

Section Number	Section Title	No. of Pages
Division 00 - Procurement and Contracting Requirements		
00 01 07	Seals Page	1
00 01 10	Table of Contents	1
00 01 15	List of Drawing Sheets	1
Division 01 - General Requirements		
01 11 00	Summary of Work	5
01 32 16.16	Construction Progress Schedule – Critical Path Method	11
01 33 00	Submittal Procedures	4
01 35 25	Special Procedures on Lockout Requirements	4
01 35 29.06	Health and Safety Requirements	6
01 35 43	Environmental Procedures	2
01 35 54	Site Security Requirements	2
01 45 00	Quality Control	2
01 51 00	Temporary Utilities	2
01 61 00	Common Product Requirements	3
01 74 00	Cleaning	2
01 74 19	Waste Management and Disposal	2
01 77 00	Closeout Procedures	1
01 78 00	Closeout Submittals	5
01 79 00	Demonstration and Training	2
01 91 13	General Commissioning Requirements	9
01 91 31	Commissioning Plan	11
Division 26 - Electrical		
26 05 00	Common Work Results for Electrical	10
26 05 03	Electrical Removals and Alterations	3
26 05 20	Wire and Box Connectors (0-1000V)	2
26 05 21	Wires and Cables (0-1000V)	3
26 05 28	Grounding – Secondary	3
26 05 29	Hangers and Supports for Electrical Systems	2
26 05 32	Outlet boxes, Conduit Boxes and Fittings	2
26 05 34	Conduits, Conduit Fastenings and Conduit Fittings	3
26 24 02	Service Entrance Switchgear	7
26 24 05	Service Entrance TVSS Protection	3
Division 27 - Communications		
27 05 26	Grounding and Bonding for Communication Systems	3
27 05 28	Pathways for Communication Systems	3
27 10 05	Structured Cabling for Communication Systems	5

END OF SECTION

Number	Title
E1	Partial Level 1 Electrical
E2	Proposed Remote Control Station Detail and Schematic
E3	Main Switchgear Elevations
E4	Main Switchgear Identification Nameplates
E5	Revised Power Distribution Single Line Diagram
E6	Existing Power Distribution Single Line Diagram

END OF SECTION

Part 1 General

1.1 DESCRIPTION OF WORK

- .1 In general, work under this contract consists of:
 - .1 Removal and replacement of protective devices in the main switchboard. Existing breakers and fused disconnect switches to be replaced by draw-out power circuit breakers.
 - .2 Removal and replacement of the automatic transfer control circuitry in the main switchboard.
 - .3 Removal and replacement of the remote-control station for remote breaker operation.
 - .4 Commissioning services to start up the equipment once the retrofit is complete.
 - .5 Supply of power to the site (via a diesel generator) during power outages needed to accomplish the work on the main switchboard. Temporary power to be supplied via an 800 kW, 600V, 3 Phase, 4W portable generator. The generator to be wired into the system via a connection box normally used for connection of a portable load bank.
- .2 Site of Work is at: Summerside Taxation Centre, 275 Pope Road, Summerside PE.
- .3 Where contractor is unsure of work to be performed, he shall request direction from Departmental Representative prior to proceeding with work.
- .4 Whenever it is proposed to make a change or changes in the design, agreement or type of equipment called for in this specification, the electrical contractor shall estimate the cost of same and submit in triplicate detailed itemized estimates of the costs of all apparatus, materials and labour entering into the change or substitution.
- .5 All work on retrofitting the existing switchgear to be carried out by personnel from the manufacturer supplying the equipment.
- .6 All project related work requiring a shutdown of power for the building must be done between the hours of Saturday 1:00 AM and Sunday 11:00 PM.

1.2 FAMILIARIZATION WITH SITE

- .1 Prior to the tender closing date, the contracting officer may arrange a site visit. Bidders are encouraged to attend the site visit to assess existing conditions, obstructions, materials, etc. No extras shall be entertained by failure to do so.

1.3 CODES AND STANDARDS

- .1 Perform work in accordance with the National Building Code of Canada (NBC) 2015 and National Fire Code of Canada (NFC) 2015 NFPA 101-2018 Life Safety Code and any other code of provincial or local application, including all amendments up to bid closing date, provided that in any case of conflict or discrepancy, the more stringent requirement shall apply.

- .2 Materials and workmanship must meet or exceed requirements of specified standards, codes and referenced documents.
- 1.4 INTERPRETATION OF DOCUMENTS
 - .1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.
- 1.5 TERM ENGINEER
 - .1 Unless specifically stated otherwise, the term Engineer where used in the Specifications and on the Drawings shall mean the Departmental Representative as defined in the General Conditions of the Contract.
- 1.6 COST BREAKDOWN
 - .1 Before submitting first progress claim submit breakdown of Contract Amount in detail as directed by Departmental Representative and aggregating contract amount. Required forms will be provided for application of progress payment.
 - .2 List items of work numerically following the same division/section number system of the specification manual and thereafter sub-divide into major work components and building systems as directed by Departmental Representative.
 - .3 Upon approval, cost breakdown will be used as basis for progress payment.
- 1.7 DOCUMENTS REQUIRED
 - .1 Maintain at job site, one copy each of the following:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda and amendments.
 - .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 stipulated elsewhere in the Contract Documents.
- 1.8 PERMITS
 - .1 In accordance with the General Conditions, obtain and pay for building permit, certificates, licenses and other permits as required by municipal, provincial and federal authorities.
 - .2 Provide appropriate notifications of project to municipal and provincial inspection authorities.

- .3 Obtain compliance certificates as prescribed by legislative and regulatory provisions of municipal, provincial and federal authorities as applicable to the performance of work.
 - .4 Submit to Departmental Representative, copy of application forms and approval documents received from above referenced authorities.
- 1.9 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 Departmental Representative to facilitate execution of work.
 - .2 Where security has been reduced by work of Contract, provide temporary means to maintain security.
 - .3 Where elevators exist in the building, only those assigned for Contractor's use may be used for moving workers and material within building. Protect walls of passenger elevators, to approval of Departmental Representative prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.
 - .4 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas which will be operative during such work.
- 1.10 ROUGHING-IN
- .1 Be responsible for obtaining manufacturer's literature and for correct roughing-in and hook-up of equipment, fixtures and appliances.
- 1.11 CUTTING, FITTING AND PATCHING
- .1 Ensure that cutting and patching required by all trades is included in total bid amount submitted for the work.
 - .2 Execute cutting, fitting and patching required to make work fit properly.
 - .3 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work. This includes patching of openings in existing work resulting from removal of existing services.
 - .4 Do not cut, bore, or sleeve load-bearing members, except where specifically approved by Departmental Representative.
 - .5 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
 - .6 Fit work airtight to pipes, sleeves ducts and conduits.
- 1.12 CONCEALMENT
- .1 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.13 LOCATION OF FIXTURES

- .1 Location of equipment, fixtures and outlets, shown or specified shall be considered as approximate. Actual location shall be as required to suit conditions at time of installation and as is reasonable.
- .2 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.
- .3 Inform Departmental Representative when impending installation conflicts with other new or existing components. Follow directives for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.14 EXISTING SERVICES

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to tenant operations.
- .2 Before commencing work, establish location and extent of service lines in area of work and notify Departmental Representative of findings.
- .3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. This includes disconnection of electrical power and communication services to tenant's operational areas. Adhere to approved schedule and provide notice to affected parties.
- .4 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .5 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .6 Protect, relocate or maintain existing active services as required. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction over service. Record locations of maintained, re-routed and abandoned service lines.

1.15 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.

1.16 ASBESTOS DISCOVERY

- .1 Demolition of spray or trowel-applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered in course of work, stop work and notify Departmental Representative immediately. Do not proceed with relevant work until written instructions have been received from Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 11 00 – Summary of Work.

1.2 REFERENCE STANDARDS

- .1 Project Management Institute (PMI Standards)
 - .1 A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Sixth Edition.
 - .2 Practice Standard for Scheduling - 2011.

1.3 DEFINITIONS

- .1 Activity: Distinct, scheduled portion of work performed during course of a project.
- .2 Activity Duration: time in calendar units between start and finish of a scheduled activity. See also Duration.
- .3 Assumption: factor in planning process that is considered true, real, or certain without proof or demonstration.
- .4 Bar Chart (Gantt Chart): graphic display of schedule-related information.
 - .1 In typical bar chart, schedule activities or work breakdown structure components are listed down left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
- .5 Baseline: approved version of a work product that can be changed only through formal change control procedures and is used as a basis for comparison.
- .6 Budget: approved estimate for a project or work breakdown structure component or schedule activity.
- .7 Cash Flow: projection of progress payment requests based on cash loaded construction schedule.
- .8 Change Control: process whereby modifications to documents, deliverables, or baselines associated with a project are identified, documented, approved, or rejected.
- .9 Completion Milestones: they are firstly Substantial Completion and secondly Final Certificate.
- .10 Constraint: scheduled limiting factor that effects execution of a project, program, portfolio, or process.

- .11 Contract: mutually binding agreement that obligates a seller to provide a specified product or service or result and obligates a buyer to pay for it.
- .12 Control: comparing actual performance with planned performance, analyzing variance, assessing trends, to effect process improvements, evaluating possible alternatives, and recommending appropriate corrective action as needed.
- .13 Corrective Action: intentional activity that realigns performance of project work with project management plan.
- .14 Critical Path: sequence of activities that represents longest path through a project, which determines shortest possible duration.
- .15 Critical Path Activity: activity on critical path in a project schedule.
- .16 Critical Path Method (CPM): method used to estimate minimum project duration and determine amount of scheduling flexibility on logical network of paths within schedule model.
- .17 Data Date: point in time when the status of the project is recorded.
- .18 Decomposition: technique used for dividing and subdividing project scope and project deliverables into smaller, more manageable parts.
- .19 Deliverable: unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.
- .20 Duration: total number of work periods (not including holidays or other non-working periods) required to complete a schedule activity or work breakdown structure component.
 - .1 Usually expressed as workdays or work weeks.
- .21 Early Finish Date (EF): in Critical Path Method, earliest possible point in time when uncompleted portions of schedule activity can finish based on schedule network logic, data date, and schedule constraints.
 - .1 Early finish dates can change as Project progresses and changes are made to Project plan.
- .22 Early Start Date (ES): in Critical Path Method, earliest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, data date, and schedule constraints.
 - .1 Early start dates can change as Project progresses and changes are made to Project Plan.
- .23 Execute: directing, managing, performing, and accomplishing project work; providing deliverables, and providing work performance information.

- .24 Finish Date: point in time associated with a schedule activity's completion.
 - .1 Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
- .25 Float: (also known as slack) amount of time a schedule activity can be delayed without delaying early start date of a successor or violating a schedule constraint.
 - .1 This resource is available to both PWGSC and Contractor.
- .26 Forecast: estimate or prediction of conditions and events in project future based on information and knowledge available at time of forecast.
 - .1 Information is based on projects past performance and expected future performance, and includes information that could impact project in future, a such as estimate at completion and estimate to complete.
- .27 Gantt Chart: see Bar Chart.
- .28 Impact Analysis: schedule analysis technique that adds a modeled delay to an accepted construction schedule to determined possible outcome of that delay on project completion.
- .29 Imposed Date: a fixed date imposed on a schedule activity or schedule milestone, usually in form of a "start no earlier than" and "finish no later than" date.
- .30 Lag: amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.
- .31 Late Finish Date (LF): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can finish based on schedule network logic, project completion date, and schedule constraints.
- .32 Late Start Date (LS): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, project completion date, and schedule constraints.
- .33 Lead: amount of time whereby a successor activity can be advanced with respect to a predecessor activity.
- .34 Logic Diagram: see Project network diagram.
- .35 Logical Relationship: dependency between two activities or between an activity and a milestone.
- .36 Master Schedule: summary-level schedule that identifies major deliverable; work breakdowns structure components, and key schedule milestones.
- .37 Milestone: significant point or event in a project, program, or portfolio.
- .38 Monitor: collect project performance data with respect to a plan, procedure performance measures, and report and disseminate performance.

- .39 Network: see Project Schedule Network Diagram.
- .40 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .41 Project Control System: fully computerized system utilizing commercially available software packages.
- .42 Project Management: application of knowledge, skills, tools, and techniques, to project activities to meet project requirements.
- .43 Project Management Plan: approved document that describes how project will be executed, monitored, and controlled.
 - .1 Primary uses of Project management plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines.
 - .2 Project management plan may be summary or detailed.
- .44 Project Management Planning: development and maintenance of Project Management Plan.
- .45 Project Management Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.
- .46 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.
- .47 Project Schedule Network Diagram: graphical representation of logical relationships among project schedule activities.
 - .1 Always drawn from left to right to reflect Project chronology.
- .48 Project Scope: work performed to deliver a product, service, or result with specified features and functions.
- .49 Quantified days duration: working days based on 5-day work week, discounting statutory holidays.
- .50 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on one or more project objectives.
- .51 Schedule: see Project Schedule.
- .52 Schedule Data: collection of information for describing and controlling schedule.
- .53 Scope: see Project Scope.
- .54 Start Date: point in time associated with activity s start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.

- .55 Work Breakdown Structure (WBS): hierarchical decomposition of total scope of work to be carried out by project team to accomplish project objectives and create the required deliverables.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Project Meeting:
 - .1 Meet with Departmental Representative.
 - .2 Participate in regular project progress meetings with Departmental Representative specifically intended to discuss update of detailed schedule and contract changes.
- .2 Scheduling:
 - .1 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.
 - .2 Ensure project schedule efficiencies through monitoring of project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
 - .3 Monitor sufficiently often so that causes of delays can immediately be identified and mitigated.
- .3 Project monitoring and reporting:
 - .1 Keep team aware of changes to schedule, and potential consequences as project progresses.
 - .2 Use narrative reports to provide advice on seriousness of challenges and measures to overcome them.
 - .3 Begin narrative reporting with statement on general status of project followed by summarization of delays, potential problems, corrective measures and project status criticality.
- .4 Critical Path Method (CPM) Requirements:
 - .1 Ensure Master Plan and Detail Schedule are practical and remain within specified contract duration.
 - .2 Revise Master Schedule and Detail Schedule deemed impractical by Departmental Representative and resubmit for approval.
 - .3 Change to Contract Duration:
 - .1 Acceptance of Master Schedule and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract.
 - .2 Duration of Contract may only be changed through bilateral Agreement.
 - .4 Consider Master Schedule and Detail Schedule deemed practical by Departmental Representative, showing Work completed in less than specified Contract duration, to have float.

- .5 First Milestone on Master Schedule and Detail Schedule will identify start Milestone with an Early Start, ES, constraint date equal to Award of Contract date.
- .6 Calculate dates for completion of milestones from Plan and Schedule using specified time periods for Contract.
- .7 Substantial Completion with Late Finish, LF, constraint equal to calculated date.
- .8 Calculations on updates such that if early finish of Interim Certificate falls later than specified Contract duration then revise the float calculation to reflect negative float.
- .9 Delays to non-critical activities with float may not be basis for time extension.
- .10 Do not use float suppression techniques such as preferential sequencing, imposed dates other than required by Contract, software constraints, extended activity times and special lead/lag logic restraints.
- .11 Allow for adverse weather conditions normally anticipated and show in Master Plan and Detail Schedule.
 - .1 Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
- .12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration.
 - .1 Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.
- .13 Arrange participation on and off site of subcontractors and suppliers, as required by Departmental Representative, for purpose of network planning, scheduling, updating and progress monitoring.
 - .1 Approvals by Departmental Representative of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
- .14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit to Departmental Representative Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to Departmental Representative for approval.
 - .1 Failure to comply with each required submission, may result in progress payment being withheld in accordance with Federal Government's GC 5 Terms of Payment.
- .4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.

- .5 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.
- .6 Refer to article PROGRESS MONITORING AND REPORTING of this specification Section for frequency of Project control system submittals.
- .7 Submit impact analysis of schedule for changes that result in extension of contract duration.
 - .1 Include draft schedule update and report as outlined in article PROGRESS MONITORING AND REPORTING.
- .8 Submit Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting as required by Departmental Representative in following form.
 - .1 Master Schedule Bar Chart.
 - .2 Construction Detail Schedule Bar Chart.
 - .3 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.
 - .4 Criticality report listing activities and milestones with up to 5 days total float used as first sort for ready identification of near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
- 1.6 QUALITY ASSURANCE
 - .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.
- 1.7 WORK BREAKDOWN STRUCTURE (WBS)
 - .1 Prepare construction Work Breakdown Structure (WBS) within
 - .1 Develop WBS through at least five levels: project, stage, element, sub-element and work package.
- 1.8 PROJECT MILESTONES
 - .1 Project milestones form targets for both Master Schedule and Detail Schedule of CPM construction network system.
 - .1 Switchgear shutdown to take measurements for new components, verify dimensions etc.
 - .2 Submittal of engineered shop drawings for retrofitted switchgear from manufacturer.
 - .3 Equipment delivery and component fabrication schedules.
 - .4 Preparations to carry out shutdown work.

.5 Shutdowns and commissioning staging.

1.9 MASTER SCHEDULE

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Schedule (CPM logic diagram) and dependent Cash Flow Projection within
 - .1 Master Schedule will be used as baseline.
 - .1 Revise baseline as conditions dictate and as required by Departmental Representative.
 - .2 Departmental Representative as Project progresses will review and return revised baseline within 5 days.
- .3 Reconcile revisions to Master Schedule and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Schedule will include:
 - .1 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
 - .2 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
 - .3 Actual/projected monthly cash flow: expressed monthly and shown in both graphical and numerical form.

1.10 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within
 - .1 Shop drawings.
 - .2 Samples.
 - .3 Approvals.
 - .4 Procurement.
 - .5 Construction.
 - .6 Installation.
 - .7 Site works.
 - .8 Testing.
 - .9 Commissioning and acceptance.
- .2 Detail CPM schedule to cover in detail minimum period of
 - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
 - .2 Detail activities completely and comprehensively throughout duration of project.
- .3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Schedule.

- .4 Clearly show sequence and interdependence of construction activities and indicate:
 - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
 - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
 - .1 Time for submittals, resubmittals and review.
 - .2 Time for fabrication and delivery of manufactured products for Work.
 - .3 Interdependence of procurement and construction activities.
 - .3 Include sufficient detail to assure adequate planning and execution of Work. Activities generally range in duration from 1 to 2 workdays each.
 - .5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow coordination and control of project activities. Show continuous flow from left to right.
 - .6 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form Critical Path. Increased number of critical activities is seen as indication of increased risk.
 - .7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Departmental Representative for review effects created by insertion of new Change Order.
- 1.11 REVIEW OF CONSTRUCTION DETAIL SCHEDULE
- .1 Allow minimum 5 work days for review by Departmental Representative of proposed construction Detail Schedule unless otherwise specified.
 - .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Departmental Representative for review within maximum 5 work days unless otherwise specified.
 - .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Departmental Representative.
 - .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.
- 1.12 COMPLIANCE WITH DETAIL SCHEDULE
- .1 Comply with reviewed Detail Schedule.
 - .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by Departmental Representative.

- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel with more experience/qualifications on site for effected activities or work package.
 - .2 Additional work shifts or shutdowns.
- .4 Submit to Departmental Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. As part of supporting evidence, include:
 - .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
 - .2 Prepared schedule indicating how change will be incorporated into overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
 - .3 Other supporting evidence requested by Departmental Representative.
 - .4 Do not assume approval of Contract extension prior to receipt of written approval from Departmental Representative.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
 - .1 Departmental Representative will determine and advise Contractor the number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.
 - .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

1.13 PROGRESS MONITORING AND REPORTING

- .1 On an ongoing basis, Detail Schedule on job site to show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update weekly, after each shutdown period. Update to reflect activities completed to date, activities in progress, logic and duration changes.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Departmental Representative copies of updated Detail Schedule.

- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit weekly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate potential delay. Include in report:
 - .1 Description of progress made.
 - .2 Pending items and status of: possible time extensions, shop drawings, change orders and permits.
 - .3 Status of Contract completion date and milestones.
 - .4 Current and anticipated problem areas, potential delays and corrective measures.
 - .5 Review of progress and status of Critical Path activities.

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 RELATED REQUIREMENTS

- .1 Section 01 78 00 – Closeout Submittals.

1.2 SUBMITTAL GENERAL REQUIREMENTS

- .1 Submit to Departmental Representative for review requested submittals specified in various sections of the specifications including shop drawings, samples, permits, compliance certificates, test reports, work management plans and other data required as part of the work.
- .2 Submit with reasonable promptness and in orderly sequence so as to allow for Departmental Representative's review and not cause delay in Work. Failure to submit in ample time will not be considered sufficient reason for an extension of Contract time and no claim for extension by reason of such default will be allowed.
- .3 Do not proceed with work until relevant submissions have been reviewed.
- .4 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .5 Where items or information is not produced in SI Metric units, provide soft converted values.
- .6 Review submittals prior to submission. Ensure that necessary requirements have been determined and verified and that each submittal has been checked and coordinated with requirements of Work and Contract Documents.
 - .1 Submittals not stamped, signed, dated and identified as to specific project will be returned unexamined by Departmental Representative and considered rejected.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .9 Contractor's responsibility for errors, omissions or deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative's review.
- .10 Submittal format:
 - .1 Submit paper originals, or alternatively clear and fully legible photocopies of originals. Facsimiles are not acceptable, except in special circumstances pre-approved by Departmental Representative. Poorly printed non-legible photocopies or facsimiles will not be accepted and be returned for resubmission.
 - .2 Submit in electronic format as pdf files. Forward pdf and in the native program format, MS Word, MS Excel, MS Project, Autocad dwg and photograph jpg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

- .11 Make changes or revision to submissions which Departmental Representative may require, consistent with Contract Documents and resubmit as directed by Departmental Representative. When resubmitting, identify in writing of any revisions other than those requested.
- .12 Keep one reviewed copy of each submittal document on site for duration of Work.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means fabrication drawings, erection drawings, diagrams, illustrations, schedules, performance charts, technical product data, brochures, specifications, test reports, installation instructions and other data which are to be provided by the Contractor to illustrate compliance with specified materials and details of a portion of work.
- .2 Shop Drawing Quantities: submit sufficient copies required by the General Contractor and sub-contractors plus 3 copies which will be retained by Departmental Representative.
 - .1 Ensure sufficient copies are submitted to enable one complete set to be included in each of the maintenance manuals specified in Section 01 78 00 – Closeout Submittals.
- .3 Shop Drawings Format:
 - .1 Opaque white prints or photocopies of original drawings or standard drawings modified to clearly illustrate work specific to project requirements. Maximum sheet size to be 1000 x 707 mm.
 - .2 Product Data from manufacturer's standard catalogue sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products, to be original full colour brochures, clearly marked indicating applicable data and deleting information not applicable to project.
 - .3 Non or poorly legible drawings, photocopies or facsimiles will not be accepted and returned not reviewed.
- .4 Shop Drawings Content:
 - .1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where items or equipment attach or connect to other items or equipment, confirm that all interrelated work have been coordinated, regardless of section or trade from which the adjacent work is being supplied and installed.
 - .2 Supplement manufacturer's standard drawings and literature with additional information to provide details applicable to project.
 - .3 Delete information not applicable to project on all submittals.
 - .4 Equipment installation/start-up data: include manufacturer's recommended installation instructions, pre-start and start-up checklists for those pieces of equipment and systems designated to be commissioned as specified in Section 01 91 13 – General Commissioning (Cx) Requirements.
- .5 Allow 14 calendar days for Departmental Representative's review of each submission.

- .6 Adjustments or corrections made on shop drawings by Departmental Representative are not intended to change Contract Amount. If adjustments affect value of Work, advise Departmental Representative in writing prior to proceeding with Work.
- .7 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections and comments are made, fabrication and installation may proceed upon receipt of shop drawings. If shop drawings are rejected and noted to be Resubmitted, do not proceed with that portion of work until resubmission and review of corrected shop drawings, through same submission procedures indicated above.
- .8 Be advised that costs and expenses incurred by Departmental Representative to conduct more than one review of incorrectly prepared shop drawing submittal for a particular material, equipment or component of work may be assessed against the Contractor in the form of a financial holdback to the Contract.
- .9 Accompany each submission with transmittal letter containing:
 - .1 Date.
 - .2 Project title and project number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .10 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and project 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 Cross references to particular details of contract drawings and specifications section number for which shop drawing submission addresses.
 - .6 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 and power requirements.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.

- .11 After Departmental Representative's review, distribute copies.
- .12 The review of shop drawings by the Departmental Representative or by an authorized designate is for sole purpose of ascertaining conformance with general concept. This review shall not mean that Canada approves the detail design inherent in the shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of the construction and Contract Documents. 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 coordination of Work of all sub-trades.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Procedures to isolate and lockout electrical facility and other equipment from energy sources.

1.2 RELATED REQUIREMENTS

- .1 Section 01 35 29.06 – Health and Safety Requirements.

1.3 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 C22.1-18, Canadian Electrical Code (CEC), Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 C22.3 No.1-15, Overhead Systems.
 - .3 C22.3 No.7-15, Underground Systems.
 - .4 Z462-18, Workplace Electrical Safety.
- .2 COSH: Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.

1.4 DEFINITIONS

- .1 Electrical Facility: means any system, equipment, device, apparatus, wiring, conductor, assembly or part thereof that is used for the generation, transformation, transmission, distribution, storage, control, measurement or utilization of electrical energy, and that has an amperage and voltage that is dangerous to persons.
- .2 Guarantee of Isolation: means a guarantee by a competent person in control or in charge that a particular facility or equipment has been isolated.
- .3 De-energize: in the electrical sense, that a piece of equipment is isolated and grounded, e.g. if the equipment is not grounded, it cannot be considered de-energized (DEAD).
- .4 Guarded: means that an equipment or facility is covered, shielded, fenced, enclosed, inaccessible by location, or otherwise protected in a manner that, to the extent that is reasonably practicable, will prevent or reduce danger to any person who might touch or go near such item.
- .5 Isolate: means that an electrical facility, mechanical equipment or machinery is separated or disconnected from every source of electrical, mechanical, hydraulic, pneumatic or other kind of energy that is capable of making it dangerous.
- .6 Live/alive: means that an electrical facility produces, contains, stores or is electrically connected to a source of alternating or direct current of an amperage and voltage that is dangerous or contains any hydraulic, pneumatic or other kind of energy that is capable of making the facility dangerous to persons.

1.5 COMPLIANCE REQUIREMENTS

- .1 Comply with the following in regard to isolation and lockout of electrical facilities and equipment:
 - .1 Canadian Electrical Code.
 - .2 Federal and Provincial Occupational Health and Safety Acts and Regulations.
 - .3 Regulations and code of practice as applicable to mechanical equipment or other machinery being de-energized.
 - .4 Procedures specified herein.
- .2 In event of conflict between any provisions of above authorities the most stringent provision will apply.

1.6 SUBMITTALS

- .1 Submit copy of lockout procedures, sample of lockout permit and lockout tags proposed for use in accordance with Section 01 33 00 – Submittal Procedures. Submit within 14 calendar days of acceptance of bid.
- .2 Submit copy of Method of Procedures (MOPs) for lockout procedures for shutdown activities requiring lock-out to Departmental Representative for review at least one week in advance of commencement of work.

1.7 ISOLATION OF EXISTING SERVICES

- .1 Obtain Departmental Representative's written authorization prior to working on existing live or active electrical facilities and equipment and before proceeding with isolation of such item.
- .2 To obtain authorization, submit to Departmental Representative the following documentation:
 - .1 Written request to isolate the particular service or facility and;
 - .2 Copy of Contractor's Lockout Procedures.
- .3 Make a Request for Isolation for each event, unless directed otherwise by Departmental Representative, as follows:
 - .1 Fill-out standard form in current use at the Facility as provided by Departmental Representative or;
 - .2 Where no form exists, make written request indicating:
 - .1 The equipment, system or service to be isolated and its location;
 - .2 Duration of isolation period (ie: start time & date and completion time & date).
 - .3 Voltage of service feed to system or equipment being isolated.
 - .4 Name of person making the request.
- .4 Do not proceed with isolation until receipt of written notification from Departmental Representative granting the Isolation Request and authorization to proceed with the work.
 - .1 Note that Departmental Representative may designate another person at the Facility being authorized to grant the Isolation Request.

- .5 Conduct safe, orderly shutdown of equipment or facility. De-energize, isolate and lockout power and other sources of energy feeding the equipment or facility.
- .6 Determine in advance, as much as possible, in cooperation with the Departmental Representative, the type and frequency of situations which will require isolation of existing services.
- .7 Plan and schedule shut down of existing services in consultation with the Departmental Representative and the Facility Manager. Minimize impact and downtime of Facility operations. Follow Departmental Representative's directives in this regard.
- .8 Conduct hazard assessment as part of the process in accordance with health and safety requirements specified Section 01 35 29.06 – Health and Safety Requirements.

1.8 LOCKOUTS

- .1 De-energize, isolate and lockout electrical facility, mechanical equipment and machinery from all potential sources of energy prior to working on such items.
- .2 Contractor personnel to wear appropriate PPE for the Arc-Flash and Shock Hazard while performing project lockout procedures and testing.
- .3 Develop and implement clear and specific lockout procedures to be followed as part of the Work.
- .4 Prepare typed written Lockout Procedures describing safe work practices, procedures, worker responsibilities and sequence of activities to be followed on site by workforce to safely isolate an active piece of equipment or electrical facility and effectively lockout and tagout its sources of energy.
- .5 Include as part of the Lockout Procedures a system of lockout permits managed by Contractor's Superintendent or other qualified person designated by him/her as being "in-charge" at the site.
 - .1 A lockout permit shall be issued to specific worker providing a Guarantee of Isolation before each event when work must be performed on a live equipment or electrical facility.
 - .2 Duties of person managing the permit system to include:
 - .1 Issuance of permits and lockout tags to workers.
 - .2 Determining permit duration.
 - .3 Maintaining record of permits and tags issued.
 - .4 Making a Request for Isolation to Departmental Representative when required as specified above.
 - .5 Designating a Safety Watcher, when one is required based on type of work.
 - .6 Ensuring equipment or facility has been properly isolated.
 - .7 Collecting and safekeeping lockout tags returned by workers as a record of the event.

- .6 Clearly establish, describe and allocate responsibilities of:
 - .1 Workers.
 - .2 Person managing the lockout permit system.
 - .3 Safety Watcher.
 - .4 Subcontractor(s) and General Contractor.
 - .7 Generic procedures, if used, must be edited and supplemented with pertinent information to reflect specific project requirements.
 - .1 Incorporate site-specific rules and procedures in force at site as provided by Facility Manager through the Departmental Representative.
 - .2 Clearly label the document as being the Lockout procedures applicable to work of this contract.
 - .8 Use energy isolation lockout devices specifically designed and appropriate for type of facility or equipment being locked out.
 - .9 Use industry standard lockout tags.
 - .10 Provide appropriate safety grounding and guards as required.
- 1.9 CONFORMANCE
- .1 Brief all workers and subcontractors on requirements of this section. Stringently enforce use and compliance.
- 1.10 DOCUMENTS ON SITE
- .1 Post Lockout Procedures on site in common location for viewing by workers.
 - .2 Keep copies of Request for Isolation forms and lockout permits and tags issued to workers on site for full duration of Work.
 - .3 Upon request, make available to Departmental Representative or to authorized safety representative for inspection.
- Part 2 Products
- 2.1 NOT USED
- Part 3 Execution
- 3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 25 – Special Procedures on Lockout Requirements.

1.2 DEFINITIONS

- .1 COSH: Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.
- .2 Competent Person: means a person who is:
 - .1 Qualified by virtue of personal knowledge, training and experience to perform assigned work in a manner that will ensure the health and safety of persons in the workplace, and;
 - .2 Knowledgeable about the provisions of occupational health and safety statutes and regulations that apply to the Work.
- .3 Medical Aid Injury: any minor injury for which medical treatment was provided and the cost of which is covered by Workers' Compensation Board of the province in which the injury was incurred.
- .4 PPE: personal protective equipment
- .5 Work Site: where used in this section shall mean areas, located at the premises where Work is undertaken, used by Contractor to perform all of the activities associated with the performance of the Work.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 10 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 found in work plan.
- .3 Submit electronic copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS SDS - Safety Data Sheets as required.

- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 10 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 10 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative'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.

1.4 HEALTH AND SAFETY PLAN

- .1 Prior to commencement of Work, develop written Health and Safety Plan specific to the Work. Implement, maintain, and enforce Plan for entire duration of Work and until final demobilization.
- .2 Health and Safety Plan shall include the following components:
 - .1 List of health risks and safety hazards identified by hazard assessment.
 - .2 Control measures used to mitigate risks and hazards identified.
 - .3 On-site Contingency and Emergency Response Plan as specified below.
 - .4 On-site Communication Plan as specified below.
 - .5 Name of Contractor's designated Health & Safety Site Representative and information showing proof of his/her competence and reporting relationship in Contractor's company.
 - .6 This designated Health & Safety Site Representative, in addition to their regular duties, will act as Health and Safety Supervisor and be responsible for implementing, enforcing and monitoring health and safety provisions.
 - .7 Names, competence and reporting relationship of other supervisory personnel used in the Work for occupational health and safety purposes.
- .3 On-site Contingency and Emergency Response Plan shall include:
 - .1 Operational procedures, evacuation measures and communication process to be implemented in the event of an emergency.
 - .2 Name, duties and responsibilities of persons designated as Emergency Warden(s) and deputies.
 - .3 Emergency Contacts: name and telephone number of officials from:
 - .1 General Contractor and subcontractors.
 - .2 Pertinent Federal and Provincial Departments and Authorities having jurisdiction.
 - .3 Local emergency resource organizations.
- .4 On-site Communication Plan:
 - .1 Procedures for sharing of work related safety information to workers and subcontractors, including emergency and evacuation measures.
- .5 Address all activities of the Work including those of subcontractors.
- .6 Review Health and Safety Plan regularly during the Work. Update as conditions warrant to address emerging risks and hazards, such as whenever new trade or subcontractor arrives at Work Site.

- .7 Departmental Representative will respond in writing, where deficiencies or concerns are noted and may request re-submission of the Plan with correction of deficiencies or concerns.
 - .8 Post copy of the Plan, and updates, prominently on Work Site.
- 1.5 FILING OF NOTICE
- .1 File Notice of Project with Provincial authorities prior to beginning of Work.
- 1.6 HAZARD ASSESSMENT
- .1 Perform site-specific health and safety hazard assessment of the Work and its site.
 - .2 Carry out initial assessment prior to commencement of Work with further assessments as needed during progress of work, including when new trades and subcontractors arrive on site.
 - .3 Record results and address in Health and Safety Plan.
 - .4 Keep documentation on site for entire duration of the Work.
 - .5 Implement and carry out a health and safety hazard assessment program as part of the work. Program to include:
 - .1 Initial hazard assessments carried out immediately upon notification of contract award and prior to commencement of work.
 - .2 On-going hazard assessments performed during the progress of work identifying new or potential health risks and safety hazards not previously known. As a minimum, hazard assessments shall be carried out when:
 - .1 New subtrade work, new subcontractor(s) or new workers arrive at the site to commence another portion of the work.
 - .2 The scope of work has been changed by Change Order.
 - .3 Potential hazards or weakness in current health and safety practices are identified by Departmental Representative or by an authorized safety representative.
 - .6 Each hazard assessment to be made in writing. Keep copies of all assessments on site for duration of work. Upon request, make available to Departmental Representative for inspection.
- 1.7 PROTECTION
- .1 Provide temporary facilities for protection and safe passage of public pedestrians and vehicular traffic around and adjacent to work site.
 - .2 Provide safety barricades, lights and signage of work site as required, providing a safe working environment for workers.
 - .3 Carry out work placing emphasis on Health & Safety of the Public, Facility Personnel, Construction Works and Protection of the Environment.

1.8 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.9 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 Contractor will be responsible and assume the role Constructor as described in the PEI Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 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.

1.10 SITE CONTROL AND ACCESS

- .1 Control the Work and entry points to Work Site. Approve and grant access only to workers and authorized persons. Immediately stop and remove non-authorized persons.
- .2 Isolate Work Site from other areas of the premises by use of appropriate means.
 - .1 Erect fences, hoarding, barricades and temporary lighting as required to effectively delineate the Work Site, stop non-authorized entry, and to protect pedestrians and vehicular traffic around and adjacent to the Work and create a safe environment.
 - .2 Post signage at entry points and other strategic locations indicating restricted access and conditions for access.
- .3 Provide safety orientation session to persons granted access to Work Site. Advise of hazards and safety rules to be observed while on site.
- .4 Ensure persons granted site access wear appropriate PPE. Supply PPE to inspection authorities who require access to conduct tests or perform inspections.

1.11 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act for Province of Prince Edward Island, and Occupational Health and Safety Regulations made pursuant to the Act.
- .2 Comply with Canada Labour Code - Part II (entitled Occupational Health and Safety) and the Canada Occupational Health and Safety Regulations (COSH) as well as any other regulations made pursuant to the Act.
 - .1 The Canada Labour Code can be viewed at: [www.http://laws.justice.gc.ca/en/L-2/](http://laws.justice.gc.ca/en/L-2/)
 - .2 COSH can be viewed at: [www.http://laws.justice.gc.ca/eng/SOR-86-304/n_e.html](http://laws.justice.gc.ca/eng/SOR-86-304/n_e.html)
 - .3 A copy may be obtained at: Canadian Government Publishing Public Works & Government Services Canada Ottawa, Ontario, K1A 0S9 Tel: (819) 956-4800 (1-800-635-7943) Publication No. L31-85/2000 E or F)

1.12 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 Departmental Representative verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety coordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.13 HEALTH AND SAFETY COORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
 - .1 Have working knowledge of occupational safety and health regulations.
 - .2 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.
 - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .4 Be on site during execution of Work.

1.14 POSTING OF DOCUMENTS

- .1 Post permits, licenses and compliance certificates, specified in Section 01 11 00 – Summary of Work, at Work Site.
- .2 Where a particular permit or compliance certificate cannot be obtained, notify Departmental Representative in writing and obtain approval to proceed before carrying out applicable portion of work.
- .3 Obtain permits, licenses and compliance certificates, at appropriate times and frequency as stipulated by authorities having jurisdiction.

1.15 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.16 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.

1.17 PROJECT/SITE CONDITIONS

- .1 Following are potential health, environmental and safety hazards at the site for which Work may involve contact with:
 - .1 Electrical hazards.
 - .2 Lock Out Procedures required.
 - .3 PPE Requirements.
- .2 Facility on-going operations:
 - .1 The Contractor will cooperate with users of existing facilities.
 - .2 Should interferences occur, take directions from Departmental Representative.
 - .3 Do not unreasonably encumber site with materials.
 - .4 Move stored products or equipment which interfere with operations.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade the environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 DISPOSAL OF WASTE AND HAZARDOUS MATERIALS

- .1 Do not bury rubbish and waste materials on site. Dispose at approved landfill sites as specified in Section 01 74 19 – Waste Management and Disposal.
- .2 Do not dispose of hazardous waste or volatile materials, such as mineral spirits, paints, thinners, oil or fuel into waterways, storm or sanitary sewers or waste landfill sites.
- .3 Store, handle and dispose of hazardous materials and hazardous waste in accordance with applicable federal and provincial laws, regulations, codes and guidelines.
- .4 Dispose of construction waste materials and demolition debris, resulting from work, at approved landfill sites only. Carry out such disposal in strict accordance with provincial and municipal rules and regulations. Separate out and prevent improper disposal of items banned from landfills.
- .5 Establish method and undertake construction practices which will minimize waste and optimize use of construction materials. Separate at source, all construction waste materials, demolition debris and product packaging and delivery containers into various waste categories in order to maximize recycling abilities of various materials and avoid disposal of debris at landfill site(s) in a "mixed state". Where recycling firms, specializing in recycling of specific materials exist, transport such materials to the recycling facility and avoid disposal at landfill sites.
- .6 Communicate with landfill operator prior to commencement of work, to determine what specific construction, demolition and renovation waste materials have been banned from disposal at the landfill and at transfer stations.

1.3 PERMITS

- .1 All guidelines and instructions stated on permits must be strictly adhered to.

1.4 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Due to nature of this Facility, and client operations therein, security regulations pertaining to site will be in place during the work resulting in need for:
 - .1 Control and limit movement of construction workers inside building;
 - .2 Escort and continuous supervision of workers by security personnel;
 - .3 Specific rules and regulations as specified in this section and as directed by the Departmental Representative to be stringently followed.
- .2 It is the Contractor's responsibility to:
 - .1 Become familiar with and abide by security rules and regulations;
 - .2 Brief all workers and subcontractors in respect of the security regulations and ensure that they abide by all rules and directives.
- .3 The Departmental Representative will coordinate a pre-construction meeting between Contractor, Facility Management and Security Personnel who will provide details and directives on control and movement on site.
- .4 Any infraction of site security regulations on the part of the Contractor, members of work force or any Subcontractor in his employ, could result in:
 - .1 Financial penalties in the form of progress payment reduction or holdback assessments being levied against the Contractor and;
 - .2 Demand immediate removal of offending party from the site.

1.2 SECURITY CONTROL LIST

- .1 Provide a list of employee names from workforce and from subcontractors who will be present at site during the course of work.
- .2 List to include each person's name, address and telephone number.
- .3 Submit copy of list to Departmental Representative for control of workers.
- .4 Update list as work progresses.
- .5 Ensure that each worker can provide proof of identity upon demand, when requested by Facility's Security Personnel, Departmental Representative or by Facility Management.

1.3 SITE SECURITY

- .1 Where work of this contract requires use of a permanently locked door, it is Contractor's responsibility to ensure that door is unlocked and locked after each use or provide a competent security guard, posted at door, when door must remain open for an elongated period of time during a particular work shift.
 - .1 Notify Facility Management when security doors will be used and stringently follow all directives to ensure building security is effectively maintained.
- .2 Where work of this contract results in removal of doors or walls (providing security to the exterior or between spaces and suites), erect temporary security hoarding over openings constructed in such a way to provide the same degree of security as doors/walls removed.
- .3 When work must be carried out during Off Hours or beyond the work hours previously agreed upon at start of work, provide notice within 48 hours beforehand to minimize impact on Facility's security and tenant operations.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.2 INSPECTION

- .1 Give timely notice requesting inspection of Work designated for special tests, inspections or approvals by Departmental Representative or by inspection authorities having jurisdiction.
- .2 In accordance with the General Conditions, Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.
- .3 If Contractor covers or permits to be covered Work designated for special tests, inspections or approvals before such is made, uncover Work until particular inspections or tests have been fully and satisfactorily completed and until such time as Departmental Representative gives permission to proceed.
- .4 Pay costs to uncover and make good work disturbed by inspections and tests.

1.3 TESTING

- .1 Tests on materials, equipment and building systems as specified in various sections of the Specifications is the responsibility of the Contractor except where stipulated otherwise.
 - .1 Provide all necessary instruments, equipment and qualified personnel to perform tests.
- .2 At completion of tests, turn over 2 sets of fully documented tests reports to the Departmental Representative. Submit in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Obtain additional copies for inclusion of a complete set in each of the maintenance manuals specified in Section 01 78 00 – Closeout Submittals.
- .3 Unspecified tests may also be made by Departmental Representative, at the discretion of the Departmental Representative. The costs of these tests will be paid for by the Departmental Representative.
- .4 Where tests or inspections reveal work not in accordance with contract requirements, Contractor shall pay costs for additional tests and inspections incurred by Departmental Representative as required to verify acceptability of corrected work.
- .5 Project work will take place over several weekend shutdowns. Contractor to ensure that all equipment installed is completed, tested, inspected and commissioned before returning system over to client after each shutdown. (all phasing to be confirmed)

1.4 REJECTED WORK

- .1 Remove and replace defective Work, whether result of poor workmanship, use of defective or damaged products and whether incorporated in Work or not, which has been identified by Departmental Representative as failing to conform to Contract Documents.
- .2 Make good damages to new and existing construction and finishes resulting from removal or replacement of defective work.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SITE ACCESS AND PARKING

- .1 The Departmental Representative will designate Contractor's access to project site as well as parking facilities for equipment and workers.

1.2 BUILDING ACCESS

- .1 Use only access doors, and circulation routes and elevators within building as designated by Departmental Representative to access interior work.

1.3 CONTRACTOR'S SITE OFFICE

- .1 Be responsible for and provide own site office, if required, including electricity, heat, lights and telephone. Locate site office as directed by Departmental Representative.

1.4 MATERIAL STORAGE

- .1 Material storage space on site is limited. Coordinate delivery to minimize storage period on site before being needed for incorporation into work.

1.5 SANITARY FACILITIES

- .1 Sanitary facilities are available at the site and may be used by Contractor's work force. Make arrangements for the use of such facilities through the Departmental Representative.

1.6 POWER

- .1 Arrange, pay for and maintain temporary electrical power supply to supply power to the emergency board E1 during outages when utility power to the main switchboard must be interrupted.
- .2 Temporary power to be supplied via an 800 kW, 600V, 3 Phase, 4W portable generator. The generator can be wired into the system via a connection box normally used for connection of a portable load bank. Provide mechanical protection for the temporary cabling or conduits running from the generator to the load bank connection box.
- .3 Pay for all costs associated with generator rental, setup, maintenance and fuel during the duration of the project. Ensure that a local diesel mechanic is on call for operational and maintenance requirements and to deal with any breakdowns, faults, issues with the temporary generator during the complete shutdown process.
- .4 Provide and pay all costs to supply and install temporary cabling, switching devices and other equipment as required to connect into power source, provide adequate ground fault protection and extend power supply from existing source to work areas. Perform work and make all connections in accordance with the CSA C22.1-18 Canadian Electrical Code, in compliance with the federal and provincial Occupational Health and Safety Regulations as specified in Section 01 35 29.06 – Health and Safety Requirements and to lockout requirements specified in Section 01 35 25 – Special Procedures on Lockout Requirements.

- .5 During power shutdown the facilities generator will need to be locked out and the facilities transfer switch manually set to the emergency source so that the temporary generator supplies power to the facilities Critical Power Switchboard NE-1.
- .6 Coordinate with the facility manager and Departmental Representative to ensure that critical loads needed for the extended shutdown period are powered, specifically the buildings heating system.

1.7 REMOVAL OF TEMPORARY FACILITIES

- .1 Remove temporary facilities from site when directed by Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Use new material and equipment unless otherwise specified.
- .2 Within 7 days of written request by Departmental Representative, submit following information for any materials and products proposed for supply:
 - .1 Name and address of manufacturer.
 - .2 Trade name, model and catalogue number.
 - .3 Performance, descriptive and test data.
 - .4 Compliance to specified standards.
 - .5 Manufacturer's installation or application instructions.
 - .6 Evidence of arrangements to procure.
 - .7 Evidence of manufacturer delivery problems or unforeseen delays.
- .3 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.
- .4 Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified.
- .5 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.

1.2 PRODUCT QUALITY

- .1 Contractor shall be solely responsible for submitting relevant technical data and independent test reports to confirm whether a product or system proposed for use meets contract requirements and specified standards.
- .2 Final decision as to whether a product or system meets contract requirements rest solely with the Departmental Representative in accordance with the General Conditions of the Contract.

1.3 ACCEPTABLE MATERIALS AND ALTERNATIVES

- .1 Acceptable Materials: When materials specified include trade names or trademarks or manufacturer's or supplier's name as part of the material description, select and only use one of the names listed for incorporation into the Work.
- .2 Alternative Materials: Submission of alternative materials to trade names or manufacturer's names specified must be done during the bidding period following procedures indicated in the Instructions to Bidders.
- .3 Substitutions: After contract award, substitution of a specified material will be dealt with as a change to the Work in accordance with the General Conditions of the Contract.

1.4 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods to be used. Do not rely on labels or enclosure provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions, so that Departmental Representative will designate which document is to be followed.

1.5 AVAILABILITY

- .1 Immediately notify Departmental Representative in writing of unforeseen or unanticipated material delivery problems by manufacturer. Provide support documentation as per clause 1.1.2 above.

1.6 WORKMANSHIP

- .1 Ensure quality of work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed.
- .2 Remove unsuitable or incompetent workers from site as stipulated in the General Conditions of the Contract.
- .3 Ensure cooperation of workers in laying out work. Maintain efficient and continuous supervision on site at all times.
- .4 Coordinate placement of openings, sleeves and accessories.

1.7 FASTENINGS – GENERAL

- .1 Provide metal fastenings and accessories in same texture, colour and finish as base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non-corrosive fasteners, anchors and spacers for securing exterior work and in humid areas.
- .2 Space anchors within limits of load bearing or shear capacity and ensure that they provide positive permanent anchorage. Wood or organic material plugs not acceptable.
- .3 Keep exposed fastenings to minimum, space evenly and lay out neatly.
- .4 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- .5 Do not use explosive actuated fastening devices unless approved by Departmental Representative. See section 01 35 29.06 – Health and Safety Requirements in this regard.

1.8 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.
- .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 and, use resilient washers with stainless steel.

1.9 STORAGE, HANDLING AND PROTECTION

- .1 Deliver, handle and store materials in manner to prevent deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled materials in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work. Provide additional cover where manufacturer's packaging is insufficient to provide adequate protection.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .5 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.
- .6 Immediately remove damaged or rejected materials from site.
- .7 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .3 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

1.2 MATERIALS

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

1.3 CLEANING DURING CONSTRUCTION

- .1 Maintain work areas in a tidy condition, free from accumulations of waste material and debris. Clean areas on a daily basis.
- .2 Provide on-site waste containers for collection of waste materials and debris.
- .3 Use separate collection bins, clearly marked as to purpose, for source separation and recycling of waste and debris in accordance with waste management requirements specified.
- .4 Remove waste materials, and debris from site on a daily basis.
- .5 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .6 Immediately clean all dust, dirt, smears, scuffs and soiled surfaces in lobbies, corridors, stairwells and within tenant occupied areas resulting from the Work.
 - .1 Perform cleaning, dusting and washing operations, carpet vacuuming (including shampooing if deemed required by Departmental Representative) and floor washing as necessary to thoroughly clean all soiled surfaces.
- .7 Remove snow and ice from access doors used by workforce.

1.4 FINAL CLEANING

- .1 In preparation for acceptance of the completed work perform final cleaning.
- .2 Remove grease, dust, dirt, stains, labels, fingerprints, marks and other foreign materials, from interior and exterior finished surfaces. Clean and polish surfaces including glass, mirrors, hardware, wall tile, stainless steel, chrome, baked enamel, plastic laminate, mechanical and electrical fixtures.
- .3 Replace items with broken pieces, scratches or if disfigured.
- .4 New switchboard upgraded breaker housings such as doors and outside cell frontages must be painted to match current main switchboard.
- .5 Clean lighting reflectors, lenses, and other lighting surfaces.
- .6 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .7 Inspect finishes, fitments and equipment. Ensure specified workmanship and operation.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DISPOSAL OF WASTE

- .1 Separate and recycle waste materials designated for disposal.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bids for recycling.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Unused paint or coating material must be disposed of at an official hazardous material collections site as approved by Departmental Representative.
- .7 Do not dispose of unused paint material into sewer system, streams, lakes, onto ground, or in any other location where it will pose a health or environmental hazard.
- .8 Disposal of waste volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers is strictly prohibited.
- .9 Dispose of unused material at an official hazardous material collections site. Do not dispose of unused hazardous material into the sewer system, streams, lakes, on ground or in any other location where they will pose a health or environmental hazard.
- .10 Do not dispose of preservative treated wood through incineration.
- .11 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .12 Dispose of treated wood, end pieces, wood scraps and sawdust at a sanitary landfill.
- .13 Dispose of unused preservative material at an official hazardous material collections site. Do not dispose of unused preservative material into the sewer system, streams, and lakes, on ground or in any other location where they will pose a health or environmental hazard.
- .14 Burying of rubbish and waste materials is prohibited.
- .15 All waste material not designated for recycle to be disposed of at an approved waste disposal site in accordance with appropriate environmental guidelines.

1.2 STORAGE AND HANDLING OF WASTE

- .1 Store materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become property of the Contractor.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

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 or recycled into specific sort areas.

3.3 DIVERSION OF MATERIALS

- .1 Separate materials from general waste and stockpile in separate piles or containers, to approval of Departmental Representative, and consistent with applicable fire regulations. Mark containers or stockpile areas. Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable, or recyclable materials is not permitted.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Administrative procedures preceding inspection and acceptance of Work by Departmental Representative.

1.2 RELATED REQUIREMENTS

- .1 Section 01 78 00 – Closeout Submittals.

1.3 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Coordinate and perform, in concert with subcontractors, an inspection and check of all Work. Identify and correct deficiencies, defects, repairs and perform outstanding items as required to complete work in conformance with Contract Documents.
 - .1 Notify Departmental Representative in writing when deficiencies from Contractor's inspection have been rectified and that Work is deemed to be complete and ready for Departmental Representative's inspection of the completed work.
- .2 Departmental Representative's Inspection: Accompany Departmental Representative during all substantial and final inspections of the Work.
 - .1 Address defects, faults and outstanding items of work identified by such inspections.
 - .2 Advise Departmental Representative when all deficiencies identified have been rectified.
- .3 Note that Departmental Representative will not issue a Certificate of Substantial Performance of the work until such time that Contractor performs following work and turns over the specified documents:
 - .1 Project record as-built documents.
 - .2 Final Operations and Maintenance manuals.
 - .3 Maintenance materials, parts and tools.
 - .4 Compliance certificates from applicable authorities.
 - .5 Reports resulting from designated tests.
 - .6 Testing, adjusting and balancing of equipment and systems complete with submission of test reports.
 - .7 Commissioning of equipment and systems specified.
- .4 Correct all discrepancies before Departmental Representative will issue the Certificate of Completion.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Project Record Documents.
- .2 Operations and Maintenance data.

1.2 RELATED REQUIREMENTS

- .1 Section 01 79 00 – Demonstration and Training.

1.3 PROJECT RECORD DOCUMENTS

- .1 Departmental Representative will provide 2 white print sets of contract drawings and 2 copies of Specifications Manual specifically for "As-Built" purposes.
- .2 Maintain at site one set of the contract drawings and specifications to record actual As-Built site conditions.
- .3 Maintain up-to-date, real time as-built drawings and specifications in good condition and make available for inspection by the Departmental Representative upon request.
- .4 As-Built Drawings:
 - .1 Record changes in red ink on the prints. Mark only on one set of prints and at completion of work, neatly transfer notations to second set (also by use of red ink).
 - .2 Submit both sets along with a digital copy on a USB stick to Departmental Representative prior to application for Certificate of Substantial Performance.
 - .3 Stamp all drawings with "As-Built". Label and place Contractor's signature and date.
 - .4 Show all modifications, substitutions and deviations from what is shown on the contract drawings.
 - .5 Record following information:
 - .1 Field changes of dimension and detail;
 - .2 Location of all capped or terminated services and utilities.
 - .3 Chases for mechanical, electrical and other services;
 - .4 All design elevations, sections, floor plans and details dimensioned and marked-up to consistently report finished installation conditions;
 - .5 Any details produced in the course of the contract by the Departmental Representative to supplement or to change existing design drawings;
 - .6 All change orders issued over the course of the contract must be documented on the finished As-Built documents, accurately and consistently depicting the changed condition as it applies to all affected drawing details.

- .5 As-Built Specifications: legibly mark in red each item to record actual construction, including:
 - .1 Changes made by Addenda and Change Orders.
 - .2 Mark up both copies of specifications; stamp "As-Built", sign and date similarly to drawings as per above clause.
 - .3 Submit both copies along with a digital copy on a USB stick to Departmental Representative prior to application for Certificate of Substantial Performance.
 - .6 Maintain As-Built documents current as the contract progresses. Departmental Representative will conduct reviews and inspections of the documents on a regular basis. Failure to maintain as-builts current and complete to satisfaction of the Departmental Representative shall be subject to financial penalties in the form of progress payment reductions and holdback assessments.
 - .7 Submit on paper and in electronic format as pdf files. Forward pdf and in the native program format, MS Word, MS Excel, MS Project and Autocad dwg and photograph jpg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.
- 1.4 REVIEWED SHOP DRAWINGS
- .1 Provide a complete set of all shop drawings reviewed for project to incorporate into each copy of the Operations and Maintenance Manuals.
 - .2 Submit full sets at same time and as part of the contents of the Operation and Maintenance Manuals specified.
- 1.5 OPERATIONS & MAINTENANCE MANUAL
- .1 O&M Manual - Definition: an organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of the specifications.
 - .2 Manual Language: final manuals to be in English.
 - .1 Upon review and acceptance by Departmental Representative, submit 3 final copies. Interim copies are not to be considered as part of the final copies unless they have been fully revised and are identical to the final approved version.
 - .3 Submission Date: submit complete operation and maintenance manual to Departmental Representative 3 weeks prior to application for Certificate of Substantial Performance of the work.
 - .4 Binding:
 - .1 Assemble, coordinate, bind and index required data into Operation and Maintenance Manual.
 - .2 Use vinyl, hard covered, 3 "D" ring binders, loose leaf, sized for 215 x 280 mm paper, with spine pocket.
 - .3 Where multiple binders are needed, correlate data into related consistent groupings.

- .4 Identify contents of each binder on spine.
- .5 Organize and divide data following same numerical system as the section numbers of the Specification Manual.
- .6 Dividers: separate each section by use of cardboard dividers and labels. Provide tabbed fly leaf for each individual product and system and give description of product or component.
- .7 Type lists and notes. Do not hand write.
- .8 Drawings, diagrams and manufacturers' literature must be legible. Provide with reinforced, punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .5 Manual Contents:
 - .1 Cover sheet containing:
 - .1 Date submitted.
 - .2 Project title, location and project number.
 - .3 Names and addresses of Contractor, and all Sub-Contractors.
 - .2 Table of Contents: provide full table of contents in each binder(s), clearly indicate which contents are in each binder.
 - .3 List of maintenance materials.
 - .4 List of spare parts.
 - .5 List of special tools.
 - .6 Original or certified copy of warranties and product guarantees.
 - .7 Copy of approval documents and certificates issued by Inspection Authorities.
 - .8 Copy of reports and test results performed by Contractor as specified.
 - .9 Product Information (PI Data) on materials, equipment and systems as specified in various sections of the specifications. Data to include:
 - .1 List of equipment including manufacturer's name, supplier, local source of supplies and service depot(s). Provide full addresses and telephone numbers.
 - .2 Nameplate information including equipment number, make, size, capacity, model number and serial number.
 - .3 Parts list.
 - .4 Installation details.
 - .5 Operating instructions.
 - .6 Maintenance instructions for equipment.
 - .7 Maintenance instructions for finishes.
- .6 Shop drawings:
 - .1 Include complete set of reviewed shop drawings into each copy of the operations and maintenance manual.
 - .2 Fold and bind material professionally in a manner that corresponds with the specification section numbering system.
 - .3 When large quantity of data is submitted, place into separate binders of same size as O&M binders.

- .7 Equipment and Systems Data: the following list indicates the type of data and extent of information required to be included for each item of equipment and for each system:
- .1 Description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
 - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .6 Servicing and lubrication schedule, and list of lubricants required.
 - .7 Manufacturer's printed operation and maintenance instructions.
 - .8 Sequence of operation by controls manufacturer.
 - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .10 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .11 Include test and balancing reports.
 - .12 Additional requirements as specified in individual specification sections.
- .8 Breaker and trip unit coordination curves and short circuit information for all electrical components. Final trip unit settings.

1.6 SPARE PARTS, TOOLS AND MAINTENANCE MATERIALS

- .1 Provide spare parts, special tools and extra materials for maintenance purposes in quantities specified in individual specification sections.
- .2 Tag all items with associated function or equipment.
- .3 Provide items of same manufacture and quality as items in Work.
- .4 Deliver to site in well packaged condition. Store in location as directed by Departmental Representative.
- .5 Clearly mark as to contents indicating:
 - .1 Part number.
 - .2 Identification of equipment or system for which parts are applicable.
 - .3 Installation instructions or intended use as applicable.
 - .4 Name, address and telephone number of nearest supplier.
- .6 Prepare and submit complete inventory list of items supplied. Include list within Maintenance Manual.

1.7 ARC FLASH LABELS

- .1 Provide arc-flash labels for equipment modified or installed or equipment changed by the installation of project equipment. Labels to contain information from the arc-flash study and match in style and size the labels currently installed at the facility.
- .2 Labels to comply with the standards set out in Z462-18 Workplace Electrical Safety.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Operations and Maintenance Manual: in accordance with Section 01 78 00 – Closeout Submittals.

1.2 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to facility personnel one week prior to date of substantial performance.
- .2 Departmental Representative will provide a list of facility personnel to receive instructions,
- .3 Cooperate with Departmental Representative in coordinating time and attendance of facility's personnel with manufacturer's training Representative(s).

1.3 QUALITY CONTROL

- .1 Ensure that only personnel from the Manufacturer providing the equipment are used to provide training and demonstrations.
- .2 When specified in individual Sections, obtain the manufacturers authorized Representative to demonstrate operation of equipment and systems, instruct facility personnel, and provide written report that demonstration and instructions have been completed.
- .3 Upon request, provide evidence to Departmental Representative of individual Trainer's knowledge and qualifications.

1.4 SUBMITTALS

- .1 Submit schedule of time, date and complete list of equipment and systems for which demonstration and training sessions will be provided. Submit schedule a minimum of 2 weeks prior to designated dates for Departmental Representative's approval.
- .2 Submit report within 1 week after completion of demonstration, that demonstration and instructions have been satisfactorily completed. Provide time and date of when each demonstration was actually given, with list of persons present.

1.5 CONDITIONS FOR DEMONSTRATIONS

- .1 Prior to carrying out demonstration and training, ensure that equipment has been inspected and tested, is fully operational, has been performance verified and TAB has been carried out.
- .2 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.6 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated personnel are present.

1.7 DEMONSTRATION AND INSTRUCTIONS

- .1 Include the following items within the demonstration and training:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each function of the equipment.
 - .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
 - .3 Review contents of manual in detail to explain all aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.
 - .5 Provide other specific training and instructions as specified in trade sections.

1.8 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Observe the allocated time period specified in trade sections. Provide additional time when required to ensure all personnel fully understand all aspects of the information and instructions being provided. Allow for questions by participants.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 Z320-11 (R2016), Building Commissioning Standard.
- .2 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 CxA – Commissioning Agent / Authority.
 - .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.

1.3 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required. Provide material, tools, labour and supervision necessary to assist the CxA in the verification and commissioning of the equipment and systems as outlined in this and related Sections.
 - .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.

1.4 COMMISSIONING OVERVIEW

- .1 Refer to Section 01 91 31 – Commissioning (Cx) Plan for additional information.
- .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 built 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 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative and CxA.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.5 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 CxA, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.6 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing to CxA.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Coordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.

- .6 Submit complete start-up documentation to the Departmental Representative and CxA.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to the Departmental Representative and CxA for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform the Departmental Representative and CxA in writing of discrepancies and deficiencies in finished works.
- 1.7 CONFLICTS
 - .1 Report conflicts between requirements of this section and other sections to Departmental Representative and CxA before start-up and obtain clarification.
 - .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.
- 1.8 ACTION AND INFORMATIONAL SUBMITTALS
 - .1 Submittals: submit to Departmental Representative and CxA in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to CxA for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to CxA 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 CxA.
- 1.9 COMMISSIONING DOCUMENTATION
 - .1 CxA to review and approve Cx documentation.
 - .2 Provide completed and approved Cx documentation to CxA.
- 1.10 COMMISSIONING SCHEDULE
 - .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.16 – Construction Progress Schedule – Critical Path Method (CPM).
 - .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

1.11 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, CxA to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Contractor, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.12 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 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Cx Team to witness of start-up and testing.
- .3 CxA reserves the right to witness start-up and testing.
- .4 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.14 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by the Departmental Representative.
 - .3 Arrange for Departmental Representative to witness tests.

- .4 Obtain written approval of test results and documentation from the Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with CxA.
 - .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.

1.15 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from the Departmental Representative and CxA after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Departmental Representative. 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 Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by the Departmental Representative.

- .3 If evaluation report concludes that major damage has occurred, the Departmental Representative 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.

1.16 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to the Departmental Representative and CxA for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit facility personnel to repeat start-up at any time.

1.17 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit to the Departmental Representative and CxA for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.18 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.19 START OF COMMISSIONING

- .1 Notify the Departmental Representative and CxA at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.20 INSTRUMENTS / EQUIPMENT

- .1 Submit to the Departmental Representative and CxA 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.

1.21 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.

1.22 WITNESSING COMMISSIONING

- .1 CxA and the Departmental Representative to witness activities and verify results.

1.23 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to the Departmental Representative and CxA within 5 days of test and with Cx report.

1.24 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify reported results based on the sampling strategy outlined in the Commissioning Plan, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of CxA.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 10% of reported results.

- .5 Perform additional commissioning until results are acceptable to CxA, the Departmental Representative.
- 1.25 REPEAT VERIFICATIONS
 - .1 Assume costs incurred by CxA and the Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive CxA or the Departmental Representative's approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 CxA deems Contractor's request for second verification was premature.
- 1.26 SUNDRY CHECKS AND ADJUSTMENTS
 - .1 Make adjustments and changes which become apparent as Cx proceeds.
 - .2 Perform static and operational checks as applicable and as required.
- 1.27 DEFICIENCIES, FAULTS, DEFECTS
 - .1 Correct deficiencies found during start-up and Cx to satisfaction the Departmental Representative and CxA.
 - .2 Report problems, faults or defects affecting Cx to the Departmental Representative and CxA in writing. Stop Cx until problems are rectified. Proceed with written approval from the Departmental Representative.
- 1.28 COMPLETION OF COMMISSIONING
 - .1 Upon completion of Cx leave systems in normal operating mode.
 - .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
 - .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by the Departmental Representative and CxA.
- 1.29 ACTIVITIES UPON COMPLETION OF COMMISSIONING
 - .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.
- 1.30 TRAINING
 - .1 In accordance with Section 01 79 00 – Demonstration and Training.
- 1.31 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS
 - .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.32 OCCUPANCY

- .1 Cooperate fully with the Departmental Representative and CxA during stages of acceptance and occupancy of facility.

1.33 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with the Departmental Representative and CxA.

1.34 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.35 DEPARTMENTAL REPRESENTATIVE'S PERFORMANCE TESTING

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.2 ACRONYMS

- .1 Cx - Commissioning.
- .2 CxA – Commissioning Agent / Authority.
- .3 BMM - Building Management Manual.
- .4 EMCS - Energy Monitoring and Control Systems.
- .5 ICL – Installation/Start-Up Check List.
- .6 MMS - Maintenance Management System.
- .7 SDS - Safety Data Sheets.
- .8 PI - Product Information.
- .9 PV - Performance Verification.
- .10 RFI – Request for Information.
- .11 TAB - Testing, Adjusting and Balancing.
- .12 WHMIS - Workplace Hazardous Materials Information System.

1.3 GENERAL

- .1 The goals of the Cx process are to provide:
 - .1 Systems, equipment and components to meet user's functional requirements before date of acceptance.
 - .2 Facility user and O&M personnel fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Cx.
 - .4 Describes process of verification of how built works meet the Departmental Representative 's design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.

- .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .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.
- 1.4 DEVELOPMENT OF FINAL CX PLAN
 - .1 The Contractor with input from the manufacturer is responsible for developing the preliminary and final Cx Plan.
 - .2 Contractor to provide a preliminary Cx Plan that sets out scope, standards, roles and responsibilities, expectations and deliverables. It is subject to change as project progresses.
 - .3 The CxA is responsible for approving the plans.
 - .4 Cx Plan to be finalized by the CxA to take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
 - .5 The CxA will provide the final Cx Plan prior to the start of the commissioning activities.
- 1.5 REFINEMENT OF CX PLAN
 - .1 During construction phase, the CxA will revise, refine and update Cx Plan to include:
 - .1 Changes resulting from program modifications.
 - .2 Approved design and construction changes.
- 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM
 - .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team and will act as the CxA.
 - .2 The CxA will coordinate the commissioning process. The Cx Team is expected to cooperate fully with the CxA.
 - .3 All members of the Cx Team to work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.
 - .4 A general description of the Cx roles is as follows:
 - .1 CxA:
 - .1 Reports to the Departmental Representative.
 - .2 Approves the Cx Plan developed by the Manufacturer.

- .3 Coordinates the Cx process.
- .4 Reviews Cx documentation and test reports for compliance with the contract documents.
- .5 Monitors operations and Cx activities.
- .6 Witnessing, certifying accuracy of reported results.
- .7 Witnessing and certifying TAB and other tests.
- .8 Ensuring implementation of final Cx Plan.
- .9 Performing verification of performance of installed systems and equipment.
- .10 Prepares final Cx report, with the assistance of the Cx Team.
- .2 Cx Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Assigning a Cx agent as point of contact with CxA for administrative and coordination purposes.
 - .2 Testing.
 - .3 TAB.
 - .4 Performance of Cx activities.
 - .5 Delivery of training and Cx documentation.
 - .6 Developing BMM.
 - .7 Implementation of Training Plan.
- .3 Contractor's Cx agent implements specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training.
 - .3 Testing.
 - .4 Preparation, submission of test reports.
- .4 Departmental Representative:
 - .1 Develops design criteria and intent, project specifications and drawings.
 - .2 Provides clarification on design criteria and intent to the Cx Team as required.
 - .3 Responds to RFI's relating to the commissioning process.
 - .4 Reviews installed equipment and systems for compliance with the tender documents prior to the commencement of Cx activities.
 - .5 Participates in the training process as required.
- .5 The Departmental Representative:
 - .1 Develops the project requirements.
 - .2 Gives final approval of the Cx work.
 - .3 Coordinates the involvement of user representatives in the Cx and training process.
 - .4 Day-to-day operation and maintenance of facility.

1.7 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: equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to the program but are outside scope or expertise of Cx specialists on this project.
 - .5 Facility Personnel: equipment for which they are the specialists.
- .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 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
 - .4 Redistribution of electrical services.
 - .5 Modifications of fire alarm systems.
 - .6 Modifications to voice communications systems.
- .3 Provide names of participants and details of instruments and procedures to be followed for Cx to CxA for review and approval.

1.8 EXTENT OF CX

- .1 Commissioning and training for systems and equipment listed below to be verified as part of the Cx process. Final systems and equipment list will be provided in the final Cx plan.
- .2 Systems and equipment to be commissioned includes, but is not limited to:
 - .1 Electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .2 Emergency power generation systems:
 - .1 Generators – check proper operation with upgraded switchgear.
 - .2 Transfer switchgear and controllers– check proper operation with upgraded switchgear.

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General requirements:
 - .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 SDS data sheets.

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:
 - .1 Cx Specifications.
 - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
 - .3 Completed installation checklists (ICL).
 - .4 Completed product information (PI) report forms.
 - .5 Completed performance verification (PV) report forms.
 - .6 Results of Performance Verification Tests and Inspections.
 - .7 Description of Cx activities and documentation.
 - .8 Description of Cx of integrated systems and documentation.
 - .9 Tests of following witnessed by CxA.
 - .10 Tests performed by the Departmental Representative /User.
 - .11 Training plans.
 - .12 Cx Reports.
 - .13 Prescribed activities during warranty period.
- .4 CxA to witness and certify tests and reports of results provided to the Departmental Representative.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by the Departmental Representative prior to permission to start up and rectification of deficiencies to the Departmental Representative satisfaction.
 - .2 Include completed documentation with Cx report.
 - .3 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Cx Team.
 - .4 CxA to monitor some of these inspections and tests.
 - .5 Include completed documentation in Cx report.
- .2 Pre-Cx activities - Electrical:
 - .1 Switchboard:
 - .1 Clean interior enclosure - blow out dust and dirt using a vacuum cleaner. Clean faces of instruments and viewing windows. Remove dust from all insulators and insulation.
 - .2 Check for heat damaged connections, loose wires and other defects. All repairs / tightening of hardware shall be performed using a calibrated torque wrench following manufacture's guidelines. In the absence of the manufacture's guidelines Table D6 of the Canadian Electrical Code can be utilized.
 - .3 Inspect bolted electrical connections for heating signs. Suspected heating connections shall be tested for high resistance using either a low-resistance ohmmeter or calibrated torque wrench as per manufacturer's instructions. All repairs / tightening of hardware shall be performed using a calibrated torque wrench following manufacture's guidelines. In the absence of the manufacture's guidelines Table D6 of the Canadian Electrical Code can be utilized.
 - .4 Check to ensure solid, vibration-free mounting.
 - .5 Check cover or door installation and locking device.
 - .6 Check security of conduits and fittings attached to enclosure.
 - .7 Check the grounding.
 - .8 Clean any air filters by washing in mild household detergent.
 - .9 Check instrument and control switches and inspect their contacts.
 - .10 Examine all indicating lamps and replace as required.
 - .11 Check terminal block contacts for loose connections.
 - .12 Check for proper condition of instrument transformers. Replace burned out fuses, if any. Check primary and secondary connections.
 - .13 Examine automatic shutters (if any) for proper operation.
 - .14 Examine all safety interlocks for correct operation.
 - .15 Check MOC (Mechanism Operated Contact) and TOC (Truck Operated Contact) switches (if provided) and their operating mechanisms for proper operation, and check their contacts.
 - .16 Check space heaters and thermostat (if fitted) for proper operation.

- .17 Inspect cable connections. All repairs / tightening of hardware shall be performed using a calibrated torque wrench following manufacture's guidelines. In the absence of the manufacture's guidelines Table D6 of the Canadian Electrical Code can be utilized.
- .18 Operate all control switches 3 times.
- .19 Ensure over current devices are correct sizes for both the anticipated load and short circuit potential.
- .20 Inspect and test all lightning \ surge arresters. (Test as per manufactures recommendations.)
- .21 Lubricate mechanisms, contacts, and other moving components.
- .22 Check for proper identification and update panel directory, tags, and single line drawings. Check for proper identification and up-to-date directory on panel.
- .23 Test and calibrate all meters, transducers and protective relays associated with the system.
- .24 After the equipment has been returned to service check the voltage and amperage on the primary wires.
- .2 Breakers:
 - .1 Remove interphase barriers and clean them and all other insulating surfaces with dry compressed air (or nitrogen gas), a vacuum cleaner, or clean lint-free rags and solvents as recommended by the manufacturer, to remove hardened or encrusted contamination.
 - .2 Inspect insulators and insulating materials for cracks, breaks and overheating. Check for electric distress, signs of corona, tracking and thermal damage as described in article 6-2.10 through 6-2.14 of NFPA 70B.
 - .3 Manually close the circuit breaker to check for proper wipe, pressure, contact alignment, and assure that all contacts are made at approximately at the same time. Check to spacing between stationary and movable contacts in the fully open position. Make all final adjustments in accordance with manufacturer's instructions.
 - .4 Check interrupts for broken or cracked ceramic parts, erosion of ceramics and dirt in interrupter. Some manufacturers also recommend a surface dielectric test of the ceramic surfaces near the contacts.
 - .5 Check air puffer devices and arc chutes or splitter plates for erosion, and repair or replace in accordance with manufacturer's instructions.
 - .6 Inspect operating mechanism for loose or broken parts; missing cotter pins or retaining keepers; missing nuts and bolts; and for binding or excessive wear. Ensure that the closing and tripping action is quick and positive, and correct binding or delays prior to returning to service.
 - .7 Inspect the closing motor or solenoid, shunt trip, auxiliary switches, and bell alarm switch for correct operation, insulation condition, and tightness of connections.
 - .8 Check on-off indicators, spring-charge indicators, mechanical and electrical interlocks, key interlocks, and padlocking fixtures for proper operation, and lubricate where required.

- .9 Check for general condition and tightness of current transformer, connection bolts, frame, fuses and mountings, and frame grounding devices. All repairs / tightening of hardware shall be performed using a calibrated torque wrench following manufacture's guidelines. In the absence of the manufacture's guidelines Table D6 of the Canadian Electrical Code can be utilized.
- .10 Exercise the circuit breaker through several close-open cycles. For electrically operated circuit breakers, operate the circuit breaker electrically. Examine the operation of the circuit breaker during these operations for any evidence of difficulty, erratic operation, etc.
- .11 Perform and record results of insulation resistance (megger test) following the manufactures recommended test voltage level measure line to load insulation resistance of each phase with breaker open. Close breaker and measure phase to phase and phase to ground insulation resistance.
- .12 Perform and record results of insulation resistance test on control wiring. Following the manufacturers recommended test voltage level measure the insulation resistance of each secondary terminal connection to ground, with breaker open and closed.
- .13 Perform and record results of contact resistance test on main contacts.
- .14 Perform and record results of secondary injection testing on the protective tripping system, using methods approved by the manufacturer.

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 Main switchboard.
- .3 CxA to monitor start-up activities.
- .4 Rectify start-up deficiencies to satisfaction of CxA.
- .5 Performance Verification (PV):
 - .1 Cx Team to participate in PV.
 - .2 Use procedures to suit project requirements. These tests will include, but will not be limited to;
 - .1 Verification of facility metering.
 - .2 Verification of utility metering (verify with utility).
 - .3 Automatic transfer upon loss of Utility L1.
 - .4 Automatic retransfer upon restoration of Utility L1.
 - .5 Automatic transfer upon loss of Utility L2.
 - .6 Automatic retransfer upon restoration of Utility L1.
 - .7 Generator start and breaker operations on loss of both Utility Line L1 and L2.
 - .8 Generator shutdown and power system retransfer to normal on restoration of either or both utility lines.

- .9 Remote breaker operation.
- .10 Verification of operation of all electrical components installed by the project
- .3 Repeat when necessary until results are acceptable to CxA and the Departmental Representative.
- .4 Cx Team to witness and certify reported results using approved PI and PV forms.
- .5 CxA to approve completed PV reports and provide to the Departmental Representative.
- .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx using Cx Plan developed by the Contractor and Manufacturer and approved by the CxA and the Departmental Representative.
- .2 CxA to monitor Cx activities.
- .3 Upon satisfactory completion, CxA to prepare final Cx Report.
- .4 CxA to witness, certify reported results of Cx activities and forward to the Departmental Representative.
- .5 The Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx Team and approved by CxA.
- .2 Tests to be witnessed by CxA and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by CxA and submitted to the Departmental Representative for review.
- .4 The Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
 - .1 HVAC and associated systems forming part of integrated HVAC systems.
 - .2 Fire pumps and controllers: ensure fire pumps are powered.
 - .3 Emergency power generator: ensure generator starts as commanded by system.
 - .4 Transfer switch and controllers: ensure transfer switch operates upon loss of both utility feeds.
- .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance, Contractor and Cx Manager to co-operate to complete inventory data sheets and provide assistance to CxA in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.15 INSTALLATION/START-UP CHECK LISTS (ICLs)

- .1 Commissioning forms and checklists to be developed by the Manufacturer and commonly used in their operation.

1.16 DELIVERABLES RELATING TO ADMINISTRATION OF CX

- .1 General:
 - .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.17 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to CxA for review and approval at 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 Pre-TAB review: 28 days after contract award, and before construction starts.
 - .3 Contractor's Cx agents credentials: 60 days before start of Cx.
 - .4 Cx procedures: 3 months after award of contract.
 - .5 Discussion of heating/cooling loads for Cx: 3 months before start-up.
 - .6 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .7 Notification of intention to start TAB: 21 days before start of TAB.
 - .8 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .9 Notification of intention to start Cx: 14days before start of Cx.
 - .10 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
 - .11 Identification of deferred Cx.
 - .12 Implementation of training plans.
 - .13 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 the Departmental Representative.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 CxA will monitor progress of Cx against this schedule.

1.18 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Cx Team to CxA who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by CxA and the Departmental Representative.

1.19 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems.
 - .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

1.20 TESTS TO BE PERFORMED BY THE DEPARTMENTAL REPRESENTATIVE /USER

- .1 None are anticipated on this project.

1.21 FINAL SETTINGS

- .1 Upon completion of Cx to satisfaction of CxA and the Departmental Representative, lock control devices in their final positions, indelibly mark settings and include in Cx Reports.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Division 01 – General Requirements.
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
- .1 C22.1-18, Canadian Electrical Code (CEC), Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3 Z462-18, Workplace Electrical Safety.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics Engineers (IEEE)
- .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .4 National Research Council of Canada
- .1 National Building Code of Canada (NBCC) 2015.
- 1.3 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.
- 1.4 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit WHMIS SDS in accordance with Section 01 35 29.06 – Health and Safety Requirements.
- .3 Submit to Electrical Inspection Services, necessary number of drawings and specifications for examination and approval prior to commencement of work. Pay all associated fees.
- .4 Submit as-built single line electrical diagrams for review. Final diagrams are to be provided under plexiglass and be securely mounted to wall in main electrical room.
- .5 Shop drawings:
- .1 Submit manufacturer shop drawings of all products and equipment.
- .2 Part numbers for submitted products and equipment to be clearly highlighted, boxed or arrowed with all required accessories and components indicated.
- .3 Submitted information must be specific, detailed and relevant to the project. Bulk, generic information is not acceptable.

- .4 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.
- .5 Identify circuit terminals on wiring diagrams and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .6 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .7 If changes are required, resubmit corrected shop drawings.
- .8 Where the use of electronic shop drawings has been agreed to by the Departmental Representative, the following additional electronic submittal requirements are to be followed:
 - .1 Shop drawings to be submitted in PDF format, legible and clear.
 - .2 Shop drawings to be grouped by specification section, with one PDF file per specification section. The file name to indicate the section number and name, i.e. "26 50 00 Lighting Rev0.PDF" with resubmissions appended Rev1, Rev2, etc.
 - .3 Supplemental information not previously submitted to be identified as follows: "26 50 00 Lighting Supplement 1.PDF", Supplement 2, etc.
 - .4 A cover sheet is to be incorporated into each PDF submission and indicate the project name and number, specification section number and name, the Contractor's name, supplier's name, date submitted, Contractor's stamp and signature identifying that the Contractor has reviewed the information prior to submission for correctness and completeness. Sufficient white space (minimum of ¼ page) is to be left for the Departmental Representative's stamp and comments.
 - .5 Electronic shop drawing transmittal forms, where provided, must be submitted as separate PDF files and not bound in with the shop drawings.
- .6 Certificates:
 - .1 Provide CSA certified equipment and material. Provide CSA recertification to modified switchboard.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 – FIELD QUALITY CONTROL.
 - .6 Submit, upon completion of Work, Contractor's guarantee and warranty certificates in accordance with Section 01 78 00 – Closeout Submittals.
 - .7 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to the Departmental Representative.
- .7 Description of Work:
 - .1 Contractor to provide a description of work and complete work plan for the supply and install of the new breakers, remote breaker control station, control system and metering.

- .8 Safety:
 - .1 Contractor to perform and submit a Site-Specific Safe Work Practice Procedures prior to commencement of work.
 - .2 Contractor to submit a Safe Operating Procedures for the complete work plan, including specifically all major building shutdowns, utility supply de-energization and re-energization and standby generator operation.
- .9 Manufacturer's Field Reports: submit manufacturer's written report to the Departmental Representative within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 – FIELD QUALITY CONTROL.
- .10 Upon completion of project, submit as-built drawings and maintenance manuals in accordance with Section 01 33 00 – Submittal Procedures.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data:
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide the Departmental Representative with a schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

1.7 QUALITY CONTROL

- .1 Quality Control: in accordance with Section 01 45 00 – Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
 - .3 Ratio must not exceed one apprentice to one licensed electrician.
 - .4 Ensure only licensed electrician authorized by PWGSC shall perform any of the tasks associated with performing Project scope.
 - .5 Project scope related to the retrofit of the switchgear to be performed factory trained technicians.

1.8 SITE VISIT

- .1 Prior to tender submission, visit the site and become familiar with the job and all conditions which may affect costs. Ignorance of existing conditions will not be considered as basis for extra claims.
- .2 To support project scope activities a power shutdown will be required in order to allow the manufacturer an opportunity to inspect the interior of the switchboard and gather any necessary information needed for the retrofit. The manufacturer is to ensure that the cost for this visit is included in the tender submission and note that the shutdown can only occur between the hours of Saturday 1:00 AM and Sunday at 11:00 PM.
- .3 Refer to Section 01 11 00 – Summary of Work for further information.

1.9 SCHEDULE

- .1 Note that the facility intends to carry on business as usual and work activities must be coordinated to maintain electrical services in occupied areas. Provide any required temporary work.
- .2 Work activities which disrupt occupants of the building, such as excessive noise caused by drilling of walls, floors or ceilings must be approved and scheduled in writing with the building maintenance superintendent at least 48 hours in advance and done outside normal working hours.
- .3 All power shutdowns which affect building occupants or building operation must have prior approval of the Departmental Representative and must be scheduled in writing at least 14 days in advance with the building maintenance superintendent. Power shutdowns must occur between the hours of 01:00AM Saturday to 11:00PM Sunday. It is anticipated that the work will need to be completed over several shutdowns.
- .4 Overtime work and work outside normal work hours deemed necessary to accomplish scheduling are the responsibility of the Contractor. All costs resulting from such overtime work must be included in the Contractor's total tender price.

- .5 The Departmental Representative may require work to be done in phases. Refer to Section 01 32 16.16 Construction Progress Schedule – Critical Path Method (CPM) for additional information and requirements. All costs associated with phasing must be included in the Contractor's total tender price.

1.10 ESSENTIAL SERVICES

- .1 Electrical and communication services including fire alarm, emergency and exit lighting, are considered essential services and must be maintained in operation at all times.
- .2 Should interruptions to these services be deemed absolutely necessary they must be approved and scheduled in writing with the Departmental Representative at least 14 days in advance.
- .3 Interruptions must be taken when acceptable to the Departmental Representative and may include weekday and weekend nights.
- .4 If an interruption in an essential service is taken, work must progress continuously until the service is restored.
- .5 Interruptions may be cancelled by the Departmental Representative at any time either prior to or during should an emergency arise. Any work must be immediately aborted and systems returned to full operating state.

Part 2 Products

2.1 PRIOR APPROVAL OF PRODUCTS

- .1 The use of any product not listed by name in the specification must be approved prior to tender submission.
- .2 By using pre-approved product substitutions, the Contractor accepts the responsibility and associated costs for all required modifications to circuitry, devices and wiring. The Contractor shall submit complete engineered shop drawings (including power wiring) with deviations from the original design highlighted in an alternate colour to the Departmental Representative for review and approval prior to rough-in.

2.2 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 Equipment to be rated for service to which it is applied; including voltage class, continuous current rating, interrupting rating and environmental conditions.
- .4 Language operating requirements: provide identification nameplates and labels for control items in English.

2.3 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 – ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.
- .4 Where electrical equipment rooms are sprinklered in accordance with the National Building Code of Canada, the electrical equipment contained in such rooms is to have enclosures which comply with Canadian Electrical Code Rule 26-008.

2.4 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and coordination responsibilities related to motors, equipment and controls, as indicated. Verify size, location and wiring requirements of all equipment with appropriate trade, reviewed shop drawings and site conditions prior to rough-in.
- .2 Provide control wiring and conduit, except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and shown only on mechanical drawings.

2.5 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and the Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

2.6 WIRING TERMINATIONS

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

2.7 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: plastic laminate lamicaid 3 mm thick plastic engraving sheet, matte white finish face, black core, lettering accurately aligned and engraved into core, attached with self-tapping screws.

.2 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
Size 8	50 x 100 mm	4 lines	6 mm high letters
Size 9	65 x 200 mm	3 lines	12 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be in English and approved by the Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets, junction and pull boxes to indicate system and/or voltage characteristics.
- .6 Transformers: indicate designated name of equipment, capacity, primary and secondary voltages.
- .7 Nameplates installed on distribution panelboards, motor control centres and splitter troughs shall indicate the following:
 - .1 Designated name of equipment.
 - .2 Voltages, number of phases and wires.
 - .3 Overcurrent protection device rating.
 - .4 Designation of power source.
 - .5 The following is an example:

PANEL A – 120/208V – 3PH – 4W
FED FROM 100A BKR IN PANEL DP1

- .8 Nameplates installed on combination starters, magnetic starters, variable frequency drives, manual starters and all various system controls, control panels, contactors, disconnect switches, and large junction and pull boxes shall contain the following information:
 - .1 Designated equipment tag and description of equipment.
 - .2 Voltage(s), number of phases.
 - .3 Designated name of power source.
 - .4 Branch circuit breaker number(s) where possible.

.5 The following is an example:

<p style="text-align: center;">CP-1 HEATING CIRCULATING PUMP 600V – 3PH, FED FROM MCC #1</p>

- .9 All junction and/or pull boxes (volume less than 8500 cu cm) shall be marked with an indelible ink marker to designate the circuit number of enclosed wiring, the designated panel name and electrical characteristics where applicable.
- .10 Install an additional nameplate on all, or any piece of electrical equipment, or apparatus, i.e. Main Switchboard, CDP panels, panelboards, motor control centres, and fusible switches, etc. that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate an interrupting capacity sized “larger” than 10 KAIC.

Example:

Minimum interrupting capacity of breakers installed in this panel is to be not less than 22 KAIC	Minimum interrupting capacity of fuses installed in this MCC is to be not less than 100 KAIC
---	---

2.8 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, indicating panel and circuit number; i.e., A-1. Normal ground circuits to have ground, neutral and phase wires identified with black on white background tape. Tape to be preprinted vinyl, self-adhesive. Circuits to be identified at both ends and at all pull and junction boxes.
- .2 Use coloured plastic tapes to identify feeders on both ends of conductors and at junction and pull boxes if conductor insulation colours are other than red, black, blue, white and green.
- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour coding: to CSA C22.1.
- .5 Use colour coded wires in communication cables, matched throughout system.

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .1 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1 or as indicated.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

Part 3 Execution

3.1 INSTALLATION

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

3.2 FIRE STOPPING

- .1 Supply and install ULC/cUL listed elastomeric fire-stopping and smoke seal materials around cable, conduit and tray openings and inside of sleeve penetrations as required to maintain firestop system rating equal to assembly.
- .2 Installation of fire-stopping and smoke seal materials and components to be in accordance with ULC/cUL certification and manufacturer's instructions.

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 Prior to rough-in, coordinate locations of conduit runs with existing conditions. Do not block access to valves and devices requiring access by operating and maintenance personnel.

3.5 COORDINATION OF PROTECTIVE DEVICES

- .1 Provide a Short-Circuit and Protective Device Coordination Study from the Utility connection to the 120/208 V distribution level. TCC curves to show coordination on log-log graph at the 600 V level.
- .2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated in the Protective Device Coordination Study.
- .3 Provide an Arc-Flash Analysis in conjunction with the Protective Device Coordination Study to determine the arc-flash boundary and personnel protective equipment requirements in accordance with the latest adopted CSA Z-462. Provide warning labels to suit.

3.6 FIELD QUALITY CONTROL

- .1 Conduct following tests in accordance with Section 01 45 00 – Quality Control. Contractor to ensure all test equipment has a valid calibration and calibration labels are visible on the equipment. Such equipment must be calibrated to a higher standard than the instruments/equipment being tested and traceable to a standard of the National Bureau of Standards. Contractor to supply any special power requirements for test equipment. All test to be performed with equipment deenergized and protective grounds in place except those tests that need to be performed while the equipment is energized.
 - .1 Power and distribution system including phasing, voltage, grounding and load balancing.
 - .2 Generator, automatic transfer switches and essential distribution.

- .3 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .4 Fall-of -potential testing:
 - .1 Perform fall-of-potential testing on the complete connected grounding system on work that is complete to ensure that the grounding system meets CEC requirements.
- .2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .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 as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- 3.7 SYSTEM STARTUP
 - .1 Instruct the Departmental Representative and the facilities operating personnel in operation, care and maintenance of systems, system equipment and components.
 - .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
 - .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.
- 3.8 CLEANING
 - .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.
 - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Division 01 – General Requirements.
 - .2 Section 26 05 00 – Common Work Results for Electrical.
 - .3 Section 26 24 02 – Service Entrance Switchgear.
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
 - .1 C22.1-18, Canadian Electrical Code (CEC), Part 1.
 - .2 Z462-18, Workplace Electrical Safety.
- 1.3 DESCRIPTION OF WORK
- .1 Removal of existing draw out and fixed breakers, fusible switches, metering, current and potential transformers, associated controls and bussing in each of the six cells in the main switchgear.
 - .2 Preparation of existing load and supply cables for reuse/reconnection to the new protective devices.
 - .3 All removal or alteration work of electrical construction to be done in accordance with the safety standards outlined in the Canadian Electrical Code and CSA Z462.
- 1.4 SITE SURVEY
- .1 Prior to Tender submission, visit the site and survey and quantify the extent of the removals/alterations required for this contract and include for all costs in the total tendered price. Any existing conditions information indicated on the drawings is for general guidance only.
 - .2 In conjunction with site visit, review electrical drawings and include all costs due to existing conditions in total tendered price.
- 1.5 PROTECTION
- .1 Protect existing equipment from debris, dust and environmental conditions.
 - .2 The Contractor is responsible for any damages to existing structure as a result of the work.
- 1.6 SALVAGE MATERIAL
- .1 Prior to demolition Departmental Representative will identify any items or equipment which is to be set aside as directed for future use. In general, this will include all draw-out circuit breakers and other components that may be able to be reused in other switchgear assemblies at the facility or elsewhere.

- .2 All other materials and equipment removed under work of this Section becomes the property of the Contractor for disposal off the property.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Remove from site and dispose of all materials at appropriate recycling facilities.
- .3 Collect and separate packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Comply with all Federal, Provincial and Municipal laws and regulations when disposing of waste.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL REMOVALS

- .1 Remove all obsolete or abandoned electrical equipment and materials including wire and conduit, except those designated for reuse.
- .2 Remove services associated with obsolete or abandoned mechanical systems.
- .3 Schedule all removal work with the Departmental Representative. Do not disrupt building operations except as permitted by the Schedule.
- .4 Any existing conduit, wiring, boxes or equipment that is to remain in service is to be properly supported as required by the CEC. Any additional hangers, straps or fasteners required are to be supplied under this contract.
- .5 Make alterations to existing electrical services as required and make good all circuits affected by the renovations.
- .6 Any existing electrical circuits and/or equipment that are interrupted during construction to accommodate alterations but are to remain in service are to be reconnected and circuits made good.
- .7 Any relocating of existing equipment and any rerouting of existing wire and conduit to coordinate with new work or as required to meet current standards, to be included in total tendered price.

3.2 CUTTING AND SEALING

- .1 Cutting required for removals and alterations to be to the approval of the Departmental Representative and performed with appropriate power tools. Penetrations through drip hoods shall utilize hubs and/or rain tight connectors complete with gasket washers.

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Section 26 05 00 – Common Work Results for Electrical.
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
- .1 C22.2 No.18.3-12, Conduit, Tubing and Cable Fittings (Tri-National Standard with ANCE NMX-J-017 and UL 514B).
- .2 C22.2 No.65-13, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
- .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.
- 1.5 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in clean, dry, well-ventilated location and in accordance with manufacturer's recommendations.
- .2 Store and protect wire and box connectors from damage.
- .3 Replace defective or damaged materials with new.

- .4 Packaging Waste Management: separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors as required. Use twist-on connectors for #14 AWG to #8 AWG wires.
- .2 Fork tongue or pin, vinyl insulated, crimp style terminals for connecting conductors #14 AWG and smaller stranded wire to screw down terminals.
- .3 Crimp style wire connectors, nylon insulated with current carrying parts of copper alloy, for connecting solid to stranded conductors.
- .4 Compression type connectors for connecting #6 AWG conductors and larger, unless indicated otherwise. Compression type connectors to have a temperature rating of 90 deg. C.
- .5 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.
- .6 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded round copper conductors.
 - .2 Clamp for stranded round copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 20 – Wire and Box Connectors (0-1000 V).
- .3 Section 26 05 29 – Hangers and Supports for Electrical Systems.
- .4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
- .2 C22.2 No.0.3-09 (R2014), Test Methods for Electrical Wires and Cables.
- .3 C22.2 No. 131-14, Type TECK 90 Cable.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

Part 2 Products**2.1 BUILDING WIRES**

- .1 Conductors:
 - .1 Solid for 10 AWG and smaller, stranded for 8 AWG and larger.
 - .2 Minimum size: 12 AWG for branch circuits, 12 AWG for bonding, 14 AWG for control circuits.
 - .3 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, non-jacketed.
 - .4 Single conductor metal sheathed cables are not permitted.

2.2 CONTROL WIRES

- .1 Minimum size: #14 AWG
- .2 Conductors: stranded annealed copper. Number of conductors as required.
- .3 Insulation: PVC type TW suitable for a working temperature range of -40°C to +75°C.

2.3 SWITCHBOARD CABLE (SIS)

- .1 Conductors: stranded copper. Class K Stranding.
- .2 Insulation: Flame retardant, heat and moisture resistant cross-linked polyethylene, gray jacket.

2.4 TECK 90 CABLE

- .1 Cable: to CAN/CSA C22.2 No. 131-M89 (R1994), Type TECK 90 Cable.
- .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, FT4 rated.
- .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.
 - .1 Manufactured from copper-free aluminum for single conductor cables and copper-free aluminum or zinc-plated machined steel for multiconductor cables.

2.5 COLOUR CODING

- .1 All conductors to be colour coded to Section 26 05 00 – Common Work Results for Electrical.

Part 3 Execution

3.1 WIRING METHODS

- .1 All work to be concealed in finished areas.

3.2 GENERAL CABLE INSTALLATION

- .1 Support cables in accordance with Section 26 05 29 – Hangers and Supports for Electrical Systems.
- .2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors – (0-1000 V).
- .3 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.

3.3 INSTALLATION OF BUILDING AND CONTROL WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF SWITCHBOARD WIRES

- .1 Install in switchgear for internal control wiring.

3.5 INSTALLATION OF TECK 90 CABLE (0 – 1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.
- .3 Fasten in place at 1500 mm intervals and 300 mm from terminations.

3.6 RESTRICTIONS

- .1 Refer to Section 26 05 29 – Hangers and Supports for Electrical Systems, for acceptable support methods.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 21 – Wires and Cables (0–1000 V).

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-2014, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association (CSA International)
 - .1 C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard with NMX-J-590-ANCE and UL 467).
 - .2 C22.1-18, Canadian Electrical Code (CEC), Part 1 (24th Edition), Safety Standard for Electrical Installations. Section 10 Grounding and Bonding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in clean, dry location and in accordance with manufacturer's recommendations.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green, Type RW90, copper conductors, size as indicated, in accordance with Section 26 05 21 – Wires and Cables (0-1000 V).
- .3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including conductors, connectors and accessories.
- .2 All grounding connectors, components and accessories to be installed in accordance with manufacturer's instructions.
- .3 Install green insulated bonding conductor in all conduit.
- .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 Install an integral bonding wire in all flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.
- .8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .9 All equipment and exposed non-current carrying metal, conduits and parts to be permanently and effectively grounded to meet minimum requirements of the CEC section 10 and as indicated on drawings and further specified. Standards set either by drawings or specifications which are above those covered by the C.E.C. section 10 are not to be reduced under any circumstances

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: switchgear and control panels.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Section 26 05 00 – Common Work Results for Electrical.
 - .2 Section 26 05 21 – Wires and Cables (0-1000 V).
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
 - .1 C22.2 No. 18.4-15, Hardware for the Support of Conduit, Tubing and Cable (Bi-National Standard with UL 2239).
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- Part 2 Products
- 2.1 SUPPORT CHANNELS
- .1 U shape, size 41 x 41 mm, 2.5 mm thick, pre-galvanized steel, surface mounted or suspended as required.
- 2.2 SPECIFIC PURPOSE SUPPORTS
- .1 Specific purpose heat treated, spring steel fasteners to support boxes, conduit and cable from main structure, channels, metal studs and T-bar ceilings.
- Part 3 Execution
- 3.1 INSTALLATION
- .1 Secure equipment to hollow or solid 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 recessed and surface mounted equipment to inverted T bar ceilings with bar type box hangers fastened to grid. Ensure that T-bars and box hangers are adequately supported to carry weight of equipment specified before installation. Box hangers to be connected to building structure with independent hanger wire.
 - .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 dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical. Provide sufficient quantity of rod hangers to support total weight of cables or conduits as well to ensure support channels remain horizontal and level.
- .8 For surface mounting of two or more conduits use channels at 1500 mm 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 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.2 RESTRICTIONS

- .1 Do not use wire lashing, perforated strap, nylon or plastic self-locking cable ties (Ty-raps) to support or secure raceways or cables.
- .2 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Section 26 05 00 – Common Work Results for Electrical.
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
- .1 C22.1-18, Canadian Electrical Code (CEC), Part 1, 24th Edition.
- .2 C22.2 No.18.1-13, Metallic Outlet Boxes (Tri-National Standard with UL 514A and ANCE NMX-J-023/1).
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 – Submittal Procedures.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- Part 2 Products
- 2.1 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 Blank cover plates for boxes without wiring devices.
- 2.2 CONDUIT BOXES
- .1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.3 FITTINGS - GENERAL

- .1 Set-screw type steel couplings and connectors for EMT. Connectors to have integral, factory installed, nylon insulated throats.
- .2 Set-screw type steel connectors for flexible conduit. Connectors to have integral, factory installed, nylon insulated throats.
- .3 Bushings and connectors with nylon insulated throats.
- .4 Knock-out fillers to prevent entry of debris.
- .5 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .6 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 The use of surface mounted conduit boxes is to be minimized, limited to unfinished areas and is subject to the approval of the Departmental Representative.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .4 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .5 Identify systems for outlet boxes as required.

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 29 – Hangers and Supports for Electrical Systems.
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
- .1 C22.2 No. 18.3-12, Conduit, Tubing, and Cable Fittings (Tri-National Standard with ANCE NMX-J-017 and UL 514B).
- .2 C22.2 No. 18.4-15, Hardware for the Support of Conduit, Tubing and Cable (Bi-National Standard with UL 2239).
- .3 C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- 1.5 LOCATION OF CONDUITS
- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- Part 2 Products
- 2.1 CONDUITS
- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with steel set-screw couplings and connectors.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, aluminum, flexible metal conduit and liquid-tight flexible metal conduit.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500 mm on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18.3, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Set-screw type steel couplings and connectors for EMT. Connectors to have integral, factory installed, nylon insulated throats.
- .3 Set-screw type steel connectors for flexible conduit. Connectors to have integral, factory installed, nylon insulated throats.
- .4 Use factory "ells" where 90 degrees bends for 27 mm and larger conduits.

2.4 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 Install conduit parallel or perpendicular to building lines.
- .3 Conceal horizontal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .4 Use electrical metallic tubing (EMT) for feeders and branch circuit work except in poured concrete, underground and where subject to mechanical damage unless indicated otherwise. Install a separate integral bond wire sized in accordance with CEC in all EMT.
- .5 Minimum conduit size: 16 mm.

- .6 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .7 Mechanically bend steel conduit over 21 mm diameter.
- .8 Install fish cord in empty conduits.
- .9 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .10 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not pass conduits through structural members except as indicated.
- .3 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

- Part 1 General
- 1.1 RELATED REQUIREMENTS
- .1 Section 26 05 00 – Common Work Results for Electrical.
- 1.2 REFERENCE STANDARDS
- .1 Canadian Standards Association (CSA International)
- .1 C22.2 No.31-14, Switchgear Assemblies.
- .2 CAN/CSA C61869-1:14, Instrument Transformers – Part 1: General Requirements.
- .3 CAN/CSA C61869-2:14, Instrument Transformers – Part 2: Additional Requirements for Current Transformers.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for service entrance board and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
- .1 Submit detailed drawings generated by manufacturer.
- .2 Indicate on drawings:
- .1 Dimensioned position and size of bus.
- .2 Dimensioned layout of internal and front panel mounted components.
- .3 Single line diagram.
- .4 Switchgear schematics.
- .4 Include time-current characteristic curves for circuit breakers rated 400A and higher.
- 1.4 QUALITY ASSURANCE
- .1 Submit copies of certified test results.
- 1.5 SYSTEM STARTUP AND TRAINING
- .1 System startup and training is to be conducted by manufacturer's authorized factory trained service technician.
- .2 Arrange and provide on-site lectures and demonstrations at time convenient to facility personnel.
- .3 Explain and demonstrate operation of facility meters including advanced monitoring functions.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for service entrance board for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .2 Submit maintenance data for complete assembly including components.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Provide one (1) set of spare parts as recommended by manufacturer.

1.9 UTILITY METERING

- .1 Utility metering along with the utility's PTs and CTs to remain.
- .2 Verify with the utility the correct operation of their meters once the upgrade is complete.

1.10 SUPPLY DATA

- .1 Power supply: 600 V, 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current 65 kA rms symmetrical.

Part 2 Products**2.1 DRAW OUT POWER CIRCUIT BREAKERS**

- .1 Draw-out power circuit breakers to operate by means of a solid-state trip unit with associated RMS current monitors and self-powered shunt trip to provide inverse time current trip under overload condition with field adjustable settings for long time, short time and instantaneous tripping for phase and ground fault short circuit protection. Note that long time, short time and instantaneous settings must be individually adjustable.
 - .1 Delayed direct-acting trips with coil rating calibration from 500% to 1500% of ampere rating of breaker for short circuit protection.
 - .2 Adjustable short delay trips with calibration from 500% to 1500% of ampere rating of breaker for short circuit protection.
 - .3 Normal stored energy, closing mechanism to provide quick-make operation.
 - .4 Stored energy, quick-make, closing mechanism with emergency manual spring charging handle, and electric recharging motor.
 - .5 On-off indicator and spring charging indicator.
 - .6 Electric operation for all breakers, internally derived.

- .2 Circuit breakers to have integral trip units with the following features:
 - .1 Integral trip unit complete with the following features:
 - .1 RMS Sensing.
 - .2 Functions.
 - .3 Front adjustable.
 - .4 Load Monitoring.
 - .5 Diagnostics.
 - .6 Communications (using customer metering as an ethernet gateway).
 - .7 Power and Energy Monitoring.
 - .8 Harmonics.
 - .9 Arc flash Reduction Maintenance System (ARMS) complete with remote operation located as indicated on drawings. Shall be capable of being activated locally as well as remotely complete with pad-lockable activation switch.
- .3 Main N1 and N2 and Tie breakers:
 - .1 3200 A frame, 100% rated, with 100% continuous current rating plug of 3000 A, LSIG.
 - .2 Interrupting Rating 65 KA,
 - .3 Draw-out, electrically operated, 130 VAC – Spring charging motor and closing coil, 130 VAC shunt trip coil, 6A/6B Auxiliary contacts, Overcurrent trip switch (OTS - operation on overload, short circuit, ground fault, integrated mechanical trip indication, manual and electrical re-set, 2 form C contacts), Breaker Operation Counter, Kirk Key provision, latch check switch, metal switchboard lock off (block close, depress open)
 - .4 Draw-out integrated cell cassette with dual baffled arc hood, line load side shutters, 100 KA rated, Mechanism Operated Switches (MOC Switch 8A/8B contacts)
- .4 Distribution breakers N1-F1, N1-F2, N2-F1 and N2-F2:
 - .1 1200 A frame, 100% rated, with 100% continuous current rating plug of 3000 A, LSIG.
 - .2 Interrupting Rating 65 KA,
 - .3 Draw-out, electrically operated, 130 VAC – Spring charging motor and closing coil, 130 VAC shunt trip coil, 4A/4B Auxiliary contacts, Overcurrent trip switch (OTS - operation on overload, short circuit, ground fault, integrated mechanical trip indication, manual and electrical re-set, 2 form C contacts), Breaker Operation Counter, Kirk Key provision, latch check switch, metal switchboard lock off (block close, depress open)
 - .4 Draw-out integrated cell cassette with dual baffled arc hood, line load side shutters, 100 KA rated, Mechanism Operated Switches (MOC Switch 4A/4B contacts).
- .5 Distribution breakers N1-F1, N1-F2, N2-F1 and N2-F2:
 - .1 800 A frame, 100% rated, with 100% continuous current rating plug of 300 A, LSIG.
 - .2 Interrupting Rating 65KA,

- .3 Draw-out, electrically operated, 130 VAC – Spring charging motor and closing coil, 130 VAC shunt trip coil, 4A/4B Auxiliary contacts, Overcurrent trip switch (OTS - operation on overload, short circuit, ground fault, integrated mechanical trip indication, manual and electrical re-set, 2 form C contacts), Breaker Operation Counter, Kirk Key provision, latch check switch, metal switchboard lock off (block close, depress open)
- .4 Draw-out integrated cell cassette with dual baffled arc hood, line load side shutters, 100 KA rated, Mechanism Operated Switches (MOC Switch 2A/2B contacts)

2.2 GROUNDING

- .1 Ensure new switchgear components are correctly grounded to the existing structure.

2.3 FACILITY METERING

- .1 Digital metering system, CSA approved. One:
 - .1 Meter for each of the busses, N1 and N2.
 - .2 Microprocessor based metering package measuring RMS values.
 - .3 Displays voltage and current for each phase, kW, kVAR, kVA, PF, Hz and accumulated kWH and kW demand.
 - .4 Monitors and stores in non-volatile memory minimum values of amps, kW, kVAR, kVA and kW demand. All values can be called up and displayed.
 - .5 Monitors individual harmonics through the 31st for volts and amps.
 - .6 Field programmable.
 - .7 RS-485 and Ethernet RJ-45 communications ports.
 - .8 4-20mA output for connection to a remote monitoring system to monitor Volts, Amps, kW demand and kWH consumption.
 - .9 Relay output contacts programmable to act as a kWH, kVARH or kVAH pulse initiator output.
 - .10 Power supply:
 - .1 120 V AC, 15 VA.
 - .11 Operating environment:
 - .1 Temperature: -10 degrees C to 50 degrees C.
 - .2 Storage temperature: -40 degrees C to 85 degrees C.
 - .3 Humidity: 5 – 95% RH at 40 degrees C.
 - .12 Meter to act as a gateway for communications to the trip units in each of the breakers on the common bus.
- .2 Current transformers: to CAN/CSA C60044-1, dry type, epoxy moulded, for indoor use with the following characteristics:
 - .1 Nominal voltage class: 600 V.
 - .2 Rated frequency: 60 Hz.
 - .3 Basic impulse level: 10 kV.
 - .4 Metering accuracy rating: 0.3.
 - .5 Rated primary and secondary current: as indicated.
 - .6 Continuous current rating factor: 1.5.

- .7 Short-time mechanical current rating 90 times primary rating.
 - .8 Short-time thermal current.
 - .9 Positive action automatic short-circuiting device in the secondary terminals.
 - .3 Metering monitoring Station. A personnel computer/server shall be provided with metering management software pre-installed, configured and tested. The computer to be installed in the Electrical Maintenance office and have the following minimum features:
 - .1 Windows based tower computer running Windows 10 Professional software.
 - .2 Intel Core i7 processor at 3.4 GHz or faster.
 - .3 32", 1920 X 1080 LED monitor.
 - .4 1 TB hard disk space.
 - .5 8 GB RAM minimum.
 - .6 100/1000 Ethernet Network Card.
 - .7 CD/DVD reader writer.
 - .8 Metering software to match metering manufacturer and to be able to display all metering points within the switchgear, including all data from the main meters as well as data from the individual trip units in each breaker.
 - .4 Unmanaged Switch. Industrial 5-Port unmanaged switch to be installed in the switchgear to connect the two facility meters to the metering monitoring station in the maintenance office. Switch to have the following features:
 - .1 5-UTP ports.
 - .2 100 MB and 1 Gb port speeds.
 - .3 DIN rail mounted.
 - .4 C/W power supply for 120 VAC.
 - .5 Industrial hardened switch.
- 2.4 AUTOMATIC TRANSFER CONTROL SYSTEM
- .1 Fully automated switching control system controlling the operation of the main and tie breakers as follows;
 - .1 Loss of power or loss of phase on the N1 or N2 power feeds;
 - .1 Open the respective incoming main breaker;
 - .2 After a time delay, close the Tie Breaker to provide power to the bus with the loss;
 - .2 Loss of power or loss of phase on BOTH of the N1 and N2 power feeds;
 - .1 Open both main breakers;
 - .2 Open the Tie Breaker;
 - .3 Send a start signal to the diesel generator.
 - .3 Upon restoration of power;
 - .1 After an adjustable time delay, open the Tie Breaker;
 - .2 After an adjustable time delay, close the main breaker(s).

2.5 ANCILLERY EQUIPMENT

- .1 Remote mounted breaker control station consisting of the following;
 - .1 30 mm Red illuminated push button for CLOSED control/status indication for each of the three breakers.
 - .2 30 mm Green illuminated push button for OPEN control/status indication for each of the three breakers.
 - .3 30 mm illuminated two-position maintained switch for Arc-flash reduction maintenance mode for each of the three breakers.
 - .4 Terminals for interconnection of cabling and internal wiring.
 - .5 Lockable cabinet with window arranged so that all status indicators are clearly visible.

2.6 BMS CONNECTION

- .1 The existing metering and control system has several connections to the facilities Building Manage System (BMS). Contractor is to reconnect these cables to the new systems.
- .2 Connections consist of 12 analog signals from the two meters and 20 digital signals from the transfer control front panel switches.
- .3 Contractor to carry price to reconnect these cables.

2.7 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results for Electrical.
 - .1 Provide two spray cans of touch-up enamel.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical and as shown on contract drawings.

Part 3 Execution

3.1 SWITCHBOARD COMPONENT INSTALLATION

- .1 Install new front doors for all cubicle sections.
- .2 Fabricate and install required bus work to connect replacement breakers to the existing main bus.
- .3 Connect main secondary service to line terminals of main breaker.
- .4 Connect load terminals of distribution breaker's to feeders.
- .5 Check factory made connections for mechanical security and electrical continuity.
- .6 Adjust breaker trip unit settings as indicated in coordination study.

- .7 Program and set up metering following manufacturer's instructions and as instructed by the Departmental Representative.

3.2 MANUFACTURER'S FIELD VERIFICATION

- .1 Manufacturer's authorized factory trained service technician to:
 - .1 Verify service entrance board installation and connections.
 - .2 Provide CSA re-certification of the switchboard assembly as a whole.
 - .3 Check breaker trip unit settings against coordination study to ensure proper operation and protection of components.
 - .4 Verify fuse types and sizes.
 - .5 Verify and commission operation of facility and utility metering.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ANSI/IEEE C67.41, C62.45.
- .2 UL1449 - Second edition.
- .3 NFPA.
- .4 IEEE Standard 1100.
- .5 UL1283 - EMI/RRI noise attenuation standard.
- .6 NEMA LS1.

1.2 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3 Section 26 05 00 – Common Work Results for Electrical.
- .4 Section 26 24 02 – Service Entrance Switchgear.

1.3 SUBMITTALS

- .1 Submittal for approval: Provide the following transient protection submittals:
 - .1 Dimensional drawing of each transient voltage surge suppressor (TVSS) 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.
 - .1 The means of connection of the TVSS to the electrical distribution system per NEMA LS1.
 - .3 Provide UL-1449, Second Edition data card from manufacturer showing the Suppressed Voltage Rating (SVR) for the specific catalog number submitted. Typical UL 1449, Second Edition 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 TVSS unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.

- .6 Submit data demonstrating the TVSS 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 a 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:
 - .1 30 – 130 Degrees F
 - .2 15 – 85 Percent Humidity Non-Condensing
 - .4 Enclosure: Heavy duty NEMA 12 dust-tight, drip-tight enclosure, as indicated.
- 2.2 TRANSIENT VOLTAGE SURGE SUPPRESSORS
- .1 General Requirements:
 - .1 Rated for a 347/600 V, 60 Hertz, 3-phase, 4-wire switchboard, amperage as indicated.
 - .2 Provide surge suppressors in accordance with the following requirements:
 - .1 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.
 - .2 Provide UL 1449, 2nd edition listed unit.
 - .3 Provide maximum UL 1449 2nd Edition Suppressed Voltage Rating (SVR) for 347/600 Volt systems as follows:
 - .1 L-N = 700V
 - .2 L-G = 700V
 - .3 N-G = 700V
 - .4 L-L = 1500V
 - .4 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.
 - .5 Provide unit with a short circuit current rating, which equals or exceeds that of the Main Switchboard.

- .6 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.
- .7 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.
- .8 Provide Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of TVSS status.
- .9 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.
- .10 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.
- .11 Provide an adjustable (resettable) 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.
- .12 ISO 9001 certified.

Part 3 Execution

3.1 GENERAL REQUIREMENTS

- .1 Install the suppression system inside the switchgear. If the suppression system cannot be installed inside the switchgear, install immediately next to or on top of service equipment where so approved by the Departmental Representative.
- .2 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 TVSS in the main service entrance equipment clearly showing lead lengths, including the neutral and ground connections.
- .3 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 for Electrical and in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.
- .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 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 21 – Wires and Cables (0 – 1000 V).
- .3 Section 26 05 28 – Grounding – Secondary.
- .4 Section 27 05 28 – Pathways for Communications Systems.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)
 - .1 ANSI/TIA-606-C (2017), Administration Standard for Telecommunications Infrastructure.
- .2 Canadian Standards Association (CSA International)
 - .1 C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard with NMX-J-590-ANCE and UL 467).
- .3 Telecommunications Industry Association (TIA)
 - .1 TIA-607-C-1 (2017), Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- .4 U.S. Department of Labor/Occupational Safety and Health Administration (OSHA)
 - .1 Nationally Recognized Testing Laboratory (NRTL).

1.3 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Insulated grounding and bonding conductors: green, Type R90, copper conductors, size as indicated, in accordance with Section 26 05 21 – Wires and Cables (0 – 1000 V).

2.2 BONDING HARDWARE

- .1 All telecommunications bonding hardware to be stainless steel.
- .2 Each bolt to have a nut, flat washer on both sides and a Belleville washer on the bolt side of the stack up.

2.3 WARNING LABELS

- .1 Non-metallic warning labels in English to: TIA-607-C.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

Part 3 Execution

3.1 BONDING GENERAL

- .1 Bond all metallic communications conduits and sleeves to ground.
- .2 For communications conduit drops remote from telecommunications rooms, install grounding bushings on conduit stub and bond conduit to ground using #6 AWG bare bonding conductor to closest grounded junction or device box. Alternatively #14 AWG green bonding conductor not exceeding 2 m in length may be utilized to bond adjacent device boxes where bonding conductor is concealed in wall construction and not subject to physical damage.
- .3 For communications conduit sleeves remote from telecommunications rooms, install grounding bushings on conduit and bond conduit sleeve to ground using #6 AWG bare bonding conductor to closest grounded junction or device box.

3.2 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors to: TIA-607-C.
- .2 Apply additional administrative labels to: ANSI/TIA-606-C.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)
 - .1 ANSI/TIA-569-D (2015), Telecommunications Pathways and Spaces.
- .2 Building Industry Consulting Service International (BICSI)
 - .1 Telecommunications Distribution Methods Manual (13th Edition).
- .3 Canadian Standards Association (CSA International)
 - .1 C22.1-15, Canadian Electrical Code (CEC), Part 1 (23rd Edition), Safety Standard for Electrical Installations.
- .4 National Research Council of Canada
 - .1 National Building Code of Canada (NBCC) 2010.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors in clean, dry location and in accordance with manufacturer's recommendations.
 - .2 Store and protect materials from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
 - .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.
- Part 2 Products
- 2.1 SYSTEM DESCRIPTION
- .1 Pathways for communications systems includes both horizontal distribution pathways as well as vertical components to point of use.
 - .2 Empty communications raceways system consists of outlet boxes, cover plates, conduits, pull boxes, sleeves and caps and fish wires.
- 2.2 MATERIAL
- .1 Conduits: in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Outlet boxes, conduit boxes and fittings: in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
 - .3 Fish wire: polypropylene type.
 - .4 Cable ties: Velcro.
- Part 3 Execution
- 3.1 INSTALLATION
- .1 Install empty raceway system, including, fish wire, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.
 - .2 For data services, install device boxes and conduit sized as indicated. Data cabling to be run completely in conduit system.
 - .3 Bonding of communications conduits is to be in accordance with Section 27 05 26 – Grounding and Bonding for Communications Systems.
 - .4 Main cable pathways to be installed parallel and perpendicular to building lines.
 - .5 Where the main cable pathway crosses through bulkheads and inaccessible ceiling spaces, provide dedicated conduit sleeves for cabling for each communications system to bridge the inaccessible space.
 - .6 Conduit sleeves through fire rated partitions must be fire stopped both inside and outside the sleeve with an approved fire stopping system, rated to match the partition.

- .7 Bonding of conduit sleeves is to be in accordance with Section 27 05 26 – Grounding and Bonding for Communications Systems.
- .8 Conduit drops and sleeves to be sized as follows:
 - .1 21 mm C – 3 Category 6 UTP cables maximum.
- .9 Communications cables to be concealed in building construction in all finished areas.
- .10 Install cables in conduit.

3.2 RESTRICTIONS

- .1 The use of nylon or plastic cable ties is not permitted.
- .2 Where conduits or ducts are intended for Utility use or for backbone or optical-fiber cables, or where indicated, do not install conduit fittings; use long sweep bends only. Do not use pull boxes in lieu of bends. Install a maximum of two 90 degree bends between pull boxes. Provide pull boxes as required by Utility and CEC.
- .3 Communications systems cabling is to be grouped in dedicated conduits or J-hook supports unless otherwise approved by the Departmental Representative. Cabling from different communications systems is not to be mixed.
- .4 Maintain 300 mm clearance between communications cables and AC power cables, power conduit and fluorescent luminaires, unless cables are installed in conduit.
- .5 Communications wires and cables installed within plenum spaces in buildings of non-combustible construction to have FT6 rated jackets in accordance with the NBCC unless installed in conduit.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

3.4 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 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 27 05 28 – Pathways for Communications Systems.
- 1.2 REFERENCE STANDARDS
- .1 American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)
- .1 ANSI/TIA-568.1-D (2015), Commercial Building Telecommunications Cabling Standard.
- .2 ANSI/TIA-568-C.2 (2009), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
- .3 ANSI/TIA-569-D (2015), Telecommunications Pathways and Spaces.
- .4 ANSI/TIA-606-C (2017), Administration Standard for Telecommunications Infrastructure.
- .2 Building Industry Consulting Service International (BICSI)
- .1 Telecommunications Distribution Methods Manual (13th Edition).
- .3 Canadian Standards Association (CSA International)
- .1 C22.2 No. 214-17, Communications Cables (Bi-National standard with UL 444).
- .4 Institute of Electrical and Electronics Engineers (IEEE)
- .1 IEEE 802.3-2015, IEEE Standard for Ethernet.
- 1.3 SYSTEM DESCRIPTION
- .1 Structured telecommunications wiring system consists of unshielded-twisted-pair cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including data for monitoring of the metering network.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
- .1 Horizontal cables link work areas to telecommunications rooms (TR's) located on same floor.
- .2 Telecommunications rooms (TR's) linked to main cross-connect /telecommunications room (MC/TR) by backbone cables.
- .3 MC/TR also linked to Entrance Facility (EF) by backbone cables.
- 1.4 COORDINATION
- .1 After tender award and prior to commencing work, meet with Departmental Representative to review work procedures and restrictions related to existing data network infrastructure and equipment.

1.5 CERTIFICATION AND WARRANTY

- .1 All cabling, termination hardware and connecting cords to be sourced from a certifying manufacturer to assure quality control.
- .2 Upon completion of the installation, the system must be certified by a qualified installer and the manufacturer that it will support Category 6 applications.
- .3 The installed system is to be provided with an end-to-end 20 year system warranty. This warranty shall guarantee against defects in materials and workmanship for the duration of the warranty period and the Certified System Vendor shall repair or replace any failed component, including labour, at no cost.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for structured cabling and associated components and include product characteristics, performance criteria, physical size, finish and limitations.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for structured cabling and associated components for incorporation into manual.
- .3 Provide record of test results as detailed under FIELD QUALITY CONTROL for incorporation into manual.
- .4 Provide certification and warranty certificate for incorporation into manual.
- .5 As-built Records and Drawings:
 - .1 Provide as-built drawings reflecting cable installation and cross-connections. Drawings to indicate outlet ID at each drop location.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 74 19 – Waste Management and Disposal and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in clean, dry, well-ventilated location and in accordance with manufacturer's recommendations.
 - .2 Store and protect structured cabling and associated components from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

- .4 Packaging Waste Management: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 FOUR-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 to: CSA-C22.2 No. 214.
- .2 Cable jacket colours to be as follows:
 - .1 Data: blue.

2.2 WORK AREA UTP 4-PAIR MODULAR JACK

- .1 Eight-position modular jack ("RJ-45"), type T568A, Category 6 to ANSI/TIA-568-C.2 and IEEE 802.3:
 - .1 Keystone style.
 - .2 Punch down UTP connector.
 - .3 Modular jack colours to be as follows:
 - .1 Data: blue.
 - .2 Category 6 (Cat 6):
 - .1 Belden KeyConnect CAT6+.
 - .2 Hubbell NextSpeed #HXJ6xx.
 - .3 Leviton #61110-Rx6.
 - .4 Panduit #CJ688TGx.
 - .5 Systimax GigaSPEED XL #MGS400.
- .2 Provide compatible single gang faceplates as follows:
 - .1 Flush entry, two (2) jack positions per faceplate.
 - .2 Provide blank fillers for unused jack positions.
 - .3 Top and bottom labeling windows for jack identification.
 - .4 Faceplate colour: white.
- .3 Provide self-contained white surface-mount box where indicated and as required, two (2) jack positions per box complete with modular jacks to suit.

2.3 UTP CROSS-CONNECT PATCH CORDS

- .1 UTP cross-connect patch cords with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack, Category 6, 4 pairs to: ANSI/TIA-568-C.2.
- .2 UTP cross-connect patch cord colour to match horizontal cable colour for application; i.e. voice (telephone), data, etc.

2.4 UTP WORK AREA CORDS

- .1 3.0 metres long, each end equipped with "RJ-45" plug, Category 6 to: ANSI/TIA-568-C.2.
- .2 UTP work area cord colour to match horizontal cable colour for application; i.e. data.
- .3 Provide one (1) UTP work area cord for each work area modular jack.

Part 3 Execution

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware as indicated and according to manufacturers' instructions. Identify and label as indicated to: ANSI/TIA-606-C.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables in pathways in accordance with Section 27 05 28 – Pathways for Communications Systems.
 - .1 Identify and label as indicated to: ANSI/TIA-606-C.
- .2 Routing of cables must be such that total length does not exceed 90 m.
- .3 Leave sufficient tail at each end for termination of cable.
- .4 Terminate horizontal cables in telecommunications room and at individual work-area jacks using T568A pin assignment. The amount of untwisting in a cable pair to terminate to be no greater than 13 mm.
 - .1 Identify and label as indicated to: ANSI/TIA-606-C.
- .5 Each horizontal cable to have identification markers installed on both ends.
- .6 Each modular jack to be identified with an alpha/numeric label.
- .7 Each patch panel or termination block to have corresponding labeling. Patch panels are to be labelled A, B, C, etc. with A being located near the top of the rack. The ports on each patch panel are to be labelled 1 to 24 or 48 as applicable.
- .8 Labeling to indicate rack number, patch panel letter and outlet number (i.e. 1A48 is rack 1, patch panel A, outlet 48).
- .9 Identification is to be consistent with existing identification method.

3.3 IMPLEMENT CROSS-CONNECTIONS

- .1 Implement cross-connections using jumper wires and patch cords as required and as specified.

3.4 FIELD QUALITY CONTROL

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy.
 - .1 Perform tests for Permanent Link on installed cables:
 - .1 Category 6 using certified level III tester to: ANSI/TIA-568.1-D.
- .2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy.
 - .1 Perform tests for Permanent Link on 4-pair cables:
 - .1 Category 6 using certified level III tester to: ANSI/TIA-568.1-D.
 - .2 Perform Wire Map tests on multi-pair UTP cables to: ANSI/TIA-568.1-D.

3.5 RESTRICTIONS

- .1 All identification labeling to be mechanically printed with permanent indelible identifying markings. Hand written labelling is not acceptable.

END OF SECTION