1.01 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract includes the following:

- .1 Modification of the existing utility service and provision of new underground raceways to accommodate new power distribution.
- .2 Provision of new power distribution to accommodate new electric bus chargers.
- .3 Provision of electric vehicle (EV) DC chargers and dispensers to accommodate charging of up to 34 buses.
  - .1 Each charger shall be configured to charge up to four buses.
  - .2 Each bus shall be able to receive up to 150kVA peak power during the charging cycle.
  - .3 Charging capacity for at least eight buses shall be available by July 1, 2024; Charging capacity for the balance of the buses shall be available by April 2025.
  - .4 Maximum combined power draw of all EV DC chargers supplied under the scope of this project shall not exceed 1350kVA.
- .4 Provision of raceways to accommodate the cabling for new chargers.
- .5 Coordination with the Utility to upgrade / upsize existing transformer.
- .6 Provision of new ventilation system to address heat rejection load associated with the new EV DC chargers.
- .7 Provision of underground raceways for future bus charging infrastructure as well as future microgrid system.

1.02 CONTRACT METHOD

.1 Construct Work under The City of Winnipeg general conditions.

1.03 SUBMITTALS

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

.2 Submit Project construction progress schedule in accordance with D18 Detailed Work Schedule.

.3 Submit site-specific and Work Plan Health and Safety Plan in accordance with D12 Safe Work Plan.

1.04 FUTURE WORK

.1 Project is designed for future expansion of the charging system, as well as installation of the microgrid system in the same area.

.2 Contract drawings outline areas for future equipment.

1.05 WORK SEQUENCE

.1 Where constrained by the availability of materials and materials lead time, contractor may complete installation of distribution and charging equipment in two phases:

.1 Contractor may energize two (2) 150kVA charger cabinets from the existing distribution using temporary breakers. The temporary breakers shall match the existing distribution.

.2 Contractor may use temporary breakers in the new 2000A distribution, providing the use of the temporary breakers is approved by the authority having jurisdiction and providing the use of temporary breakers does not impact the warranty on the overall system. Warranty on the new breakers supplied under contract shall commence once the breakers are installed, operational, and serving the charging equipment.

.3 If applicable, staged approach shall be detailed in contractor's bid, complete with the anticipated schedule. The schedule shall clearly indicate the number of power outages that will be required to complete the work.

1.06 CONTRACTOR USE OF PREMISES

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

.1 The City of Winnipeg occupancy of tracks area.

.2 The City of Winnipeg access to and occupancy of the main electrical room without the need for a safety orientation.

.2 Co-ordinate use of premises under direction of the The City of Winnipeg.

.3 Maintain The City of Winnipeg's access to the main electrical room during the construction by providing a safe, clear path through the area of work.

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

.5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by the The City of Winnipeg.

.6 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.

1.07 OWNER OCCUPANCY

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

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

1.08 ALTERATIONS, ADDITIONS OR BUILDING

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

.1 Take all necessary measures to ensure that the scope of work does not have an impact on the residential dwellings adjacent to the parking facility.

1.9 EXISTING SERVICES

.1 Notify, the The City of Winnipeg 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 The City of Winnipeg 5 business day notice for necessary interruption of mechanical 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 The City of Winnipeg's operation.

.3 Provide alternative routes for personnel, pedestrian and vehicular traffic. Maintain code compliant exit path from the facility at all times during the course of work. Where existing exit paths cannot be maintained, engage code consultant to confirm that the temporary egress paths are in compliance with the code requirements.

.4 Establish location and extent of service lines in area of work before starting Work. Notify Contract Administrator of findings.

.5 Submit schedule for approval by the The City of Winnipeg 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 as required to maintain critical building and tenant services.

.7 Where unknown services are encountered, immediately advise the The City of Winnipeg 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.

1.10 DOCUMENTS REQUIRED

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

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Reviewed Shop Drawings.
- .5 List of Outstanding Shop Drawings.
- .6 Change Orders.
- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

END OF SECTION

1.01 ACCESS AND EGRESS

.1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.02 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with The City of Winnipeg to facilitate work as stated.

.2 Maintain existing services to building and provide for personnel and vehicle access.

.3 Where security is reduced by work provide temporary means to maintain security.

.4 The contractor is responsible for providing and maintaining sanitary facilities on site, within the area of work.

.5 The City of Winnipeg will not be providing contractor site parking.

.6 Contractor shall coordinate on-site material drop off with The City of Winnipeg a minimum 2 business days prior to the scheduled materials delivery.

.7 Closures: protect work temporarily until permanent enclosures are completed.

1.03 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible interference or disturbance to building operations occupants, public and normal use of premises. Arrange with The City of Winnipeg to facilitate execution of work.

1.04 EXISTING SERVICES

.1 Notify, The City of Winnipeg, the Contract Administrator and Manitoba Hydro of intended interruption of services and obtain required permission.

.2 Where Work involves connecting to existing services, give The City of Winnipeg a minimum 5 day notice for necessary interruption of electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants.

.3 Construct and clearly mark areas around the area of work to prevent access by general public.

1.05 SPECIAL REQUIREMENTS

.1 Carry out noise generating Work that may impact adjacent residential occupancies Monday to Friday from 9:00 to 16:00 hours.

.2 Submit schedule in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM).

.3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.4 Keep within limits of work and avenues of ingress and egress.

.5 Ingress and egress of Contractor vehicles at site shall be coordinated with The City of Winnipeg.

.6 Deliver materials outside of peak traffic hours unless otherwise approved by The City of Winnipeg.

1.06 BUILDING SMOKING ENVIRONMENT

.1 Comply with all smoking and vaping restrictions. Smoking and vaping is not permitted on premises.

END OF SECTION

1.01 ADMINISTRATIVE

.1 Schedule and administer bi-weekly project meetings throughout the progress of the work at the request ofThe City of Winnipeg.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting a minimum of three business days in advance of meeting date to The City of Winnipeg and the Contract Administrator.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

.7 Reproduce and distribute copies of minutes within three business days after meetings and transmit to meeting participants and affected parties not in attendance.

.8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.02 PRECONSTRUCTION MEETING

.1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Contract Administrator, The City of Winnipeg, Contractor, major Subcontractors (including electric bus charger supplier representative), shall be in attendance.

.3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.

.4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with D18 Detailed Work Schedule.

.3 Schedule of submission of shop drawings. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Delivery schedule of specified equipment in accordance with D18 Detailed Work Schedule.

.5 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.6 The City of Winnipeg provided products.

.7 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

.8 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.9 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

.10 Monthly progress claims, administrative procedures, photographs, hold backs.

.11 Appointment of inspection and testing agencies or firms.

.12 Insurances, transcript of policies.

1.03 PROGRESS MEETINGS

.1 During course of Work and two weeks prior to project completion, schedule progress meetings bi-weekly.

.2 Contractor, major Subcontractors involved in Work, Contract Administrator and The City of Winnipeg are to be in attendance.

.3 Notify parties minimum five business days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within five business days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for affect on construction schedule and on completion date.

.12 Other business.

END OF SECTION

1.01 ADMINISTRATIVE REQUIREMENTS

.1 Submit to The City of Winnipeg 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 before submission to The City of Winnipeg. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated 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 The City of Winnipeg, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify site measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by The City of Winnipeg review of submittals.

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

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

1.02 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, 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 The City of Winnipeg’s review of each submission.

.4 Adjustments made on shop drawings by The City of Winnipeg are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to The City of Winnipeg before proceeding with Work.

.5 Make changes in shop drawings as The City of Winnipeg may require, consistent with Contract Documents. When resubmitting, notify The City of Winnipeg in writing of revisions other than those requested.

.6 Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data, and sample.
- .5 Other pertinent data.

.7 Submissions to include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of site measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified site dimensions and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

.8 After The City of Winnipeg’s review, distribute copies.

.9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as The City of Winnipeg may reasonably request.

.10 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by The City of Winnipeg 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 The City of Winnipeg.

- .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.

.12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by The City of Winnipeg.

.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 Contract complete with project name.

.13 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by The City of Winnipeg.

.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 Site Reports for requirements requested in specification Sections and as requested by The City of Winnipeg.

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

.16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by The City of Winnipeg.

.17 Delete information not applicable to project.

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

.19 If upon review by The City of Winnipeg, no errors or omissions are discovered or if only minor corrections are made, copies 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 Public Services and Procurement Canada (PSPC) is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that PSPC 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 construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at the project site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of Work of Subcontractors.

1.03 SAMPLES

.1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.

.2 Notify The City of Winnipeg in writing, at time of submission of deviations in samples from requirements of Contract Documents.

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

.4 Adjustments made on samples by The City of Winnipeg are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to The City of Winnipeg before proceeding with Work.

.5 Make changes in samples which The City of Winnipeg may require, consistent with Contract Documents.

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

1.04 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of color digital photography in .jpg format, minimum 5MP resolution with progress statement.

.1 Photograph all underground work before the services are installed and before the services are backfilled. Photos shall allow identification of the location that is being photographed, via inclusion of the surrounding features.

.2 Photograph all stages of slab restoration, including material compaction, rebar installation, concrete pour, concrete curing process.

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

.3 Frequency of photographic documentation: weekly and as required to capture the site progress.

1.05 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

END OF SECTION

1.01 QUALITY

.1 Refer to City of Winnipeg Standard Construction Specifications.

1.02 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 of Winnipeg of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

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

1.03 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 sheet materials, and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 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.

.8 Remove and replace damaged products at own expense and to satisfaction of The City of Winnipeg.

.9 Touch-up damaged factory finished surfaces to The City of Winnipeg’s satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.04 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

1.05 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 The City of Winnipeg in writing, of conflicts between specifications and manufacturer's instructions, so that The City of Winnipeg will establish course of action.

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

1.06 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 The City of Winnipeg if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. The City of Winnipeg reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with The City of Winnipeg, whose decision is final.

1.07 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.

1.08 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform The City of Winnipeg if there is interference. Install as directed by the The City of Winnipeg.

1.09 LOCATION OF FIXTURES

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

.2 Inform The City of Winnipeg of conflicting installation. Install as directed.

1.10 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, and work in the Tracks area, 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.

1.11 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.

1.12 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 The City of Winnipeg.

1.13 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, building occupants 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.

END OF SECTION

1.01 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by The City of Winnipeg.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by The City of Winnipeg. Do not burn waste materials on site, unless approved by The City of Winnipeg.

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

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.

.6 Dispose of waste materials and debris off site.

.7 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.

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

.9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.02 FINAL CLEANING

.1 Refer to City of Winnipeg Standard Construction Specifications.

1.03 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.01 SUMMARY

.1 This Section includes requirements for management of construction waste and disposal, which forms the Contractor's commitment to reduce and divert waste materials from landfill.

.2 The City of Winnipeg has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors be employed by the Contractor.

1.02 RELATED REQUIREMENTS

.1 Not Used.

1.03 DEFINITIONS

.1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.

.2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, repair and demolition operations.

.3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity, or reactivity.

.4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.

.5 Non-toxic: Not poisonous to humans either immediately or after a long period of exposure.

.6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

.7 Recycle: To remove a waste material from the Project site to another site for remanufacture into a new product for reuse by others.

.8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.

.9 Return: To give back reusable items or unused products to vendors for credit.

.10 Reuse: To reuse a construction waste material in some manner on the Project site.

.11 Salvage: To remove a waste material from the Project site to another site for resale or reuse by others.

.12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.

.13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

.14 Toxic: Poisonous to humans either immediately or after a long period of exposure.

.15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

.16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:

.1 Solvents in paints and other coatings;

.2 Wood preservatives; strippers and household cleaners;

.3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.

.4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

.17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM E 1609 01, Standard Guide for Development and Implementation of a Pollution Prevention Program

.2 Recycling Certification Institute (RCI)

.1 RCI Certification Construction and Demolition Materials Recycling

1.05 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate waste management requirements with all Divisions of the Work for the Project.

.2 Preconstruction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 19 - Project Meetings before starting any Work of the Contract attended by The City of Winnipeg, Contractor and affected Subcontractors to discuss the Contractor's Construction Waste Management Plan and to develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.

1.06 ACTION AND INFORMATIONAL SUBMITTALS

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

1.07 PROJECT CLOSEOUT SUBMITTALS

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

1.08 QUALITY ASSURANCE

.1 Provide proof of the following during the course of the Work:

.1 Compliance Certification: Provide proof that recycling center is third party verified and is listed as a Certified Facility through the registration and certification requirements of the Recycling Certification Institute.

1.09 DELIVERY, STORAGE, AND HANDLING

.1 Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the Project waste and the available recycling and reuse programs in the Project area.

.2 Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:

.1 Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.

.2 Arrange for collection by or delivery to the appropriate recycling or reuse facility.

.3 Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.

Part 2 Products

2.01 NOT USED

.1 Not Used.

Part 3 Execution

3.01 WASTE MANAGEMENT IMPLEMENTATION

.1 Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, composting and return methods being used for the Project to Subcontractors at appropriate stages of the Project.

.2 Separation Facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting and return:

.1 Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

.2 Hazardous wastes shall be separated, stored, and disposed of in accordance with local regulations.

3.02 SUBCONTRACTOR'S RESPONSIBILITY

.1 Subcontractors shall cooperate fully with the Contractor to implement the CWM Plan.

.2 Failure to cooperate may result in The City of Winnipeg not achieving their environmental goals and may result in penalties being assessed by the Contractor to the responsible Subcontractors.

END OF SECTION

1.01 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

.1 Convene meeting one week before Contract completion with contractor's representative, Contract Administrator and The City of Winnipeg, in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify Project requirements.

.2 Review manufacturer's installation instructions and warranty requirements.

.2 Contract Administrator, on behalf of The City of Winnipeg, to establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks before Substantial Performance of the Work, submit to The City of Winnipeg, digital copy of operating and maintenance manual in English.

.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.

1.03 FORMAT

.1 Organize data as instructional manual, complete with linked headers for each section.

.2 Text: manufacturer's printed data, or typewritten data.

.3 Provide 1:1 scaled CAD files in dwg format via secure file transfer.

1.04 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;

.1 Date of submission; names.

.2 Addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.

.3 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 - Demonstration and Training.

1.05 AS-BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for The City of Winnipeg one record copy of:

.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Site test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.

.2 Store record documents and samples in site office apart from documents used for construction.

.1 Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

.1 Label each document "PROJECT RECORD" in neat, large, printed letters.

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

.1 Do not use record documents for construction purposes.

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

1.06 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of red line drawings.

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

.3 Record information concurrently with construction progress.

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

.4 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 Site changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 Referenced Standards to related shop drawings and modifications.

.5 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 orders.

.6 Other Documents: Maintain manufacturer's certifications, inspection certifications, site test records, required by individual specifications Sections.

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

1.07 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 routine 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 coordination drawings, with installed colour coded diagram of all the mechanical and electrical services.

.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 91 13 - General Commissioning Requirements.

.15 Additional requirements: As specified in individual specification Sections.

1.8 MATERIALS AND FINISHES

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

.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.

1.9 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 before 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 Maintenance Manual.
.5 Obtain receipt for delivered products and submit before to final payment.

.3 Special Tools:

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

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

.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.

1.10 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.

1.11 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, 30 days before planned pre-warranty conference, for The City of Winnipeg's approval.

.3 Warranty management plan to include required actions and documents to assure that The City of Winnipeg receives warranties to which The City of Winnipeg is entitled.

.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit, warranty information made available during construction phase, to The City of Winnipeg and Contract Administratorfor approval before each monthly pay estimate.

.6 Assemble approved information in a pdf file:

.1 Separate each warranty or bond with link from the Table of Contents listing.

.2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within ten business days after completion of applicable item of work.

.4 Verify that documents are in proper form, contain full information, and are notarized.

.5 Co-execute submittals when required.

.6 Retain warranties and bonds until time specified for submittal.

.7 Except for items put into use with The City of Winnipeg's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct joint 11 month warranty inspection, measured from time of acceptance, by Contract Administrator and The City of Winnipeg.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers, or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include HVAC balancing, motors, transformers.

.3 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.4 Contractor's plans for attendance at 11 month post-construction warranty inspections.

.5 Procedure and status of tagging of equipment covered by extended warranties.

.6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.10 Respond in timely manner to oral or written notification of required construction warranty repair work.

.11 Written verification to follow oral instructions.

.1 Failure to respond will be cause for The City of Winnipeg to proceed with action against Contractor.

1.12 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil- and water-resistant tag approved by The City of Winnipeg.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Leave date of acceptance until project is accepted for occupancy.

.4 Indicate the following information on tag:

.1 Type of product/material.
.2 Model number.
.3 Serial number.
.4 Contract number.
.5 Warranty period.
.6 Inspector's signature.
.7 Construction Contractor.

END OF SECTION

1.01 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to The City of Winnipeg's personnel two weeks before date of substantial performance or interim completion (whichever occurs first).

.2 The City of Winnipeg: Provide list of personnel to receive instructions and coordinate 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 in accordance with manufacturer’s literature.
- .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 Instructions:

- .1 Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals 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 Ventilation Control System: 6 hours of instruction over three sessions. Two sessions shall be conducted two weeks apart, one session shall be conducted six month after the substantial completion.
- .2 Electric bus charging system: 24 hours of instruction over 6 sessions. Four sessions shall be conducted one week apart. One session shall be conducted six month after the substantial completion. One session shall be conducted 11 months after the substantial completion.
- .3 Emergency Procedures: 6 hours of instruction over three sessions. Coordinate session timing with The City of Winnipeg.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks before designated dates, for The City of Winnipeg’s approval.

.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.4 Give time and date of each demonstration, with list of persons present.

.5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions minimum five business days prior to commencement of the training sessions.

.6 Provide single page check list procedure for the use of emergency shut-off key, and the steps require to safely restore the power distribution system.

.1 Include photos of the locations of the key, as well as photos of the main distribution and the breakers.

.2 Procedure to require full load shed of the main distribution prior to re-energizing the main breaker.

.3 Procedure to highlight PPE requirement for re-energization of the main distribution based on the outcome of the arc flash study, as well as best safety practices for operating large breakers.

1.03 QUALITY ASSURANCE

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

.1 Instruct The City of Winnipeg's personnel.

.2 Submit written report that demonstration and instructions have been completed.

END OF SECTION

1.01 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Commissioning Training.

1.02 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.03 INSTRUCTORS

.1 Contract Administrator will provide:

.1 Descriptions of systems.

.2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have certified.

1.04 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.05 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating Manual.

.3 Maintenance Manual.

.4 Management Manual.

.5 TAB and PV Reports.

.3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement training materials:

.1 Transparencies for overhead projectors.

.2 Multimedia presentations.

.3 Manufacturer's training videos.

.4 Equipment models.

1.06 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length.

.3 Training to be completed prior to acceptance of facility.

1.07 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Contract Administrator will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Contract Administrator and The City of Winnipeg.

1.08 TRAINING CONTENT

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:

.1 Review of facility and occupancy profile.

.2 Functional requirements.

.3 System philosophy, limitations of systems and emergency procedures.

.4 Review of system layout, equipment, components and controls.

.5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

.6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.

.7 Maintenance and servicing.

.8 Trouble-shooting diagnosis.

.9 Inter-Action among systems during integrated operation.

.10 Review of O&M documentation.

Provide specialized training as specified in relevant Technical Sections of the construction specifications.

END OF SECTION

1.01 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 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.

1.02 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. 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 BMM.
.3 Effectively train O&M staff.

.2 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 user requirements.

.3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.03 COMMISSIONING OVERVIEW

.1 Section 01 91 13.13 - Commissioning Plan.

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

.3 Cx to be a line item of Contractor's cost breakdown.

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

.5 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 built is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.6 The City of Winnipeg will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Contract Administrator.

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.04 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 The City of Winnipeg or 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 or hold-back assessments.

1.05 PRE-CX REVIEW

.1 Before Construction:

.1 Review Contract Documents, confirm by writing to The City of Winnipeg.

.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 The City of Winnipeg.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Ensure "As-Built" system schematics are available.

.4 Inform The City of Winnipeg in writing of discrepancies and deficiencies on finished works.

1.06 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to The City of Winnipeg before start-up and obtain clarification.

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

1.07 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 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to The City of Winnipeg for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to The City of Winnipeg where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by The City of Winnipeg.

1.08 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 The City of Winnipeg to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to The City of Winnipeg.

1.09 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.

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, The City of Winnipeg will 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 Cx Agent, 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 The City of Winnipeg to witness start-up and testing.

.3 Contractor's Cx Agent 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.

.3 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

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 The City of Winnipeg 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 The City of Winnipeg. 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 The City of Winnipeg.
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by The City of Winnipeg.
- .3 If evaluation report concludes that major damage has occurred, The City of Winnipeg 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 The City of Winnipeg for approval before commencement of commissioning.

.2 Start-up documentation to include:

- .1 Factory and on-site test certificates for specified equipment.
- .2 Pre-start-up inspection reports.
- .3 Signed installation/start-up check lists.
- .4 Start-up reports,
- .5 Step-by-step description of complete start-up procedures, to permit The City of Winnipeg 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 The City of Winnipeg 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 of Winnipeg and Contract Administrator at least 14 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to The City of Winnipeg 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 simulated operating conditions, over entire operating range, in all modes.

.2 Under actual operating conditions, over entire operating range, in all modes.

.3 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.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

.1 Contract Administrator and / or The City of Winnipeg 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 City of Winnipeg and Contract Administrator within 5 business days of test and with Cx report.

1.23 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by The City of Winnipeg in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.24 EXTENT OF VERIFICATION

.1 Bus Chargers / Bus Dispencers:

.1 Provide manpower and instrumentation to verify up to 100 % of reported results.

.2 Power Distribution:

.1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.

.3 Number and location to be at discretion of The City of Winnipeg.

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

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

.6 Perform additional commissioning until results are acceptable to The City of Winnipeg.

1.25 REPEAT VERIFICATIONS

.1 Assume costs incurred by The City of Winnipeg and Contract Administrator for third and subsequent verifications where:

.1 Verification of reported results fail to receive The City of Winnipeg’s approval.

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

.3 The City of Winnipeg 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 The City of Winnipeg.

.2 Report problems, faults or defects affecting Cx to The City of Winnipeg in writing. Stop Cx until problems are rectified. Proceed with written approval from The City of Winnipeg.

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 issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by The City of Winnipeg.

1.29 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.30 TRAINING

.1 In accordance with Section 01 79 00.13 - 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 of Winnipeg 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 The City of Winnipeg.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

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 THE CITY OF WINNIPEG'S PERFORMANCE TESTING

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

END OF SECTION

1.01 SUMMARY

.1 Section Includes:

.1 Description of overall structure of Plan and roles and responsibilities of commissioning team.

1.02 GENERAL

.1 Provide a fully functional bus charging system complete with supporting mechanical systems and the upstream power distribution system:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance,

.2 Systems, equipment and components operate consistently throughout the full range of bus charging scenarios: from a single bus to sequential charging of four buses.

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

.4 Complete documentation relating to installed equipment and systems.

.5 Emergency procedures have been developed for emergency system shutdown and the system restoration.

.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 of Winnipeg’s design requirements.

.5 Produces a complete functional system prior to issuance of Certificate of Occupancy.

.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 Acronyms:

.1 Cx - Commissioning.

.2 BMM - Building Management Manual.

.3 EMCS - Energy Monitoring and Control Systems.

.4 WHMIS Safety Data Sheets (SDS).

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting and Balancing.

.8 WHMIS - Workplace Hazardous Materials Information System.

.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.

1.03 DEVELOPMENT OF 100% CX PLAN

.1 Cx Plan to be 95% completed before added into Project Specifications.

.2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:

.1 Approved shop drawings and product data.

.2 Approved changes to contract.

.3 Contractor's project schedule.

.4 Cx schedule.

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

.6 Project construction team's and Cx team's requirements.

.3 Submit completed Cx Plan to The City of Winnipeg and obtain written approval.

1.04 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:

.1 Changes resulting from Client program modifications.

.2 Approved design and construction changes.

.2 Where changes to the CX are warranted, revise, refine and update every 4 weeks during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to The City of Winnipeg for review and obtain written approval.

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

1.05 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

.1 The City of Winnipeg to maintain overall responsibility for project and is sole point of contact between members of commissioning team.

.2 Project Manager will select Cx Team consisting of following members:

.1 Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

.2 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 The City of Winnipeg 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 Developing BMM.

.6 Ensuring implementation of final Cx Plan.

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

.8 Implementation 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 Assigning one person as point of contact with Contract Administrator and PWGSC Cx Manager for administrative and coordination purposes.

.5 Contractor's Cx agent implements specified Cx activities including:

.1 Demonstrations.

.2 Training.

.3 Testing.

.4 Preparation, submission of test reports.

.6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:

.1 Receiving facility.

.2 Day-To-Day operation and maintenance of facility.

1.06 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 Electric vehicle charging equipment manufacturer: equipment specified to be installed and started by manufacturer.

.1 To include performance verification.

.3 Electric Bus (New Flyer) representative.

.2 Client: responsible for provision of electric buses.

.3 Ensure that Cx participant:

.1 Could complete work within scheduled time frame.

.2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:

.1 Modify ventilation rates to meet changes in equipment heat rejection and outdoor air temperature.

.2 Changes to heating or cooling loads beyond scope of EMCS.

.3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.

.4 Redistribution of electrical services.

.5 Modifications of fire alarm systems.

.4 Provide names of participants to The City of Winnipeg and details of instruments and procedures to be followed for Cx 2 months prior to starting date of Cx for review and approval.

1.07 EXTENT OF CX

.1 Commission mechanical systems and associated equipment:

.1 Ventilation systems:

.1 Ventilation Fan.

.2 Motorized Dampers.

.3 Starter interlock with fire damper.

.2 EMCS:

.1 Interface between ventilation fan HOA starter and existing building EMCS.

.2 Commission electrical systems and equipment:

.1 Low voltage below 1000 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.2 Other systems and equipment:

.1 Electric Bus Charging System:

.1 Electric Bus Chargers

.2 Electric Bus Charger Dispensers

1.08 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 Warranties.

.2 Project record documentation.

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

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

.5 WHMIS information.

.6 WHMIS Safety Data Sheets (SDS).

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

.8 Feeder termination torque test report forms.

.9 Feeder megger test report forms.

1.09 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:

.1 Cx Specifications.

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

.3 Completed installation checklists (ICL).

.4 Completed product information (PI) report forms.

.5 Completed performance verification (PV) report forms.

.6 Results of Performance Verification Tests and Inspections.

.7 Description of Cx activities and documentation.

.8 Description of Cx of integrated systems and documentation.

.9 Tests performed by The City of Winnipeg.

.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 of Winnipeg.

.5 The City of Winnipeg to participate.

1.10 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

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

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

.2 The City of Winnipeg to use approved check lists.

.3 The City of Winnipeg will monitor some of these pre-start-up inspections.

.4 Include completed documentation with Cx report.

.5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by The City of Winnipeg and does not form part of Cx specifications.

.6 The City of Winnipeg or The City of Winnipeg's representative(s) will monitor some of these inspections and tests.

.7 Include completed documentation in Cx report.

.2 Pre-Cx activities - MECHANICAL:

.1 HVAC equipment and systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 At this time, complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.4 Perform TAB on systems. TAB reports to be approved by The City of Winnipeg.

.2 EMCS:

.1 EMCS trending to be available as supporting documentation for performance verification.

.2 Perform point-by-point testing in parallel with start-up.

.3 Carry out point-by-point verification.

.4 Demonstrate performance of systems, to be witnessed by The City of Winnipeg prior to start of 30 day Final Acceptance Test period.

.5 Perform final Cx and operational tests during demonstration period and 30 day test period.

.6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".

.3 Pre-Cx activities - ELECTRICAL:

.1 Power Distribution System:

.1 Contractor to test main breaker emergency shunt trip circuit prior to energizing bus chargers.

.2 Electric Bus Charging system:

.1 Contractor to perform all bus charging equipment testing, commissioning and verification steps as outlined by the bus charging equipment manufacturer.

.1 Contractor to perform separate charging system testing with a single bus connected to the charger.

.2 Contractor to perform separate charging system testing with four buses connected to one charger.

1.11 START-UP

.1 Start up components, equipment and systems.

.2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:

.1 Electric Bus Charging System.

.3 The City of Winnipeg to monitor some of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of The City of Winnipeg.

.4 Performance Verification (PV):

.1 Approved Cx Agent to perform.

.1 Repeat when necessary until results are acceptable to The City of Winnipeg.

.2 Use procedures modified generic procedures to suit project requirements.

.3 The City of Winnipeg to witness and certify reported results using approved PI and PV forms.

.4 The City of Winnipeg to approve completed PV reports and provide to The City of Winnipeg.

.5 The City of Winnipeg 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.

1.12 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx agency using procedures developed by The City of Winnipeg and approved by The City of Winnipeg.

.2 The City of Winnipeg to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 The City of Winnipeg to witness, certify reported results of, Cx activities and forward to the City of Winnipeg.

.5 The City of Winnipeg reserves right to verify a percentage of reported results at no cost to contract.

1.13 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed by The City of Winnipeg and approved by The City of Winnipeg.

.2 Tests to be witnessed by The City of Winnipeg and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by The City of Winnipeg and submitted to The City of Winnipeg for review.

.4 The City of Winnipeg reserves right to verify percentage of reported results.

.5 Integrated systems to include:

.1 Ventilation system.

.2 Fire alarm system.

.3 Emergency key trip system.

.6 Identification:

.1 In later stages of Cx, before hand-over and acceptance The City of Winnipeg and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.14 CX REPORTS

.1 Submit reports of tests, witnessed and certified by the Contract Administrator to The City of Winnipeg, 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 The City of Winnipeg.

1.15 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of ventilation system.

1.16 TESTS TO BE PERFORMED BY THE CITY OF WINNIPEG/USER

.1 Not Used.

1.17 TRAINING PLANS

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

1.18 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of The City of Winnipeg, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

.2 Where possible, copy all digital settings to a portable digital media, clearly label the media with system name, firmware version and date, and turn over the media to The City of Winnipeg.

END OF SECTION

Part 1 General

1.01 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results For Electrical.

1.02 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CSA C22.2 No. 346:22 (R2022), DC Charging Equipment for Electric Vehicles.

.2 Open Charge Alliance (OCA):

.1 OCCP 1.6-J-2022, Open Charge Point Protocol 1.6-J (JSON over WebSockets).

.3 SAE International (SAE):

.1 SAE J1772-2022, Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler.

.4 Underwriters Laboratories Inc. (UL):

.1 UL 1773-2020, Standard for Personal Termination Boxes.

.2 UL 2231-1-2021, Personal Protection Systems for Electric Vehicle (EV) Supply Circuits, Part 1.

.3 UL 2231-2-2020, Personal Protection Systems for Electric Vehicle (EV) Supply Circuit: Particular Requirements for Protection Devices for Use in Charging Systems.

.4 UL 2594-2016, Standard for Electric Vehicle Supply Equipment.

1.03 SUBMITTALS

.1 Refer to Section 26 05 00 - Common Work Results For Electrical.

.2 Outline sketch with dimensions showing arrangement of charging cubicles, charging dispensers and any associated equipment.

.3 Shipping weight.

.4 Schematic diagram showing components and the interconnecting cables.

.1 If different from the infrastructure outlined on the drawings, include a drawing detailing the alternative equipment layout and all the raceways.

.5 Charger data: type and capacity, battery charging sequence, estimated noise level, metering, alarms, interfaces, controls and efficiency.

.6 Charger cabinet and dispenser cabinet installation instructions.

.7 Charger cabinet and dispenser cabinet testing and commissioning instructions.

.8 Charger cabinet and dispenser cabinet operation and maintenance instructions.

1.04 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for EV charger for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.2 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.

.3 Copy of approved shop drawings.

.4 Technical description of components.

.5 Parts lists with catalogue numbers and names and addresses of suppliers.

1.05 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Manufacturer regularly engaged in the manufacture of electric vehicle chargers of the types and sizes required, whose products have been in satisfactory use in similar service in Canada or North America for not less than five years.

.2 Electric Vehicle Chargers: Comply with requirements of applicable local codes, as well as cUL, and CSA standards pertaining to electric vehicle chargers.

.1 Electric vehicle chargers cETLus Listed to CSA C22.2 No. 346:22.

1.06 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 Closeout Submittals.

.2 Provide one spare set of filters for each of the EV charging cabinets.

.3 Provide complete set of proprietary tools (if any) necessary to maintain and adjust every serviceable part of the EV charger and EV charging dispenser assembly.

.4 Provide software and proprietary cable(s) (if applicable) required to adjust configuration of the EV charging equipment.

Part 2 Products

2.01 CHARGER CABINET CHARACTERISTICS

.1 Input: 600V AC, 3 phase, 3 wire, grounded 60 Hz.

.2 Input power factor: >0.95

.3 DC output: 0-1000VDC, 0-200A, 150kVA.

.1 Where a different output is provided, charging system shall be configured to deliver up to 150kVA to an individual dispenser.

.4 Auxiliary output: 120VAC.

.1 If the charger does not provide auxiliary output power, supply and install new matching 120/208V 100A 3Ph 4W 44CCT (min) 22KAIC panelboard cw 15kVA

(min) transformer fed out of a new matching breaker in the main building distribution. Size panelboard to accommodate all EV charging dispensers included in Phase 2, as well as all future EV charging dispensers, based on the equipment provided under this contract. Size transformer primary and secondary conductors in accordance with 2021 CEC Table 2.

.5 Communication via multimode dielectric fiber or STP CAT6.

.6 One charger capable of supporting four (4) charging dispensers, operating either in parallel (equal power to all), or priority (prioritize dispensers in a pre-configured sequence), while limiting the load per charger cabinet to 150kVA.

.1 Contractor may propose an alternative equipment configuration, providing:

.1 The proposed equipment configuration fits within the physical space allocated for the chargers, as indicated on the drawings.

.2 The proposed equipment configuration limits the overall charging system demand to 1350kVA for Phase 1, without the need for licensed software subscription.

.3 The proposed equipment configuration is capable of charging the buses on a schedule equivalent to that of a sequential 4-dispencer system.

.4 The proposed equipment configuration is designed to provide up to 150kVA of charging power at each charging dispenser.

.2 Contractor to submit the alternative equipment configuration for The City of Winnipeg's review minimum one week prior to the tender closing date.

.7 Dead front free standing sheet steel, minimum 2.5 mm thick, sprinkler proof.

.8 Access from front only.

.9 Emergency stop button mounted on the front panel.

.10 Indicators on the front panel of the unit to indicate charging status, system status, troubles and errors.

.11 Apply finish in accordance with Section 26 05 00 – Common Work Results - Electrical.

.12 Operating temperature: -25 degrees C to +45 degrees C, up to 95% relative humidity.

.13 Minimum efficiency: 95.5%

.14 Maximum weight: 1500kg per cabinet.

2.02 CHARGING DISPENSER CHARACTERISTICS

.1 DC output: 100 to 1000VDC; up to 150kVA, 99.5% efficiency.

.2 AC input: 120 or 230VAC, 1ph

.3 Maximum auxiliary energy consumption: 500W

.4 Operating temperature: -25 degrees C to +45 degrees C, up to 95% relative humidity.

.5 Wall mounted configuration, supported using strut channel.

.6 Access from front only.

.7 Indicator lights or HMI interface to relay charging status, system status, troubles and errors.

.8 Charging port: CCS Type 1 / SAE J1772.

.9 CCS Cable Length: 7 meters..

.10 Cabinet complete with cable management for storage of CCS cable elevated from the floor when not in use and for storage of excess cable when the dispenser is in use.

2.03 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 For major components such as input breakers, output breaker: size 4 nameplates.

.3 For mode lights alarms, meters: size 2 nameplates.

2.04 ACCEPTABLE MANUFACTURERS

.1 ABB, Siemens, Hitachi or approved equal.

Part 3 Execution

3.01 INSTALLATION

.1 Locate and install EV charger cabinets as indicated on the drawings.

.1 Coordinate raceway requirements with the EV charger supplier. Where EV charger supplier dictates the use of raceways and wiring that differ from the raceways depicted on the drawings, include all costs associated with the raceways and wiring required by the EV charger supplier. Outline variances in raceways and wiring within tender documents.

.2 Install chargers in accordance with manufacturer's installation instructions.

.3 Install dispenser cabinets in accordance with manufacturer's installation instructions.

.1 Provide strut channel supports for the dispensers and the associated cables. Strut channel supports shall span from the garage floor to the underside of the deck.

.2 Mark out location of the dispensers, the associated strut channel supports and the protective bollards on the floor of the transit garage, and review all locations with The City of Winnipeg prior to commencing the rough-ins.

.4 Unless the wiring is comprised of teck cable on cable tray, all wiring shall be installed in EMT conduits.

.5 Communication wiring shall comprise of either 50/125 OM4 8-strand dielectric fiber or CAT6 23AWG CU STP pre-terminated cable, unless specified otherwise by the EV charger manufacturer.

.6 Connect output terminals to dispenser unit(s), as shown on the drawings, and in accordance with EV charger manufacturer's recommendations, including:

.1 DC Charging power

.2 AC Auxiliary output power

.3 Communication cables (Shielded CAT6 or dielectric fiber)

.7 Configure EV chargers in coordination with The City of Winnipeg:

.1 Review all available charger features and functions with The City of Winnipeg

.2 Document The City of Winnipeg's setting preference and include copy of the preferences in the O&M manual.

.3 Where charger settings can be backed up to a portable media, provide The City of Winnipeg with a digital copy of the settings.

.8 Interface all EV chargers with the existing Johnson Controls DDC system to report charger alarm / trouble via a dry contact. Assign one input per charger on the DDC system.

.1 Supply all the necessary hardware and enclosures to interface the EV chargers with the DDC system.

.2 Engage The City of Winnipeg's contractor to make modifications to the DDC system programming and pay all associated fees.

.3 Ensure sufficient space within the enclosure to accommodate hardware required for the interface with the Phase 2 EV chargers.

3.02 CLEANING AND PROTECTION

.1 Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer prior to substantial performance.

.2 Clean the space prior to energizing the EV chargers to minimize filter contamination.

.3 Where EV chargers have operated for more than two months prior to the substantial completion, replace EV charger filters at the time of the substantial completion.

3.03 TESTS

.1 Refer to 01 91 13 – General Commissioning and 01 91 13.13 – Demonstration and Training for Building Commissioning for equipment testing requirements.

.2 Test EV charging cabinet and dispenser cabinet in accordance with manufacturer's recommendations.

.3 Engage electric bus manufacturer representative to assist with the testing. Pay all associated fees.

.4 Conduct multiple bus charging tests by connecting a single electric bus to the EV charging cabinet via a single dispenser, with bus battery level at 20%, 50%, 70%, and 80%.

.1 Allow the bus to charge to 90% during each test.

.2 During the charging process, monitor and record all parameters recommended by the EV charging cabinet manufacturer.

.3 During the charging process, monitor and record all parameters recommended by the EV bus manufacturer.

.4 Document the above information, as well as charge start time, charge end time, ambient temperature at the location of the bus, EV charger power draw (recorded every 5 minutes) and names / signatures of the individuals performing and witnessing the testing.

.5 Conduct multiple bus charging tests by connecting four electric buses to the EV charging cabinet via four dispensers, with the battery status as outlined below.

.1 Allow all buses to charge to 90% during each test.

.2 During the charging process, monitor all parameters recommended by the EV charging cabinet manufacturer.

.3 During the charging process, monitor all parameters recommended by the EV bus manufacturer.

.4 Document the above information, as well as charge start time, charge end time, ambient temperature at the location of the bus, and names / signatures of the individuals performing the testing.

.5 Test the following bus configurations:

.1 All buses at 20%.

.2 All buses at 80%

.3 1st and 3rd bus at 20%, 2nd and 4th bus at 80%.

.6 Allow five business days of on-site assistance by EV equipment manufacturer representative to assist The City of Winnipeg with testing of the EV buses in conjunction with the EV charging equipment.

.1 The days may be used concurrently or individually, at The City of Winnipeg's discretion.

3.04 WARRANTY

.1 Minimum warranty on the EV charging cabinets and the associated dispensers shall be two (2) years from the date of substantial completion.

.2 Contractor to provide separate price to extend the warranty on EV charging cabinets and the associated dispensers to five (5) years from the date of substantial completion.

3.05 TRAINING

.1 Refer to Section 01 79 00 – Demonstration and Training for training requirements.

END OF SECTION

1.01 INTENT

.1 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances. Include all costs to obtain all permits and to pay for all fees and charges, including inspection charges by the authorities that issue the permits. Coordinate all related inspections.

.2 Contract documents of the Specifications and Drawings, are generally diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents. Provide adequate access space for maintenance and service.

.4 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment as determined by the Transit Representative.

1.02 WARRANTY

.1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of substantial performance of work. The Mechanical Contractor shall repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing the operating and maintenance instructions have been complied with. The period of guarantee specified shall not, in any way, supplant any other guarantees of a longer period provided by Manufacturer or as called for in the project documents.

1.03 METRIC CONVERSION

.1 All units in this division are expressed in SI units. Soft metric conversions are used throughout.

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals use the same SI units as stated in the specification.

.4 Equivalent Nominal Diameters of Pipes - Metric and Imperial

.1 Where pipes are specified with metric dimensions and only Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide adapters to ensure compatible connections to all metric sized fittings, equipment and piping.

.2 When CSA approved SI Metric pipes are available and are provided, the contractor shall provide adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

.3 Record accurately on "as-built" drawings the type of pipe (i.e., Metric or Imperial) installed.

EQUIVALENT NOMINAL DIAMETERS OF PIPES

mm	Inches	mm	Inches	mm	Inches
6	1/8	65	2-1/2	375	15
8	1/4	80	3	450	18
10	3/8	100	4	500	20
15	1/2	125	5	600	24

20	3/4	150	6	750	30
25	1	200	8		
32	1-1/4	250	10		
40	1-1/2	300	12		
50	2				

.5 Metric Duct Sizes

.1 The metric duct sizes are expressed as 25 mm = 1 inch.

1.04 COORDINATION OF WORK

.1 Cooperate and coordinate with other trades on the project.

.2 Refer to electrical, mechanical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Provide coordination drawings showing the work of all trades and contractors involved, in areas of potential conflict or congestion, as requested by the Transit Representative at no additional cost.

.3 Coordinate electrical requirements for all equipment with electrical drawings.

.4 Where dimensional details are required, work with the applicable architectural and structural drawings.

.5 Full size and detailed drawings shall take precedence over scale measurements from drawings.

1.05 CUTTING AND PATCHING

.1 Provide inserts, holes, and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.

.2 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from Transit Representative before drilling, coring, cutting or burning structural members. Ensure post tensioned or pre-stressed strands are located accurately and avoid with an adequate margin of safety.

1.06 ACCESS DOORS

.1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:

.2 Fire dampers

.3 Controls

.4 Expansion joints

.5 Filters

.6 Steel frame access panel with stainless steel piano-type hinge, channel reinforced steel door panel, three fasteners per door. Door panel recessed to receive ceiling or wall material to give finished appearance showing only hinge and fasteners. Provide acoustic gasket between door panel perimeter and steel frame. Rated access doors shall be UL-listed.

.7 Sizes to be 200 mm x 200 mm (8” x 8”) for cleanout, 300 mm x 300 mm (12” x 12”) for hand 600 mm x 600 mm (24” x 24”) for body access minimum.

.8 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

1.07 FIRESTOPPING AND SEALING

.1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The contractor is required to coordinate with the architectural drawings to contractual rated wall types and installation details.

1.08 VOC COMPLIANCE

.1 VOC: Content: Sealants and sealant primers shall comply with the following:

.1 Architectural sealants shall have a VOC content of 250 g/L or less.

.2 Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

.3 Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

1.9 ACTION AND INFORMATIONAL SUBMITTALS

.1 All shop drawing submittals shall be of PDF format. Identify materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Transit Representative's office. Maintenance and operating manuals are not suitable submittal material. Space must be left on the shop drawing to accommodate the Transit Representative's review stamp. Where equipment is identified by name or number on the drawings or specification, clearly mark each shop drawing with the identical name and/or number.

.2 Clearly mark each sheet of submittal material (using arrows, underlining, or circling) to show differences from what is specified, particularly sizes, types, model numbers, rating, capacities, and alternatives approved by Transit prior to award. Specifically note on the submittal specified features such as special tank linings, pump seals, materials or painting.

.3 Include dimensional and technical data sufficient to check if equipment meets requirements. Include wiring, piping, service connection data and motor sizes.

.4 Prior to submission to the Transit Representative, the Contractor shall review all shop drawings. By this review, the Contractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each shop drawing with the requirements of the work of the Contract documents. The Contractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Transit Representative.

.6 Submittals shall be made in metric units. Units of measure (L/s, kPa, kW, etc) shall match those noted on the equipment schedules.

1.10 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

1.11 TEMPORARY OR TRIAL USAGE

.1 Temporary or trial usage requested by The City of Winnipeg of mechanical equipment supplied under contract shall not represent acceptance. Operate and maintain all equipment and systems during trial usage.

.2 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.3 For all ventilation systems, the operation of the system shall be pre-tested by running the units in a 100% fresh air, 100% exhaust air mode once all distribution ductwork is installed.

END OF SECTION

1.01 SUMMARY

.1 Section Includes:

.1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to the Contract Administrator at project milestones.

.2 Operating and Maintenance Manuals.

.3 As-built Drawings.

1.02 CLOSEOUT SUBMITTALS

.1 Submit operating and maintenance manuals in accordance with Division 01 and as follows.

.2 Operating and Maintenance Manuals:

.1 Organize Each Manual into the Following Divisions:

.1 Operation Division

.2 Maintenance Division

.3 Contract Documentation Division

.2 Operations Division:

.1 The operations division shall have all data organized into sections according to the system category with individual divider tabs as follows:

.1 AIR - Air Systems

.2 CTL - Control Systems

.3 CLG - Cooling Systems

.4 HTG - Heating Systems

.5 MIS - Miscellaneous Systems

.3 Organize data for each system category (section) into individual sub-systems. Provide an index for each system category and a divider tab for each individual system.

.4 For Each Individual Sub-System Include the Following:

.1 System Description - Provide details of system type, composition, areas served, location in the building, design criteria and function of major components. All equipment arranged to operate together as one system shall be considered part of that system description. Design criteria shall, at minimum, include the following:

.1 Occupied space conditions

.2 Outdoor ambient conditions

.3 Air circulation rate

.4 Exhaust air rate

.5 Minimum outside air

.5 System Schematics - Provide a system schematic showing all components comprising the central system. Identify each component using DDC system mnemonic and generic name designation. Use this equipment designation in all references to the equipment throughout the manual.

.1 Include: Ventilation systems.

.6 Operating Instructions: Provide, in "operator" layman language, the specific instructions for start-up, shutdown and seasonal change over of each system component. Include exact type and specific location of each switch and device to be used in the system operation. Identify safety devices and interlocks that must be satisfied in order for the equipment to start. Also, list conditions to be fulfilled before attempting equipment start-up, i.e. valves position correct, glycol mixture concentration proper, piping filled with fluid, filters/strainers in place, etc.

.7 Equipment Identification: Provide data for each system component on equipment identification forms.

.8 Maintenance Division:

.1 Organize Data into the Following Sections With Divider Tabs:

.1 Maintenance Tasks and Schedules

.2 Spare Parts

.3 Suppliers and Contractors

.4 Tags and Directories

.2 Maintenance Tasks and Schedules: Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from manufacturers maintenance brochures, for each component of each system in the following format.

.1 Daily

.2 Weekly

.3 Monthly

.4 Semi-annually

.5 Annually

.6 When Required.

.3 Spare Part List: Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize from manufacturers maintenance brochures the recommended spare parts for each component of each system.

.4 Suppliers and Contractor List: Provide summary of Suppliers and Contractors for each components of each system. List name, address and telephone number of each.

.5 Tags and Directories: Provide a copy of the Mechanical Drawing List, and all other directories as specified in the contract documents.

.9 Contract Documentation Division:

.1 Organize all data required by the construction contract into sections, with divider tabs, as follows:

.1 Drawings List

.2 Shop Drawings and Product Data

.3 Certifications

.4 Warranties and Bonds

.5 Maintenance Brochures

.6 Reports

.2 Shop Drawings and Product Data: Provide final copies of all shop drawings and product data required by the contract documents. Include

section index and divider tabs. Maximum of 25 sheets or one system shop drawing per tab.

.3 Certifications: Provide copies of Contractor Certifications for the performance of product and systems. Include copies of all pressure tests for piping and ductwork systems, equipment alignment certificates, local authority inspection reviews, backflow prevention certification, and fire protection certifications. Include section index and divider tabs with maximum of 25 sheets or one report per tab.

.4 Warranties and Bonds: Include one copy each of the Contractor's, warranty, manufacturers' warranties longer than one year, the bond, and any service contract provided by the contractor. Provided section index.

.5 Maintenance Brochures: Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment, or system. provide section index and divider tabs. Maximum of 25 sheets or one system brochure per tab.

.6 Reports: Include copies of all reports relating to the testing, adjusting and balancing of equipment and systems, water treatment reports and manufacturer's start-up reports, as required by the contract specification sections.

.10 Submissions and Approvals:

.1 First Draft Submission:

.1 Submit a draft copy of the operations and maintenance manuals for format review at the 50% construction completion stage.

.2 Draft submission is to be bound in 3 ring loose leaf type binders and shall include the following information:

.1 A table of contents for the complete manual.

.2 Index of each division of the manual.

.3 Index of each section of the operations and maintenance divisions.

.4 A sample operations division write-up for a typical system, including sample schematic.

.5 A sample maintenance division write-up for the same typical system.

.6 Sample proof of binder covers and spines.

.3 On completion of review of the first draft submission, the Contract Administrator will return the copy of the manual with review comments for resubmission.

.2 Provisional Edition:

.1 Submit two copies of the provisional edition of the manual at the 75% construction completion stage.

.2 The provisional edition shall be complete in all respects, except for reports and certificates to be produced during the facility start-up phase. This manual shall have the same physical format, including divider tabs and indices, as the final edition of the manual. This provisional edition may be bound in standard three-ring loose leaf binders.

.3 One copy of the provisional edition shall be kept on site as an interim reference for all parties engaged in the facility start-up phase, and shall be used to familiarize and train the operating staff.

.4 The second copy shall be returned to the contractor with review comments.

.5 The contractor shall update contents of the site copy of the provisional edition manual as new information is generated during the facility start-up phase.

.3 Final Edition:

.1 Prior to final acceptance the contractor shall submit three (3) copies of the final edition of the manual.

.2 This final edition shall include all outstanding project information and conform to all requirements listed in this document.

.3 As-built Drawings:

.1 Keep, on site, available to the Contract Administrator at all times and particularly for each regularly scheduled site meeting, a complete set of prints, edge bound, that are to be updated daily showing any and all deviations and changes from the Contract Drawings. This set of drawings is to be used only for this purpose, and must not be used as the daily general reference set.

.2 Provide as-built drawings which identify location of fire dampers, major control lines, access doors, and actual room names or numbers. As well, deviations that are to be recorded shall include, in general, items that are significant or are hidden from view and items of major importance to future operations and maintenance, and to future alterations and additions including cleanouts and isolation valves.

.3 At substantial completion, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings, and change orders, to a set of white-print red-line markups. Prior to substantial performance, turn over a completed set of white-print red-line markup drawings.

.4 Each “as-built” drawings shall bear the Contractor’s identification, the date of record and the notation “We hereby certify that these drawings represent the “Work Record of Construction”. The Contractor’s signature and company seal shall be placed below that notation.

END OF SECTION

Part 1 General

1.01 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel

.2 CAN/CGSB-24.3, Identification of Piping Systems

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide in accordance with Division 01.

.2 Product data to include paint colour chips, other products specified in this section.

1.03 WASTE MANAGEMENT AND DISPOSAL

.1 Comply with Division 01.

.2 Dispose of unused paint material at official hazardous material collections site approved by The City of Winnipeg.

.3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard

Part 2 Products

2.01 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be 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.

2.02 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to the following table:

Size #, mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x50	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

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: Use size # 5.

.2 Equipment in Mechanical Rooms: Use size # 9.

2.03 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.04 FIRE DAMPERS

.1 Fire damper access doors shall be labeled with the words “Fire Damper” in stencilled letters not less than 13mm in height.

.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.05 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.06 EXPOSED DUCTWORK PAINTING

.1 Tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

Part 3 Execution

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 TIMING

.1 Provide identification only after all painting has been completed.

3.03 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide CSA registration plates as required by respective agency.

3.04 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 in any way.

3.05 LOCATION OF IDENTIFICATION ON AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment 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 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 At beginning and end points of each run and at each piece of equipment in run.

.7 At point, immediately upstream of major manually operated or automatically controlled dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.8 Identification to be easily and accurately readable from usual operating areas and from access points.

.1 Position of identification to be 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.

END OF SECTION

Part 1 General

1.01 SUMMARY

.1 Sections Includes:

.1 Prepare the facility for balancing.

1.02 RELATED REQUIREMENTS

.1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC Systems

Part 2 Products

2.01 NOT USED

.1 Not used.

Part 3 Execution

3.01 INSTALLATION

.1 Bring the work to an operating state and ready for balancing, including:

.1 Clean equipment and ductwork.
.2 Install air terminal devices.
.3 Verify lubrication of equipment.
.4 Install permanent instrumentation.
.5 Complete the "start-up" of equipment.
.6 Check rotation and alignment of rotating equipment and tension of belted drives.
.7 Set control points of automatic apparatus, check-out sequence of operation.
.8 Make available control diagrams and sequence of operation.
.9 Clean work, remove temporary tags, stickers, and coverings.
.10 Make available one (1) copy of Maintenance Manuals especially for use in balancing.
.11 Provide Balancing Agency a complete set of mechanical drawings and specifications.

.2 Contractor shall:

.1 Make corrections as required.
.2 Coordinate all visits with The City of Winnipeg.
.3 Provide and install any additional balancing valves, dampers, and other materials necessary to properly adjust or correct the systems to design flows.
.4 Provide and install revised pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows (Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC Systems).
.5 Operate automatic control system and verify set points during Balancing.

END OF SECTION

Part 1 General

1.01 SUMMARY

.1 Section Includes:

.1 TAB is used throughout this Section to describe the process, methods, and requirements of testing, adjusting, and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.02 QUALITY ASSURANCE

.1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.

.2 Balancing of air system and sound level readings shall be performed by the same agency.

.3 Balancing procedures shall be in accordance with SMACNA and ASHRAE Standards.

1.03 APPROVED AGENCIES

.1 Approved agency shall be a certified member of the Canadian Associated Air Balance Council (CAABC).

1.04 RELATED REQUIREMENTS

.1 Documentation for HVAC Systems — Section 23 05 05

1.05 SITE VISITS

.1 After each site visit, a written report shall be submitted to the Contractor and Contract Administrator. Site visits shall commence after the start of air and liquid distribution work and be spread over the construction period to the start of the balancing work.

.2 A review of the installation and access to all dampers and equipment shall be made at the specified site visits and any additional dampers required for proper balancing shall be forwarded in writing to be reviewed by the Contract Administrator.

.3 Begin balancing after equipment start-up and testing and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.06 TESTING AND BALANCING AGENDA

.1 General: Submit balancing agenda to the Contract Administrator for review at least thirty (30) days prior to the start of balancing work. Start balancing work only after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.

.3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.4 Sample Forms: Form showing application of procedures to typical systems.

.5 At the completion of balancing the first major air system or pre-arranged milestone, the balancing agent shall notify The City of Winnipeg to re-visit the site to evaluate work completed to this time. Provide The City of Winnipeg with 10 days written notice, prior to request for site visit.

1.07 BALANCE REPORT

.1 Submit two copies of rough balancing reports to the Contract Administrator for review, prior to on-site verification and acceptance of Project.

.2 Provide three copies of final reports to contractor for inserting in existing Facility Operating and Maintenance Manuals as described in Section 23 05 05, Documentation for HVAC Systems.

.3 Include types, serial number, and dates of calibration of instruments in the reports.

1.08 SYSTEM DATA

.1 Air Handling Equipment

.1 Design Data:

.1 Total air flow rate;
.2 Fan total static pressure;
.3 System static pressure;
.4 Motor Kw (HP), r/min, amps, Volts, Phase;
.5 Outside air flow rate L/s (cfm);
.6 Fan r/min;
.7 Fan/kW (HP);

.2 Installation Data:

.1 Manufacturer and model;
.2 Size;
.3 Arrangement discharge and class;
.4 Motor type, kW (HP), r/min, voltage, phase, cycles, and load amperage;
.5 Location and local identification data.

.3 Recorded Data:

.1 Fan

.1 Air flow rate;
.2 Fan total static pressure;
.3 System static pressure;
.4 r/min.

.2 Duct Air Quantities - All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum) major return air openings back to duct shafts.

.1 Duct sizes;
.2 Number of pressure readings;
.3 Sum of velocity measurements;
.4 Average velocity;
.5 Duct recorded air flow rate;
.6 Duct design air flow rate.

.3 Air Inlet and Outlets:

.1 Outlet identification location and designation;

.2 Manufacturers catalogue identification and type;

.3 Design and recorded velocities;

.4 Design and recorded air flow rates;

1.09 INSTRUMENTS

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

Part 2 Execution

2.01 GENERAL PROCEDURE

.1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on splitters, dampers, and other adjustment devices.

.2 After correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:

.1 Determine and tabulate similar sized grilles being balanced for AK schedule.

.2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.

.3 AK factor from schedule, must be approved by the DCC Representative during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).

.4 No flow hoods are to be used for measurement of exhaust or return air grilles.

.4 Balancing shall be performed to the following accuracies:

.1 Air - terminal outlets ±10% (outlets less than 200 L/s [425 cfm])

.2 Air - terminal outlets ±5% (outlets greater than 200 L/s[425 cfm])

.3 Air - central equipment ±5%

.5 Where axial fans (if any) require blade pitch changes, this shall be the responsibility of the balancing contractor.

2.02 AIR SYSTEM PROCEDURE

.1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

.1 Ensure dampers or volume control devices are in fully open position.

.2 Balance central apparatus to ±5% air flow.

.3 Balance branches and mains in accordance with 3.1.4.

.4 Recheck central apparatus.

.5 Balance all terminal air outlets in accordance with 3.1.4.

.6 Re-balance central apparatus to ±5%.

.7 Recheck all air outlets.

.8 Perform acoustical measurements.

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.3 Take static pressure readings.

.4 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 16 for rectangular ducts, and 10 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse.

.5 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.6 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.7 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

.8 Verify all terminal unit factory settings for maximum air flow (and minimum if applicable). Adjust terminal unit controller if required. Record adjusted units.

.9 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. For multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.10 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 12.5 Pa (0.05” WG) shall be achieved, measured with negligible outside wind velocity.

2.03 FIRE DAMPER / FIRE STOP FLAP VERIFICATION

.1 Visually inspect all fire dampers and fire stop flaps:

.1 Installation is straight.

.2 Wall angles properly installed.

.3 Duct has break away connection.

.4 Fire stopping material where used is properly installed.

.5 Adequate access.

.6 Clearance between sleeve and wall.

.2 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.

.3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.

.4 Testing of 10% of the fusible links shall be performed with a suitable heat source capable of generating sufficient heat to detonate fusible link without burning or generating carbon deposits on the blades, frame, or adjacent ductwork. Selection of links to be test dropped

to be as directed by The City of Winnipeg. The City of Winnipeg shall witness retesting and resetting.

.5 If fire damper does not close properly, sheet metal trade to repair installation and balancing agency to retest.

.6 All fire damper tests shall be witnessed by two parties, certified by Contractor, and endorsed by the testing personnel.

.7 Contact Authority Having Jurisdiction in writing prior to testing each damper and have authorities witness tests as required.

2.04 BALANCING REPORT

.1 Submit draft copies of rough balancing reports prior to final acceptance of project.

.2 Include types, serial number, and dates of calibration of instruments.

.3 Record test data on a white print made from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

.4 Submit with report, fan curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

.5 Report shall be indexed as follows:

.1 Air:

.1 Summary
.2 Procedure
.3 Instrumentation
.4 Drawings
.5 Equipment Summary
.6 Fan Sheets
.7 Fan Curves
.8 Fan Profile Data
.9 Static Data
.10 Air Monitoring Station Data
.11 Traverse Data and Schedule
.12 Terminal Unit Summary
.13 Outlet Data Summary and Schematics (per system)
.14 Building Schematic
.15 Building Pressurization Data
.16 Weather Conditions at Time of Test
.17 Diagnostic
.18 Millwright Reports

.2 Acoustics:

.1 Summary
.2 Procedure
.3 Instrumentation
.4 Drawings
.5 Profile

.6 Scale Readings

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Sequence of Operations for HVAC Controls Section 23 09 93

Part 2 Products

2.1 GENERAL

.1 All new HVAC equipment is to be installed with control, with all sensors and wiring tied back to the existing Building Management System (BMS).

.2 Equipment shall be set up to be compatible for integration in the existing BMS.

.3 Provide all materials and labour required to connect control components.

.4 Provide electric/digital devices as part of this contract.

.5 Provide field instrumentation and sensing devices analog or digital as applicable which measure temperature, pressure, flow, current, voltage, equipment states, etc., and which input signals to the SCU terminal strip that conform to the input requirements.

.6 Provide output devices and actuators which convert the digital or analog output signal from the SCU to activate relays or open and close valves, dampers, etc.

.7 The end to end accuracy called for in Subsection 2.2 includes the combined effect of sensitivity, hysterisis, linearity and repeatability between the measured variable and the input to the analog-to-digital convertor for the full sensing range.

.8 The letter under the "Type" column in Subsection 2.2 is the same used in the points list.

2.2 CONTROL PANELS

.1 Mount DDC controllers in control panels and field interface equipment (i.e. relays, transducers, etc.) in separate field interface control panels.

.2 Control panels are to be of unitized cabinet type construction, fabricated from 2.5 mmrolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications. Control panels located outdoors are to be weater- rated down to -40°C.

.3 Mount pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

.4 Mount panels on vibration free walls or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.6 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 volt supply.

.7 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.8 Identify all wiring by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.9 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.10 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position. "Hand-Off-Auto" selector switches shall be provided for all ventilation fans and sump pumps.

.11 Control Power for control panel shall be 120 Volts A.C. from panel circuits provided by Division 26.

.12 Install bonding conductor between main control and auxiliary panels complete with grounding lugs, in addition to CSA grounding requirements.

.13 When fabrication of first panel is completed, arrange for inspection and approval by Contract Administrator and City of Winnipeg before proceeding with further panel construction.

2.3 WIRE

.1 Control wiring for digital functions shall be 20 AWG minimum with 300 Volt insulation.

.2 Control wiring for analog functions shall be 20 AWG minimum with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.3 Sensor wiring shall be 20 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.4 Transformer current wiring shall be 16 AWG minimum.

.5 Identify all wiring and cabling by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring.

2.4 CONDUITS AND CABLES

.1 All wiring shall be in conduit or trays. Flexible conduit may be used for final connection of control devices. Maximum length of flexible conduit to be 1 m. Conform to Division 26 requirements for conduit and trays specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 In the field panel, run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring.

.5 Provide instrumentation complete with standard electrical conduit box for termination unless otherwise noted.

.6 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

.7 Color code all conductors and conduits by permanently applied color bands. Color code shall follow base building schedule.

.8 Sensor and actuator wiring for room controllers run within enclosed ceiling spaces or walls of drywall construction may be installed without conduit, provided that it adheres to the following installation requirements:

.1 Plenum rated cabling is used;
.2 cabling is run perpendicular to building lines and is supported using proper tyraps either to the building structure or to conduit and intervals of no more than two (2) feet;
.3 cabling follows ductwork where practical and is installed on top of ductwork;
.4 all splices and terminations are made within junction boxes; and
.5 strain relief is provided for all wiring entering junction boxes.
.6 The use of plaster rings for mounting of space sensors on drywall will be an acceptable alternative to junction boxes when splices and terminations can be made within the sensor enclosures.

2.5 RELATED ACCESSORIES

.1 Provide and install all necessary transducers, interposing relays, interface devices, contactors, starters and EP's to perform control functions required.

.2 It is the responsibility of the Contractor to identify, at the time of proposal submission, all additional items not specified that are required to meet the operational intent specified.

.3 Items required but not identified at the time of proposal acceptance shall be the Contractor's responsibility.

2.6 DAMPER OPERATORS

.1 Electronic

.1 Provide electronic proportional damper actuators with spring return to “fail-safe” in normally open or normally closed position.

.2 Damper operator’s spring return shall have sufficient torque to provide tight shut off in the most extreme expected operating condition.

.3 Damper actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. All actuators shall provide a 2 to 10 VDC position feedback signal.

.4 Dampers shall be fully open on a BAS command of 100% and closed on a BAS command of 0%.

.5 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section. The damper area driven by each damper operator shall not exceed 1.6 meters.

.6 Positioning time for full closed to full open not to exceed 90 seconds.

.7 Positioning time for full open to full closed not to exceed 45 seconds.

.8 Where multiple damper actuators are utilized for one damper or multiple damper sections, or where multiple dampers are controlled in unison, all damper actuators shall be controlled by one BAS analog output signal.

.9 Where possible do not mount actuators outdoors or in the air stream.

.10 Where actuators must be mounted in the air stream provide actuators with integral heaters.

.11 Standard of Acceptance – Johnson Controls.

2.7 ANALOG INPUT SENSORS

.1 Temperature

Application	Type	Operating Range	End to End Accuracy	Remarks
Space Temp.	Tr	10°C to 301°C(50°F to ___)	±0.3°C	c/w tamper-proof cover
Outside Air	To	-50°C to (___°F)	±0.5°C	c/w solar-shield

.2 Pressure

Acceptable Manufacturers for Sp and Vp Sensors: Modus, Setra.

Application	Type	Operating Range	End to End Accuracy	Remarks
Static-air	Sp	0 to 500 Pa (0 to 2” WG) 0 to 1,250 Pa (0 to	±2% ±2%	

	5" WG) 0 to 2,500 Pa (0 to 10" WG)	±2%	
Air Pressure			±2.5Pa

.3 Electrical

Application	Type	Operating Range	End to End Accuracy	Remarks
Current transformers	Ct	as required	±0.25% full scale	

2.8 ANALOG OUTPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
To damper motors	Dm	0 - 10 VDC 4-20 MA 20 - 104 kPa (4 – 15 psi)	±2% full scale	

2.9 DIGITAL INPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
Current Sensing Relays	Ri	as required	N/A	-adjustable trip c/w LED Status indication.
Motor status Relays	St	as required	N/A	-auxiliary contacts

2.10 DIGITAL OUTPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
Relays	Ry	N/A	N/A	-Double Voltage DPDT plug-in type with terminal base contacts rated at5 amp 120 VAC.

Part 3 Execution

.1 The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

.2 System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

.1 The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

.2 The System shall maintain all settings and overrides through a system reboot.

.3 System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

3.2 DDC SYSTEM CONTROLLERS

.1 Field Equipment Controller

.1 The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.

.1 The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

.1 The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

.2 The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

.3 A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.

.4 The Conformance Statement shall be submitted 10 days prior to bidding.

.2 The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.

.3 Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.

.4 The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

.5 The FEC shall include troubleshooting LED indicators to identify the following conditions:

.1 Power On

.2 Power Off

.3 Download or Startup in progress, not ready for normal operation

.4 No Faults

.5 Device Fault

.6 Field Controller Bus - Normal Data Transmission

.7 Field Controller Bus - No Data Transmission

.8 Field Controller Bus - No Communication

.9 Sensor-Actuator Bus - Normal Data Transmission

.10 Sensor-Actuator Bus - No Data Transmission

.11 Sensor-Actuator Bus - No Communication

.6 The FEC shall accommodate the direct wiring of analog and binary I/O field points.

.7 The FEC shall support the following types of inputs and outputs:

.1 Universal Inputs - shall be configured to monitor any of the following:

.1 Analog Input, Voltage Mode

.2 Analog Input, Current Mode

.3 Analog Input, Resistive Mode

.4 Binary Input, Dry Contact Maintained Mode

.5 Binary Input, Pulse Counter Mode

.2 Binary Inputs - shall be configured to monitor either of the following:

.1 Dry Contact Maintained Mode

.2 Pulse Counter Mode

.3 Analog Outputs - shall be configured to output either of the following

.1 Analog Output, Voltage Mode

.2 Analog Output, current Mode

.4 Binary Outputs - shall output the following:

.1 24 VAC Triac

.5 Configurable Outputs - shall be capable of the following:

.1 Analog Output, Voltage Mode

.2 Binary Output Mode

.8 The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

.1 The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.

.2 The FC Bus shall support communications between the FECs and the NAE.

.3 The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.

.4 The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.

.5 The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

.9 The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

.1 The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.

.2 The SA Bus shall support a minimum of 10 devices per trunk.

.3 The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

.10 The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

.11 The FEC shall support, but not be limited to, the following:

.1 Chilled water/central plant automation applications including but not limited to the selection and sequencing of up to 8 chillers of different sizes (constant or variable speed capacity control), 8 primary and secondary chilled water pumps, as well as selection and sequencing of cooling towers and bypass valve. Sequencing of the devices shall consider user-defined efficiency ratings, runtime equalization and number-of-starts/number-of -stops.

.2 Heating central plant applications

.3 Built-up air handling units for special applications

.4 Terminal units

.5 Special programs as required for systems control

.2 Input/Output Module

.1 The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.

.2 The IOM shall communicate with the FEC over the FC Bus or the SA Bus.

.3 The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

.1 The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

.2 The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

.3 A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.

.4 The Conformance Statement shall be submitted 10 days prior to bidding.

.4 The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

.5 The IOM shall have a minimum of 4 points to a maximum of 17 points.

.6 The IOM shall support the following types of inputs and outputs:

.1 Universal Inputs - shall be configured to monitor any of the following:

.1 Analog Input, Voltage Mode

.2 Analog Input, Current Mode

.3 Analog Input, Resistive Mode

.4 Binary Input, Dry Contact Maintained Mode

.5 Binary Input, Pulse Counter Mode

.2 Binary Inputs - shall be configured to monitor either of the following:

.1 Dry Contact Maintained Mode

.2 Pulse Counter Mode

.3 Analog Outputs - shall be configured to output either of the following

.1 Analog Output, Voltage Mode

.2 Analog Output, current Mode

.4 Binary Outputs - shall output the following:

.1 24 VAC Triac

.5 Configurable Outputs - shall be capable of the following:

.1 Analog Output, Voltage Mode

.2 Binary Output Mode

.7 The IOM shall include troubleshooting LED indicators to identify the following conditions:

.1 Power On

.2 Power Off

.3 Download or Startup in progress, not ready for normal operation

.4 No Faults

.5 Device Fault

.6 Normal Data Transmission

.7 No Data Transmission

.8 No Communication

3.3 INSTALLATION

.1 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats in compliance with ADA requirements.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 Fans that are to be sequenced with intake or discharge dampers through a single output point, shall be wired such that operation of damper end switch alone will not start fan. I.E. The end switch and DDC “ON” command must both be required to start the fan when the "hand/off/auto" selector switch is in the auto position.

.4 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.5 Install all safety limits at the operators level.

.6 Safety devices including but not limited to freeze stats and pressure switches shall be hardwired to trip fan starters on alarm condition. Auxiliary contacts shall be wired back to the BAS for monitoring where identified on the points list.

.7 Provide hardwire interlocking capability for all mechanical systems operated from the fire alarm system. Capability shall include EPV's for box and damper control as well as freezestat override on operating air systems.

.8 Control System Power

.1 Provide emergency power to all control system components as necessary to provide continued monitoring and control from the control room operators workstation of all equipment supplied with emergency power.

.2 Provide separate power circuits for:

.1 Each ASC.

.3 ASC’s for VAV boxes, digital room control and other terminal equipment devices may be powered from a common circuit provided that:

.1 Circuit loading does not exceed 900 VA,
.2 A minimum of one circuit per air system is provided for the terminal equipment controllers associated with the air system, and
.3 Terminal equipment controllers for different air systems are not powered from the same circuit.

.4 Power for all transducers and other instrumentation associated with a controller shall come from the same circuit that is feeding the digital controller.

.5 Identify in the record drawings the panel and circuit number serving each controller.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Entire specification – all areas of common work.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 01.

.2 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Mechanical Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.3 Consult with the Contract Administrator during the shop drawing stage to finalize the control sequences for each system.

Part 2 Products

.1 Not Applicable.

Part 3 Execution

3.1 GENERAL

.1 All equipment to be set up to fail safe.

.2 Sequence of operation at start-up of entire mechanical system, post power failure, to stage individual motors to reduce initial current draw.

.3 All temperature setpoints are to be adjustable.

.4 New equipment will be integrated into the existing BMS. Contractor to provide 2 days of assistance following project closeout.

.5 Each insulated damper to be controlled by two modulating dampers (one per section)

3.2 EXHAUST FAN AND DAMPERS

.1 Mode Control:

.1 This system operates continuously.

.2 Off Mode: (operator selectable at BMS)

.1 The fan will be off. The outdoor air, transfer air, recirc air, and relief air dampers will be fully closed.

.3 Ventilation Mode:

.1 The outdoor air, transfer air, recirc air dampers will be modulated to maintain the average temperature sensed within the mechanical room above the minimum set-point of 10.0°C (adjustable). Fan to run continuously when the system is in operation.

.2 The fan motor speed will be adjusted to assist in maintaining temperature control. Fan motor speed to be controlled via VFD.

.3 Three (3) temperature sensors will provide input to a temperature averaging calculation that will control damper and fan modulation. These will be located as shown on the drawings but generally sensing temperature in the following zones:

.1 General battery charging area

.2 General outside air intake discharge vicinity

.3 Future general battery charging

.4 Should a cold condition temperature be sensed (setpoint to be adjustable) by the Air Intake Vicinity temperature sensor, the control logic will prioritize the damper and motor control to prioritize room temperature to satisfy this sensor.

.5 The control sequence will be staged as follows:

.1 Dampers will adjust to temperature setpoint with fan running at minimum speed.

.2 Should the setpoint not be achieve via damper modulation, the fan speed shall be increased by 10%. Allow 10 minutes (adjustable) of delay for system to settle.

.3 Dampers will attempt to regain control of setpoint. If this is not successful, motor speed shall increase by an additional 10%.Allow 10 minutes (adjustable) to settle

.4 Repeat above fan adjustment and delay in 10% increments until fan reaches full speed. Should system continue not to be able to reach setpoint, signal and alarm to the operator.

.5 Once setpoint is achieved continue hold at state achieved, upon loss of setpoint adjust in the same ramping up sequence or ramping down sequence (reverse of above) depending on means of being off set-point (above or below)

.6 Pressure control:

.1 New battery charger room control panel will receive garage static pressure status (analog) from existing DDC. Relief air damper to be modulated when battery charger room system is operational. Damper to be adjusted based on overall garage pressure control scheme. Coordinate with Transit.

.4 Alarms:

.1 If the fan status does not match the fan command within the alarm delay time (adjustable, initially set at 30 seconds), an alarm will be generated.

.2 Register an alarm on the failure of any damper to open/close.

.3 If any room temperature drops below 10.0°C (adjustable) or rises above 40.0°C (adjustable) for more than a 5 minute time period (adjustable), an alarm will be generated.

.4 Control of fans in fire alarm mode is by Division 26 fire alarm system. Controls to provide hardwired interface from supply fan motor emergency shut off contacts to fire alarm panel. On fire alarm condition the exhaust fan is to be shut-down and system is to switch to off mode. Reset of the system shall be manual through the operator workstation.

.5 Unit shall switch to off mode upon loss of power and shall automatically restart when power interruption ends. Monitor normal power status and turn off control loop during loss of normal power.

END OF SECTION

Part 1 General

1.01 SUMMARY

.1 Sections Includes:

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

1.02 QUALITY ASSURANCE

.1 Ductwork shall meet the requirements of NFPA No. 90A - Air Conditioning and Ventilating Systems; NFPA No. 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems;

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks as a minimum where more stringent requirements are not identified in the contract documents. Straight tap fittings and dovetail joints are not permitted.

.3 Ductwork used on this project shall be clean and free from scale, corrosion, and deposits.

.4 All ductwork shall be delivered clean to the site and maintained in clean condition. Dirty ductwork shall be removed from site.

1.03 ACTIONS AND INFORMATIONAL Submittals

.1 Submit shop drawings of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

Part 2 Products

2.01 MATERIALS

.1 HVAC Ducts: Galvanized steel lock forming quality, having galvanized coating of 380 g/m2 (0.078 lb/ft2) for both sides.

.2 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

.3 Sealant: Water resistant, fire resistive, compatible with mating materials.

.4 Hangers and Supports:

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA [following table]:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10

2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 Concrete: manufactured concrete inserts.

.2 Steel joist: manufactured joist clamp and steel plate washer.

.3 Steel beams: manufactured beam clamps:

2.02 FABRICATION

.1 Prior to the fabrication of ductwork, coordinate and field measure all ductwork to ensure a complete installation with respect to all other services. Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the contract.

2.03 VOC COMPLIANCE

.1 VOC: Content: Sealants and sealant primers shall comply with the following:

.1 Architectural sealants shall have a VOC content of 250 g/L or less.

.2 Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

.3 Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

Part 3 Execution

3.01 INSTALLATION

.1 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the Contract.

.2 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm (18”) cross brace for rigidity. Open corners are not acceptable.

.3 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.4 Construct tees, bends and elbows with radius of not less than 1-1/2 times width of duct on centre line. Where not possible and where rectangular elbows are specified, provide double wall air foil type turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fiberglass inside.

.5 Increase duct sizes gradually, not exceeding 15 deg. divergence wherever possible. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.

.6 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled. Seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.

.7 Set plenum doors 150 mm (6”) above floor. Arrange door swings so that fan static holds door in closed position.

.8 Ducts shall not have a pressure drop greater than 0.3 cm per 30 lineal meters. Contractor to review any proposed routing or sizing modifications with Contract Administrator prior to completion.

3.02 DUCT SEALING

.1 All supply, return and exhaust duct joints, longitudinal as well as transverse, shall be sealed using,

.1 Low Pressure Ductwork:

.1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm (16 gauge) use heavy mastic type sealant.

.2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

.3 Other Joints: Heavy mastic type sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct, demonstrate that leakage does not exceed 5%, and obtain approval from the Contract Administrator.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.03 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.04 INSTALLATION

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors.

.3 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal cap with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.4 Interrupt duct linings at fire, balancing, backdraft and smoke dampers so as not to interfere with operation of devices. Provide sheet metal edge protection over linings on both side of damper device.

.5 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

.6 Protect carbon steel ductwork exposed to weather by painting or coating with suitable weather resistant material.

.7 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment.

.8 Do not use flexible duct to change direction. Provide a minimum of three (3) duct diameters of straight metal duct between box inlet and flexible connector.

.9 Connect diffusers or troffer boots to low pressure ducts with 300 mm (12”) maximum stretched length of flexible duct. Hold in place with caulking compound and strap or clamp.

.10 Prove that ductwork is substantially airtight before covering or concealing. Perform leak tests of all major duct runs and verify that overall leakage rate does not exceed 5%.

.11 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

.12 All segmented type elbows shall be spot welded. No adjustable type elbows are allowed.

.13 All ducts crossing walkways shall be offset to run as close as possible to underside of structure above.

.14 Rigidly construct metal ducts with joints mechanically airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk all duct joints and connections with sealant as ducts are being installed. Seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.

.15 Lap metal ducts in direction of air flow. Hammer down all edges and slips to leave smooth duct interiors.

.16 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

.17 Paint all exposed ducts with the same color as existing.

END OF SECTION

Part 1 General

1.01 SUMMARY

.1 Sections Includes:

- .1 Duct access doors
- .2 Fire dampers
- .3 Balancing dampers
- .4 Flexible connections
- .5 Backdraft dampers

1.02 REFERENCE STANDARDS

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

- .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.03 QUALITY ASSURANCE

.1 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 "Fire Dampers".

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.

.3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and DCC Representative.

.4 Access doors shall be ULC labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA HVAC Duct Construction Standards.

1.04 ACTIONS AND INFORMATIONAL SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications, and datasheet in accordance with Division 01.

Part 2 Products

2.01 MANUFACTURERS

.1 Acceptable Manufacturers:

- .1 Flexible Connections: Thermaflex, Wire-Mould, Flexmaster
- .2 Fire Dampers: Controlled Air, Ruskin, Price, Nailor
- .3 Insulated Dampers: Tamco
- .4 Non-Insulated Dampers: Greenheck
- .5 Access Doors: Controlled Air, Nailor, Air-O-Metal, Titus

2.02 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1.3 kg/m^3.

2.03 ACCESS DOORS IN DUCTS

.1 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25mm (1") thick insulation with suitable sheet metal cover frame for insulated ductwork.

.1 Fabricated with two butt hinges and two sash locks for sizes up to 450mm (18"), two hinges and two compression latches with outside and inside handles for sizes up to 600mm x 1200mm (24" x 48") and an additional hinge for larger sizes.

2.04 TURNING VANES

.1 Factory or shop fabricated single thickness or double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.05 FIRE DAMPERS

.1 Install ULC listed and labelled fusible link folding blade fire dampers in fire separations where shown, and where otherwise required by authorities having jurisdiction. Fire dampers shall conform to the most recent issue of the National Building Code of Canada. Fire dampers and fusible links shall be tested and approved by ULC or other Testing Agency recognized by the Authorities Having Jurisdiction. Fusible links shall be readily removable by hand for testing without use of auxiliary equipment such as pliers.

.2 Depending on the rating of fire separation, based on architectural drawing and specifications, the rating, construction and testing of fire dampers shall meet the following:

.1 N.B.C.C.

.2 ULC S112

.3 NFPA 252

.4 ULC or ULI 10(b)

.5 Authorities Having Jurisdiction

.3 Use type 'B' fire dampers, i.e. blades out of air stream, in all ducts passing through fire separations. Use combination fire damper-balancing damper, with blades in air stream, on sidewall supply or return or floor mounted supply registers, up to maximum size of 0.372m. For all sidewall return grilles or sidewall return registers above 0.372m in size, use a type 'A' fire damper, i.e. blades in the air stream.

.4 Fire dampers in fume hood exhaust system shall have #316 stainless steel blades, shafts, linkage and casing.

2.06 SPLITTER DAMPERS

.1 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration.

.2 Fabricate galvanized steel, minimum 1.6mm (16 gauge), and provide with adjustable rod and locking screw.

.3 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.07 BALANCING DAMPERS

.1 Fabricate of galvanized steel, minimum 1.6mm (16 gauge). Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length.

.2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400mm (16”) deep and on accessible round ducts.

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425mm (17”) and over in depth and on all inaccessible rectangular and round ducts.

.4 On rectangular ducts, up to 275mm (11”) deep construct of single blade (butterfly) type.

.5 On rectangular ducts 300mm to 400mm (12” x 16”) deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.6 On rectangular ducts over 425mm (17”) deep construct of multiple opposed blades, mechanically interlocked with blades no greater than 200mm (8”) deep and pivots equally spaced.

.7 On round ducts construct of single blade (butterfly) type. On 500 Pa (2” WG) class and on all dampers over 300mm (12”) diameter fabricate with full blade-length shaft.

.8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.

.9 Provide over-ride limiting stops on all operating mechanisms.

.10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.

.11 On round ductwork, install operating mechanism on a steel mounted base firmly secured to the ductwork.

.12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.08 INSULATED MOTORIZED CONTROL DAMPERS

.1 Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” (2.03 mm) in thickness. Damper frame shall be 4” (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Frame to be assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.

.2 Entire frame shall be thermally broken by means of polyurethane resin pockets complete with thermal cuts.

.3 Blades shall be maximum 6" (152.4 mm) deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06” (1.52mm). Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29. All blades shall be symmetrically pivoted.

.4 Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

.5 Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.

.6 Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a

polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable. Bearings are to be maintenance-free, requiring no lubrication.

.7 Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be zinc-plated steel.

.8 Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.

.9 Dampers shall be designed for operation in temperatures ranging from -40°F (-40°C) to 212°F (100°C).

.10 Dampers shall be AMCA rated for Leakage Class 1A at 1 in w.g. (0.25 kPa) static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

.11 Dampers shall be custom made to required size, with blade stops not exceeding 1¼" (31.7 mm) in height. The blade stop shall be a continuous and integral part of the head/sill. Welded and caulked blade stops shall not be acceptable.

.12 Dampers shall be opposed blade action or parallel blade action, as indicated on the plans.

.13 Dampers shall be Flanged to Duct install type.

.14 Operators: Provide modulating electric actuators with damper position determined by modulating control signal. NEMA enclosure. Provide spring return for "fail safe" in normally open or normally closed position. Size operators for control dampers against maximum pressure or dynamic closing pressure, whichever is greater. Provide adjustable external stops to limit stroke in both directions. All mixed air system operators to have positioners.

2.09 NON-INSULATED MOTORIZED CONTROL

.1 Dampers with seals shall have a maximum leakage of 3 cfm/sq. ft. @ 1 in. wg, dampers without seals shall have a maximum leakage of 35 cfm/sq. ft. @ 1 in. wg.

.2 Dampers shall have a maximum differential pressure rating of 15 in. wg

.3 Dampers shall have a maximum velocity rating of 5000 fpm.

.4 Damper frame shall be a minimum of 14 ga. galvanized steel formed into a 8 in. x 2 in. channel with 2 in. flanges.

.5 Damper blades shall be 16 ga. airfoil shape galvanized steel. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal. Blade operation is parallel or opposed.

.6 Each blade stop (at top and bottom of damper frame) shall occupy no more than ½ in. of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.

.7 EPDM or Silicone blade seals are optional.

.8 Linkage concealed in jamb, plated steel material. Stainless steel is available as an option.

.9 Axle to be minimum ¾ in. square plated steel. Stainless steel axle is optional.

.10 Axle bearings shall be oil impregnated stainless steel sleeve type press fit into the damper frame. Bolted bronze bearings and relubricable ball bearings are optional.

.11 Mill Galvanized finish.

.12 Operators: Provide modulating electric actuators with damper position determined by modulating control signal. NEMA enclosure. Provide spring return for "fail safe" in normally open or normally closed position. Size operators for control dampers against maximum pressure or dynamic closing pressure, whichever is greater. Provide adjustable external stops to limit stroke in both directions. All mixed air system operators to have positioners.

2.010 FLEXIBLE CONNECTIONS

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150mm (6”) wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150mm (6”) intervals. Flexible connection airtight at 500 Pa (2” WG).

2.10 BACKDRAFT DAMPERS

.1 Construct of minimum 1.3mm (18 gauge) galvanized steel channel frame.

.2 Construct of minimum 0.6 mm (26 gauge) aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to 240mm (9”), multiblade dampers for ducts greater than 240mm (9”).

.3 Provide full blade-length shafts complete with brass or nylon bearings.

.4 Provide neoprene anti-clatter blade strips on pivot side of blades.

.5 Construct blade connecting linkage of minimum 2.0mm (14 gauge) aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.6 Maximum blade length of 750mm (30”).

.7 Backdraft damper suitable for 10 m/s (2000 fpm) face velocity.

Part 3 Execution

3.01 APPLICATION

.1 Provide access door minimum 450mm x 350mm or 50mm (18” x 14” or 2”) smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 At 6.0 m (20’-0”) intervals on all horizontal ducts.

.2 At 12.0 m (40’-0”) intervals in all vertical duct systems.

.3 At the base of all duct risers.

.4 Both sides of turning vanes in all ducts.

.5 At each fire damper location.

.6 At each side of all heating or cooling coils.

.7 At all locations of internally duct mounted devices including automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and control sensors and devices.

.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.3 Coordinate with the General Contractor for correct size openings and proper fire guard sleeving for fire damper penetration.

.4 At each point where ducts pass through partitions, the opening around the duct shall be sealed with non-combustible material.

.5 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger ducts.

.6 Provide balancing dampers on medium and high pressure systems where indicated. Splitter dampers shall not be used on medium and high pressure system.

.7 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

.8 For connections to medium and high pressure fans, install 15mm (½") thick neoprene pad over fabric and hold in place with additional metal straps.

.9 All fire dampers are to be left in the closed position for balancing contractor to fix open.

END OF SECTION

Part 1 General

1.01 REFERENCE STANDARDS

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

- .1 ANSI/AMCA Standard 99, Standards Handbook
- .2 ANSI/AMCA Standard 210/ (ANSI/ASHRAE 51), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
- .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans
- .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data

.2 The Master Painters Institute (MPI)

- .1 MPI Architectural Painting Specifications Manual (2019)
  - .1 MPI #18, Primer, Zinc Rich, Organic

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

- .1 Submit shop drawings and product data in accordance with Division 01 and as follows:
  - .1 Fan performance curves showing point of operation, kW (BHP) and efficiency.
  - .2 Sound rating data at point of operation.
  - .3 Motors, sheaves, bearings, shaft details.
  - .4 Minimum performance achievable with variable speed controllers as appropriate.

.3 Quality Assurance Submittals: Submit following in accordance with Section 01 40 00 - Quality Requirements:

- .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.

1.03 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for incorporation into manual in accordance with Division 01.

1.04 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01.

1.05 MAINTENANCE

.1 Extra Materials:

.1 Spare parts to include:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.2 List of specialized tools necessary for adjusting, repairing or replacing.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.

Part 2 Products

2.01 PERFORMANCE / DESIGN CRITERIA

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Provide balanced variable sheaves for motors 11.2 kW (15 HP) and under and fixed sheave for 15 kW (20 HP) and over.

.3 Fans are to be capable of accommodating static pressure variations of ±10% with no objectionable operating characteristics.

.4 Supply replacement pulleys and sheaves for fans as required to properly balance the systems to design flows at actual job site static pressure conditions. Obtain requirements from balancing agency (Refer to Section 23 05 93, Testing, Adjusting and Balancing for HVAC Systems.)

.5 Size motors for parallel operating fans for non-overloading operation with only one fan operating.

.6 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters, and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for fan.

2.02 EXHAUST FAN

.1 Refer to drawings for specified fan and performance requirements.

2.03 VARIABLE FREQUENCY DRIVES (when not provided by equipment manufacturer)

.1 Fan control is to be provided with variable frequency controllers. Motors must be matched to the VFD. VFDs shall be manufactured in accordance with:

.1 NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

.2 UL 508C - Underwriter's Laboratory

.3 CAN/CSA-C22 No. 14-M91. - Canadian Standards Association.

.4 CSA 22.1

.5 Canadian RFI and EMI regulations

.6 EN Standard/CE marked for EMC directives

.7 Immunity and Emissions

.1 EN 50081-1

.2 EN 50081-2

.3 EN 55011 Class A

.4 EN61800-3

.5 EN60204-1

.6 EN50178

.8 C-UL marking to provide an approved listing for both United States and Canadian users. The Manufacturer will furnish the product as listed and classified by Underwriter's Laboratories as suitable for the purpose specified and indicated.

.9 FCC Regulations including but not limited to Part 15 IEEE 519 - 1992 : Conforming but not limited to the following values from the Standard. for special applications - hospitals

.1 THD for Voltage 3%

.2 THD for Current as per IEE519-92

.3 Harmonic levels for each individual voltage and current harmonic to meet IEEE 519 - 92.

.4 Individual and total voltage and current distortion as per IEE519-92.

.5 Voltage notching as per IEE519-92. (Notch Area and Depth as per Table 10.2 for special applications)

.6 Levels shall be limited to the requirements set by IEE519-92 for special applications.

.2 Furnish complete variable frequency drives as specified herein for the fans designated on the drawing schedules to be variable speed. Co-ordinate with suppliers as required to ensure optimum drive selection. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be sprinkler-proof NEMA 3R rated.

.3 The VFD shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three phase power for stepless motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified in the electrical specifications.

.4 The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage. All VFDs shall include input line reactors.

.5 The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control. The VFD shall maintain a constant V/Hz ratio.

.6 The VFD and options shall be tested to ANSI/UL Standard 508. The complete drive, including all specified options, shall be ULC and CSA listed.

.7 Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1992, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems. The total voltage distortion shall not exceed 5%. The 3% voltage notching shall comply with IEEE 5,1992 for special applications.

.8 The VFD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules and Regulations, Part 15 for Class A computing devices. The VFD shall carry a FCC compliance label. PWM type drives shall include RFI filters.

.9 Motor noise as a result of the VFD shall be limited to three dB over across the line operation, measured at three feet from the motor's centre line.

.10 The VFD and it's peripheral devices as required by specifications are to be located in a NEMA rated enclosure to suit the environment in which it is located (e.g. weatherproof, sprinklerproof where required). The enclosure is to be selected to reduce RFI and EMI emissions. The location of the devices in the enclosure shall be selected to mitigate the emission of RFI and EMI between components. The VFD shall include all filters, reactors, etc. for the reduction of harmonic, RFI, and EMI emissions created by the drive. The VFD shall include all filters, reactors, etc. necessary for the operation of the VFD. The drive shall be capable of operating with normal levels of distortion on the line.

.11 Shop drawings are to be submitted for each VFD. Shop Drawings shall include but not be limited to the following submissions:

.1 Catalogue and technical data.

.2 Submit specification comply/non-comply the shop drawing submission, addressing each item of the specification indicating that it complies or stating the deviation.

.3 Outline dimensions, weights etc. including any special locating/installation instructions.

.4 Control drawings and schematic diagrams including all connections to external equipment and devices. Include single line and impedance diagrams. Include internal circuit schematics and the layout of all electronic and electrical components.

.5 Line harmonic calculations, including filter calculations required to comply with the voltage and current distortion levels required by IEEE 519 (IEEE 519-92). Include the voltage distortion level at the electrical distribution equipment. The intent is to reduce the harmonic content to a level that will not create damage to The City of Winnipeg's equipment, and to reduce harmonic content at the point of common coupling

.6 Instruction manuals for programming and installation.

.7 Include a list of all initial values of parameter settings. Optimize the parameter settings for this application.

.12 Protective Features

.1 Individual motor overload protection for each motor controlled.

.2 Protection against input power undervoltage, overvoltage, and phase loss.

.3 Protection against output current overload and instantaneous over current.

.4 Protection against over temperature within the VFD enclosure

.5 Protection against over voltage on the DC bus.

.6 Protect VFD from sustained power or phase loss. Under voltage trip activates automatically when line voltage drops more than 10% below rated input voltage.

.7 Automatically reset faults due to Under voltage, over voltage, phase loss, or over temperature.

.8 Protection against output short circuit and motor winding shorting to case faults, as defined by UL508.

.9 Status lights or digital display for indication of individual fault conditions.

.10 Controller capable of operating without a motor or any other equipment connected to the drive output to facilitate start-up and troubleshooting.

.11 Input line reactors shall be provided to minimize harmonics introduced to the AC line, and to provide additional protection to AC line transients.

.13 Interface Features

.1 Door mounted Hand/Off/Auto selector switch to start and stop the VFD. In the auto position, the VFD will start/stop from a remote contact closure. In the HAND Position, the VFD will run regardless of the remote contact position.

.2 Manual speed control capability.

.3 Local/Remote selector switch. In the remote position, motor speed is determined by the follower signal. In the local position, motor speed is determined by the manual speed control.

.4 Power/on light to indicate that the VFD is receiving utility power.

.5 Fault light to indicate that the VFD has tripped on a fault condition.

.6 Digital meter with selector switch to indicate percent speed and percent load.

.7 A set of form-C, dry contacts to indicate when the VFD is in the run mode.

.8 A set of form-C, dry contacts to indicate when the VFD is in the fault mode.

.9 A 0 to 10Vdc output signal to vary in direct proportion to the controller's speed.

.10 VFD to have terminal strip to accept N.C. safety contacts such as freeze stats, smoke alarms, etc. VFD to safely shut down in drive or by-pass mode when contacts open.

.11 VFD to accept an additional N.C. contact to interface with the Hand-Off-Auto switch for remote Stop/Start control.

.12 VFD shall accept a 4 to 20mA, 0 to 5Vdc, 0 to 10Vdc.

.14 Adjustments

.1 Maximum speed, adjustable 50 to 100% base speed.

.2 Minimum speed, adjustable 0 to 50% base speed.

.3 Acceleration time, adjustable 3 to 60 seconds.

.4 Deceleration time, adjustable 3 to 60 seconds with override circuit to prevent nuisance trips if deceleration time is set too short.

.5 Current limit, adjustable 0 to 105%.

.6 Overload trip set point.

.7 Offset and gain to condition the in-put speed signal.

.8 Time delay relay adjustable 0 to 2 minutes for start-up.

.15 Service Conditions

.1 Ambient temperature, 32 to 104°F (0 to 40°C).

.2 0 to 95% relative humidity, non-condensing.

.3 Elevation to 3,300 feet (1,000 meters) without derating.

.4 AC line voltage variation, -10 to +10% of nominal.

.16 Special Features

.1 The following special features shall be included in the VFD enclosure. The unit shall maintain its ULC and CSA listings.

.1 Manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller. The bypass circuitry shall be mounted in a separate section of the VFD enclosure. Motor overload protection shall be provided in both drive and bypass modes.

.2 A door interlocked, pad lockable drive disconnect switch shall be provided to disconnect power from the VFD only.

.3 A second fused disconnect switch or circuit breaker shall be provided as a means of disconnecting all power to both the VFD and bypass circuits, as well as providing short circuit and locked rotor protection to the motor while in the bypass mode.

.4 The disconnect and bypass functions may be accomplished via disconnects, contactors and overloads, or with a four position drive/off/line/test switch with motor starter and bypass fuses.

.5 Disconnect shall be c/w provision for padlocking in the OFF position.

.6 A low speed alarm indicator shall be provided to indicate that the drive speed has fallen below an adjustable setting.

.7 Provide a RS 485 Serial Communications Kit to convert VFDs internal data into RS 485 bus format. This is to allow the following to be monitored at a building systems terminal: fault indication, run indication, overcurrent indication, over voltage indication, Under voltage indication, overload indication, speed indication, and load indication. It shall allow the following output from the terminal to the drive: Run /Stop commands and speed control command.

.8 Provide VFD enclosure air filters.

.17 Quality Assurance

.1 The complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and the load and speed shall be cycled during the test.

.2 All optional features shall be functionally tested at the factory for proper operation.

.3 The VFD manufacturer shall provide calculations specific to this installation which show the total harmonic voltage distortion is less than 5%. Prior to installation, the VFD manufacturer shall provide the total estimated harmonic distortion (THD) caused by the VFDs. The results shall be based on information obtained from the power provider, the designers and The City of Winnipeg.

.4 If the voltage THD exceeds 5%, the VFD manufacturer shall recommend what additional equipment is required to reduce the voltage THD to an acceptable level.

.18 Submittals

.1 Submit manufacturer's performance data including dimensional drawings, customer connection drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFDs FLA rating, certification agency file numbers and catalogue information.

.19 Provide four (4) hours on site training for The City of Winnipegs' personnel.

.20 Provide extension to building automation system.

.21 Division 26 to wire.

Part 3 Execution

3.01 INSTALLATION: GENERAL

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

3.02 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.03 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

3.04 CLEANING

.1 In accordance with Division 01.

END OF SECTION

Part 1 General

1.01 SUMMARY

.1 Sections Includes:

.1 Diffusers

.2 Grilles and Registers

.3 Diffuser Boots

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide in accordance with Division 01.

.2 Submit shop drawings with complete catalogue information, materials of construction, dimensions, and accessories.

.3 Submit colour selection charts of finishes, for approval prior to fabrication.

1.03 QUALITY ASSURANCE

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.

.2 Unit rating shall be approved by ADC and AMCA.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

.4 Outside louvers shall bear AMCA seal for free area and water penetration.

1.04 SITE CONDITIONS

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.

.2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform with Architectural features, symmetry and lighting arrangement.

Part 2 Products

2.01 MANUFACTURERS

.1 Acceptable Manufacturers:

.1 Diffusers/Grilles/Registers: Titus, Price, Nailor

2.02 GENERAL

.1 Base air outlet application on space noise level of NC 30 maximum.

.2 Provide supply outlets with sponge rubber seal around the edge.

.3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.4 Provide plaster frame for diffusers located in plaster surfaces.

.5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.6 Refer to Grille and Diffuser Schedule on drawings.

.1 Coordinate prefinished metal colours with Division 09 Painting.

Part 3 Execution

3.01 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with oval head or flat head screws in countersunk holes where fastenings are visible.

.3 Paint ductwork visible behind air outlets matte black.

END OF SECTION

Part 1 General

1.01 REFERENCES

.1 Abbreviations and Acronyms:

EEMAC	Electrical & Electronic Manufacturers Association of Canada
CSA	Canadian Standards Association
UL	Underwriters' Laboratory
FM	Factory Mutual
NEMA	National Electrical Manufacturers Association (U.S.)
JIC	Joint Industry Conference
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
CEC	Canadian Electrical Code
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
NBCC	National Building Code of Canada
ANSI	American National Standards Institute
AHJ	Authority Having Jurisdiction

Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

.2 Definitions:

Standard of Acceptance:

.1 Standard of Acceptance means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 Where two or more manufacturers are listed, the manufacturer's name shown first or underlined or shown with a model name and/or number was used in preparing the base design. Tenders may be based on any one of those named, provided that they meet every aspect of the base design and every aspect of the drawings and specifications.

.3 Where other than the first named or the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Equipment/materials shall not exceed the available space limitations. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.

.3 REFERENCE STANDARDS

.1 CSA Group

.1 CSA C22.1-22, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83 (R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000V.

.3 CSA Z462 – Workplace Electrical Safety Standards

.4 CAN/CSA C22.2 No. 18.3-12 (R2017) – Conduit, tubing and Cable Fittings

.5 CAN/CSA-C22.2 No. 65-18 – Wire Connectors

.2 Institute of Electrical and Electronics (IEEE):

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.3 CAN/ULC:

.1 CAN/ULC S524 – Standard for Installation of Fire Alarm Systems

.2 CAN/ULC S537 – Canadian Standard for Verification of Fire Alarm Systems

.1 CAN/ULC S1001 – Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems

.4 Illumination Engineering Society of North America (IESNA)

.1 LM80-08, IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

.2 LM-79-08, IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

.3 TM-21-11, IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

.4

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.2 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 01.

.1 Submittals shall be made in electronic format, using Portable Document Format (.pdf).

.2 Submittals shall be reviewed, stamped and signed by the Contractor prior to being submitted for Contract Administrator’s review.

.3 Shop Drawings:

.1 Submit manufacturer's installation instructions, product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Advertising literature will be rejected.

.2 Group shop drawings together into packages for each major system, including but not limited to the following:

.1 Power distribution equipment

Shop drawings not grouped together as indicated above may be rejected.

.3 Shop drawings shall clearly indicate equipment approvals for use in Canada.

.1 Where shop drawings include assemblies, the approval(s) shall be clearly specified for the overall assembly, and not individual components.

.4 Where applicable, indicate clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Contract Administrator.

.6 Refer to the balance of Division 26 specifications for additional technical shop drawing requirements.

.7 If changes are required after the shop drawings have been reviewed by the Contract Administrator, notify the Contract Administrator in writing before the changes are made and re-submit the shop drawings for review.

.4 Certificates:

.1 Where required by the code or where required by the local AHJ, all equipment and materials shall be delivered to the site complete with CSA certification labels, or equivalent labels recognized by the AHJ.

.1 Where multiple CSA approved components are combined into an assembly, the certification shall apply to the overall assembly.

.2 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

.3 Where there is no alternative to supplying equipment which is not CSA or cUL certified, Contractor shall obtain special approval from the Authority Having Jurisdiction.

.2 Submit test results of installed electrical systems and instrumentation in accordance with the requirements outlined in the Contract Documents.

.3 Permits and fees: in accordance with General Conditions of contract.

.4 Submit, upon completion of Work, load balance report for all new and modified electrical panels.

.5 Submit certificate of acceptance from authority having jurisdiction to the Contract Administrator upon completion of Work.

.5 Manufacturer's Field Reports: where required by Division 26, submit to Contract Administrator manufacturer's written report.

1.03 CLOSEOUT SUBMITTALS

.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 01.

.2 Operation and Maintenance Data:

.1 Submit operation and maintenance data as described herein and in accordance with the requirements outlined in Division 26 specifications.

.2 Provide operating instructions for each system and each piece of equipment supplied under contract. Operating instructions to include following:

.1 Health and Safety precautions.

.2 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.3 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.4 Troubleshooting 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.

.6 List of recommended spare parts.

.7 Documentation pertaining to the material extended warranty (where applicable).

.3 Provide names and addresses of local suppliers for materials included in maintenance manuals.

.4 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.5 Post instructions where directed.

.6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

.2 Record Documentation:

.1 Provide project record documents as specified in Division 01 as further called for in this Division.

.2 During the construction period, keep on site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Contract Administrator on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.

.3 Include with the record drawings a list for each motor indicating motor or equipment number and name, nameplate voltage, horsepower and current, the size and setting of overload and breaker or fuse protection provided.

.4 The Electrical Division shall include all associated costs to obtain and complete the CAD Record Drawings including retaining the services of an approved CAD draftsperson to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.

.5 Submit the "Record Drawing" CAD files and one set of plots to the Contract Administrator prior to Total Performance of the contract.

.6 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

1.04 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 Replace defective or damaged materials with new.

Part 2 Products

2.01 PERFORMANCE / DESIGN CRITERIA

.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 Where equipment is installed in sprinklered areas, equipment enclosures shall be sprinkler-proof.

.1 Where conduits are added to the existing sprinkler-proof enclosures, Contractor shall maintain the integrity of the sprinkler-proofing provisions.

.2 Contractor to avoid top-entry on sprinkler-proof enclosures where possible.

.4 Where equipment is installed outdoors, equipment enclosures shall have a minimum rating of CSA Type 3R.

.5 All local motor control devices shall be grouped and mounted on a free-standing frame of CSA approved assembly construction easily accessible and as close to the motor as possible.

.6 Provide weight-distribution means, where required, or coordinate weight distribution means provisions by other trades, so as not to exceed the load-bearing capacities of floors or walls that bear the weight of, or support, electrical items.

.7 Equipment shall not be held in place by its own weight. Provide base anchor fasteners in each case.

.8 Surface wall mounted panelboards and other electrical equipment shall be installed on plywood mounting boards.

.1 Boards shall be provided under this section of the specifications, sized to suit equipment indicated and/or implied.

.2 Plywood mounting boards shall consist of 20 mm fir plywood fastened securely to wall.

.3 Plywood mounting boards, strapping and trim shall be treated with fire retardant wood preservative prior to installation and painted with one coat of primer and two coats of grey enamel ASA61. Painting shall be completed before any electrical equipment is mounted on the plywood.

.4 Service entrance equipment shall be spaced from the plywood mounting boards to the satisfaction of the inspection authorities.

2.02 MANUFACTURERS

.1 Where two or more units of the same class or type of equipment are required, the units shall be the product of a single manufacturer, although components of equipment need not be products of the same manufacturer.

.2 Addition of Acceptable Manufacturers:

.1 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Contract Administrator for consideration not later than five (5) working days prior to closing of tender.

.2 Alternate approvals will be given in writing only. No other substitution will be permitted after closing of tenders.

.3 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Contractor shall determine that the alternate product meets the specification requirements before proposing an alternative product.

.4 Where alternate equipment/materials are selected, Contractor shall be solely responsible for any costs arising due to effects of the alternate products on other parts of the work of this Trade and all other Trades. Where substantial changes in arrangement are required, submit shop drawings of the proposed changes with Plan and Section views and show effects on work of other Trades. Alternate equipment/materials shall not exceed the available space limitations. Maintain installation, access and servicing clearances. No extra will be allowed due to the use of alternate equipment/materials.

.5 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.

.6 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.

2.03 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.04 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of AHJ.

.2 Decal signs, minimum size 175 x 250 mm.

2.05 WIRING TERMINATIONS

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

2.06 EQUIPMENT IDENTIFICATION

.1 Lamacoid 3 mm thick plastic engraving sheet, mechanically attached with self tapping screws. Unless specified otherwise by The City of Winnipeg, Lamacoid label colors shall be based on the power source for associated equipment as follows:

.1 Utility Power - black face, white core

.2 Emergency Power – red face, white core

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters

NAMEPLATE SIZES			
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on labels shall be approved by Contract Administrator prior to manufacture.

.5 Allow for minimum of twenty-five (25) letters per label.

.6 Nameplates for terminal cabinets and junction boxes shall indicate system and/or voltage characteristics.

.7 Disconnects, starters and contactors: indicate equipment being controlled, equipment voltage and the source of power including panel designation and circuit number (where applicable).

.8 Terminal cabinets and pull boxes: indicate system voltage, upstream panel name and circuit number.

.9 Transformers: indicate capacity, primary and secondary voltages, upstream panel name and circuit number.

.10 Power outlets and light switches: indicate panel and circuit number.

.11 Where equipment is indicated on the single line diagram, verbiage on the label shall be identical to the single line diagram.

.12 Underground installation labels shall be installed in accordance with Canadian Electrical Code and requirements of the AHJ.

.13 Provide junction boxes, relay panels and miscellaneous equipment energized from two or more sources with a warning nameplate prominently displayed, noting number and location of sources and their voltage.

.14 Provide a typewritten circuit directory with a clear plastic cover for each panelboard in a suitable holder on the inside of each panel door.

.1 Unless otherwise noted, the directory shall indicate the name of the upstream panel, upstream breaker or switch circuit number, upstream breaker or switch size and load description.

2.07 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain clockwise phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1

.4 Use colour coded wires in communication cables, matched throughout system.

2.08 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Orange	
Communication		
Fire Alarm	Red	
Security		

2.09 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 to EEMAC Y1 1 1955.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y 1 1958.

.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.

.4 Hot dip galvanized enclosures shall be galvanized once all the perforations and bends have been made. Where the finish has been damaged during the installation, touch up the finish in accordance with manufacturer’s directions. Include copy of manufacturer’s directions in the O&M manual.

Part 3 Execution

3.01 EXAMINATION

.1 Visit the site before preparing the tender and examine all existing conditions. No extra cost will be considered for any misunderstanding of work to be done resulting from failure to visit the site.

.2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, in the drawing, or between drawings and/or specifications of different divisions. Obtain written clarification from the Contract Administrator if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the costliest alternative.

.3 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory

installation. Make no deviations to the design intent involving extra cost to The City of Winnipeg, without the Contract Administrator's written approval.

.4 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

.5 Work out jointly all interference problems on the site and coordinate all work before fabricating or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Contract Administrator and all affected parties.

.6 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Contract Administrator of space problems before installing any material or equipment. Demonstrate to the Contract Administrator on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

3.02 INSTALLATION

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices, in accordance with the local laws and the requirements of the local legislation.

.2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province or Territory where the work is being constructed.

.3 Do complete installation in accordance with the local adaptation of CSA C22.1 except where specified otherwise.

.4 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise. Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems and shown on mechanical drawings.

.5 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Contract Administrator and the Trade.

.6 The Contract Administrator shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

.7 Install equipment in strict accordance with manufacturer's recommendations and governing rules, regulations and codes.

.8 Where requirement conflict occurs, allow for supply install of all materials in accordance with the most stringent and most expensive requirements.

.9 All materials supplied and installed under this Division shall be new, unless explicitly stated otherwise on the drawings, and of uniform construction.

.10 All installations are to ensure maximum headroom, minimum interference with free use of surrounding areas, and best access to equipment.

.11 The electrical drawings do not show all architectural, mechanical, and structural details. All electrical schematics are shown diagrammatically unless otherwise noted. The Contractor shall review the mechanical and structural drawings to obtain building dimensions and details. Verify dimensions accurately by measurements.

.12 Drawings are diagrammatic, are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings.

.13 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Contract Administrator where definite locations are not indicated.

.14 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

.15 To change the location of electrical equipment, submit a request in writing to the Contract Administrator for approval. If approved, such changes shall be made at no additional cost to The City of Winnipeg.

.16 No extra will be allowed for any additional labor or materials required for relocation of equipment due to interference with equipment of other trades, beams, joists, walls, etc., unless the conflict has been submitted to the Contract Administrator in writing before closing of tenders.

.17 To deviate major service runs from the location shown on the drawings, submit to the Contract Administrator coordination drawings showing such deviations together with reasons for deviations and obtain approval from the Contract Administrator before proceeding with the installation. The coordination drawings shall capture all structural and mechanical elements within the vicinity of the originally proposed route and the alternative route.

.18 Sleeves and openings in the structure shall not displace reinforcing steel and shall receive approval of the Contract Administrator prior to placement.

.19 Contractor shall complete x-ray of floors and walls, identifying reinforcing steel rebar, prior to coring or cutting the slab.

.20 Contractor shall take all the necessary precautions not to cut or damage any rebar during coring or cutting.

.21 Contractor shall take all the necessary steps to ensure against risk of fire during coring and cutting, including but not limited to:

.1 Conducting assessment of flammable materials in the vicinity of the area of work.

.2 Taking all the necessary precautions to eliminate the risk of fire.

.3 Advise Contract Administrator prior to cutting or coring in instances where the risk cannot be mitigated.

.22 For new construction, or existing construction where the existing laminated single line is not available, contractor shall provide single line electrical diagrams in glazed frames as follows:

.1 Electrical distribution system: locate in main electrical room.

.2 Drawings: 600 x 600 mm minimum size.

.23 For existing construction where an existing laminated single line diagram is present, contractor shall update the existing single line diagram.

.1 Location and size to match existing.

.24 Submit to power utility application for new service or service modification, as applicable. Contract Administrator will provide electrical load information upon request.

.25 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.

.26 Protect equipment and material from the weather, moisture, dust and physical damage.

.27 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to The City of Winnipeg.

.28 Protect all existing services encountered. Obtain instructions from the Contract Administrator when existing services require relocation or modification.

.29 Restore damaged or marred factory finish to factory quality.

.30 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his/her trade to the approval of the Contract Administrator.

3.03 NAMEPLATES AND LABELS

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

.2 Where the scope of work includes performance of an arc flash study, provide arc flash safety labeling on electrical equipment in accordance with CSA - Z462.

3.04 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: Schedule 40 RPVC, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.05 LOCATION OF DEVICES

.1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.2 Prior to commencing rough ins, coordinate electrical device locations with architectural drawings and other trades. In the event of conflict with other trades, submit an RFI with the proposed device location.

.3 Change location of electrical devices at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before commencement of rough-ins.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.06 MOUNTING HEIGHTS

.1 Prior to commencing the rough-in, Contractor shall conduct a coordination review between architectural and electrical drawings. If a discrepancy is identified, contractor shall raise the discrepancy via an RFI prior to commencing the rough-ins.

.2 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.3 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.4 Install electrical equipment at following heights unless indicated otherwise on the drawings.

- .1 Local switches: 1200 mm.
- .2 Wall receptacles:
  - .1 General: 400 mm.
  - .2 Above top of continuous baseboard heater: 200 mm.
  - .3 Above top of counters or counter splash backs: 175 mm.
  - .4 In mechanical rooms: 1200 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Voice and data communication outlets: adjacent to power receptacles.
- .5 Voice and data communication outlets at high elevations: 1500 mm.
- .6 Fire alarm stations: 1200 mm.
- .7 Fire alarm strobes: at the highest elevation between 2000mm and 2400mm but at least 150mm below the ceiling.

3.07 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Install circuit protective devices such as overcurrent trips, relays and fuses to required values and settings.

.2 Complete power system study on the distribution included in the scope of work:

- .1 Determine minimum short circuit current rating for all the electrical distribution equipment supplied under the scope of work based on full (not series) rating of the equipment.

.2 Determine arc flash levels at each distribution panel supplied under the scope of work.

.3 Confirm breaker selection and trip unit settings (where applicable) required to coordinate the breakers and ensure selective tripping between the upstream and the downstream breakers.

.4 Where applicable, coordinate ground fault trip settings to prevent nuisance trips.

.5 Where selective tripping cannot be achieved with the equipment specified in the Contract Documents, submit an RFI to Contract Administrator for review.

.6 Submit a power system study report for Contract Administrator's review and as a part of the Operation and Maintenance manual.

.1 The report shall be generated using the latest version of the software at the time of tender.

.2 The report shall be sealed by the engineer licensed to practice in the Province or Territory that the report pertains to.

.7 Provide Contract Administrator digital file of the model used to complete the power system study.

3.08 FIELD QUALITY CONTROL

.1 Ensure that the system and its components are ready prior to the inspection and test for acceptance.

.2 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

.3 Prior to the Contract Administrator's acceptance, all electrical equipment, materials, and systems installed shall be subject to a review and applicable performance tests supervised by the Contract Administrator to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.

.4 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, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.5 Testing:

.1 All testing shall be conducted by fully qualified personnel only.

.2 Tests requiring initial power energization of a system shall not be made without notification of the Contract Administrator.

.3 Use calibrated equipment to complete the torque voltage readings, load balancing and megger tests. Include copies of calibration certificates in the operation and maintenance manual.

.4 Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to The City of Winnipeg.

.5 Submit digital copy of the test certificates to the Contract Administrator and include in the O&M manual.

.6 Conduct and document following tests.

.1 Phasing, voltage, grounding and load balancing on all panels.

.2 Torque on all field-assembled electrical connections rated at 100A or more.

.3 Lighting and lighting controls.

.4 Emergency Lighting.

.5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.6 Fire alarm verification inspection report.

.7 Structured cabling report.

.8 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.

.4 Include cable megger logs in the O&M manual.

.9 Grounding System.

.7 Upon completion of the tests, submit all tests in accordance with Section 01 78 00 – Closeout Submittals.

.8 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

.9 Test the grounding system efficacy for compliance with the Electrical Code and the Supply Authority requirements. Record the resistance of each ground electrode group. Report the test results to the Contract Administrator for review and approval prior to energizing the system.

.1 Notify Inspection and Supply Authorities so that they may be present to witness Contractor testing, and provide any assistance required by these Authorities for their own testing procedures.

.10 Where specified in the Contract Documents, carry out tests in presence of the Contract Administrator.

.11 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.1 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to The City of Winnipeg.

.12 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.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.09 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.

.2 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.

.3 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the warranty.

3.10 SYSTEM STARTUP

.1 Where required by Division 26, 27 and / or 28 specifications, instruct Operating Personnel in operation, care and maintenance of systems, system equipment and components by means of classroom and hands-on training session(s).

.1 Provide training outline a minimum of 5 business days prior to commencing the training.

.2 Provide operation and maintenance manuals complete with all the necessary information for the training a minimum of 5 business days prior to the commencing of the training.

.3 Unless noted otherwise within the contract documents, where training is specified, allow a minimum of 4 hours per system.

.4 Maintain a training sign-off log for each training session and include copies of all training logs in the close-out documentation. At a minimum, the logs shall indicate the following information:

.1 Name, qualifications and contact information of the instructor.

.2 First and last name of each individual in attendance during the training session.

.3 Signature of the instructor and each individual who attended the training session.

.4 Date, starting time and duration of the training session.

.5 Where specified in the Contract Documents, provide video recording of the training session. The recording shall be provided in a digital format at 1080P (minimum). Audio shall be recorded in a fashion to minimize any background noises, while clearly capturing instructor’s voice. The video shall be edited to minimize the duration by eliminating the segments not vital to the training session. The video shall be taken using a camera on a tripod to ensure against image vibration. The video shall compile footage from multiple cameras where necessary, to capture all the educational material required for future staff training.

.2 Where specified, arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 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.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Division 01 and as specified in other Sections.

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

.3 Final Cleaning:

.1 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt. Remove fingerprints from reflective surfaces.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime paint exposed non-galvanized hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results - Electrical

.2 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

.3 Section 26 05 29 - Hangers and Supports for Electrical Systems

.4 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets

.5 Section 26 05 32 - Outlet Boxes, Conduit Boxes, and Fittings

.6 Section 26 27 26 - Wiring Devices

1.02 REFERENCES

.1 National Electrical Manufacturers Association (NEMA)

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 CLOSEOUT SUBMITTALS

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

1.05 COORDINATION

.1 The building shall remain open and in normal operation during the construction period.

.2 Where existing services, such as electrical power, fire alarm system, sound system, etc., are required to be disrupted and/or shut-down, coordinate the shut-downs with The City of Winnipeg and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 10 Working Days in advance of performing work and obtain The City of Winnipeg's written consent prior to implementing.

.3 Should any temporary connections be required to maintain services during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of The City of Winnipeg and Contract Administrator.

.4 Refer to General Conditions for phasing and staging of work and adhere to that schedule. Comply with instructions regarding working hours necessary to maintain the building in operation.

.5 Coordinate complete installation of relocated utility services, if required, with Utilities to ensure minimum interruption of service. Coordinate the transfer of the existing Hydro service point to the new service point with the Hydro utility in order to keep power interruptions to a minimum.

1.06 EXISTING DEVICES IN NEW CONSTRUCTION

.1 Where existing devices (receptacles, switches, etc.) presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc., as required to mount the device to the new wall.

.2 Where existing conduits pass vertically through a floor area, relocate those conduits to be installed concealed in a new wall or surface-mounted in a service area. Extend conduit, wiring, etc., as required.

.3 Existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.

1.07 EXISTING WIRING

.1 In all areas where existing walls, ceiling, etc. are required to be cut into or removed or other similar construction or alterations are required, the existing wiring in the areas required to remain in use for any reason, this Contractor shall re-route, alter and/or divert all such wiring in these areas in an approved manner, concealed in the building structure where required in such a manner that the original electrical capacity or characteristics of the existing wiring is maintained.

.2 Cutting and patching necessary for conduit work, etc. shall be as specified in other sections and shall be included in this section. Routes of conduits, etc. shall be co-coordinated with The City of Winnipeg and Contract Administrator in order to keep such cutting and patching to a minimum. All existing wiring that is required to remain in use and required to be diverted and extended to appropriate existing panels, etc. shall be installed in conformity with the wiring method specified.

.3 Existing branch circuit wiring within the area of the renovations which is substandard or does not meet normal requirements shall be noted and The City of Winnipeg advised. All existing circuits which are required to be reconnected shall be free from interconnection (cross-connected circuits, ie; accidentally connected to the conductors of another circuit) and shall conform to insulation tests described elsewhere. The responsibility for existing wiring which is not required to be altered in any way and is beyond the area of this contract is not included in this scope of work unless such wiring is specifically affected due to work carried out in this contract.

.4 Existing wiring and outlets, etc. no longer required to remain in use shall be removed or if this is not possible, rendered permanently in accessible and completely disconnected from the electrical distribution system.

.5 Disconnect, remove and discard all existing demolished Lighting Fixtures for the construction of new ceilings where required. Store new Light Fixtures on site as directed by The City of Winnipeg.

1.08 SCHEDULE OF WORK

.1 Coordinate all work impacting existing building systems with The City of Winnipeg.

.2 Provide The City of Winnipeg with a detailed schedule of service interruptions. For service interruptions to critical systems such as building power distribution, provide detailed description of work, start and end time of the task associated with the service interruption, and contingency plan to ensure that the facility remains operational in the event of unforeseen circumstances.

Part 2 Products

2.01 MATERIALS

.1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.

.2 New fire alarm devices, speakers, starters, panelboards, etc., required to be tied into existing systems shall match the existing devices unless otherwise noted on plans.

.3 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturer's requirements and instructions.

Part 3 Execution

3.01 EXAMINATION

.1 Verification of Conditions: verify the construction area prior to any demolition or new construction.

.1 Visually inspect all areas of the construction area and take photos as required to document all existing conditions.

.2 Inform the Project Manager or 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 the Project Manager or Contract Administrator.

3.02 INSTALLATION

.1 Install boxes, conduit and wiring through existing areas as required for the new installation.

.2 Add modules, switches, etc., in existing control panels, as required, to extend existing systems to new or renovated areas.

.3 Patch and repair walls and ceilings in existing areas that have been damaged to cut open due to the new electrical installation.

.4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

.5 Remove all unused existing wiring and conduits back to respective panels where practical or terminate in accessible junction boxes and identify the circuits as spares.

.6 Update and replace existing panel directories showing all remaining circuits and all new or spare circuits.

.7 Re-label existing panels as indicated on Drawings.

.8 Where work on existing building requires operation of the facility generator, supply fuel to the generator during the outage; replenish fuel upon completion of the system outage.

3.03 CLEANING

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical: Action and Information Submittals; Reference Standards; Delivery, Storage and Handling.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors.

.2 Include product characteristics, performance criteria, physical size, finish and limitations.

1.03 REFERENCE STANDARDS

.1 Refer to Section 26 05 00 – Common Work Results for Electrical.

1.04 DELIVERY, STORAGE AND HANDLING

.1 Refer to Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.01 MATERIALS

.1 Irreversible Compression type wire connectors: CAN/CSA-C22.2 No.65,

.1 Current carrying parts of copper or copper alloy.

.2 2 hole NEMA long barrel compression lugs.

.3 Sized to fit copper conductors as required.

.2 Fixture type splicing connectors: CAN/CSA-C22.2 No.65, with current carrying parts of copper or copper alloy, sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for copper bars.

.3 Stud clamp bolts.

.4 Bolts for copper bar.

.5 Sized for conductors and bars as indicated.

.4 Clamps or connectors for armoured cable, TECK cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.3.

2.02 Wire Connectors

.1 Use self-insulated connectors for hand twist wire joints for lighting, small power, and control wiring.

.2 Use non-insulated ring type compression lugs for terminating #10 AWG and smaller motor connections. Tape with rubber and scotch tape. Lugs to accept 10-32 x 3/8” machine bolts. Approved manufacturers: Thomas and Betts or approved equal.

.3 Terminate conductors #8 AWG and larger with Thomas & Betts Colour-Keyed compression connectors Series 54000, or on lugs provided with equipment.

.4 Use cable preparation compound on all terminations for compression connectors. Approved products: Thomas & Betts “KOPR-SHIELD” Series CP8 or approved equal.

Part 3 Execution

3.01 EXAMINATION

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

.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.

3.02 INSTALLATION

.1 Remove insulation carefully from ends of cables and conductors, and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors, where the use of aluminum conductors is permitted.

.2 Install Irreversible Compression type connectors and with appropriate compression tools recommended by the connector manufacturer.

.1 Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65

.3 Cover all 120V splices with shrink insulation rated for 600V (minimum).

.1 Insulation shall be either cold-shrink or require heat gun but shall not be designed to be activated with an open flame.

.2 Approved manufacturers: Burndy, 3M, Thomas and Betts.

.4 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

.5 Install bushing stud connectors in accordance with manufacturer’s recommendations.

3.03 CLEANING

.1 Refer to Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 26 05 00 - Common Work Results for Electrical: Product Data; Delivery, Storage and Handling.

.2 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

.3 26 05 36 - Cable Trays for Electrical Systems

1.02 PRODUCT DATA

.1 Provide product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.03 DELIVERY, STORAGE AND HANDLING

.1 Refer to section 26 05 00 - Common Work Results for Electrical.

Part 2 Products

2.01 BUILDING WIRES

.1 Conductor material: copper, unless indicated otherwise.

.2 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.3 Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE for circuits rated up to 300V.

.4 Copper conductors: size as indicated, with 1000V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE for circuits rated above 300V.

.5 Copper conductors: size as indicated, with insulation rating as per bus charger manufacturer’s requirements, where cables are specified between the bus chargers and the charger dispenser units.

THHN or T90 Nylon-Dry location not to exceed 90 degrees C.

2.02 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 Cross-linked polyethylene XLPE.

.2 Rating: 1000 V, unless higher rating is required based on installation methods.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: Interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller.
.2 Two hole steel straps for cables larger than 50 mm.
.3 Channel type supports for two or more cables at 190 mm centers.
.4 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:

.1 Watertight, approved for TECK cable.

2.03 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Connectors: anti short connectors. (Bushings)

2.04 DC Cables

.1 Cables shall be in accordance with the bus charger manufacturer requirements and adhere to all the applicable codes and standards enforced by the authority having jurisdiction.

2.05 Variable Frequency Drive (VFD) Cables

.1 Cables shall be in accordance with the VFD manufacturer’s recommendations, based on the length of the cables between the VFD and the load.

Part 3 Execution

3.01 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.1 Perform megger tests on all feeders using 1000V megger.
.2 Perform continuity to ground test on all branch circuits.

.3 Perform tests before energizing electrical system.

3.02 GENERAL CABLE INSTALLATION

.1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.

.4 Conductor length for parallel feeders to be identical.

.5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.6 Wiring in walls: drop or loop vertically from above to better facilitate future renovations.

.1 Wiring from below and horizontal wiring in walls is not permitted unless indicated otherwise on the drawings.

.7 Branch circuit wiring to be 2-wire circuits only: Common neutrals not permitted.

.8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend.

3.03 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Before pulling wire, ensure conduit is dry and clean.

.1 If moisture is present, thoroughly dry out conduits; vacuum if necessary.

.3 To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease.

.4 Do not install wire when ambient temperature is below the minimum permitted installation temperature for each insulation type.

.1 When installing wiring at ambient temperatures below +10 degrees Celsius, submit confirmation from the wire manufacturer on the minimum wire installation temperature.

.5 Install wiring in underground ducts in accordance with Section 33 65 76.

3.04 Do not exceed manufacturer’s recommended pulling tension when installing wires into conduit or raceways INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable securely supported by straps and hangers.

3.05 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

3.06 INSTALLATION OF ALUMINUM SHEATHED CABLE

.1 Group cables wherever possible on channels.

3.07 INSTALLATION OF DC CABLES

.1 Install DC cables in accordance with bus charger manufacturer recommendation.

3.08 Installation of VFD Cables

.1 Install VFD cables in accordance with manufacturer's recommendations.

3.09 VOLTAGE REGULATION

.1 Branch circuit conductor sizes shall be #12 AWG or larger based on the routing of conduit and run lengths as shown on the drawings, and shall comply with the Canadian Electrical Code, Part I, which allows a maximum 3% voltage drop for branch circuits.

.2 Contractor shall base all voltage drop calculations on the Canadian Electrical Code (CEC), Part I, and utilizing a current of 80% of the circuit protective device specified.

.3 When exact run lengths are determined for all branch circuits, and prior to installation of the conductors, ensure that the maximum voltage drop (based on 80% of circuit protective device) does not exceed 3%. Increase wire size from #12 AWG, and the respective conduit size if and as necessary, to ensure that the 3% voltage drop is not exceeded.

.4 Reference conductor length schedule:

Maximum One-way Length of Run		
Conductor	120 Volts	347 Volts
#12	20 m	65 m
#10	35 m	105 m
#8	55 m	175 m
#6	95 m	280 m

.5 The above table is based on 80% capacity of a 15 amp circuit. All other loads will require calculations to be conducted by the installing contractor to determine appropriate wire size as per the CEC.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results - Electrical

.2 Section 26 05 21 - Wire and Cables (0-1000V)

.3 Section 26 09 23.01 - Metering and Switchboard Instruments

1.02 REFERENCES

.1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 CSA International

.1 CSA C22.2 No. 41, Grounding and Bonding Equipment

.2 CSA G7.1, Copper Grounding Conductors

1.03 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 grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.04 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

Part 2 Products

2.01 EQUIPMENT

.1 Grounding conductor system, circuit and equipment, grounding shall be bare stranded copper, sized in accordance with the Canadian Electrical Code.

.2 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.3 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.

.4 Rod electrodes: stainless steel 19 mm diameter by minimum 6 m long.

.5 Grounding conductors: bare stranded copper, soft annealed, size as indicated and as mandated by code.

.1 In the event of a discrepancy, the contractor shall carry the larger conductor size.

.6 Insulated grounding conductors: green, copper conductors, size as indicated.

.7 Ground bus: copper, complete with insulated supports, fastenings, connectors.

.8 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.

Part 3 Execution

3.01 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.

3.02 INSTALLATION GENERAL

.1 Locate existing building ground grid and test to ensure that ground grid resistance does not exceed 5 ohm.

.1 Add additional ground rods if and as required in accordance with CEC Section 10 to achieve ground grid resistance of 5 ohms.

.2 Where EMT is used, run ground wire in conduit.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to electrodes using copper welding by Cadweld process.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints are not permitted.

.8 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.

.9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end and run separate ground conductor.

.13 Ground secondary service pedestals.

.14 Provide separate ground conductors in all raceways PVC conduit, plastic or fiberglass raceways EMT conduit and rigid conduit. All conduit shall have a minimum #12 AWG insulated ground wire.

3.03 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral points of 600V systems.

.1 Extend system grounding to the existing main building distribution.

.2 Grounding conductor shall be routed in primary conduits or adjacent to primary cables.

3.04 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.

3.05 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

.2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.06 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. A report shall be submitted to the Contract Administrator from the testing agency.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

.5 A ground electrode with an unsatisfactory resistance test result shall be altered as necessary until the required resistance reading is achieved.

3.07 PAD MOUNTED TRANSFORMER

.1 Provide grounding connections to the pad mounted transformer in conformance with the requirements of the supply authority.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results - Electrical

.2 Section 26 05 34 - Conduit, Conduit Fastenings, and Conduit Fittings

.3 Section 26 05 36 - Cable Trays for Electrical Systems

.4 Section 26 05 21 - Wire and Cable s (0-1000V)

1.02 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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.01 MANUFACTURER

.1 Acceptable manufacturers: Burndy, Electrovert, Unistrut, Pilgrim, Pursley or approved equal.

2.02 SUPPORT CHANNELS

.1 U shape, galvanized steel size 1.6”x1.6” (40 x 40 mm), 0.1” (2.5 mm) thick, surface mounted, suspended or set in poured concrete walls and ceilings as required.

Part 3 Execution

3.01 EXAMINATION

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

.1 Visually inspect substrate in presence of 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.

3.02 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with approved 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, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 1 ¼" (35 mm) and smaller.

.2 Two-hole steel straps for conduits and cables larger than 1 ¼" (35 mm).

.3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems.

.1 Support individual cable or conduit runs with ¼" (6 mm) diameter threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 0.4" (10 mm) diameter threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels at 60" (1.52 m) on centre spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.13 Where conduit and cable runs are installed on support systems, they shall be run so as to be as inconspicuous as possible. Coordinate support system path with equipment, of other trades, to ensure proper installation of electrical equipment. Run support system path perpendicular or parallel to building lines.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results For Electrical

.2 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

1.02 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 SYSTEM DESCRIPTION

.1 Provide boxes to suit each specified application. Locate as indicated and install vertically

Part 2 Products

2.01 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1. Section 12.

.2 102 mm square or larger outlet boxes as required.

.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.

2.02 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Electro-galvanized steel device boxes for flush installation, minimum size 4" (100 mm) square with extension and plaster rings, as required.

.3 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit.

.4 4" (100 mm) square outlet boxes for lighting fixture outlets.

.5 4" (100 mm) square outlet boxes with extension and plaster rings flush-mounting devices in finished plaster and tile walls.

2.03 CONDUIT BOXES

.1 Cast FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices and receptacles where exposed to moisture.

2.04 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 1 1/4" (35mm) and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.05 OCTAGON BOXES

.1 Not to be used as a Junction Box. Only to be used for mounting Exit Signs and Fire Alarm Devices.

Part 3 Execution

3.01 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 1/4" (6 mm) of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

.7 Maintain continuity of vapour barrier where boxes are installed in exterior walls or ceilings.

.8 Boxes shall be mounted plumb and square with building lines and installed vertically.

.9 Coordinate boxes in masonry with brick or block configuration. Boxes shall be sawcut in bottom of appropriate brick or block.

.10 Coordinate locations with millwork.

.11 Verify exact location of floor boxes with Architect. Adjust floor boxes level with finished floor.

.12 Verify exact location of service fittings with furniture drawings and/or Architect. Service fittings shall be installed parallel and perpendicular to building lines.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Basic Electrical Materials and Methods

.2 Section 26 05 29 - Hangers and Supports for Electrical Systems

1.02 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 45, Rigid Metal Conduit.

.3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83, Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 LOCATION OF CONDUIT

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Electrical Subcontractor shall produce layout sketches of conduit runs through mechanical and electrical service areas in order to avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

Part 2 Products

2.01 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded, minimum ¾" (19mm) or size as indicated.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings, minimum ¾" (19mm) or size as indicated.

.3 Rigid pvc conduit: to CSA C22.2 No. 211.2, minimum ¾" (19mm) or size as indicated.

.4 Flexible metal conduit: to CSA C22.2 No. 56 and liquid-tight flexible metal conduit, size as indicated.

2.02 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 1 1/4" (35 mm) NPS 2 and smaller.

.2 Two hole steel straps for conduits larger than 1 1/4" (35 mm) NPS 2.

.3 Beam clamps to secure conduits to exposed steel work.

.4 U-Channel type supports for two or more conduits at 60" (1.52 m) intervals on centre (surface mounted or suspended).

.5 Threaded rods, 3/8" (10 mm) diameter, to support suspended channels. One rod shall be non-ferrous.

2.03 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory elbows where 90 degrees bends for 2 ½” (63mm) and larger conduits.

.3 Steel set screw connectors and couplings. Insulated throat liners on connectors.

.4 Steel raintight connector fittings complete with O-rings, for use on weatherproof or sprinklerproof enclosures. Steel raintight couplings shall be used for surface conduit installation exposed to moisture or sprinkler heads. Steel raintight connectors shall be used for all top entries to panels, contactors and motor control centres.

2.04 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 4” (100) mm or 8” (200) mm linear expansion, as required.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 3/4” (19) mm deflection in all directions as required.

.3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

.4 O-ring type expansion fittings for PVC conduit.

.5 Flexible watertight conduit between junction boxes with integral bonding jumper suitable for linear and lateral movement greater than 3/4" (19 mm).

2.05 FUTURE PULL CORD

.1 ¼” Polypropylene Rope: Install in empty conduits.

Part 3 Execution

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 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.

.3 Use electrical metallic tubing (EMT) except where noted otherwise.

.4 Use rigid pvc conduit underground or in corrosive areas.

.5 Use explosion proof flexible connection for connection to explosion proof motors.

.6 Install conduit sealing fittings in hazardous areas.

.1 Fill with compound.

.7 Minimum conduit size for lighting and power circuits: ¾” (19mm)

.8 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.9 Mechanically bend steel conduit over ¾” (19 mm) diameter.

.10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.11 Install fish cord in empty conduits.

.12 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

.14 Wiring home runs to panels and main branch wiring runs in ceiling spaces shall be run in conduit. Wiring drops from conduit systems into boxes for wiring devices in steel stud partitions may be wired with AC-90. AC-90 drops to light fixtures shall not run horizontally more than 6' (1.83 m) from conduit system junction boxes in ceiling space. AC-90 drops from conduit system in the ceiling space to feed outlets in steel stud partitions shall not run more than 6' (1.83 m) horizontally from the ceiling outlet box to the point where the AC-90 drops vertically into the partition.

.15 Use rigid PVC conduit for underground installations. Provide spare ducts as indicated.

.16 Use flexible metal conduit for connection to motors, fluorescent fixtures recessed in T-bar ceilings, suspended fixtures, transformers and equipment subject to movement or vibration. Provide a separate insulated grounding conductor within flexible conduit.

.17 All wiring under computer floors shall be in liquid-tight flexible metal conduit, or teck cable, where indicated.

.18 Use threaded, rigid conduit and fittings in hazardous areas, concrete encased duct banks or where conduit is exposed to mechanical injury. Install conduit sealing fittings in hazardous areas and fill with compound. Field threads on rigid conduit shall be of sufficient length to draw conduits up tight. Mechanically bend rigid steel conduit over 3/4" (21 mm) diameter.

.19 Install (2) 1" (25mm) spare conduits out of Panel up to ceiling space and (2) 1" (25mm) spare conduits down to ceiling spaces below from each recessed panelboard, cabinet, annunciator, etc. Terminate these conduits in 16" x 16" x 4" (400 x 400 x 100 mm) junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in a flush concrete-type box with extension ring.

.20 Conduit shall be sized as per Canadian Electrical Code or as shown on drawings. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and shall be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.

.21 Provide separate ground conductors in all raceways PVC conduit, plastic or fiberglass raceways EMT conduit and rigid conduit. All conduit shall have a minimum #12 AWG insolated ground wire.

3.03 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not locate conduits within 78" (2 m) of infrared or gas-fired heaters.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 6” (150) mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.04 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install conduit horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.05 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Submit a marked up drawings of proposed conduit runs complete with conduits sizes to Structural Engineer and Contract Administrator for approval prior to installation.

.2 Locate to suit reinforcing steel.

.1 Install in centre one third of slab.

.3 Protect conduits from damage where they stub out of concrete.

.4 Install sleeves where conduits pass through slab or wall.

.5 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.

.1 Use cold mastic between sleeve and conduit.

.6 Conduits in slabs: minimum slab thickness 4 times conduit diameter. Do not install conduits larger than 1" (27 mm) in concrete slabs within prior approval of Architect.

.7 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.8 Organize conduits in slab to minimize cross-overs.

.9 Maximum permissible conduit size in slabs is 1" (27 mm). Parallel runs of conduit shall have a minimum separation of 6" (150 mm) face-to-face. Conduits may cross provided the maximum aggregate height based on outside diameters does not exceed 2 ½" (64 mm). Do not install conduits in drop panels, beams or columns.

.10 Provide 5" x 7" (125 x 175 mm) color photographs of conduits installed in slab, where conduits are grouped, or cannot follow perpendicular or parallel to building lines. As-constructed Drawings shall show all conduit runs embedded in concrete slabs, or run below slab, with measurements from fixed building lines (and/or columns).

.11 Provide separate ground conductors in all raceways PVC conduit, plastic or fiberglass raceways EMT conduit and rigid conduit. All conduit shall have a minimum #12 AWG insolated ground wire.

3.06 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 1” (27 mm) and larger below slab and encase in 3” (75 mm) concrete envelope. Provide ground wire in all conduits below grade.

.1 Provide 50 mm of sand over concrete envelope below floor slab.

3.07 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

.3 Use PVC conduits underground. Provide a separate ground wire in non-metallic conduits.

.4 All fittings shall be waterproof.

END OF SECTION

Part 1 General

1.01 References

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No.126, Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA) standards

.1 NEMA VE 1-1998, Metal Cable Tray Systems.

1.02 Shop Drawings And Product Data

.1 Submit shop drawings and product data in accordance with section 26 05 01 – Common Work Results - Electrical.

.2 Identify types of cable tray used.

.3 Show actual cable tray installation details and suspension system.

Part 2 Products

2.01 CABLE TRAY

.1 Ladder type, Aluminum, Class A to CAN/CSA C22.2No.126.

.2 Centre hung. NEMA 12C CSA Class D bottom rung with 9” (225 mm) rung spacing, c/w stiffener bars on tray over 12” (300 mm) wide or suspended down more than 24” (600 mm).

.3 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable tray supplied.

.4 Provide additional offsets, bends, transitions, etc. as required to adjust cable tray routing and height to avoid conflict with ducts, pipes, beams, etc. Coordinate exact routing of cable tray on site with other trades.

.5 Provide barriers where different voltage systems are in same cable tray.

.6 Acceptable manufacturers: B-Line, MP Husky or approved equal.

2.02 Supports

.1 Provide supports every 1.5m, within 760mm from each connection or fitting, at either end and as required.

.2 Centre suspend using ½” (13 mm) threaded rods with double locknuts below the tray and single locknuts above.

.3 Use double spline and two (2) 3/8” (10 mm) threaded rod hangers for cable tray wider than 18” (450 mm).

.4 Cable tray shall be designed for loads up to 40kg / meter.

Part 3 Execution

3.01 Installation

.1 Install complete cable tray system as indicated.

.2 Support cable tray on centre at a height, as indicated.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.4 Provide additional offsets, bends, etc. as required to adjust cable tray routing and height to avoid conflict with ducts, pipes, beams, etc.

.5 Cable tray drop-off chutes shall be fitted in all instances where cable exits this tray downward.

.6 Each Cable tray section (or 3m interval maximum) shall be grounded with a #6 AWG RW90 insulated green copper conductor installed within the cable tray. The insulated ground conductor shall be connected to the cable tray with a Cable Tray Ground Clamp specifically manufactured for this purpose, standard of acceptance to be Burndy #GBM28CG2.

.7 Arrange for opening in walls and floors for width and depth of cable tray to pass through. Firestop cable tray penetrations with removable, engineered fire-stopping system when passing through fire-rated walls. Firestopping shall be supplied in accordance with ULC-S115. Refer to Section 07 84 00 for additional details.

.8 Within the IT rooms the cable tray deck shall be located above the equipment rack centre line. Clearance of cable tray above finished floor shall be coordinated with communication rack elevations.

.9 Ensure separation of cable tray from adjacent services in accordance with Section 27 05 14 3.1.1.

3.02 Cables In cable trays

.1 Lay cables into cable tray individually. Use rollers when necessary to pull cables.

.2 Secure cables in cable tray at 6’ (1.83m) intervals with aluminum clamps.

.3 Identify cables in cable tray in accordance with Section 26 05 01.

.4 Ensure that minimum cable bending radius is maintained during and after the installation.

END OF SECTION

Part 1 General

1.01 REFERENCES

.1 Insulated Cable Engineers Association, Inc. (ICEA)

.2 Canadian Standards Association, (CSA International)

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.03 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 – Common Work Results for Electrical 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect cables from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 26 05 00 – Common Work Results for Electrical.

1.04 QUALITY ASSURANCE

.1 Refer to Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.01 CABLE PROTECTION

.1 38 x 140 mm planks pressure treated with coloured, or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.02 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

.2 Cedar post type markers: to CAN/CSA-Z809 or FSC or SFI 89 x 89 mm, 1500 Mm long, pressure treated with coloured, or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.

.1 Nameplate: aluminum anodized 89 x 125 mm, 1500 mm thick mounted on cedar post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction.

Part 3 Execution

3.01 EXAMINATION

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

.1 Visually inspect substrate in presence of CNL Representative.

.2 Inform CNL Representative 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 CNL Representative.

3.02 DIRECT BURIAL OF CABLES

.1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.

.1 Do not pull cable into trench.

.2 Include offsets for thermal action and minor earth movements.

.1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits. Maintain 300 mm minimum horizontal separation between low and high voltage cables.

.2 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.3 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

.4 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.5 Install treated planks on lower cables 600 mm minimum in each direction at crossings.

.6 After sand protective cover specified is in place, install continuous row of interlocking cable blocks 38 x 140 pressure treated planks as indicated to cover length of run.

3.03 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.04 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using qualified personnel.

.1 Include necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds.

.1 Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing in accordance with manufacturer's recommendations.

.4 Leakage Current Testing:

.1 Raise voltage in steps from zero to maximum values as specified by ICEA or manufacturer for type of cable being tested.

.2 Hold maximum voltage for the specified time period by ICEA or manufacturer.

.3 Record leakage current at each step.

.7 Provide CNL Representative with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.05 CLEANING

.1 Progress Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.

.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 26 05 00 – Common Work Results for Electrical.

.3 Waste Management: separate waste materials for reuse in accordance with Section 26 05 00 – Common Work Results for Electrical.

3.06 PROTECTION

.1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results – Electrical

.2 Section 26 28 16 - Moulded Case Circuit Breakers

.3 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

.4 Section 26 05 21 - Wire and Cables (0-1000V)

.5 Section 26 24 02 - Service Entrance Board

1.02 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C39.1, Requirements, Electrical Analog Indicating Instruments.

.2 CSA International

.1 CAN3-C17, Alternating - Current Electricity Metering.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 - Common Work Results – Electrical

.2 .Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include meter, outline dimensions, panel drilling dimensions and installation cutout template.

1.04 MAINTENANCE MATERIAL & DATA

.1 Provide data for incorporation into Maintenance Manual specified in Section 26 05 00.

.2 One set spare parts as recommended by Manufacturer.

1.05 SOURCE QUALITY CONTROL

.1 Refer to Section 26 05 00.

1.06 MATERIALS

.1 Meters: to CSA C17.

.2 Meter mounting devices: to CSA C22.2 No. 115.

.3 Digital instruments: to ANSI C39.1, ANSI C12.20.5 and UL508.

.4 Instrument transformers: to CSA C13.

Part 2 Products

2.01 METER

.1 Provide digital power meters where indicated on the single line diagram.

.1 Meter accuracy shall be in accordance with ANSI C12.20.5 (0.5%).

.2 Instrument Transformers:

.1 The panelboard manufacturer shall supply and install all the required instrument transformers on the secondary circuits as indicated on the single line diagram.

.3 Metering class, 5A secondary, current transformers shall be properly sized for the load and installed in each phase of the selected circuits.

.1 Where Neutral is present, provide current transformer on the neutral.

.4 The circuits to be equipped with metering transformers include the main feeders and other circuits as indicated on the drawings.

.5 Metering Equipment:

.1 Micro-processor based, capable of high rate digital sampling of current and voltage signals to provide accurate, true RMS metering.

.2 The overall accuracy of the metering devices shall be in line with metering transformers' accuracy and with the character of metering application.

.3 For energy management and building submetering application, 0.5% system accuracy is acceptable.

.4 No annual recalibration by the user shall be required.

.5 One form 'C' dry contact output shall provide pulses proportional to energy consumption (kWh). The pulses shall be compatible with a standard Digital Input of a generic DDC panel (last at least 5 sec so that the panel can record them properly).

.6 All output signals shall be isolated from the input. The analog output signal's 'Common' shall be grounded through the DDC System.

.7 The meter shall present minimum burden (less than 0.5VA) in current inputs so that small VA CTs or the existing CTs can be used without accuracy deterioration.

.8 The meter shall operate properly over a wide range of input voltages and currents.

.1 Continuous overload of 200% of the rated current input shall not damage the meter.

.2 Line voltage fluctuations up to 20% shall not affect the accuracy.

.9 The meter shall store all set-up parameters in non-volatile memory that does not require any batteries.

.10 In addition to analog output signals representing all measured and calculated parameters as per Item .4, the meter shall be equipped with an RS232 port for user's programming and remote monitoring via standard Hayes compatible modem.

.11 The RS232 communication shall use plain ASCII format that allows the use of any generic communication software with user's DOS based PC.

.12 The meter shall support a local or a remote display to allow on-site viewing of all the measured and calculated parameters. If equipment with the display, the total accumulated kWh shall be stored in non-volatile memory during power shut-downs or momentary breaks.

2.02 METER CABINET

.1 Where metering cabinet is used in lieu of meters integrated in the equipment, the cabinet shall consist of a sheet steel CSA enclosure with meter backplate, to accommodate meters, test terminal block and associated equipment, factory installed and wired.

2.03 TEST TERMINAL BLOCKS

.1 Test terminal blocks: as required.

2.04 SHOP INSTALLATION

.1 Install instruments on panel.

.2 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, signal sources, electrical supplies.

2.05 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

2.06 SHOP FABRICATION

.1 Check meters and phase selector switches.

2.07 MANUFACTURERS

.1 Acceptable manufacturers: Eaton, Schneider, Cutler Hammer and Square D.

Part 3 Execution

3.01 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metering and switchboard instruments 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.

3.02 METERING INSTALLATION

.1 Where meters are installed outside of the distribution equipment, install meters and instruments in location free from vibration and shock.

.2 Make connections in accordance with diagrams.

.3 If applicable, ensure power factor corrective equipment connected on load side of meter.

.4 Connect meter and instrument transformer cabinets to ground.

.5 Wiring associated with the meter, other than communication wiring, shall be minimum #14 AWG 600 Volt Cable with PVC Jacket with multiple twisted shielded pairs.

3.03 FIELD QUALITY CONTROL

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.

.2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

.4 Perform tests to obtain correct calibration.

.5 Do not dismantle meters and instruments.

3.04 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metering and switchboard instrument installation.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical

.2 Section 26 28 16 - Moulded Case Circuit Breakers

.3 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

.4 Section 26 05 21 - Wire and Cables (0-1000V)

.5 Section 26 09 23 - Metering and Switchboard Instruments

1.02 REFERENCES

.1 CSA Group

.1 CSA C22.2 No.31, Switchgear Assemblies.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Shop Drawings:

.1 Indicate on drawings:

.1 Floor anchoring method and foundation template.

.2 Dimensioned cable entry and exit locations.

.3 Dimensioned position and size of bus.

.4 Overall length, height and depth.

.5 Dimensioned layout of internal and front panel mounted components.

.6 Shipping sections and weights.

.2 Include time-current characteristic curves for circuit breakers and fuses.

1.04 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

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

.2 Provide:

.1 One set spare parts as recommended by Manufacturer.

1.05 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for service entrance board for incorporation into manual.

Part 2 Products

2.01 SERVICE ENTRANCE BOARD

.1 Service Entrance Board: to CSA C22.2 No.31.

.2 Power supply: 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current rated at 42 KA RMS symmetrical min. and as required by Short Circuit Study (refer to Section 26 05 00).

.3 Rating: As indicated on drawings.

.4 Cubicles: free standing, dead front, totally enclosed sheet steel, 'sprinklerproof' enclosure with steel frame, sheet steel barriers to separate adjoining sections size as indicated.

.5 Barrier metering section from adjoining Sections.

.6 Provision for installation of power supply authority metering transformers in barriered Section.

.7 Metering as indicated under Section 26 09 23 – Metering and Switchboard Instruments.

.8 Distribution section.

.9 Hinged access panels with captive knurled thumb screws. Utility metering section to have provision for utility seals.

.10 Bus bars and main connections: Copper.

.11 Bus from load terminals of main breaker to main lugs of distribution section.

.12 Identify phases with colour coding.

.13 Customer metering instruments, transformers and selector switches.

.14 High conductivity tin plated copper bus.

2.02 MOULDED CASE CIRCUIT BREAKERS

.1 Molded case circuit breakers: to CSA C22.2 No. 5

2.03 GROUNDING

.1 Copper ground bus extending full width of cubicles and located at bottom.

.2 Bond non-current carrying metal parts to ground bus.

2.04 FINISHES

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

.1 Service entrance board exterior: gray.

.2 Supply 2 spray cans of touch-up enamel.

.3 Treated to inhibit rusting.

2.05 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplates:

.1 Black plate, white letters, size 5, to indicate
Line 1 – Distribution, Voltage & wires.
Line 2 – Fed from (Transformer/CDP).
Line 3 – Transformer / CDP location.

.2 Complete board labelled: "600 V."

.3 Main disconnect labelled: "Main Breaker".

.4 Branch disconnects labelled: as indicated on the drawings.

.5 Sub-breakers: labeled to indicate panel or equipment fed.

2.06 SOURCE QUALITY CONTROL

.1 Refer to Section 26 05 00.

2.07 SHOP FABRICATION

.1 Assemble and wire complete service entrance board.

.2 Energize switchboard.

.3 Check meters and phase selector switches.

.4 Prepare switchboard for shipment to site.

2.8 MANUFACTURERS

.1 Acceptable manufacturers: Cutler Hammer and Square D.

2.9 ENERGY MANAGEMENT

.1 Provide terminal board and wiring from separate customer CT's and PT's to facilitate the installation of demand, watt hour energy management equipment.

2.10 DISTRIBUTION SECTION

.1 The distribution section shall consist of a CDP type panelboard with molded case circuit breakers. Each breaker shall be manually operated, fixed type with trip ratings as shown on the drawings. Minimum interrupting rating shall be 42,000 amps symmetrical and as required by Short Circuit Study (refer to Section 26 05 00).

.2 The distribution section shall be provided with a minimum of 10-200 amp, 3 pole frame spaces, each with mounting hardware.

.3 Provide doors cw padlock provisions for the CDP Section of Main Distribution.

Part 3 Execution

3.01 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for service entrance board 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.

3.02 INSTALLATION

.1 Locate service entrance switchboard as indicated.

.2 Connect main secondary service to line terminals of main switchboard.

.3 Connect load terminals of distribution breaker's to outgoing feeders.

.4 Check factory made connections for mechanical security and electrical continuity.

.5 Run one grounding conductor 3/0 AWG bare copper in 27 mm conduit from ground bus to main building ground on the exterior of the building.

.6 Check trip unit settings against co-ordination study and shop drawings to ensure proper working and protection of components.

.7 Manufacturer shall provide test equipment and field test overload, magnetic and ground fault tripping. Include test report in Maintenance Manuals.

.8 Arrange for main distribution switchboard to be mounted on housekeeping pad.

.9 Switchboard manufacturer shall provide a coordination and short circuit study and submit to Contract Administrator with switchboard shop drawings.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical

.2 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

.3 Section 26 28 16 - Moulded Case Circuit Breakers

1.02 REFERENCES

.1 CSA International

.1 CSA C22.2 No.29, Panelboards and Enclosed Panelboards.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.04 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for Panelboards for incorporation into manual.

1.05 PLANT ASSEMBLY

.1 Install circuit breakers in Panelboards before shipment.

.2 In addition to CSA requirements, manufacturer’s nameplate shall show fault current that panel, including breakers, has been built to withstand.

Part 2 Products

2.01 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29-M1989 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 CDP panels: to CSA22.2 No.29 and shall be manufactured to allow installation of two 200a frame breakers adjacent to each other - horizontally.

.3 250V panelboards: bus and breakers rated for 10kA (symmetrical) interrupting capacity or as indicated.

.4 600V panelboards: bus and breakers rated for 18kA (symmetrical) interrupting capacity or as indicated.

.5 250V panelboards: bus and breakers rated for 25kA (symmetrical) interrupting capacity or as indicated.

.6 600V panelboards: bus and breakers rated for 22kA (symmetrical) interrupting capacity or as indicated.

.7 Sequence phase bussing such that circuit breakers shall be numbered vertically in consecutive order with each breaker identified by permanent number identification as to circuit number and phase.

.8 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.9 Minimum of 2 flush locks for each Panelboard.

.10 Two keys for each Panelboard and key Panelboards alike.

.11 Copper bus with neutral of same ampere rating of mains.

.12 Mains: suitable for bolt-on breakers, and spaces shall be provided with mounting hardware.

.13 Trim with concealed front bolts and hinges.

.14 Trim and door finish: baked grey enamel.

.15 Isolated ground bus.

.16 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

.17 Flush or surface-mounted tubs as shown.

.18 Finish trim and door baked grey enamel.

.19 CDP-type Panelboards (breakers or fusible) shall be provided with a minimum of 6-200 amp, 3-pole, frame spaces each complete with mounting hardware.

.20 All Panelboards and CDP’s shall have “sprinklerproof” enclosures in sprinklered areas, and all shall have lockable doors and isolated ground bus.

.21 Panelboards and CDP’s fed from Emergency power shall be painted Red.

2.02 CUSTOM BUILT PANELBOARD ASSEMBLIES

.1 Double section panels as indicated.

.2 Feed through lugs as indicated.

.3 Weatherproof enclosure as indicated.

.4 Built-in contactors as indicated.

.5 L.V. relay sections as indicated.

2.03 BREAKERS

.1 Breakers: to Section 26 28 16 - Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in Panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for fire alarm, emergency, door supervisory, intercom, stairway, exit lights and night light circuits.

.5 Branch circuit breakers shall be 15A single-pole, unless otherwise indicated on drawings.

2.04 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplate for each Panelboard and CDP size 3 engraved as indicated.

.1 Line 1 – Panel ID.

.2 Line 2 – Amp of Feeder, Breaker, Voltage & Wire.

.3 Line 3 – Fed from Panel & Room Number.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Size 2 nameplate for each breaker in CDP Panelboards

.1 Line 1 – Panel ID.

.2 Line 2 – Panel location (Room #).

.5 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

.6 Circuits supplying Patient Care Areas must be entered in circuit directory with Bold Font.

2.05 MANUFACTURERS

.1 Acceptable manufacturers: Cutler Hammer, Siemens, Eaton, Square D.

Part 3 Execution

3.01 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for Panelboards 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.

3.02 INSTALLATION

.1 Locate Panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on U-channels. Where practical, group Panelboards on common length of U-channel.

.3 Mount Panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.

.4 Connect loads to circuits as indicated.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Provide a separate neutral for each branch circuit.

.7 Install spare conduits from recessed Panelboards in accordance with Section 26 05 34.

.8 Connect isolated ground bus in Panelboards to main building ground source with #2/0 AWG, green insulated ground wire, in conduit unless otherwise noted.

.9 Wiring in Panelboards shall be neat and set in as if laced. All neutral conductors shall be identified in the panel with their associated circuit numbers by means of Brady Markers.

.10 All Panelboards throughout the building shall be phased together such that the left hand, centre, and right hand Panelboard busses represent Phases A, B and C, respectively. All indicating meters shall be identified to this sequence.

.11 Branch circuit panels shall be complete with 10% spare breakers and 10% space (and mounting hardware) based on Panel capacity for future breakers.

3.03 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by Panelboards installation.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 21 05 01 - Common Work Results – Mechanical

.2 Section 26 05 00 - Common Work Results for Electrical

.3 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings

.4 Section 26 05 21 - Wire and Cables (0-1000V)

.5 Section 26 05 32 - Outlet Boxes, Conduit Boxes, and Fittings

.6 Section 26 29 10 - Motor Starters to 600V

.7 Section 26 24 19 - Motor Control Centres

.8 Section 26 28 23 - Disconnect Switches – Fused and Non-Fused

1.02 REFERENCES

.1 CSA International

.1 CAN/CSA C22.2 No. 94.2, Enclosures for Electrical Equipment, Environmental Considerations.

.2 National Fire Protection Association (NFPA)

.1 NFPA 20, Standard for the Installation of Stationary Fire Pumps for Fire Protection.

.3 Underwriters' Laboratories of Canada (ULC)

1.03 SYSTEM DESCRIPTION

.1 Provide complete electrical power and control connections for mechanical equipment, except as noted herein, or as noted on the drawings.

1.04 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 mechanical equipment connections and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Overall dimensions.

.2 Fixing support dimensions, details.

.3 Schematic, wiring, interconnection diagrams.

1.05 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for mechanical equipment connections incorporation into manual.

Part 2 Products

2.01 MATERIALS

.1 Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.

.2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical equipment, except for temperature/humidity control systems.

.3 Unless otherwise noted, motors and control devices shall be supplied by Division 21, 22, and 23. Motor horsepower ratings shall be as shown in the Division 21, 22, and 23 specifications. Motor voltage and phase ratings shall be as shown on the Division 26 and 27 drawings.

.4 Provide the Mechanical Contractor with a copy of the Motor Schedule and ensure conformance with voltage shown. Additional prints of Motor Schedule will be made available by the General Contractor.

2.02 EXTERIOR EQUIPMENT

.1 All equipment, mounted on the exterior of the building, shall be weatherproof.

Part 3 Execution

3.01 POWER WIRING

.1 Install power feeders, starters, disconnects, and associated equipment and make connections to all mechanical equipment.

.2 Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.

.3 Install main power feeders to starter/control panels furnished by Division 21, 22, and 23. Install branch wiring from starter/control panels to controlled equipment such as motors, electric coils, etc.

.4 Flexible connections to motors shall not exceed 6 feet (1.83 m), unless approved by Contract Administrator, and shall be liquid tight flex with watertight connectors.

3.02 CONTROLS

.1 Install all electrical controls, except low voltage temperature controls, unless otherwise noted herein. Controls which have both electrical and mechanical connections shall be installed by the trade supplying the control.

.2 Wire and connect line voltage remote thermostats and P/E switches for furnaces, condensing units, force flows, gas-fired unit heaters, electric heaters and rooftop units.

.3 Wire and connect float switches, pressure switches, alternators, alarms, etc. for sump pumps, sewage pumps, domestic hot water recirculating pumps, booster pumps, jockey pumps and compressors.

.4 Conduit, wire, devices and fittings required to wire and connect low voltage controls which are an integral part of a packaged unit, shall be supplied by the trade supplying the packaged unit, unless otherwise indicated. Control wiring shall be installed in conduit.

.5 Conduit, wire, devices and fittings required to wire and connect low voltage temperature control systems, shall be supplied and installed by the trade supplying the temperature control system. Control wiring shall be installed in conduit.

.6 Wire and connect electrical interlocks for starters supplied by Division 21, 22, and 23.

.7 Wire and connect hi-limit cutouts for remotely mounted electric heating coils provided by Division 21, 22, and 23.

.8 Wire and connect thermistor control devices, built-in to large motors, to motor starters, as per wiring diagrams provided by Division 21, 22, and 23.

3.03 COORDINATION

.1 Refer to Mechanical Drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.

.2 Obtain full information from Division 21, 22, and 23, regarding wiring controls, overload heaters, equipment ratings and over-current protection. Notify the Division 21, 22, and 23, at once, if any information provided is incorrect or unsatisfactory.

.3 Coordinate control wiring requirements with Division 21, 22, and 23 and provide all control wiring and connections as required to make the control systems operate as specified.

.4 Refer to Division 21, 22, and 23 specifications for any further electrical requirements.

.5 Review both electrical and mechanical drawings and specifications and coordinate all controls with Mechanical Sub trades through General Contractor. Report all discrepancies to Contract Administrator before close of tender. No additional money will be justified for assumptions made on any duplication of information.

.6 Submit to General Contractor, as part of the tender submission, a list of controls and wiring to be provided in the Electrical Contract.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical

.2 Section 26 24 16 - Panelboards Breaker Type

1.02 REFERENCES

.1 CSA International

.1 CSA C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Include time-current characteristic curves for breakers with interrupting capacity of 25,000 A symmetrical (rooms) and over at system voltage with ampacity of 800A and over.

.4 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted Contract Administrator for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin Contract Administrator. Unless complying with this requirement, Contract Administrator reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.4 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

Part 2 Products

2.01 MANUFACTURERS

.1 Acceptable manufacturers: Cutler Hammer, Square D.

2.02 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C (104 degrees F) ambient.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

2.03 THERMAL MAGNETIC BREAKERS

.1 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 tripping for short circuit protection.

2.04 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS

.1 Thermal magnetic breakers with current limiters.

.1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.

.2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

.1 Breakers applied following manufacturer's guidelines and accepted best practice.

2.05 SOLID STATE TRIP BREAKERS

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, short circuit protection as indicated on the drawings.

2.06 OPTIONAL FEATURES

.1 Include:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Under-voltage release.

.4 On-off locking device.

.5 Handle mechanism.

2.07 GROUND FAULT CIRCUIT INTERUPTERS

.1 Molded case circuit breakers as above with integral Class A Group 1 ground fault interrupter.

Part 3 Execution

3.01 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 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.02 INSTALLATION

.1 Install circuit breakers as indicated.

.2 Series rated circuit breakers shall not be used, unless the use is authorized in writing by The City of Winnipeg.

END OF SECTION

Part 1 General

1.01 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical

.2 Section 26 24 20 - Mechanical Equipment Connections

1.02 REFERENCES

.1 CSA Group

.1 CAN/CSA-C22.2 No.4, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162 and UL 98).

.2 CSA C22.2 No.39, Fuseholder Assemblies.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Submit shop drawings in accordance with Section 26 05 00.

.3 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.01 MANUFACTURERS

.1 Acceptable manufacturers: Cutler Hammer / Square D.

.2 Weatherproof 3 pole toggle type motor disconnects shall be P&S # 7800 MD Series Motor starting switches with enclosure.

2.02 DISCONNECT SWITCHES

.1 Fusible and Non-fusible, disconnect switch in EEMAC “1” enclosure for interior applications and EEMAC ”3” for exterior applications, CSA enclosure to CAN/CSA-C22.2 No.4 unless otherwise indicated.

.2 Provision for padlocking in ON-OFF switch position by 3 locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, in accordance with Section 26 28 13 - Fuses.

.5 Fuseholders: in each switch suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Single-phase motor disconnect switches shall be one or two-pole toggle-type, 20 amp, 120/347V AC, brown handle with side and back wiring complete with pilot light.

.9 Three-phase motor disconnect switches for motor up to 5HP at 208V and 10HP at 600V shall be 3-pole, toggle-operated with surface-mounting enclosure, as indicated.

.10 Three-phase motor disconnect switches for motors above 5HP at 208V or 10HP at 600V non-fusible safety switches, sized as required. Switch shall be non-teasing, quick-make, quick-break type with visible blades, line terminal shield and enclosure, as indicated, with cover interlock and lockable handle.

.11 All Motor Disconnect Switches shall be horse power rated.

2.03 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Indicate name of load controlled on size 3 nameplate.

.1 Line 1 – Equipment description.

.2 Line 2 – Voltage & Fed from.

.3 Line 3 – Panel & Circuits if required.

Part 3 Execution

3.01 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused 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.

3.02 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable where indicated or where required by the inspection authorities and/or for equipment supplied by other trades.

.2 Install motor disconnect switches where indicated.

END OF SECTION