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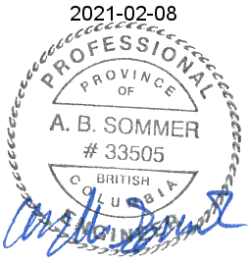
END OF SECTION

2021-02-08



Seal #1

Andrea Sommer, P.Eng.
PBX Engineering Ltd.
Division 01 Specifications
Division 26 Specifications
Division 27 Specifications
Division 31 & 33 Specifications

NOTES:

Each Engineer that has applied a seal above shall indicate which sections of the specifications he or she is certifying and the engineering company they work for. Alternatively, the Engineer may indicate which engineering discipline he or she is certifying as long as the name of the engineering company they work for (the source) is shown on the applicable technical specifications.

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Not Used.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises of electrical upgrades for Cowichan hatchery facility.

.2 Work includes but is not limited to:

- .1 Provide new equipment and remove end of service life equipment as indicated on contract documents.
- .2 Replace existing main distribution in the electrical building including the incoming service section, automatic transfer switch, and the existing motor control center “MCC”.
- .3 Relocate the existing generator battery rack.
- .4 Provide a new control panel within the electrical building.
- .5 Replace existing end of life distribution in the old hatchery building (Interpretive building).
- .6 Remove all out of service equipment located in the old hatchery building.
- .7 Replace the existing 480V heater in the hatchery shop with 600V heater.

.3 Contractor shall obtain and pay for all permits required to perform the work outlined in the Contract Documents including but not limited to electrical and building permits.

1.4 SCHEDULE

.1 Work shall be performed to meet the schedule as indicated in the DFO RFP.

.2 Due to funding restrictions, work must be completed by the date listed.

1.5 Work Environment

.1 Contractor shall include in Bid price all costs associated with transportation of equipment and personnel to the place of work.

- .1 Include all costs associated with overnight accommodation and provision of meals for personnel if required.

1.6 CONTRACT METHOD

.1 Refer to DFO Front End Documents

- .1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations thereunder.
- .2 Purchase and maintain general liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required to provide to Consultant.

.2 WorkSafeBC

.1 Within five (5) working days of execution of the Contract, provide written confirmation from the WorkSafeBC that the prime contractor and all subcontractors are registered in good standing with WorkSafeBC. No invoice will be payable until such confirmation has been received.

.3 Performance Assurance:

.1 Accepted Bidder must provide Performance and Labour and Materials Payment Bonds each in the amount of fifty percent (50%) of the Contract Price.

.2 Include cost of bonds in Bid Price.

.3 Obligee on bonds shall be the Owner.

.4 Provide these bonds within ten (10) Working Days of contract award. Maintain bonds in good standing until Contract fulfillment.

.5 Ensure the Performance Bond is issued on CCDC-221 Performance Bond form, and Labour and Material Bond is issued on CCDC 222 Labour and Material Performance Bond form or other forms approved by the Surety Association of Canada and issued by a Surety acceptable to the Owner.

1.7 WORK BY OTHERS

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

.2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Consultant, in writing, any defects which may interfere with proper execution of Work.

1.8 FUTURE WORK

.1 Not Required.

1.9 WORK SEQUENCE

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

.2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction. Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.

.3 Required stages:

.1 Perform work in phased manner as described in Contract Documents.

.4 Maintain fire access/control.

1.10 CONTRACTOR USE OF PREMISES

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

.1 Owner occupancy.

.2 Work by other contractors.

.2 Co-ordinate use of premises under direction of Consultant.

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

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

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

.6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.11 OWNER OCCUPANCY

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

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

1.12 PRE-PURCHASED AND OWNER SUPPLIED EQUIPMENT

.1 Certain items of equipment have will be Owner Supplied. Refer to Division 26 for details.

.2 Schedule of Owner Supplied Equipment.

.1 Control Panel

.3 Notify Owner in writing at least 10 calendar days in advance of date on which materials and equipment are required.

1.13 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

.2 Use only elevators existing in building for moving workers and material.

.1 Protect walls of passenger elevators, to approval of Consultant prior to use.

.2 Accept liability for damage, safety of equipment and overloading of existing equipment.

1.14 EXISTING SERVICES

.1 Notify Consultant and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give Owner 48 hours of 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 tenant operations.

.3 Provide alternative routes for pedestrian and vehicular traffic.

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

.5 Submit schedule to and obtain approval from Consultant 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 when directed by Consultant to maintain critical building and tenant systems.

.7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.

.8 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

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

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

.11 Construct barriers in accordance with WorkSafeBC requirements.

1.15 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy 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.

PART 2 PRODUCTS

.1 Not used.

PART 3 EXECUTION

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results.

1.3 ACCESS AND EGRESS

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

1.4 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Project Manager and Consultant 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 Owner will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.

.5 Use only assigned elevators, stairwells, or paths of travel in existing in building for moving workers and material.

.1 Protect walls of passenger elevators, to approval of Project Manager and Consultant prior to use.

.2 Accept liability for damage, safety of equipment and overloading of existing equipment.

.6 Protect work temporarily until permanent enclosures are completed.

.7 Workers shall refrain from use of loud and vulgar language. Non- compliance to this policy will result in the specific worker(s) involved being required to immediately leave the site and to be permanently removed from any subsequent involvement on this project by the Contractor.

.8 Use of loud radios shall be prohibited.

.9 Pets are not allowed on site.

.10 Vehicles must be parked in designated areas.

.11 The Owner will designate storage areas for tools and equipment. The Contractor shall assign and coordinate storage facilities for sub-Contractors within these designated areas.

1.5 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.6 EXISTING SERVICES

.1 Notify Project Manager, Consultant, and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give Project Manager, and Consultant a minimum of 5 working days of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.3 Provide for personnel and vehicular traffic.

.4 Construct barriers in accordance with WorkSafeBC, safety authority, Authority Having Jurisdiction, and Project Manager.

1.7 SPECIAL REQUIREMENTS

.1 Submit schedule in GANTT Chart format.

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

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

1.8 SECURITY

.1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.

1.9 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is permitted only in approved areas as designated by the Owner.

1.10 ACCOMODATIONS AND MEALS

.1 Contractor shall be responsible for all cost associated with accommodation and meals while performing work.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Not Used.

1.3 ADMINISTRATIVE

.1 Consultant shall schedule and chair meetings and record the meeting minutes.

.2 Consultant shall prepare agenda for meetings.

.3 Distribute written notice of each meeting to subcontractors four days in advance of meeting date.

.4 Provide physical space and make arrangements for meetings.

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

1.4 PRECONSTRUCTION MEETING

.1 After award of Contract, Consultant will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

- .1 Attendance by Contractor and major Subcontractors is mandatory.
- .2 Consultant, Owner, Contractor, and major Subcontractors (minimum electrical and civil contractors), will be in attendance.
- .3 Parties shall be notified a minimum of 5 days prior to meeting.
  - .1 Contractor shall be responsible for notifying and coordinating attendance of Subcontractors.

.2 Contractor shall prepare preliminary Schedule of Work for review at preconstruction meeting.

.3 Agenda will include but not be limited to:

- .1 Appointment of official representative of participants in the Work.
- .2 Schedule of Work.
- .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Delivery schedule of major equipment.
- .5 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .6 Owner 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.

1.5 PROGRESS MEETINGS

.1 Allow for construction progress meetings via teleconference or on site to discuss construction progress and address any questions or coordination items as required.

.2 Contractor, major Subcontractors involved in Work Consultant and Owner are to be in attendance.

.3 Notify parties minimum one week prior to meetings as to who is required to attend from Consultant Team.

.4 Agenda may 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 effect on construction schedule and on completion date.
.12 Other business.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results

1.3 ADMINISTRATIVE

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

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

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

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

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

.6 Notify Project Manager and Consultant in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

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

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Project Manager or Consultant's review of submittals.

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

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

1.4 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 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada where applicable.

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

.4 Allow 5 business days for Consultant's review of each submission.

.5 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Project Manager and Consultant prior to proceeding with Work.

.6 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Project Manager and Consultant in writing of revisions other than those requested.

.7 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.

.8 Submissions 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 field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

.9 After Project Manager and Consultant's review, distribute copies.

.10 Submit electronic copy in pdf format shop drawings for each requirement requested in specification and as Project Manager or Consultant may reasonably request.

.11 Submit electronic copy in pdf format of product data sheets or brochures for requirements requested in specification Sections and as requested by Project Manager or Consultant where shop drawings will not be prepared due to standardized manufacture of product.

- .1 Indicate exact model number and all options to be supplied on data sheet.

.12 Submit electronic copy in pdf format of test reports for requirements requested in specification Sections and as requested by Project Manager or Consultant.

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

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

.13 Submit electronic copy in pdf format of certificates for requirements requested in specification Sections and as requested by Project Manager or Consultant.

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

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

.14 Submit electronic copy in pdf format of manufacturer’s instructions for requirements requested in specification Sections and as requested by Project Manager or Consultant.

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

.15 Submit electronic copy in pdf format of Manufacturer's Field Reports for requirements requested in specification Sections and as requested Project Manager or Consultant.

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

.17 Submit electronic copy in pdf format of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Project Manager or Consultant.

.18 Delete information not applicable to project.

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

.20 Indicate equipment numbers(s) or descriptions(s) on each submittal.

.21 If upon review by Project Manager and Consultant, 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.

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

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic of colour digital photography in jpg or tif format, standard resolution as directed by Project Manager and Consultant.

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

.3 Number of viewpoints: to adequately capture the stages of existing equipment, equipment removal, equipment during construction, and final equipment replacement.

.4 Frequency of photographic documentation: as directed by Consultant.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Results

1.3 REFERENCES

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

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Province of British Columbia

.1 Workers Compensation Act, RSBC latest version.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation

.3 Submit copies of Contractor's authorized representative's work site health and safety inspection reports as required by the authority having jurisdiction and provide a weekly update for the Consultant or Owner.

.4 Submit copies of reports or directions issued by health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with authority having jurisdiction

.7 Consultant or Owner will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant or Owner within 5 days after receipt of comments from Consultant or Owner.

.8 Consultant’s or Owner’s review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

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

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

1.5 FILING OF NOTICE

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

1.6 SAFETY ASSESSMENT

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

1.7 MEETINGS

.1 Schedule and administer Health and Safety meeting with Consultant or Owner prior to commencement of Work.

1.8 REGULATORY REQUIREMENTS

.1 Do Work in accordance with Authority having jurisdiction.

1.9 PROJECT/SITE CONDITIONS

.1 Refer to hazardous materials report for facility appended to the specification for additional information.

1.10 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

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

1.11 RESPONSIBILITY

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

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

1.12 COMPLIANCE REQUIREMENTS

.1 Comply with Workers Compensation Act, B.C. Reg.

.2 Comply with requirements of Authority Having Jurisdiction

1.13 UNFORSEEN HAZARDS

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

1.14 HEALTH AND SAFETY CO-ORDINATOR

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

.1 Have site-related working experience specific to activities associated with renovation and replacement of electrical distribution in existing buildings with the potential to have hazardous materials.

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

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

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

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

1.15 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant or Owner.

1.16 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Consultant or Owner.

.2 Provide Consultant or Owner with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Consultant or Owner may stop Work if non-compliance of health and safety regulations is not corrected.

1.17 BLASTING

.1 Blasting or other use of explosives is not permitted

1.18 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Consultant or Owner.

1.19 WORK STOPPAGE

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

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

1.1 INSPECTION

.1 Allow Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

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

.1 Provide a minimum of two (2) business days' notice to Consultant and Project Manager.

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

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Consultant for purpose of inspecting and/or testing the High Voltage grounding grid. Cost of such services will be borne by the Owner.

.1 Refer to Division 26 for specific testing agency requirements to be coordinated by Electrical Subcontractor.

.2 Provide equipment required for executing inspection and testing by appointed agencies. Attend site and provide all support required by testing agencies.

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

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Consultant. Pay costs for retesting and re-inspection.

1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

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

1.4 PROCEDURES

.1 Notify appropriate agency Consultant in advance of requirement for tests, in order that attendance arrangements can be made.

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

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

1.5 REJECTED WORK

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

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

.3 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Consultant.

1.6 REPORTS

.1 Submit inspection and test reports in digital PDF format to Consultant.

.2 Provide copies to subcontractor of work being inspected or tested.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

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

1.8 MOCK-UPS

.1 Not Required.

1.9 MILL TESTS

.1 Submit mill test certificates as required of specification Sections.

1.10 EQUIPMENT AND SYSTEMS

.1 Refer to Divisions 26 and 27 for electrical system requirements.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 Within text of each specifications section, reference may be made to reference standards.

.1 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.2 If there is question as to whether products or systems are in conformance with applicable standards, Consultant reserves right to have such products or systems tested to prove or disprove conformance. Cost for such testing will be borne by Contractor in event of non-conformance.

1.2 QUALITY

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

.2 All products, materials, equipment, and articles incorporated in Work shall bear CSA, cUL, or equivalent approval. Notify Consultant if specified products are not available with certification for use in Canada.

.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections or field reviews. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

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

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Consultant 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 Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

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

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

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

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

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

.6 Store sheet materials, 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 Consultant.

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

1.5 TRANSPORTATION

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

.2 Transportation cost of products supplied by Owner will be paid for Contractor. Unload, handle and store such products.

1.6 MANUFACTURER'S INSTRUCTIONS

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

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

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

1.7 QUALITY OF WORK

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

.2 Before installation, notify Consultant of any installation conflicts between trades. Install as directed by Consultant.

.3 Do not employ anyone unskilled in their required duties. Consultant and Project Manager reserve right to require dismissal from site, workers deemed incompetent or careless.

.4 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

1.8 CO-ORDINATION

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

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

1.9 CONCEALMENT

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

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

1.10 REMEDIAL WORK

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

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

1.11 LOCATION OF FIXTURES

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

.2 Inform Consultant of conflicting installation. Install as directed.

1.12 FASTENINGS

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

.2 Prevent electrolytic action between dissimilar metals and materials.

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

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

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

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

1.13 FASTENINGS - EQUIPMENT

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

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

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

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

1.14 PROTECTION OF WORK IN PROGRESS

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

1.15 EXISTING UTILITIES

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

.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.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Not Used.

1.3 REFERENCES

.1 Owner Contract

1.4 SURVEY REQUIREMENTS

.1 Not Required.

1.5 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work and notify Consultant of findings.

.2 Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by Consultant.

.3 No documentation is available showing location of existing underground services. Buried services on the site include but are not limited to water, sewer, high voltage (25kV) distribution, low voltage (600 and 208V) distribution, and communications systems.

.4 Perform Ground Penetrating Radar scans of all areas to be excavated and/or where equipment is to be installed outdoors prior to commencing Work.

.1 Export results of drawings into CAD format and provide drawing to Consultant.

.2 Use survey paint to mark location of all services in areas to be excavated.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 No accurate surveyed plan is available for the site. Location of all buildings, outdoor equipment, and proposed locations of new equipment are to be considered as approximate. Contractor shall verify exact locations on site.

.3 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.4 Inform Consultant of impending installation and obtain approval for actual location.

.5 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

1.7 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

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

1.8 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit name and address of Contractor performing Ground Penetrating Radar scans to Consultant.

.2 On request of Consultant, submit documentation to verify accuracy of field engineering work.

1.9 SUBSURFACE CONDITIONS

.1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 PROJECT CLEANLINESS

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

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant or Project Manager. Do not burn waste materials on site.

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

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

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

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

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

.8 Debris and waste will be managed and disposed of in a proper manner as approved by the owner. Permits for waste handling and disposal will be obtained by the contractor.

1.3 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.1 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.2 Prior to final review remove surplus products, tools, construction machinery and equipment.

.3 Remove waste products and debris other than that caused by Owner or other Contractors.

.4 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site.

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

.6 Remove stains, spots, dust, marks and dirt from electrical equipment, walls, and floors.

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

.8 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling as required by the waste management service and in accordance with project documents

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Not Used.

1.3 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Consultant to review and discuss Waste Management Plan and Goals.

.2 Waste Management Goal is to divert all materials considered recyclable from landfill sites.

.3 Accomplish maximum control of solid construction waste.

.4 Preserve environment and prevent pollution and environment damage.

1.4 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation waste.

.2 Inert Fill: inert waste - exclusively asphalt and concrete.

.3 Recycled: ability of product or material to be recovered at end of its life cycle and reused.

1.5 DISPOSAL OF WASTES

.1 Debris and waste will be managed and disposed of in a proper manner as approved by the owner. Permits for waste handling and disposal will be obtained by the contractor.

.2 Do not bury rubbish or waste materials.

.3 Burning of any materials on site is prohibited.

.4 Do not dispose of waste, volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers.

.5 Keep records of construction waste including:

.1 Number and size of bins.

.2 Waste type of each bin.

.3 Reused or recycled waste destination.

.6 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.7 Dispose of Hazardous wastes at an approved facility only. Provide proof of proper disposal to Consultant.

1.6 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Provide temporary security measures approved by Consultant.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 APPLICATION

.1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean up work area as work progresses.

.3 Source separate materials to be reused/recycled in specific sort areas.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Not Used.

1.3 REFERENCES

.1 Not Used

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Acceptance of Work Procedures:

- .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
  - .1 Notify Consultant in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
  - .2 Submit closeout documentation required for occupancy including closeout of all electrical permits and final testing acceptance of all life safety systems.
  - .3 Request Consultant's inspection.
- .2 Consultant's Occupancy Field Review:
  - .1 Consultant and Contractor to inspect Work and identify defects and deficiencies.
  - .2 Contractor to correct Work as directed.
- .3 Declaration of Substantial Performance: when Consultant considers occupancy deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- .4 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .5 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
  - .1 Work: completed and inspected for compliance with Contract Documents.
  - .2 Defects: corrected and deficiencies completed.
  - .3 Equipment and systems: tested, adjusted, balanced, and fully operational.
  - .4 Certificates required by Utility companies: submitted.
  - .5 Operation of systems: demonstrated to Owner's personnel.
  - .6 Work: complete and ready for final inspection.
- .6 Final Inspection:
  - .1 When completion tasks are done, request final inspection of Work by Consultant, and Contractor.

.2 When Work incomplete according to Consultant, complete outstanding items and request re-inspection.

.7 Final Payment:

.1 When Consultant considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.

.2 When Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.

.8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.5 FINAL CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results

.2 Commissioning Oversight Operation & Maintenance Manual Review Checklist

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Two weeks prior to Substantial Performance of the Work, submit to the Project Manager, two final hard copies and one electronic copy of operating and maintenance manuals in English.

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

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

1.4 O&M MANUAL FORMAT

.1 Organize data as instructional manual.

.1 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

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

.1 Identify contents of each binder on spine.

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

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

.5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

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

.7 Drawings: provide with reinforced punched binder tab.

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

.8 Provide to scale CAD files in dwg format on CD.

1.5 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 Consultant 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.

.6 Training: refer to Section 01 79 00 - Demonstration and Training.

.7 Refer to attached Commissioning Oversight Operation & Maintenance Manual Review Checklist for additional requirements for O&M manual submission.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, at site for Project Manager and Consultant 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 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction in secure location.

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

.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 Consultant.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of drawings, and in copy of Project Manual, provided by Project Manager.

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

.2 Record information concurrently with construction progress.

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

.3 Contract Drawings and shop drawings: mark each item to record actual construction, including:

.1 Changes made by change orders.

.2 Details not on original Contract Drawings.

.3 References to related shop drawings and modifications.

.4 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.

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

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

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

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

.6 Include sequence of operation by controls manufacturer.

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

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

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

.10 Additional requirements: as specified in individual specification 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 Project Manager

.2 Include approved listings in Maintenance Manual.

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

.2 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 Project Manager.

.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.

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

.2 Store components subject to damage from weather, or temperature extremes in suitable weatherproof, heated or conditioned areas.

.3 Remove and replace damaged products at own expense and for review by Project Manager or Consultant.

1.11 WARRANTIES AND BONDS

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

.1 Warranty management plan to include required actions and documents to assure that Owner receives warranties to which it is entitled.

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

.3 Submit, warranty information made available during construction phase, to Project Manager for approval prior to each monthly pay estimate.

.4 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:

.1 Separate each warranty or bond with index tab sheets keyed to 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 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.

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

.6 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 electrical equipment.

.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 9 month post-construction warranty inspections.

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

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

.8 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the Owner to proceed with action against Contractor.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Commissioning

1.3 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.

1.4 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. 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.

1.5 COMMISSIONING OVERVIEW

.1 Section 01 91 31 - Commissioning (Cx) Plan.

.1 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.

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

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

.4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the facility 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.

.5 Project Manager will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Project Manager and Consultant.

.2 Equipment, components and systems have been commissioned.

.3 O M training has been completed.

1.6 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 Consultant, to ensure effective performance.

.1 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.

1.7 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Consultant:

.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 Consultant, Departmental Representative Project Manager.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

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

.4 Inform Project Manager and Consultant in writing of discrepancies and deficiencies on finished works.

1.8 CONFLICTS

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

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

1.9 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit no later than 2 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 Project Manager and Consultant for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Project Manager and Consultant 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 Consultant.

1.10 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.

.1 Project Manager and Consultant to review and approve Cx documentation.

.2 Provide completed and approved Cx documentation to Project Manager and Consultant.

1.11 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule

.1 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.

1.12 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.

1.13 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for review by Consultant.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Consultant

.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.

.3 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.

.4 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.

.1 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.

.2 Correct deficiencies and obtain approval from Owner’s representative Project Manager and Consultant after distinct phases have been completed and before commencing next phase.

.3 Document require tests on approved PV forms.

.4 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Project Manager. 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 Project Manager and Consultant.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Project Manager and Consultant.

.3 If evaluation report concludes that major damage has occurred, Project Manager or Consultant 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 Consultant and Project Manager for approval before commencement of commissioning.

.1 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 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.

.1 With assistance of manufacturer develop written maintenance program and submit to Project Manager for approval before implementation.

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

.3 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.

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

1.18 START OF COMMISSIONING

.1 Notify Project Manager 14 days prior to start of Cx.

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

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Project Manager and Consultant 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 actual operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

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

.3 Follow equipment manufacturer's operating instructions.

1.21 WITNESSING COMMISSIONING

.1 Consultant, Departmental Representative, or Project Manager may choose 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.

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

.2 Provide copies to Project Manager and Consultant within 5 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

.1 Building operations during normal hours are not to be disturbed, as such, it is necessary to complete Cx of new equipment outside normal operating hours using, if necessary, simulated loads.

1.24 REPEAT VERIFICATIONS

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

.1 Verification of reported results fail to receive Project Manager’s and Equipment Manufacturer’s approval.

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

.3 Project Manager or Consultant deems Contractor's request for second verification was premature.

1.25 SUNDRY CHECKS AND ADJUSTMENTS

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

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

1.26 DEFICIENCIES, FAULTS, DEFECTS

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

.1 Report problems, faults or defects affecting Cx to Project Manager and Consultant in writing. Stop Cx until problems are rectified. Proceed with written approval from Project Manager and Consultant.

1.27 COMPLETION OF COMMISSIONING

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

.1 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.2 Cx to be considered complete when contract Cx deliverables have been submitted reviewed and accepted by Project Manager and Consultant.

1.28 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.

1.29 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Must be within equipment manufacturer's requirements.

1.30 PERFORMANCE TESTING

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

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 5 01 - Commissioning

1.3 SUMMARY

.1 Section Includes:

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

1.4 REFERENCES

.1 Underwriters' Laboratories of Canada (ULC)

.2 Canadian Electrical Code CSA C22.1

1.5 GENERAL

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

.2 Acronyms:

.1 Cx - Commissioning.
.2 MSDS - Material Safety Data Sheets.
.3 WHMIS - Workplace Hazardous Materials Information System.

.3 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.

1.6 CX PLAN

.1 Cx Plan to be completed a minimum of 4 weeks prior to scheduled commissioning.

.2 Cx Plan shall 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.
.7 Manufacturer’s requirements and availability.

.3 Submit completed Cx Plan to Consultant and obtain written approval.

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

.1 Changes resulting from Client program modifications.
.2 Approved design and construction changes.

.5 Due to the phased nature of this project, multiple Cx plans may be submitted covering each commissioning and startup phase.

.6 Revise plan(s) as required to accommodate site conditions, schedule changes, and Consultant feedback.

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

1.7 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

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

.1 Contractor is responsible for:

.1 Organizing Cx.

.2 Ensuring implementation of final Cx Plan.

.3 Implementation of Training Plan.

.4 Testing.

.5 Performance of Cx activities.

.6 Delivery of training and Cx documentation.

.7 Assigning one person as point of contact with Consultant for administrative and coordination purposes.

.8 Preparation and submission of test reports.

.1 Obtain test reports from Manufacturer's Representatives for prepurchased equipment and incorporate into overall test reports for submission to Consultant.

1.8 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 Manufacturer's representative as required in other Specification Sections.

.3 Equipment manufacturer: equipment specified to be installed and started by manufacturer.

.1 To include performance verification.

.4 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.

.2 Ensure that Cx participant:

.1 Could complete work within scheduled time frame.

.2 Is 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 Redistribution of electrical services.

.3 Provide names of participants to Consultant and details of instruments and procedures to be followed for Cx 1 month prior to starting date of Cx for review and approval.

1.9 EXTENT OF CX

.1 Commission electrical systems and equipment:

.1 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.2 Power generation systems:

.1 Transfer switch and controllers.

.3 Control Systems:

.1 VFDs and control panels

.2 Coordinate with owner and assist in commissioning of owner-supplied control equipment.

1.10 DELIVERABLES RELATING TO THE CX PROCESS

.1 General:

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

.2 Definitions:

.1 Cx as used in this section includes:

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

.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

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

.2 Results of Performance Verification Tests and Inspections.

.3 Description of Cx activities and documentation.

.4 Training Plans.

.5 Cx Reports.

.6 Prescribed activities during warranty period.

.4 Consultant to witness and review tests and reports of results.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

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

.1 Pre-Start-Up reviews: conducted at the discretion of the Consultant, prior to permission to start up and rectification of deficiencies to Consultant’s satisfaction.

.2 Notify Consultant and Project manager a minimum of 14 days prior to each pre-startup inspection to allow the opportunity for Consultant and Project Manager to witness inspections.

.2 Pre-Cx activities - ELECTRICAL:

.1 Refer to Divisions 26 and 27

1.12 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 Electrical Equipment – Refer to Division 26.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Consultant to monitor Cx activities.

.2 Upon satisfactory completion, Contractor to prepare Cx report.

.3 Consultant to review the certified testing reported results of, Cx activities.

1.14 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Consultant for review and approval same time as project Construction Schedule. Include:

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

.1 Design criteria, design intents.

.2 Notification of intention to start Cx: 10 business days before start of Cx.

.3 Identification of deferred Cx.

.4 Implementation of training plans.

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

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

.2 After approval, incorporate Cx Schedule into Construction Schedule.

1.15 TESTS TO BE PERFORMED BY OWNER/USER

.1 Commissioning of control cabinet PLC and programming shall be by Owner. Contractor shall assist Owner in commissioning including providing a minimum of one journeyman electrician on site during all commissioning activities to assist in troubleshooting and correction of field wiring as required.

1.16 TRAINING PLANS

.1 Refer to Section 26 05 12 – Demonstration and Training

1.17 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of Consultant lock panels, breaker settings, etc. in their final positions and include any updates made in Cx Reports and O&M manual.

1.18 PAYMENTS FOR CX

.1 To be included in the tender bid.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SUMMARY OF WORK

.1 The scope of work for this project includes but is not limited to:

- .1 Provide new distribution throughout the facility as indicated on Drawings.
- .2 Provide new instrumentation and controls as indicated on Drawings. Instrumentation and controls shall be connected to Owner-supplied control panel.
- .3 Install owner-supplied and programmed control panel, and assist owner with testing and commissioning of complete system including owner supplied equipment.
- .4 Coordination and Arc Flash Study:
  - .1 A coordination and arc flash study will be completed by the Consultant. Contractor shall include provisions to provide all data required to complete this study including but not limited to conductor lengths, breaker frame and trip unit models, and equipment photos as required. This includes any existing distribution which does not require replacing under the scope of this project.
  - .2 Consultant shall provide arc flash labels to the Contractor. Contractor shall install labels on the equipment.

1.3 CODES AND REFERENCES

.1 Definitions:

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

.2 Any reference to Codes, Standards, and Regulations contained within the Contract Documents shall be taken as the latest or most current in effect at time of Tender.

.3 In no instance shall the standards established by the Contract Documents be reduced by any referenced Code or Regulation.

.4 Reference Standards:

- .1 CSA Group
  - .1 CSA C22.1, Canadian Electrical Code, Part 1 (Current Edition), Safety Standard for Electrical Installations.
  - .2 CAN/CSA-C22.3 No.1, Overhead Systems.
  - .3 CAN/CSA-C22.3 No.3, Underground Systems.
  - .4 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, Current Edition.

.5 Any references to other standards and specifications within the contract documents shall be understood to be references to the technical requirements of the referenced document only. Unless specifically noted otherwise, non-technical content of referenced documents shall not replace any of the front-end requirements stated in the contract documents. This includes but is but not limited to measurement and payment clauses, terms and conditions, and schedule of values.

.6 It is the contractor's responsibility to ensure they are familiar with the technical requirements of the referenced codes and standards. The contractor must include all required costs in the tender price.

1.4 DEFINITIONS

.1 The word 'Provide' means the supply, delivery, and installation of device or equipment referenced to the level required to be complete and operational.

.2 The word 'Supply' means to obtain and deliver to the project site, ready for unpacking, assembly, and installation.

.3 The word 'Install' means the unloading, unpacking, assembling, erecting, applying, finishing, protecting, cleaning and similar operations at the project site to complete items of work supplied by others.

.4 AHJ: Authority Having Jurisdiction

1.1 RESPONSIBILITY AND COORDINATION

.5 Provide all labour, materials, equipment, tools, and incidentals necessary to provide a complete electrical installation as indicated on the Drawings and as set out in these Specifications.

.6 Without relieving the Contractor of his responsibilities, the Specifications have been divided into approximate trade sections for convenience. These Sections do not, however, limit the responsibility of any subcontractor or supplier. The Consultant will not arbitrate on any dispute between the subcontractors' responsibilities. The onus of defining the extent of the subcontractors' work remains with the Contractor, who, when awarding subcontracts, will ensure that the area of responsibility of any particular subcontractor is set out in full detail.

.7 The Contractor shall advise the Consultant during the tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Consultant at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

.8 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Consultant prior to tender closing. Failing this, the most expensive alternative is to be allowed for.

.9 Advise the Consultant of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are

obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

.10 Advise the consultant during the tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated construction schedule. Failure of the contractor to perform the above shall cause the contractor to supply, at his own expense, alternate or temporary material or equipment as selected by the consultant at a later date. Alternatively, the contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of expediting.

.11 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all proposed and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced, and replaced if and when required. Advise the Consultant of space problems before fabricating or installing any material or equipment. Demonstrate to the Consultant on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Consultant's written direction.

.12 Where electrical work and materials are noted as being provided by the Owner or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

.13 Ensure that any building structure loaded during the installation is adequate to carry such load.

.14 Testing in accordance with Section 26 05 10 Testing and Commissioning.

.15 A contractor is entitled to engage in the regulated work for which the contractor is licensed.

- .1 A licensed contractor must not:
  - .1 Manage or do regulated work that is:
    - .1 Outside the scope of the license,
    - .2 Contrary to any term or condition of the license, or
    - .3 Contrary to any term or condition imposed by the regulations on the use of the license, or
  - .2 Permit regulated work to be undertaken by persons under the control of the licensed contractor if they are not authorized.
- .2 A licensed contractor must:
  - .1 Maintain current knowledge of the Acts, relevant regulations, relevant directives, relevant safety orders and any other relevant material that the minister makes publicly available, and
  - .2 Ensure that individuals who do regulated work for the licensed contractor maintain similar current knowledge.

1.5 PERMITS, FEES, AND INSPECTIONS

.1 Before commencing work obtain and pay for all necessary approvals and permits. The Consultant shall provide printed drawings required by the AHJ to obtain such permits.

.2 Arrange for inspection of the work at rough-in completion, prior to Substantial Completion, and as otherwise required by all applicable Authorities Having Jurisdiction.

.1 Notify Consultant of any changes required by the Authorities Having Jurisdiction prior to proceeding with changes.

.3 Provide Consultant with a certificate of unconditional approval for all electrical work from the appropriate Authorities Having Jurisdiction. The electrical work shall not be considered substantially complete prior to submission of the inspection certificate.

1.6 EVALUATION OF CONTRACT CHANGES

.1 Notwithstanding other provisions of the Contract, this Contractor shall supply detailed information for the valuation of all changes to the Contract. Such information shall include, but not necessarily be limited to, the following:

.1 Labour hours per unit of material or equipment to be added, deleted, or altered.

.2 Units of material or equipment to be added or deleted.

.3 Cost to the Contractor per unit of material, equipment and labour broken down by category of labour and type of material or equipment.

.4 Extensions of the above to arrive at total costs.

.5 Other miscellaneous and identifiable charges such as delivery, restocking, overhead, profit, etc.

.6 Include in the valuation of any change to the Contract the cost, if any, of recording such change on the record drawings as previously specified.

1.7 MEASUREMENT AND PAYMENT

.1 Notwithstanding any other provisions of this Contract, supply the following general information and any additional information as may be requested by the Consultant as part of each Monthly Progress Claim.

.1 Indicate the labour cost and the material cost separately for each Item of Work within Divisions 26, 27, and 28.

.2 Progress claims will be certified as per contract requirements.

.3 Format for Monthly Progress Draws shall be approved by the Consultant prior to the first submission.

.4 For each Monthly Progress Draw, each change order shall be listed separately.

.5 Indicate both the Change Order number and title on the progress draw.

1.8 REVIEW OF WORK

.1 The Consultant will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.

.1 The Contractor shall notify the Consultant a minimum of 48 hours prior to completion of rough-in to allow review prior to Work being concealed.

1.9 CONSTRUCTION PROGRESS MEETINGS

.1 The electrical trade shall allow in their tender price to be present at all construction site progress and coordination meetings during construction.

1.10 SCHEDULING OF WORK

.1 Work shall be scheduled as required to coordinate with other Divisions and Owner's work restrictions.

1.11 GUARANTEE

.1 Furnish a written guarantee to the Owner prior to final contract payment, which will be in effect for one year from the date of final acceptance of the complete work. Replace or repair at no cost to the Owner any defective material or workmanship except where, in the opinion of the Prime Consultant, such defects are due to the misuse or neglect by the Owner.

.2 This general guarantee shall not act as a waiver of any specified of special equipment guarantees which cover a greater length of time.

1.12 FIRE RATING OF PENETRATIONS

.1 Maintain fire ratings around conduits passing through floors, ceilings and fire rated walls.

.2 Use fire stop products, approved by the Consultant, at each penetration.

.3 Material of the same manufacturer is to be used throughout the entire project as part of a fully rated fire stop system.

.4 Acceptable manufacturers: Hilti, 3M or approved equal.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 General Submittal Requirements

.1 All submissions shall be provided in electronic PDF format.

.2 Allow a minimum of five (5) working days for consultant to review each submittal.

.3 Accompany submissions with transmittal letter containing the information listed below. Any submissions submitted without this information will not be reviewed and will be returned to the contractor for resubmission:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each drawing, product data and sample.

.5 Other pertinent data.

.2 Proposed Alternates

.1 For any alternates proposed to standard of acceptance shown in drawings, submit manufacturer's printed product literature and data sheets for products proposed. Include a list of items where the proposed alternative is not equivalent to the standard of acceptance system.

.2 All proposed alternates must be submitted for consultant review in writing minimum 1 week prior to tender addendum cutoff date. No proposed alternates will be entertained after close of tender.

.3 For any proposed alternates, provide complete product data as required for consultant to make a review as to suitability of item as a replacement.

.3 Project Planning

.1 Submit the following documents to the Consultant a maximum of 14 days after Contract award:

.1 Project schedule in Gantt chart format.

.2 Schedule of Values for payment certification.

.3 Schedule of shop drawings to be submitted.

.4 WCB Letter of Proof of Insurance.

.5 Certificate of Insurance for CGL with the Owner listed as a Certificate Holder.

.2 Project Schedule shall include anticipated date for submittal of shop drawings as required to meet project construction schedule.

.4 Shop Drawings

.1 Where specifically noted in other Sections in Divisions 26, 27, and 28, submit drawings stamped and signed by professional Consultant registered or licensed in Province of BC, Canada.

.2 Review of shop drawings by the Consultant is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.

.3 Shop Drawings shall be provided for but not limited to the following systems:

.1 Firestopping systems for all firestopping required to be installed under Divisions 26, 27, and 28.

.2 Distribution equipment including but not limited to switchgear, switchboards, panelboards, standalone breakers, disconnects, fuses, transformers, and motor control centres.

.3 Any circuit breakers to be installed in existing panels.

.4 Lighting equipment including but not limited to luminaires, drivers, and lighting controls.

.5 Fire alarm equipment including but not limited to control panels, annunciators, communication equipment, initiation devices, notification devices, ancillary devices, and cable.

.6 Telecommunication equipment including but not limited to racks, UPS, PDUs, patch panels, patch cords, switches, wall outlets, ports, and cable.

.7 Wiring devices including but not limited to receptacles and switches.

.8 Large raceway infrastructure including but not limited to cable tray and fittings, bus duct, wire duct, and sleeves.

.9 Digital metering including but not limited to meter unit, CTs, PTs, shorting blocks.

.10 Security systems including but not limited to system controllers, card access devices, intrusion alarm devices, video surveillance devices, management software.

.11 Generator

.12 For any power distribution equipment provided, submit power studies as outlined in section 260573 Short Circuit/Protective Equipment Evaluation, sealed and signed by a Professional Engineer.

.4 Refer to other Sections within Divisions 26, 27, and 28 for detailed shop drawing submission requirements.

.5 Provide shop drawings in sufficient time to avoid any delivery delays to the project, allowing minimum 1 week for consultant review. No extras or substitutions will be allowed to expedite delivery of materials unless alternates are approved prior to close of tender. In the case that product or material delivery will cause a delay to the project, the contractor shall be responsible for all associated delay costs to the contract as well as arrange and pay for the following:

.1 Supply of temporary products suitable to the space prior to substantial completion and project handover. Proposed temporary products shall be reviewed and approved by the consultant for suitability to the space.

.2 Changing out the temporary products to the specified products once they arrive. This work shall be scheduled so as to cause no interruption to the occupant schedule, allowing for weekend or night work as required.

.6 Contractor shall review all shop drawings prior to submittal. All shop drawings shall be stamped and signed by both the Electrical Contractor and General Contractor. Unstamped drawings will be returned without comment.

.7 Each shop drawing shall clearly indicate the equipment ID and equipment type (e.g. Luminaire Type ‘A’, Panelboard SD-A) where applicable.

.8 Where manufactures’ brochures that include multiple equipment or device models are submitted, they shall be clearly labelled with the equipment model and options to be supplied at each location. Submit relevant sections of manufacturer’s catalogues only. Submissions of complete catalogues will be rejected.

.9 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.

.10 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.11 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.12 Submit complete shop drawing packages for each system. Partial submissions will be returned without comment.

.13 Ensure that copies of all shop drawings are available at the job site.

.5 Testing and Commissioning Results

.1 Submit certificates and test results of installed electrical systems and instrumentation as noted in separate system sections.

.2 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance as described in PART 3 - FIELD QUALITY CONTROL.

.6 Substantial Completion Submittals - In addition to submittals noted in other specification sections, copies of the following documentation will be required to be submitted to the consultant and accepted before the project can be considered fit for occupancy and substantially complete:

.1 Electrical Permit inspection / close-out documentation.

.2 Fire alarm verification report.

.3 Seismic Engineer Schedules

.4 Insulation resistance (megger) testing report

.5 Telecom cabling test report

.6 Lighting controls commissioning report

.7 Backup power equipment (generator, ATS, UPS, battery pack, etc.) commissioning reports

.8 Proposed layout and sections of Operations and Maintenance Manual

.7 Project Completion Submittals- Copies of the following documentation will be required to be submitted to the consultant and accepted before the project can be considered contractually complete and ready for final invoicing:

.1 Final As-Built Drawings

.1 Submit record drawings including all as-built information and changes on completion of project.

.1 Each record drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these Drawings represent the building as built."

.2 Provide a copy of record drawings to Consultant for review at Substantial Completion.

.2 Submit for review single line electrical diagrams to be laminated and located:

.3 In the main electrical room.

.2 Operation and Maintenance Manuals as per Section 26 05 11 Electrical Operations and Maintenance Data. Allow for minimum 2 weeks consultant review of Operations and Maintenance Manuals

1.14 SPARE PARTS AND MAINTENANCE MATERIALS

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

1.15 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, at site for Project Manager and Consultant 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 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction in secure location.

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

.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 Consultant.

.6 Obtain and pay for three sets of white prints. As the project progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each project meeting.

.7 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.

.8 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.

.9 Maintain in the job site office in up-to-date condition, one (1) complete set of whiteprints of each of the Electrical Contract Drawings and one (1) set of Specifications, including Revision Drawings, marked clearly and indelibly in red, indicating as-built conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.

.10 Record Drawing markings shall include but shall not be limited to the following

.1 All changes in circuiting

.2 Size and routing of all installed feeder raceways and cables.

.3 Number and size of conductors in feeder raceways and cables.

.4 Location of all junction boxes and pull boxes

.5 Location of all access panels

.6 Location of all conduit or duct stubs, installed equipment, devices and fixtures

.7 All changes to electrical installation resulting from Addenda,

.8 Change Orders and Site Instructions

.9 Exact location of all services left for future work

.10 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways

.11 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.2 Recording Information on Project Record Documents.

.12 Record information on set of drawings, and in copy of Project Manual, provided by Project Manager.

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

.14 Record information concurrently with construction progress.

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

.15 Contract Drawings and shop drawings: mark each item to record actual construction, including:

.1 Changes made by change orders.

.2 Details not on original Contract Drawings.

.3 References to related shop drawings and modifications.

.16 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.

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

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

1.16 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.1 Except for equipment intended for installation outdoors, store equipment indoors in dry location.

.2 Store and protect equipment and materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.3 Packaging Waste Management: remove and dispose of all packaging waste materials.

.1 Where possible, return packaging materials to supplier for re-use.

.2 Divert all recyclable materials from landfill.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels in English.

2.2 MATERIALS AND EQUIPMENT

.1 Equipment and material shall be new and certified by a certification body accredited by the Standards Council of Canada (SCC). Where there is no alternative to supplying equipment which is not certified, obtain special approval and pay all associated fees. Notify Consultant prior to supplying material that is not SCC approved.

.2 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Section [26 29 03 - Control Devices] except for conduit, wiring and connections below 50 V which are related to control systems [specified in mechanical sections] [as shown on mechanical drawings].

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of the authority having jurisdiction, code requirements, and as specifically noted in the Contract Documents.

.2 Engraved signs using rigid phenolic engraving material, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

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

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates: rigid phenolic engraving material 3 mm, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.

.2 Nameplate colours as follows:

.1 Normal Power Systems: black face, white core

.2 Emergency/Standby Power Systems: red face, white core

.3 Life Safety Systems: red face, white core

.4 Colours for other equipment as specified by the Consultant.

.3 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
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

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates to be approved by Consultant prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

2.7 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 phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 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.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by application of powder coat rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green".

.2 Paint indoor switchgear and distribution enclosures light gray.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Pre-Bid Examination

.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting bid.

.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

.3 Report to the Prime Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

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

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant 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 Consultant.

3.2 INSTALLATION

.1 In accordance with CSA C22.1 except where specified otherwise.

.2 Overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

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

3.4 CONDUIT AND CABLE INSTALLATION

.1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 IDENTIFICATION OF CODE REQUIRED EQUIPMENT CLEARANCE

.1 Provide paint outline and hatching of area in front of electrical equipment in service areas denoting working area to remain clear as per Section 2-308 and 2-310 of the Canadian Electrical Code. Paint to be suitable for floor material, coloured safety yellow (RAL 1023). All outline and hatching lines shall be minimum 100mm wide.

3.6 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.7 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1150 mm.

.2 Wall receptacles:

.1 General: 300 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: 1150 mm.

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and interphone outlets: 300 mm.

.5 Wall mounted telephone and interphone outlets: 1150 mm.

.6 Fire alarm stations: 1150 mm.

.7 Fire alarm bells: 2100 mm.

.8 Television outlets: 300 mm.

.9 Wall mounted speakers: 2100 mm.

.10 Clocks: 2100 mm.

.11 Doorbell pushbuttons: 1150 mm.

3.8 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.9 FIELD QUALITY CONTROL

.1 Refer to Section 26 05 10 Testing & Commissioning

3.10 SUBSTANTIAL PERFORMANCE REVIEW

.1 Prior to requesting the Consultant complete a Substantial Performance review, the Contractor shall submit written confirmation that:

.1 All applicable Substantial Completion submittals have been provided.

.2 All wiring devices, cover plates, motor controls, light fixtures and other equipment are operational, plumb, clean, and correctly labelled.

.3 All electrical equipment has been cleaned and vacuumed

.4 All Test Reports have been submitted including but not limited to data test reports and fire alarm verification reports with no exceptions noted.

.5 All firestoppingt/smoke sealing of conduits, cables, cable trays, wireways, etc. at all wall and floor penetrations has been completed.

.6 Verification letter from the Seismic Consultant.

.7 Draft copy of the Maintenance Manual.

3.11 FINAL COMPLETION REVIEW

.1 Prior to requesting the Consultant complete a final contract completion review, the Contractor shall submit written confirmation that:

.1 All applicable final completion submittals have been provided.

.2 All deficiencies noted from the Substantial Performance review have been addressed.

.3 Factory finished equipment has been cleaned, touched up, or refinished as necessary to present a new appearance.

.4 All light fixtures, fixture lenses, and reflectors have been cleaned.

.5 All loose equipment including spare parts have been turned over to the Owner.

3.12 SYSTEM STARTUP

.1 Arrange and pay for services of manufacturer's factory service Consultant to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel including but not limited to VFDs and automatic transfer switch.

.2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.13 CLEANING

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Where work is performed in a phased manner, or Owner will take partial occupancy of the area of Work, perform final cleaning at the end of each Phase or prior to Owner taking occupancy of each area.

.4 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical, 01 33 00 Submittal Procedures, and 01 78 00 Closeout Submittals.

.2 **Shop Drawing** submittals are required to be submitted prior to ordering of materials for this section. These shop drawings shall include the following:

.1 Shop drawings of all seismic restraint systems not covered by the ECABC Seismic Restraint Manual including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.

.2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

.3 **Permit Close-out** submittals are required to be submitted prior to ordering of materials for this section. These submittals shall include the following:

.1 Seismic Engineer Letters of Assurance Schedule S covering seismic anchorage of entire project electrical scope.

.4 **Project Close-out** submittals are required to be submitted for this section prior to project close-out and final invoicing. These submittals shall include the following:

.1 Final reviewed shop drawings incorporated into the O&M Manual.

1.4 REGULATORY REQUIREMENTS

.1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.

.2 The Seismic Consulting Engineer shall able to provide proof of professional insurance and the related practice credentials if requested by the Electrical Consultant. The Seismic Consulting Engineer shall be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC requirements.

.3 The Contractor's Seismic Consultant shall submit original signed BC Building Code Letters of Assurance Schedules S-B and S-C to the Prime Consultant.

.4 Use the Electrical Contractors Association of BC (ECABC) details in the absence of any local requirements with the following inputs:

.1 Zone: Select the project location from the table in the ECABC Seismic Restraint Manual.

.2 Importance Factor: 1.0

.3 Site class to be confirmed with Seismic Engineer. If no site class information is available, assume site class E (worst case).

.5 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.5 SCOPE

.1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

.2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01 and other Division 26 specification sections.

.3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

.4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

.5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender. The contractor shall include for all costs related to seismic restraint.

.6 In the case where standard equipment mounting or standard additional bracing is sufficient as per the ECABC Seismic Restraint Manual, the Seismic Consultant shall review to ensure the Seismic Restraint Manual has been interpreted and applied correctly.

.7 Int the case where the equipment in question is not covered by the ECABC Seismic Restraint Manual, the Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.

.8 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

.9 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

.10 Include all costs associated with the Seismic installation and certification in the base tender.

PART 2 PRODUCTS

2.1 SLACK CABLE SYSTEMS

.1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.

.2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.

.3 Coordinate requirements of slack cables with suppliers prior to installation.

PART 3 EXECUTION

3.1 GENERAL

.1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

3.2 CONDUITS

.1 Provide restraint installation information and details on conduit and equipment as indicated below:

.2 Vertical Conduit:

.1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.

.2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.

.3 Riser joints shall be braced or stabilized between floors.

.3 Horizontal Conduits:

.1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing.

.4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.

.5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.

.6 Do not brace conduit runs against each other. Use separate support and restraint system.

.7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.

.8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

.9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

.1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Seismic Engineer shall design anchors and bolts.

3.4 LIGHT FIXTURES

.1 Luminaires installed in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two tight cables which are connected to the fixture at diagonal points.

.2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.

.3 Fixtures which are hung independently of ceiling systems shall have minimum of two seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.

.4 Cables shall be corrosion resistant and approved for the application.

.5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 EXISTING CONDITIONS

.1 Examine site prior to submitting Tender and be responsible for ascertaining all conditions which will affect this trade whether shown on the drawings or not and take all the necessary measurements.

.2 Investigate and confirm the locations, the method of connections and routes of existing and new electrical facilities. Report at once any discrepancy between drawings, specifications and existing conditions.

.3 Absorb any costs incurred by failure to carry out this investigation and examination.

1.3 CIRCUIT TRACING

.1 Contractor is required to confirm and create accurate typewritten branch circuit schedules for panelboards that are being modified or part of a shutdown. Contractor is to confirm circuits on site, update any changes, and submit to the consultant for update on Record Drawings. Label all receptacles and equipment with circuit number.

1.4 GENERAL REQUIREMENTS

.1 Provide and be responsible for the removal, relocation, reconnection, etc., of electrical devices, equipment, material, etc., as indicated on the drawings and/or as required by renovations to existing building and the installation of new facilities.

.2 All electrical devices and equipment which are disconnected, removed from service, etc., and which are not reused on the job and not required are to be offered to Owner. If refused, remove from site.

.3 Continuity of power and communication shall be maintained or restored promptly where services to other portions of a site are affected by renovation or demolition that is outlined on architectural, structural, mechanical or electrical plans or specifications.

1.5 SHUTDOWNS

.1 Outage plan to be provided by the contractor to the Owner and Consultant team for review and approval prior to interruption of any existing services. An pre-outage meeting with the Owner and Consultant is required to review the proposed plan. The general outline of the plan to be submitted as follows:

.1 Electrical Power Pre-Change Over Meeting.

.1 Meeting time.

.2 Personnel required, including specialty personnel (e.g.: utility, mechanical contractor, etc.).

.3 Pre-requisite Information: Distribution coordination studies and test results. Generator load test results.

.2 List all loads to be shut down.

.1 Distribution.

.2 Sub-distribution.

.3 Panels.

.4 Circuits.

.5 Generators.

.3 Portable generator requirement to supply equipment during service changeover.

.4 Schedule.

.1 Date and time of each activity.

.2 Length of each activity.

.5 Back out plan.

.6 Monitoring plan.

.7 List of personnel to be on site.

.1 Electrical contractor foreman and required personnel.

.2 Owner representatives and maintenance personnel

.8 Submit confirmation sheet on panelboards. Trace circuits per Section 1.3

PART 2 PRODUCTS

.1 Manufacturers of existing devices and equipment where known are indicated on the drawings or in the specifications.

.2 Material and equipment added shall match existing wherever possible unless otherwise noted.

PART 3 EXECUTION

3.1 GENERAL

.1 Visit site prior to submitting Tender and make survey of renovation areas. Check out locations and operation of all systems and be aware of all requirements involved in changes and modifications to systems. Consult maintenance staff for any information regarding type and operation of systems. Take into account and allow for all work required to existing facilities to meet requirements as indicated on the drawings and in the specifications.

.2 Provide all labour and equipment required to remove existing electrical facilities in the area to be renovated as noted.

.3 Disconnection, relocation, reconnection, etc. of existing facilities will be required to accommodate Owner's use of the facilities. Be aware of all requirements and make all allowances to accommodate these requirements.

.4 Provide all labour and materials required to revise existing electrical facilities as indicated on the drawings and/or as required by building renovations and for installation of new facilities.

.5 Existing facilities shall remain operational during construction period. When renovations are complete, all facilities shall be checked and tested and shall be left in a proper working order and to the satisfaction of Engineer and Owner.

.6 Where walls, ceilings, floors, etc., containing electrical devices, material and equipment, etc., are removed and the deletion of outlets in said areas disrupt service to adjacent devices and equipment, then conduit and wiring shall be provided to pick up adjacent devices and equipment to maintain continuity of service.

3.2 DISPOSAL OF HAZARDOUS MATERIAL

.1 Dispose of PCB Ballasts, radioactive material in smoke detectors, PCB capacitors, and PCB transformers in accordance with:

.1 Canadian Environmental Protection Act (Canada)

.2 Canadian Environmental Protection Act - Chlorobiphenyls Regulations (Canada)

.3 Provincial Environmental Protection Act

.4 Transportation of Dangerous Goods Act, (Canada)

.5 Dangerous Goods Transportation and Handling Act

.6 Other legislation and regulations which apply to the performance of the work of this section.

.2 Perform work in accordance with the recommendations in the following Environment Canada publications:

.1 Handbook on PCBs in Electrical Equipment by Environment Canada.

.2 Identification of Fluorescent Lamp Ballasts Containing PCBs, EPS 2/CG/2, April 1986, by Environment Canada.

.3 Persons employed for the removal of capacitors and other energized electrical equipment shall be qualified electricians.

.4 Where contact with liquid PCB is possible, personnel shall be instructed in handling procedures, safety precautions, use of safety equipment and applicable Provincial and Federal legislation and regulation.

.5 Handling and transportation of hazardous wastes shall be performed by a company registered as a carrier with the Provincial Environment department.

.6 Submit proof that all persons involved in handling, packing, loading, transportation, unloading, unpacking and disposal of PCB waste are trained in accordance with the Dangerous Goods Transportation and Handling Act.

.7 Dispose of all radioactive smoke detector components as radioactive waste when, smoke detectors:

.1 contain 5 microcuries (185 kilobecquerels) or more of Americium-241 or any amount of Radium.

.2 containing less than 5 microcuries (185 kilobecquerels) of Americium-241 are disposed of in quantities of ten or more.

.8 Dispose of radioactive smoke detector components by making disposal arrangement with one of the following radioactive waste disposal facilities:

.1 Original equipment manufacturer.

.2 Waste Operations Branch
Atomic Energy of Canada Ltd.
Chalk River, Ontario K0J 1J0

.3 Atomic Energy of Canada licensed waste disposal facility.

.9 Contact selected radioactive waste disposal facility to obtain their instructions for packaging, labeling and shipping of radioactive smoke detector components.

.10 Package, label and ship radioactive smoke detector components in accordance with waste disposal facility's instructions and in accordance with Provincial and Federal legislation and regulations governing the handling, transportation and disposal of radioactive materials.

3.3 LAMP DISPOSAL

.1 Contractor to recycle lamps (glass, phosphor, and metal). Provide receipt in maintenance manual for lamp recycling.

3.4 EXISTING SYSTEM SHUTDOWNS

.1 Shutdowns for tie into existing systems may be required after normal working hour to maintain facility operation.

.2 All costs related to non-coordinated nuisance alarms or the fire alarm system caused by this contractor will be borne by this contractor (i.e. false charges by Fire Department).

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

1.3 SCOPE

.1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day and during the evenings, seven days a week, year round. Maintain electrical and communication systems as required to minimize service disruptions. All service disruptions must be pre-approved by the Owner.

.2 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.

.3 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Consultant who will provide instruction.

.4 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

1.4 EXAMINATION

.1 Refer to Prime Consultant divisions.

PART 2 PRODUCTS

2.1 STANDARDS

.1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

PART 3 EXECUTION

3.1 DEMOLITION

.1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.

.2 All redundant electrical components in the areas of demolition excluding those specifically identified, shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

.1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before startup.

.2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

.1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location. All lighting switches and all receptacles shall be new.

3.4 DISRUPTION OF CIRCUITS

.1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Consultant. Specific tasks involving the demolition of essential circuits will require that the contractor obtain permission from the Owner before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

.1 Except as specifically noted, all abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.

.2 Remove all accessible (eg. Surface) wiring and cables back to source.

.3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.

.4 All remaining circuits to be rerouted as required and suitably secured to the building structure to CEC Standards.

.5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SUMMARY

.1 Test and check all portions of the electrical systems for satisfactory operation. All tests shall be tabulated, signed and incorporated into the Operating and Maintenance Manuals. All testing and commissioning to be carried out under this contract. Procedures and tests outlined below are electrical tests required in addition to normal visual and mechanical inspections which must be carried out prior to placing equipment in service.

.2 Prior to field testing, obtain applicable copies of factory tests for comparative results.

.3 Additional testing requirements may be outlined in specific Sections in Division 26, 27, and 28.

PART 2 PRODUCTS

.1 Not used.

PART 3 EXECUTION

.1 General

- .1 Contractor shall coordinate and pay for all testing required by the Contract Documents including any additional testing required by the Authority Having Jurisdiction.
- .2 All deficient equipment/devices shall be replaced and retested.
- .3 Testing for each System shall be performed after the System installation is complete and prior to the system being put into continuous operation.
- .4 Advise the Consultant a minimum of three (3) working days in advance of each test and carry out tests in the presence of the Consultant if required by the consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit detailed typewritten test reports to the Consultant within five (5) working days after the completion of each test. Include all test reports in the Maintenance Manuals.
  - .1 Test reports shall clearly indicate each component that has been individually tested, test results, and whether the results are within acceptable limits.
  - .2 Each test report shall be accompanied by a cover sheet outlining the test and summarizing any items that have failed the tests.
    - .1 Cover sheet shall include names, signatures, and contact information of the individuals who conducted the tests.
- .7 Protective Device Setting and Testing
  - .1 All work shall conform to NETA standards.
  - .2 Ensure circuit protective devices including but not limited to overcurrent trips, relays, and fuses are installed to required values per protection and coordination study.

.2 Contractor Testing:

.1 Infra-Red Scanning:

.1 Perform infrared scan of all distribution equipment under loaded conditions (new and existing).

.2 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report, 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.

.3 Systems: well pump control systems.

.1 Contractor shall assist owner in commissioning of control systems including owner-supplied control panel.

.4 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.

.5 Breakers and Load Break Switches

.1 clean and lubricate;

.2 visual inspection;

.3 manual function test;

.4 torque test;

.5 contact resistant test (100 amp resistance tester);

.6 electrical function test;

.7 function trip test of all protective relay device.

.6 Breakers - Molded Case Breakers 150 Amp Frame and Larger:

.1 Visually inspect.

.2 Ductor test.

.3 Megger test.

.4 Mechanical function test.

.5 Set all units with adjustable magnetic trip units.

.6 Where solid state protection is provided with large breakers, test units as follows:

.1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.

.2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction.

.3 If manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.

.4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.

.5 Check C/T and P/T ratios and compare to coordination data.

.7 Fused or Unfused Disconnect Switches:

.1 Visually inspect and clean.

.2 Ductor test across switch blade contact surfaces.

.3 Megger test.

.4 Mechanical function test.

.8 Transformers

.1 Visual inspection of enclosure and all accessories.

.2 Torque test all bus connections and cable terminations and seal with red lacquer.

.3 Megger test.

.4 Dielectric power factor test.

.5 Core ground test.

.6 Ratio test in all tap positions.

.7 Test operation of temperature and operation of all associated alarm contacts.

.8 Test and calibrate ground fault relays and function test to trip associated breakers.

.9 Make voltage and power factor checks throughout building. If directed by the Consultant, adjust transformer tap settings. Readings taken at this time to be logged, tabulated and any adjustments made to be suitably logged and incorporated in the Operating and Maintenance Manuals.

.9 Transfer Switch - Low Voltage

.1 Torque test all bus joints and cable terminations and seal with red lacquer.

.2 Ductor test.

.3 Megger test.

.4 Power up control circuits, simulate loss of normal power and function all devices including timers.

.5 Apply device settings as specified.

.6 Wiring Checks as listed:

.1 Check all control, relaying and instrumentation wiring against vendor wiring schematics, three line diagrams and project specifications.

.2 Test each circuit for continuity using a buzzer or similar device.

.3 All current circuits shall be injected, all voltage circuits shall be powered at 120 Volts, all devices functioned and checked against control schematic diagram.

.4 Check polarity and verify phase relationships on all three phase metering circuits.

.5 Where errors are discovered and changes are required, mark up and note required corrective action on vendor prints.

.10 Coordination Study

.1 Implement and tag all breakers and relays with Coordination Study settings.

.2 Submit documentation of this work.

.11 Motor Control Centre

.1 Megger Test all motor feeders

.2 Check polarity and verify phase relationships on main feeder and all equipment feeders. Bump Test all existing motors fed from the new MCC.

.3 Power up control circuits. Verify operation of all control circuits re-terminated at new MCC.

.4 Test operation of each piece of equipment in ‘Hand’

.5 Test operation of each piece of equipment in 'Auto'

.6 Where required, verify shutdown of equipment on fire alarm.

.12 Devices

.1 Test all receptacles for proper polarity, circuitry and grounding.

.13 Instrumentation

.1 All instrumentation and control wiring up to the termination point at the Owner-supplied control panel is the responsibility of the contractor.

.2 Provide commissioning checksheet for testing and commissioning of all instrumentation devices and hard-wired PLC I/O points.

.3 All field devices and instrumentation shall be tested prior to connection to PLC control panel.

.1 Verify signal levels and wiring connections to instrumentation and control equipment.

.2 Each instrument loop to be tested as an integrated system. Check operation from field elements through to wiring entering into control panel.

.4 HMI, VFD, and PLC Programming by the Owner. Contractor shall assist Owner in PLC startup and testing.

.1 Programming of any other device, instrument, controller or system, and supplied and installed by the Contractor is the responsibility of the Contractor.

.2 Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during testing.

.3 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 to Consultant for review. Include field reports in Operations and Maintenance Manuals.

.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 Obtain manufacturer's field services for commissioning of equipment as required in other Sections of Division 26, 27, and 28 specifications.

.4 Testing by Independent Testing Agency

.1 Contractor shall arrange and pay for system testing to be performed by an independent testing agency.

.2 All required testing shall be completed and any deficiencies corrected prior to energizing equipment.

.3 Check resistance to ground before energizing any equipment.

.4 Contractor shall provide all necessary tools, material, and labour to prepare the equipment for testing, to assist the testing agency representatives during the tests, and to re-connect equipment on completion of testing.

.1 Include in Bid price all costs associated with the coordination of testing, provision of labour required to carry out testing, and required materials other than testing instruments.

.5 Conduct additional testing as required in other Sections in Division 26, 27, and 28.

3.2 STANDARDS

.1 The following tests shall be conducted in accordance with latest CSA, ASTM, IEEE and IPCEA standards, recommendations for power cable and equipment testing and authority waving jurisdiction. Notwithstanding, the test levels listed in these standards, in no case shall the maximum DC test level exceed manufacturer's factory test AC level for that equipment.

.2 Equipment shall be tested to a maximum test voltage level agreeable to equipment.

.3 Where production tests are required by EEMAC or CSA for manufactured equipment, provide records of these tests.

.4 All tests shall be completed in accordance with manufacturer's published instructions. If these instructions do not conform to the test requirements as specified herein inform the Engineer prior to proceeding with the test.

3.3 TEST APPARATUS AND INSPECTION REPORT

.1 The testing company to be responsible for furnishing all apparatus and labour required for the test operations.

.2 Inspection and test results to be recorded on a suitable form which shall be furnished by the testing company. The inspection and report forms shall be submitted to the Engineer. Each form to be signed by the test technician. Space to be provided for noting approved items and their disposition.

.3 Testing company to submit full commissioning reports and information for as-built drawings and acceptance documents signed by test technician.

.4 Upon completion of the project, the testing company to assemble complete sets of inspection/test results/reports to be placed in the operating and maintenance manuals.

3.4 SYSTEM ACCEPTANCES

.1 Prior to requesting inspection, submit, for review by the Consultant letters from the Manufacturers of equipment and systems indicating the their Technical Service Representative have inspected and tested the equipment and systems and are satisfied with the methods of installation, connections and operation.

.2 Acceptance letters shall be submitted for the following:

.1 Distribution and Power Panels.

.2 Transformers.

.3 Motor Control Centres.

.4 Variable Frequency Drives

.5 Instrumentation

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 RELATED REQUIREMENTS

.1 Electrical Systems Testing and Commissioning Section 26 05 10.

1.3 WORK INCLUDED

.1 Provide operation and maintenance data as specified herein for incorporation in operation and maintenance manuals. Before requesting final certificates, submit copies of the operation/maintenance manuals.

1.4 MANUALS

.1 Submit three (3) hard copy bound sets and one (1) digital set of the operations and mantinance manual on CD or USB memory stick.

.1 Submit one draft hard copy to the Consultant for review at Substantial Completion prior to final issue.

.2 O&M Manual Format

.1 Organize data as instructional manual.

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

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

.1 Identify contents of each binder on spine.

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

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

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

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

.8 Drawings: provide with reinforced punched binder tab.

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

.9 Provide to scale CAD files in dwg format on CD.

.3 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.4 Contents:

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

.1 Date of submission; names.

.2 Addresses, and telephone numbers of Consultant 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.

.6 Training: refer to Section 26 05 12 Electrical Equipment and Systems Demonstration and Training.

.5 The divider tabs shall be laminated Mylar plastic and coloured according to Section . Plastic tabs with typewritten card insertions will not be accepted. Index manuals as follows:

.1 Tab 1.0 Division 26, 27, and 28 System complete with title page.

.2 Tab 1.1 List of Division 26, 27, and 28 Drawings

.3 Tab 1.2 Description of Systems

.4 Tab 1.3 Equipment Suppliers and Parts

.5 Tab 2.0 (.1, .2, etc.) Shop Drawings.

.6 Divider tabs shall be mylar plastic and colour coded.

.6 Each manual shall contain:

.1 Table of contents. Arrange contents sequentially by systems under section numbers. Label tabs of dividers between each to match section numbers in table of contents. Table of contents to be reviewed and accepted by consultant prior to final assembly of manual.

.2 Name and contact information of all project Contractors including all Electrical subcontractors.

.3 Copies of all contractor and subcontractor statements of warranty.

.4 Name and contact information of all Electrical equipment suppliers.

.5 Systems Descriptions. A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.

.6 Descriptive and technical data.

.7 Maintenance and operating instructions for all electrical equipment and controls. (These operating instructions need not be manufacturer’s data but may be typewritten instructions in simple language to guide the Owner in the proper operation and maintenance of this installation.)

.8 Lubricating and servicing intervals recommended.

.9 A copy of all wiring diagrams complete with wire coding.

.10 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.

.11 Copy of test data.

.12 A motor list showing each motor number, name, horsepower, nameplate, current rating, heater size and type, and current being drawn.

.13 Include type and accuracy of instruments used.

.14 Set of final reviewed Shop Drawings.

.15 Provide manufacturer's installation instructions for all systems and components.

.16 provide manufacturer's operation instructions for all systems and components

.17 Provide manufacturer's maintenance instructions for all systems and components. Include the following:

- .1 Complete parts list for all serviceable components, including description and catalogue number.
- .2 List of spare parts supplied under the Contract and list of other spare parts recommended by manufacturers.

.18 Provide copies of all inspection certification reports from authorities having jurisdiction.

.19 Provide copies of reports documenting the results of all tests, including factory tests, required by the Contract Documents to be performed.

.20 Provide copies of all manufacturer's warranties.

.21 Record Drawings.

.22 Operating instructions to include following:

- .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- .3 Safety precautions.
- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .6 Recommended spare parts

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 INTENT

.1 Provide demonstration and instruction sessions to familiarize Owner's operation and maintenance personnel with electrical systems and their operation and maintenance.

1.3 MANUFACTURER'S SITE SERVICES

.1 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction seminars for systems specified in this Section.

1.4 DEMONSTRATION AND INSTRUCTION SEMINARS

.1 Present Operator Training Seminar.

PART 2 PRODUCTS

.1 Not used.

PART 3 EXECUTION

3.1 SYSTEMS AND EQUIPMENT DEMONSTRATIONS AND INSTRUCTION SEMINARS

.1 Provide demonstration and instruction seminars for the following equipment and systems identified. Include in demonstrations and instruction seminars, the information specified for each piece of equipment and system.

.1 Power Distribution.
.2 Instrumentation
.3 Transformers.
.4 Switchgear Enclosures.
.5 Circuit Breakers.
.6 Power Factor Correction Equipment.
.7 Panelboards.
.8 Motor Control Centres
.9 Power Metering
.10 Automatic Transfer Switch

END OF SECTION

PART 1 CONCRETE WORK

.1 All concrete required for and/or installed under Division 26 shall be as specified in other Divisions. Unless otherwise noted, it shall have a specified strength of 20,000 kPa(3000 psi) at 28 days and an entrained air content of 6% ±1%.

.2 Use proper placement techniques to remove entrained air. Do not place thereon or attach thereto any materials or equipment prior to a minimum curing period of seven (7) days.

.3 Vibrators shall be utilized for the placement of all concrete.

PART 2 HOUSEKEEPING PADS

.1 Provide steel reinforced concrete housekeeping pads/bases of minimum 100 mm height for all floor mounted equipment, including but not limited to switchgear, auxiliary system cabinets, etc. Size pads with reference to equipment shop drawings and so as to include for the installation of future equipment where future extensions to equipment are shown or noted.

PART 3 OPENINGS

3.1 OPENINGS AND SLOTS

.1 Provide all openings as necessary and as specified elsewhere to permit the installation of all conduits and cables and recessed equipment and devices.

.2 Grind and file smooth the interiors and edges of all sleeves and slots prior to pulling any cables.

PART 4 WALL, CEILING, AND FLOOR PENETRATIONS

.1 Any and all penetrations through walls, ceilings and floors (fire, smoke, sound as well as all other penetrations) must be sealed after the installation of all conduits, cables, bus ducts, cable trays, wireways, etc., to maintain the integrity of the separations in a manner approved by the Consultant and the authorities having jurisdiction. Use sealing materials as specified herein and shown on the drawings.

.2 Rated sealing systems for penetrations of Fire Rated walls, ceilings and floors: Hilti, or approved equal, refer to the drawings. Contractors are to submit ULC, cUL, WHI, or equivalent certified Design or System Data Sheets to demonstrate compliance of a particular Floor or Wall Assembly, Through Penetrant, and Sealant with requirements and for what period of time.

.3 Provide bus ducts, cable trays, wireways, etc., with fire barriers at each floor and at each fire separation and smoke separation, and further seal against the migration of smoke.

.4 Seal all slots, core holes, etc., not being used.

.5 Provide fire-rated gypsum board of required thickness around all surfaces of recessed panelboards and cabinets within rated separations so as to maintain the separation rating as approved by the authorities having jurisdiction.

.6 Provide fire-rated gypsum board enclosures for lighting fixtures recessed in fire rated ceiling assemblies, all as required by the authorities having jurisdiction.

PART 5 WATERPROOFING/VAPOUR BARRIERS

.1 Generally penetrations through waterproofing members and vapour barriers will not be permitted. However, where any work must pierce vapour barriers and waterproofing membranes including waterproofed concrete, the method of installation, colour of caulking material and location of penetration shall be as approved by the Consultant and as coordinated with Structural Engineer prior to proceeding with the work. Supply and install all necessary sleeves, caulking and flashing and make the penetrations watertight. For penetrations of vapour barrier, maintain integrity of the system. Restore penetrations through existing surfaces to match the surroundings.

.2 Provide specified caulking around all exterior recessed lighting fixtures in concrete steps, walls, etc.

.3 Provide clear silicon bead on top and down both sides of all exterior wall mounted devices (e.g. light fixtures and gongs) where devices are exposed to the weather.

PART 6 EQUIPMENT FINISHES

.1 Thoroughly degrease all metalwork and apply one overall coat of zinc chromate primer to all electrical equipment enclosures, supports, switchgear cubicles, bus ducts, gutters, panelboards, low tension and other cabinets. Unless otherwise directed, apply one overall coat of grey enamel and a second coat of gloss enamel. Paint all exposed surfaces.

.2 Grey ASA #61 unless matching existing equipment in which case colour shall match existing.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Ensure that equipment finishes are not defaced during installation. Scratched or otherwise marred surfaces shall be refinished before the job will be accepted. Other surfaces shall be completely repaired to match original paint. Patching of damaged area will not be accepted.

.4 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

.5 Generally, equipment finishes shall be as outlined under applicable sections of the specifications.

PART 7 VIBRATION AND NOISE CONTROL

7.1 MOUNTING

.1 Electrical equipment such as transformers and standby diesel engine generator sets shall be mounted using vibration isolators to prevent the transmission of isolators shall be selected in accordance with the weight distribution of equipment so as to produce the manufacturers' recommended uniform deflection. Such equipment shall be restrained at each isolator pad using bolts into the floor slab with neoprene washers and clearance holes to prevent short circuiting.

7.2 CONNECTIONS

.1 Connections to rotating, vibrating, or other noise-producing equipment such as motors, generators and transformers shall be by means of flexible conduit and flexible stranded conductors so as to minimize transmitted noise and vibration. Where equipment is mounted by means of resilient supports and is subject to physical displacement under such conditions as energizing a motor, the flexible conduit connections shall be formed into a loop of sufficient length to permit freedom of travel.

PART 8 ACOUSTICAL SPECIFICATIONS FOR TRANSFORMER

8.1 GENERAL

.1 Supply transformers generating a space average noise level in the respective Electrical Rooms not exceeding 70 decibels (re: 20 microPa) measured in any third octave bank between 50 Hz and 1,000 Hz based on a 300 kVA transformer.

.2 Log kVA re: 300 kVA. Use a room absorption equivalent to 1/3 of the floor area. Supply the name of a similar installation.

.3 Sound level measurements made at the project site will be made in general accordance with ANSI Standard S1.32, recognizing that the respective Electrical Rooms may not meet the full requirements of the Standard.

.4 Supply vibration isolation such that the airborne noise isolation provided by the building structure is not limited by structure-borne noise transmission. The following are minimum isolation requirements:

.1 Mount the transformer core on 25 mm (1”) deflection spring isolators, including in-series neoprene elements with an effective deflection of 2.5 mm (.10”) and use restraints meeting the National Building Code with respect to seismic requirements. (Also refer to Section 16192 Seismic Restraints).

.5 Where a transformer is located on a slab on grade, use pad isolators sized for a minimum 2.5 mm (.10”) defection, with seismic restraints.

.6 If the transformer core is mounted on separate transverse steel supporting members independent of the transformer enclosure, size the members for a 140 Hz cantilever resonant frequency under the dead load of the member (0.013 mm (.0005”) dead load cantilever deflection) and the isolator stiffness.

.7 Where smaller transformers are supplied with core bolted into steel supports within the cabinet, supply neoprene pad isolation within cabinet with minimum 2.5 mm (.10”) deflection working against the vibration isolation provided the isolator/pad supports is not limited by the braided connectors. If such flexibility is impractical, isolate the cabinets and all other associated equipment on the neoprene pads with 2.5 mm (.10”) deflection and isolate the conduit to meet the requirement.

.8 For 10 metres (30’) in all directions from the transformer, provide neoprene hangers with 0.1" Static deflection in threaded rod supports for conduit, cable trays, etc. Avoid rigid connections to the structure.

.9 Submit shop drawings detailing proposed isolation.

PART 9

.1 Locate all mechanical equipment, electrical conduit, and lighting at least 300 mm (12”) below the ceiling slab, including wall-mounted equipment. Do not locate mechanical ducts over transformer cabinets.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 CSA International

.1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.

.2 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results-Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to NEMA to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamps for copper and aluminum conductors as required.

.3 Stud clamp bolts.

.4 Bolts for copper bar as required.

.5 Bolts for aluminum bar as required.

.6 Sized for conductors as indicated.

.4 Clamps or connectors for TECK cable and flexible conduit, as required to: CAN/CSA-C22.2 No.18.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and cables and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.

.3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

.4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results-Electrical.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE Non Jacketted.

2.2 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: 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride,.

.7 Fastenings:

- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at 1500 mm centers.
- .3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:

- .1 Watertight, approved for TECK cable.

2.3 MINERAL-INSULATED CABLES

.1 Not Required.

2.4 ARMOURED CABLES

.1 Not Permitted.

2.5 ALUMINUM SHEATHED CABLE

.1 Not Required

2.6 CONTROL CABLES

.1 Type: soft annealed copper conductors, size and quantity as indicated:

.1 Insulation: thermoplastic.

.2 Sheath : thermoplastic jacket.

.2 Type: low energy 300 V twisted pair control cable: stranded annealed copper conductors sized as indicated

.1 Insulation: PVC

.2 Shielded twisted pair, quantity of pairs as indicated.

.3 Shielding: tape coated with paramagnetic material over each pair.

.4 Overall covering: PVC jacket

2.7 NON-METALLIC SHEATHED CABLE

.1 Not Permitted.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 26 05 10 – Testing and Commissioning.

3.2 GENERAL CABLE INSTALLATION

.1 Install cable in trenches in accordance with Section 33 65 76 - Direct buried underground cable ducts.

.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: Not Permitted

.7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.9 Unless otherwise noted, joints in wiring shall only occur where branch circuits divide at a junction box.

.10 Conductors shall be colour coded and the colour coding shall be consistent throughout the project.

.11 Termination lugs for all feeder cables shall be compression type.

3.3 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 In underground ducts in accordance with Section 33 65 76 Direct Buried Underground Cable Ducts.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed securely supported by straps or hangers.

3.5 INSTALLATION OF MINERAL-INSULATED CABLES

.1 Not Required.

3.6 INSTALLATION OF ARMOURED CABLES

.1 Not Required.

3.7 INSTALLATION OF ALUMINUM SHEATHED CABLE

.1 Group cables wherever possible on channels.

3.8 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit and underground ducts as indicated.

.2 Ground control cable shield.

3.9 INSTALLATION OF NON-METALLIC SHEATHED CABLE

.1 Install cables.

.2 Install straps and box connectors to cables as required.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 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 Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Grounding conductors: bare stranded copper, soft annealed, size as indicated on Drawings or per CEC where not indicated on Drawings.

.3 Insulated grounding conductors: green, copper conductors, size as indicated.

.4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.5 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 Compression type connectors Burndy Hy-Press or approved equal.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Connect to existing building ground.

.2 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. 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 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Connect building structural steel and metal siding to ground by welding copper to steel.

.8 Make grounding connections in radial configuration only, with connections terminating at single grounding point as indicated on Drawings. Avoid loop connections.

.9 Ground secondary service pedestals.

3.2 MAINTENANCE HOLES

.1 Not Required.

3.3 ELECTRODES

.1 Not Required.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 208 V system.

3.5 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.

3.6 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 minimum size 2/0 AWG or as indicated on Drawings.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and 26 05 10 – Testing and Commissioning

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 Not Required.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results - Electrical

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

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

.2 Cord Grips: Kellems grip Type 073-03 and 073-04 or approved equal.

.3 Wire and cable ties: nylon ‘Ty-rap’ or approved equal for wiring and control cable. Velcro cable wraps for data cables.

.4 Threaded hanger rods: galvanized steel, minimum 6mm diameter; larger sizes as shown on drawings or as required.

.5 Conduit and cable clamps for individual or pair runs:

.1 One-hole steel or galvanized malleable iron for sizes 53mm and smaller.

.2 Two-hole steel for sizes larger than 53mm.

.6 Fixture suspension chain: #3 Tenso chain.

.7 Backboards: New 21mm (3/4”) G1S paint grade fir plywood.

.8 Conductor supports for vertical runs: O-Z Electrical Mfg. Co. Type ‘S’ or ‘R’ as required or equal, for not more than 5 wires or cables each not greater than 250 kCMIL. Kellems grip Type 022-11 or approved equal for all manufacturer-approved combinations of wires and/or cables.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Secure equipment to hollow masonry, tile and plaster surfaces with nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition..

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: connection blocks to match required size and number of incoming and outgoing conductors as indicated.

2.2 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on turned edge covers.

2.3 CABINETS

.1 Not Required.

PART 3 EXECUTION

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.

.2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated on Drawings.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square or larger outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 Not Required

2.4 CONCRETE BOXES

.1 Not Required

2.5 FLOOR BOXES

.1 Not Required

2.6 CONDUIT BOXES

.1 Cast FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

.2 Non-metallic sheathed cable shall NOT be used on this project.

2.8 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 35mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 SERVICE FITTINGS

.1 Not Required.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges, 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 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.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 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 (Current Edition).

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

.2 Quality assurance submittals:

.1 Test reports: submit certified test reports.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel, threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Rigid pvc conduit: Schedule 40, to CSA C22.2 No. 211.2.

.5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One hole malleable iron or galvanized steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.5 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT where installed in damp locations.

.1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Surface mount conduits.

.4 Use rigid galvanized steel conduit outside and where exposed to mechanical injury, except where specified otherwise.

.5 Use electrical metallic tubing (EMT) indoors, where not subject to mechanical injury.

.6 Use schedule 40 rigid pvc conduit underground.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.8 Minimum conduit size for lighting and power circuits: 21 mm.

.9 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.10 Mechanically bend steel conduit over 19 mm diameter.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.14 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Not Required.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Not Required.

3.7 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 Insulated Cable Engineers Association, Inc. (ICEA)

.2 Master Municipal Construction Documents Association (MMCD)

.1 MMCD Platinum Volume I & II

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 CABLE PROTECTION

.1 Where approved to reduce burial depth of conduits or cables.

.2 50mm of concrete topping unless approved otherwise.

2.2 MARKERS

.1 Not Required

PART 3 EXECUTION

3.1 DIRECT BURIAL OF CABLES

.1 After sand bed in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling, 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 Make termination and splice only as indicated leaving 0.6 m minimum of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's written recommendations using approved splicing kits.

.4 Underground cable splices not acceptable.

.5 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.

.6 Cable separation:

.1 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 0.6 m minimum in each direction at crossings.

.7 After sand protective cover specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, restore surface to existing condition or better.

3.2 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.

3.3 MARKERS

.1 Not Required.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and 26 05 10 Testing and Commissioning.

.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 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.

.7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 CSA International

.1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).

.2 CSA C9, Dry-Type Transformers.

.3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 DESIGN DESCRIPTION

.1 Design 1.

.1 Type: ANN.

.2 60 Hz.

.3 kVA, Phase, and Voltages as indicated on Drawings.

.4 Voltage taps: minimum of 4 – 2 ½% primary taps, two full capacity above normal and two full capacity below normal.

.5 Insulation: Class 220°C, 150°C temperature rise.

.6 Basic Impulse Level (BIL): standard.

.7 Hipot: standard.

.8 Average sound level:standard

.9 Impedance at 17 degrees C: standard

.10 Enclosure: CSA, removable metal front panel.

.11 Mounting: as indicated on Drawings.

.12 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.13 Aluminum windings.

.14 Winding configuration to be as noted on drawings.

.15 Voltage Regulation to be 4% or better.

.16 Vibration dampers

2.2 EQUIPMENT IDENTIFICATION

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

.2 Label size: 7.

.3 Nameplate shall include equipment name, transformer kVA, primary and secondary voltage, impedance (%), upstream distribution panel and circuit.

.1 Confirm nameplate wording with Consultant prior to manufacture.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Mount Transformers up to as indicated.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

.8 Make conduit entry into bottom 1/3 of transformer enclosure.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 CSA Group

.1 CSA C22.2 No.31, Switchgear Assemblies.

1.3 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 service entrance board and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

.2 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.

.3 Include time-current characteristic curves for circuit breakers and fuses.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit maintenance materials in accordance with Section 26 05 00 – Common Work Results – Electrical and Section 26 05 11 Operations and Maintenance Data.

.2 Provide:

.1 6 extra fuses for each type up to and including 600 A.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE BOARD

.1 Service Entrance Board: to CSA C22.2 No.31.

.2 Rating: as indicated on drawings.

.3 Cubicles: free standing, dead front.

.1 Maximum dimensions: 810mm wide x 533mm deep

.2 Coordinate floor mounted anchor points with manufacturer to align with existing concrete channels. Where anchor points to not align, provide modified mounting signed and sealed by the contractor's or equipment manufacturer's seismic engineer.

.4 Barrier metering compartment from adjoining compartments.

.5 Provision for installation of power supply authority metering in barriered Section.

.6 Distribution section: Not required

.7 Incoming Wireway section: Not required

.1 Utility service point of demarcation is at the private pole weatherhead outside the building. Conductors terminating at the main breaker are customer-owned.

.8 Hinged access panels with captive knurled thumb screws.

.9 Bus bars and main connections: aluminum.

.10 Bus from load terminals of main breaker via metering section to main distribution lugs

.11 Identify phases with colour coding.

2.2 MOULDED CASE CIRCUIT BREAKERS

.1 To Section 26 28 16.02 Moulded Case Circuit Breakers

2.3 FUSIBLE DISCONNECTS AND FUSES

.1 Not Required

2.4 GROUNDING

.1 Copper ground bus extending full width of cubicles and located at bottom.

.2 Lugs at each end for size 3/0 grounding cable.

2.5 GROUND FAULT UNIT

.1 Provide ground fault indication.

2.6 SURGE PROTECTION DEVICE

.1 Refer to section 26 41 00.02 Secondary Lightning Arrestors

2.7 POWER SUPPLY AUTHORITY METERING

.1 Separate compartment and metal raceway for exclusive use of power supply authority metering.

.2 Mounting accessories and wiring for metering supplied by power supply authority:

.1 potential transformers.

.2 current transformers.

.3 Demand meter with kWh register (existing external meter to be re-used).

2.8 FINISHES

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

.1 Service entrance board exterior: gray.

2.9 EQUIPMENT IDENTIFICATION

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

.2 Nameplates:

.1 White plate, black letters, size 7.

.2 Complete board labelled: "MDC-1 347/600V, 400A"

.3 Main disconnect labelled: "Utility Main Breaker".

.4 Provide lamacoid list to Consultant for approval prior to manufacture.

2.10 SOURCE QUALITY CONTROL

.1 Consultant to witness final factory tests.

.2 Consultant in writing 5 days in advance that service entrance board is ready for testing.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Locate service entrance board and fasten to wall/floor.

.2 Connect main secondary service to line terminals of main breaker.

.3 Connect load terminals of distribution section to ATS.

.4 Check factory made connections for mechanical security and electrical continuity.

.5 Connect grounding and bonding per Drawings.

.6 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.29, Panelboards and Enclosed Panelboards.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

PART 2 PRODUCTS

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 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 Bus and breakers rated as indicated on Drawings. Symmetrical interrupting capacity as indicated on Drawings but not less than 10kA.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Two keys for each panelboard and key panelboards alike.

.7 Aluminum bus with neutral of same ampere rating of mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked enamel.

.11 Isolated ground bus.

.12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

.13 Provide minimum additional space for future breakers in panelboards as follows:

.1 Panelboards 208V, up to 225A: minimum 10% space and 10% spare 15A breakers or as noted on Drawings

.2 Distribution panelboards 208V, over 225A: 20% space or as noted on Drawings

.3 Distribution boards greater than 208V: 20% or as noted on Drawings

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case 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 as indicated. Turn over unused lock-on devices to Consultant.

.5 Lock-on devices for fire alarm, exit circuits.

2.3 EQUIPMENT IDENTIFICATION

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

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

.5 Circuits supplying Patient Care Areas must be entered in circuit directory with Bold Font.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus .

.6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

.2 Section 26 29 10 – Motor Starters to 600V.

.3 Section 26 29 23.11 – Variable Frequency Drives

.4 Section 26 35 33 – Power Factor Correction Equipment

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No. 254 – Motor Control Centres

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

.2 Shop Drawings:

.1 Indicate on drawings:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable and/or Bus duct entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams.

.3 Submit maintenance materials in accordance with Sections 26 05 00 – Common Work Results Electrical and 26 05 11 – Operations and Maintenance Data.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 SUPPLY CHARACTERISTICS

.1 As indicated on Drawings.

2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Indoor NEMA 1 gasketted enclosure, front mounting.

.4 Class II

.5 Control Terminals:

.1 Extend control wiring as indicated on typical wiring diagram from each motor control module to control terminal section. All terminals to be number coded and otherwise suitably identified to indicate which section or module of motor control centre they are associated with and their function. Control wiring diagrams of each typical type with conductor identification clearly shown to be affixed to interior cover of control terminal section.

.2 Control terminal section to house all controls and time delay relays associated with the mechanical system and control systems.

2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 165 mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top or side.

.8 Provision for outgoing cables to exit via top and bottom.

.9 Removable lifting means.

.10 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

2.4 SILLS

.1 Continuous channel iron floor sills for mounting bases with holes for bolts.

.1 Channel and bolt dimensions as required by manufacturer for seismic restraint of equipment.

2.5 BUSBARS

.1 Main horizontal and branch vertical, three phase and neutral high conductivity tin plated aluminum busbars in separate compartment self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 400 A minimum.

.2 Branch vertical busbars: 300 A.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current as indicated on drawings.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

.1 A **tin-plated copper** ground bus shall be provided that runs the entire length of the MCC. A compression lug shall be provided in the MCC for a bonding conductor sized as indicated on Drawings. The ground bus shall be provided with a minimum of 6-10 mm holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.

.2 Each vertical section shall have a copper vertical ground bus that is connected to the horizontal ground bus. This vertical ground bus shall be installed so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.

2.7 MOTOR STARTERS AND DEVICES

.1 Refer to Section 26 29 10 Motor Starters to 600V.

2.8 VARIABLE FREQUENCY DRIVES

.1 Refer to Section 26 29 23.11 Variable Frequency Drives

.2 Refer to Drawings for VFD wiring and door panel details.

2.9 POWER FACTOR CORRECTION

.1 Refer to Section 26 35 33 Power Factor Correction Equipment

2.10 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.11 WIRING IDENTIFICATION

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

2.12 EQUIPMENT IDENTIFICATION

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

.1 Motor control centre main nameplate: size No. 7, engraved as indicated.

.2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.13 FINISHES

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

.2 Paint motor control centre exterior light gray and interiors white.

2.14 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Consultant to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Install on existing concrete channels.

.3 Make field power and control connections as indicated.

.4 Ensure correct overload heater elements are installed.

.5 Touch-up scratched or marred surfaces to match original finish.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and section 26 05 10 – Testing and Commissioning.

.2 Ensure moving and working parts are lubricated where required.

.3 Demonstrate operation of starters to prove satisfactory performance of motor control centre.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 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-2010).

.2 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

.2 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage and/or an ampacity of 400 A and over.

.3 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit PDF copy 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 to Consultant 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 by Consultant. Unless complying with this requirement, Consultant 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 and person of distributor responsible for Contractor's account.

.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.

.5 Name and address of building where circuit breakers will be installed:

.1 Project title: [_____].

.2 End user's reference number: [_____].

.3 List of circuit breakers: [_____].

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, ground-fault circuit-interrupters, to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.

.3 Plug-in moulded case circuit breakers: not accepted.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 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 3-8 times current rating.

.6 Circuit breakers with interchangeable trips as indicated.

.7 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated on Drawings.

.8 All breakers 400 A and greater shall be solid state trip.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Not Required

2.3 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 and instantaneous tripping for short circuit protection.

2.4 MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.5 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS

.1 Thermal magnetic breakers with current limiters.

.1 Not Required

.2 Series rated breakers:

.1 Not Accepted

2.6 SOLID STATE TRIP BREAKERS

.1 Where indicated on Drawings.

.2 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.

.3 Long time, short time, instantaneous tripping for phase and ground fault short circuit protection as indicated on Drawings.

.1 Where long time, short time, and instantaneous (LSI) tripping is indicated on drawings, all trip settings shall be **independently** adjustable.

.4 All breakers 400A and greater shall be solid state trip regardless of whether requirement for L, S, I, or G trip capability is indicated on drawings.

2.7 OPTIONAL FEATURES

.1 Not Required

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

.2 All moulded case circuit breakers to be installed in new distribution or panel boards shall be factory installed.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 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.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible or Non-fusible, as indicated, Horsepower rated for motors, disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4 size as indicated.

.2 Provision for padlocking in 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 13.01 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No.39 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.

2.2 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 4 nameplate.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Technical Specification 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCES

.1 CSA International

.1 CSA C22.2 No.14, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

1.4 SHOP DRAWINGS AND SUBMITTALS

.1 Submit documents to the Contract Administrator in accordance with Technical Specification 26 05 00 - Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 - Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 GENERAL

.1 Materials and installation for Transmitting and Indicating devices.

.2 Provide each device as a pre-assembled, packaged unit. Upon delivery to the Work Site, each system shall be ready for installation with only final piping and electrical connections required by the Contractor.

.3 Factory-calibrate transmitter to the calibration ranges specified by Owner or Consultant. Calibrate transmitters using NIST-approved bench calibration procedures. Store

calibration data digitally in the transmitter. Program transmitter with the instrument tag designation indicated on the Contract Drawings. Submit factory calibration data as described elsewhere in this Technical Specification.

.4 Metering Accuracy

.1 Determine system metering accuracy as a comparison of the actual process value to the value read at the principal readout device such as the recorder or man-machine interface device. Do not preclude system requirements from any requirements specified herein for individual devices.

.2 For systems where the primary measuring element and transmitter are furnished under this Section, the accuracy shall be 0.25 percent or better, or unless specified otherwise

.5 Provide devices supplied under this Technical Specification as the product of a single manufacturer.

.6 Unless otherwise specified, provide transmitters with integral isolated 4-20 mA output “two wire type” transmitters with operating power derived from the signal loop. Transmitters are to support an external load of up to 600 ohms or greater with a loop power supply of 24 VDC.

.7 Provide transmitters with adequate power output to drive devices associated with that signal loop. Provide signal boosters as required to achieve adequate signal strength.

.8 Transmitter’s 4-20 mA output is to be galvanically isolated from the process and the transmitter case.

.9 Provide microprocessor-based transmitters. For the pressure transmitter sensing cells an isolating diaphragm in combination with a sensing diaphragm using silicone oil as a pressure transmission medium.

.10 Transmitters shall not be damaged by reverse polarity.

.11 Transmitters are to have local indication scaled in Engineering Units and are to include a lamacoid label indicating the Engineering Units. Mount the transmitter such that this indication is correctly oriented and visible from the normal operating floor position.

.12 Transmitter and/or primary element enclosures (or housings) are to be, as a minimum, rated CSA Type 4; where located outdoors or in areas specified as corrosive, enclosures to meet CSA Type 4X requirements.

.13 Transmitter flanges, adaptors, and associated bolts, nuts, etc. are to be fabricated from 316 stainless steel.

.14 Two spare fuses of each type required.

2.2 MOUNTING HARDWARE

.1 Provide all mounting brackets, cables, connectors, and hardware necessary to install primary elements.

.2 Provide brackets and mounting hardware to allow standard 50mm pipe-stand or wall mounting, unless otherwise noted.

.3 Fabricate brackets from aluminum or stainless steel and all sundry hardware from stainless steel.

.4 Primary elements and transmitters are to be complete with necessary liquid filling, identification, configuration, etc. as necessary to make the unit ready for use.

2.3 INTERCONNECTING CABLE

.1 Provide an interconnecting cable from the element to the transmitter for systems where the primary element and transmitter are physically separated.

.2 The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter.

.3 Length of cable shall be as indicated in the Instrument Specification Sheet, or if not specifically indicated, shall provide a continuous unbroken length sufficient to route via approved supports from the element to the transmitter plus additional length to permit the element to be easily removed and reinstalled.

2.4 PROGRAMMING DEVICE

.1 For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, provide two such programming devices for each class or type of instrument. Include appropriate operation manuals and the programming device in the training requirements.

.2 For systems that allow the programming device functions to be implemented in software, running on a laptop computer, provide two full licensed copies of the software instead of the programming device.

2.5 PRESSURE TRANSMITTERS

.1 Not used.

2.6 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Not used.

2.7 TEMPERATURE TRANSMITTERS

.1 Not used.

2.8 EXTERNAL CONTROL COMPONENTS

.1 Flow Meter:

.1 Not used

.2 Level Float Switches:

.1 Provide float switches with contacts that will activate in the presence of liquid.

.2 Specific Gravity: 0.95 – 1.10

.3 Materials:

.1 Body: Polypropylene (Grey)

.2 Length: 162mm

.3 Strain Relief: EPDM Rubber

.4 Weight: Zinc

.4 Cable:

.1 Conductors: 3C No. 18

.2 Length: to suit installation. 20m minimum.

.3 Coil excess cable on hanger cable support.

.3 Standard of acceptance: Flygt ENM-10 Level Regulator.

.4 Well Level Sensor Equipment:

.1 Type: Hydrostatic Level Measurement

.2 Standard of Acceptance: KPSI 700S

.3 Housing: 316 Stainless Steel

.4 Application: Water

.5 Vented Gauge

.6 Electrical Connection Molded cable seal

.7 Pressure Connection Ported nose cap

.8 Sensor Outer Diameter: 25mm

.9 Cable:

.1 Submersible

.2 Polyurethane outer jacket

.3 Confirm length of integral manufacturer cable prior to order.

.10 Provide complete with vent tube

.11 4 – 20mA output

.12 Extra Features:

.1 Integrated temperature transmitter

.2 Cable Hanger

.13 Confirm level ranges at maximum and minimum output with Owner prior to order.

.5 Panel Meter

.1 Not Used

.6 Valve Chamber Flood Switch

.1 Not used.

.7 Hatch Switch:

.1 Not used.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Mount transmitters so that interference to the function is not caused by surrounding structures.

.2 Provide 35mm stilling conduit and cap for mounting level sensor. Use liquid tight cable fitting to position and secure level sensor to conduit cap.

.3 Contractor to calibrate panel meter to operate with well level transducer. Relay outputs to be configured to output on specified well low level.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Technical Specification 26 05 00 Common Work Results - Electrical and Technical Specification 26 05 10 Testing and Commissioning.

END SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1, Part 4: Electromechanical contactors and motor-starters.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product wiring diagrams, characteristics, performance criteria, physical size, finish and limitations.

.3 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

.2 Extra Materials:

.1 Provide listed spare parts for each different size and type of starter.

.1 3 contacts, stationary.

.2 3 contacts, movable.

.3 1 contacts, auxiliary.

.4 1 control transformer.

.5 1 operating coil.

.6 3 fuses. (if applicable)

2.2 MANUAL MOTOR STARTERS

.1 Not Required.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic or combination magnetic starters as indicated on Drawings

.2 Size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.3 Combination type starters to include circuit breaker with operating lever on outside of enclosure to disconnect circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Not Required.

2.5 MULTI-SPEED STARTERS

.1 Not Required.

2.6 MAGNETIC STARTER, REDUCED VOLTAGE, AUTO-TRANSFORMER

.1 Not Required.

2.7 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.8 ACCESSORIES:

.1 Pushbuttons: heavy duty, oil tight.

.1 Overload reset

.2 Selector switches: heavy duty, oil tight.

.1 Hand-off-Auto

.3 Indicating lights: LED, heavy duty.

.1 Running – Green

.2 Stopped – Red

.3 Water Level Low – Red

.1 Refer to Drawings. Water Level Low indicator light to be operated by external signal from PLC.

.4 Provide Size 1 nameplate for all accessories mounted on front of starter.

.5 Auxiliary control devices as indicated.

2.9 FINISHES

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

2.10 EQUIPMENT IDENTIFICATION

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

.2 Magnetic starter designation label, white plate, black letters, size 1 engraved as indicated.

.3 Where starters are installed outside of an MCC, starter designation label shall include equipment ID and description, phase, voltage, upstream distribution source panel and circuit.

.4 Where starters are installed in an MCC, starter designation label shall include equipment ID and description.

.5 Obtain approval from Consultant for wording of identification labels prior to manufacture.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical, Section 26 05 10 Testing and Commissioning, and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SCOPE

.1 Materials and installation of Variable Frequency Drives

1.3 RELATED TECHNICAL SPECIFICATIONS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

.2 Technical Specification 26 24 19 Motor Control Centres

.3 Technical Specification 26 29 10 Motor Starters to 600 V

.4 Technical Specification 26 05 10 Testing and Commissioning

1.4 REGULATORY REQUIREMENTS

.1 The Variable Frequency Drives (VFD) and all components shall be designed, manufactured and tested in accordance with the latest applicable standards.

.1 IEEE 519-1992: Guide for harmonic content and control

.2 UL508C: Power Conversion Equipment

.3 cUL

.4 NEMA ICS 7.0: Industrial Controls & Systems for AFD

.5 IEC 61800-2 and -3

.6 EN 50082-1 and -2

.7 Fulfill all EMC immunity requirements

.2 In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

1.5 SHOP DRAWINGS AND SUBMITTALS

.1 Submit documents to the Contract Administrator in accordance with Technical

Specification 26 05 00 - Common Work Results – Electrical.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 - Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 HARMONIC MITIGATION

.1 Line Filter:

.1 Standard of Acceptance: MTE RLW Series or approved alternative.

.2 DV/DT Filter:

.1 The DV/DT filter shall be located at the VFD and shall reduce the DV/DT clamp any voltage overshoots of the VFD output. It will return the energy in the voltage overshoots to the VFD DC bus. A power dissipative resistance device is not acceptable.

.2 Standard of Acceptance: MTE dV Sentry Series or approved alternative.

2.2 VARIABLE FREQUENCY DRIVES (VFD)

.1 Pump Motors

.1 The VFDs shall be selected in accordance with the pump motor ratings. Refer to single line diagram.

.2 Refer to Drawings for detailed VFD input/output and control requirements.

.3 VFD shall include Modbus TCP/IP communications port and capabilities for connection to the PLC. Control Inputs/Outputs via Modbus TCP/IP shall include but not be limited to the following.

.1 Remote (auto mode) Speed reference (0 – 100%)

.2 Speed feedback indication

.3 Running feedback indication

.4 Fault Reset

.5 Fault Indication

.4 Constant Torque

.5 Overload rating:

.1 150% for one minute of motor FLA

.2 110% continuous of motor FLA.

.6 Provide Terminal blocks for field wiring.

.7 Include inputs for VFD run/stop.

.8 Include relay outputs for VFD running and fault status.

.9 Include analog inputs/outputs for VFD speed setpoint and feedback.

.10 Provide adequate ventilation for stated site conditions.

.11 Mount within motor control centre.

.1 Complete mounted assembly shall be CSA certified or equivalent.

.12 Provide remote mounted control panel installed on front door of VFD cabinet.

.1 Include panel platform for docking of control panel.

.13 Standard of Acceptance:

.1 Eaton DG1

.2 Schneider ATV630

2.3 BYPASS

.1 Provide external bypass contactors for VFD, installed in separate MCC section for physical separation.

.1 Bypass operation selection shall be from hand operated selector switch on the front of the equipment.

.2 Refer to Section 26 29 10 Motor Starters to 600V and Drawings.

2.4 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 600 V, 60 Hz ac.

.3 Secondary: 120 V, AC.

.4 Close voltage regulation as required by magnet coils and solenoid valves.

2.5 THERMOSTAT (LINE VOLTAGE)

.1 Enclosure mounted, for enclosure ventilation.

.2 Temperature setting range to be determined by manufacturer equipment cooling requirements.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install control devices and interconnect as indicated on the Contract Drawings and per manufacturers recommendations.

3.2 CONTROLS

.1 Refer to drawings for door-mounted control requirements.

.2 VFD Programming shall be completed by the Owner.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Technical Specification 26 05 00 - Common Work Results for Electrical and Technical Specification 26 05 10 Testing and Commissioning.

.2 Operate each VFD in all modes (Hand/Off/Auto, and VFD/Bypass).

.3 Confirm correct operation of all interlocks.

.4 Perform complete system check-out for operational sequencing.

.5 Demonstrate system operation to Owner.

END SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.190, Capacitors for Power Factor Correction.

1.4 SUBMITTALS

PART 2 PRODUCTS

2.1 CAPACITORS

.1 Capacitor unit for power factor correction: to CSA C22.2 No.190.

.2 Capacitor characteristics:

.1 Capacitor kVAR as determined by manufacturer to be suitable for connected motors.

.2 Voltage, and phase as indicated on Drawings.

.3 Enclosure: indoor, installed in motor control centre.

.4 Short circuit capacity as indicated on Drawings.

.5 Capacitor characteristics as required by MCC Manufacturer.

2.2 FINISH

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

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install and connect capacitors.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 26 05 10 Testing and Commissioning.

.2 Carry out following tests by manufacturer within 24 hours of energizing equipment:

.1 Voltage and current are balanced and within capacity rating.

.2 Operating kVAR.

.3 Terminal to case resistance is greater than 1000 megohm for two bushing capacitors.

.1 For one bushing capacitor check by measuring discharge time constant.

.2 This should be less than 60 s and residual capacitor voltage should be reduced from crest value of nominal rated voltage to less than 50 V.

.3 Provide certified test results to Consultant.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 CSA International

.1 CSA C22.2 No.5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).

.2 CSA C22.2 No.178.1, Automatic Transfer Switches.

.3 CAN/CSA C60044-1, Instrument Transformers.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2, Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of BC , Canada.

.1 Indicate on drawings:

.1 Make, model and type.

.2 Load classification:

.1 Tungsten lamp load: [_____]

.2 kW.

.3 Ballast lamp load: [_____] kW.

.4 Motor load: [_____] kW.

.5 Restricted use: resistance and general loads, 0.8 pf or higher [_____] kW.

.3 Single line diagram showing controls and relays.

.4 Description of equipment operation including:

.6 Automatic starting and transfer to standby unit and back to normal power.

.7 Test control.

.8 Manual control.

.9 Automatic shutdown.

.3 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual. Include:

.1 Certified copy of factory test results.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Shop drawings.

.4 Detailed instructions to permit effective operation, maintenance and repair.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.2 MATERIALS

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

2.3 CONTACTOR TYPE TRANSFER EQUIPMENT

.1 Contact Type Transfer Equipment: to CSA C22.2 No.178.1.

.2 Two 3-pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked with CSA enclosure.

.3 4 wire, solid neutral.

.4 Rated as indicated on Drawings.

.5 Main contacts: silver surfaced, protected by arc disruption means.

.6 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

.7 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.8 Fault withstand rating: as indicated on drawings

.9 Lever to operate switch manually when switch is isolated.

.10 Neutral bar, solid, fully rated.

2.4 CIRCUIT BREAKER TYPE TRANSFER EQUIPMENT

.1 Circuit Breaker Type Transfer Equipment: to CSA C22.2 No.5.

.2 CSA Enclosure, wall mounted.

.3 4 wire, solid neutral.

.4 Rated as indicated on Drawings.

.5 Fault withstand rating: as indicated on drawings.

.6 One normal 3 pole moulded-case circuit breaker with non automatic trip, mounted on common base, designed for double throw action, motor operated, mechanically held and interlocked

.7 One emergency 3 pole moulded-case circuit breaker with non automatic trip, motor operated, mechanically held and interlocked.

.8 Circuit breakers:

- .1 Trip free in closed position.
- .2 Interrupting rating: as indicated on drawings
- .3 Dead front construction with access to relays and controls for inspection and maintenance, and manual operating lever for transfer switch.
- .4 Auxiliary contact: to initiate emergency generator start-up on failure of normal power.

.9 Solid neutral bar

2.5 CONTROLS

.1 Selector switch - 4 position "Test", "Auto", "Manual", "Engine start".

- .1 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
- .2 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
- .3 Manual position - transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
- .4 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120 V secondary to isolate control circuits from:

- .1 Normal power supply.
- .2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

- .1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
- .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 s.
- .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 s delay.
- .4 Time delay on retransfer from standby to normal power, adjustable 5 to 180 s.
- .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 5 s intervals to 180 s.

.6 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.4 Solid state electronic in-phase monitor

2.6 ACCESSORIES

.1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.

.2 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.

.1 Integrated Digital Power Meter:

.1 Digital true RMS, indicating type 1 % accuracy or better, flush panel mounting including:

.1 Current - Phase A, Phase B, Phase C, 3-Phase.

.2 Voltage - Phase A, Phase B, Phase C, 3-Phase.

.3 Power - Phase A, Phase B, Phase C, 3-Phase.

.4 Frequency

.5 Energy

.6 Power Factor

.7 Demand - Phase A, Phase B, Phase C, 3-Phase.

.8 Max/Min Historical Values

.2 Provide complete with all required CTs and PTs

.3 Power meter shall be supplied fully wired with no field connections required.

2.7 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Control panel:

.1 For selector switch and manual switch: size 4nameplates.

.2 For meters, indicating lights, minor controls: use size 3 nameplates.

2.8 GENERATOR DISTRIBUTION BREAKERS

.1 All breakers and other forms of disconnect between the generator and automatic transfer switch shall have auxiliary contacts monitored by the transfer switch to provide trouble alarm for a “not normal” situation. The monitoring wiring diagram shall be included in the transfer switch submittals.

2.9 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.

.2 Notify Consultant 5 days minimum in advance of date of factory test.

.3 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

.4 In-phase monitor operation.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Locate, install and connect transfer equipment as indicated.

.2 Check relays and solid state monitors and adjust as required to ensure correct operation.

.3 Install and connect remote alarms.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and 26 05 10 Testing and Commissioning.

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 ANSI/IEEE C67.41, C62.45.

.1 UL1449 Current Edition

.2 NFPA.

.3 IEEE Standard 1100.

.4 UL1283 - EMI/RRI noise attenuation standard.

.5 NEMA LS1.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.

.2 Section 26 24 02 – Service Entrance Board.

.3 Section 26 23 00 – Low Voltage Switchgear.

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

.2 Submittal for approval: Provide the following transient protection submittals:

.1 Dimensional drawing of each Surge Protective Device (SPD) type, indicating proposed mounting arrangements.

.2 Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability per NEMA LS1.

.3 The means of connection of the SPD to the electrical distribution system per NEMA LS1.

.3 Provide UL-1449,data card from manufacturer showing the Voltage Protection Rating (VPR) for the specific catalog number submitted. Typical UL 1449 data is not acceptable.

.4 Mark the devices with the short circuit current rating. Meet or exceed the available fault current. Provide test data from an independent testing laboratory to demonstrate the short circuit current rating has been tested on a complete device

.5 Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE SPD unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.

.6 Submit data demonstrating the SPD unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 10,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.

1.4 WARRANTY

.1 Provide manufacturer product warranty against defects in operation and material for a period of not less than 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ENVIRONMENTAL

.1 General Requirements:

.1 No audible noise.

.2 No appreciable magnetic fields. Provide proven application of use directly in computer rooms in any location without danger to disc units, disk packs, or tapes.

.3 Operating Conditions:

.4 0 - 30 Degrees F

.5 15 - 90 Percent Humidity Non-Condensing

.6 Enclosure: Heavy duty NEMA 12 dust-tight, drip-tight enclosure, as indicated.

2.2 SURGE PROTECTIVE DEVICES

.1 General Requirements:

.1 Rated for 60 Hertz, voltage, phase, wire, and amperage as indicated on Drawings.

.2 Provide surge suppressors in accordance with the following requirements:

.1 UL 1449 Type 1, 2, or 3 as indicated.

.2 Unit parallel in design and connected in parallel to main switchboard. Each surge suppression element (MOV) individually fused so that a failure of one element and/or fuse has no affect on other surge suppression elements.

.3 Provide UL 1449 (current edition) listed unit.

.4 UL 1449 Nominal Discharge Current of 20kA.

.5 Provide maximum UL 1449 Maximum Continuous Operating Voltage (MCOV) of 150% of the system nominal voltage.

.6 Provide maximum UL 1449 Voltage Protection Rating (VPR) for 347/600 Volt systems as follows:

.7 L-N = 1500V

.8 L-G = 1500V

.9 N-G = 1500V

.10 L-L = 2500V

.11 Provide maximum surge current rating of 100,000 amperes L-N, 100,000 amperes L-G, and 100,000 amperes N-G, based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform. Provide a higher maximum surge current rated device if required to meet the requirements of paragraph 1.03, B., 7. above.

.12 Provide unit with a short circuit current rating, which equals or exceeds that of the Main Switchboard.

.13 Provide UL 1283 listed unit as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 30 dB at 100 kHz, 50 dB at 1 MHz, 50 dB at 10 MHz, and 45 dB at 100 MHz.

.14 Include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.

.15 Provide Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.

.16 Provide integral, non-fused disconnect system which causes no interruption to the protected load for testing and maintenance. Disconnect system shall not require removal or replacement for warranty or other repairs.

.17 Provide an audible alarm with an alarm on/off switch to silence the alarm and a push-to-test switch to test the alarm function.

.18 Provide an adjustable (resetable) counter to totalize transient voltage surges in both the normal and common mode. Provide readout with at least a seven-digit LCD located on the unit front cover and provided with a 10-year battery back-up to maintain counts in the event of power loss.

.19 ISO 9001 certified.

.20 Withstand: Each unit must be capable of surviving more than 2500 ANSI/IEEE C62.41 Category C1 transients without failure or degradation of UL 1449 Suppression Voltage Rating.

.21 Peak Surge Current: the minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as shown in the following table:

Application	Service Size	Min. Surge Current Per Phase
Service Entrance (Switchboards Switchgear, MCC Main Entrance) *L-G, L-N and N-G (WYE system)	400A	160kA
	401 to 800A	250kA
	Above 800A	320kA

.22

2.3 ACCESSORIES

.1 Push to test feature to verify operational integrity.

.2 Form C dry contacts one NO, one NC for remote status monitoring.

.3 Provide audible alarm and surge counter as shown on the contract drawings.

.4 Disconnect Switch: include a disconnect located in-line with the SPD system enclosure with an external manual operator. The switch shall disconnect all phase conductors, not including neutral, from the high-energy surge current diversion modules.

2.4 SYSTEM APPLICATION

.1 Provide Type 2 SPD in switchboards and panelboards, where indicated on Drawings.

.2 Provide SPD tested and suitable for ANSI/IEEE C62.41 Category C3 environments at service entrance locations where indicated on Drawings.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

.1 SPDs installed in switchboards, switchgear, and MCCs shall be installed by assembly manufacturer.

.2 Service entrance suppressors may be installed next to the switchboard where approved by the Consultant.

.3 Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

.4 Install suppression system immediately next to or on top of service equipment where so approved by the Consultant.

.5 Install conductors between suppressor and point of attachment to service equipment sized in accordance with manufacturer's Shop Drawings and conductor lengths as short as possible, preferably not to exceed 600 mm. Provide information from manufacturers who offer an integrated SPD in the main service entrance equipment clearly showing lead lengths, including the neutral and ground connections.

.6 Grounding: bond suppressor ground to the equipment grounding conductor and service entrance ground.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work results – Electrical.

.2 Inspect primary and secondary connections for tightness and signs of overheating.

.3 Check fuses for correctness of type and size.

.4 Check grounding connections.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

1.3 SUBMITTALS

.1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, conduits, pull boxes, sleeves and caps, fish wires, and underground ducts.

.2 Conduits for typical single communication outlets shall be minimum 27mm unless otherwise noted

.3 Typical outlet boxes shall be minimum double gang, complete with single gang mudring unless otherwise noted

2.2 MATERIAL

.1 Conduits: EMT type indoors, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Underground cable ducts: RPVC Schedule 40 type, in accordance with Section 33 65 76 - Direct Buried Underground Cable Ducts.

.3 Cable trays: Not Required

.4 Overhead distribution system: Not Required

.5 Junction boxes in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.6 Outlet boxes: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.7 Fish wire: polypropylene type.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install empty raceway system, including, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.

.2 Daisy chaining of outlets will not be accepted, system will be installed in a star topology unless noted otherwise.

.3 Contractor must plan and measure each run of CAT cable before ordering materials and installation and alert the Consultant if any run exceeds 70 meters in length. Proceed with installation of raceways for CAT runs exceeding 70 meters only if directed in writing.

3.2 GROUNDING AND BONDING

.1 Bond metallic communications conduits at both ends, to control panel ground bus and to equipment end ground bus with No. 6 AWG Cu conductor.

.2 Bond Communications Control Panel ground bus to main building ground bus with No. 6 AWG Cu conductor.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section shall be read in conjunction with all other Sections in all Divisions. Refer to Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).

.2 CSA-C22.2 No. 232, Optical Fiber Cables.

.2 BICSI

.1 Telecommunications Distribution Methods Manual (TDMM) – Latest Edition.

.3 Telecommunications Industry Association (TIA)

.1 TIA-568.0 (Latest Edition), Commercial Building Telecommunications Cabling General Requirements.

.2 TIA-568 (Latest Edition), Commercial Building Balanced Twisted-Pair Telecommunications Cabling and Components.

.3 TIA -568.3 (Latest Edition), Optical Fiber Cabling Components Standard.

.4 TIA -606 (Latest Edition), Administration Standards for Telecommunications Infrastructure.

.5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.

.6 TIA-598 (Latest Edition), Optical Fiber Cable Color Coding.

1.3 DEFINITIONS

.1 Refer to TIA -598 (Latest Edition), Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.4 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables to link TCP/IP connected equipment to switch in main control panel.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

.1 Cables and all cable accessories (termination, jacks, etc.) shall be of one manufacturer throughout.

2.2 FOUR-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

.1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 or MPG or CMG to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: [TIA -568.0 (latest edition).

2.3 MULTI-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

.1 Not Required.

2.4 WORK AREA UTP 4-PAIR MODULAR JACK

.1 Eight-position modular jack ("RJ-45"), type T568ACategory 6 to: TIA -568.0 (latest edition)

.1 In self-contained surface-mount box,

.2 Mounted in compatible single gang faceplate, angle entry, jack positions per faceplate as indicated.

2.5 UTP PATCH CORDS

.1 Length: as required for a complete, tidy installation. Provide patch cords of shortest length which can be utilised for the installation.

.2 Factory-installed male plug at both ends to mate with "RJ-45" jack, Category 6, 4 pairs to: TIA -568.0 (latest edition).

2.6 UTP HORIZONTAL CABLING FOR TCP/IP CONNECTED EQUIPMENT

.1 Length: as required.

.2 Factory-installed male plug on both ends to mate with "RJ-45" jack, Category 6 to: TIA -568.0 (latest edition).

2.7 UTP WORK AREA CORDS

.1 Not Required

PART 3 EXECUTION

.1 Installation of cabling, terminations, and hardware shall be conducted in compliance with the best practices identified in the BICSI Telecommunications Distribution Methods Manual (TDMM).

.2 All cabling runs must maintain minimum separation from sources of EMI interference including line voltage, high voltage, ballast/switching power supplies, and transformers. Cables found to be in conflict with sources of EMI will be required to be re-routed at no cost to the owner.

.3 Cables must be installed as per manufacturer's recommendations, pull tension must not exceed the maximum allowable strength.

.4 Cables found to have been superficially damaged (kinked or torn jackets, etc.) will be required to be replaced at no cost to the owner even if the link test meets minimum standards.

.5 Cable dressing and bundling shall be made using Velcro straps. Use of zip ties or other non-approved restraints shall not be allowed. Any installed non-standard cable bundling products shall be removed, the cables inspected for damage, and if necessary replaced.

.6 Prior to installing cables, contractor must review raceway for the run and allow to provide drop outs, supporting waterfalls, grommets, and any other reasonable miscellaneous cable restraints/support hardware as needed.

.7 Cable support products such as jhooks and other supports shall be manufactured specifically for the purpose of supporting communications cable. Site fabricated frames or other supports shall be allowed only as noted in writing.

.8 Maximum cable lengths are not to exceed 90 meters for CAT cable (including patch cords in communication room and at equipment end). Fiber lengths are not to exceed those recommended by the manufacturer. Contractor must plan installation routing and alert the engineer if any links are found to exceed or be within 3 meters of maximum distance. Planning must take place prior to starting rough-in or preparatory cutting/coring work. No extras will be allowed for revision of raceway or preparatory cutting/coring installation that was not coordinated before installation began.

3.2 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Not Required.

3.3 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Not Required

3.4 INSTALLATION OF EQUIPMENT CABLES

.1 Cables shall be installed and terminated by manufacturer certified technician.

.2 Install equipment cables from equipment as indicated.

.1 Identify and label as indicated to: TIA-60 (Latest Edition)

3.5 WARRANTY

.1 Warranty for complete communications cabling assembly shall be extended to 25 years.

3.6 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies provide complete record of results as electronic record on USB memory stick.

.1 Perform tests 100% of cross-connected data horizontal cabling to:

.1 Category 5e using certified level IIe tester to: TIA -568 (Latest Edition).

.2 Category 6 using certified level III tester to: TIA -568 (Latest Edition).

.2 Tests for CAT 5e and CAT 6 cables shall include: wiremap, propagation delay, delay skew, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, ACR, and PSACR.

.1 Provide report summary identifying links with pass, fail, conditional pass, and conditional fail.

.2 Failing or conditionally failing links must be corrected and re-tested at the Contractor's expense.

.3 Conditional Pass links must be highlighted and will, at the discretion of the Owner and Consultant, be required to be corrected and re-tested at the Contractor's expense.

.3 Perform Wire Map tests on multi-pair UTP cables to: TIA -568 (Latest Edition).

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 33 65 75 Direct Buried Underground Cable Ducts.

1.3 MEASUREMENT PROCEDURES

.1 Excavated materials will be measured in cubic metres in their original location.

.1 Common excavation quantities measured will be actual volume removed within following limits:

.1 Width for trench excavation as indicated.

.2 Width for excavation for structures as indicated.

.3 Depth from ground elevation immediately prior to excavation, to final depth of trench.

.2 Rock quantities measured will be actual volume removed within following limits:

.1 Width for trench excavation as indicated.

.2 Width for excavation for structures to be bounded by vertical planes up to 500 mm outside of and parallel to neat lines of footings as indicated.

.3 Depth from rock surface elevations immediately prior to excavation, to elevation as indicated.

.4 Where design elevation is less than 300 mm below original rock surface, depth will be considered to be 300 mm below original rock surface.

.5 Volume of individual boulders and rock fragments will be determined by measuring three maximum mutually perpendicular dimensions.

.2 Shoring, bracing, cofferdams, underpinning and de-watering of excavation will not be measured separately for payment.

.3 Backfilling to authorized excavation limits will be measured in cubic metres compacted in place for each type of material specified.

.4 Placing and spreading of topsoil will be measured for payment in cubic metres calculated from cross sections taken in area of excavation from original location.

.1 If double handling of topsoil is directed by Consultant (stockpiling and later placing), then quantities will be measured twice; on excavation from original location and on excavation from stockpile.

1.4 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C117 (Current Edition), Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136 (Current Edition), Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422-63(Current Edition), Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698 (Current Edition), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ^{3}) (600 kN-m/m ^{3}).

.5 ASTM D1557 (Current Edition), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ^{3}) (2,700 kN-m/m ^{3}).

.6 ASTM D4318 (Current Edition), Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1 (Current Edition), Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2 (Current Edition), Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A3000 (Current Edition), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001 (Current Edition), Cementitious Materials for Use in Concrete.

.2 CSA-A23.1/A23.2 (Current Edition), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.4 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.5 DEFINITIONS

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock : solid material in excess of 1.00 m ^{3} and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m^3 bucket. Frozen material not classified as rock.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

.3 Topsoil:

.1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.

.4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.7 Unsuitable materials:

.1 Weak, chemically unstable, and compressible materials.

.2 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 ASTM C136: Sieve sizes to CAN/CGSB-8.2.

.2 Table:

Sieve Designation	% Passing
2.00 mm	[100]
0.10 mm	[45 - 100]
0.02 mm	[10 - 80]
0.005 mm	[0 - 45]

.3 Coarse grained soils containing more than [20] % by mass passing 0.075 mm sieve.

.8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Quality Control: in accordance with Section 01 45 00 - Quality Control:

.1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.

.2 Submit for review by Consultant proposed dewatering methods as described in PART 3 of this Section.

.3 Submit to Consultant written notice at least 7 days prior to excavation work, to ensure cross sections are taken.

.4 Submit to Consultant written notice when bottom of excavation is reached.

.5 Submit to Consultant testing and inspection results report as described in PART 3 of this Section.

.3 Preconstruction Submittals:

.1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.

.2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field.

1.7 QUALITY ASSURANCE

.1 Qualification Statement: submit proof of insurance coverage for professional liability.

.2 Where Consultant is employee of Contractor, submit proof that Work by Consultant is included in Contractor's insurance coverage.

.3 Submit design and supporting data at least 2 weeks prior to beginning Work.

.4 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.

.5 Keep design and supporting data on site.

.6 Engage services of qualified professional Engineer who is registered or licensed in Province of BC, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

.7 Do not use soil material until written report of soil test results are reviewed by Consultant.

.8 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Divert excess materials from landfill to local facility for reuse as directed by Owner.

1.9 EXISTING CONDITIONS

.1 Examine soil report included in Contract Documents

.2 Buried services:

.1 Before commencing work establish location of all buried services on and adjacent to site.

.1 Perform ground penetrating radar (GPR) Scan of all areas to be excavated.

.2 Provide Consultant with results of Scan including location of all underground services in CAD drawing format.

.3 Review results of GPR Scan with Consultant prior to commencing excavation work.

.4 Establish location and state of use of buried utilities and structures.

.5 Mark locations of all buried utilities and structures with survey marking paint.

.6 Where crossing of buried services and structures identified by GPR scan is required, confirm locations of buried utilities by careful test excavations prior to commencing excavation Work.

.2 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.3 Size, depth and location of existing buried utilities and structures are not known. Buried services in areas of excavation may include but are not limited to: water lines, sewer lines, communications lines, low voltage (600 and 208V) power, high voltage distribution.

.4 Prior to beginning excavation Work, notify Consultant.

.5 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.6 Where utility lines or structures exist in area of excavation, obtain direction of Consultant before proceeding with Work.

.7 Record location of maintained, re-routed and abandoned underground lines.

.8 Confirm locations of recent excavations adjacent to area of excavation.

.3 Existing buildings and surface features:

.1 Conduct, with Consultant, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Consultant

.3 Where required for excavation, cut roots or branches.

.4 Restore existing surface features to original condition after completion of excavation Work.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Type 1 and Type 2 fill: properties to and the following requirements:

.1 Crushed, pit run or screened stone, gravel or sand free from clay lumps, cementation, and organic material.

.2 Gradations to be within limits specified when tested to ASTM C136 or ASTM C117 as applicable. Sieve sizes to CAN/CGSB-8.2.

.2 Type 3 fill: selected material from excavation or other sources, approved by Consultant for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Sand: clean, washed, coarse sand free from clay, shale, and organic matter.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/PROTECTION

.1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures and applicable local regulations.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Consultant approval.

.4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.5 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

.1 Begin topsoil stripping of areas after area has been cleared of brush or grasses and removed from site.

.2 Strip topsoil to as required.

.1 Do not mix topsoil with subsoil.

.3 Stockpile in locations as indicated as directed by Owner.

.1 Stockpile height not to exceed 2 m and should be protected from erosion.

3.5 STOCKPILING

.1 Stockpile fill materials in areas designated by Consultant.

.1 Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Health and Safety Act for the Province of BC.

.2 During backfill operation:

.1 Unless otherwise indicated or directed by Consultant, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.

.3 When sheeting is required to remain in place, cut off tops at elevations as indicated.

.4 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

.2 Remove excess materials from site.

3.7 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.3 Protect open excavations against flooding and damage due to surface run-off.

.4 Dispose of water in as directed by Owner and in manner not detrimental to public and private property, or portion of Work completed or under construction.

3.8 EXCAVATION

.1 Advise Consultant and Owner at least 5 days in advance of excavation operations.

.2 Excavation must not interfere with bearing capacity of adjacent foundations.

.3 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.4 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Consultant.

.5 Restrict vehicle operations directly adjacent to open trenches.

.6 Dispose of surplus and unsuitable excavated material off site.

.7 Do not obstruct flow of surface drainage or natural watercourses.

.8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.9 Notify Consultant when bottom of excavation is reached.

.10 Obtain Consultant approval of completed excavation.

.11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Consultant.

.12 Correct unauthorized over-excavation as follows:

.1 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected Standard Proctor maximum dry density.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated on Drawings.

.2 Place bedding and surround material in unfrozen condition.

3.10 BACKFILLING

.1 Vibratory compaction equipment.

.2 Do not proceed with backfilling operations until completion of following:

.1 Consultant has inspected and approved installations.

.2 Consultant has inspected and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.4 Removal of concrete formwork.

.5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfilling around installations:

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

.3 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Consultant:

.2 If approved by Consultant, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Consultant.

.7 Consolidate and level unshrinkable fill with internal vibrators.

3.11 RESTORATION

.1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Consultant.

.2 Reinstate lawns to elevation which existed before excavation.

.3 Reinstate gravel roadways disturbed by excavation to thickness, structure and elevation which existed before excavation.

.4 Clean and reinstate areas affected by Work as directed by Consultant.

.5 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.6 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 11 00 – Summary of Work.

.3 Section 26 05 00 – Common Work Results – Electrical

.4 Section 26 05 14 – Power Cables and Overhead Conductors

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 211. (latest edition), Rigid Types EBI and DB2/ES2 PVC Conduit.

.2 CSA C22.2 No. 211.3 (latest edition), Reinforced Thermosetting Resin Conduit (RTRC) and Fittings (Bi-national standard, with UL 1684).

1.3 SUBMITTALS

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

.2 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for solvent cement. Indicate VOC content.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and Handle materials in accordance with Section 26 05 00 – Common Work Results Electrical

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 Construction-Demolition Waste management

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Dispose of unused solvent cement at an official hazardous material collections sites as approved by Consultant. Do not dispose of unused solvent cement into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct: to CSA C22.2 No. 211.1, type rigid PVC for direct burial with minimum wall thickness at any point of 2.8 mm. Nominal length: 3.0 m plus or minus 12 mm. Type DB2 (thinwall) PVC conduits unacceptable.

.2 Duct sizes per Drawings.

.3 Rigid PVC split ducts.

.4 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.5 Rigid PVC 90° and 45° bends.

.6 Rigid PVC 5° angle couplings.

.7 Use epoxy coated galvanized steel conduit for sections extending above finished grade.

.8 Expansion joints at transition to EMT at building entry.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 FIBREGLASS DUCTS

.1 Not Required

2.4 PLASTIC POLYETHYLENE PIPE

.1 Rigid plastic polyethylene pipe with approved couplings and fittings required to make complete installation.

2.5 CABLE PULLING EQUIPMENT

.1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.6 MARKERS

.1 Markers on grade not required.

.2 150 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tape. Install at depth as per drawings.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install duct in accordance with manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5 m throughout duct length.

.4 Slope ducts with 1 to 400 minimum slope.

.5 During construction, cap ends of ducts to prevent entrance of foreign materials.

.6 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end. Pull rope shall be left in spare ducts for future use.

.8 Install markers as required.

.9 Do not conceal conduits until written approval from Consultant is provided.

.10 Do not conceal mechanical protection until written approval from Consultant is provided.

END OF SECTION