

.1 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.9 REPORTS

.1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, supplemented as specified herein.

1.10 TRAINING

.1 In accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel.

2 PRODUCTS

2.1 TEST EQUIPMENT

.1 Provide all testing equipment required to perform testing for the systems to be commissioned, except for equipment specific to and used by TAB. Provide a sufficient quantity of two-way radios for each subcontractor, as required..

.2 Submit list of test equipment and instrumentation to be used for testing including equipment/instrument identification number, equipment application or planned use, manufacturer, make, model, and serial number, and calibration history with certificates. Also list special equipment and proprietary tools specific to a piece of equipment required for testing.

.3 Provide manufacturer's proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not. Provide manufacturer test equipment, demonstrate its use, and assist in the commissioning process as needed.

.4 Provide data logging equipment and software required to test equipment.

3 EXECUTION

3.1 MEETINGS

.1 Attend all meetings in accordance with Specification Section 01 91 13 – General Commissioning Requirements.

.2 Provide timely updates on construction schedule changes so Contactor has scheduling information needed to execute commissioning process efficiently. Notify the Contract Administrator of anticipated construction delays to commissioning activities not yet performed or not yet scheduled.

3.2 STARTUP CHECKS

.1 Complete and sign Form 102: Certificate of Satisfactory Installation and the installation start-up checklists as specified by the commissioning plan. Provide manufacturer's installation manual for each type of unit. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.3 STARTUP AND INITIAL CHECKOUT

.1 Document start-up and initial testing procedures including:

.1 Startup tests and factory testing reports.

.2 Manufacturer's representative start-up, operating, troubleshooting and maintenance procedures.

.3 Additional documentation necessary for third party certification programs (e.g. Manitoba Hydro, Manitoba Office of the Fire Commissioner, Planning and Property Development, etc.).

.4 Perform and clearly document system operational checks, system setpoint modifications, and quality control checks as they are completed, and providing a copy to the Contract Administrator.

.5 Correct deficiencies for each piece of equipment before functional performance testing.

3.4 FUNCTIONAL TESTING

.1 Conduct functional testing in accordance with Specification Section 01 91 13 – General Commissioning Requirements and the requirements in this section.

.2 Preparation

.1 Put equipment and systems into operation and continue operation during each working day of commissioning, as required. Verify temperature, level, flow, and pressure signals in accordance with Contract Documents.

.2 Perform minor adjustments to equipment and systems during functional tests as deemed necessary by the Contract Administrator. Where calibrated sensors cannot be used to record test data, provide measuring instruments, logging devices, and data acquisition equipment to record data for the complete range of test data for the required test period.

.3 Test Setup

.1 Perform each test under conditions that simulate actual conditions as close as is practically possible. Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion of the test, return the affected systems to their pre-test condition.

.4 Manufacturer's Representative

.1 Provide a factory trained representative authorized by the equipment manufacturer to perform functional testing for the following equipment:

.1 Air cooled chiller.

.2 Circulation pumps.

.2 Ensure the test representative reviews, approves, and signs the completed field test report. Include person's name with signatures.

.5 Simulating Conditions

.1 Functional testing is conducted by simulating conditions at control devices to initiate a control system response. Before testing, calibrate all sensors, transducers and devices. Over-writing control input values through the control system is not acceptable unless approved by the Contract Administrator. Do not simulate conditions when damage to the system may result. Do not use signal generators to simulate sensor signals unless approved by the Contract Administrator, as noted above, for special cases. Control set points can be altered. Caution: Set points are not to be raised or lowered to a point to cause damage to the components or systems.

.6 TAB Review

.1 The Contract Administrator will review the TAB Report and request TAB verifications. Any deficiencies noted during this verification are to be resolved and the TAB report corrected by the Contractor and accepted by the Contract Administrator.

.7 Automation Test Procedures and Reports

.1 All deficiencies noted during the commissioning of the automation systems are to be resolved prior to performance testing of the systems. Any additional deficiencies of the automation system noted during performance testing are to be resolved and accepted by the Contract Administrator prior to recommencing with the performance testing.

.8 Retesting Requirements

.1 Abort tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Re-test only after all deficiencies identified during the original tests have been corrected and accepted by the Contract Administrator.

.9 Completion of Functional Tests

.1 Functional testing can be accepted prior to seasonal testing if they comply with the Contract requirements and accepted design requirements that can be tested during initial functional tests. All test procedures must be successful completed prior to full systems acceptance.

.2 Complete and sign Form 103: Certificate of Equipment Satisfactory Performance and the functional performance test checklists as specified by the commissioning plan once the functional tests have been completed and accepted by the Contract Administrator.

3.5 PERFORMANCE TESTING

.1 Conduct performance testing in accordance with Specification Section 01 91 13 – General Commissioning Requirements and the requirements in this section.

.2 Seasonal Tests

.1 Perform initial seasonal performance tests as soon as all Contract Work is completed, but prior to facility turnover, regardless of the season.

.2 In addition to the initial performance tests, perform performance tests of the systems during season of maximum cooling. Schedule seasonal performance tests in coordination with the Contract Administrator. Submit seasonal test reports within 10 Business Days of test completion.

.3 Execute seasonal performance testing, witnessed by the Contract Administrator. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

.3 Full Load Tests

.1 Perform full load performance tests as soon as all Contract Work is completed, but prior to facility turnover. Performance tests under full-load conditions. Develop and implement means of artificial loading to demonstrate the ability of the process cooling systems to handle peak process loads. Schedule tests in coordination with the Contract Administrator. Submit test reports within 10 Business Days of test completion.

.2 Execute full-load performance testing, witnessed by the Contract Administer. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any full load testing.

.4 Completion of Functional Tests

.1 All performance test procedures must be successful completed prior to acceptance.

.2 Complete and sign Form 104: Certificate of Certificate of Satisfactory Performance and the performance test checklists as specified by the commissioning plan once the performance tests have been completed and accepted by the Contract Administrator.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications, datasheet, and SDS in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Instructions: submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

2 PRODUCTS

2.1 CLEANING SOLUTIONS

.1 Low foaming detergent at all temperatures

.2 No pH neutralization required

.3 Designed for use on most metals including aluminum and PVC

.4 Bio-degradable

.5 Phosphate free

.6 Nitrite free

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 CLEANING HYDRONIC SYSTEMS

.1 System: The chilled glycol distribution system consists of new PVC and existing carbon steel piping that shall be cleaned as part of this Work.

.2 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.3 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.4 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.5 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 28 Calendar Days prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.7 Methods of disposing of the waste.

.6 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that devices (e.g. coils, pumps, chillers, etc.) can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install pressure gauges on strainers to detect plugging.

.7 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.8 Hydronic Systems:

.1 Flush system thoroughly with water, back flush pump, strainers, blow down drain valves and risers to remove all loose debris. Remove the accumulated sludge in the chiller evaporator's tubes.

.2 Fill system with fresh water, ensure air is vented from system.

.3 Use water meter to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier using the chemical bypass pot feeder.

.5 Circulate for a minimum of 48 hours or as directed by the chemical treatment specialist. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.6 During recirculation, backflush strainers, drain valves and risers at the lowest point. The initial time within eight hours of starting and then twice daily at alternating ten and fourteen hour intervals.

.7 Drain the cleaning water completely.

.8 Then fill and drain the system several times. Circulate for 30 minutes every time after the system is refilled.

.9 Bleed the system at several points until the water is clear and non-foaming. Clean the pump and system strainers.

.10 Draw a water sample from the system and submit the sample for laboratory analysis.

.11 Once the results of the laboratory report are accepted by the Contract Administrator the system can be completely drained and filled with the glycol solution and inhibitor. Test the solution ratio and inhibitor strength. Make the adjustments and retest as required. include in procedural report. Refer to ASTM E202 for test procedures and acceptable fluid characteristics.

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment.

.5 Check glycol level in the glycol feed mixing tank.

.6 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.7 Bring system to the design temperature and pressure.

.8 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.9 Adjust pipe supports, hangers, springs as necessary.

.10 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.11 If sliding type expansion joints bind, flexible connectors misalign, or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.12 Re-tighten bolts using torque wrench, to compensate for system relaxation. Repeat several times during commissioning.

.13 Check operation of drain valves.

.14 Adjust valve stem packings as systems settle down.

.15 Fully open balancing valves (except those that are factory-set).

.16 Check operation of over-temperature protection devices on circulating pumps.

.17 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation procedures for control of Hurst Pump Room HVAC systems.

1.2 SUBMITTALS

.1 Provide shop drawing and O & M submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit the manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

1.3 OPERATING INSTRUCTIONS

.1 Provide three sets of control sequences complete with description of operating sequence.

.2 Where adjustment devices, throttling devices, and gauges are installed, mark clearly and identify the readings required for the intended performance of the system.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store, and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 ELECTRONIC CONTROL

.1 Product requirements for electronic control are specified in Section 40 92 00 – Automation – Primary Control Devices.

Part 3 Execution

3.1 AIR HANDLING UNITS – AHU-M601, AHU-M602

.1 Run Conditions:

.1 Each unit shall run according to the following modes:

.1 HAND: With the H-O-R switch in HAND position the supply fan shall start and run continuously, subject to safeties and alarms.

.2 OFF: With the H-O-R switch in OFF position the supply fan shall stop.

.3 REMOTE: With the H-O-R switch in the REMOTE position the HVAC PLC shall energize the AHU fan, subject to safeties and alarms.

.2 Start-up

.1 On a signal from the HVAC PLC, the system will prove the AHUs mixed air dampers (FV-M6015 and FV-M6025) are in position such that the outside air damper is closed, and the return air is open.

.2 When dampers are proven the supply fan for the first unit will energize through the associated starter.

.3 Startup of the AHUs shall be staggered as follows:

.1 Adjustable timer delay: 30 seconds (adjustable 15 to 300 seconds)

.3 Shutdown

.1 On a signal from the HVAC PLC or in Off-mode:

.1 the AHUs mixed air dampers (FV-M6015 and FV-M6025) will move to the position such that the outside air damper is normally closed, and the return air is normally open.

.2 the supply fan de-energizes.

.4 The unit shall maintain:

.1 A 24°C (adjustable) station cooling setpoint. (TT-M6002)

.2 Room Temperature Alarms shall be provided as follows:

.1 High Room Temp: If the station temperature (TT-M6002) is greater than 35°C (adjustable), then a temperature alarm high (TAH) is generated.

.2 Low Room Temp: If the station temperature (TT-M6002) is less than 8°C (adjustable), then a temperature alarm low (TAL) is generated.

.3 AHU Supply Fan:

.1 The supply fan in each AHU shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling when the station temperature set point is met, the supply fan shall have a user definable (adjustable) minimum runtime.

.2 The AHUs shall be commanded to run when the station temperature (TT-M6002) is above setpoint.

.3 The AHUs shall be commanded off when all of the following conditions are met:

.1 Chiller is off.

.2 Free cooling mode is not enabled.

.3 Station temperature setpoint is met within 2°C (adjustable) deadband.

.4 Alarms shall be provided as follows for each fan:

.1 Fault alarm: Commanded on, but the status is off.

.2 Supply Fan In-Hand: HVAC PLC commanded off, but the status remains on after a user adjustable time delay.

.3 Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adjustable).

.4 Chilled Water Cooling

.1 The chilled water cooling shall be enabled whenever:

.1 Outside air temperature (TT-M6041) is above 13°C (Adjustable)

.2 AND the station temperature (TT-M6002) is above the cooling setpoint.

.3 AND the supply fan status is on.

.2 Mixing Dampers

.1 The AHUs mixed air dampers (FV-M6015 and FV-M6025) will move to the position such that the outside air damper is in a minimum position, and the return air is open.

.5 Free Cooling using Mixing Dampers:

.1 The PLC shall measure the station temperature (TT-M6002) and modulate the AHUs mixed air dampers (FV-M6015 and FV-M6025) in sequence to maintain a 15°C (adjustable) setpoint.

.2 The free cooling mode shall be enabled whenever:

.1 The outside air temperature (TT-M6041) is below 14°C (adjustable),

.2 The outside air temperature (TT-M6041) is below the station temperature (TT-M6002), and

.3 The AHU supply fan status is on.

.3 The chiller (CHLR-M630) shall turn off.

.4 The chilled water pump (P-M631 or P-M632) shall remain operational for a user defined time period (adjustable) after the chiller has turned off.

.6 Room Ambient Carbon Monoxide (CO) Detection and Ambient Explosive Gas Detection.

.1 The PLC shall receive a 20% LEL Methane signal from AE-M6901-1 and AE-M6902-2 and a 70 PPM CO signal from AE-M6901-1, AE-M6902-2 and AE-M6902-3 via Control Relays CR-1 and CR-2 in the Main Control Panel.

.2 Upon receiving an alarm condition, PLC will

.1 Command EF dampers (XV-M6510, XV-M6520, XV-M6530) open and signal EFs on.

.1 EFs to operate as per their sequences.

.2 Signal AHUs as follows:

.1 AHU outside air damper to 100% open

.2 AHU return air damper to fully closed

.3 AHU Fan ON, if not already in operation

.3 EFs to operate continuously until alarm condition has cleared for 5 minutes (adjustable 0 to 30 minutes).

.4 PLC will then

.1 Signal EFs off

.2 Return AHUs to last control sequence.

3.2 CHLR-M630

.1 Chiller - Run Conditions:

.1 The chiller shall be enabled to run whenever:

.1 Called to run by the HVAC PLC CP-M806.

.1 Controller shall provide programmable run time for hours and days of operation on a full year cycle.

.2 The chiller controller shall have its own internal logic to prevent short cycling.

.3 The chiller shall run subject to its own internal safeties and controls.

.2 Chilled Water Pump Lead/Standby Operation:

.1 The two chilled water pumps P-M631 and P-M632 shall run anytime the chiller is called to run.

.2 The duty pump shall start prior to the chiller being enabled and shall stop only after the chiller is disabled. The pumps shall therefore have:

.1 A user adjustable delay on start, and

.2 A user adjustable delay on stop.

.3 The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown, and sequencing.

.4 The two pumps shall operate in a duty/standby fashion.

.1 The duty pump shall run first.

.2 On failure of the duty pump, the standby pump shall run and the duty pump shall turn off.

.5 The designated duty pump shall alternate upon one of the following conditions (user selectable):

.1 manually through a software switch;

.2 if pump runtime (adjustable) is exceeded;

.1 daily;

.2 weekly; or

.3 monthly.

.6 Alarms shall be provided as follows:

.1 Chilled Water Pump (P-M631)

.1 Fault alarm: Commanded on, but the status is off.

.2 Running In-Hand: HVAC PLC Commanded off, but the status remains on after a user adjustable time delay.

.3 Runtime Exceeded: Status runtime exceeds a user definable time period (adjustable) while running in-hand and the chiller is off.

.2 Chilled Water Pump (P-M632)

.1 Fault alarm: Commanded on, but the status is off.

.2 Running In-Hand: HVAC PLC Commanded off, but the status remains on after a user adjustable time delay.

.3 Runtime Exceeded: Status runtime exceeds a user definable time period (adjustable) while running in-hand and the chiller is off.

.3 Chiller:

.1 The chiller shall be enabled by a user adjustable timer after pump statuses are proven on. The chiller shall therefore have a user adjustable delay on start.

.2 The delay time shall be set appropriately to allow for orderly chilled water system start-up, shutdown, and sequencing.

.3 The chiller shall run subject to its own internal safeties and controls.

.4 Alarms shall be provided as follows:

.1 Fault alarm: Commanded on, but the status is off.

.5 Chiller Chilled Water Supply Setpoint:

.1 The chiller shall maintain a constant chilled water supply temperature setpoint of 5.5°C (adjustable).

.2 The 3-way cooling coil chilled water control valve for each AHU (TV-M6011 and TV-M6021), shall modulate as required to maintain room set point provided by station temperature transmitter TT-M6002.

.6 Chilled Water Temperature Monitoring:

.1 The following temperatures shall be monitored:

.1 Chilled water supply. (TT-M6303)

.2 Alarms shall be provided as follows:

.1 High Chilled Water Supply Temp: If the chilled water supply temperature is greater than 13°C (adjustable).

.2 Low Chilled Water Supply Temp: If the chilled water supply temperature is less than 3°C (adjustable).

3.3 EXHAUST FANS – EF-M6510, EF-M6520, EF-M6530

.1 Run Conditions:

.1 The exhaust fans shall run according to the following modes:

.1 HAND: With the H-O-R switch in HAND position the exhaust fan shall start and run continuously, subject to safeties and alarms.

.2 OFF: With the H-O-R switch in OFF position the exhaust fan shall stop.

.3 REMOTE: With the H-O-R switch in the REMOTE position the HVAC PLC shall energize the exhaust fan, subject to safeties and alarms.

.2 Start-up

.1 On a signal from the PLC the EF dampers (XV-M6510, XV-M6520, XV-M6530) shall prove fully open.

.2 EF shall activate.

.1 Startup of the EFs shall be staggered as follows:

.2 Adjustable timer delay: 30 seconds (adjustable 15 to 300 seconds)

.3 AHUs shall respond as follows, whether AHU fan is operating or not.

.1 AHU outside air damper to 100% open

.2 AHU return air damper to fully closed

3.4 IDENTIFICATION

.1 Provide in accordance with Section 23 05 54 - Mechanical Identification.

3.5 MANUFACTURER'S INSTRUCTIONS

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

3.6 TRAINING

.1 Provide one 4-hour on-site training session on complete operations and maintenance of the system.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1-10, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.

.4 ASME B18.2.1-10, Square Hex Bolts and Screws (Inch Series).

.5 ASME B18.2.2-10, Square and Hex Nuts (Inch Series).

.6 ASME B31.9, Building Service Piping.

.3 ASTM International (ASTM)

.1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

.2 ASTM A563, Standard Specification for Carbons and Alloy Steel Nuts.

.3 ASTM D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

.4 ASTM D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

.5 ASTM D2564 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

.6 ASTM D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

.7 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.4 CSA Group (CSA)

.1 CSA-B137 Series, Thermoplastic pressure piping compendium - Fourth Edition.

.5 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-41.22, Fibreglass-Reinforced Plastic Corrosion- Resistant Equipment.

.6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)

.1 MSS-SP-67-2002a, Butterfly Valves.

.2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-05, Grey Iron Swing Check Valves Flanged and Threaded Ends.

.4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85-02, Grey Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

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

.2 Indicate on drawings:

.1 Components and accessories.

.2 Operating characteristics.

.3 Samples

.1 Submit a sample fabrication of a 150 mm schedule 80 PVC pipe and coupling assembly completed for each pipefitter, plumber, or steamfitter working on the Work. Pipe and coupling to be cut in half along the longitude to expose the joint after curing.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

.1 Include special servicing requirements.

1.4 EXTRA STOCK MATERIALS

.1 Supply spare parts as follows:

.1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.

.2 Discs: 1 minimum for every ten valves, each size. Minimum one.

.3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.

.4 Valve handles: 2 minimum of each size.

.5 Gaskets for flanges: 1 minimum for every ten flanges.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 GENERAL

.1 Material shall be supported by service organizations. These service organizations shall be reasonably convenient to the Material installation and able to render satisfactory service to the Material on a regular and emergency basis as required.

2.2 PIPING

.1 As specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

10: Polyvinyl Chloride (PVC) Pipe and Fittings

13: Copper and Copper Alloy Tubing and Fittings

2.3 PIPE SEAL SYSTEM

.1 Modular sealing-element unit, designed for field assembly and filling annular space between pipe and sleeve or pipe and core.

.2 Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

.3 Pressure Plates: Reinforced nylon polymer.

.4 Connection Bolts and Nuts: Steel with two part zinc dichromate and corrosion inhibiting coating.

.5 Standard of Acceptance: Link Seal or approved equal in accordance with B7.

2.4 VENT AND DRAIN VALVES

.1 Pipes 50 mm and smaller: 13 mm vent, 25 mm drain unless shown otherwise.

.2 Pipes 65 mm and larger: 19 mm vent, 25 mm drain unless shown otherwise.

3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator 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 Contract Administrator.

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

3.4 TESTING

.1 Provide 48 hours' notice to the Contract Administrator prior to the start of testing.

.2 Test Pressure:

.1 Nominal working pressure plus fifty percent but no greater than the system design pressure.

.3 Hydrostatic testing shall only commence after the solvent-welded joints have been allowed to cure for a minimum period of 24 hours at 23 degrees Celsius. Timed from the last joint completed.

.4 Provide:

.1 Appropriate means to isolate the new pipe system for existing systems for the completion of the testing.

.2 Valves at the high points in the pipe system being tested for venting of air.

.5 Fully inspect with the Contract Administrator the installed piping system for evidence of mechanical abuse and/or joints that may not have been solvent-welded. The Contract Administrator shall accept the installation of the system prior to further testing procedures.

.6 Isolate any instrumentation or device that are not rated for the test pressure.

.7 Slowly fill the pipe system being tested with water. The velocity of the water shall not exceed 0.3 metres per second. Any entrapped air shall be evacuated by venting from the high points. Do not pressurize at this stage.

.8 Achieve equilibrium temperature in the pipe system before the start of testing. Note outdoor ambient conditions may impact the time duration if the indoor and outdoor systems are tested as one system.

.9 In conjunction with the Contract Administrator check the pipe system being tested for leaks. If no leaks are evident, check for and remove any remaining air and increase pressure up to 345 kPa (50 psig). Do not pressurized further at this stage.

.10 Leave the pipe system being tested pressurized for 10 minutes. If the pressure decays, inspect for leaks. If the pressure remains constant slowly increase to the Test Pressure.

.11 Leave the pipe system being tested pressurized for a period not exceeding one hour. During this time the pressure should not change.

.12 In the event a significant drop in static pressure or extended times are required to achieve pressure, either joint leakage has occurred or air remains in the system. Inspect the line for leakage. If a leak has occurred repair and restart the test. If no leak is apparent reduce the system pressure, check and vent any trapped air. Bring the system up to 345 kPa (50 psig) and leave for 10 minutes before increasing up to the Test Pressure.

.13 Document the pressure test procedure and results. The Contract Administrator verify the test documents.

.14 After filling system with glycol conduct visual inspections of the system for leaks while bring the system up to the nominal working pressure.

3.5 GLYCOL CHARGING

.1 Retest for concentration to ASTM E202 after cleaning.

3.6 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 13 - Performance Verification HVAC Systems.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

3.8 PIPE SEAL SYSTEM

.1 The below grade exterior concrete wall is to be cored to accommodate the specified pipe and seal.

.2 Install pipe seal systems in exterior concrete walls at piping entries into the building.

.3 Select type, size, and number of sealing elements required for pipe size and hole size.

.4 Centre piping in the wall penetration, ensure the piping is adequately supported on both sides of the penetration. The seal shall not support the weight of the pipe assembly.

.5 Loosen rear pressure plate to allow the installation of the seal assembly.

.6 Ensure the bolt heads are facing the installer and slide the seal assembly into the annular space at the bottom position and work both sides up towards the top position of the annular space. Use a liquid detergent to assist the installation in the annual space if the fit is tight. Use of grease is prohibited.

.7 Tighten and torque the bolts in accordance with the manufacturer's instructions.

PIPING SCHEDULE

Service	Size (mm)	Exposure	Material	Data Sheet Number	Design Temp. (°C)	Design Pressure (kPa)	Test
GS	13 to 200	EXP	PV80	10	38	550	H
GR	13 to 200	EXP	PV80	10	38	550	H
Ancillary	13 to 75	EXP	CUL	13	38	1,378	H

LEGEND

Service

GS Glycol Supply

GR Glycol Return

Exposure

EXP Exposed

SUB Buried

Material

CUx Copper (**x** – **K** for Type K, **L** for Type L, **M** for Type M)

PVx Polyvinyl Chloride (**x** – **40** for schedule 40, **80** for schedule 80)

Pressure Testl

H Hydrostatic

P Pneumatic

NA Not Applicable

DATASHEET 10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly
Flanges	All	One piece and/or Vanstone, molded hub type PVC flat face flange in accordance with Fittings above, 57 kg ANSI B16.1 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts and ASTM A563 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 3 mm thick material suitable for glycol service. Raised Face Mating Flange: Flat ring 3 mm material suitable for glycol service, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564

DATASHEET 13 COPPER TUBING AND FITTINGS	
Item	Description
Tubing	Seamless, conforming to ASTM B88 for glycol ancillary systems (i.e. pressure gauges, vents, make-up systems, and drains)
Fittings	All Services: Commercially pure wrought copper, socket joint, conforming to ASTM B75, dimensions conforming to ANSI B16.22
Unions	Wrought or cast copper, solder type
Solder	All Services: 95-5 wire solder (95 percent tin, 5 percent antimony), conforming to ASTM B32 Grade 95TA. Do not use cored solder

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 Refer to the latest adopted standard.

.2 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII.

.3 ASTM International (ASTM)

.1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01, Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84, Standard Specification for Ductile Iron Castings.

.5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 CSA Group (CSA)

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air separators, air vents, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide wiring diagrams required for components or systems showing the factory wiring and the field wiring requirements.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.

.3 Submit 3 copies of operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic specialties from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 Expansion Tanks – Bladder Type

.1 Vertical steel pressurized bladder type expansion tank.

.2 Capacity: as scheduled.

.3 Bladder sealed in EPDM suitable for 115°C operating temperature.

.4 Working pressure: 860 kPa with ASME stamp and certification.

.5 Air precharged to 84 kPa (initial fill pressure of system).

.6 Base mount for vertical installation.

.7 Removable bladder.

.8 Acceptable material: Amtrol, Armstrong, Bell & Gossett, or approved equal in accordance with B7.

2.2 AUTOMATIC AIR VENT

.1 Body: Non-ferrous automatic air vents

.2 Rating: Maximum operating temperature of 115 degrees Celsius at 1 MPa.

.3 Connections: NPT threaded sized as required.

.4 Acceptable material: Armstrong, Bell & Gossett, or approved equal in accordance with B7.

2.3 HIGH CAPACITY AIR VENT

.1 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.2 Float: solid material suitable for 115 degrees C working temperature.

.3 Acceptable material: Bell & Gossett, or approved equal in accordance with B7.

2.4 AIR SEPARATOR

.1 Vessel shell diameter to be three times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction.

.2 The air separator must be designed, constructed and stamped for 862 kPa at 177 degrees Celsius in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors.

.3 Finish: factory primed and painted with enamel paint.

.4 Insulation: factory insulated with a maximum thickness of 25 mm of closed cell insulation to prevent surface condensation at the system operating conditions.

.5 Acceptable material: Armstrong, Bell & Gossett, or approved equal in accordance with B7.

2.5 PIPELINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.

.2 Screen: stainless steel or brass with 1.19 mm perforations.

.3 Working pressure: 860 kPa.

2.6 PUMP SUCTION DIFFUSER

.1 Body: Cast iron angle type body with removable strainer basket and internal straightening vanes, a suction pipe support, and a blowdown outlet and plug. Unit body shall have arrows clearly cast on the sides indicating the direction of flow.

.2 Strainer: In accordance with ASTM F1199, except as modified and supplemented by this specification. Strainer screen shall be made of minimum 0.8 mm [brass sheet,] [monel,] [corrosion-resistant steel,] with small perforations numbering not less than 60 per square centimeter to provide a net free area through the basket of at least 3.30 times that of the entering pipe. Flow shall be into the screen and out through the perforations.

.3 Provide an auxiliary disposable fine mesh strainer which shall be removed after 30 Calendar Days of the system start-up. Provide warning tag indicating scheduled date for removal.

.4 Acceptable material: Armstrong, Bell & Gossett, or approved equal in accordance with B7.

2.7 MULTI-PURPOSE VALVE

.1 General: Valve shall perform the functions of a non-slam check valve, a manual balancing valve, and a shutoff valve. Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure.

.2 Body and accessories: Cast or ductile iron construction with bronze and/or stainless steel accessories. Provide an integral pointer on the valve which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow.

.3 Connections:

.1 NPS 1-1/2 and smaller: NPT connections.

.2 NPS 2 and larger: flanged connections.

.4 Acceptable material: Armstrong, Bell & Gossett, or approved equal in accordance with B7.

2.8 GLYCOL FEED SYSTEM

.1 208 litre storage tank with cover; pump suction hose with inlet strainer; 120V/1 ph/60 hz 0.7 Amp pressure pump with thermal cutout, integral pressure switch; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm; manual diverter valve for purging air and agitating contents of storage tank; adjustable pressure regulating valve (35 to 380 kPa) compete with pressure gauge; built-in check valve; union connection; 12 mm x 900 mm flexible hose with check valve, low level pump cut-out.

.2 Low level monitoring to be integrated into site PLC for remote alarming back to the Water Treatment Plant Control Room.

.3 Glycol feed system shall be completely pre-assembled and certified to CSA C22.2 no. 68.

.4 Acceptable material: Axiom SF100 or approved equal in accordance with B7.

2.9 THREE WAY HYDRONIC CONTROL VALVE

.1 Coordinate valve selection with the Controls Contractor.

.2 Modulating three way mixing, equal percentage, globe valve with electronic control suitable for 50% glycol for hydronic heating applications.

.3 ANSI Leakage rate: maximum 0.05% of Cv

.4 Maximum operating pressure: 1600 kPa

.5 Body: Red Brass

.6 Stem: Stainless Steel

.7 Range: 50:1 rangeability per VDI/VDE 2173

.8 Plug/Ball/Disc: Brass

.9 Packing to suit 30% glycol.

.10 Electronic actuator.

3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator 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 Contract Administrator.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 GENERAL

.1 Run blow off connections to discharge into glycol feed system storage tank (FDR-M633).

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 AIR SEPARATORS

.1 Install and support the air separator in accordance with the manufacturer’s instructions.

.2 Ensure supports are sized to support the wet operating weight of the air separator.

3.5 PUMP SUCTION DIFFUSER

.1 Provide a primed and painted steel schedule 40 pipe foot support leg adjusted to support the weight of the pipe system to prevent damage to the pump and suction diffuser.

.2 Install to provide adequate space for the draining of the diffuser pipework and removal of the strainer.

3.6 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit system operation requirements.

.2 Install isolation valve at inlet to tank.

.3 The connection point from tank-to-system shall be connected as close as possible to the suction side of the system circulating pumps.

.4 Connection of the system pipe for horizontal pipe runs shall be at the sides of the main to minimize air and/or debris entering the tank.

3.7 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each automatic control valve and as indicated.

3.8 AIR VENTS

.1 Install at high points of systems.

.2 Pipe the discharge to glycol feed system storage tank (FDR-M633).

3.9 GLYCOL FEED SYSTEM

.1 Arrange the piping of glycol drain, relief, and return lines to system to allow for easy removal of the tank cover.

.2 Adjust the regulating valve pressure setting to suit system operation requirements.

.3 Prior to Total Performance and once the glycol piping system is filled to the correct pressure ensure the tank is approximately 2/3 full and record the level.

3.10 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 Latest adopted version of the following:

.2 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IES Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.3 American Society for Testing and Material (ASTM)

.1 ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Application.

.4 National Research Council of Canada

.1 National Energy Code of Canada

.5 CSA Group (CSA)

.1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.

.6 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.7 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1, Motors and Generators.

.8 Hydraulics Institute (HI)

.1 HI 1.1 and HI1.2, Rotodynamic (Centrifugal) Pump for Nomenclature and Definitions.

.2 HI 1.3, Rotodynamic (Centrifugal) Pump Applications.

.3 HI 9.6.4, Rotodynamic Pumps for Vibration Analysis and Allowable Values.

.4 HI ANSI/HI 9.6.3, Rotodynamic Pumps – Guideline for Operating Regions – B120.

.5 HI ANSI/HI 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests - A136.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pumps and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with 01 33 00 Submittal Procedures.

.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

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

.1 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

1.3 QUALITY ASSURANCE

.1 Manufacturer Services

.1 Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, testing of the equipment, and conduct training.

.2 Submit the names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

1.4 STANDARD PRODUCTS

.1 Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has been in satisfactory HVAC operation at least 2 years prior to issuance of this Tender.

.2 Support equipment with a service organization that is reasonably convenient to the jobsite.

.3 Pumps and motors of the same types must each be the product of one manufacturer.

1.5 CONFORMANCE WITH AGENCY REQUIREMENTS

.1 Where materials or equipment are specified to be an approved type, attach the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services.

.2 A written certificate from the testing agency must accompany the materials or equipment and be submitted stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate must indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered and may be acceptable as evidence that the items conform with agency requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and the manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic pumps from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 GENERAL

.1 Safety Requirements

.1 Fully enclose or guard couplings, projecting set-screws, keys, and other rotating parts, that pose an entangling hazards.

2.2 MATERIALS AND EQUIPMENT

.1 Nameplates

.1 Securely affix a standard nameplate to pumps and motors in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, for each pump show the design flow rate in litres per second at the rated speed in rpm and total head in metres of the operating fluid.

.2 For each electric motor show at least the minimum information required by NEMA MG 1.

.3 Show such other information as the manufacturer may consider necessary to complete identification on the nameplate.

2.3 IN-LINE VERTICAL PUMPS

.1 Volute: cast iron radially split, with tapped openings for venting, draining, and gauge connections, with flanged suction and discharge connections.

.2 Impeller: bronze.

.3 Shaft: 316 stainless steel.

.4 Seal assembly: mechanical for service to 110 degrees C.

.5 Coupling: The pump shall include a spacer coupling of high tensile aluminum, split to allow the servicing of the mechanical seal without disturbing the pump or motor. Coupling shall incorporate tapered washer shaft jacking design.

.6 Motor: Motors shall be NEMA Premium efficient and shall be the size, voltage, and enclosure called for in the Drawings. Motors shall have heavy-duty grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed.

.7 Capacity: as indicated on schedules in the Mechanical Drawings.

.8 Design pressure: 1210 kPa.

.9 Spare Parts:

.1 For each type of pumps and drives, the following spare parts shall be supplied along with the pumps. The supplier may also recommend spare parts other than those listed below if necessary.

Parts	No. of Sets for Each Model of Pump
Shaft with keys, washers, bolts and lock nut	1
Impeller	1
Bearings (Pump)	2
Bearings (Motor), Brushes and Washers	2
Mechanical Seal - Set	1
Coupler Assembly	1
Set of Fasteners	1
Gasket Set for casing and impeller seal	1

2.4 EQUIPMENT ATTACHMENTS

.1 Attachments

.1 Furnish all necessary bolts, nuts, washers, bolt sleeves, and other types of attachments with the equipment for the installation of the equipment.

.2 Bolts conform to the requirements of ASTM A307 and hexagonal nuts of the same quality as the bolts used.

.3 Threads must be clean-cut and conform to ASME B1.1.

.4 Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, must be zinc coated after being threaded, by the hot-dip process conforming to [ASTM A123/A123M] [ASTM A153/A153M] as appropriate.

.5 Bolts, nuts, and washers specified or indicated to be stainless steel must be Type 316.

.2 Tools

.1 Furnish a complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment.

.2 Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.

.3 Special tools must be high-grade, smooth, forged, alloy, tool steel.

.4 Furnish one pressure grease gun for each type of grease required.

.5 Deliver all tools at the same time as the equipment to which they pertain.

.6 Properly store and safeguard such tools until Substantial Performance, at which time deliver them to the Contract Administrator.

.3 Finishes

.1 All motors, pump casings, and similar parts of equipment must be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer.

.2 Give ferrous surfaces not to be painted a shop coat of grease or other suitable rust-resistant coating.

.4 Factory Tests

.1 Pumps must be tested by the manufacturer or a nationally recognized testing agency in compliance with HI 1.3.

.2 Submit certified test results.

3 EXECUTION

3.1 EXAMINATION

.1 After becoming familiar with all details of the work, verify all dimensions in the field and advise the Contract Administrator of any discrepancy before performing the work.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

.1 General

.1 Install each pump and motor in accordance with the written instructions of the manufacturer.

.2 Ensure that pump is pipe-mounted and free to float with any movement, expansion and contraction of piping system.

.3 Support pump using floor mounted saddle as required.

.4 Install hangers and supports in accordance with Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

.5 Adjust hangers and supports after pump is installed to ensure proper support.

.6 For vertical in-line pumps supported from structure, ensure no pipe strain is imposed on pump flanges.

.7 Install pressure gauges on suction and discharge pump connections.

.8 Align pipe flanges with pump flanges and bolt together in accordance with pump manufacturer’s written recommendations.

.9 Provide access space around the device for servicing no less than the minimum recommended by the manufacturer.

.10 Check rotation prior to start-up.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements; supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that any cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours minimum.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Adjust alignment of piping and conduit to ensure true flexibility.

.8 Eliminate cavitation, flashing and air entrainment.

.9 Adjust pump shaft seals, stuffing boxes, glands.

.10 Measure pressure drop across strainer when clean and with flow rates as finally set.

.11 Replace seals if pump used to degrease system or if pump used for temporary heat.

3.5 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate with water at elevated temperatures.

.2 Measure using procedures prescribed in Section 01 91 13 - General Commissioning Requirements.

.3 Where procedures do not exist, discontinue PV, report to Contract Administrator and await instructions.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning Requirements reports supplemented as specified herein. Reports to include:

.1 Record of points of actual performance at maximum and minimum conditions and as finally set at completion of commissioning on pump curves.

.2 Provide Report Forms within the TAB report.

.3 Pump performance curves.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 WHIMIS Safety Data Sheets (SDS).

1.2 SUBMITTALS

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

.1 Product Data:

.1 Submit manufacturer's instructions, SDS, printed product literature and data sheets for HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit the percentage by volume of glycol and the following fluid properties of the glycol-based heat transfer fluid: thermal conductivity, density, viscosity, and specific heat.

.3 Submit written documentation provided by the manufacturer of the glycol-based heat transfer fluid demonstrating compliance to the corrosion standards of ASTM D1384 (less than 0.5 mil penetration per year for all system metals).

.4 Submit a manufacturer’s certificate of analysis that guarantees the content of the delivered glycol-based heat transfer fluid product. The manufacturer’s certificate shall be furnished with the glycol-based heat transfer fluid and presented to the Contractor at the time of delivery. A copy shall be forwarded to the Contract Administrator.

.5 Submit log books and operation and maintenance manuals in accordance with Section 01 78 00 – Closeout Submittals and as described in Item 2.1.1.

.2 Shop Drawings:

.1 Submit shop drawings as required by section 01 33 00 – Submittal Procedures.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Provide copy of recommended cleaning procedures and chemicals for review by Contract Administrator.

2 PRODUCTS

2.1 GENERAL

.1 Provide test equipment, log books, and written operating manuals associated with the glycol system. Manual to include detailed schematic drawings showing all special fittings, timers, controllers, etc. for each system.

2.2 GLYCOL

.1 Provide a 30% by volume solution of industrial grade inhibited propylene glycol-based heat transfer fluid. The solution is to be premixed by the supplier with the correct ratio of distilled water. Field mixing of glycol solution is unacceptable. Glycol solution is to be delivered to the Site by tank or in drums.

.2 The fluid must be dyed to facilitate leak detection.

.3 The fluid must be easily analyzed for glycol concentration and inhibitor level, and easily reinhibited using replacement inhibitor readily available from the fluid manufacturer.

.4 The fluid manufacturer shall provide an annual analysis free of charge to the City. The analysis shall report glycol concentration, freeze point temperature, inhibitor level, pH reserve alkalinity, and contaminants such as: chloride, sulfate, nitrite, nitrate, and total hardness. Recommendations on additions of glycol or inhibitors shall also be given as needed.

.5 The fluid must pass ASTM D1384 (less than 0.5 mil penetration per year for all system metals).

.6 The water used to dilute the concentrated inhibited glycol-based heat transfer fluid must be either distilled or deionised water.

.7 Acceptable Material: DOWFROST HD, PR100-50 & AFCO 0392, or approved equal in accordance with B7.

2.3 CHEMICAL FEED SYSTEMS

.1 Inhibitor

.1 Chemical treatment to consist of a Molybdate based closed system treatment which shall protect the piping system by forming a thin film on the internal piping surfaces.

.2 Solution to be added through the chemical bypass pot feeder.

.3 Provide one (1) Molybdenum test kit to verify water treatment performance.

.4 Recommended start-up dosage to be in accordance with feedrate as determined by water treatment system supplier. For purpose of tendering consider 75-100ppm of Molybdate.

.5 Solution to arrive on site in sealed drums in liquid form. Contractor responsible to store the chemical in a cool, dry, well ventilated area.

.6 Product data:

.1 Liquid.

.2 Clear pale yellow colour.

.3 Zero degree Celcius freeze point.

.4 pH of 11.2

.5 Specific gravity of 1.132.

.7 Provide one (1) year supply of chemical to protect systems from corrosion.

.2 Sidestream Filter

.1 Filter cartridge housing to accept double open-end style cartridges with machined knife edge seal surfaces for a no-bypass seal, 3/4 inch NPT connections. Sump seals shall be spring loaded to allow variable cartridge lengths. Seals to suit propylene glycol. Acceptable Material: Chem-Aqua GFS 20 filter cartridge housing or approved equal in accordance with B7.

.2 20 micron filter cartridges 500 mm long, 65 mm OD, cotton, tinned ST core. Acceptable Material: Chem-Aqua or approved equal in accordance with B7.

.3 Chemical By-Pass Pot Feeder

.1 Epoxy coated carbon steel construction, 7.5 litre capacity, seals to be suitable for polypropylene service, 2.0 MPa maximum working pressure at 93 degrees Celsius, 89 mm threaded cap, four 3/4 inch NPT ports. Acceptable Material: General Filtration model PF-2-X4-HP or approved equal in accordance with B7.

.4 Site Glass:

.1 Brass body with EPDM O-Ring, tempered borosilicate glass window, 304 SS cage, TPX ball, cork washer, maximum working pressure 860 kPa at 93 degrees Celsius, 3/4 inch NPT connections. Acceptable Material: AXIOM ASFI-075 or approved equal in accordance with B7.

2.4 TEST EQUIPMENT

.1 Provide one refractometer to the City used to measure the freezing point in degrees Fahrenheit of the inhibited glycol/water solution in the system. Acceptable Material: Extech Instruments, Misco Products, Reichert Industrial Fluid, or approved equal in accordance with B7.

3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC water treatment systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator 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 Contract Administrator.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 CHEMICAL FEED PIPING

.1 Install crosses at all changes in direction. Install plugs in unused ports.

3.4 GLYCOL SYSTEM

.1 The system shall be cleaned and flushed prior to the installation of the industrially inhibited glycol-based heat transfer fluid to remove dirt, weld slag, filings, solder flux, oil, etc. The system should be cleaned in accordance with the requirements of Section 23 08 16 – Cleaning and Start-up of HVAC Piping Systems and leak tested.

.2 The clean water shall be drained from the system and disposed of in a manner in accordance with the requirements of the authority having jurisdiction.

.3 Fill the system with provided glycol solution.

.4 The Contractor shall take a fluid sample with the supplied test kit after the system has been circulating for a minimum of 24 hours. The manufacturer shall provide a thermal fluid analysis report to the Contract Administrator in writing. The Contractor shall be responsible to complete any changes in the heat transfer solution if it does not meet with these Specifications.

.5 The Contractor will provide a system nameplate permanently encased in clear, plastic with, but not limited to, the following information: date, description of heat transfer fluid, manufacturer’s name, address and telephone numbers for normal and emergency contact, percent glycol by volume, freeze point, total system volume in litres, a copy of or reference to the Material Safety Data Sheet (SDS), instructions for sampling the fluid, and the address to which the sample is to be sent. Include a notation that the samples will be analyzed free of charge and that recommendations will be provided for adjusting glycol concentration, adding corrosion inhibitors, and for filtering maintenance must be performed (via annual analysis by the manufacturer) in order to prevent corrosion of the piping system components, degradation of piping system materials, degradation of the glycol, sludge formation in the system, or freezing of the solution.

3.5 FIELD QUALITY CONTROL

.1 Commissioning

.1 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before TAB of connected systems.

.2 Pre-commissioning Inspections: verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of initial glycol solution analysis.

.4 Required quality of glycol solution.

.3 Commissioning procedures:

.1 Analyze glycol in system.

.2 Based upon an assumed rate of loss approved by Contract Administrator, establish schedule for inhibitor addition.

.3 Record types, quantities of chemicals applied.

.4 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.5 Commissioning Reports:

.1 To include system schematics, test results, test certificates, glycol analyses, design criteria, other data required by Contract Administrator.

.6 Commissioning activities during Warranty Period:

.1 The Contractor shall be responsible to maintain the appropriate glycol to water ratios in the system during the end of the warranty period for the new chiller.

3.6 CLEANING

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

.1 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Reference Standards

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI)

.1 AHRI-550/590-03, Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.

.2 ASTM International (ASTM)

.1 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.3 CSA Group (CSA)

.1 CSA B52-05 SMART, Mechanical Refrigeration Code.

.4 Environment Canada/Environmental Protection Services (EPS)

.1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 Closeout Submittals

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

.2 ASME Pressure vessel documentation.

.3 Chiller installation, start-up and commissioning checklists

.4 Operation and Maintenance Data: submit operation and maintenance data for centrifugal glycol chillers for incorporation into manual.

.5 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.

1.3 Storage and Handling

.1 Installing Contractor shall be responsible for craning City supplied chiller from the designated craning area to the chiller pad. Installing Contractor to comply with the requirements of the Pipe Loading Assessment Report.

.2 Comply with the manufacturer’s instructions for transporting and rigging.

.3 Store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.4 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect centrifugal glycol chillers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

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

.1 Supplied by the City.

3. EXECUTION

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for chiller installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator 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 Contract Administrator.

3.2 Application

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 Installation and Start-Up

.1 Coordinate chiller start-up and on-site commissioning with manufacturer’s factory-trained service engineer provided by the City under a separate Contract.

.2 The manufacturer or its approved representative will participate in and coordinate with the Contract Administrator, the City, the Contractor, controls sub-contractor and other trades to ensure proper application and integration of the chiller in the PLC control system.

.3 Provide appropriate protection apparatus.

.4 Install unit as indicated, to manufacturer's recommendations, and in accordance with EPS1/RA/2.

.5 Ensure adequate clearances for servicing and maintenance.

.6 Manufacturer to approve installation, to supervise start up, ensure proper operation, and to instruct City personnel.

.7 Units shall be field charged with HFO-R1234ZE refrigerant. Refrigerant to be provided by the City and/or chiller supplier.

3.4 Cleaning

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by glycol chiller installation.

END OF SECTION

1. GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group

.1 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 CSA C235:19, Preferred Voltage Levels for AC Systems up to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 Online IEEE Standards Dictionary at: https://ieeexplore.ieee.org/browse/standards/dictionary?activeStatus=true.

.3 City of Winnipeg Water and Waste Department – Electrical Design Guide, Rev 05

.4 City of Winnipeg Water and Waste Department – Identification Standard, Rev 04

1.2 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by the online IEEE Standards Dictionary.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for electrical equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, accessories, and other items that must be shown to ensure coordinated installation.

.2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.3 If changes are required, notify Contract Administrator of these changes before they are made.

.4 Certificates:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction and/or inspection authorities for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to the City and Contract Administrator.

1.4 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for electrical equipment for incorporation into manual.

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect electrical equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

2.2 MATERIALS AND EQUIPMENT

.1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction and/or inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Factory assemble control panels and component assemblies.

2.3 WIRING TERMINATIONS

.1 Ensure lugs, terminals, and/or screws used for termination of wiring are suitable for copper conductors.

2.4 IDENTIFICATION LAMACOIDS

.1 Identification lamacoids: to Electrical Design Guide.

.2 All lamacoids to be 3 mm thick plastic lamacoid nameplates, white face, black lettering.

.3 Mechanically attach with self-tapping stainless steel screws. Where mechanically fastened lamacoids will compromise the enclosure rating ot the electrical equipment or are not practical adhesive such as 3M 467MP is allowable.

.4 Apply lamacoids as per Electrical Design Guide Table 2-1: Lamacoid Requirements. Additional information shall be provided where required.

.5 Provide warning and caution lamacoids in conformance with the latest requirements of the CEC. Lamacoids will have white lettering on a red background

2.5 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT AND CABLE IDENTIFICATION

.1 Wiring and cabling type identification: to Electrical Design Guide.

.2 Colour code conduits, boxes and metallic sheathed cables.

.3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.4 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colour.

Type	Prime	Auxiliary
208/120/240V Power	**Black**	
347/600V Power	**Yellow**	

2.7 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish.

.2 Paint indoor switchgear and distribution enclosures light gray to ANSI 61.

3. EXECUTION

3.1 INSTALLATION

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

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

3.4 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.6 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

.1 Circuits originating from branch distribution panels.

.2 Lighting and its control.

.3 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.

.3 Carry out tests in presence of Contract Administrator.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.7 SYSTEM STARTUP

.1 Instruct the City and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 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.

3.8 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

1. GENERAL

1.1 Refer to 01 33 00 - Submittal Procedures

1.2 SUBMITTALS

Item	Description	Submittal	Prerequisite
1	Proposed Lamacoid Labels	Shop Drawings	7 days prior to planned date of label preparation
2	Cable Tray	Shop Drawings	7 days prior to planned order date
3	Cable	Shop Drawings	7 days prior to planned order date
4	Cable Connectors	Shop Drawings	7 days prior to planned order date
5	Splitter	Shop Drawings	7 days prior to planned order date
6	Conduit	Shop Drawings	7 days prior to planned order date
7	Electric Motors	Shop Drawings	7 days prior to planned order date
8	Motor Starters to 600 V	Shop Drawings	7 days prior to planned order date
14	Circuit Breakers	Shop Drawings	7 days prior to planned order date
15	Disconnect Switch	Shop Drawings	7 days prior to planned order date
16	Control Devices	Shop Drawings	7 days prior to planned order date
27	Red Line Markups	As Built Drawings	At Substantial Completion
28	As built current measurements on all installed circuits	Table of readings with circuit identifier	At Substantial completion

END OF SECTION

1. GENERAL

1.1 INTENT

.1 Except where otherwise specified, arrange and pay for testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the Contract Administrator who shall also sign the test documentation.

.5 Submit procedures proposed in writing for approval two (2) weeks prior to test.

.6 Unless otherwise specified, testing requirements apply to the:

.1 Equipment grounding.

.2 Motors.

.3 Motor starters.

.4 Cable and wiring systems, all voltage classes.

.5 Control enclosures.

.6 Components and the ancillary devices not specifically noted or detailed in the specifications, but which is evidently required to furnish a complete system as intended.

1.2 MANUFACTURER'S PRODUCTION TEST RECORDS

.1 If requested, submit copies of production test records for production tests required by NEMA and CSA standards for manufactured electrical equipment.

1.3 SITE TESTING REPORTS

.1 Log and tabulate test results on appropriate test report forms.

.2 Submit forms to Contract Administrator for approval prior to use.

.3 Submit completed test report forms as specified, immediately after tests are performed.

1.4 REFERENCE DOCUMENTS

.1 Perform tests in accordance with:

.1 The Construction Contract.

.2 Requirements of Authorities Having Jurisdiction.

.3 Manufacturer's published instructions.

.4 Applicable CSA, IEEE, NEMA and ASTM standards.

.5 Canadian Standards Association (CSA).

.6 Underwriters Laboratories of Canada (ULC).

.2 If requirements of any of the foregoing conflict, notify Contract Administrator before proceeding with test and obtain clarification.

1.5 STARTING AND TESTING-GENERAL

.1 Prior to testing ensure all electrical equipment is cleaned and free of dust.

.2 After testing, protect equipment subject to dust from construction activities.

.3 Notify the City when starting and testing of all systems has been completed.

.4 Do not conceal or cover equipment until inspected, tested, and approved by Contract Administrator.

.5 Assume all liabilities associated with starting, testing, and balancing procedures.

.6 Assume all costs associated with starting, testing, adjusting, and balancing, including supply of testing equipment and witnessing of factory testing by Contract Administrator.

1.6 MANUFACTURER’S STARTING RECOMMENDATIONS

.1 Prior to starting equipment or systems, obtain and review Manufacturer's installation, operation and starting instructions.

.2 Use Manufacturer's and Supplier's starting personnel where required to maintain validity of manufacturer's warranty.

.3 Compare installation to Manufacturer's published data and record discrepancies. Modify procedures detrimental to equipment performance prior to starting equipment.

1.7 MANUFACTURER'S SITE SERVICES

.1 Arrange and pay for the Site Services of appropriately qualified Manufacturer's Representatives where site testing, adjusting, or balancing of electrical equipment or systems' performed by Manufacturer's Representatives is:

.1 Specified;

.2 At the request of the Contract Administrator; or

.3 Otherwise required to ensure that electrical equipment and systems are operational in full compliance with the Construction Contract.

1.8 CONSTRUCTION CONTRACTOR AND MANUFACTURER REPORT

.1 Log and tabulate test results on appropriate test report forms.

.2 Submit completed test report forms immediately after tests are performed.

.1 Record all data gathered on site on approved test report forms.

.2 Note any damage, missing parts or incomplete work on test form.

.3 Record date of corrected deficiencies on form.

.4 Provide the Contract Administrator with one (1) pdf copy and one (1) photocopy of each completed test report form.

.5 Maintain one (1) photocopy on site of all data taken during starting and testing period.

.6 Maintain one (1) copy of all final starting, testing, balancing and adjusting reports on site up to interim acceptance of the work for reference purposes.

.3 Arrange for manufacturer to submit copies of all production test records for production tests required by NEMA and CSA standards for manufactured electrical equipment to the Contract Administrator prior to shipping.

.4 Arrange for manufacturer to submit brief step-by-step description of entire starting procedure to allow the City to repeat starting at any time.

1.9 CORRECTIONS OF DEFICIENCIES

.1 Correct all Construction Contract deficiencies found during electrical starting and testing of equipment and systems and Contract Administrator's performance verification.

1.10 SEQUENCING AND SCHEDULING

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

1.11 COORDINATION

.1 Coordinate starting of electrical equipment and systems with testing, adjusting, and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.

.2 Mechanical equipment and systems specified in Division 21 to 23.

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such Work has been completed prior to starting of electrical equipment and systems.

2. PRODUCTS

2.1 TEST EQUIPMENT

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

3. EXECUTION

3.1 READINESS FOR TESTING AND GENERAL REQUIREMENTS

.1 Prior to energization of any equipment and commencement of tests, visually check and verify that the following has been completed:

.1 The entire assembly is clean inside and outside. The cables are not lying loosely or hanging free.

.2 The equipment is adequately bonded and grounded with the ground wires installed clear of bus work.

.3 The phasing of all bus work and of primary circuits is identified.

.4 All equipment is correctly identified (front and back, if applicable).

.5 Each starter is identified with correct drive number and drive title.

.6 All cables leaving electrical equipment have proper cable connectors and are properly identified.

.7 All unused holes are properly plugged.

.8 All unused wall and floor openings are sealed watertight and gas tight for hazardous areas.

.9 Relay and metering sections of equipment enclosures are properly identified.

.10 Motors and connected units have been properly secured to the base and aligned.

.11 Equipment nameplate data corresponds with characteristics of power supply.

.12 Emergency or stand-by lighting system is operational.

.13 The installation is in a safe condition, there are no unguarded live parts. Conduit seals are in place if a hazardous condition could occur during the testing phase.

3.2 PRE-FUNCTIONAL CHECKOUT

.1 Prior to functional testing, adjust and make operational all protective devices. Prior to energization of equipment, perform a functional checkout of the control circuit consisting of energizing each control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. Submit a description of the proposed functional test procedures prior to the performance of functional checkout.

.2 Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Construction Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation. Co-ordinate motor rotation check with Corporation's personnel.

.3 Satisfy all of the requirements of this Section during the pre-operational check-out and test phase.

3.3 CHECK-OUT TAGS

.1 Attach a "Check-Out Tag" to each piece of equipment which has an equipment number assigned.

.2 On completion of each phase of the installation, enter the appropriate information on the tag. Include test results or make cross-reference to appropriate test form in the 'Remark' section.

.3 Tag shall be 90 mm x 215 mm, yellow coloured with metal reinforced eye.

.4 Where appropriate and where a pre-developed form has not been included in the Construction Contract Documents, create and maintain a record of check-out and/or activity and associated result justifying completion of the electrical check-tag.

3.4 COORDINATION OF PROTECTIVE DEVICES

.1 The Contractor will provide an updated co-ordination study of the electrical distribution system taking the system upgrades into consideration.

.2 Ensure installed circuit protective devices such as overcurrent trips, relays and fuses are set to values and settings shown, to be verified by a manufacturer.

3.5 LOAD BALANCE

.1 Measure phase current to panelboards, switchboards, and motor control centres with normal loads operating at time of acceptance. If load unbalance exceeds 15%, adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, a report listing phase and neutral currents on panelboards, switchboards, transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.6 MINIMUM TEST REQUIREMENTS

.1 The tests stipulated in this Section are minimum requirements.

.2 Conduct additional tests recommended by equipment manufacturers or as deemed necessary by the Contract Administrator as construction progresses.

3.7 INSULATION RESISTANCE MEASUREMENTS

.1 General:

.1 Prior to energizing the equipment, conduct insulation resistance measurements on conductors and energized parts of electrical equipment. Minimum acceptable values of insulation resistance shall be in accordance with the CSA standards for the equipment or material being tested, unless otherwise specified. Record the ambient temperature at which insulation resistance is measured on the test form.

.2 Record insulation resistance measurements on the appropriate forms. Insulation with resistance of less than 10 megohms is not acceptable.

.3 Circuit breakers, motor circuit protectors, fuses and contactors shall all be set to the open circuit condition prior to insulation resistance testing and remain so for the duration of testing. Transient voltage surge suppression devices to be disconnected prior to testing and remain disconnected until testing is finished.

.2 Test Instruments:

.1 Unless otherwise specified, use the following insulation resistance testers (Megger):

.1 500 V instrument for circuits, feeders and equipment up to 350 V.

.2 1000 V instrument for 350-600 V circuits, feeders and equipment.

.3 Conductor and Cable Tests:

.1 Measure the phase-to-ground insulation resistance for all circuits 120 V and above except lighting circuits. Measurements may be made with motors and other equipment connected. Disconnect solid state equipment unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 VDC.

.2 Check phase rotation and identify each phase conductor of each feeder.

.3 Check each feeder for continuity, short circuits and grounds.

.4 After installing cable but before splicing and terminating, perform insulation resistance test on each phase conductor.

.5 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Replace entire length of cable if cable fails to meet any of test criteria.

.4 1 kV and 600 V Power Cables:

.1 Refer also to MCC tests.

.2 Insulation tests between phases and from phases to ground:

.1 Hipot.

.2 Megger.

.3 The following minimum values must be attained:

Item	**Rated Cable Voltage 25 kV**
Hipot voltage	80% of cable manufacturer's test value
Hipot duration: Equipment connected Equipment not connected	 1 min. 5 min.
Megger reading	20 M ohms

.4 Check for correct grounding of cable armour and shield.

3.8 CIRCUIT BREAKERS (ALL VOLTAGES)

.1 Visually inspect all connections and assemblies and check of all manual operations and physical interlocks on circuit breakers as specified.

.2 Check all electrical control, including anti-pump and trip free operation.

.3 Check correct position indication.

.4 Verify trip settings from each protective device.

.5 Conduct tests and record information listed in Forms 16020-K and L.

3.9 LOADBREAK SWITCHES AND DISCONNECTS (ALL VOLTAGES)

.1 Check all manual operations and physical interlocks.

.2 Check correct position indication.

.3 Check and verify auxiliary contact operation from remote monitoring equipment.

3.10 MOTOR STARTER CIRCUITS

.1 Conduct tests and record information listed in Form 16020-V.

.2 Verify continuity of motor starter wiring.

.3 Verify correctness of operation by operation of all motor starter controls, interlocks and automatic devices.

.4 In the cases of motor starters, make these tests with starter racked out and with control fuse removed, using a temporary "foreign" control supply.

.5 With the load end of each cable connected to the load (motor etc.) and with the contactor or switch open, Megger the outgoing feeder cables and motor windings to ground by connecting the Megger to the load side terminals of the starter or switch. Test only one (1) phase on motor starters, and all three (3) phases on fused switch feeder units. Megger readings shall be 5 megohms or higher.

.6 Verify phase rotation.

.7 Visual inspection of fuses and verify overload settings with motor nameplate data. Verify MCP settings.

3.11 AC MOTORS

.1 Record and conduct tests listed in Form 16020-C. This applies to ALL motors, existing and new, that are involved in this project.

.2 Check for proper lubrication.

.3 Check for direction of rotation, verify correct rotation.

.4 Check for vibration and excessive noise.

.5 Measure the insulation resistance of all motors before they are connected. Motors 50 hp and larger shall have their insulation resistance measured at the time of delivery as well as when they are connected. Insulation resistance values less than 10 megohms are not acceptable.

.6 With the incoming feeder cable disconnected, with all feeder switches and motor starters racked in, or connected, with all feeder switches and motor starter contactors open and with ground detector and voltmeter fuses removed, Megger between phases and each phase to ground. Megger readings shall be 10 megohms or higher.

.7 With the load end of each cable connected to the motor and with the contactor or switch open, Megger the outgoing feeder cables and motor windings to ground by connecting the Megger to the load side terminals. Test/record one (1) phase on motor starters, all three (3) phases on fused switch feeder units. Megger readings shall be 5 megohms or higher.

3.12 CALIBRATION AND VERIFICATION

.1 Description:

.1 Calibrate and verify the following equipment:

.1 600 V switchgear and panels.

.2 Protective and control equipment.

.3 Low voltage including D.C. voltage systems.

.2 The calibration and verification shall be carried out in the field after installation and connection of equipment, but prior to energization, in the presence of the Contract Administrator.

.2 Qualifications:

.1 Work shall be performed by a firm specializing in and with relevant experience in testing H.V. and L.V. switchgear and protective relaying, as listed in Clause 3.4.2.

.3 Calibration and Verification:

.1 The calibration and verification shall be carried out in the following stages:

.1 Low Voltage distribution transformers.

.2 Secondary switchgear/PDCs.

.3 Low voltage systems equipment.

.4 Motor control centres.

.5 Power factor correction equipment.

.6 Variable frequency drives.

.2 Advise Contract Administrator well in advance when each stage is ready for the calibration and verification and:

.1 Ensure that all equipment is installed, connected and cleaned inside and out.

.2 Ensure that the specified tests have been carried out.

.3 The electrical rooms are cleaned and are adequately illuminated and heated.

.4 Provide 120 V power for test purposes.

.5 Provide qualified personnel to assist in the calibration and verification.

.6 Provide all other facilities, equipment and personnel as reasonably required to assist in the calibration and verification.

.3 For each circuit breaker, calibrate all protective relays and overcurrent device time and instantaneous trips in accordance with requirements of the protected equipment and overall coordination scheme. Field set each relay according to the recommended settings.

.4 Verify all transformer ratios, insulation values, fuse sizes, C.T. and P.T. ratios, etc., and certify that the installation is in accordance with the requirements of the manufacturer and the Coordination/Short Circuit Study. Submit a written report on this verification to the Contract Administrator.

.5 Carry out the tests required of calibration and verification firm as specified in the other related sections.

.6 Ensure all bus and cable connections are tightened to Manufacturer's specifications.

.7 Clean all relays with dry, dust-free compressed air.

3.13 SUBMITTALS FOR INFORMATION ONLY

.1 Submit details of all test procedures and instruments, together with technician’s names, to the Contract Administrator, prior to proceeding.

.2 Submit written verification (pdf and photocopy) report after installation is completed to reflect as-built conditions.

3.14 TEST FORMS

.1 The forms listed below and included in this section are referenced from other sections of the specifications.

Form No.	Title
16020-A	Wire and Cable Resistance Test Data Form
16020-B	Cable Insulation Resistance Test Report
16020-C	Installed Motor Test Form
16020-L	Moulded Case Breaker Test Report

16020-A. Wire and Cable Resistance Test Data Form

Wire or Cable No.: _____ Temperature, °C_____

Location of Test	Insulation Resistance (megohms)
1.	
2.	
3.	
4.	
5.	
6.	
7.	

CERTIFIED_____ Date_____

Contractor's Representative

WITNESSED_____ Date_____

City’s Representative

16020-B. Cable Insulation Resistance Test Report

CLIENT:							REF. NO.:
LOCATION:							DATE:
APPROX. TEST TEMP.:				TEST VOLTAGE:			ENGR.:
CABLE IDENTIFICATION:	PHASE TO GROUND			PHASE TO PHASE			REMARKS:
	A	B	C	AB	BC	CA	
NOTES:							
1. All readings in megohms unless otherwise noted.							

16020-C. Installed Motor Test Form

Motor Equipment Number _____ Date of test ___

Equipment Driven_____

MCC Location _____

Insulation resistance phase-to-ground megohms: Ambient temp _____°C

Phase A_____, Phase B_____, Phase C_____

Motor Rotation:_____ (CW or CCW as viewed from non-drive end)

Current at Full Load: Measured Voltage:

			No-Load	Full Load
Phase_____	Current, _____Amp	AB _____	_____	
Phase_____	Current, _____Amp	BC _____	_____	
Phase_____	Current, _____Amp	CA _____	_____	

Thermal Overload Device: Manufacturer/catalog #_____Amperes _____

Circuit breaker (MCP) setting: __

Motor Nameplate Markings: Serial Number _____

Mfr

Mfr_____ Type_____ Frame_____ hp_____

Volts_____ Phase_____ RPM_____ **Service factor_____

Amps_____ Freq_____Hz Ambient temp rating_____ °C

Time rating _____**Design letter _

kVA Code letter Insulation class

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED_____ Date___

Contractor's Representative

WITNESSED_____ Date___

City's Representative

16020-L. Moulded Case Breaker Test Report

CUSTOMER:				LOCATION:										JOB NO.:		
														DATE:		
SWITCHGEAR DESIGNATION:										VOLTAGE:				TESTED BY:		
BREAKER IDENTIFICATION	BREAKER			MILLIVOLT DROP @ RATED CURRENT			TRIP TIME IN SECONDS @ 300% RATED CURRENT			MFG. PUBLISHED TIME		INSTANTANEOUS TRIP (AMPS)				REMARKS
	RATING	MFG	TYPE	A	B	C	A	B	C	MIN	MAX	A	B	C	SET	

REMARKS:

NEMA MAXIMUM TRIP TIMES	
BREAKER RATING	SECONDS
15 - 45 AMP	100
50 - 100 AMP	200
110 - 450 AMP	300
500 - 600 AMP	350
700 - 1200 AMP	600
1400 - 2500 AMP	750

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.

.3 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

.4 CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

1.2 SUBMITTALS

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

Part 2 Products

2.1 GENERAL

.1 Wire: to CAN/CSA-C22.2 No. 38

.2 Conductors:

.1 Size as indicated. Minimum size for power wires: 12 AWG unless noted otherwise on the Drawings.

.2 Stranded for 10 AWG and larger and as specifically indicated herein.

.3 All conductors to be copper.

.3 Voltage rating:

.1 Power circuits 480 V and less: 600 V

.2 Power circuits > 480 V: 1000 V

.3 Insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

.4 Power supply conductor colour coding shall be in accordance with the Canadian Electrical Code. Wires sized 2 AWG and smaller to be factory-coded, taping will not be accepted.

.5 Control / Automation Wire Color Coding

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1	120VAC Line:	Black
.2	120VAC Control:	Red
.3	120VAC Neutral:	White
.4	24VDC Supply:	Blue

.5 24VDC Control: Blue
.6 24VDC Common: Brown
.7 4-20mA Signal: White (+), Black (-)
.8 Protective Earth : Green
.9 Signal Ground: Green/Yellow

.6 Acceptable cable manufacturer: Belden, Nexans, General Cable, Southwire, or approved equal in accordance with B7.

2.2 TECK 90 CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.
.2 Circuit conductors: copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: polyvinyl chloride material.

.7 Fastenings:

.1 One hole malleable iron / steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
.2 Channel type supports for two or more cables.
.3 Threaded rods: 8 mm dia. to support suspended channels.
.4 Stainless steel straps, hardware, channels, supports for Nema 4, Nema 4x, CSA enclosure type 4, CSA enclosure type 4X areas, all wet areas.

.8 Connectors:

.1 Watertight, approved for TECK cable:
.1 an elastomeric bevelled bushing.
.2 a funnel entry, splined gland nut.
.3 a taper threaded hub.
.4 a hexagonal body and gland nut

.9 Acceptable cable manufacturer: Nexans, General Cable, Southwire, or approved equal in accordance with B7.

2.3 ACIC/CIC CONTROL CABLE

.1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.2 Conductors: copper, stranded, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene(XLPE) rated type RW90.

.1 Voltage: 600V insulation

.4 Shielding as indicated on the drawings:

.1 ISOS – Individually shielded pairs with overall shield

.2 OS – Overall shield

.3 A higher level of shielded cable may be substituted for unshielded or overall shielded cable, unless otherwise specified, provided that all appropriate shield grounding, as required by the Contract Administrator, is performed. All subsequent related changes, such as required conduit size, fittings, etc, are the responsibility of the Contractor.

.5 Armour Type: Aluminum Interlocked

.6 RoHS compliant.

.7 Fastenings:

.1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole aluminum straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 1000 mm centers.

.3 Threaded rods: 8 mm dia. to support suspended channels.

.4 Stainless steel straps, hardware, channels, supports for Nema 4, Nema 4x, CSA enclosure type 4, CSA enclosure type 4X areas, all wet areas.

.8 Connectors:

.1 Watertight, approved for TECK cable:

.1 an elastomeric bevelled bushing.

.2 a funnel entry, splined gland nut.

.3 a taper threaded hub.

.4 a hexagonal body and gland nut.

.9 Acceptable cable manufacturer: Nexans, General Cable, Southwire, or approved equal in accordance with B7.

2.4 ETHERNET CABLE - SHIELDED & NON-ARMORED

.1 Requirements:

.1	Cable:	Industrial Grade Cat 6, 600V, Shielded
.2	Shield Design:	100 % coverage Foil Shielded
.3	Conductors:	4 pair, Bonded pair, 23 AWG, copper, solid.
.4	Insulation:	Polypropylene
.5	Operating temperature:	-40°C to 75°C
.6	Installation temperature:	-25°C to 75°C

.7 Flame test: CSA FT4

.8 cUL, CMR, RoHS compliant.

.9 Traction stress maximum: 177.928 N

.10 Minimum bending radius: 101.600 mm

.11 Manufacturer:

.1 Belden 7953A

.2 Or approved equal in accordance with B7.

2.5 INSULATED GROUND CONDUCTORS

.1 Insulated copper ground conductors:

.1 Size: as indicated on the Drawings, but in no case smaller than CEC required sizes.

.2 Type: soft drawn, stranded, flexible, high conductivity

.3 Shall meet the requirements of ASTM B8.

.4 Insulation: chemically cross-linked thermosetting polyethylene (XLPE) material, rated RW90

.5 Flame Test Rating:

.1 CSA FT4 (if exposed)

.2 CSA FT1 (if entirely within conduit)

.6 Insulation voltage rating: 600V

.7 Colour: green or green with yellow stripes as indicated on the Drawings.

.2 Acceptable cable manufacturer: Belden, Nexans, General Cable, Southwire, or approved equal in accordance with B7.

2.6 BARE GROUND CONDUCTORS

.1 Bare copper ground conductors:

.1 Size: as indicated on the Drawings, but in no case smaller than CEC required sizes.

.2 Type: soft drawn, stranded, flexible, high conductivity.

.3 Shall meet the requirements of ASTM B8.

.2 Acceptable cable manufacturer: Belden, Nexans, General Cable, Southwire, or approved equal in accordance with B7.

2.7 CABLE / WIRE TAGS

.1 Cable and conduit tags to be Brady B33-7515-7643 or approval equal in accordance with B7.

.2 Wire tags to be Brady polyolefin wire marking sleeves, suitable for the wire size

.3 All marking shall be typewritten in permanent ink.

.4 Affix tags using plastic tie-wraps

Part 3 Execution

3.1 GENERAL

.1 Do not splice cables. A continuous length is required for all feeds.

.2 Install in accordance with the manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

.3 Install in conduit as per Section 26 05 34 - Conduits, Conduit Fastenings, and Fittings. Alternatively, for armored cabling, provide cable tray for cable installation.

.4 Exercise care in stripping insulation from wire. Do not nick conductors.

.5 Provide bonding conductors as required by code as a minimum, or larger if indicated in the Contract documents.

.6 Provide scanning, coring, and drilling for installation of all wires and cables through concrete or structural members. Ensure damage to structures or other systems does not occur.

3.2 INSTALLATION OF TECK CABLES

.1 Provide cable tray for all Teck 90 cable runs.

.2 Surface mount runs less than 2 meters in length for direct connections to motors / equipment provided that cabling does not interfere with access into space, or with maintenance of systems. Provide clamps spaced a maximum of 1 m apart.

.3 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms or deviations between parallel conductors. Conductors with insulation resistance values, at one minute, less than 25 megaohms or that deviate from other similar conductors by more than 50% will be rejected.

3.3 INSTALLATION OF CONTROL AND INSTRUMENTATION CABLES

.1 Provide cable tray or conduit for all control cables. All non-armored cables shall be installed in conduit. Armored control cables shall be installed in cable tray.

.2 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.

.3 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Fully insulate the shield. Do not cut the shield drain wire off.

.4 ACIC cable may be installed in cable tray, provided that:

.1 The cable tray does not contain power cables unless specifically authorized by the Contract Administrator in writing.

.2 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

.5 Provide separation of cables from sources of noise, including other cables.

.1 For analog signals, provide separation distances as follows:

.1	120 VAC, 8 AWG and smaller:	100 mm
.2	120 VAC, >8 AWG:	300 mm
.3	600 VAC power:	300 mm
.4	VFD or other high harmonic cable:	300 mm in metallic conduit/600 mm other raceway
.5	Medium Voltage:	450 mm

.2 For control signals < 50V, provide separation distances as follows:

.1	120 VAC, 8 AWG and smaller:	50 mm
.2	120 VAC, >8 AWG:	300 mm
.3	600 VAC power:	300 mm
.4	VFD or other high harmonic cable:	300 mm in metallic conduit/600 mm other raceway
.5	Medium Voltage:	450 mm

.3 For 120 VAC control signals, provide separation distances as follows:

.1	120 VAC, 8 AWG and smaller:	none
.2	120 VAC, >8 AWG:	metal barrier or 150 mm
.3	600 VAC power:	metal barrier or 150 mm
.4	VFD or other high harmonic cable:	150 mm in metallic conduit/300 mm other raceway
.5	Medium Voltage:	450 mm

.4 Advise the Contract Administrator if these separations cannot be achieved.

3.4 INSTALLATION OF ETHERNET COPPER CABLES

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Provide separation of Ethernet cables from sources of noise, including other cables.

.1 Provide separation distances as follows:

.1	Instrumentation/Control < 50:	50 mm
.2	120 VAC, 8 AWG and smaller:	100 mm
.3	120 VAC, >8 AWG:	300 mm
.4	600 VAC power:	300 mm

.5 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway

.6 Medium Voltage: 450 mm

.2 Advise the Contract Administrator if these separations cannot be achieved.

.3 Ethernet cables shall be installed in conduit.

3.5 TERMINATIONS AND SPLICES

.1 Wire nuts are permitted only in the following circuits:

.1 Lighting circuits.

.2 Power receptacle and motor circuits.

.2 Terminate wiring on terminal blocks located inside junction boxes for other circuits:

.1 Fire alarm,

.2 Controls and instrumentation,

.3 Communications,

.3 Exercise care in stripping insulation from wire. Do not nick conductors.

.4 Strictly follow the manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

.5 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.

.1 Manufacturer: Thomas and Betts, Sta-Kon, or approved equal in accordance with B7.

3.6 INSTALLATION IN CONDUIT

.1 Utilize cable grips, appropriately selected to accommodate the type and geometry of the cable.

.2 Utilize cable pulling lubricant, compatible with the cable and conduit.

3.7 CABLE INDENTIFICATION

.1 Provide cable tags at both ends for all cables.

END OF SECTION

1. GENERAL

1.1 WORK INCLUDED

.1 All branch circuit conduits shall contain a green ground conductor.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

2. PRODUCTS

2.1 EQUIPMENT

.1 Grounding Conductors: bare stranded copper, soft annealed, size as indicated.

.2 Insulated grounding conductors: green, stranded copper conductors, Type RW90 size as indicated.

.3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

- .1 Grounding and bonding bushings.
- .2 Protective type clamps.
- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

3. EXECUTION

3.1 EXAMINATION

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

- .1 Visually inspect substrate in presence of Contract Administrator.
- .2 Inform Contract Administrator 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 Contract Administrator.

3.2 INSTALLATION GENERAL

.1 Where EMT is used, run ground wire in conduit.

.2 Protect exposed grounding conductors from mechanical injury.

.3 Make buried connections, using copper welding by thermit process, permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.8 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Provide shop drawing and O & M submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings and product data:

.1 Provide manufacturer's printed product literature and datasheets.

.2 Indicate connection details.

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.1 Indoors, dry locations: Conduit support structures shall employ an aluminum strut framing system together with the manufacturer’s connecting components and fasteners for a complete system.

.2 Exterior and wet locations: 316 stainless steel.

.2 Accessories:

.1 Exterior and wet locations: 316 stainless steel.

.2 Nuts, bolts, washers, machine screws, fittings, accessories: 316 Stainless steel.

2.2 CONCRETE AND MASONRY ANCHORS

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

.3 Manufacturer: Hilti (Canada) Limited or approved equal in accordance with B7.

2.3 SPACERS

.1 PVC coated malleable metal spacers, CSA approved for the purpose.

.2 Aluminum or stainless steel (wet locations) channel may be utilized where conduits are grouped, however a non-metallic spacer must be provided between the metallic channel and concrete.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile, or plaster surfaces with galvanized anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit, or cables using clips, spring loaded bolts, or cable clamps designed as accessories to basic channel members.

.5 Maximum spacing between conduit supports:

.1	16mm conduit:	1.0 m
.2	21mm conduit:	1.5 m
.3	27mm conduit	1.5 m
.4	35mm conduit	2.0 m
.5	41mm conduit and larger	2.5 m

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole straps for conduits and cables larger than 50 mm.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 8 mm dia threaded rods and spring clips.
- .2 Support two or more cables or conduits on channels supported by 8 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels for supports of the conduits.

.9 For surface mounting of conduit on a concrete surface, provide PVC coated conduit spacers. Do not mount conduit directly onto concrete surfaces.

.10 Provide metal brackets, frames, hangers, clamps, and related types of support structures where indicated or as required to support conduit and cable runs.

.11 Do not install conduit directly onto concrete. Provide offset supports.

.12 Ensure adequate support for raceways and cables dropped vertically where there is no wall support.

.13 Do not use wire lashing or perforated strap to support or secure cables.

.14 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 Contract Administrator.

.15 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with the manufacturer's installation recommendations.

.16 Bond all metallic components to ground, utilizing 2/0 AWG copper conductor for all systems that are part of a Station in accordance with the Canadian Electrical Code.

END OF SECTION

1. GENERAL

1.1 REFERENCES

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA ICS 6, Industrial Control and Systems: Enclosures.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit Shop Drawings and product data for cabinets in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 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 BOXES, CABINETS, AND PULL BOXES

.1 NEMA Type of enclosure refer to Section 26 05 00 - Common Work Results for Electrical.

.2 Outdoor, wet, Category 1 and Category 2 locations: NEMA 4X, polyester, watertight and corrosion resistant with gasketed, screw covers for surface mounting.

.3 Other Locations: NEMA 12, PVC, corrosion resistant with gasketed, screw covers for surface mounting.

.4 Provide terminal block kit assembly for each junction box.

3. EXECUTION

3.1 JUNCTION BOXES AND PULL BOXES:

.1 Install junction boxes and pull boxes in inconspicuous but accessible locations.

3.2 IDENTIFICATION:

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

1. GENERAL

1.1 WORK INCLUDED

.1 Provide a complete system of boxes for the installation of wiring and equipment.

1.2 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CSA C22.1-Canadian Electrical Code, Part 1.

2. PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 PVC BOXES

.1 Use surface mounted PVC boxes wherever PVC conduit is used.

.2 NEMA 4X boxes shall be used in outdoor, wet, Category 1 and Category 2 locations.

2.3 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3. EXECUTION

3.1 INSTALLATION

.1 NEMA Type of boxes refer to Section 26 05 00 - Common Work Results for Electrical.

.2 Support boxes independently of connecting conduits.

.3 Fill boxes with paper, sponges or foam similar approved material to prevent entry of construction material.

.4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connectors. Reducing washers not allowed.

END OF SECTION

1. GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA C22.2 No. 18.1-13 (R2018), Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX- J-023/1)

.2 CSA C22.2 No. 18.2-06 (R2016), Nonmetallic Outlet Boxes

.3 CSA C22.2 No. 18.3-12 (R2017), Conduit, tubing, and cable fittings (Tri-national standard, with ANCE NMX-J-017 and UL 514B)

.4 CSA C22.2 No. 18.4:15 (R2019), Hardware for the support of conduit, tubing, and cable (Bi-national standard with UL 2239)

.5 CSA C22.2 No. 56-17, Flexible metal conduit and liquid-tight flexible metal conduit

.6 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing

.7 CSA C22.2 No. 211.2-06 (R2016), Rigid PVC (Unplasticized) Conduit

.8 CSA C22.2 No. 227.2.1:19, Liquid-tight flexible nonmetallic conduit (Trinational standard with NMX-J-764-ANCE and UL 1660)

.2 City of Winnipeg Water and Waste Department – Electrical Design Guide, Rev 05

.3 City of Winnipeg Water and Waste Department – Identification Standard, Rev 04

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

.1 Submit cable manufacturing data.

.3 Quality assurance submittals:

.1 Test reports: submit certified test reports.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: submit manufacturer's installation instructions.

2. PRODUCTS

2.1 CABLES AND REELS

.1 Provide cables on reels or coils.

.1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

2.2 CONDUITS

.1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.

.2 Rigid Metal Conduit: to CSA C22.2 No. 45.1.

.3 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.4 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.2.

2.3 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 50 mm and smaller.

.1 Two-hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.5 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.

.1 Set-screws are not acceptable.

2.5 FISH CORD

.1 Polypropylene.

3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms or in unfinished areas.

.3 Use electrical metallic tubing (EMT) where not subject to mechanical injury.

.4 Use rigid galvanized steel conduit in exterior, general and hazardous locations in accordance with the Electrical Design Guide.

.5 Use rigid PVC conduit underground.

.6 Minimum conduit size for lighting and power circuits: 21 mm.

.7 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.9 Install fish cord in empty conduits.

.10 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.11 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface channels.

.5 Do not pass conduits through structural members.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel.

.2 Protect conduits from damage where they stub out of concrete.

3.5 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL

1.1 DESCRIPTION

.1 Provide a complete system of cable trays required to fully support all cable and conduit where necessary. System shall provide separate trays or barriers for 600 VAC systems, 120 VAC systems, and 24 VDC systems. System shall be complete with all supports and hangers and necessary for the installation.

.2 Coordinate the location of the support channels so as not to interfere with other services.

.3 Not all cable trays required is indicated on the Drawings. Provide additional tray as required to fully support all cable and conduit throughout the facility.

1.2 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 126.1, Metal Cable Tray Systems.

.2 CSA C22.2 No. 126.2, Non-metallic Cable Tray Systems.

.2 NEMA:

.1 NEMA VE 2-2013 Cable Tray Installation Guidelines.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit Shop Drawings and Product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Provide detailed layout plans indicating cable tray locations, sizes, barriers and supports.

.3 Prior to construction, submit design Drawings and calculations indicating all tray loading and seismic support designs have been reviewed by and bear the stamp of a Professional Engineer registered in the Province of Manitoba.

2. PRODUCTS

2.1 CABLE TRAY

.1 All tray mounted indoor and outdoor shall be aluminum tray type, Class C1 to CSA C22.2 No. 126.1 with 300 mm rung spacing, 150 mm side rails and width as required to prevent cable de-rating. All outdoor cable tray shall be covered.

.2 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints, reducers and other fittings where required. Field fabricate only those fittings not available from Manufacturer.

.3 Provide rod hanger clamps, rod hangers, wall mounting support brackets and all necessary accessories for complete installation. The material of these items are to match the tray type which they are supporting.

.4 Cable tray rungs shall include cable tie slots for horizontally mounted tray, to secure cables at regular intervals with cable ties.

.5 Cable tray rungs shall include open slot channel for vertically mounted tray, to secure cables at regular intervals with cable clamps.

.6 Approved manufacturers:

.1 Thomas & Betts.

.2 Cooper B-Line.

2.2 ACCESSORIES AND SUPPORTS

.1 Rod hanger clamps, rod hangers, trapeze supports, wall mounting support brackets, fasteners and all necessary accessories for complete installation, to suit cabletray width and loading.

.2 Indoor and Outdoor Cable Tray: Aluminum accessories and fittings, where available from the manufacturer. Where a fitting or accessory is not available in aluminum, stainless steel type 316 is to be used. Accessories or hardware embedded in, or surface mounted to unpainted concrete are to be stainless steel type 316. Rod hangers are to be stainless steel type 316. Provide galvanic isolation between dissimilar finishes.

.3 Approved manufacturers:

.1 Thomas & Betts.

.2 Cooper B-Line.

2.3 CHANNELS

.1 Indoor and Outdoor Applications: Aluminum channels, strut, accessories and fittings, where available from the manufacturer. Where a fitting or accessory is not available in aluminum, stainless steel type 316 is to be used. Channels, strut, accessories or hardware embedded in, or surface mounted to unpainted concrete are to be stainless steel type 316. Provide galvanic isolation between dissimilar finishes.

.2 Apply plastic caps to ends where it poses hazard to personnel, e.g. flow meter display stands.

.3 Approved manufacturers:

.1 Thomas & Betts.

.2 Cooper B-Line.

3. EXECUTION

3.1 INSTALLATION

.1 Cable tray shall be installed according to the latest revision of NEMA VE 2.

.2 Suspend cable trays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and not more than 3000 mm on centers. Fasten hangers to channels securely mounted to the structure.

.3 Do not drill through wood ceiling trusses. Provide wood blocking on top of ceiling truss to anchor rod hangers and channels.

.4 Install trays and raceways generally as indicated on Drawings. Coordinate this Work with the other trades to ensure adequate horizontal and vertical clearances.

.5 Provide minimum vertical clearance above the trays as indicated on the Drawings.

.6 Provide minimum 600 mm horizontal clearance on one side of cable tray throughout.

.7 All trays are shown diagrammatically on the Drawings. Determine the exact location in the field. Install tray runs to prevent interference with process or service piping and ducting and to maintain clearance for tray access. Coordinate the exact location of tray supports and runs with the work of other Divisions.

.8 Do not install tray routes and tray supports until the location of same has been reviewed by the Contract Administrator.

.9 Install tray systems in such a manner as to conserve head-room and minimize the use of free space through which they pass. Maintain a minimum 2200 mm clear head-room wherever possible.

.10 Run trays parallel to building lines unless otherwise shown on the Drawings. Where two or more trays run the same route, make parallel and ensure offsets and bends are uniform.

.11 When the ends on square strut channel type shelf brackets are below 2100 mm AFF in a walking area, cut flush with tray. Permanently cap the end of square strut channels, etc. with plastic caps. Suitably protect sharp corners and edges of tray to prevent personal hazard.

.12 Where hanger rods are used, use stainless steel and not be smaller than 12 mm in diameter.

.13 Extend a stranded #2/0 tin plated bare, or green insulated, copper ground conductor the length of each tray route, and solidly connect sections of tray runs to the ground bus of the electrical room. Connect ground conductor to the tray every 15 m with approved grounding clamps suitable for connecting aluminum tray with copper conductor.

.14 Generally run cables of different voltage classes in separate trays. Where a common tray is shown on Drawings, separate the cables for different voltage classes from each other by metal barriers as supplied by the tray manufacturer.

.15 Check all trays for surface smoothness prior to installation and remove all burrs, ridges, etc. on tray surfaces facing cables.

.16 Size cable trays as indicated on Drawings. If any discrepancies are found or changes in tray size are required, advise the Contract Administrator before installing the tray.

3.2 CABLES IN CABLE TRAY

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 Secure cables in tray at 5 m centers, with nylon ties.

.4 Identify cables with nameplates in accordance with Section 26 05 00 - Common Work Results for Electrical.

.5 Mark power and communication runs in accordance with colour coding outlined in Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 InterNational Electrical Testing Association (NETA) Acceptance Testing Specifications, 2017 (ATS-2017)

1.2 TESTING REPORT

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

.2 A draft individual inspection and test report shall be completed for each piece of equipment and sent to the Contract Administrator for review a maximum of one month after the completion of the inspections at the Site.

.3 Upon acceptance of all the individual inspection and test reports, prepare and submit to the Contract Administrator for review a draft overall inspection and test report that details all investigations and tests.

.4 The report shall include the following:

- .1 Summary of project.
- .2 Testing equipment used.
  - .1 Detail the type, manufacturer, model, and last calibration date of all testing equipment.
- .3 Description of equipment tested.
- .4 Description of all tests.
- .5 Typed inspection forms including:
  - .1 Identification of the testing organization.
  - .2 Equipment identification.
  - .3 Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.
  - .4 Date of inspections, tests, maintenance, and/or calibrations.
  - .5 Identification of the testing technician.
  - .6 Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.
  - .7 Indication of expected results, when calibrations are to be performed.
  - .8 Indication of “as-found” and “as-left” results, as applicable.
- .6 Itemized list of all repaired deficiencies which shall include:
  - .1 Detailed description of the deficiency.
  - .2 The cost associated with the deficiency repair.

.7 Itemized list of all un-repaired deficiencies encountered which shall include:

.1 Detailed description of the deficiency.

.5 The overall inspection and test report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the overall inspection and test report in the appropriate section and completely resubmitted.

.6 The Contractor shall furnish three paper copies and two electronic copies of the final overall inspection and test report.

.1 The electronic copies of the report, including the test forms, shall be provided in both PDF format and in native format (i.e Microsoft Word).

.7 The final overall inspection and test report shall be submitted a maximum of two weeks after the Contractor receives the mark-up of the draft overall inspection and test report from the Contract Administrator.

Part 2 Products

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 SCOPE OF TESTING

.1 equipment including but not limited to:

.1 Motor Starters
.2 VFDs
.3 Circuit Breakers
.4 Controls and communication equipment

.2 Grounding system

.3 All power cables greater than #6 AWG.

3.2 INPECTION, TESTING, AND MAINTENANCE PROCEDURES

.1 General

.1 All tests shall be performed based on NETA standard ATS-2017. Where manufacturer's specifications, tolerances, and/or published data are not available, refer to the appropriate tables in ATS-2017.

.2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.

.3 Utilize the existing Drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from

that shown on the Drawings, mark-up the Drawings with red pen as required to reflect the installation. Include the marked-up Drawings in the report.

.4 The scope of required Drawing checks is limited to the equipment and components that are part of the electrical inspection work.

.5 Any repairs made that affect the accuracy of the Drawings shall be marked up on the Drawings.

.6 Drafting of Drawings is not required.

.7 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the individual inspection and test report.

.8 Where corrections or repairs are made, record both as found/as left test readings on the inspection form. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.

.2 Inspection Forms

.1 The inspection forms to be completed by the Contractor are provided for reference in PDF format.

.2 Microsoft Word form templates will be provided prior to the Work being initiated.

.3 Make appropriate print-outs of the inspection forms and utilize for entry of data and test results on Site.

.4 Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.

.5 Complete the inspection forms in the entirety and include them in the individual inspection and test report.

.6 Submit electronic PDF copies of the inspection forms.

.7 The scope of work required in the Specifications is in no way limited by the inspection forms or spaces provided. Provide additional pages, documents, and forms as required to provide a complete individual inspection and test report.

.8 The inspection forms may be updated during the Work by the City or the Contract Administrator. Utilize the latest forms provided.

.9 Perform insulation resistance temperature correction calculations.

3.3 CABLES, < 1000 V (ALSO FEEDERS IN CONDUIT)

.1 Inspection and testing shall be comprised of the following:

.1 For cables/wires 4/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate and correct values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.2 Torque all accessible bolted electrical connections.

.3 Inspect compression applied connectors for correct cable match and indentation.

.4 Inspect grounding and cable/conduit support.

.5 Verify that visible cable bends meet or exceed the minimum allowable bending radius.

.6 Measure length of cable/conduit and record in meters.

.7 If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.8 Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1000 megaohms. The voltage applied shall be 500 Vdc for 300 V rated cables, and 1000 Vdc for 600 V or 1000 V rated cables.

3.4 METERING DEVICES, DIGITAL

.1 Inspection and testing shall be comprised of the following:

.1 Record the equipment nameplate data for inclusion in the individual inspection and test report.

.2 Inspect physical and mechanical condition.

.3 Torque all bolted connections.

.4 Verify accuracy of voltage and current at a minimum of two points each.

.5 If required, calibrate meters in accordance with manufacturer’s published data.

3.5 MOTORS, INDUCTION, AC, 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Record the equipment nameplate data for inclusion in the individual inspection and test report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging. Air baffles and filter media should be clean. Cooling fans should operate. Slip ring wear and brushes should be within manufacturer’s tolerances for continued use. Brush rigging should be intact.

.5 Clean the unit.

.6 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.7 Verify the application of appropriate lubrication and lubrication systems.

.8 Verify the absence of unusual mechanical or electrical noise or signs of overheating.

.9 Perform a rotation test to insure correct shaft direction.

.10 Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test voltage shall be in accordance with manufacturer's published data or 500 Vdc.

.1 Where possible, test each winding separately. Ground all windings not under test.

.2 Ensure all cables and accessories are disconnected during the test.

.3 For motors <= 150kW (200 HP), the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.

.4 For motors > 150kW (200 HP), the test duration is to be ten (10) minutes. Calculate the dielectric absorption ratio and polarization index.

.5 Correct test results to 40 °C.

.6 Investigate readings below 100 megaohms. Investigate dielectric absorption ratios less than 1.4 and polarization index ratios less than 2.0 for Class B insulation and Class F insulation.

.11 Where it is not possible to perform an insulation resistance test separately on each winding, perform a winding resistance test on each winding using a low-resistance ohmmeter.

.12 Measure running voltage and current and evaluate relative to load conditions and nameplate full-load amperes. Utilize a true RMS meter.

.1 Where powered by a VFD with bypass, perform test with the motor powered by the VFD and by the bypass starter.

.13 Perform insulation-resistance test on insulated bearings in accordance with manufacturer's published data, if applicable.

.14 Perform resistance tests on resistance temperature detector (RTD) circuits. RTD circuits should conform to design intent and/or machine protection device manufacturer's specifications.

3.6 MOTOR STARTERS, 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Record the equipment nameplate data for inclusion in the individual inspection and test report.

.2 Record all adjustable settings, size of overload, etc.

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage, alignment, and grounding.

.5 Verify the unit is clean.

.6 Torque all accessible bolted power connections.

.7 Inspect contactors for evidence of overheating or stress.

.8 Visually inspect and exercise circuit breaker.

.9 If power fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

3.7 CIRCUIT BREAKERS, INSULATED-CASE/MOLDED CASE, 600 V

.1 Inspection and testing shall include the following:

.1 Record the equipment nameplate data for inclusion in the individual inspection and test report.
.2 Record all adjustable settings.
.3 Inspect physical and mechanical condition.
.4 Inspect anchorage and alignment.
.5 Clean the unit.
.6 Torque all accessible bolted power connections.
.7 Operate the circuit breaker to insure smooth operation.
.8 Test all breakers utilizing the “Push-To-Trip” button, if equipped.
.9 Move operating handle to the off and on position.
.10 Restore breaker position to original position.

.2 For cables 4/0 AWG and larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

.3 For breakers with a frame size greater or equal to 250A, or as specified elsewhere in the Specification:

.1 Perform an insulation resistance test.
.2 Breakers rated < 600V, test voltage is to be 500 VDC.
.3 Breakers rated >= 600V, test voltage is to be 1000 VDC.
.4 Perform a contact/pole-resistance test.

3.8 TRANSFORMERS, LOW VOLTAGE, DRY-TYPE

.1 Inspection and testing shall be comprised of the following:

.1 Record the equipment nameplate data for inclusion in the individual inspection and test report.
.2 Inspect physical and mechanical condition.
.3 Inspect anchorage, alignment, and grounding.
.4 Clean the unit.
.5 Torque all accessible bolted power connections.
.6 Record the tap setting.
.7 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Duration of the test is to be one minute. Calculate the dielectric absorption ratio.
.1 600 V windings shall be tested at 1000 Vdc.
.2 120/208 V windings shall be tested at 500 Vdc.

3.9 GROUNDING SYSTEM

.1 Inspection and testing shall be comprised of the following:

.1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the

switchgear, transformers, and MCCs. Investigate connections with a resistance greater than 0.5 milliohms.

END OF SECTION

1. GENERAL

1.1 DESCRIPTION

.1 Low voltage electric motors and accessories, furnished under other Sections, and which are a part of equipment assemblies shall be in conformance with the requirements specified in this Section, unless otherwise noted. This Section includes performance, and descriptive type Specifications.

.2 Unless otherwise specified or approved, all electric motors furnished and installed by the Construction Contractor shall conform to the requirements specified herein.

.1 Motors connected to variable frequency drives shall be inverter-duty rated in accordance with the requirements of NEMA MG 1.

.2 Motors rated 0.75 kW or greater shall be premium-efficiency-type per NEMA MG 1.

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers (IEEE):

.1 112: Standard Test Procedure for Polyphase Induction Motors and Generators.

.2 1349: Guide for the Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations.

.2 National Electric Manufacturers Association (NEMA):

.1 MG 1: Motors and Generators.

.3 Canadian Standards Association (CSA):

.1 C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC elsewhere in this document shall include reference to such amendments.

1.3 SUBMITTALS

.1 Shop Drawings: Submit the following in accordance with Section 01 33 00.

.2 Submit Shop Drawings and manufacturers' product data in accordance with the requirements of Section 26 05 00 - Common Work Results for Electrical.

.1 Descriptive literature and motor characteristics.

.2 Shop Drawings and descriptive data to include:

.1 Complete list of all motors to be furnished.

.2 Outlines, dimensions, weights, and wiring diagrams.

.3 Location of main and accessories boxes with size of conduit entrance.

.4 Efficiency and power factor at 1/2, 3/4 and full load.

.5 Bearing design data and grease requirements.

.6 Nameplate data.

.7 Shop test report.

.8 Field acceptance test report.

.9 Strip heaters kW and voltage ratings.

.10 Power factor correction capacitors, where required.

.11 Built in overload protection device.

.12 Starting restrictions, acceleration time-current curve of motor starting load (100 hp and larger).

.13 Thermal damage curve and allowable stall time, full voltage (100 hp and larger).

.3 Submit Pump, Motor and VFD Coordination Certificate.

1.4 QUALITY ASSURANCE

.1 Provide in accordance with Section 01 45 00 and as specified.

.2 Motors to comply with the latest reference standards listed below.

.1 Electrical Code (EC).

.2 Underwriters Laboratories (UL).

.3 National Electric Manufacturers Association (NEMA):

.1 NEMA Standard MG 1 - Motors and Generators.

.4 American Bearing Manufacturers Association (ABMA).

.5 American National Standard Institute (ANSI).

.6 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE Standard 112 – Standard Test Procedure for Polyphase Induction Motors and Generators.

.2 IEEE 1349 - Guide for the Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations.

.3 Routine tests shall be performed on representative motors and shall include the information described on NEMA MG 1-12.61. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Provide in accordance with Section 01 65 00 and as specified.

.2 Shipping:

.1 Ship motors assembled to driven equipment complete except where partial disassembly is required by transportation regulations or for protection of components.

.2 Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

.3 Deliver spare parts at same time as associated devices. Deliver to the City after completion of work.

.3 Receiving and Storage:

.1 Inspect and inventory items upon delivery to site.

.2 Store and safeguard equipment and material in heated storage facility as recommended by equipment manufacturer and required by Section 01 65 00.

.3 Protect motors from moisture at all times.

.4 Prolonged Storage:

.1 For extended outdoor storage, remove motors from equipment and store separately.

.2 If storage is anticipated to be longer than two (2) months, store in accordance with the manufacturer instructions including the following additional steps.

.3 Keep motor space heaters energized.

.4 Fill the oil reservoirs of motors with sleeve bearings to the proper level with the specified oil.

.5 Motors with anti-friction bearings to receive an initial change of grease and then be re-greased every six (6) months.

.6 Remove the motor shaft braces and the rotate motor shaft every two (2) weeks. Replace the shaft braces prior to relocation to the installation site. Under no circumstances should the motor be lifted without the braces in place.

2. PRODUCTS

2.1 MOTOR MANUFACTURERS

.1 General Electric Company.

.2 Reliance Electric.

.3 U.S. Motors.

.4 Or approved equal.

2.2 ELECTRIC MOTOR RATINGS

.1 Voltage ratings:

.1 Unless otherwise specified, motors with ratings of 0.37 to 261kW (0.5 to 350 hp) shall be rated 600 V (nameplate rating), three-phase, 60 Hz; motors 0.25 kW or less to be rated 115 V, single-phase, 60 Hz.

.2 High-voltage motors, if indicated on Drawings, shall be specified elsewhere in the specifications.

.2 The following specific motor requirements shall be in the equipment specifications:

.1 Motor speed.

.2 Motor enclosure type.

2.3 MOTOR DESIGN REQUIREMENTS

.1 Motor heaters shall be supplied on all motors installed outdoors or in unheated areas. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 V, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate.

.2 Unless otherwise specified or permitted all electric motors furnished and installed by the Construction Contractor shall conform to the requirements hereinafter set forth.

.3 Motors connected to variable frequency drives shall be inverter duty rated.

.4 Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10% below nameplate rating. Where indicated on the electrical drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

.5 The motor shall have sufficient capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

.6 Type of Motors:

.1 All motors shall be NEMA Design B or of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.

.7 Insulation:

.1 All motors shall have Class B or Class F insulation with temperature rise by resistance at full load rating of a Class B insulation in accordance with NEMA MG 1 and based on a maximum ambient temperature of 40°C unless otherwise specified.

.2 Insulation systems shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalis and mechanical or thermal shock for 600 V motors. Provide 80°C, Class B rise or better by resistance at 100% load and provide a Class F insulation system, suitable for an ambient temperature motor operation of 0 to 40°C at no more than 1000 m above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

.3 Motors for outdoor service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

.4 Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

.8 Enclosures:

.1 Motors shall have a steel or cast iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 6 mm diameter, shall be provided inside the conduit box for motor frame grounding.

.1 Totally enclosed fan cooled: TEFC motors shall have a steel or cast iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40°C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

.9 Special Purpose Motors:

.1 Inverter duty rated: Motors for operation on variable frequency drives shall meet performance standards in NEMA MG 1, Part 31. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated. Internal service factor shall be 1.15 that of the nameplate. Ventilation system shall be designed for maximum heat transfer. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

.10 Auxiliary Devices:

.1 Three-phase motors shall not be provided with starting capacitors.

.2 Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either

incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and to be provided with a single conduit box.

.11 General Design of Motors:

.1 Motors shall comply with NEMA MG1, unless otherwise specified.

.2 All polyphase non-explosion proof motors shall be designed for energy efficient operation and meet the requirements of MG 1-12.53 a and b.

.3 Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.

.4 Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.

.1 Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.

.2 Bearings for totally enclosed and explosion proof motors shall be of the ball type.

.3 Bearing minimum L-10 fatigue life at 100% load shall be 50,000 hours.

.4 Bearing grease shall be of the 120°C thermal capability type.

.5 Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.

.6 Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision to be made for access for testing.

.7 All three-phase two-speed motors shall be of the two-winding design.

.8 All three-phase motors shall be provided with a 1.15 service factor.

.9 Three-phase motors shall be of cast iron construction including frame and end brackets.

.10 Totally enclosed motors shall be provided with automatic breather and drain.

.11 Motor nameplates shall be stainless steel.

.12 Motor terminal boxes and leads:

.1 Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 100 mm beyond the face of the box. The size of cable terminals, and terminal box conduit hoses shall be as permitted by the Contract Administrator. An acceptable type of solderless lug to be furnished. Totally enclosed and explosion proof motors to have cast-iron terminal boxes.

.2 Leads for space heaters shall be brought out into an auxiliary, cast, conduit box on the motor side opposite to the main terminal box. Auxiliary box to have 50 mm (1 inch) threaded conduit openings and shall be so constructed that conduit entrance may be placed at top, bottom, or either side.

.3 A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.

.12 Motor Efficiencies:

.1 Three phase motors rated 0.75 kW and larger shall be of the premium efficiency, “Design E”, type per Table 12.1 of NEMA MG1 Part 12. Motors shall have a NEMA Nominal Efficiency not less than the values referenced in NEMA MG1. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or motor speeds not listed shall conform to comparable standards of construction and materials as those for listed motors.

.13 Shop Painting:

.1 Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

.14 Motor Data:

.1 The Construction Contractor shall furnish the Contract Administrator with five (5) certified copies of characteristic curves of each motor furnished, except 115 V motors. Curves shall be supplied as a part of the driven equipment submittal.

.15 Motor Shop Tests:

.1 Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG 1. NEMA report-of-test forms to be used in submitting test data.

.2 Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MG 1-12.53 a and b.

.3 For induction motors larger than 75 kW, complete tests of each motor furnished to be made and certified tests data sheets to be submitted, unless witness shop tests are required by the technical specifications pertaining to the equipment. Each motor shall be tested at rated voltage for: efficiency and power factor at 50, 75, and 100% of it rated horsepower; for temperature rise, torque, no-load current, starting current, full load current, and dielectric strength; and for compliance with all specified performance requirements.

.4 For induction motors 3.75 kW up to and including 75 kW, copies of routine tests reports of electrically duplicate motors shall be furnished.

.5 Test data not required for motors 2.25 kW and smaller.

.16 Spare Parts:

.1 Provide in accordance with Section 01 78 00 and as specified.

.2 Furnish one (1) spare bearing of each type for each motor size and type.

.17 Capacitors for Motors:

.1 All three-phase, non-explosion-proof 600 V motors (except for motors driven through variable frequency drive units) shall be provided with a capacitor of the maximum kVAR. Size recommended by the motor manufacturer and in accordance with the requirements of the CEC.

.2 Capacitors shall be furnished with the motors. All capacitors to be installed and wired in accordance with the requirements of the CEC.

.3 Capacitor shall be rated 600 V, 3-phase, 60 Hz.

.4 Each capacitor unit to be enclosed in a corrosion-resistant weatherproof dust-tight housing for indoor and outdoor use with threaded conduit connection. A heavy-duty corrosion-resistant wall rack shall be provided with each capacitor. Discharge resistors to be included to reduce the voltage to 50 V or less within one minute after the capacitor is disconnected from the source.

.5 Capacitors shall be dry-film or liquid-insulated and shall be hermetically sealed in steel enclosures.

.6 Each capacitor unit shall be furnished with three high-interrupting capacity current-limiting fuses. Fuss shall be equipped with blown-fuse indicators.

.7 Capacitor enclosures shall be suitable for conduit connection and of the NEMA enclosure type required for the area as indicated on the Drawings. Covers shall be gasketed, bolt-on type.

.8 Capacitors shall be cUL listed.

.9 Capacitors shall be by General Electric Co.; Square D Co.; Sprague; or equal.

2.4 ELECTRICAL INTERFACE

.1 All items of electrical equipment that are furnished with process, heating, ventilating, or other equipment shall conform to the requirements specified under the applicable electrical sections of the Division 26 Specifications. Enclosures for electrical equipment such as switches, starters, etc., shall also conform to the requirements specified under the applicable electrical sections of the Division 26 Specifications.

3. EXECUTION

3.1 MANUFACTURER'S REPRESENTATIVE

.1 All motors are to be supplied as an integral component of some other item of equipment. The Manufacturer's Representative for that equipment is responsible for the supervision of installation, site testing, and commissioning of the motor as part of the equipment as specified in other Sections. The Manufacturer's Representative for the motor shall inform both the representative for the equipment and the installer of requirements for the motor, installation, testing, and commissioning.

3.2 INSTALLATION

.1 Verify heaters are energized on motors installed in outdoor or unheated areas.

.2 After motor installation but before connection to power wiring, test motor winding insulation in accordance with the applicable Division 26 requirements.

.3 After connection to power wiring, check for operating temperature, correct rotation, vibration, alignment and operating current drawn under load.

.4 Submit all motor test results for review and record.

3.3 TESTING AND COMMISSIONING

.1 Ensure the motor operates as intended during testing of the individual equipment and during process commissioning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates, and their installation.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.

.4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit Shop Drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 SWITCHES – TWO POSITION, SINGLE POLE

.1 15 A, 120 V, single pole switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually operated heavy duty ac switches with following features:

.1 Heavy duty mounting strap.

.2 Terminal holes approved for No. 10 AWG wire.

.3 Silver alloy contacts.

.4 One piece lexan toggle, lever, and cam.

.5 Suitable for back and side wiring.

.6 Green hex head grounding terminal.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable manufacturer:

.1 Hubbell or approved equal in accordance with B7.

2.2 DUPLEX RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, heavy duty specification grade to: CSA-C22.2 No.42 with following features:

.1 Heavy duty nylon face with steel reinforcing plate in centre.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Receptacle contacts to utilize spring steel clips to reduce contact fatigue.

.2 Receptacles of one manufacturer throughout project.

.3 Acceptable manufacturer:

.1 Hubbell 8200 or approved equal in accordance with B7.

2.3 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, 1 mm thick cover plates wiring devices mounted in flush-mounted outlet box.

.5 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Receptacles:

.1 Install duplex receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Install welding receptacles in accordance with manufacturer's recommendations. Mount at 1200mm above finished floor (to bottom of receptacle).

.3 Mount duplex receptacles vertically.

.4 Mount duplex receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Install a permanent label or lamacoid for all wiring devices indicating the circuit(s) contained within.

.1 Example: C711-2 (Panelboard PNL-C711, circuit 2)

END OF SECTION

1. GENERAL

1.1 REFERENCES

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250, Enclosures for Electrical Equipment (1000 V Maximum).

.2 NEMA ICS 6, Industrial Control and Systems: Enclosures.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Include time-current characteristic curves for breakers with minimum symmetrical (rms) interrupting capacity as shown at system voltage.

2. PRODUCTS

2.1 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breakers: to CSA C22.2 No. 5.

.2 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

.3 Bolt-on moulded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40ºC ambient.

.4 Common-trip breakers with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.6 Circuit breakers with interchangeable trips as indicated.

.7 Circuit breakers shall have a minimum symmetrical interrupting capacity of 42 kA. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to 42 kA, regardless of whether equipped with instantaneous trip protection or not.

.8 Where circuit breakers are to be installed in existing panelboards, the manufacturer shall be the same as the existing panelboard.

3. EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated on Drawings and specified herein.

.2 Install circuit breakers in panelboards to satisfy branch circuit requirements under the Scope of Work of this Construction Contract.

.3 Identification: Provide lamacoid plate on each breaker showing voltage, source of supply and load being fed - 600 V, 3-phase, 3-wire as appropriate.

END OF SECTION

1. GENERAL

1.1 SECTION INCLUDED

.1 Materials and installation for fused and non-fused disconnect switches.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4, Enclosed Switches.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria (including interrupting rating), enclosure rating, and limitations.

.3 Spare Parts:

.1 Submit spare parts as described in Part 2.1.8 of this section and in accordance with Section 01 78 00 - Closeout Submittals.

2. PRODUCTS

2.1 DISCONNECT SWITCHES

.1 CSA approved.

.2 Disconnect switches to be heavy duty, horsepower (motor) rated.

.3 Size to accommodate the required loads. Minimum sizes as indicated on Drawings.

.4 Disconnect switches shall be CSA enclosures type 2 (for interior dry, clean areas) and CSA enclosure type 4X (for exterior or wet area).

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Disconnects for motor loads to be heavy duty, motor rated.

.7 Disconnect switches shall have the appropriate interrupting rating (kAIC). Minimum rating is 10 kAIC. For interrupting ratings greater than 10 KAIC, utilize fused disconnects.

.8 Provide fuses as indicated on the Drawings (or as needed to increase the kAIC rating). Provide 3 spare fuses for every type.

.9 Provision for padlocking in on-off switch position.

.10 Switch mechanism: quick-make, quick-break action with self-wiping contacts.

.11 For switches 100A and over, provide non-tracking arc shrouds.

.12 Solderless pressure lugs for cable connectors.

.13 All switch poles to operate together, simultaneously with a common operating bar.

.14 Highly visible ON-OFF switch position indication on switch enclosure cover.

.15 Approved Manufacturers

.1 Schneider Electric, or approved equal in accordance to B7.

3. EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches.

.2 Connect line and load cables to all disconnect switches.

.3 Connect electrode ground to ground terminal within service entrance rated disconnect switches.

.4 Ensure neutral-ground bonding link is installed in service entrance rated disconnect switches.

.5 Install fusing.

.6 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals and Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Shop Drawings:

.1 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 type.
.5 Wiring diagrams
.6 Terminal block layout and connections

1.2 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for each type and style of motor in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit spare parts as indicated in part 2.8 of this section and in accordance with Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 GENERAL

.1 Starters: to NEMA ICS 2-2000.

.2 Equipment Identification:

.1 Refer to Section 26 05 01 – Common Work Results - Electrical
.2 Colour: White nameplate, black letters.
.3 Text Size: 8mm high letters.
.4 Text as shown on the Drawings.

.3 Control Wiring:

.1 Tin Plated Copper, 16 AWG, TEW unless otherwise indicated.

.4 Wire Identification:

.1 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram. Markings are to be computer generated.

.5 Device Identification:

.1 Door-mounted indicating lights, push buttons, selector switches, as indicated on the Drawings. Identification to be lamacoids.

.2 On the door interior, install identification labels adjacent to each pilot device containing the identifier of the pilot device (e.g. HS-EF-G1). The identification is to be provided by a lamacoid.

.3 Internal components such as contactors and relays must be identified by a lamacoid. Relays composed of a base and removable relay are to be identified on the base or enclosure back-panel rather than on the removable relay component.

.6 Finishes:

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor switchgear and distribution enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during construction.

.1 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

2.2 FULL VOLTAGE MAGNETIC STARTERS

.1 UL/CSA listed, NEMA size as shown on the Drawings.

.1 Smallest size of starter: NEMA size 1, unless otherwise indicated

.2 IEC rated starters are not acceptable.

.2 Magnetic of size, type, rating, and enclosure type as indicated with components as follows:

.1 The Short Circuit Current Rating (SSCR) of the assembly must equal or exceed 25 kA.

.2 Combination style motor starter, with instantaneous overcurrent protection, starter contactor, overload protection.

.3 All coils to be epoxy coated.

.4 Transient suppressors shall be supplied for all coils in each individual starter unit.

.5 Contactor solenoid operated, rapid action type.

.6 Smart motor starter contactor / overload protective device:

.1 Electronic overloads, manually reset from outside enclosure.

.2 Modbus TCP over Ethernet communications.

.7 Wiring and schematic diagram inside starter enclosure in visible location.

.8 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.9 Transient suppressors shall be supplied for all coils in each individual starter unit.

.10 Motor overload protective device in each phase, manually reset from outside enclosure.

.11 Wiring and schematic diagram inside starter enclosure in visible location.

.12 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.3 Accessories:

.1 Selector switches: heavy-duty oil tight labelled as indicated.

.2 Indicating lights: heavy-duty oil tight type and color as indicated.

.3 1-N/O spare auxiliary contact.

.4 Approved manufacturers:

.1 Schneider TeSys T or approved equal in accordance with B7.

2.3 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with primary and secondary fuses, installed in with starter as indicated.

.2 Size control transformer as indicated and as necessary to support the system controls.

2.4 ACCESSORIES

.1 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.5 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results -Electrical.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Starter designation label, white plate, black letters, size 5 or larger as needed to accommodate 8MM text, engraved to indicate the equipment tag, as well as the equipment description.

2.7 SPARE PARTS

.1 Fuses: two of each rating.

.2 Two indicating lamp bulbs of each type.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses are installed.

.4 Confirm motor nameplate and adjust / replace overload device to suit.

3.2 MOTOR STARTER TESTING

.1 Perform complete testing of motor starter operation, including but not limited to simulating a soft starter module fault to ensure the starter can be reset and put back into operation.

.2 Submit test results to the Contract Administrator.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 05 – Acceptance Testing and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section covers items common to sections of Division 40. This section supplements the requirements of Division 1.

1.2 CODES AND STANDARDS

.1 Complete installation in accordance with latest CSA C22.1 except where specified otherwise.

.2 Comply with all laws, ordinances, rules, regulations, codes, and orders of all authorities having jurisdiction relating to this Work.

1.3 DRAWINGS AND SPECIFICATIONS

.1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.2 These Specifications and the Drawings and Specifications of all other divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.

.3 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.

1.4 CARE, OPERATION, AND START-UP

.1 Instruct City maintenance and operating personnel in the operation, care, and maintenance of systems, system equipment, and components.

.2 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 all aspects of its care and operation.

1.5 PERMITS, FEES, AND INSPECTION

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 Pay associated fees.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department and Supply Authority prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from Electrical Inspection Department and Supply Authority to the Contract Administrator.

1.6 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department and Supply Authority.

.3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

1.7 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

1.8 EQUIPMENT IDENTIFICATION

.1 Identify equipment with nameplates as follows:

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic lamicoid nameplates, white face, black lettering, mechanically attached with self tapping screws.

.3 Wording on nameplates to be approved by the Contract Administrator prior to manufacture.

.4 Allow for average of 25 letters per nameplate.

.5 Identification to be English.

1.9 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings on both ends of all conductors and circuit wiring.

.1 Wire tags to be heat shrink type with black letters on white background.

.2 Wire tags to be legible and visible after the system is installed (ie/ not blocked).

1.10 SUBMITTALS

.1 Provide submittals as indicated in the individual Specifications and in accordance with 01 33 00 – Submittal Procedures and 01 78 00 – Closeout Submittals.

1.11 AS-BUILT AND RECORD DRAWINGS

.1 The Contractor shall keep one (1) complete set of white prints at the Site during the Work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of recording all changes in the Work.. As the Work on-site proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract. As-Built and Record Drawings to include circuiting of all devices, conduit, and feeder runs (complete with conductor size and number) and locations of all electrical and automation equipment.

1.12 OPERATION AND MAINTENANCE MANUALS

.1 Operation and Maintenance Manuals

- .1 Refer to Section 01 78 00 – Closeout Submittals for general operation and maintenance manual requirements.
- .2 In addition to the general requirements, provide the following information:
  - .1 Table of Contents – Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.
  - .2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
  - .3 Manuals containing all pertinent information, drawings, and documents of the Contractor's supply and/or documentation included with the instruments supplied by others, such as:
    - .1 Mechanical drawings of the equipment.
    - .2 Installation drawings and procedures.
    - .3 Instrument model numbers.
    - .4 Equipment specifications.
    - .5 Detailed utility requirements.
    - .6 Replacement parts list with model numbers.
    - .7 Recommended preventative maintenance frequency.
    - .8 Troubleshooting procedures.
    - .9 Procedures for dismantling.
    - .10 Procedure to operate the equipment/instruments.
    - .11 Recommended cleaning procedure.
    - .12 Recommended list of supplies to be used in conjunction with the operation and maintenance of the equipment.
    - .13 Recommended spare parts list.
  - .4 A copy of all wiring diagrams completes with wire coding.
  - .5 Include type and accuracy of instruments used.
  - .6 Set of final reviewed Shop Drawings.
  - .7 Testing documentation including:
    - .1 Loop check report.
    - .2 Factory Acceptance Test (FAT) report.
    - .3 Site Acceptance Test (SAT) report.

.2 PLC Software Operation and Maintenance Manual:

.1 Provide a manual that contains, at minimum, all pertinent information, drawings, and documents associated with the PLC program(s) and associated integration, including:

.1 Printout of the entire PLC program(s). Printout to be sealed by the Contractor's professional engineer.

.2 Repair instructions for common issues.

.3 Printout of any related design documents, such as interface lists, etc.

.4 Flash drive in a sleeve containing the latest PLC program including configuration software.

END OF SECTION

Part 1 General

1.1 DESIGN REQUIREMENTS

.1 Develop a demonstration and test procedure, along with test forms, for the FAT.

1.2 SUBMITTALS

.1 Submit the following for review at least 31 Calendar Days prior to FAT.

.1 Detailed test procedure and test forms for review.

.1 Incorporate all changes to the procedure and test forms requested by the Contract Administrator.

.2 Submit the following, to be received on the date of the FAT:

.1 Detailed listings of all control logic and software utilized to implement the control sequences, for the scenarios demonstrated as part of the FAT. Listings are to be neatly organized and commented as required. All supporting documents, including variable listings, are to be included.

.3 Submittal of the test results for review and acceptance.

1.3 CLOSEOUT SUBMITTALS

.1 Include all FAT documentation and test forms in the operating and maintenance manuals.

1.4 DEMONSTRATION AND TESTING

.1 The location of the FAT will be in a Contractor supplied facility, within Winnipeg, Manitoba, Canada.

.2 Correct deficiencies and re-test until satisfactory performance is obtained.

.3 Acceptance of tests during the FAT will not relieve the Contractor from responsibility for ensuring that complete systems meet every requirement of the Contract.

1.5 COMPLETION OF FAT

.1 The FAT is considered to be complete only when full approval of the Contract Administrator has been received by the Contractor.

.2 Schedule additional re-tests until approval is obtained.

Part 2 Not Used

Part 3 Execution

3.1 PROCEDURES

.1 All tests shall be documented.

.2 Produce test forms to allow for recording the results of the simulations and tests.

.3 Propose the desired date of the FAT to the Contract Administrator with at least seven (7) calendar days advanced notice. The Contract Administrator may, at their discretion, observe FAT based on the completeness of the submittal or other factors.

.1 Demonstration tests to include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.

.2 Hardware, including construction, visual inspection, wiring, labeling, agreement with Shop Drawing, requirements and acceptance criteria.

.3 Complete demonstration that the PLC program meets the requirements of the Electric and Electronic Control System For HVAC document described in Section 23 09 33 – Electric and Electronic Control System for HVAC.

.4 Test each I/O point from the terminal block to the PLC system.

.5 Testing of all status and alarm signals. Alarm assignments: Type, value, priority, etc shall be checked.

.6 Controller processor spare capacity.

.7 System programming and configuration capability.

.4 The Contract Administrator may request additional tests and simulations at the FAT.

.5 The Contract Administrator will review the system, simulations, and test results. Incorporate comments and feedback from the Contract Administrator into the system design.

3.2 Evaluation

.1 All evaluations will be pass/fail.

.2 The Contractor is expected to ensure that all required demonstrations are fully operable and meet required specifications, prior to the FAT. Upon failure of a required demonstration in the FAT, the Contractor shall provide subsequent re-tests to the satisfaction of the Contract Administrator.

.3 Acceptance of the FAT results by Contract Administrator is required prior to the shipment to site.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submit commissioning test plans, procedures and commissioning forms, in writing, at least 31 Calendar Days prior to commissioning.

.2 Submit Final Automation Commissioning Report as described in Part 1.5 of this specification.

1.2 COMMISSIONING FORMS

.1 Sample commissioning forms will be provided with the tender. The Contractor is responsible for providing all required testing and commissioning forms including checklists, forms, and reports as necessary. Microsoft Word versions of the sample commissioning forms can be provided after contract award.

.2 Supplement the provided forms as required to make a complete commissioning report package.

1.3 COMMISSIONING

.1 Carry out commissioning under direction of the Contract Administrator and in the presence of representatives of the Contract Administrator and the City.

.2 Inform and obtain approval from the Contract Administrator in writing at least 14 Calendar Days prior to commissioning or each test. Indicate:

- .1 Location and part of system to be tested or commissioned.
- .2 Testing/commissioning procedures and anticipated results.
- .3 Names of testing/commissioning personnel.
- .4 City personnel requirements to assist with commissioning.

.3 Correct deficiencies and re-test until satisfactory performance is obtained.

.4 Acceptance of tests will not relieve the Contractor from their responsibility of ensuring that complete systems meet every requirement of the Contract.

.5 Perform tests as required.

1.4 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by the Contract Administrator.

1.5 CLOSEOUT SUBMITTALS

.1 Submit to the Contract Administrator the Final Automation Commissioning Report.

.2 The Final Automation Commissioning Report to:

.1 Include measurements, final settings, and certified test results.

.2 Include completed commissioning forms.

.3 Bear signature of the commissioning technician and supervisor.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments, and modifications as set during commissioning.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions, or energy consumption.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system.

.2 Provide two-way radios for communication between field technicians.

.3 Test instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.4 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 6 months prior to tests.

Part 3 Execution

3.1 STATUS PRIOR TO COMMISIONING

.1 Prior to commissioning, ensure that the following is completed:

.1 Installation of all panels and completion of all wiring connections.

.2 Testing wiring for continuity from the field device to the control panel.

.2 Provide a minimum of one qualified technician to test and commission the control system.

3.2 PROCEDURES

.1 Scope of the test includes hardware, software, programming, configuration, documentation etc.,

.2 Hardware, includes construction, visual inspection, wiring, labeling, agreement with Shop Drawing, requirements and acceptance criteria,

.3 Test each I/O point from the instrument to the PLC system.

.1 Test both states of discrete points.

.2 Test, at minimum, two values for analog points.

.3 Test communications of the PLC with the City’s SCADA systems.

.4 Test each piece of equipment individually for complete functionality.

.5 Completely test the E-Stop functionality of each piece of equipment, as provided.

.6 All modifications to the software program, to bypass interlocks or sensors, shall be recorded and documented clearly in a separate document, and in the software.

.1 Any software bypasses that remain, prior to leaving the Site, must be authorized by the Contract Administrator or designated representative.

.7 All deficiencies must be corrected by the Contractor.

.8 Commission each system using procedures prescribed by the Contractor Administrator.

.9 Optimize operation and performance of systems by fine-tuning control loops and PID values. Record and submit a list of final PID tuning values to the City.

3.3 SYSTEM SOFTWARE

.1 Load PLC system with appropriate program, fully tested and approved as part of the software FAT.

.1 Any changes made to the software after the FAT must be submitted for review and approval of the Contract Administrator.

.2 Any issues identified on Site must be communicated to the Contract Administrator. Approval is required prior to making any modifications.

.3 The Contractor is reminded that this facility is critical to operation of the City's water distribution system.

3.4 CHECKLISTS, FORMS, AND REPORTS

.1 Complete commissioning forms including checklists, forms, and reports for each instrument, loop, and control device.

.1 Instrument Loop Checklist.
.2 Discrete I/O Checklist
.3 Analog I/O Checklist
.4 Panel Hardware/ Software Checklist

3.5 DEMONSTRATION

.1 Demonstrate to the Contract Administrator operation of systems including sequence of operations under all potential conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General SUMMARY

.1 Section Includes:

.1 Process and HVAC instrumentation.

1.2 REFERENCES

.1 National Electrical Manufacturers Association (NEMA).

.1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 Canadian Standards Association (CSA International).

.1 CSA-C22.1-2009, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submit Shop Drawings and manufacturer's installation instructions.

.2 Manufacturer's Instructions:

.1 Include manufacturer's installation instructions for specified equipment and devices in operation and maintenance manuals.

.3 Submit documentation as described in Section 40 80 11 - Automation Commissioning for devices listed within this section.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant.

.3 Operating conditions: 0 – 35 degrees C with 5 - 95% RH (non-condensing) unless otherwise specified.

.4 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 OUTDOOR/INDOOR TEMPERATURE ELEMENT AND TRANSMITTER (Wall mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120mm.

.3 Probe diameter 6.25mm.

.4 Measurement range: -200 to 850 degree Celsius.

.5 Protective sheath for external mounting.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06 Degree Celsius.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X wall mount electrical enclosure with temperature element mounted externally.

.4 Operating Ambient Conditions:

.1 -40 to 85 degree Celsius, 98% relative humidity with condensation.

.5 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300,

.2 Or approved equal in accordance with B7.

2.3 HVAC TEMPERATURE ELEMENT AND TRANSMITTER (Pipe mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120mm.

.3 Probe diameter 6.25mm.

.4 Measurement range: -200 to 850 Degree Celsius.

.5 Insertion type element.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06 Degree Celsius.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85 degree Celsius, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300 or Magnetrol Autrol Series,

.2 Or approved equal in accordance with B7.

2.4 ROOM TEMPERATURE ELEMENT AND TRANSMITTER

.1 Requirements:

.1 Sensor:

.1 Device box cover type 2- wire RTD, Pt100.

.2 Measurement range: 0 to 50 Degree Celsius.

.3 Stainless steel or Powder coated white steel.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06 Degree Celsius.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85 degree Celsius, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300 or Magnetrol Autrol Series,

.2 Or approved equal in accordance with B7.

2.5 HVAC TEMPERATURE SWITCHES

.1 Requirements:

.1 Functionality: Field adjustable with reference dials for each pole.

.2 Output: Qty 2, individually adjustable, DPDT dry contacts.

.3 Operating Temperature: -20 to 40 degree Celsius minimum.

.4 Sensor: Local.

.5 Mounting: Duct.

.6 Enclosure Rating: NEMA Type 4X.

.7 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Ashcroft B-Series,

.2 United Electric B402-120,

.3 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturer's recommended methods, procedures, and instructions.

.3 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.

.4 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Install communication wiring in conduit or utilizing ACIC cabling if shown on the Drawings.

.1 Provide complete conduit /cable system to link instrumentation and the control panel(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design Drawings do not show conduit layout.

3.2 TEMPERATURE SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils or filter racks.

.4 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from the one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

3.3 IDENTIFICATION

.1 Identify field devices with lamacoids. Install in a conspicuous location.

3.4 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 40 80 11 - Automation Commissioning.

3.5 TRAINING

.1 Provide one 4-hour training session on complete operations and maintenance of the system.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices including damper actuators.

1.2 REFERENCES

.1 Association (NEMA).

.1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 Canadian Standards Association (CSA International).

.1 CSA-C22.1-2009, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submit Shop Drawings and manufacturer's installation instructions.

.2 Manufacturer's Instructions:

.1 Include manufacturer's installation instructions for specified equipment and devices in operating and maintenance manuals.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.

.3 Operating conditions: 0 to 32 degrees Celsius with 5 to 95% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including portable two-way radios.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 ELECTRONIC MODULATING DAMPER ACTUATORS

.1 Requirements:

.1 General:

.1 Drawings, control diagrams, and schedules indicate estimated quantities of actuators for each motorized damper.

.2 Select actual quantity of actuators required to operate each damper in accordance with size of damper provided.

.3 Coordinate exact quantity of actuators with electrical work to ensure that necessary wiring and conduit is provided for installation.

.4 Equip modulating damper actuators with spring return fail safe function.

.2 CSA or cUL approved.

.3 Operating voltage: 120 VAC.

.4 Provide a 4-20 mA position signal for each modulating damper.

.5 Provide a 4-20 mA position feedback signal for each modulating damper.

.6 Ambient operating temperature -40 to 50 degree Celsius.

.2 Acceptable manufacturer:

.1 Schischek by Rotork Controls (Canada) Ltd., InMax,

.2 Or approved equal in accordance with B7.

2.3 ELECTRONIC ON-OFF DAMPER ACTUATORS

.1 Requirements:

.1 General:

.1 Drawings, Control Diagrams and schedules indicate estimated quantities of actuators for each motorized damper.

.2 Select actual quantity of actuators required to operate each damper in accordance with size of damper provided.

.3 Coordinate exact quantity of actuators with electrical work to ensure that necessary wiring and conduit is provided for installation.

.4 Equip on-off damper actuators with spring return fail safe function.

.2 CSA or cUL approved,

.3 Operating voltage: 120 VAC,

.4 Provide two auxiliary end-switch contacts, one for fully open and one for fully close, for each on/off damper.

.5 Ambient operating temperature -40 to +50 degree Celsius,

.2 Acceptable manufacturer:

.1 Schischek by Rotork Controls (Canada) Ltd., InMax,

.2 Or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturer's recommended methods, procedures, and instructions.

.3 Dampers mounted outdoors shall be protected from direct sun exposure, rain and snow.

.4 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.

.5 Electrical:

- .1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install communication and control wiring in conduit. Utilize armored cabling only when run on cable tray.
  - .1 Provide complete conduit /cable system to link instrumentation and the control panel(s).
  - .2 Provide complete cable tray system for armored cabling.
  - .3 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
  - .4 Maximum conduit fill not to exceed 40%.
  - .5 Design Drawings do not show conduit layouts or cable tray layouts. Provide as required, to suit the space.

.6 Terminate devices with leads in junction boxes with terminals.

- .1 Wire nuts are not permitted.
- .2 Protect leads in flexible conduit.

3.2 IDENTIFICATION

.1 Identify all instruments, control panels, and PLC panels with hard plastic lamacoid nameplates. Mount in a manner so that the tags are visible. Refer to Section 40 05 01 – Common Work Results – Automation.

3.3 TESTING AND COMMISSIONING

.1 Calibrate and test control devices for accuracy and performance in accordance with Section 40 80 11 – Automation Commissioning.

3.4 TRAINING

.1 Provide one 4-hour training session on complete operations and maintenance of the system.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International),

.1 C22.2 No.205-M1983(R2004), Signal Equipment.

.2 International Electrotechnical Commission (IEC),

.1 IEC 61131, Programmable Controllers.

.3 City of Winnipeg Design Standards,

.1 Tag Naming Standard, 612620-0014-40ER-0001 Rev. 00.

1.2 DEFINITIONS

.1 **"PLC"** means Programmable Logic Controller

.2 **"FAT"** means Factory Acceptance Testing. All FAT type testing to be performed at the equipment vendor facilities, utilizing the equipment vendor's labor, materials and test equipment

.3 **"I/O"** means Input/Output

1.3 SOFTWARE OWNERSHIP

.1 The City will fully own all PLC programming logic supplied and may utilize the software provided for any purpose including:

.1 Modification and revision.

.2 Use at other City facilities.

.2 The City may turn the software over to a 3rd party, for use at any City owned facility.

.3 Provide source code for all custom software and function blocks or any other software logic utilized in the application.

.1 Source code for base function blocks provided by the PLC manufacturer are not required.

1.4 DESIGN REQUIREMENTS

.1 Design, program, and implement a complete operating HVAC PLC control system.

.2 Provide a functional requirement description document of the HVAC PLC control system.

.3 The Contractor's HVAC PLC program design is to be based upon the hardware design Drawings, Section 23 09 33– Electric and Electronic Control System for HVAC, and the HVAC equipment manufacturer's control recommendations.

.1 Utilize a tag naming convention that extends and does not conflict with the tag scheme utilized on site.

.2 Utilize the City of Winnipeg Identification Standard (Rev. 4 Updated 2019-02-08) within the functional requirements document and HVAC PLC program.

.4 Input conditioning to map inputs from physical inputs and networked devices to internal HVAC PLC tags.

.5 Output conditioning to map internal HVAC PLC tags to physical outputs and networked devices.

.6 The PLC software design is to be supervised and authenticated (sealed) by a professional engineer licensed to practice in Manitoba.

.7 Do not assume that the Contractor's internal standards or standard programming methodology will be acceptable for this project. No additional payment will be made for assumptions made regarding standard methods utilized by the Contractor.

.8 The Contract Administrator will review the overall design. Make changes as requested by the Contract Administrator.

1.5 SUBMITTALS

.1 All submittals to be in accordance with Section 01 33 00 – Submittal Procedures.

.2 Stage 1:

.1 Submit product datasheets and PLC panel hardware shop drawings.

.3 Stage 2:

.1 Submit a draft functional requirement document prior to initiating programming which includes:

.1 The general PLC program structure.

.2 The programming languages (function block) to be utilized.

.3 A sample section of code.

.4 Panel local HMI screen

.5 HMI interface with Station SCADA.

.6 SCADA interface map.

.7 Variable naming methodology.

.4 Stage 3:

.1 Submit a 25% complete functional requirement document submittal, including:

.1 Software logic printout.

.2 The primary purpose of this submittal is to ensure that the methodology being utilized is as per requirements prior to the bulk portion of the Work being completed. At this point, copies of code for similar pieces of equipment should not be completed.

.5 Stage 4:

.1 Submit a 99% complete functional requirement document submittal a minimum of 31 Calendar Days prior to the FAT, including:

.1 Complete software logic printout.

.6 Submit operation and maintenance manuals as described in Part 1.6 of this Specification.

.7 Submit spare parts as described in Part 2.4 of this Specification and in accordance with 01 78 00 – Closeout Submittals.

1.6 OPERATION AND MAINTENANCE MANUALS

.1 Operation and maintenance manuals to be submitted in accordance with Section 01 78 00 – Closeout Submittals.

.2 Include the following in the operation and maintenance manuals:

.1 Product datasheets.

.2 Hardware and software user manuals.

.3 PLC logic printout.

.4 Flash drive sleeve with USB memory stick containing PLC application program.

Part 2 Products

2.1 PROGRAMMABLE LOGIC CONTROLLER

.1 Part or Model numbers shall be as shown on the control panel Drawings. (refer to Drawing 1-0650M-A0040):

.2 Provide all required hardware for a complete installation.

2.2 Human Machine Interface HMI

.1 Part or Model numbers shall be as shown on the control panel Drawings. (refer to Drawing 1-0650M-A0040):

.2 Provide all required hardware for a complete installation.

2.3 ACCESSORIES

.1 Include the following accessories:

.1 One flash card, installed in the PLC processor, for running the application program.

.2 One spare flash card of the same size and configuration as that utilized in the processor.

.3 Serial or USB transfer cable for downloading the application program.

2.4 USB MEMORY STICK

.1 Provide a USB memory stick as part of the commissioning process, with the following:

.1 Latest application program, with documentation.
.2 PLC hardware user manuals
.3 PLC software user manuals.

.2 Locate the memory stick in a pocket in the control panel.

2.5 SPARE PARTS

.1 Supply the following spare parts (refer to Drawing 1-0650M-A0040 for model numbers):

.1 One power supply module.
.2 One processor module.
.3 One RTU module.
.4 One DI 24 VDC I/O module.
.5 One DO 24 VDC I/O module.
.6 One AI module.
.7 One AO module.

.2 Complete set of spare parts to be supplied prior to commissioning.

Part 3 Execution

3.1 HARDWARE INSTALLATION

.1 Update the processor and all updatable modules with the latest firmware before the FAT. Any latter firmware update requires a rechecking plan to be provided by the Contractor and approved by the Contract Administrator. The application rechecking plan should include a recheck of any part of the application software impacted by the firmware changes.

.2 The Contractor shall inform the Contract Administrator of any new firmware or software updates issued by the manufacturer after FAT. The Contractor shall inform the Contract Administrator if the installation of the new firmware or software update is required.

.3 Application rechecking due to firmware or software updates shall be performed at no additional cost.

.4 The Contractor to program the HVAC PLC and the panel HMI at Hurst station.

.5 Contractor to Create HMI screen based on HVAC P&IDs layout.

.6 City will provide and implement SCADA HMI modification.

Following is required for The City to complete the HMI modification:

.1 A minimum of 3 weeks advance notice that HMI modification will be required.

.2 Contractor to provide I/O list, control narrative and description of what is to be displayed

3.2 PLC PROGRAMMING SERVICES

.1 General Requirements:

.1 Program in a manner to make the program easy to follow and maintain.

.2 Insert comments into the program to clarify all items not readily apparent.

.3 Utilize commonly accepted good programming practices.

.4 Utilize function blocks to encapsulate common systems and sections of code.

.5 All field inputs to be checked against range limits. If a field input is outside of its range limits or the data cannot be otherwise propagated because of an equipment fault, the data is to be declared “bad” within the control system.

.6 All tag names are to be named and identified using positive logic. Where required, provide comments to clarify the states.

.7 Program PID control loops to provide bumpless transfer when switching between automatic and manual control modes.

.8 Configure alarms generated in the HVAC PLC into two types:

.1 Automatic reset alarms clear upon the alarm condition being removed. Provide logic as required to ensure that fast cycling of the alarm does not occur.

.2 Manual reset alarms require reset from the HMI. Utilize manual reset alarms where the initiating condition would be removed by the action resulting from the alarm. Ensure that manual reset alarms are configured such that a reset signal from the HMI will not clear the alarm unless the initiating condition is cleared.

.9 For any piece of equipment that has control from the HVAC PLC, provide a manual and auto control mode selector buttons on the equipment faceplate and allow for manual control of the equipment from the HMI. Provision of a hardwired local, hand, or manual control mode in the field does not eliminate this requirement.

.10 Avoid creating unnecessary tags and variables. Any unused and/or obsolete and/or non-functional tags, logic, logic sections, etc. to be removed and purged from the final version of the program.

.11 Purge and pack memory periodically to reduce memory fragmentation.

.2 Provide all required HVAC PLC programming.

3.3 PLC COMMISSIONING SERVICES

.1 Provide all required HVAC PLC commissioning services as per Section 40 80 11 – Automation Commissioning.

.2 Upon completion of commissioning, load latest software onto spare card in spare processor. Test spare card prior to turning over to the City.

3.4 TRAINING

.1 Provide one 4-hour on-site training sessions by the equipment vendor or manufacturer to train operational and maintenance personnel in the use and maintenance of the system.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 All control panels shall be built by a CSA/cUL-approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.

.2 All control panels shall be factory assembled and pre-wired. The control panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the site.

.3 Supply, install, wire, and test all components inside the control panels according to the Specifications herein and the Drawings.

1.2 SUBMITTALS

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

.2 Prior to construction:

.1 Submit product datasheets for review and approval of the Contract Administrator prior to construction of the control panels.

.2 Submit stamped red-line mark-ups of the proposed modifications to the control panels. If significant modifications are proposed/required, the sealed Tender Drawings (included in this package) in AutoCAD format will be supplied to the Contractor for revision and reference.

.3 Prior to shipment:

.1 Submit electronic pictures of enclosure exterior and interior, including door interior.

.1 Pictures to be of sufficient resolution to read component labels.

.2 As-built drawings:

.1 Submit as-built drawings. Minor changes may be made via red-line mark-ups.

.2 Draft significant changes on AutoCAD drawings.

.3 Submit panel FAT report to Contract Administrator for review.

.4 Do not ship control panel until approval from the Contract Administrator is received.

1.3 INSPECTION

.1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.2 If requested, demonstrate and test the control panel in the presence of the Contract Administrator's designated representative.

Part 2 Products

2.1 GENERAL

.1 Construct the control panels in accordance with the supplied Drawings.

.2 Control devices of each category shall be of same type and manufacturer.

2.2 ENCLOSURES

.1 Install lamacoids as per the control panel layout Drawings.

.2 All indoor control panels shall be NEMA 12 or as shown on Drawings. Exterior panels shall be NEMA 4X.

.3 All enclosure angles and cut-outs shall be free of dents, gouges, or weld marks and shall present a clean, smooth appearance.

.4 No screws, fittings, or other fastenings shall be used on external panel faces, which must be free of any marks, scratches, or defaults.

.5 The door is to be a minimum 14 gauge steel plate, full height, and flush with adjacent surfaces.

.6 The exterior of the control panel shall be painted ANSI 61 grey.

.7 The interior of the control panel shall be painted gloss white.

.8 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.

.9 All control panel doors shall be 900 mm (36 inches) wide maximum.

.10 All control panel doors shall open through 180 degrees without restriction.

.11 All control panels of a depth greater than or equal to 300 mm (12 inches) shall be equipped with a fluorescent lighting device located in the cabinet's upper portion with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.

.12 Enclosure brand shall be Hoffman or approved equal in accordance with B7.

2.3 POWER SOURCE

.1 Each power source must be protected by a CSA approved circuit breaker or fuse.

.2 The location of each power source must be clearly shown.

.3 Panels powered by more than one (1) electrical source shall display on their door; "Caution: This panel is electrically powered by more than one source".

2.4 COMPONENTS

.1 Unless written approval for use of unapproved components is received from the Contract Administrator, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.

.2 Rails (DIN Rails)

.1 Rails used must be DIN Rail style TS 35mm, slotted.

.2 When used to mount terminals, rails shall be mounted on straight raisers (rail support / mounting feet) so as to raise them to the same height as the highest adjacent wiring duct.

.3 Raisers (rail support / mounting feet) shall not be used when rail hosts heavy components.

.3 Terminals

.1 Requirements:

.1 TS-35 DIN Rail mounting.

.2 Voltage rating:

.1 600V for general control circuits.

.2 600V for power circuits.

.3 Manufacturer: Phoenix Contact or approved equal in accordance with B7.

.2 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.

.3 Each terminal shall bear an identification number on both sides.

.4 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The Contractor must supply and install such components when required.

.4 Ground Bus Bar

.1 Supply a ground bus bar in each control panel.

.2 Requirements:

.1 Tapped holes with screws.

.2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare.

.3 Maximum one wire termination per screw.

.5 Pushbutton, Switch, and Indicator Light

.1 When required, all control panel pushbuttons, switches, and indicator lights shall be at least NEMA 12 (or better)-type devices.

.2 Manufacturer to be Schneider Electric or approved equal in accordance with B7.

.6 Programmable Logic Controllers

.1 As per section 40 94 43- Programmable Logic Controller (PLCs).

.7 General Purpose Relays

.1 Type: DPDT or as shown on Drawings.
.2 Indication: LED.
.3 Coil voltage: As per Drawings.
.4 Contact rating: 5A (120 VAC), 5A (24 VDC).
.5 Provide diode suppression for DC coils.
.6 Socket mounting: 35mm DIN rail
.7 Approvals: CSA.
.8 Manufacturer: Omron, Finder or approved equal in accordance with B7.

.8 I/O Relays

.1 Relay interface for PLC Discrete Inputs, 1PDT :
  .1 Coil rating: 3.5 mA at 120 VAC.
  .2 Contact material: Gold-plated silver tin oxide alloy.
  .3 Contact switching voltage: 36 V dc max.
  .4 Contact minimum switching current: 1 mA.
  .5 Contact maximum inrush current: 50 mA.
  .6 Wire Size: 26 to 14 AWG for both input and output side.
  .7 Color: Gray body.
  .8 Width: 6.2 mm.
  .9 Bridging: Plug-in bridge.
  .10 Approvals: cULus
  .11 Standard of acceptance: Phoenix Contact 2966281.
.2 Relay interface for PLC Discrete Outputs, 1PDT :
  .1 Coil rating: 9 mA at 24V dc.
  .2 Contact material: Silver tin oxide alloy.
  .3 Contact switching voltage: 5V ac min, 250 V ac max.
  .4 Contact limiting continuous current: 6A.
  .5 Wire Size: 26 to 14 AWG for both input and output side.
  .6 Color: Gray body.
  .7 Width: 6.2 mm.
  .8 Bridging: Plug-in bridge.
  .9 Approvals: cULus
  .10 Standard of acceptance: Phoenix Contact 2966171.

.9 Analog Signal Isolators:

.1 Provide galvanic isolation between analog signals where not already provided by the programmable logic controller or other components.
.2 Input: 0-5V, 1-5V, 0-10V, and 4-20 mA (switch selectable).
.3 Output: 4-20 mA.
.4 Channels per isolator: 2 or 4.
.5 DC input resistance:
  .1 Current inputs: 50 Ω.
  .2 Voltage inputs: 1 MΩ.
.6 Performance:

.1 Output ripple: < 10 mV peak-to-peak measured across a 250 Ω resistor.

.2 Isolation: 1000V rms input-to-output and channel-to-channel.

.3 Common mode rejection: > 95dB @ 60 Hz, 500V rms maximum.

.7 Features:

.1 Adjustable zero and span for each channel via potentiometers.

.2 Removable wiring connectors.

.8 Environmental:

.1 Temperature range, operating: -40 to 70 degrees Celsius.

.2 Relative humidity, operating: 0 to -95 percent non-condensing.

.3 Ambient temperature effect: plus or minus 0.015 percent of span/ degrees C maximum.

.9 Manufacturers:

.1 Acromag,

.2 MTL Instruments,

.3 Phoenix Contact.

.4 Or approved equal in accordance with B7.

.10 24 VDC Uninterruptible Power Supplies

.1 Approvals: CSA.

.2 Input: 100-240 VAC, 45-65 Hz.

.3 Output: 24VDC.

.4 Mounting: NS 35 DIN rail.

.5 Capable of redundant operation with redundancy module.

.6 Performance:

.1 Load regulation: < 2%.

.2 Temperature derating: 2.5 %/ degree Celsius from 60 degree Celsius.

.3 Output ripple: < 20 mV

.4 Efficiency: 90% (120 VAC) and 96% (Battery operation).

.7 Features:

.1 Capable of parallel operation.

.2 Dynamic Boost 15A.

.3 Input transient surge protection.

.4 Protection Class I

.8 Status lights:

.1 DC OK LED.

.2 Alarm LED.

.3 BAT MODE.

.4 Ready.

.5 Remote.

.6 BAT-Start.

.9 Energy Storage, lead AGM, VRLA technology, 24 V DC, 3.4 Ah

.10 Environmental:

.1 Temperature, operating: -25 to 70 degree Celsius.

.2 Humidity, operating: max 93%, non-condensing.

.11 Manufacturer and series:

.1 Phoenix Contact, TRIO-UPS-2G/1AC/24DC/10,

.2 Phoenix Contact, UPS-BAT/VRLA/24DC/3.4AH,

.3 Or approved equal in accordance with B7.

.11 Grounding

.1 All control panel components shall be adequately grounded in accordance with the component manufacturer, especially control system components.

.2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

.12 Internal Wiring

.1 Panel wiring shall be installed in a neat and orderly manner.

.2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.

.3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.

.4 All wires and cables inside the control panels shall be identified on both ends with non-erasable markers.

.5 Identification for wire shall be in accordance with the supplied documents, such as wiring diagrams.

.1 Label both ends of each wire.

.2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.

.3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.

.6 Individual conductors or wires exiting a cable shall be identified using wire and cable tags, with printed labels.

.7 The routing of all analog, digital, power, and networking wiring and cabling inside control panels shall be segregated as much as possible by the type of signal they are carrying.

.8 All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.

.9 All analog twisted pair wiring shall be 18 AWG shielded such as Belden No. 8760, or approved equal in accordance with B7. Shield wires exiting the jacket must be covered with a black heat shrink and the overall cable at the jacket end must also be covered with a heat shrink.

.10 All 24 VDC or 120 VAC discrete signal wiring shall be 16 AWG TEW stranded conductor.

.11 All 120 Vac power wiring shall be 14 AWG TEW stranded conductor, minimum.

.12 All 24 Vdc power wiring shall be 12 AWG TEW stranded conductor, minimum.

.13 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.

.14 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Each end of the loop shall be properly supported.

.15 Ethernet Patch Cords

.1 Requirements:

.1 Cat-6.

.2 Jacket colour: Blue.

.16 Wiring Duct

.1 All wires shall be run in narrow slot wiring duct such as such as Panduit or approved equal in accordance with B7.

.2 Wiring duct shall be installed on both sides of the panel and between the DIN rails.

.3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by wiring duct for a maximum of 10 cm.

.17 Wire ties shall be non-metallic.

.18 Wiring shall be arranged to be readily accessible for inspection and maintenance.

.19 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.

.13 Internal Lighting

.1 All control panels of a depth greater than or equal to 300 mm shall be equipped with a lighting device with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.

.2 Fixture mounting: top-centre of enclosure, unless otherwise noted.

.3 Lights: LED, white.

.4 Manufacturer:

.1 Hoffman,

.2 Or approved equal in accordance with B7.

.14 Overcurrent Protection

.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

Part 3 Execution

3.1 COMPONENT INSTALLATION

.1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.

.2 Each component inside the control panel shall be identified with a nameplate corresponding to the Drawings.

.3 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.

.4 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.

.5 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by, or interfere with, the removal of any panel instrument.

.6 Nameplates shall be made of hard plastic lamacoid material with a white background and engraved black letters for internal and external components. Refer to section 40 05 01 - Common Work Results – Automation.

.7 Supply and install all required fuses.

.8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.

.9 Control devices shall be grouped according to voltage and function to reduce electrical noise.

.10 Cutouts for instruments shall be within the tolerances specified by the instrument manufacturer.

.11 If cutouts are specified for future instruments, the cutouts shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.

.12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

.14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

3.2 IDENTIFICATION

.1 Perform terminal identification using a computerized device. Handwriting is not acceptable.

.2 Label terminals as shown on Drawings.

.3 Install label above each terminal block with terminal block name.

.4 Refer to spec section 40 05 01 for Equipment Identification.

3.3 TESTING

.1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT and shall include at minimum:

.1 Provide a signed and dated inspection sheet with all tests performed listed on it.

.2 The list of the various test procedures described hereunder is not restrictive and does not relieve the Contractor of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.

.3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.

.4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.

.5 Tests to include:

.1 Power supply functionality,

.2 PLC component functionality,

.3 Point to point tests of all inputs and outputs,

.4 Power terminal voltage verification,

.5 Relays and switches functionality,

.6 Receptacle functionality,

.7 Communications / Ethernet switch functionality,

.6 If the panel is modified after tests have been performed, tests shall be repeated.

3.4 SHIPMENT

.1 Request for shipment of any panel having shortages of equipment is subject to approved in writing by the Contract Administrator. The Contract Administrator has sole discretion on either granting approval or not granting approval for shipment.

3.5 SPARE COMPONENTS

.1 Supply two spares of each fuse type and rating. Place in a clear plastic bag and attach to the panel door interior

END OF SECTION

Part 1 General

1.1 Description

.1 This section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose of proper operation and maintenance of all equipment supplied and installed under this Contract.

.2 The Contract Administrator has the authority to determine if the training is sufficient based on the lesson plan submitted by the Contractor.

.3 Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

1.2 Submittals

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

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to the Contract Administrator 30 Calendar Days prior to anticipated date of beginning of training.

.1 List name of trainers and type of visual and audio aids to be used.

.3 Submit training materials as described in Part 1.5 of this Specification.

1.3 Quality Assurance

.1 Provide competent instructors thoroughly familiar with all aspects of the instrumentation and controls system installed in the facility.

.2 The Contract Administrator reserves the right to review the credentials of the proposed instructor(s) and approved the proposed instructed or request an alternate.

1.4 Instruction

.1 Provide instruction to designated City personnel in adjustment, operation, maintenance, and pertinent safety requirements of the system installed.

.2 The training sessions shall be comprised of both classroom training and field training. As a minimum, they shall cover the following topics for each item of equipment or system:

.1 Safety.
.2 Operation.
.3 Troubleshooting.
.4 Preventative and predictive maintenance.
.5 Corrective maintenance.
.6 Parts.
.7 Local representation.

1.5 Training Materials

.1 Provide equipment, visual and audio aids, and materials necessary for training.

.2 Supply one manual for each trainee (for 20 personnel), plus 3 spare, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance

1.6 Training Program

.1 Operations Training

.1 Location:

.1 Hurst Pumping Station

.2 Duration: Session is not more than Four hours.

.3 Number of Sessions: Coordinate with Contract Administrator prior to training.

.4 Number of trainees: Coordinate with Contract Administrator prior to training.

.5 Audience: Operations and maintenance personnel.

.6 Content:

.1 General system overview.

.2 Description of system components.

.3 Presentation of the control panel and system operation.

.4 Presentation on the PLC controls.

.5 Presentation on the motor starters and HVAC operation.

1.7 Monitoring of Training

.1 The Contract Administrator to monitor the training program and may modify the schedule and content.

Part 2 Products

2.1 General

.1 Not Applicable.

Part 3 Execution

3.1 Training

.1 Provide on-site training to City personnel, as indicated above.

END OF SECTION

Part 1 General

1.1 MAINTENANCE SERVICES

.1 Maintain equipment per manufacturer's recommendations up to the final completion of the construction.

1.2 SUPPORT SERVICES

.1 Duration:

.1 The duration of support services is to extend during the warranty period (one year past Total Performance).

.2 Requirements:

.1 Provide telephone support for all products supplied (during regular business hours).

.2 Respond to emergency service calls (during regular business hours).

.3 Telephone Support:

.1 Telephone support to utilize service personnel knowledgeable in the products and have the required troubleshooting skills.

.2 No payment will be made for telephone support during the warranty period.

.4 Emergency Service Calls:

.1 Respond to service calls from the City when the system is not functioning correctly.

.2 Qualified control personnel to be available to provide on-site service upon a critical failure, whenever required.

.1 A critical failure is the inability to operate of any part of the critical system supplied by the Contractor.

.2 Critical systems include, but are not limited to:

.1 Communication networks.

.2 PLC system.

.3 Chiller system, chilled water pumps and associated equipment.

.3 Perform work continuously until system is restored to a reliable operating condition.

.4 Response Time:

.1 The response time to emergency service calls is to be less than four hours.

.5 Record each service call request, when received separately and include:

.1 Serial number identifying component involved.

.2 Location, date, and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.6 Costs:

.1 If the issue is determined to be due to poor workmanship or defect of the Contractor, no payment will be made to the Contractor.

.2 If the issue is determined to be due to failure of a physical component supplied and is covered under manufacturer's warranty, no payment will be made to the Contractor.

.3 If the issue is determined to be due to an issue outside of the Contractor's responsibility, the Contractor will not be paid for the service call to the Site (or for estimating the required work), but will be paid a mutually agreed upon value to correct the issue, at the discretion of the City.

Part 2 Products

2.1 NOT APPLICABLE.

.1 Not applicable.

Part 3 Execution

3.1 NOT APPLICABLE.

.1 Not applicable.

END OF SECTION