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Public Works and
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Canada

POWER STATION REPLACEMENT, SEPT-ÎLES TERMINAL

PWGSC Ref.: R.068661.001
SNC-Lavalin Ref.: 632802

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TECHNICAL SPECIFICATIONS ELECTRICAL, CIVIL AND CONTROLS

ISSUED FOR TENDER

SNC-Lavalin Inc.
455 René-Lévesque Blvd. West
Montréal, Quebec H2Z 1Z3
Telephone: 514-393-1000
Fax: 514-866-0795

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Prepared by:

Robert Desroches, Eng.
(Electrical)

Claude Plourde, Eng.
(Electrical)

Jean Desjardins, Eng.
(Structure)

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1. GENERAL**1.1 Work by Others**

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

1.2 Future Work

- .1 Ensure that work avoids encroachment into areas required for future work.

1.3 Work Sequence

- .1 Construct work in stages to accommodate the Departmental Representative's use of premises during construction.
- .2 Coordinate Progress Schedule and coordinate with the Departmental Representative occupancy during construction.
- .3 Required stages:
 - .1 Contractor shall submit work execution and phasing schedule to Owner.
- .4 Construct work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of work will provide alternate usage.
- .5 Maintain fire access/control.

1.4 Work Period

- .1 Conduct work within a period of 16 calendar weeks starting from the first day of site mobilization, which must take place in May 2017 further to contract awarding.

- .2 Before September 2, 2016, a mandrel shall be pulled in the four (4) existing empty conduits located between the existing pad-mounted transformer and the former down conductor connecting overhead to underground lines.

1.5 Contractor Use of Premises

- .1 Restricted use of site until Substantial Performance, as directed by Departmental Representative.
- .2 Limit use of premises for work, for storage, and for access, to allow:
 - .1 The Departmental Representative's occupancy.
 - .2 Maintaining operations by users.
 - .3 Public usage.
- .3 Coordinate use of premises under direction of Departmental Representative.
- .4 Storage areas needed for operations under this Contract shall be made available to Contractor as indicated on plans.
- .5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .7 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.6 Occupancy by the Departmental Representative

- .1 The Departmental Representative will occupy premises during entire construction period for execution of normal operations.
- .2 Cooperate with the Departmental Representative in scheduling operations to minimize conflict and to facilitate the Departmental Representative's usage.

1.7 Partial Occupancy by the Departmental Representative

- .1 Execute Certificate of Substantial Performance for each designated portion of work prior to the occupancy by the Departmental Representative. Contractor shall allow:
 - .1 Access for the Departmental Representative's personnel.
 - .2 Use of parking facilities and traffic lanes.
 - .3 Operation of control and electrical systems.

1.8 Items Supplied by the Departmental Representative

- .1 Departmental Representative Responsibilities:
 - .1 Arrange for delivery to site in accordance with Progress Schedule.
 - .2 Inspect deliveries jointly with Contractor.
 - .3 Submit claims for transportation damage.
 - .4 Arrange for replacement of damaged, defective or missing items.
- .2 Contractor Responsibilities:
 - .1 Designate submittals and delivery date for each product in Progress Schedule.
 - .2 Receive and unload products at site.
 - .3 Inspect deliveries jointly with the Departmental Representative; record shortages, and damaged or defective items.
 - .4 Handle products at site, including unpacking and storage.
 - .5 Protect products from damage, and from exposure to elements.
 - .6 Assemble, install, connect, adjust, and finish products.
 - .7 Provide installation inspections required by public authorities.

- .8 Repair or replace items damaged by Contractor or Subcontractor on site under his control.

1.9 Alterations, Additions or Repairs to Existing Building

- .1 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 For the transport of workers, materials and equipment, coordinate with the Departmental Representative.
 - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.

1.10 Existing Utility Services

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Provide alternative routes for personnel, pedestrian and vehicular traffic.
- .3 Establish location and extent of service lines in area of work before starting work. Notify Departmental Representative of findings.
- .4 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .5 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .6 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

- .8 Record locations of maintained, re-routed and abandoned service lines.
- .9 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.11 Required Documents

- .1 Maintain at job site, one (1) copy of each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and other safety related documents.
 - .11 Other documents as specified.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Access and Egress**

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

1.2 Use of Site and Facilities

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Use only elevators or escalators existing in building for moving workers and material.
 - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Closures: protect work temporarily until permanent enclosures are completed.

1.3 Alterations, Additions or Repairs to Existing Building

- .1 Execute work with least possible interference or disturbance to building operations. Arrange with Departmental Representative to facilitate execution of work.

1.4 Existing Services

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where work involves connecting to existing services, give Departmental Representative 72 hours of notice for necessary interruption of electrical service throughout course of work. Keep duration of interruptions to a minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for personnel, pedestrian and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

1.5 Special Requirements

- .1 Carry out noise generating work Monday to Friday from 18:00 to 07:00 hours, specifically in the terminal's public areas. In the "basement" areas and those restricted to the public, coordination may be done with the airport management.
- .2 Submit schedule in accordance with Section 01 32 16.07 – Construction Progress Schedule – Bar (GANTT) Chart.
- .3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .4 Keep within limits of work and avenues of ingress and egress.
- .5 Ingress and egress of Contractor's vehicles at site is limited to areas indicated on plans.
- .6 Deliver materials outside of peak traffic hours 06:00 to 19:00 unless otherwise approved by Departmental Representative. Coordinate deliveries with the Departmental Representative.

- .7 Contractor is solely responsible for work performed in winter conditions and associated costs. Contractor must ensure that all clauses, conditions specific to various specifications sections and manufacturer requirements are respected at all times during performance of work. When required, Contractor must demonstrate to Departmental Representative that said conditions and requirements are met. Contractor must take measures to correct situation to satisfaction of Departmental Representative.

1.6 Security

- .1 Where security has been reduced by work of Contract, provide temporary means to maintain security.
- .2 Identification or access cards
 - .1 It is the responsibility of the Contractor that all personnel assigned to these works possess and visibly wear an identification or access card issued by the Ministry to determine the permitted access areas.
 - .2 The Contractor shall ensure that any identification or access cards are returned to the Ministry 30 days after acceptance of the work. A fee of \$50 per missing card will be retained.
- .3 Security clearances
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - .2 Obtain requisite clearance, as instructed, for each individual required to enter premises.
 - .3 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
- .4 Security escort
 - .1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.

- .2 A security escort is required everywhere in the terminal and particularly in the regulated zone. The Departmental Representative, together with the General Contractor, will designate and authorize two people to act as security escorts, for which the following conditions and responsibilities apply:
 - .1 This person must act as the official foreman assigned to the project and remain in this role for the entire project, and not be replaced during the project, in order to maintain consistency.
 - .2 This person will receive instructions from Transport Canada, must undergo the necessary examinations and commit to respecting the conditions involved in obtaining a security clearance.
 - .3 This person ensures that all employees under his responsibility, including sub-contractors, do not commit infractions.
 - .4 This person must be present at all times on site during work.
 - .5 This person must be able to be contacted outside of work hours.
 - .6 Temporary security escorts may be necessary in some circumstances.

1.7 Building Smoking Environment

- .1 Comply with smoking restrictions. Smoking is not permitted in the work area, outside the "air" side and in a radius of nine (9) metres around the building on "city" side. Use designated smoking areas.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Cash Allowances**

- .1 Include in Contract Price specified cash allowances.
- .2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services and other authorized expenses incurred in performing Work.
- .3 Contract Price, and not cash allowances, includes Contractor's overhead and profit in connection with such cash allowance.
- .4 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .5 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .6 Include progress payments on accounts of work authorized under cash allowances in Departmental Representative's monthly certificate for payment.
- .7 Amount of each allowance, for work specified in respective specifications section is as follows:
 - .1 Section 26 05 00 includes allowance of \$50,000 for Hydro-Québec electricity distributor services.
 - .2 Section 26 05 00 includes allowance of \$500 for telephone distributor services.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Administrative**

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2 If schedule changes, notify Departmental Representative of meeting four (4) days in advance of meeting date.
- .3 Meetings will be held in Transport Canada's administrative facilities.
- .4 Departmental Representative will record meeting minutes.
- .5 Departmental Representative will distribute copies of minutes to meeting participants via email within three (3) days after meetings.
- .6 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 Pre-Construction Meeting

- .1 Schedule a pre-construction meeting within 15 days after date of Contract Award with Contract parties to discuss administrative procedures and define parties' responsibilities.
- .2 Departmental Representative, Contractor, major subcontractors and site inspectors shall attend pre-construction meeting.
- .3 Establish time and location of meeting and notify parties concerned a minimum of five (5) days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative (Cont'd) of participants in the work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.07 – Construction Progress Schedule – Bar (GANTT) Chart.

- .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 – Construction Facilities.
- .5 Site security in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.
- .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .7 Record drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .8 Maintenance manuals in accordance with Section 01 78 00 – Closeout Submittal.
- .9 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 – Closeout Submittals.
- .10 Monthly progress claims, administrative procedures, photographs, hold back.
- .11 Appointment of inspection and testing agencies or firms.
- .12 Insurances, transcript of policies.

1.3 Construction Progress Meetings

- .1 During course of work and prior to project completion, schedule progress meetings bi-weekly.
- .2 Contractor and Departmental Representative are to be in attendance.
- .3 Notify parties minimum five (5) days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) days after meeting.

- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL

1.1 Definitions

- .1 Activity: element of work performed during course of project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Workweek: Monday to Friday, inclusive, will provide five-day workweek and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative and/or Consultant to enable monitoring of project work in relation to established milestones.

1.2 Requirements

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete work in accordance with prescribed milestones and time frame.
- .3 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.

1.3 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit to Departmental Representative within ten (10) working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

1.4 Project Milestones

- .1 Project milestones form interim targets for Project Schedule.
 - .1 Exterior work must be completed within forty (40) working days of Award of Contract date.
 - .2 Finishing and interior fit-up work and electrical and mechanical facilities must be completed within sixty-five (65) working days of Award of Contract date.
 - .3 Interim Certificate (Substantial Completion) within seventy-five (75) working days of Award of Contract date.

1.5 Master Plan

- .1 Structure schedule to allow orderly planning, organizing and execution of work as Bar Chart (GANTT).
- .2 Departmental Representative and Consultant will review and return revised schedules within five (5) working days.

- .3 Revise impractical schedule and resubmit within five (5) working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 Project Schedule

- .1 Develop detailed project schedule from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows.
 - .1 Shop Drawings, Samples.
 - .2 Permits.
 - .3 Mobilization.
 - .4 Siding and Roofing.
 - .5 Electrical.
 - .6 Controls.
 - .7 Testing and Commissioning.
 - .8 Supplied equipment long delivery items.

1.7 Project Schedule Reporting

- .1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 Project Meetings

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather-related delays with their remedial measures will be discussed and negotiated.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Administrative**

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative's review.
- .10 Keep one (1) reviewed copy of each submission on site.

1.2 Shop Drawings and Product Data

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow seven (7) days for Departmental Representative's review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of work, state such in writing to Departmental Representative prior to proceeding with work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.

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

- .10 Submit one (1) electronic copy of product data sheets or brochures for requirements requested in specification sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .11 Submit one (1) electronic copy of test reports for requirements requested in specification sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accordance with specified requirements.
 - .2 Testing must have been within three (3) years of date of contract award for project.
- .12 Submit one (1) electronic copy of certificates for requirements requested in specification sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit one (1) electronic copy of manufacturer's instructions for requirements requested in specification sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit one (1) electronic copy of manufacturer's Field Reports for requirements requested in specification sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

- .16 Submit one (1) electronic copy of Operation and Maintenance Data for requirements requested in specification sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of work may proceed.
- .20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of work of sub-trades.

1.3 Photographic Documentation

- .1 Submit one (1) electronic copy of colour digital photography in jpg format, standard resolution, monthly with progress statement.
- .2 Project identification: name and number of project and date of exposure indicated.

1.4 Certificates and Transcripts

- .1 Immediately after Award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after Award of Contract.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

SHOP DRAWING - IDENTIFICATION FORM

(This form must be filled out by the Contractor.)

PROJECT: PWGSC POWER STATION REPLACEMENT SEPT-ÎLES TERMINAL PWGSC REF.: R.068861.001 SNC-LAVALIN REF.: 632802	OWNER (CLIENT): PWGSC ARCHITECT:												
SUBCONTRACTOR: Address: Responsible person: Telephone: Email	ENGINEER: SNC-LAVALIN INC. 455 René-Lévesque Blvd. West Montreal (Quebec) H2Z 1Z3 TEL.: 514-393-1000												
SUPPLIER: Address : Responsible person: Telephone: Email:	GENERAL CONTRACTOR: Responsible person: Telephone : Email: Approval: <div style="text-align: right;">(Signature)</div>												
MANUFACTURER: Address : Responsible person: Telephone: Email:	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">PRODUCT SUBMITTED:</th> <th style="width: 50%;">DRAWING ISSUED FOR:</th> </tr> <tr> <td>AS IS EQUIVALENT SUBSTITUTION</td> <td>VERIFICATION INFORMATION COORDINATION OTHER _____</td> </tr> </table>	PRODUCT SUBMITTED:	DRAWING ISSUED FOR:	AS IS EQUIVALENT SUBSTITUTION	VERIFICATION INFORMATION COORDINATION OTHER _____								
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SPECIALTY (discipline): <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">SHOP DRAWING NO.:</th> <th style="width: 50%;">NUMBER of PAGES:</th> </tr> <tr> <td colspan="2">TERM OF DELIVERY (after verification):</td> </tr> <tr> <td colspan="2" style="height: 100px; vertical-align: top;">DESCRIPTION OF SHOP DRAWING:</td> </tr> </table> REFERENCE TO DRAWING: REFERENCE TO SPECIFICATIONS: Volume: _____ Article: _____ Division: _____ Page: _____ COMMENTS: <div style="height: 100px;"></div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">REV.</th> <th style="width: 85%;">DATE ISSUED</th> </tr> <tr> <td style="height: 40px;"></td> <td></td> </tr> <tr> <td style="height: 40px;"></td> <td></td> </tr> </table>	SHOP DRAWING NO.:	NUMBER of PAGES:	TERM OF DELIVERY (after verification):		DESCRIPTION OF SHOP DRAWING:		REV.	DATE ISSUED					<div style="border: 1px solid black; padding: 10px;"> <div style="display: flex; align-items: center;"> <div> Verification of conformity SNC • LAVALIN </div> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <u>Nature and scope of the examination</u> Verification of conformity according to the specifications and drawings. </div> <p style="margin-top: 10px;">This verification is by no way a complete and detailed audit of the design.</p> <div style="margin-top: 10px;"> <input type="checkbox"/> No correction noted <input type="checkbox"/> Perform indicated corrections <input type="checkbox"/> Correct and resubmit <input type="checkbox"/> Refused </div> <p style="margin-top: 10px;">Date: _____</p> <p style="margin-top: 10px;">Signature <input type="checkbox"/> Engineer <input type="checkbox"/> Other _____</p> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>_____ Name</div> <div>_____ OIQ member N°</div> </div> <p style="font-size: small; margin-top: 10px;">The review of this paper is limited to the nature and scope indicated. The person or company who prepared it cannot be relieved of its obligations in any cases, of any nature whatsoever.</p> </div>
SHOP DRAWING NO.:	NUMBER of PAGES:												
TERM OF DELIVERY (after verification):													
DESCRIPTION OF SHOP DRAWING:													
REV.	DATE ISSUED												

1. GENERAL**1.1 References**

- .1 Transport Canada.

1.2 Protection of Public Traffic

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.
- .2 When working on travelled way:
 - .1 Place equipment in position to minimize interference and hazard to travelling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .3 No roadway can be closed without written approval of Departmental Representative.
 - .1 Before rerouting traffic, install appropriate signage, in compliance with Work Area Traffic Control Manual.

1.3 Informational and Warning Devices

- .1 Provide and maintain signs, flashing warning lights and other devices to indicate construction activities or other temporary unusual conditions resulting from project work which requires road user response.
- .2 Supply, place and erect signs, delineators, barricades and miscellaneous warning devices as required.
- .3 Before commencing work, consult Departmental Representative to prepare list of signals and other necessary devices for work. If the situation on work site changes, revise list to satisfaction of Departmental Representative.

- .4 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability and location. Clean as required to ensure clarity and reflectance. Immediately repair or replace any defective, unsafe or non-compliant traffic control devices.
 - .2 Removing or covering signs which do not apply to conditions existing from day to day.

1.4 Temporary Parking

- .1 Contractor shall refer to electrical plans for areas delineated and reserved for Contractor during performance of work.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 General Protection**

- .1 Do not disrupt airport business except as permitted by Departmental Representative.
- .2 Provide temporary protection for safe handling of public, personnel, pedestrians and vehicular traffic to Section 01 56 00 –Temporary Barriers and Enclosures.

1.2 Movement of Equipment and Personnel

- .1 In areas of airport not closed to aircraft traffic:
 - .1 Obtain Departmental Representative's approval on scheduling of work.
 - .2 Control movements of equipment and personnel as directed by Departmental Representative.

1.3 Unserviceable Areas

- .1 Respect lighting standards for obstructions/barricades. Mark off areas made unserviceable for aircraft by work of this Contract by providing highly visible danger markings by day and red lights by night, by TP-302 – Aerodromes Standards and Recommended Practices.
- .2 Open flames and flammable fuels are not permitted.
- .3 Park equipment not in use and stockpile materials so that stockpile tops are below 50 to 1 ratio from ends of useable landing strip and below 20 to 1 ratio from sides of aircraft traffic areas.
 - .1 Mark tops with red lights as directed by TP312 – Aerodromes Standards and Recommended Practices and by Departmental Representative.

1.4 Trenching

- .1 Obtain Departmental Representative's written permission to undertake trenching on pavements open to aircraft traffic.

1.5 Airport Facilities

- .1 Departmental Representative will stake or indicate location of underground facilities such as cables, pipes, ducts and other services and utilities.
- .2 Notify Departmental Representative of work areas 48 hours minimum in advance of operations to allow sufficient time for underground facilities and service to be located.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL

1.1 Section Includes

- .1 The Contractor shall manage his operations so that safety and security of the public and of site workers always take precedence over cost and scheduling considerations.

1.2 References

- .1 Canada Labour Code - Part II, Canadian Occupational Safety and Health Regulations.
- .2 Canadian Standards Association (CSA).
- .3 Workplace Hazardous Materials Information System (WHMIS).
- .4 Act Respecting Occupational Health and Safety, R.S.Q. Chapter S-2.1.
- .5 Construction Safety Code, S-2.1, r.6.

1.3 Submittals

- .1 Submit the documents required according to Section 01 33 00 – Submittal Procedures.
- .2 Submit to the Departmental Representative, the CSST, the *Association paritaire en santé et sécurité du secteur de la construction* (ASP Construction), the site-specific safety program, as outlined in 1.8 at least ten (10) days prior to start of work. The Contractor must review his program during the course of the project if any change occurs in work methods or site conditions. The Departmental Representative may, after receiving the program or at any time during the project, ask the Contractor to update or modify the program in order to better reflect the reality of the construction site and activities. The Contractor must make the required changes before work begins.
- .3 Submit to the Departmental Representative the site inspection sheet, duly completed, at the intervals indicated in 1.13.1.
- .4 Submit to the Departmental Representative within 24 hours a copy of any inspection report, correction notice or recommendation issued by federal or provincial inspectors.

- .5 Submit to the Departmental Representative within 24 hours an investigation report for any accident involving injury and any incident exposing a potential hazard.
- .6 Submit to the Departmental Representative all safety data sheets for hazardous material to be used at the site at least three (3) days before they are to be used.
- .7 Submit to the Departmental Representative copies of all training certificates required for application of the safety program, in particular:
 - .1 General construction site safety and health courses.
 - .2 Safety officer attestations.
 - .3 First aid in the workplace and cardiopulmonary resuscitation.
 - .4 Work likely to release asbestos dust.
 - .5 Work in confined spaces.
 - .6 Lockout procedures.
 - .7 Wearing and fitting of individual protective gear.
 - .8 Forklift truck.
 - .9 Positioning platform.
 - .10 Any other requirement of regulations or the safety program.
- .8 Medical examinations: wherever legislation, regulations, directives, specifications or a safety program require medical examinations, Contractor must:
 - .1 Prior to start-up, submit to the Departmental Representative certificates of medical examination for all concerned supervisory staff and employees who will be on duty when the site opens.
 - .2 Thereafter, submit without delay certificates of medical examination for any newly hired concerned personnel as and when they start work at the site.

- .9 Emergency plan: the emergency plan, as defined in 1.8.3, shall be submitted to Departmental Representative at the same time as the site-specific safety program.
- .10 Notice of site opening: notice of site opening shall be submitted to the *Commission de la santé et de la sécurité du travail* before work begins. A copy of such notice shall be submitted to Departmental Representative at the same time and another posted in full view at the site. During demobilization, a notice of site closing shall be submitted to the CSST, with copy to the Departmental Representative.
- .11 Plans and certificates of compliance: submit to the CSST and Departmental Representative a copy signed and sealed by an engineer of all plans and certificates of compliance required pursuant to the Construction Safety Code (S-2.1, r. 6), or by any other legislation or regulation or by any other clause in the specifications or in this contract. Copies of these documents must be on hand at the site at all times.
- .12 Certificate of compliance delivered by the CSST: the certificate of compliance is a document delivered by the CSST confirming that the Contractor is in good standing with the CSST, i.e., that he has paid out all the benefits concerning this contract. This document must be delivered to Departmental Representative at the end of the work.

1.4 Hazards Assessment

- .1 The Contractor must identify all hazards inherent to each task to be carried out at the site.
- .2 The Contractor must plan and organize work so as to eliminate hazards at source or promote mutual protection so that reliance on individual protective gear can be kept to a minimum. Where individual protection against falling is required, workers shall use a safety harness that meets standard CAN/CSA-Z-259.10-M90. Safety belts shall not be used as protection against falling.
- .3 Equipment, tools and protective gear which cannot be installed, fitted or used without compromising the health or safety of workers or the public shall be deemed inadequate for the work to be executed.

- .4 All mechanical equipment shall be inspected before delivery to the site. Before using any mechanical equipment, submit to the Departmental Representative a certificate of compliance signed by a qualified mechanic. Whenever he suspects a defect or accident risk, the Departmental Representative may at any time order the immediate shut-down of equipment and require a new inspection by a specialist of his own choosing.
- .5 For use of equipment for lifting persons or materials, ensure that the inspections required by the standards are met and be able to provide a copy of certificates of inspection upon request of Representative of the Ministry.

1.5 Meetings

- .1 The Contractor's decisional representative must attend any meetings at which site safety and health issues are to be discussed.
- .2 Set up a site safety committee and convene meetings in accordance with the Construction Safety Code (S-2.1, r.6).

1.6 Legal and Regulatory Requirements

- .1 Comply with all legislation, regulations and standards applicable to the site and its related activities.
- .2 Comply with specified standards and regulations to ensure safe operations at a site containing hazardous or toxic materials.
- .3 Regardless of the publication date shown in the Construction Safety Code, always use the most recent version.

1.7 Site-Specific Conditions

- .1 At the site, the Contractor must take into account the following specific conditions:
 - .1 The terminal's personnel and users' circulation near the construction area.

1.8 Safety and Health Management

- .1 Acknowledge and assume all the tasks and obligations which customarily devolve upon a principal Contractor under the terms of the Act Respecting Occupational Health and Safety (R.S.Q., chapter S-2.1) and the Construction Safety Code (S-2.1, r.6).
- .2 Develop a site-specific safety program based on the hazards identified and apply it from the start of project work until close-out is completed. The safety program must encompass all information appearing in 1.7 and must be submitted to all parties concerned, in accordance with the provisions set forth in 1.3. At a minimum, the site-specific safety program must include :
 - .1 Company safety and health policy.
 - .2 A description of the work, total costs, schedule and projected workforce curve.
 - .3 Flow chart of safety and health responsibilities.
 - .4 The physical and material layout of the site.
 - .5 First aid and first-line treatment standards.
 - .6 Identification of site-specific hazards.
 - .7 Risk assessment for the tasks to be carried out, including preventive measures and the procedures for applying them.
 - .8 Training requirements.
 - .9 Procedures in case of accident/injury.
 - .10 Written commitment from all parties to comply with the prevention program.
 - .11 A site inspection schedule based on the preventive measures.
- .3 The Contractor must draw up an effective emergency plan based on the characteristics and constraints of the site and its surroundings. Submit the emergency plan to all parties concerned, pursuant to the provisions of 1.3. The emergency plan must include:
 - .1 Evacuation procedure.

- .2 Identification of resources (police, firefighters, ambulance services, etc.).
- .3 Identification of persons in charge at the site.
- .4 Identification of those with first aid training.
- .5 Training required for those responsible for applying the plan.
- .6 Any other information needed, in light of the site characteristics.

1.9 Responsibilities

- .1 No matter the size of the construction site or how many workers are present at the workplace, designate a competent person to supervise and take responsibility for health and safety. Take all necessary measures to ensure the health and safety of persons and property at or in the immediate vicinity of the site and likely to be affected by any of the work.
- .2 Take all necessary measures to ensure application of and compliance with the safety and health requirements of the Contract Documents, applicable federal and provincial regulations and standards as well as the site-specific safety program, complying without delay with any order or correction notice issued by the *Commission de la santé et de la sécurité du travail*.
- .3 Take all necessary measures to keep the site clean and in good order throughout the course of the work

1.10 Communications and Posting

- .1 Make all necessary arrangements to ensure effective communication of safety and health information at the site. As workers arrive on site, they must all be informed of their rights and obligations pertaining to the site-specific safety program. The Contractor must insist on their right to refuse to perform work which they feel may threaten their own health, safety or physical integrity or that of other persons at the site. The Contractor must keep and update a written record of all information transmitted with signatures of all workers involved.
- .2 The following information and documents must be posted in a location readily accessible to all workers:

- .1 Notice of site opening.
- .2 Identification of principal Contractor.
- .3 Company OSH policy.
- .4 Site-specific safety program.
- .5 Emergency plan.
- .6 Data sheets for all hazardous material used at the site.
- .7 Minutes of site committee meetings.
- .8 Names of site committee representatives.
- .9 Names of those with first aid training.
- .10 Action reports and correction notices issued by the CSST.

1.11 Unforeseen Circumstances

- .1 Whenever a source of danger not defined in the specifications or identified in the preliminary site inspection arises as a result of or in the course of the work, immediately suspend work, take appropriate temporary measures to protect the workers and the public and notify the Departmental Representative, both verbally and in writing. Then the Contractor must modify or update the site-specific safety program in order to resume work under safe conditions.

1.12 Inspection of Site and Correction of Hazardous Situations

- .1 Inspect the work site and complete the site inspection sheet at least once a week.
- .2 Immediately take all necessary measures to correct any lapses from legislative or regulatory requirements and any hazards identified by a government inspector, by the Departmental Representative, by the site safety and health coordinator or during routine inspections.
- .3 Submit to the Departmental Representative written confirmation of all measures taken to correct lapses and hazardous situations.

- .4 Give the safety officer or, where there is no safety officer, the person assigned to safety and health responsibilities, full authority to order interruption and resuming of work as and when deemed necessary or desirable in the interests of safety and health. This person should always act so that the safety and health of the public and site workers and environmental protection take precedence over cost and scheduling considerations.
- .5 Without limiting the scope of sections 1.8 and 1.9, the Departmental Representative may order cessation of work if, in his view, there is any hazard or threat to the safety or health of site personnel or the public or to the environment.

1.13 Blasting

- .1 Blasting and other use of explosives are forbidden unless authorized in writing by the Departmental Representative.
- .2 Any operation involving explosives must be carried out under the supervision of a qualified shot firer.
- .3 The purchase, carriage, storage and use of explosives must comply with all applicable federal and provincial legislation:
 - .1 Canada: Explosives Act (E-17), Explosives Regulations (C.R.C. CH. 599), Standard for Storage of Blasting Charges and Detonators, Transportation of Dangerous Goods Act and Regulations.
 - .2 Quebec: Explosives Act (E-22), Explosives Regulations (E-22, r.1), Construction Safety Code (S-2.1, r.6), Transportation of Dangerous Goods Regulations.
- .4 The Contractor shall obtain all permits required pursuant to the legislation and regulations referred to above and keep copies on hand at the site.
- .5 The Contractor shall facilitate inspection of the site, stored explosives and vehicles used to transport explosives by any government representatives or police officers whose jurisdiction encompasses explosives.

1.14 Powder Actuated Devices

- .1 Use of power hammers must be authorized by the Departmental Representative.
- .2 Any person using a power hammer shall hold a training certificate and meet all requirements of Section 7 of the Construction Safety Code (S-2.1, r. 6).
- .3 Any other explosive-actuated devices are not permitted.

1.15 Lockout

- .1 For all work on energized equipment or equipment that may be started accidentally, the Contractor shall draw up and implement a lockout procedure and complete the Request for Electrical Isolation Form provided by the manager in charge of the work site.
 - .1 Although the list herein is not exhaustive, here are some examples for which the use of the form is obligatory:
 - .1 Main building power feeders.
 - .2 Feeder supply panels and sub-panels.
 - .3 Bus ducts.
 - .4 Motor control centres.
 - .5 Emergency power circuits.
 - .6 Fire alarm and fire protection equipment.
 - .7 Mechanical protective equipment.
 - .8 Alarm circuit for building services, including all heating, ventilating and air conditioning equipment.
 - .9 Circuits supplying more than one (1) piece of equipment.
 - .10 Circuits affecting one (1) single piece of equipment used in a cooling or heating system.

- .2 After having completed the form, the Contractor, shall have it countersigned by the manager in charge of the work site before starting work.
- .2 Notwithstanding the previous paragraphs, the Contractor shall, in an emergency situation, receive an verbal guarantee of isolation from the manager in charge of the work site and immediately countersign the request of electrical isolation.
- .3 The procedure requested at paragraph 1 must comply with the principles listed in the pamphlet entitled *Le cadenassage* published by the *Association paritaire pour la santé et la sécurité du travail secteur construction* (ASP Construction).
- .4 Supervisors and all workers involved must have followed ASP Construction's course *Les techniques de cadenassage* [(514 355-6190 or 1 800 361-2061)] or an equivalent course given by another firm.
- .5 Identify all work that must absolutely be done on live equipment and establish the safety measures that will be applied, including the personal protective equipment.

1.16 Work at Heights

- .1 General
 - .1 See also "Specific Conditions for Roofing Work".
 - .2 The Contractor must ensure that any person carrying out work that poses a risk of falling more than 2.4 m use fall protection equipment.
 - .3 Plan and organize work so as to eliminate the danger at source or ensure collective protection, thereby minimizing the use of personal protective equipment. When personal fall protection is required, workers must use a safety harness that complies with CSA standard CAN/CSA Z-259.10 M90. A safety belt must not be used as fall protection.
 - .4 Every person using an elevating platform must have training regarding this equipment.

- .5 Wearing a safety harness is obligatory in any elevating platform with telescopic, articulated or rotary boom.
- .6 Delineate a danger zone in any place where equipment for work at heights is used.

.2 Special Requirements – Scaffolding

.1 Foundation:

- .1 Scaffolding shall be installed on a solid foundation so that it does not slip or rock.
- .2 Contractors wishing to install scaffolding on a roof, overhang, canopy or awning shall submit their calculations and loads to the Departmental Representative and shall obtain permission from the Departmental Representative before beginning installation.

.2 Assembly, bracing and mooring:

- .1 All scaffolding shall be assembled, braced and moored in accordance with the manufacturer's instructions and the provisions of the Construction Safety Code.
- .2 Where a situation requires the removal of part of the scaffolding (e.g., crosspieces), the Contractor shall submit an assembly procedure signed and sealed by an engineer certifying that the scaffolding assembled in that manner will allow the work to be done safely given the loads to which it will be subjected.
- .3 For scaffolding where the span between two supports is greater than 2.4 m, the Contractor shall provide an assembly plan signed and sealed by an engineer.

.3 Protection against falls during assembly:

- .1 Workers working above the ground shall be protected against falls at all times during assembly.
- .2 Before the work begins, the Contractor shall submit to the Departmental Representative a procedure stating the protective measures used and, if applicable, identifying the

anchor points for the safety cables or moorings. This procedure shall be in accordance with sections 3.9.4.5, 2.9.1 and 2.10.12 of the Construction Safety Code (amended on August 2, 2001).

.4 Platforms:

- .1 Scaffolding platforms shall be designed and installed in accordance with the provisions of the Construction Safety Code.
- .2 If planks are used, they shall be approved and stamped in accordance with section 3.9.8 of the Construction Safety Code (in effect January 1, 2002).
- .3 The platforms shall cover the entire surface protected by the guardrails.
- .4 The above notwithstanding, scaffolding four (4) sections (or 6 metres) high or higher shall have a full platform covering the entire surface of the putlogs every 3 m or fraction thereof, and the components of that platform shall not be moved at any time to create an intermediate landing.

.5 Guardrails:

- .1 A guardrail shall be installed on every landing.
- .2 Crossbraces shall not be considered guardrails.
- .3 Where scaffolding four (4) sections (or 6 metres) high or higher requiring full platforms is used, guardrails shall be installed on each landing at the start of work and shall remain in place until the work is completed.

.6 Access:

- .1 The Contractor shall ensure that access to the scaffolding does not compromise worker safety.
- .2 Where the platforms of the scaffolding are comprised of planks, ladders shall be installed in such a way that planks extending beyond the platform do not block the way up or down.

- .3 Notwithstanding the provisions of the Construction Safety Code, stairs shall be installed on all scaffolding that has six (6) or more rows of uprights or is six (6) sections (or 9 metres) high or higher.
- .7 Protection of the public and occupants:
 - .1 The Contractor shall identify the boundaries of and barricade the work area so as to limit access to authorized workers only.
 - .2 The Contractor shall install covered walkways, nets or other similar devices to protect the public or the occupants against falling objects.
- .8 Use of public thoroughfares:
 - .1 Where it is necessary to encroach on a public thoroughfare, the Contractor shall obtain at the Contractor's expense any authorizations and permits required by the competent authority.
 - .2 The Contractor shall install at the Contractor's expense any signage, barricades or other devices needed to ensure the safety and security of the public and the Contractor's own facilities.

1.17 Lifting Material

- .1 Lifting devices shall be positioned in such a way that loads are not carried over workers, occupants or the public.
- .2 The Contractor must transmit to the Departmental Representative a work procedure, signed and sealed by an engineer, including inter alia the position of the crane, a sketch of the trajectory of the transported loads, the length of the mast and a lifting plan for the handling of loads above occupied buildings. The Departmental Representative can, if deemed necessary, impose work during the evening and on weekends.
- .3 All mobile cranes manufactured after January 1, 1980 must be equipped with a safety device against overloading.

- .4 All mobile cranes with cables manufactured after January 1, 1970, except if they are used for means other than lifting loads, must be provided with a safety device against two-blocking. Mobile cranes with cables manufactured before January 1, 1970 must have been equipped with this device at the latest on December 31, 2006.
- .5 The Contractor shall provide the Engineer with a mechanical service inspection certificate for each lifting device. Inspections must be carried out just prior to the delivery of the equipment to the work site.
- .6 For all winch installations, the Contractor shall provide the Departmental Representative with the installation method recommended by the manufacturer. If unavailable, the Contractor shall then provide an installation procedure signed and sealed by an engineer. The installation procedure must take into account load bearing capacity, the amount, weight and location of counterweight and any other detail that may affect the capacity and stability of the device.
- .7 In addition to the mechanical service inspection certificate, the annual inspection certificate and the crane logbook must be aboard all crane and crane-truck cabs.
- .8 The entire lifting area shall be closed off to prevent non-authorized people from entering it.
- .9 The Contractor shall obtain all of the permits at his own expense, in the event the thoroughfare must be temporarily closed off to meet the requirement stipulated in the preceding paragraph or for any other reason pertaining to the safety of workers, occupants or the public.
- .10 The Contractor shall carefully inspect all of the slings and lifting accessories and make sure that those in poor condition are destroyed or scrapped.
- .11 Compressed gas cylinders shall be lifted with a basket specially designed for this purpose.

1.18 Silica

- .1 Preventive measures to be applied at the work site
 - .1 Source reduction methods

- .1 Work in wet environments or use of tools with inflow of water in order to reduce dust or collect dust at the source and retain it with a high efficiency filter not to propagate dust in the environment.
- .2 Clean surfaces and tools with water, never with compressed air.
- .3 Sand and pickle surfaces by using an abrasive containing less than 1% of silica (also called amorphous silica).
- .4 When required, install shields or other containment device to prevent silica dust from migrating toward other workers or the public.
- .2 Individual protection equipment
 - .1 Wear individual respiratory protection equipment (mask) during all operations that could generate silica dust. Select respiratory protection in accordance with the *Guide des appareils de protection respiratoire utilisés au Québec* available at: http://www.prot.resp.csst.qc.ca/Guid_APR.pdf
 - .2 Wear an ocular protection (glasses or visors).
 - .3 Wear coveralls to prevent contamination outside the worksite.
- .3 Personal hygiene
 - .1 Do not eat, drink or smoke in a dusty environment.
 - .2 Wash hands and face before drinking, eating or smoking.

1.19 Lead

- .1 Work involving a low exposure to lead
 - .1 Adequate measures
 - .1 The Contractor shall be aware of all hazards associated with exposure to lead. The Contractor agrees to take all necessary measures to protect the health of his workers and the public. The following rules are the minimum and in no way diminish

the requirements set out in current statutes and regulations. If, after the workers have undergone blood tests or air samples have been analysed, it is determined that the measures taken are not sufficient, the Contractor shall stop the work and, at his own expense, modify the work procedure, provide other protective equipment or take any other measures needed to ensure that the health of the workers and the public is not compromised.

- .2 The Contractor shall use work methods that make it possible to contain and control contaminated residue. Decontamination shall be done using a wet process unless that process is impossible or gives rise to other hazards. Depending on the processes used, it may be necessary to keep the work area under negative pressure in order to prevent contaminated dust or mist from escaping.

.2 Training

- .1 Before authorizing them to enter the contaminated area, the Contractor shall train all of his workers and any subcontractors' workers so that they are able to do their work safely. This training shall include, but is not limited to:
 - .1 Hazards of lead exposure.
 - .2 Ways lead can enter the body.
 - .3 Detailed description of work methods.
 - .4 Preventive measures.
 - .5 Essential sanitation measures.
 - .6 The right of workers under the Act Respecting Occupational Health And Safety and the Canada Labour Code to refuse any work that could compromise their safety and health.

.3 Respiratory protection

- .1 Without limiting the other regulatory requirements applicable to respiratory protection, every person who is in a decontamination area shall wear a mask with a HEPA (high-efficiency particulate air) filter. At the time of hiring, the Contractor shall conduct the necessary tests to ensure that all workers are able to properly wear the required respiratory protection. Workers who have a beard or whose face is a shape that does not allow the mask to fit perfectly shall not be permitted to enter the contaminated area.

.4 Work clothes

- .1 The Contractor shall provide the workers with disposable coveralls with a hood and rubber safety boots. The workers shall remove and dispose of their coveralls and remove their boots every time they leave the contaminated work area, whether they are leaving to eat, take a break or simply go to the bathroom. A supply of clean coveralls shall be available outside the contaminated area. Soiled coveralls shall be treated as contaminated materials.

.5 Washroom facilities

- .1 Wash basins (or equivalent) with disposable towels shall be made available to the workers. The workers shall wash their hands and face every time they leave the contaminated area.

.6 Rest and/or dining room

- .1 The Contractor must clean (by wet process) the floors and the tables of the rest and/or dining room in order to limit the possibility of contamination per ingestion or inhalation.

.7 Equipment provided to the Departmental Representative

- .1 The Contractor shall provide at no charge to the Departmental Representative or persons designated by the Departmental Representative protective equipment (coveralls, boots, masks and other equipment as required depending on the procedure), access, and the facilities needed to safely perform normal monitoring and inspection duties.

- .2 Work involving a medium or high exposure to lead
 - .1 In addition to the requirements for work involving low exposure to lead, the Contractor shall take the measures outlined below.
 - .2 Environmental monitoring
 - .1 The Contractor shall retain the services of a private laboratory to check lead levels at least once a day in every area occupied by workers at some time during the day (including washroom facilities and break rooms) and outside the building, halfway between the building and the living quarters. Testing shall be done while activities are under way in those areas. The tests consist in taking ambient air samples in work areas and outside the building and dust samples in break rooms and cloakrooms. The results shall be made available within 24 hours and shall be recorded in a log book. The log book or a copy thereof shall be accessible to all workers. The Contractor shall take the necessary measures to maintain an airborne lead concentration of less than 0.05 mg/m^3 in areas deemed not to be contaminated.
- .3 Medical surveillance
 - .1 The Contractor must give a completed copy of the *Rapport de conformité médicale : Aptitude à travailler en présence de contamination au plomb* form for each employee. Blank copies of the form are available through the Departmental Representative.
 - .2 The Contractor shall contact public health departments and, if necessary, authorized private clinics and laboratories so that the following requirements can be met:
 - .1 Before the beginning of work, all workers shall undergo a medical blood-lead measurement (time zero).
 - .2 Blood-lead testing of all workers shall be repeated every two (2) weeks after decontamination work begins, and workers whose blood-level is more than $30 \text{ } \mu\text{g/dl}$ shall be removed from the contaminated area.

Workers whose blood-lead level is more than 40 µg/dl shall be removed from the work site.

- .3 The test results shall be forwarded to the Departmental Representative within 14 calendar days. Please ensure that the laboratory is capable of providing the results within the required period.
- .4 Workers removed from the site shall not be permitted to return until their blood-lead level has returned to less than 15 µg/dL. Pregnant women shall not be permitted to enter the site at any time while the work is being done.
- .3 If one or more workers undergo a second blood-lead test and the results are higher than the first test, the Contractor shall review its work methods, protective measures and prevention program monitoring measures. The Contractor shall forward to the Departmental Representative a written list of the measures he plans to take to further reduce exposure levels.

1.20 Asbestos Work

- .1 Before undertaking work liable to emit asbestos dust, the Contractor must :
 - .1 Provide a written procedure considering all items specified in the Construction Safety Code S-2.1, r-6.
 - .2 Show that the worker has been trained in the risks, prevention methods and safe working methods (ASP Construction) (art.3.23.7).
 - .3 Show that he has on hand all the material and the equipment necessary to respect the procedure and execute safety work.

1.21 Excavating And Trenching

- .1 To follow Canadian Safety Code guidelines on excavation.

1.22 Hot Work

.1 General

- .1 Hot work means any work where a flame is used or a source of ignition may be produced, i.e., riveting, welding, cutting, grinding, burning and heating.
- .2 Before the beginning of work, the Contractor must have received the PWGSC “Hot Work Permit” (ELF 367) completed by the manager in charge of the work site when the duties to be undertaken involve hot work.
- .3 Work on construction sites must be carried out in compliance with Fire Commissioner of Canada Standard CI 301, Standard for Construction Operations, June 1982. This standard is available at the following website:
http://www.hrsdc.gc.ca/eng/labour/fire_protection/policies_standards/commissioner/301/page00.shtml
- .4 A working portable fire extinguisher suitable to the fire risk shall be available and easily accessible within a 5 m radius from any flame, spark source or intense heat.
- .5 An individual shall be appointed to go on rounds (fire) for a period of 30 minutes after the end of the shift. This individual shall countersign the permit and give it to the person in charge of the work site (or the individual he/she appoints) after the 30-minute period.
- .6 The storage of propane cylinders shall comply with the CAN/CSA-B149.2-F00 Propane Storage and Handling Code and meet the specific conditions outlined in this document. The cylinders shall be stored outdoors, in a safe place, away from any unauthorized handling, in a storage cabinet specially designed for this purpose. The cylinders shall be securely kept upright and locked at all times in a place where no vehicles are allowed, unless the cylinders are protected by bars or the equivalent.
- .7 All of the cylinders used or stored on the work site shall be equipped with a collar designed to protect the valve.

- .8 Filling the cylinders on the work site is forbidden, unless a procedure compliant with CAN/CSA B149.2 standard is approved and authorized by the Departmental Representative.
- .2 Welding and cutting
 - .1 Note: for welding and cutting activities, make sure that the following conditions are met in addition to the ones mentioned above.
 - .2 The works must be carried out in accordance with the articles “3.13. Compressed Gas Supply” and “3.14. Welding and Cutting” of the Construction Safety Code, S-2.1, r. 6.
 - .3 Work on construction sites must be carried out in compliance with Fire Commissioner of Canada Standard CI 302, Standard for Welding and Cutting, June 1982. This standard is available at the following website:

http://www.hrsdc.gc.ca/eng/labour/fire_protection/policies_standards/commissioner/302/page05.shtml
 - .4 The welding and cutting devices are excessively dangerous with regard to the fire risk of the building workplace. The following precautions must be taken at the time of this type of work :
 - .1 Store all compressed gas cylinders on a fireproof fabric and make sure that the room is well ventilated.
 - .2 Store all oxygen cylinders more than 6 metres from a flammable gas cylinder (ex: acetylene) or a combustible such as oil or grease, unless the oxygen cylinder is separated from it by a wall made of non-combustible material as mentioned in article 3.13.4 of the Construction Safety Code, S-2.1, r. 6.
 - .3 Set up fireproof fabrics when welding work is done overhead and there is risk of sparks falling.
 - .4 Store the cylinders far from all heat sources.
 - .5 Do not store cylinders close to the staircases, exits, corridors and elevators.

- .6 Do not put acetylene in contact with metals such as silver, mercury, copper and alloys of brass having more than copper 65%, to avoid the risk of an explosive reaction.
- .7 Check that welding equipment with electric arc has the necessary voltage and is suitably grounded.
- .8 Ensure that the conducting wires of the electric welding equipment are not damaged.
- .9 Place the welding equipment on flat ground away from weather conditions.
- .10 Move away or protect combustible materials which may be near the welding equipment.
- .11 Do not weld or cut any closed containers.
- .12 Envisage protection measures when welding or cutting is carried out near drains, tanks or other containers containing flammable materials.
- .13 Do not perform any cutting, welding or work with an open flame on a container, tank, pipe or other container with a flammable or explosive substance unless:
 - .1 Air samples indicating that work can be performed without danger have been taken; or
 - .2 Provisions to ensure the safety of the workers have been taken.

1.23 Changing Light Bulbs and Lighting Tubes

- .1 In addition to the other safety requirements set out in this document, the Contractor has to comply with the following requirements to prevent electric shock when changing light bulbs and lighting tubes:
 - .1 Ensure that the workers assigned to the work have received all of the information needed to carry out the work safely and that they at least apply the following safety measures.

- .2 Check the condition of the work area before beginning the work. If the area is very humid, if there is water in the vicinity or if the electrical system is explosion-proof, do not carry out the work and notify the Departmental Representative.
- .3 Check the condition of the light bulbs and fluorescent tubes to be changed. If a light bulb or fluorescent tube shows signs of damage or wear, if it is difficult to remove or if there are traces of a ballast leak, do not carry out the work and notify the Departmental Representative.
- .4 Wear leather gloves. Ensure that they do not show signs of damage or wear every time such work is to be performed.
- .5 Wear safety goggles.
- .6 The ladders and stepladders used have to be made of fibreglass.
- .7 Block off areas where climbing equipment is being used.
- .8 Insulate light switches whenever possible (switch off).
- .9 Place a danger label on the switch indicating that it should not be switched on.
- .10 Replace the light bulbs and fluorescent tubes with the same type of bulbs and tubes of the same size and wattage. If there is doubt, notify the Departmental Representative.

1.24 Cleaning Work

- .1 The Contractor must be in compliance with the Workplace Hazardous Materials Information System Regulation, and must ensure that the material safety data sheets for all hazardous products used are permanently kept in the building where these products are stored, that these data sheets are updated further to product purchases, and that containers of all sizes are duly labeled. The Contractor must demonstrate to the Departmental Representative's satisfaction that all of its employees have received adequate WHMIS training.
- .2 The Contractor must ensure that non-compatible chemicals are stored in such a way that they never come into contact with each other.

- .3 Ensure workers wear the proper gloves when using cleaning products.
- .4 Ensure the public is protected from any risk of slipping on freshly washed floors.
- .5 Ensure workers wear the proper gloves when cleaning outdoors if there is a risk of contact with biological contaminants (droppings, birds' nests, etc.).
- .6 For outdoor work, advise the Departmental Representative of any accumulation of bird or animal droppings so he/she can advise you of the necessary procedures to follow.

1.25 Specific Conditions for Confined Spaces

- .1 Class 1
 - .1 Regarding all Class 1 (low-risk) confined spaces, all persons involved shall have followed a basic training. Though it is not necessary to implement special work practices in low-risk confined spaces, the Contractor shall implement methods that ensure the health and general safety of persons who must work in these spaces.
 - .2 Before having access to confined spaces, the manager responsible for the workplace shall be informed of the expected date and time of entry and exit.
 - .3 Persons who have access to low-risk confined spaces must record the relevant information in the Confined Space Entry Log (ELF 103 form), i.e., all persons entering this class of confined space shall record each entry and each exit.
- .2 Classes 2 and 3
 - .1 Regarding all Class 2 and 3 confined spaces (medium- and high-risk), the following measures shall be strictly applied.
 - .1 The Contractor's prevention program shall include a written procedure which identifies:
 - .1 Necessary work tools.

- .2 Instruments, installed or to be installed in the confined space, and measures to take for their installation, use, maintenance, protection and moving.
 - .1 Pipes and conduits entering the confined space.
 - .2 Risks and security measures to be taken depending on the work to be carried out.
- .2 Hazardous material that may be found in the confined space.
 - .1 Appropriate rescue methods and equipment as well as emergency plan.
- .2 The Contractor shall complete an access permit (ELF 101 form). The permit shall be valid for the duration of a work shift and shall take into account information contained in the assessment report and special conditions related to the work to be carried out. The Contractor may use his own form if it provides all the information that appears on the appended form.
- .3 The Contractor shall complete a Hot Work Permit when the work to be carried out includes operations such as welding, cutting or any other activity that creates flames or sparks.
- .4 All persons having access to the confined space and the safety guard shall have the following training certificates:
 - .1 Safety for work in PWGSC confined spaces (ASP Construction or equivalent training).
 - .2 Workplace First Aid and CPR (organization recognized by the CSST).
 - .3 Use of ventilating equipment (ASP Construction or equivalent training).
 - .4 Use of safety harness (ASP Construction or equivalent training).
 - .5 Use and maintenance of respiratory protection equipment (ASP Construction or equivalent training).

- .6 Gas detection equipment (ASP Construction or equivalent training).
- .7 When the use of air adduction respirators or autonomous respirators is planned for, thorough training in the preparation, maintenance and use of such equipment (manufacturer, supplier or recognized organization).
- .8 In remote areas where no local rescue and emergency intervention unit is available, the Contractor shall designate persons who are capable of carrying out rescue operations in confined spaces. First-aid attendant designated by the Contractor shall have relevant training in the use of rescue equipment.
- .5 All persons who must use air adduction respirators or autonomous respirators shall present a medical certificate confirming that they are fit to use this kind of equipment. This certificate shall be valid for two (2) years.
- .6 Employees who are required to work in sewage collection systems or other similar systems shall be immunized against infectious diseases, in compliance with the immunization program prescribed by Health Canada, which is, against diphtheria and tetanus and for work to be done at the Correctional Service Canada, against hepatitis B.
- .7 The antidiphtheria-tetanus vaccination is strongly recommended, though it is not mandatory.
- .8 The Contractor shall establish emergency and rescue procedures in cooperation with municipal and ambulance services. These procedures, together with the relevant phone numbers and the whereabouts of the nearest phone shall be conspicuously posted near the work station.
- .9 Before entry into a confined space, and every 15 minutes thereafter, the Contractor shall take readings of oxygen concentration, flammable gases and all toxic gases likely to be present, carbon monoxide and hydrogen sulphide in particular. These readings shall be recorded in a register, unless the detecting devices are equipped with an alarm and operate on a continuous basis. Detecting devices that are used shall be calibrated and adjusted by a competent person

according to the manufacturer's directives, so that the alarms comply with the limits set out on the permit. NOTE: for welding and cutting tasks, readings of concentration must be done on a continuous basis.

- .10 The Contractor is responsible for the provision and maintenance of gas detecting devices. The Engineer may at any time require the Contractor's equipment to be checked for accuracy by a qualified person. In the event of failure of a detecting device, work shall be suspended immediately and all workers shall leave the confined space. In these circumstances, no claim for time lost shall be accepted.
- .11 If a detecting device alarm is set off, all workers shall leave the confined space. The Contractor shall then find the source of contamination, neutralize it, ventilate the confined space to eliminate contaminant residues and authorize access to the confined space only when concentrations of oxygen and gas have returned to normal.
- .12 Compressed gas cylinders or welding equipment shall not be brought into confined spaces: this equipment shall remain outside and shall not block entrances or exits; all cylinders shall be properly secured.
- .13 Tools and electrical devices used to gain access to confined spaces shall be grounded and, when necessary, designed to be explosion-proof. All equipment must be connected to a ground fault interrupter outlet or to a step-down transformer. The Contractor shall, at his own cost, hire a qualified electrician to adjust power receptacles and/or circuit breakers that he intends to use which do not meet these criteria.
- .14 The Contractor shall provide a ventilation system to keep concentrations of contaminants below admissible limits.
- .15 The Contractor shall put up posters to prevent unauthorized persons from entering the confined space.
- .16 When it is impossible to maintain the noise level under 85 dB, the Contractor shall provide all workers with ear protection adapted to the desired level of attenuation and work to be carried out.

- .17 The Contractor shall ensure that all workers wear the required personal protection equipment.
- .18 The Contractor shall assign a competent person to assume the function of safety guard. The safety guard shall:
 - .1 Be properly informed of work procedures in a confined space.
 - .2 Ensure constant communication with all workers in the confined space. The instructions that are applied shall be adapted to confined spaces. The Contractor shall choose means of communication according to identified risks and other relevant factors, that is the protection equipment the workers must wear, noise levels in confined spaces and surrounding areas, remoteness, lighting conditions, etc.
 - .3 Be familiar with gas detecting devices and see to their proper functioning for the duration of the work.
 - .4 Be familiar with auxiliary ventilation systems and see to their proper functioning for the duration of the work.
 - .5 Be familiar with emergency procedures.
 - .6 Ensure that:
 - .1 All workers who enter the confined space respect the Contractor's work procedure.
 - .2 The working conditions and the environment inside the confined space are in no way detrimental to workers' health and safety.
- .19 The safety guard shall, at all times, be posted at the entrance of the confined space and shall not leave his station as long as there is a worker inside the confined space.
- .20 The Contractor shall designate a person to be in charge of the safety of the confined space. This person shall be present at all times on the job site.

- .21 The same person may act as a security guard and be responsible for the safety of confined spaces, provided all requirements of both functions are met.

END OF SECTION

1. GENERAL**1.1 References****.1 Definitions**

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

1.2 Action and Informational Submittals**.1 Product Data**

- .1 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 – Health and Safety Requirements.
- .2 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
- .3 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.

- .3 Names and qualifications of persons responsible for training site personnel.
- .4 Descriptions of environmental protection personnel training program.
- .5 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .6 Spill Control Plan to include procedures, instructions and reports to be used in event of unforeseen spill of regulated substance.
- .7 Non-Hazardous Solid Waste Disposal Plan identifying methods and locations for solid waste disposal including clearing debris.
- .8 Air Pollution Control Plan detailing provisions to assure that dust, debris, materials and trash are contained on project site.
- .9 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial and Municipal laws and regulations for storage and handling of these materials.
- .10 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water and water used in flushing of lines.

1.3 Fires

- .1 Fires and burning of rubbish on site are not permitted.
- .2 Provide supervision, attendance and fire protection measures as directed.

1.4 Drainage

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
- .3 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 Site Clearing and Plant Protection

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Minimize stripping of topsoil and vegetation.

1.6 Pollution Control

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
 - .1 Provide temporary enclosures where directed by Departmental Representative.

- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.7 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.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

3.1 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave work area clean at end of each day.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

- .4 Waste Management: separate waste materials for reuse/recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1. GENERAL**1.1 References and Codes**

- .1 Perform work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 Hazardous Material Discovery

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative. Refer to Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions.
- .2 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.

1.3 Building Smoking Environment

- .1 Comply with smoking restrictions and municipal by-laws.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Inspection**

- .1 Allow Departmental Representative access to work. If part of work is in preparation at locations other than place of work, allow access to such work whenever it is in progress.
- .2 Give timely notice requesting inspection if work is designated for special tests, inspections or approvals by Departmental Representative.
- .3 If Contractor covers or permits to be covered work that has been designated for special tests, inspections or approvals before such is made, uncover such work, have inspections or tests satisfactorily completed and make good such work.
- .4 Departmental Representative will order part of work to be examined if work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such work and pay cost of examination and correction. If such work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 Independent Inspection Agencies

- .1 Independent inspection/testing agencies will be engaged by Departmental Representative. Cost of such services will be borne by Departmental Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relieve responsibility to perform work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.3 Access to Work

- .1 Allow inspection/testing agencies access to work, off-site manufacturing and fabrication plants.
- .2 Cooperate to provide reasonable facilities for such access.

1.4 Procedures

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 Rejected Work

- .1 Remove defective work, whether result of poor workmanship, use of defective products or damage and whether incorporated into work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective work or work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.6 Reports

- .1 Submit three (3) copies of inspection and test reports to Departmental Representative.

1.7 Mock-ups

- .1 Prepare mock-ups for work specifically requested in specifications. Include for work of sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative as specified in specific section.
- .3 Prepare mock-ups for Departmental Representative's review with reasonable promptness and in orderly sequence, to not cause delays in work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Specification section identifies whether mock-up may remain as part of work or if it is to be removed and when.

1.8 Mill Tests

- .1 Submit mill test certificates as required of specification sections.

1.9 Equipment and Systems

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Installation and Removal**

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.2 Water Supply

- .1 Departmental Representative will provide continuous supply of potable water for construction use.

1.3 Temporary Heating and Ventilation

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of work.
 - .2 Protect work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10°C in areas where construction is in progress.
- .5 Ventilating
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building not to be used.
- .7 Ensure Date of Substantial Performance and warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Departmental Representative.
- .8 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .9 Be responsible for damage to work due to failure in providing adequate heat and protection during construction.

1.4 Temporary Power and Lighting

- .1 Departmental Representative will pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 V.
- .2 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lux.

- .3 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than three (3) months.

1.5 Telecommunications

- .1 Provide and pay for temporary telecommunications facilities, including telephone, fax, data hook-up, lines, equipment necessary for own use and use of Departmental Representative; ensure hook-up of these facilities to main networks and pay costs of all services.

1.6 Fire Protection

- .1 Provide and maintain temporary fire protection equipment during performance of work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-[M1978(R2003)], Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-[M1987(R2003)], Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.

1.2 Installation and Removal

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation. Plan must respect architectural plans and locations indicated. Provide OMEGA type fence 1,800 mm high where indicated on plans.
- .2 Indicate use of supplemental or other staging area.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use.

1.3 Scaffolding

- .1 Scaffolding in accordance with CAN/CSA-S269.2.

- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs.

1.4 Hoisting

- .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with subcontractors for their use of hoists.
- .2 Hoists to be operated by qualified operator.

1.5 Elevators

- .1 Designated existing elevators to be used by construction personnel and transporting of materials. Coordinate use with Departmental Representative.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

1.6 Site Storage/Loading

- .1 Storage areas are indicated on plans.
- .2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .3 Do not load or permit to load any part of work with weight or force that will endanger work.

1.7 Construction Parking

- .1 Parking will be permitted on site in areas indicated on architectural plans.
- .2 Provide and maintain adequate access to project site.
- .3 Clean (airport) runways and taxi areas where used by Contractor's equipment.

1.8 Offices

- .1 Owner will provide location for storage and site office for workers. Electrical services fit-out will fall under the Contractor's responsibility.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary within designated area. Direct location of these offices.
- .4 Departmental Representative's site office.
 - .1 Owner will provide temporary office for Departmental Representative.

1.9 Equipment, Tool and Materials Storage

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.
- .3 Ensure that no materials, equipment and devices installed for their protection is likely to catch in the wind and collide with an aircraft or obstruct the visibility in the air side.

1.10 Sanitary Facilities

- .1 Existing sanitary facilities of airport can be used for work force in accordance with governing regulations and ordinances.
- .2 Keep area and premises in sanitary condition.

1.11 Construction Signage

- .1 Provide and erect project sign, within three (3) weeks of signing Contract, in a location designated by Departmental Representative.
- .2 Construction sign 1.2 m X 2.4 m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.

- .3 Indicate on sign, name of Owner and Contractor of design style established by Departmental Representative.
- .4 No other signs or advertisements, other than warning signs, are permitted on site.

1.12 Protection and Maintenance of Traffic

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Provide necessary lighting, signs, barricades and distinctive markings for safe movement of traffic.
- .9 Dust control: adequate to ensure safe operation at all times.
- .10 Location, grade, width and alignment of construction and hauling roads: subject to approval by Departmental Representative.
- .11 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .12 Provide snow removal during period of work.

- .13 Remove, upon completion of work, haul roads designated by Departmental Representative.

1.13 Clean-up

- .1 Remove construction debris, waste materials and packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

1.14 Temporary Partitions

- .1 Provide temporary partitions to delineate the work by zone, in accordance with requirements in architectural plans.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-O121-M1978(R2003), Douglas Fir Plywood.

1.2 Installation and Removal

- .1 Provide temporary controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.3 Guard Rails and Barricades

- .1 Provide and install secure, rigid guard rails and barricades where required.
- .2 Provide and install as required by governing authorities.

1.4 Weather Enclosures

- .1 Provide weather-tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Design enclosures to withstand wind pressure and snow loading.

1.5 Dust-Tight Screens

- .1 Provide dust-tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of work and public.
- .2 Maintain and relocate protection until such work is complete.

1.6 Access to Site

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

1.7 Public Traffic Flow

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

1.8 Fire Routes

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

1.9 Protection for Off-Site and Public Property

- .1 Protect surrounding private and public property from damage during performance of work.
- .2 Be responsible for damage incurred.

1.10 Protection of Building Finishes

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of work.
- .2 Provide necessary screens, covers and hoardings.
- .3 Confirm with Departmental Representative three (3) days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

1.11 Waste Management and Disposal

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

2. PRODUCTS

.1 Not used.

3. EXECUTION

.1 Not used.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Within text of each specifications section, reference may be made to reference standards. List of standards reference writing organizations is contained in affected sections.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 Quality

- .1 Products, materials, equipment and articles incorporated into work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 Availability

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of work.
- .2 In event of failure to notify Departmental Representative at commencement of work and should it subsequently appear that work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 Storage, Handling and Protection

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber and sheet material on flat, solid supports and keep clear of ground. Slope to shed moisture.

- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over nameplates.

1.5 Transportation

- .1 Pay costs of transportation of products required in performance of work.

1.6 Manufacturer's Instructions

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided.
- .2 Notify Departmental Representative in writing of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 Quality of Work

- .1 Ensure quality of work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

- .3 Decisions as to standard or fitness of quality of work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.8 Co-ordination

- .1 Ensure cooperation of workers in laying out work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 Concealment

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.10 Remedial Work

- .1 Perform remedial work required to repair or replace parts or portions of work identified as defective or unacceptable. Coordinate adjacent affected work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 Location of Fixtures

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

1.12 Fastenings

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

- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 Fastenings – Equipment

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished, unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 Protection of Work in Progress

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

1.15 Existing Utilities

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

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

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Action and Informational Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Owner or separate contractor.
- .3 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of Owner or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 Materials

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 – Submittal Procedures.

1.3 Preparation

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 Execution

- .1 Execute cutting, fitting and patching to complete work.
- .2 Fit several parts together, to integrate with other work.
- .3 Uncover work to install ill-timed work.
- .4 Remove and replace defective and non-conforming work.
- .5 Provide openings in non-structural elements of work for penetrations of mechanical and electrical work.
- .6 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
- .7 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .8 Restore work with new products in accordance with requirements of Contract Documents.
- .9 Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- .10 At penetration of fire-rated wall, ceiling or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 – Firestopping, full thickness of the construction element.

- .11 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .12 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 Waste Management and Disposal

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Project Cleanliness**

- .1 Maintain work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .6 Dispose of waste materials and debris at designated dumping areas on Crown property.
- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 Final Cleaning

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

CLEANING

- .2 Remove waste products and debris other than that caused by others, and leave work clean and suitable for occupancy.
- .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls and floors.
- .8 Clean lighting reflectors, lenses and other lighting surfaces.
- .9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .10 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .11 Inspect finishes, fittings and equipment and ensure specified workmanship and operation.
- .12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Sweep and wash clean paved areas.
- .15 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

1.3 Waste Management and Disposal

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Waste Management Goals**

- .1 Prior to start of work, conduct meeting with Departmental Representative to review and discuss PWGSC's waste management goal and Contractor's proposed Waste Reduction Workplan for Construction, Renovation and /or Demolition (CRD) waste to be project generated.
- .2 PWGSC's waste management goal: to divert a minimum 25% of total project waste from landfill site.
- .3 Target percentage goals are achievable for waste diversion. Contractor to review and confirm Departmental Representative's Waste Audit acceptable values.
- .4 Minimize amount of non-hazardous solid waste generated by project and accomplish maximum source reduction, reuse and recycling of solid waste produced by CRD activities.
- .5 Protect environment and prevent environmental pollution damage.

1.2 References

- .1 Definitions
 - .1 Approved/Authorized recycling facility: waste recycler approved by applicable provincial authority or other users of material for recycling approved by the Departmental Representative.
 - .2 Class III: non-hazardous waste – construction renovation and demolition waste.
 - .3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition and/or renovation activities.
 - .4 Cost/Revenue Analysis Workplan (CRAW): based on information from Waste Reduction Workplan, and intended as financial tracking tool for determining economic status of waste management practices (Schedule E).
 - .5 Inert Fill: inert waste – exclusively asphalt and concrete.

- .6 Waste Source Separation Program (WSSP): implementation and coordination of ongoing activities to ensure designated waste materials will be sorted into pre-defined categories and sent for recycling and reuse, maximizing diversion and potential to reduce disposal costs.
- .7 Recyclable: ability of product or material to be recovered at end of its life cycle and remanufactured into new product for reuse.
- .8 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .9 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating or thermally destroying waste.
- .10 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from remodelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .11 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .12 Separate Condition: refers to waste sorted into individual types.
- .13 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.
- .14 Waste Audit (WA): detailed inventory of estimated quantities of waste materials that will be generated during construction, demolition, deconstruction and/or renovation. Involves quantifying by volume/weight amounts of materials and wastes that will be reused, recycled or landfilled. Refer to Schedule A.

- .15 Waste Diversion Report: detailed report of final results, quantifying cumulative weights and percentages of waste materials reused, recycled and landfilled over course of project. Measures success against Waste Reduction Workplan (WRW) goals and identifies lessons learned.
- .16 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating required submittal and reporting requirements.
- .17 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse or recycling of materials generated by project. Specifies diversion goals, implementation and reporting procedures, anticipated results and responsibilities. Waste Reduction Workplan (Schedule B) information acquired from Waste Audit.

1.3 Documents

- .1 Post and maintain in visible and accessible area at job site, one (1) copy of following documents:
 - .1 Waste Audit (Schedule A).

1.4 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Prepare and submit following prior to project start-up.
 - .1 One (1) copy and one (1) electronic copy of completed Waste Audit (WA): Schedule A.
- .3 Prepare and submit on monthly basis, throughout project or at intervals agreed to by Departmental Representative the following:
 - .1 Receipts, scale tickets, waybills, and/or waste disposal receipts that show quantities and types of materials reused, recycled or disposed of.
 - .2 Updated Waste Materials Tracking form.

- .3 Written monthly summary report detailing cumulative amounts of waste materials reused, recycled and landfilled, and brief status of ongoing waste management activities.
- .4 Submit prior to final payment the following:
 - .1 Waste Diversion Report, indicating final quantities (in tonnes) by material types salvaged for reuse, recycling or disposal in landfill and recycling centres, re-use depots, landfills and other waste processors that received waste materials.
 - .2 Provide receipts, scale tickets, waybills and waste disposal receipts that confirm quantities and types of materials reused, recycled or disposed of and destination.

1.5 Waste Audit (WA)

- .1 Departmental Representative will prepare WA prior to project start-up. WA will be provided with bid documentation (see Schedule A).
- .2 WA provides detailed inventory, estimated quantities and types of waste materials that will be generated as well as their potential to be reused and/or recycled and project's waste diversion goals and objectives.
- .3 After award of Contract, Contractor to review WA and confirm that anticipated quantities of waste generated are accurate and goals achievable.
- .4 If after review, Contractor determines that indicated quantities or opportunities in WA are not accurate or achievable, Contractor to provide written details of discrepancies and revised quantities for areas of concern. Contractor to meet with Departmental Representative to review and justify revisions.
- .5 Post on-site WA where Contractor and subcontractors are able to review content.

1.6 Waste Reduction Workplan (WRW)

- .1 Prepare and submit WRW (Schedule B) at least ten (10) days prior to project start-up.

- .2 WRW identifies strategies to optimize diversion through reduction, reuse, and recycling of materials and comply with applicable regulations based on information acquired from WA.
- .3 WRW should include but not be limited to:
 - .1 Applicable regulations.
 - .2 Specific goals for waste reduction, identify existing barriers and develop strategies to overcome them.
 - .3 Destination of materials identified.
 - .4 Deconstruction/disassembly techniques and schedules.
 - .5 Methods to collect, separate and reduce generated wastes.
 - .6 Location of waste bins on site.
 - .7 Security of on-site stock piles and waste bins.
 - .8 Protection of personnel, Subcontractors.
 - .9 Clear labelling of storage areas.
 - .10 Training plan for Contractor and Subcontractors.
 - .11 Methods to track and report results reliably (Schedule D).
 - .12 Details on materials handling and removal procedures.
 - .13 Recycler and reclaimer requirements.
 - .14 Quantities of materials to be salvaged for reuse or recycled and materials sent to landfill.
 - .15 Requirements for monitoring on-site waste management activities.
- .4 Structure WRW to prioritize actions and follow 3Rs hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .5 Post WRW or summary where workers at site are able to review content.

- .6 Monitor and report on waste reduction by documenting total volume (in tonnes) and cost of actual waste removed from project (Schedule D).

1.7 Use of Site and Facilities

- .1 Execute work with minimal interference and disturbance to normal use of premises.
- .2 Maintain security measures established by facility and provide temporary security measures approved by Departmental Representative.

1.8 Waste Processing Sites

- .1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.

1.9 Quality Assurance

- .1 After award of Contract, a mandatory site examination will be held for this project for Contractor responsible for construction, renovation demolition/deconstruction waste management.
 - .1 Date, time and location will be arranged by Departmental Representative.

1.10 Storage, Handling and Protection

- .1 Store materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .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.

- .5 Protect structural components not removed and salvaged materials from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .7 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
- .8 Separate and store materials produced during project in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Obtain waybills, receipts and/or scale tickets for separated materials removed from site.
 - .4 Materials reused on site are considered to be diverted from landfill and as such are to be included in all reporting.

1.11 Disposal of Wastes

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm or sanitary sewers.
- .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

.4 Remove materials on-site as work progresses.

.5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in the waste audit.

1.12 Scheduling

.1 Coordinate work with other activities at site to ensure timely and orderly progress of work.

2. PRODUCTS

.1 Not used.

3. EXECUTION

3.1 Application

.1 Do work in compliance with WRW.

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

3.2 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 – 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 11 – Cleaning.

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

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

- .2 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian Environmental Protection Act (CEPA)
- .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 Administrative Requirements

- .1 Acceptance of Work Procedures
 - .1 Contractor's Inspection: Contractor to conduct inspection of work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative inspection.
 - .2 Departmental Representative Inspection.
 - .1 Departmental Representative and Contractor to inspect work and identify defects and deficiencies.
 - .2 Contractor to correct work as directed.
 - .3 Completion Tasks: submit written certificates in French that tasks have been performed as follows.
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted and balanced and fully operational.
 - .4 Certificates required by Boiler Inspection Branch: submitted.

- .5 Operation of systems: demonstrated to Owner's personnel of the building responsible of the operation of systems.
- .6 Work: complete and ready for final inspection.
- .4 Final Inspection
 - .1 When completion tasks are done, request final inspection of work by Departmental Representative.
 - .2 When work incomplete according to Owner and Departmental Representative, complete outstanding items and request re-inspection.
- .5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- .6 Commencement of Lien and Warranty Periods: date of Departmental Representative's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .7 Final Payment
 - .1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
 - .2 When work deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.3 Final Cleaning

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

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

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian Environmental Protection Act (CEPA)
- .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 Administrative Requirements

- .1 Pre-warranty Meeting
 - .1 Convene meeting one (1) week prior to contract completion with Contractor's representative and Departmental Representative in accordance with Section 01 31 19 – Project Meetings, to:
 - .1 Verify project requirements;
 - .2 Review manufacturer's installation instructions and warranty requirements.
 - .2 Departmental Representative to establish communication procedures for.
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.3 Action and Informational Submittals

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

- .2 Two (2) weeks prior to Substantial Performance of the work, submit to the Departmental Representative four (4) final copies of operating and maintenance manuals in French.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 Format

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8½" X 11" with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under section numbers and sequence of table of contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.

1.5 Contents – Project Record Documents

- .1 Table of contents for each volume: provide title of project;
 - .1 Date of submission; names.

- .2 Addresses, and telephone numbers of Consultant and Contractor, with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems to show control and flow diagrams.
 - .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 – Quality Control.
 - .6 Training: refer to Section 01 79 00 – Demonstration and Training.

1.6 As-Built Documents and Samples

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one (1) record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.

- .2 Store record documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks and secure storage.
- .3 Label record documents and file in accordance with section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.7 Recording Information on Project Record Documents

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including.
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.

- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including.
 - .1 Manufacturer, trade name and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.8 Equipment and Systems

- .1 For each item of equipment and each system include description of unit or system and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down and emergency instructions.
 - .2 Include summer, winter and any special operating instructions.

- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing and checking instructions.
- .6 Provide servicing and lubrication schedule and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 – Quality Control.
- .15 Additional requirements: as specified in individual specifications sections.

1.9 Materials and Finishes

- .1 Building products, applied materials and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

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

1.10 Maintenance Materials

- .1 Spare Parts

- .1 Provide spare parts in quantities specified in individual specifications sections.
 - .2 Provide items of same manufacture and quality as items in work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.

- .2 Extra Stock Materials

- .1 Provide maintenance and extra materials, in quantities specified in individual specifications sections.
 - .2 Provide items of same manufacture and quality as items in work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.

- .3 Special Tools

- .1 Provide special tools, in quantities specified in individual specifications section.

- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.11 Delivery, Storage and Handling

- .1 Store spare parts, maintenance materials and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.12 Warranties and Bonds

- .1 Develop Warranty Management Plan to contain information relevant to warranties.
- .2 Submit Warranty Management Plan, thirty (30) days before planned pre-warranty conference, to Departmental Representative for approval.
- .3 Warranty Management Plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

- .5 Submit warranty information made available during construction phase to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows.
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier and manufacturer with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers and manufacturers, within ten (10) days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Include information contained in Warranty Management Plan as follows.
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.

CLOSEOUT SUBMITTALS

- .3 Location where installed.
- .4 Name and phone numbers of manufacturers or suppliers.
- .5 Names, addresses and telephone numbers of sources of spare parts.
- .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .4 Procedure and status of tagging of equipment covered by extended warranties.
- .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .10 Written verification to follow oral instructions.
- .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.13 Warranty Tags

- .1 Tag, at time of installation, each warranted item. Provide durable, oil- and water-resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Administrative Requirements**

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two (2) weeks prior to date of final inspection.
- .2 Owner: provide list of personnel to receive instructions, and coordinate their attendance at agreed-upon times.
- .3 Preparation
 - .1 Verify conditions for demonstration and instructions of devices, equipment and systems as well as training sessions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation in accordance with relevant sections.
 - .4 Ensure testing, adjusting and balancing have been performed and equipment and systems are fully operational.
- .4 Demonstration and Instructions
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing and maintenance of each item of equipment at agreed-upon times, at the equipment location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.2 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two (2) weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 Quality Assurance

- .1 When specified in individual sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct Owner's personnel.
 - .2 Provide written report that demonstration and instructions have been completed.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

- .1 Not used.

END OF SECTION

1. GENERAL**1.1 Summary**

- .1 Related Requirements
 - .1 Section 01 91 31 – Commissioning (Cx) Plan.
 - .2 Section 01 91 33 – Commissioning Forms.
 - .3 Section 01 91 41 – Commissioning: Training.
 - .4 Section 01 91 51 – Building Management Manual (BMM).
- .2 Acronyms:
 - .1 AFD – Alternate Forms of Delivery, service provider.
 - .2 BMM – Building Management Manual.
 - .3 Cx – Commissioning.
 - .4 EMCS – Energy Monitoring and Control Systems.
 - .5 O&M – Operation and Maintenance.
 - .6 PI – Product Information.
 - .7 PV – Performance Verification.
 - .8 TAB – Testing, Adjusting and Balancing.

1.2 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 that 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, trouble-shooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per Client's requirements or determined by designer. To meet project functional and operational requirements.
- .4 AFD managed projects: the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

1.3 Overview of Commissioning

- .1 Section 01 91 31 – Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 – Commissioning (Cx) Plan.
- .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 include 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.
- .2 Equipment, components and systems have been commissioned.
- .3 O&M training has been completed.

1.4 Non-Conformance to Performance Verification Requirements

- .1 Should equipment, system components and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by Departmental Representative, 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.

1.5 Pre-CX Review

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to Departmental Representative.
 - .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 and 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 Departmental Representative.
- .7 Have Cx schedules up to date.
- .8 Ensure systems have been cleaned thoroughly.
- .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 Conflicts

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 Action and Informational Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit no later than four (4) weeks after award of Contract:
 - .1 Name of Contractor's Cx Agent.
 - .2 Draft Cx documentation.
 - .2 Preliminary Cx schedule.

- .3 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least eight (8) weeks prior to start of Cx.
- .4 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least eight (8) weeks prior to start of Cx.
- .2 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 Commissioning Documentation

- .1 Refer to Section 01 91 33 – Commissioning (Cx) Forms.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 Commissioning Schedule

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 – Construction Progress Schedules – Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and Cx sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 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.

1.11 Witnessing of Starting

- .1 Provide 14 days' notice prior to commencement.
- .2 Departmental Representative to witness start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.12 Manufacturer's Involvement

- .1 Factory testing: Manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by Departmental Representative.
 - .3 Arrange for Departmental Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain Manufacturer's installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
 - .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.
- .5 To report results in clear, concise and logical manner.

1.13 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 specifications, 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 Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document requires 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 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 Departmental Representative.
- .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be removed from site and replaced with new.
- .4 Subject new equipment/systems to specified start-up procedures.

1.14 Start-up Documentation

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of Cx.
- .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.
- .3 Step-by-step description of complete start-up procedures to permit Departmental Representative to repeat start-up at any time.

1.15 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 Departmental Representative for approval before implementation.

- .3 Operate and maintain systems for length of time required for Cx to be completed.
- .4 After completion of Cx, operate and maintain systems until issuance of certificate of interim acceptance.

1.16 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.

1.17 Start of Commissioning

- .1 Notify Departmental Representative 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.

1.18 Instruments/Equipment

- .1 Submit to Departmental Representative 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.

1.19 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.
- .4 EMCS trending to be available as supporting documentation for Performance Verification.

1.20 Witnessing Commissioning

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

1.21 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 Departmental Representative within five (5) days of test and with Cx report.

1.22 Commissioning Constraints

- .1 It is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.23 Extrapolation of Results

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

1.24 Extent of Verification

- .1 Everywhere:
 - .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment and instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

1.25 Repeat Verifications

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results failed to receive Departmental Representative's approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 Departmental Representative 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 and Defects

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from 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 Departmental Representative.

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 91 41 – Commissioning (Cx): Training.

1.31 Maintenance Materials, Spare Parts and 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 Departmental Representative during stages of acceptance due to the continued occupation of the building during Construction and Cx.

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

1.34 Performance Verification Tolerances

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

1.35 Owner's Performance Testing

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

2. PRODUCTS

.1 Not used.

3. EXECUTION

.1 Not used.

END OF SECTION

1. GENERAL**1.1 Summary**

- .1 Related Requirements
 - .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
 - .2 Section 01 91 33 – Commissioning Forms.
 - .3 Section 01 91 41 – Commissioning: Training.

1.2 References

- .1 American Water Works Association (AWWA).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA-13-13, Installation of Sprinkler Systems Handbook.
 - .2 NFPA-14-13, Automatic Sprinkler Systems Handbook.
 - .3 NFPA-20-13, Standard for the Installation of Stationary Fire Pumps for Fire Protection.
- .3 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC – Commissioning Guidelines CP.4 -3rd edition-03.
- .4 Underwriters' Laboratories of Canada (ULC).

1.3 General

- .1 Provide a fully functional facility:
 - .1 Systems, equipment and components meet user's functional requirements before date of acceptance and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
 - .2 Facility user and O&M personnel have been fully trained in aspects of installed systems.

- .3 Optimized life cycle costs.
- .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources and 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 design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 Cx – Commissioning.
 - .2 BMM – Building Management Manual.
 - .3 EMCS – Energy Monitoring and Control Systems.
 - .4 MSDS – Material Safety Data Sheets.

- .5 PI – Product Information.
- .6 PV – Performance Verification.
- .7 TAB – Testing, Adjusting and Balancing.
- .8 WHMIS – Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx: Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 Composition, Roles and Responsibilities of CX Team

- .1 Commissioning Agent
 - .1 The Agent is engaged by the Contractor.
 - .2 Ensure that Cx activities are conducted in accordance with the Cx Plan;
 - .3 Commissioning Officer shall, without limitation:
 - .1 Gather the Cx team members and coordinate activities with teams to implement the Cx Plan.
 - .2 Present the implementation guidelines of the Commissioning process at the meeting prior to the work.
 - .3 Draw up work checklists and transmit such to the Contractor.
 - .4 Develop the Cx Plan in consultation with the Departmental Representative.
 - .5 Develop functional performance testing and review with the Contractor.

- .6 Verify compliance of shop drawings for the project definition.
- .7 Witness all Cx trials and sign all records of testing, at the same time of testing.
- .8 As a witness, record each performance checklist or test form.
- .9 Witness the initiation of each piece of equipment and gather reports provided by manufacturers.
- .10 Witness the tests and measurements and balancing procedures.
- .11 Lead meetings in the Cx process.
- .12 Perform periodic site visits to verify compliance with the project definition.
- .13 Reviewing the draft of the OMM.
- .14 Review the Cx schedule.
- .15 Order functional performance tests to be undertaken.
- .16 Write the interim report of the Cx process.
- .17 Coordinate training of those responsible for operating facilities.
- .18 Review the training materials.
- .19 Attend training sessions.
- .20 If necessary, provide additional training.
- .21 Review the Operations and Maintenance Manual.
- .22 Review and comment on testing and balancing report.
- .23 Serve as resource person for the Operation & Maintenance personnel during the first year of operation.
- .24 Produce final report of the Cx process.

- .25 Once the interim and final Cx reports are completed, submit them to the Departmental Representative.
- .26 Perform tests with different seasonal contractors' stakeholders.
- .2 Subcontractors
 - .1 Subcontractors in mechanics and electricity are designated by the manufacturer and must:
 - .1 Attend different Cx meetings.
 - .2 Handle all Cx activities required.
 - .3 Perform a preliminary start-up of equipment before Cx led by Cx Agent.
 - .4 Perform all tests, as specified in the Cx Plan and the contract file and complete the various performance tracking sheets as presented in Cx Plan.
 - .5 Establish and coordinate the Cx schedule with the builder.
 - .6 Give the constructor operating and maintenance information so that these data are incorporated into OMM;
 - .7 Prepare a training plan and submit it to the Cx Officer for approval;
 - .8 Ensure the participation of the main manufacturers of equipment, depending on the training needs of the building operations employees;
 - .9 Participate in setting seasonal service and delays.
- .3 The Manufacturer (General Contractor)
 - .1 Participate, together with the Cx Agent to complete the Cx Plan. Once Cx is complete, provide a written statement attesting to the compliance of the operation of building systems for performance specifications;

- .2 Provide materials and manpower required for the implementation of Cx and managing.
- .3 The builder must:
 - .1 Prepare and provide the Cx schedule for the second Cx meeting and update all subsequent meetings.
 - .2 Inform the Cx Agent, through market coordinator, all tests to record with a minimum of five (5) days before the start of Cx;
 - .3 Collect and transmit to the Cx Agent all test reports and Cx equipment (Official Report of the Cx Agent and / or relative suppliers and subcontractors);
 - .4 Prepare and provide the final Cx report to present to the Cx Agent;
 - .5 Prepare and provide the training schedule and submit it to the Cx Agent for approval within a minimum of ten (10) days;
 - .6 Ensure the presence of different stakeholders in setting service and seasonal delays.

1.5 Scope of Cx

- .1 Commission mechanical systems and associated equipment:
 - .1 Control systems for power demand:
 - .1 Control systems in areas listed on plans and in specifications.
 - .2 Commission electrical systems and equipment.
 - .3 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Power measurement and control.
 - .4 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.

.5 Medium voltage system:

.1 Medium voltage equipment and material.

1.6 Training Plans

.1 Refer to Section 01 91 41 – Commissioning (Cx): Training.

1.7 Final Settings

.1 Upon completion of Cx to satisfaction of Cx Agent, lock control devices in their final positions, indelibly mark settings marked and include in Cx reports.

2. PRODUCTS

.1 Not used.

3. EXECUTION

.1 Not used.

END OF SECTION

1. GENERAL**1.1 Summary**

- .1 Related Requirements
 - .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
 - .2 Section 01 91 31 – Commissioning (Cx) Plan.

1.2 Installation/Start-Up Check Lists

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Cx and will be included in Building Maintenance Manual (BMM) upon completion of project.
- .5 Use of check lists will not be considered part of Cx process but will be stringently used for equipment pre-start and start-up procedures.

1.3 Product Information (PI) Report Forms

- .1 Product Information (PI) forms compile gathered data on items of equipment produced by equipment manufacturer and include nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that are necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM upon completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records' measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Departmental Representative will develop and provide to Contractor required project-specific Cx forms in electronic format complete with specification data.
- .2 Revise items on Cx forms to suit project requirements.
- .3 Samples of Cx forms and a complete index produced to date will be attached to this section.

1.6 Changes and Development of New Report Forms

- .1 When additional forms are required, but are not available from the Departmental Representative, develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
 - .1 Additional Cx forms to be in same format as provided by Departmental Representative.

1.7 Commissioning Forms

- .1 Use Cx forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for use:
 - .1 Departmental Representative provides Contractor project-specific Cx forms with specification data included.
 - .2 Contractor will provide required shop drawing information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .6 Record analytical and substantiating data.
 - .7 Verify reported results.
 - .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
 - .9 Submit immediately after tests are performed.
 - .10 Reported results in true measured SI unit values.
 - .11 Provide Departmental Representative with originals of completed forms.

- .12 Maintain copy on site during start-up, testing and commissioning period.
- .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51 – Building Management Manual (BMM).

1.8 Language

- .1 To suit the language profile of the awarded contract.

2. PRODUCTS

- .1 Not used.


3. EXECUTION

- .1 Not used.

END OF SECTION

APPENDIX 1

COMMISSIONING FORMS

 SNC • LAVALIN	HIGH VOLTAGE DISCONNECT SWITCH VERIFICATION REPORT	
	Project No.:	POWER STATION REPLACEMENT FOR SEPT-ÎLES TERMINAL
SNC-Lavalin Ref.: 632802	Client:	PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

CHARACTERISTICS

Manufacturer:		Location:
Type:		
Current: A	Voltage: V	Identification:
Type of fuses / fuse holders: A		
Rating of fuses / elements: V		Version:

VISUAL INSPECTION AND MECHANICAL VERIFICATION


Inspection Points	Comments
Condition of contacts	
Insulators, supports, insulated barriers	
Connection tightness	
Alignment and synchronization	
Interlocks and indicators	
Mechanical verification	
Condition of fuse holders	

CONTACT RESISTANCE (at 10 A)

Disconnect switch	A: $\mu\Omega$	B: $\mu\Omega$	C: $\mu\Omega$
Fuses	A: $\mu\Omega$	B: $\mu\Omega$	C: $\mu\Omega$
Fuses + fuse holders	A: $\mu\Omega$	B: $\mu\Omega$	C: $\mu\Omega$

COMMENTS


	INITIALS:
	Date:
	VERIFIED
N/A: NOT APPLICABLE; N/V: NOT VERIFIED; OK: SATISFACTORY; X: DEFECTIVE, SEE COMMENTS	PAGE:

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SPECIFIC COMMISSIONING PLAN

1.1 TRANSFORMER

Equipment			
Manufacturer		Model	
Serial no.		Location	
Capacity (kVA)		Type of winding	
Impedance		Insulation class (°C)	
Tap number and setting (%)		Temperature rise (°C)	
Primary (V, phases, wires)		Secondary (V, phases, wires)	
DESCRIPTION OF VERIFICATIONS			
STATIC VERIFICATION	√	N.A.	COMMENTS
• Equipment corresponds to plan and shop drawing			
• No visible trace of damage that occurred during delivery			
• All transport supports / protections has been removed			
• Verification checklist completed by manufacturer and appended			
• Status of core			
• All cables are properly installed			
• Rotation verified at primary and secondary			
• Status of cleanliness of winding and transformer cell			
• Status of isolators			
• Status of supports, spacers, levelling pads			
• Status of cables lugs (minimum torque : consult table)			
• Cable size compliant – primary and secondary			
• Sufficient distance between grounded medium voltage cables and energised parts			
• Secondary wires connected to the 100 % tap			
• Magnetic mass grounded in one point			
• Capacity of the primary breaker or fuse compliant			
• Fans mounted on transformer – verified and operational			
• Status alarm verified and connected to BAS			

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SPECIFIC COMMISSIONING PLAN

OPERATIONAL VERIFICATION

- Windings insulation resistance measurements**

Targeted values : 600 V and less – min. 500 MΩ at 1 000 Vcc
601 V to 5 000 V – min. 5 000 MΩ at 2 500 Vcc
5 001 V and over – min. 25 000 MΩ at 5000 Vcc
MΩ stabilised must be higher than MΩ @ 1 min

Equipment : Megohmmeter

H1-H2		H1-H3		H2-H3	
MΩ @ 1 min.		MΩ @ 1 min.		MΩ @ 1 min.	
MΩ stabilised		MΩ stabilised		MΩ stabilised	

X0-X1		X0-X2		X0-X3	
MΩ @ 1 min.		MΩ @ 1 min.		MΩ @ 1 min.	
MΩ stabilised		MΩ stabilised		MΩ stabilised	

X1-X2		X1-X3		X2-X3	
MΩ @ 1 min.		MΩ @ 1 min.		MΩ @ 1 min.	
MΩ stabilised		MΩ stabilised		MΩ stabilised	

- Primay and secondary voltage values**

Equipment : Ohmmeter

H1-H2		H1-H3		H2-H3	
X0-X1		X0-X2		X0-X3	
X1-X2		X1-X3		X2-X3	

GENERAL COMMENTS : _____

PERFORMED BY:

SIGNATURE

COMPANY

DATE

WITNESSED BY:

SIGNATURE

COMPANY

DATE

VERIFIED BY:

SIGNATURE

COMPANY

DATE



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page

SPECIFIC COMMISSIONING PLAN

DESCRIPTION OF VERIFICATIONS

[illegible]

GENERAL COMMENTS :

PERFORMED BY:

SIGNATURE

COMPAGNIE

DATE _____

WITNESSED BY:

SIGNATURE

COMPAGNIE


DATE

VERIFIED BY:

SIGNATURE

COMPAGNIE


DATE _____

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SPECIFIC COMMISSIONING PLAN

1.1 PANELBOARD BREAKER TYPE - DISTRIBUTION PANEL

Equipment					
Manufacturer		Model			
Serial no.		Location			
Voltage (V, phases, wires)		Capacity (A)			
DESCRIPTION OF VERIFICATIONS					
STATIC VERIFICATION			√	N.A.	COMMENTS
<ul style="list-style-type: none"> Equipment corresponds to plan and shop drawing No visible trace of damage that occurred during delivery Static verification checklist completed by manufacturer and appended No traces of water or condensation No dust Appropriate anchoring Appropriate painting and finished area Lamicoid plate installed and visible Capacity of short-circuit current and circuit breakers correspond to plan Status of cables lugs (minimum torque : consult table) The insulation resistance of the main feed has been tested with a megohmmeter. (minimum 100 MΩ at 1000 Vdc) Branched wires are correctly shaped inside the panel There is a 1 m clearance in front of the panel Cable size – primary (AWG) Identification of up-to-date circuit breaker card installed inside the panel Locked panel door verified and functional Door in door 					
			OPERATIONAL VERIFICATION		
<ul style="list-style-type: none"> Voltage and current measurement Equipment : Ohmmeter 					
Voltage (V)			Current (A)		
Phase A-B	Phase B-C	Phase A-C	Phase A	Phase B	Phase C

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SPECIFIC COMMISSIONNING PLAN

GENERAL COMMENTS :

PERFORMED BY:

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COMPANY


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SPECIFIC COMMISSIONNING PLAN


VERIFIED BY:			
	SIGNATURE	COMPANY	DATE

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SPECIFIC COMMISSIONING PLAN

1.1 GROUNDING


Manufacturer		Localization of main grounding conductor	
DESCRIPTION OF VERIFICATIONS			
STATIC VERIFICATION	√	N.A.	COMMENTS
<ul style="list-style-type: none">Grounding network<ul style="list-style-type: none">Type of wire used are as per plansGrounding network corresponds to planGrounding has been verified for all main conductors (max 0.5Ω at the last bar)Grounding bars are present in each electrical utility room and equipment is correctly connectedGrounding bars are present in each telecommunication room and equipment is correctly connectedThe raised floor has been connected to the grounding network by ground wiresMetal portions of the water distribution network are connected to the grounding network by ground wiresMetal portions of the wastewater drainage network are connected to the grounding network by ground wiresMetal portions of the gas distribution network are connected to the grounding network by ground wiresEarting<ul style="list-style-type: none">Number of grounding platesSpacing between each platesLength and width of each platesGrounding is connected to the lightning arrestor system ground			
	OPERATIONAL VERIFICATION		
<ul style="list-style-type: none">Measurement of building earting. Provide value and describe method used			

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SPECIFIC COMMISSIONING PLAN

1.1 DISTRIBUTION EQUIPMENT 600V

Equipment			
Manufacturer		Model	
Serial no.		Location	
Voltage (V, phases, wires)		Capacity (A)	
Short circuit capacity (kA, S)			
DESCRIPTION OF VERIFICATIONS			
STATIC VERIFICATION	✓	N.A.	COMMENTS
• Equipment corresponds to plan and shop drawing			
• No visible trace of damage that occurred during delivery			
• Static verification checklist completed by manufacturer and appended			
• No dust and no traces of water or condensation			
• Appropriate anchoring			
• Appropriate painting and finished area			
• Lamicoid plate installed and visible			
• Capacity of short-circuit current and breakers corresponds to plan			
• Cable size corresponds to plan			
• Equipment is properly grounded			
• Sequence of distribution cables is correct			
• All cables are properly secured			
• Status of cables lugs (minimum torque : consult table)			
• Status of bussing connections (minimum torque : consult table)			
• All protection relays and measurement instruments are properly identified and work properly			
• All protection relays are adjusted in accordance with coordination study			
• Electric and Kirk key interlock are working			
• Mimic bus single line diagram is inside the panel			
• Stickers present as per electrical arc-flash study			

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SPECIFIC COMMISSIONNING PLAN

1. GENERAL**1.1 Summary**

- .1 Related Requirements
 - .1 Section 01 79 00 – Demonstration and Training.
 - .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
 - .3 Section 01 91 31 – Commissioning (Cx) Plan.

1.2 Trainees

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Property Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 Instructors

- .1 Departmental Representative will provide.
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel to provide instruction on the following:
 - .1 Start-up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components concerned.

- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 Training Objectives

- .1 Training to be detailed and duration to ensure the trainees' acquisition of knowledge and competence to ensure:
 - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
 - .2 Effective ongoing inspection, measurements of system performance.
 - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
 - .4 Ability to update documentation.
 - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 Training Materials

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Maintenance Manual.
 - .4 Management Manual.
 - .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.

- .5 Supplement training materials:
 - .1 Multimedia presentations.
 - .2 Manufacturer's training videos.
 - .3 Equipment models.

1.6 Scheduling

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be three (3) hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 Responsibilities

- .1 Be responsible for:
 - .1 Implementation of training activities.
 - .2 Coordination of work and participation among instructors.
 - .3 Quality of training and training materials.
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by instructors, witnessed by Departmental Representative.

1.8 Training Content

- .1 Training to include demonstrations by instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.

- .3 System philosophy, limitations of systems and emergency procedures.
- .4 Review of system layout, equipment, components and controls.
- .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 Interaction among systems during integrated operation.
- .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.9 Video-Based Training

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval two (2) months prior to commencement of scheduled training.
- .2 On-site training videos:
 - .1 Videotape training sessions for use during future training.
 - .2 To be performed after systems are fully commissioned.
 - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

2. PRODUCTS

- .1 Not used.

3. EXECUTION

.1 Not used.

END OF SECTION

APPENDIX 1

TRAINING PLAN – ELECTRICITY

TRAINING PLAN – ELECTRICITY This training plan is part of the “Commissioning: Training” specifications.					
Purpose	Instructor	Content (approx. 30% theory, 70% practical)	Approx. Length	Training Materials and Tools	
Overview 1. General overview of concepts. 2. Electrical installations interaction.	Installer	1. Explanation of electrical installations. 2. Interaction of electrical installations with boiler. 3. Site visit during project's first stages. 4. Lectures during Cx stage.	½ day	1. 25 kV/4. 10 kV circuit schematics, low-voltage and control circuits. 2. Installed systems and equipment. 3. Design criteria, design intent.	
High-voltage electrical supply and distribution 1. Details provided on all installations and in-depth knowledge of their operations	Installer, Equipment Manufacturer	1. Explanation of operating concepts including those for transformers, HV switchgear and controls. 2. Equipment operating and adjusting. 3. Study of O&M manuals. 4. Equipment troubleshooting. 5. Observation during construction. 6. Site visits, lectures.	1 day	1. As-built distribution schematics, test reports. 2. Systems operating manual. 3. Maintenance manual. 4. Installed systems and equipment. 5. Control schematics. 6. Demonstrations.	
Low-voltage electrical systems (including low-voltage lighting controls) 1. Training on equipment start-up, operation and shutdown. 2. Understanding of installation design to avoid faults and reduce troubleshooting.	Installer, Equipment Manufacturer	1. Start-up, testing and operation of all installations and controls (operating, limits and safety). 2. Annual maintenance, re-start following a fault. 3. Study of O&M manuals; equipment troubleshooting. 4. Observation during construction. 5. Site visits, lectures.	1 day	1. Installed equipment. 2. Demonstrations. 3. As-built drawings. 4. Systems operating manual. 5. Equipment operating manuals. 6. Control schematics and reports.	
Special systems: 1. Electrical demand control system.	Installer, Supplier	1. Site visit.		1. Installed equipment. 2. Demonstrations. 3. As-built drawings. 4. Systems operating manual. 5. Equipment operating manuals. 6. Control schematics and reports.	

END OF SECTION

1. GENERAL

1.1 Summary

- .1 Section includes:
 - .1 This section is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.
- .2 Acronyms:
 - .1 BMM – Building Management Manual.
 - .2 Cx – Commissioning.
 - .3 PI – Product Information.
 - .4 PV – Performance Verification.
 - .5 TAB – Testing, Adjusting and Balancing.
 - .6 WHMIS – Workplace Hazardous Materials Information System.

1.2 General Requirements

- .1 Standard letter size paper 216 mm x 279 mm.
- .2 Methodology used to facilitate updating.
- .3 Drawings, diagrams and schematics to be professionally developed.
- .4 Electronic copy of data to be in a format accepted and approved by Departmental Representative.
- .5 PWGSC document entitled “CP.4: Guide to the development of Building Management Manuals” is an integral part of this tender document.

1.3 Approvals

- .1 Prior to commencement, coordinate requirements for preparation, submission and approval with Departmental Representative.

1.4 General Information

- .1 Provide Departmental Representative the following for insertion into appropriate part and section of BMM:
 - .1 Index and table of contents.
 - .2 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors who participated in delivery of project – as indicated in Section 1.2 of BMM.
 - .3 Summary of control systems and electrical systems installed and commissioned – as indicated in Section 1.4 of BMM.
 - .1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
 - .4 Part 2 will be provided by the Departmental Representative, and you must integrate this into the BMM.
 - .5 Operating and Maintenance Manual – Section 3 of BMM.
 - .1 System, equipment and components Maintenance Management System (MMS) identification – Section 3 of BMM.
 - .2 Information on operation and maintenance of equipment installed and commissioned – Section 3 of BMM.
 - .3 Information on operation and maintenance of control systems installed and commissioned – Section 3 of BMM.
 - .4 Operating and Maintenance Manual – Section 3.1 of BMM.
 - .6 Part 5 – Related appendices.
 - .1 Mechanical – 5.4.
 - .2 Electrical – 5.5.
 - .3 O&M Budget – 5.7.

- .4 Construction Document – 5.8.
- .7 Final commissioning plan as actually implemented.
- .8 Completed commissioning checklists.
- .9 Commissioning test procedures employed.
- .10 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.
- .11 Commissioning reports.

1.5 Contents of Operating and Maintenance Manual

- .1 For detailed requirements refer to Section 01 78 00 – Closeout Submittals.
- .2 Departmental Representative to review and approve format and organization within 12 weeks of award of contract.
- .3 Include original manufacturers' brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.
- .7 Approved project shop drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.

- .11 Inspection certificates with expiration dates, which require ongoing re-certification inspections.
- .12 Maintenance program supporting information including:
 - .1 Recommended maintenance procedures and schedule.
 - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

1.6 Supporting Documentation for Insertion into Supporting Appendices

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
 - .1 General:
 - .1 Finalized commissioning plan.
 - .2 WHMIS information manual.
 - .3 Approved "as-built" drawings and specifications.
 - .4 Procedures used during commissioning.
 - .5 Cross-reference to specification sections.
 - .2 Mechanical:
 - .1 Control and wiring schematics and functional description.
 - .2 TAB and PV reports.
 - .3 Copies of posted instructions.
 - .3 Electrical:
 - .1 Installation permits, inspection certificates.
 - .2 TAB and PV reports.
 - .3 Electrical work log book.

- .4 Charts and schedules.
- .5 Locations of cables and components.
- .6 Copies of posted instructions.
- .2 Assist Departmental Representative with preparation of BMM.

1.7 Language

- .1 English and French language to be in separate binders.

1.8 Identification of Facility

- .1 When submitting information to Departmental Representative for incorporation into BMM, use following system for identification of documentation:
 - .1 Installation;
 - .2 Building;
 - .3 Integrated Systems;
 - .4 Systems;
 - .5 Subsystems;
 - .6 Components;
 - .7 Components Checkpoints.

1.9 Use of Current Technology

- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
- .2 Obtain Departmental Representative's approval before starting work.

2. PRODUCTS

.1 Not used.

3. EXECUTION

.1 Not used.

END OF SECTION

APPENDIX 1

GUIDE TO THE DEVELOPMENT OF BUILDING MANAGEMENT MANUALS (CP.4)



Public Works and
Government Services
Canada

Travaux publics et
Services gouvernementaux
Canada

PWGSC

Commissioning Guidelines

CP.4

Guide to development of

BUILDING MANAGEMENT MANUALS

3rd edition
November 2003

Prepared by
National Commissioning Committee

Issued by
Real Property Branch

CP.4 - Guide to the development of Building Management Manuals (BMM)

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CP.4 - Guide to the development of Building Management Manuals (BMM)

Chapter 1. General requirements

1.1 Description

The Building Management Manual (BMM) is addressed to the Owner/Investor and/or Asset and Facility Management and the disciplinary operating and maintenance personnel. It may be considered as the project's "Owners Manual".

The Building Management Manual **for SMALLER PROJECTS** is intended to supplement existing Building Management Manuals, unless the project is so extensive that the existing Building Management Manual is manifestly redundant,

- .1 The Building Management Manual explains:
 - .1 **"what"** systems, equipment and/or components were incorporated into the building,
 - .2 **"why"** the system, equipment and components were selected, and
 - .3 **"how"** the design and operating concepts of the sub-systems, systems and integrated systems are accomplished.
- .2 The Building Management Manual describes, not necessarily in this order:
 - .1 **the design intent** of the project, explains the purpose of the facilities from the consultant's point of view,
 - .2 **how the design meets the Client's functional and operational requirements** as well as Corporate and Project Objectives.
 - .3 **the design philosophy**, the conceptual framework of the project and provides a record of, and rationale for, decisions made throughout the development of the design, including the rationale for system selection based on life cycle cost analysis.
 - .4 **information required for the successful operation and maintenance** of the building, its equipment, components and systems.
 - .5 **the tools to facilitate informed decisions in the future** by the Building Management.

1.2 Application

The requirements of the Building Management Manual applies to new projects, renovations and fit-ups.

- .1 **Application to existing buildings:**

Existing buildings which have undergone extensive renovations generally require a completely new Building Management Manual. The task of updating an existing O&M Manual is not normally worth the effort.

- .2 Existing buildings undergoing minor-medium-sized renovations, fit-ups, etc:**
The existing O&M Manual(s) can generally be readily updated to reflect the new work, by removing all redundant data and replacing it with new data.
- .3 SMALLER PROJECTS new projects up to about \$1M:**
Generally require a Building Management Manual that may not need to be as extensive in scope as would be required for larger projects over \$1M. This Manual will provide guidance in this regard.

1.3 Criteria for development

The Building Management Manual supports the management and operation of the building throughout its entire life cycle. It is therefore important that the manuals be

- .1 professionally developed,**
- .2 well organized in terms of text and graphics to** facilitate its use as a building reference document,
- .3 simple to prepare,**
- .4 easy to update,** with information located in one place only with cross-referencing as necessary and without any duplication,
- .5 delivered in a timely manner** because much of it is needed during training,
- .6 assembled in a well-organized manner,** making it easy to use,
- .7 completely accurate and contain only information that is relevant to this building** so as to provide for safe, reliable and efficient operation. Collections of catalogue pages, cuts and manufacturers' brochures should not be accepted.

1.4 Indexing

All data in all manuals shall be separated using hard paper separators having large, strong indexing tabs protected by clear plastic covers with descriptors matching the approved identification nomenclature

1.5 Use of the Building Management Manual

CP.4 - Guide to the preparation of Building Management Manuals should be attached to, and form part of, the Project Brief.

1.6 Production

The Project Design Team shall be responsible for the production of the BMM. However, the Project Construction Team, the Project Commissioning Team and the Facility Management Team shall cooperate fully.

For LARGER PROJECTS the Building Management Manual shall be prepared on current electronic word-processing equipment using software approved by the Department. The main emphasis must be on ease of accessibility at all times, maintenance in up-to-date state and comparability with User's requirements.

1.7 Deliverables

Two (2) copies of each manual shall be provided on CD-ROM-RW diskette and four (4) hard copies shall also be provided.

1.8 Language

Separate manuals are to be provided for each official language as required by the Project Brief..

1.9 Units of measurement

All measurements shall be reported in SI units

1.10 Text

All text shall be clear, concise, arranged in logical sequence, preferably written in the imperative voice using vocabulary and expressions clearly understood by Building Management personnel.

Text should be 1.5 line spacing with 0.75" margin on left-hand side for binding and 0.5" margin on right-hand side. Text is to be on 210 x 297 mm 10M/20# white bond paper with text on one or two sides. Text referring to drawings, schematics and diagrams shall be on the facing page to facilitate cross- referencing.

For details of requirements for drawings, diagrams, schematics, charts and tables, refer to *CP.10: "Report Forms and Schematics"*.

1.11 Development and submission of BMM

It is essential that the Project Manager's approval be obtained before starting work.

- .1 At the Conceptual Design Report stage (or Schematic Design phase) it will represent the Designer's point of view** and will be produced in draft form, and two copies, meeting the language requirements of the Project Brief shall be submitted with the Conceptual Design Report (or Schematic Design Report) in a 3-ring, D-ring binder.
- .2 During detailed design Development** it will be revised, updated and submitted at the end of each required project delivery phase specified in the Project Brief with a view to becoming a complete project record. At each submission, its format, structure and organization shall be such that subsequent submissions need only the addition of missing information.
- .3 When the construction documents are tender ready**, the BMM shall be 90% complete from the design perspective.
- .4 Updating during construction and commissioning** shall include:
 - .1 confirmation of adherence to established design criteria,
 - .2 updating project archives,
 - .3 recording changes in control and operating philosophy, methods of integrating control systems with central control systems,

- .4 Updating descriptions of architectural and engineering systems, design intents, design assumptions.
- .5 **Semi-final submission requirements:** The 99% complete Building Management Manual shall be submitted for review within twelve (12) weeks prior to commencement of training. Incorporate all comments so as to reflect the final as-built works including all changes, modifications, revisions and adjustments.
- .6 **Use during commissioning and training:** The Building Management Manual must be available during the actual Commissioning of the installations and training of Facility Operations Staff.
- .7 **Final submission requirements:** Prior to the issuance of the Final Certificate of Completion, provide The BMM as described under 1.7 - Deliverables, above - all meeting the language requirements of the Project Brief.

1.12 Binders for LARGER PROJECTS

Use 50-mm three-ring D-ring binders having clear vinyl pockets on front and spine. Identify each binder with the name of the building, manual name, part number and volume number. Each binder shall be prefaced with a complete Table of Contents. Binders shall not be more than two-thirds full. Cross-reference binders and sections as necessary

Separate binders shall be used for English and French versions of the BMM.

1.13 Binders for SMALLER PROJECTS

If the new data is not incorporated into existing BMM or O&M Manuals, replace existing binders with new 50-mm three-ring D-ring binders having clear vinyl pockets on front and spine to enable proper identification. Each binder shall be prefaced with a complete Table of Contents. Binders shall not be more than two-thirds full. Cross-reference binders and sections as necessary.

Separate binders shall be used for English and French versions of the BMM.

1.14 Use of BMM during training sessions

The BMM will be available for use during the Commissioning phase in the training of O&M Personnel and the Property Management personnel. Refer also to *CP.5 Guide to the preparation of Training Plans*.

1.15 Storage facilities for LARGER PROJECTS

The size of the project may indicate that the Building Management Manual may be too large for three-ring binders. In this case, filing cabinets or other approved storage facilities must be organized.

1.16 Conflicts with NMS Section 01730 - Operating and Maintenance Manuals

Since it has been observed that there may be conflicts with NMS Section 01730, it is recommended that the entire contents of Section 01730 be deleted and a single sentence inserted therein, referring the reader to Section 01814 - Commissioning: Manuals.

1.17 BMM for Parliamentary Precinct Directorate (PPD) projects

- .1 Fire Protection Manual** is normally produced by the Property Manager. It contains information relevant to emergency evacuation plans, fire drills, fire suppression systems, emergency electrical supply, battery-powered emergency lighting, fire pumps, portable extinguishers, fire alarm systems, voice communications systems, standpipe and hose systems, doors in fire separations, exit lights, hydrants, etc. This manual is to be based on existing PWGSC Fire Protection Manuals, but enhanced to be made facility-specific. The manual is to be architectural CAD-based and in full colour, matching format and graphical appearance for devices and systems in other facilities. Verify with the Commissioning Manager as to the requirements relating to this manual including requirements for completion.

 - .1 For requirements relating to schematics, refer to *CP.10: "Report Forms and Schematics"*.
- .2 Electrical Panel Inventory:** indicating detailed inventory of electrical circuitry, per panel board, installed or modified as part of the project. Manual is to be in conformity to details outlined in Appendix G of the PWGSC Electrical Panel Work Authorization (PEPWA). Manual format to be approved by the Commissioning Manager. Samples of existing electrical panel inventories for PPD buildings is available from the Commissioning Manager.

Chapter 2 Organization of the Building Management Manual

2.1 Introduction

The Building Management Manual is well organized, text and graphics that facilitate its use as a building reference document, with a detailed index and section dividers.

The format should use a combination of paragraphs, point form, sketches, photographs and schematics, and reduced size line diagrams (in folded arrangement, if necessary).

The following organization is suggested, but is not to be considered as complete or mandatory.

2.2 Contents

The BMM shall contain a design description of each system, including architectural, structural, mechanical, electrical, civil, fire protection, acoustical and other systems as well as all site systems.

2.3 Overall organization of the BMM

The BMM shall normally be divided into 5 “**Parts**”, each of which shall be sub-divided into “**Sections**”. These shall be as follows:

PART 1: GENERAL PROJECT DESCRIPTION

- Section 1.1: Index and List of contents.
- Section 1.2: Complete list of names, addresses, telephone & FAX nos.
- Section 1.3: Client’s functional and operational requirements.
- Section 1.4: General description of building and systems
- Section 1.5: Accessibility requirements - ie. methods used to comply with code requirements.
- Section 1.6: FHBRO Heritage Character Statement (HCS)

PART 2: DESIGN CRITERIA, DESIGN INTENT, DESIGN PHILOSOPHY. APPLICABLE CODES AND STANDARDS

- Section 2.1: Design criteria, design intent (ie. how the design criteria have been met), design philosophy, how Client’s requirements have been met.
- Section 2.2: Design information, design decisions, design assumptions, design compromises, client concessions:
- Section 2.3: Applicable Statutory and Regulatory Codes, Standards and Guidelines

PART 3: SYSTEMS OPERATION AND MAINTENANCE

- Section 3.1 Standard operating procedures (SOP) manual
- Section 3.2 Operating and maintenance (O&M) manual

PART 4: BUILDING MANAGEMENT

- Section 4.1: Building documentation
- Section 4.2: Maintenance and service contracts
- Section 4.3: Life Safety Compliance (LSC) Manual:

PART 5: SUPPORTING APPENDICES

- Section 5.1: Architectural appendices
- Section 5.2: Structural appendices
- Section 5.3: Fire protection and fire prevention appendices
- Section 5.4: Mechanical appendices
- Section 5.5: Electrical appendices
- Section 5.6: WHMIS information manual
- Section 5.7: Operation and maintenance (O&M) budget
- Section 5.8: “As-built” construction documents.

[illegible]

BUILDING MANAGEMENT MANUAL - Check List			
	Larger Projects	Smaller Projects	Comments
3: Special tests or reports on component issues 4: report outlining requirements for occupancy 5: All code analyses 6: fire and life safety evaluation 7: accessibility report 8: Special concerns such as fire truck weight, height 9: Facility operation under heightened security conditions 10: Special tests or reports on component issues	YES YES YES YES YES YES YES YES	YES NO NO NO NO NO NO NO	For SMALLER projects whether the need applies will depend upon the size and complexity of the project and whether these items were applied to the project
PART 3 - SYSTEMS OPERATION and MAINTENANCE			
3.1: Standard operating procedures (SOP) manual 1: Information directory 2: Drawings, schematics, diagrams, areas served, system description 3: Operating standards, operating logs, operating routines, procedures, EMCS data 4: EMCS controls information 5: Troubleshooting information	YES YES YES YES YES YES	YES YES YES YES YES YES	 Generally, there should be one O&M manual for each discipline and for each system within that discipline.
3.2: Operating and maintenance (O&M) manual 1: Information directory 2: Approved shop drawings, product data and associated maintenance data 3: Information supporting the maintenance program 4: MMS equipment inventory	YES YES YES YES YES	YES YES YES YES YES	
PART 4 - BUILDING MANAGEMENT			
4.1: Building documentation 1: Index of all manuals 4.2: Maintenance and service contracts	YES YES YES	Maybe Maybe	May not be necessary for SMALLER projects

BUILDING MANAGEMENT MANUAL - Check List			
	Larger Projects	Smaller Projects	Comments
.1: Index of contracts 4.3: Life Safety Compliance (LSC) Manual .1: Emergency information relating to all possible emergencies .2: Emergency provisions .3: Emergency control procedures .4: Emergency evacuation procedures	YES YES YES YES YES YES	Maybe	May not be necessary for SMALLER projects May already exist or not be necessary, or may already exist, for SMALLER PROJECTS.
PART 5 - SUPPORTING APPENDICES			
5.1: Architectural appendices .1: Door schedules doors .2: Finishing schedules .3: Inspection certificates, construction permits .4: Area measurement/ space usage report	YES YES YES YES YES	YES YES YES YES Maybe	May not be necessary for SMALLER projects
5.2: Structural appendices: .1: Roof anchor log book .2: Floor loading plans	YES YES YES	YES YES YES	
5.3: Fire protection and fire prevention appendices: .1: Fire protection system test reports .2: Smoke test reports .3: Commissioning reports for fire protection and fire prevention systems	YES YES YES YES	YES YES YES YES	
5.4: Mechanical appendices .1: Inspection certificates, installation permits .2: All engineering calculations .3: Piping and ducting pressure test certificates .4: Charts - valve, steam traps, etc .5: Copies of posted instructions	YES YES YES YES YES YES	YES YES YES YES YES YES	
5.5: Electrical appendices:	YES	YES	

BUILDING MANAGEMENT MANUAL - Check List			
	Larger Projects	Smaller Projects	Comments
.1: Inspection certificates, installation permits .2: Electrical work log book .3: Charts and schedules .4: Locations of cables and components .5: Copies of posted instructions 5.6: WHMIS information manual 5.7: Operation and maintenance (O&M) budget 5.8: “As-built” construction documents: .1: “As-built” drawings and specifications .2: All approved change orders .3: Copies of identification charts and posted instructions	YES YES YES YES YES YES YES YES YES YES YES	YES YES YES YES YES YES YES YES YES YES YES	

PART 1: GENERAL PROJECT DESCRIPTION

Section 1.1: Index and list of contents. The index includes a complete detailed reference (sub-index) to describe where other related operations and maintenance information is located

Section 1.2: Complete list of names, addresses, telephone and facsimile numbers of all firms, designers, consultants, sub-consultants, specialist consultants and agents who participated in the design and delivery of the facility.

Section 1.3: Client's functional and operational requirements.

Section 1.4 for LARGER PROJECTS: to include general description of building and systems - including:

- .1 Energy conservation strategy** for the building,
- .2 Design life span of the building,**
- .3 Office planning strategy** with floor protocol, related information, and simplified plans illustrating client group configurations or zones,
- .4 Alternative layouts for function rooms,**
- .5 Special concerns such as** fire truck weight or height provisions for access to the building (e.g. small bridges),
- .6 Provisions for anticipated future changes** as identified,
- .7 Special maintenance issues,** such as exterior bronze work, decorative hardware, floors, marble, etc.,
- .8 Project archives** - to include how these archives are to be managed, updated and delivered at the end of the project,
- .9 Summary of systems:**
 - .1 Architectural systems** - including acoustical systems,
 - .2 Structural engineering systems** - such as raised floor systems,
 - .3 Civil engineering systems** - such as site services, landscape design intent, including location of hose bibs, coverage of irrigation systems, Christmas lighting on trees, shrubs, snow removal/dumping arrangements, grounds maintenance arrangements, other special requirements,
 - .4 Mechanical engineering systems** - including central heating and cooling plant, steam and hydronic systems, HVAC systems, plumbing systems, laboratory systems, storm water, regular and laboratory waste systems, EMCS., refrigeration systems,
 - .5 Electrical engineering systems** - including high, medium and low voltage systems, alternative power systems, low voltage lighting control and communications systems.

Section 1.4 for SMALLER PROJECTS: General description of new systems and changes to existing systems within the existing building and additions. To include:

- .1 ONLY the appropriate items listed above for larger projects, PLUS.**
- .2 Changes to special maintenance issues**, such as exterior bronze work, decorative hardware, floors, marble, etc.,
- .3 Changes to existing project archives** - including how these archives are to be managed

Section 1.5: Accessibility requirements - being methods used to comply with code requirements. (for code requirements, refer to PART 2, Section 2.3). To include:

- .1 Way-finding and other similar signage information.**

Section 1.6: FHBRO Heritage Character Statement (HCS) Commemorative Integrity Statement (CIS), Conservation Strategy Report, etc.

END OF PART 1

**PART 2 - DESIGN CRITERIA, DESIGN INTENT, DESIGN PHILOSOPHY
APPLICABLE CODES AND STANDARDS**

General description of systems to be included in the SOP Manual

- .1 Descriptive information** relating to the installed systems would include:
 - .1 sequence of operation,
 - .2 building operation under heightened security conditions (e.g. facility required to silence fire alarm signally during important meetings and uses fire watch process) emergency procedures,
 - .3 equipment data, MMS system, equipment, and component identification.

- .2 Architectural systems** - would include information on operation and maintenance on all installed systems including, as appropriate:
 - .1 building envelope (eg. curtain walls, roofs),
 - .2 dock levellers,
 - .3 swing cages,
 - .4 vertical transportation,
 - .5 furnishings and finishes (eg. doors and windows and related hardware,
 - .6 door and window hardware (cross-reference to PART 5 - Supporting Appendices),
 - .7 finishing schedules (cross-reference to PART 5 - Supporting Appendices),
 - .8 window washing/cleaning and roof anchor information,
 - .9 landscaping,
 - .10 maintenance requirement for special surfaces, (cross-reference to PART 5 - Supporting Appendices).

- .3 Fire protection systems:** (Cross-reference to PART 4 - Building Management). Would include information on operation and maintenance on all fire protection and life safety systems installed, including, as appropriate:
 - .1 fire pumps,
 - .2 standpipe and hose systems,
 - .3 wet and dry pipe sprinkler systems (provide single line diagram), including any special features (eg. sprinklers at windows),
 - .4 smoke control and smoke management systems (including diagrams of fire and smoke control zones, rated separations) and lists of type and locations of fire dampers - cross-reference to Section 3.3 - Mechanical),
 - .5 fire detection, fire protection and suppression systems,
 - .6 Fire protection requirements for mechanical and electrical systems to include, but are not necessarily limited to:
 - .1 general control strategies, sequences, and reset schedules;
 - .2 seasonal switch-over procedures,
 - .3 emergency procedures during a fire condition, power or equipment failure,
 - .4 Reduced simplified plans illustrating system configurations, including single line and plan drawings of zoning of each system.

- .5 fire, smoke, carbon dioxide and carbon monoxide detectors and alarm systems
- .4 **Mechanical:** Would include information on operation and maintenance on all mechanical systems installed, including, as appropriate:
 - .1 central heating and cooling plant,
 - .2 steam and hydronic distribution systems (provide single line diagrams or schematics),
 - .3 refrigeration systems (provide single line diagrams or schematics),
 - .4 HVAC, heat recovery and exhaust systems,
 - .5 plumbing systems, sanitary systems, storm water systems,
 - .6 laboratory waste treatment systems,
 - .7 EMCS (including general control strategies, sequences, and reset schedules, seasonal switch-over procedures).
- .5 **Electrical:** Would include information on operation and maintenance on all electrical systems installed, including, as appropriate:
 - .1 normal Power (provide single line diagrams),
 - .2 emergency power (provide single line diagrams),
 - .3 lighting systems and low voltage lighting control systems,
 - .4 data communication systems (provide single line diagrams),
 - .5 high and medium voltage distribution systems.

Section 2.1: Design criteria, design intent (ie. how design criteria have been met), design philosophy, how Client's requirements have been met (ie. WHY the components and the systems were chosen.

Section 2.2: Design information, design decisions, design assumptions, design compromises, client concessions: This section:

- .1 identifies agreements with respect to regulatory / statutory requirements,
- .2 should be organized by discipline: eg. Architectural, Structural, Fire protection and prevention, Mechanical and Electrical, with all the design information and decisions clearly outlined,
- .3 cross-references to codes and standards used and specifies appropriate sections
- .3 identifies conformity to statutory requirements such as fire and life safety, code compliance, accessibility, heritage buildings, This section is organized by discipline, with all the design information and decisions clearly outlined and cross-referenced to codes and standards used, and specify appropriate sections
 - .1 **Architectural:** aesthetics (materials and colours, lighting, floor layouts and details as required,
 - .2 **Structural:** Floor load capacity, roof load capacity, special design elements,

- .3 **Fire protection and prevention:** Type of building (eg., high rise), fire ratings, type of systems selected with rationale for selection, Plans with fire separations, and egress routes indicated,
 - .4 **Mechanical:** Indoor environmental criteria for each space (eg. temperature, RH, noise criteria, humidity, air changes/hour, inter-space pressurization, air flow patterns and velocities, indoor air quality), space requirements, system selection with rationale for selection,
 - .5 **Electrical:** Space requirements (lighting, fire alarm, normal/emergency power, data communication, systems selection with rationale for selection, single line diagrams for power and fire alarm systems
- .4 provides general description of systems relating to the installed systems would include:
- .1 location of equipment,
 - .2 area served,
 - .3 narrative description of how each system operates, why it was selected, how the system will achieve its designed purpose, based on the functional and operational requirements as well as the Design Criteria,
 - .4 options and analyses that were considered,
 - .5 any special features,
 - .6 interfaces with existing systems,

Section 2.3: Applicable statutory and regulatory codes, standards and guidelines and where they were applied.

For SMALLER PROJECTS, this would include:

- .1 **A fire and life safety evaluation** and a record of any special negotiated agreements with municipal and federal authorities having jurisdiction.
- .2 **An accessibility report** recording agreements, special exceptions, proof of approvals, noting the enhanced requirements of the CAN CSA 651 Barrier Free Design Standard, current edition,
- .3 **Special tests or reports on component issues** (e.g. fire load from boxed files, heritage door fire test results, etc.)

For LARGE PROJECTS, this would include all of the above PLUS:

- .4 **A report outlining requirements for occupancy**, existing related issues, classification of spaces considering the NBCC, Treasury Board Standards, and related codes and standards.
- .5 **All code analyses** (all relevant reports/letters/etc.) in an AutoCAD file and to form part of the “As-Built” Record Drawings so that these issues can be read in conjunction with the drawings,
- .6 **A fire and life safety evaluation** and a record of any special negotiated agreements with municipal and federal authorities having jurisdiction,

- .7 **An accessibility report** recording agreements, special exceptions, proof of approvals, noting the enhanced requirements of the CAN CSA 651 Barrier Free Design Standard, current edition,
- .8 **Special concerns such as fire truck weight or height** provisions for access to the facility (e.g. on small bridges),
- .9 **Facility operation under heightened security conditions** (e.g. facility required to silence fire alarm signally during important meetings and uses fire watch process),
- .10 **Special tests or reports on component issues** (e.g. fire load from boxed files, heritage door fire test results, etc.)

END OF PART 2

PART 3 - SYSTEMS OPERATION and MAINTENANCE

Section 3.1 Standard operating procedures (SOP) Manual

- .1 Generally, there should be one binder for each discipline and for each system within that discipline, containing information:**
 - .1 relating to the detailed description of each system,
 - .2 relating to day-to-day operation of the system,
 - .3 permitting operating personnel to make decisions which are in complete agreement with the Client's requirements within the limits of the installed system..
- .2 Development:** The SOP Manual is produced by the Designer using the format established by the generic SOP document. The Project Manager will review and approve its format at the outset.

During all stages of development, the Contractor cooperates with the Designer by providing all required data and information, identifying changes in set points of operating, limit and safety controls during start-up, verification, commissioning, adjustments in operating procedures, etc.

- .1 By the end of PDS Stage 3 - Implementation - Preliminary Design** the SOP Manual will include:
 - .1 the area and its function served by the system and all connected or related loads,
 - .2 floor plans indicating zoning of systems,
 - .3 drawings, schematics and descriptions of the system, subsystems, equipment, components, functions and input/output parameters of each controller, start-up and shut-down procedures.
 - .4 brief narrative description of the sequence of operations and its components.

For SMALLER PROJECTS the above stage in the -production of the SOP Manual may not be necessary.

- .2 By the end of PDS Stage 3 - Implementation - Working Documents,** to be 90% complete & include:
 - .1 detailed narrative descriptions of the sequence of operations.
 - .2 all necessary emergency procedures or requirements.
 - .3 details of its relationship to all other system.
- .3 During PDS Stage 3 - Implementation - Construction,** the Designer will bring the SOP Manual to 99% completion prior to pre-start-up inspections.

- .4 During PDS Stage 3 - Implementation - Construction and PDS Phase 4 - Commissioning**, the SOP Manual is brought to 100% completion at least [6] weeks prior to issuance of the Interim Certificate of Completion, using data obtained during start-up, verification and commissioning. This will include:

 - .1 documenting control systems as finally set,
 - .2 instructions for operation under all conditions and under all loads.
 - .3 details of response to emergency situations.
- .5 During PDS Phase 5 - Operation**, it may be necessary to make further changes to reflect operation under varying conditions of occupancy.
- .3 Organization of the SOP Manual:** In general, the contents should be arranged as follows:

Division 1: Information directory: To provide easy access to all information, it should include:

- .1 table of contents listing all systems in the building,
- .2 list of equipment for each system, cross-referenced to the Operating and Maintenance Manual
- .3 identity of binder providing information,
- .4 table of contents of each binder.

Division 2: Drawings, schematics, diagrams, areas served, system description. To include, but not necessarily limited to:

- .1 drawings, schematics, diagrams, charts identifying all systems and the area(s) served by each system.
- .2 For each system:
 - .1 drawings, schematics, diagrams, and narrative description
 - .2 operational tolerances of systems, equipment and components,
 - .3 manufacturers' recommendations for operation under all normal and emergency conditions,
 - .4 cross-references to the approved TAB and PV reports for each system - located in the appropriate section of PART 5 - SUPPORTING APPENDICES.

Division 3: Operating standards, operating logs, operating routines, procedures, EMCS data: To be clearly understandable to building operators and the Property Manager and to include, but not necessarily limited to:

- .1 required standards of performance,
- .2 operating logs to monitor performance,

- .3 reporting requirements for all licensing and inspections as applicable,
- .4 identity of all activities associated with normal and abnormal operation,
- .5 details of load-shedding procedures,
- .6 operating checklists,
- .7 seasonal start-up and shutdown procedures,
- .8 electrical safety single line diagrams for electrical systems,
- .9 EMCS data to include system schematics, input/output summaries, complete with alarm limits for each device, copy of the actual program language.
- .10 All special or codified (eg. Labour Canada regulations and amendments) procedures relating to environmental control, health and safety, and productive work environment.

Division 4: EMCS controls information: To include:

- .1 system schematics, graphical and electrical drawings, and devices,
- .2 narrative description of the control programming, point names, safety features, reset schedules,
- .3 input/output summaries, complete with alarm limits for each device,
- .4 copy of the actual program language

Division 5: Troubleshooting information: This may include:

- .1 elementary questionnaires,
- .2 simple walk-through inspections,
- .3 sophisticated diagnostic or expert analysis (depending upon the complexity of the system and the technical expertise of the O&M personnel). The intent is to allow Users of this manual to isolate probable causes in an orderly and efficient manner.

End of Section 3.1 - Standard operating procedures (SOP) manual

Section 3.2 Operating and maintenance (O&M) manual

Generally, there should be one operating and maintenance manual for each discipline and for each system within that discipline.

- .1 **Development:** Normally the operating & maintenance (O&M) manual is produced by the Contractor under the guidance and supervision of the Designer and the Project Manager. The O&M Manual is prepared using the Product Information (PI) Report forms, data provided by the Contractor and information from other sources as required.

During all stages of development, the Contractor cooperates with the Designer and the Project Manager in the development of the O&M manual.

- .1 **Assembly is started at the commencement of PDS 3 - Implementation - Construction** and is 90% complete prior to pre-start-up inspections.
- .2 **During PDS Phase 4 - Commissioning**, this manual is amended so as to become 100% complete at least [6] weeks prior to the issuance of the interim certificate of completion. The O&M manual must be available at all times during commissioning and the training of the O&M personnel.
- .3 **During PDS Phase 5 - Operation:** The Contractor must cooperate with the Designer and Commissioning Manager to supplement it, modify it, provide additional requested information, identifying all changes in maintenance procedures and schedules, etc.
- .2 **Approvals:** The format and organization of the O&M manual must be reviewed by the Commissioning Manager within 12 weeks of the award of Construction Contract. This must be identified as an item in the Construction and Completion Schedule and the Commissioning Schedule.
- .3 **Contents:**
 - .1 It is not merely a collection of catalogue pages, cuts and manufacturers' brochures.
 - .2 It must be complete in every respect and include information relating to ONLY what is installed on this project.
 - .3 It is most important that maintenance personnel gain easy access to all information contained in the O&M manual when preparing work procedures, servicing or repairing the equipment, ordering parts, etc.
 - .4 Depending upon the size of the project, the O&M manual should include:

Division 1: Information directory: providing information relating to system equipment and component inventory

Division 2: Approved shop drawings, product data and associated maintenance data. With today's technology, there should be no difficulty in making these completely project-specific. They shall include the following data:

- .1 Shop drawings and product data, containing:**
 - .1 capacity, operating parameters,
 - .2 operating, safety and limit devices,
 - .3 physical sizes, O&M clearances, mountings,
 - .4 performance standards, characteristics, curves and graphs showing point of actual operation and efficiencies,
 - .5 details of all accessories, drives, safety guards and adjustment limits,
 - .6 details of motors, starters, controls and all electrical data,
- .2 Manufacturers' construction, installation, mounting, commissioning, O&M recommendations and instructions, warranties, start-up and shutdown procedures, and training material,**
- .3 Completed product information (PI) report forms containing original purchase order number, date of purchase, name, address and telephone number of vendor,**
- .4 Inventory of spare parts, special tools, maintenance materials, together with source and availability information, instructions for use and/or installation, details of packaging, identification and location of storage,**
- .5 Warranty information and installation information: To include:**
 - .1 lists of extraordinary warranties.
- .6 Inventory of all inspection certificates complete with summary of expiry dates so as to facilitate updating, renewal and periodic ongoing inspections.**

Division 3: Information supporting the maintenance program: This should include:

- .1 Recommended project-specific maintenance procedures and frequencies,
- .2 Everything necessary for the preparation of predictive, preventive, breakdown and all other project-specific

- .3 maintenance programs including location of the equipment, frequency, task time allotted, tools, spare parts and other consumables required, skill level, frequency, task time, etc., Information relating to removal and replacement of major equipment including, as a minimum, details of methods, lifting equipment required, route of egress and entry.

Division 4: MMS equipment inventory. Where there is an existing identification system which can be retained, the manual should be organized to match this inventory.

End of Section 3.2 - Operating and maintenance (O&M) manual

END OF PART 3

PART 4 - BUILDING MANAGEMENT

4.1 General

This Part would include information required to manage the building under normal and emergency situations.

IMPORTANT NOTE: Do not duplicate information contained in other Parts of this Building Management Manual. Cross-reference where required between the various Parts of this Building Management Manual and to other manuals.

Section 4.1: Building documentation:

This section may not be necessary for SMALLER PROJECTS.

- .1 **Index of all manuals** outlining : i) purpose ii) information contained, and iii) location where documents are archived.

Section 4.2: Maintenance and service contracts:

This section may not be necessary for SMALLER PROJECTS.

- .1 **Provide index of contracts** with brief outline of (i) extent of contract; (ii) contract period and cost; (iii) service provider; (iv) monitoring agent.

Section 4.3: Life Safety Compliance (LSC) Manual:

This manual may not be necessary, or may already exist, for SMALLER PROJECTS.

This manual is to be based upon the PWGSC LSC Manual, but enhanced to be made facility specific. Samples of existing LSC Manuals are available from the Commissioning Manager for reference purposes. It should include:

- .1 **Emergency information relating to all possible emergencies** such as:

- .1 the presence of smoke, fire (cross-reference to PART 3 - Section 3.2), or floods,
- .2 the presence of gas,
- .3 electrical power failure,
- .4 failure of water supply, heating, cooling, elevators, escalators,
- .5 refrigerant release, chemical spills,
- .6 heating and cooling generation plant emergencies, failure of fuel supplies,
- .7 intrusion and breach of security.

Include list of emergency contacts with phone numbers. Information is to be immediately available and comprehensible to technical and non-technical users.

- .2 **Emergency provisions:** in the event of flood design features, earthquake calculations (where applicable), dedicated emergency generators for high security, medical facilities, high tech systems, emergency control procedures, etc,

- .3 Emergency control procedures** during a fire condition, power or equipment failure,
- .4 Emergency evacuation procedures.**

END OF PART 4

PART 5 - SUPPORTING APPENDICES

The purpose of this Part is to capture all design and other information that does not naturally belong in any other Part of the Building Management manual.

Section 5.1: Architectural appendices: Including:

- .1 Door schedules doors** (numbered as occupancy) **and hardware,**
- .2 Finishing schedules,**
- .3 Inspection certificates and all necessary construction permits,**
- .4 PV reports for all architectural systems and equipment.**

The following items may not be required for SMALLER PROJECTS:

- .5 Area measurement/ space usage report** - to include a complete summary of types of surfaces and finishes, special or unusual surfaces, features or unique products or sources.

Section 5.2: Structural appendices: Including:

- .1 Roof anchor log book** outlining all roof anchor points, code requirements and procedures to be employed when washing windows and using roof anchors,
- .2 Floor loading plans** with load assumptions and method of structural calculation, include for point and distributed loads.
- .3 PV reports for all structural systems.**

Section 5.3: Fire protection and fire prevention appendices: Including:

- .1 Fire protection system test reports.**
- .2 Smoke test reports,**
- .3 PV reports for fire protection and fire prevention systems..**

Section 5.4: Mechanical appendices: Including:

- .1 Inspection certificates and all necessary installation permits,**
- .2 All engineering calculations,** including heating and cooling load calculations. Calculations submitted shall not necessarily be reviewed. They are required for record purposes and in certain instances to assist in the understanding and interpretation of designs,
- .3 TAB and PV reports for all mechanical systems and equipment.**
- .4 Piping and ducting pressure test certificates,**
- .5 Charts - valve, steam traps, etc.,**
- .6 Copies of posted instructions**

Section 5.5: Electrical appendices: Including:

- .1 Inspection certificates and all necessary installation permits,**
- .2 TAB and PV reports for all electrical systems and equipment.**
- .3 Electrical work log book** for recording all future electrical work, as required by authority having jurisdiction,
- .4 Charts and schedules,**

- .5 Locations of cables and components,**
- .6 Copies of posted instructions**

Section 5.6: WHMIS information manual:

Including data sheets relating to controlled substances in use within the operation of the building. This manual is to be subdivided by supplier, then product. A detailed index is to appear at the beginning of the manual.

Section 5.7: Operation and maintenance (O&M) budget:

Containing a detailed breakdown of various items with the assessment of the systems selection, estimated electrical, mechanical, or specialty equipment annual energy consumption and systems maintenance, operation and/or service contract costs.

Section 5.8: “As-built” construction documents.

These are the accurate record of construction and include:

- .1 "As-built" drawings and specifications,**
- .2 all approved change orders** supplemented by schematics and diagrammatic layouts as necessary,
- .3 copies of identification charts and posted instructions**

Section 5.9: Final commissioning reports

- .1 Final commissioning report,**
- .2 Final evaluation report.**

END OF PART 5

Chapter 3 Schematics and Diagrams for Manuals

3.1 Requirements

Refer to *CP.10: "Report Forms and Schematics"*.

END OF CP.4
Guide to the preparation of
BUILDING MANAGEMENT MANUALS

1. GENERAL**1.1 References**

- .1 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.2 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 21 - Construction/Demolition Waste Management Disposal.

1.3 Site Conditions

- .1 Review "Designated Substance Report" and take precautions to protect environment.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative.
 - .1 Proceed only after written instructions have been received from Departmental Representative.
- .3 Notify Departmental Representative before disrupting building access or services.

2. PRODUCTS

- .1 Not used.

3. EXECUTION**3.1 Examination**

- .1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.

3.2 Preparation

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment as well as utilities.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
 - .5 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Demolition/Removal:
 - .1 Remove items as indicated.
 - .2 Remove parts of existing building to permit new construction.
 - .3 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to facilitate implementation of new elements.

3.3 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

- .3 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1. GENERAL

1.1 Work Description

- .1 All general requirements described in the other sections of the specifications as well as the addenda are relevant to the work described below. Contractor shall supply all materials, equipment, labour and services to complete the work included in the present section and as shown on drawings.
- .2 The present section of the specifications includes formwork, falsework, formwork cleaning, and form removal for all cast-in-place concrete work shown on drawings.
- .3 Contractor shall foresee and perform at his expense all works other than those described in the specifications and which are required and necessary to complete the work.

1.2 Related Sections

- .1 Section 03 20 00 "Concrete Reinforcement".
- .2 Section 03 30 00 "Cast-in-Place Concrete".

1.3 Reference Standards

- .1 CSA A23.1-09 "Concrete Materials and Methods of Concrete Construction".
- .2 CSA S269.1-1975, "Falsework for Construction Purposes".
- .3 CSA S269.2-M87, "Access Scaffolding for Construction Practice".
- .4 CSA S269.3-M92, "Concrete Formwork".

1.4 Formwork Calculation

- .1 Calculation, setting and construction of formwork and falsework are the responsibility of Contractor.
- .2 Engage and pay services of a qualified professional member of the *Ordre des ingénieurs du Québec* to design and inspect formwork and falsework.

- .3 The professional who designs falsework shall provide proof that he has insurance for professional responsibility, except if he is an employee of the Contractor. In this case, the Contractor shall provide proof that the work of his professional employee is covered by his insurance policy.
- .4 Comply at all times with government standards (whether municipal, provincial or federal) on Contractor's duties concerning the protection of workers on construction sites and on falsework. Comply with regulations from the "*Commission de la santé et de la sécurité du Québec*" (CSST).
- .5 Limit loads on floors and underlying structures to respect structural capacity shown on drawings.
- .6 Take into account the construction sequences for falsework design.
- .7 Formwork shall be calculated for loads and lateral pressures described in standard CSA S269.3. Loads due to the wind to be recommended by National Building Code of Canada.
- .8 Calculation considerations and loads to comply with CSA S269.3.
- .9 Comply with CSA S269.1 and CSA S269.2 for falsework, shoring and scaffolding.

1.5 Shop Drawings

- .1 Shop drawings shall clearly indicate method and schedule of construction, materials, arrangement of joints, ties, shores, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework drawings.
- .2 Indicate on shop drawings, each time falseworks are attached or supported on an existing structure or on the current structure, the intensity and direction of maximum loads transmitted to supporting structures. Take into account construction live loads.
- .3 Each shop drawing must bear the stamp and signature of a qualified professional member of the Ordre des ingénieurs du Québec engaged and paid by the Contractor.
- .4 Keep a copy of shop drawings on-site at Departmental Representative's disposal.

1.6 Alignments and Elevations

- .1 Contractor is responsible to locate work from information contained in drawings.
- .2 Contractor is responsible to establish work levels from information contained in drawings using reference level provided.

2. PRODUCTS**2.1 Materials**

- .1 Formwork lumber: plywood and wood formwork materials conforming to CSA A23.1.
- .2 Steel formwork: rigid, waterproof joints, well fastened which do not stain concrete surface.
- .3 Materials for falsework: conforming to CSA S269.1 and CSA S269.2.
- .4 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, which prevent concrete from sticking to forms and from staining concrete.

3. EXECUTION**3.1 Construction**

- .1 Before construction of formwork, verify alignments and levels of existing or newly constructed elements and ensure that dimensions correspond to those specified on drawings. Notify Departmental Representative of any deviation.
- .2 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated and conforming to CSA A23.1 and CSA S269.3. Respect tolerances required by CSA A23.1.
- .3 Forms to be solidly assembled and strong enough to resist all phases of concrete placing with vibrators without deforming or moving.

- .4 Cover formwork with form releasing agent before placing reinforcement. Make sure reinforcement, embedded parts and existing concrete surface of construction joints are not in contact with releasing agent.
- .5 Construct falsework in accordance with CSA S269.1 and CSA S269.2.
- .6 Hand trim sides and bottoms and remove loose earth in excavations before placing concrete.
- .7 Align form joints and make them watertight. Keep form joints to minimum.
- .8 Form chamfers, chases, slots, openings, drips, recesses, expansion and control joints as indicated on structural, architectural and mechanical drawings.
- .9 Before pouring concrete, the professional responsible for formwork and falsework design shall inspect work in accordance with CSST regulations.
- .10 Clean all formwork and construction joint surfaces from debris, sawing debris, snow or ice in accordance with CSA 23.1 before pouring concrete. Do not use de-icing salt to melt ice.
- .11 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 Twenty-four (24) hours for footings and abutments.
- .12 Shoring shall not be removed before concrete is strong enough to support its concrete load and any other construction overload and to limit creep effects when concrete is in the early stages of curing. Contractor shall be responsible for any damage caused by early removal of formwork.
- .13 Carefully remove formwork of visible surfaces to avoid concrete deterioration.
- .14 Reuse of formwork and falsework subject to requirements of CSA A23.1.

END OF SECTION

1. GENERAL**1.1 Work Description**

- .1 All general requirements described in the other sections of the specifications as well as the addenda are relevant to the work described below. Contractor shall supply all materials, equipment, labour and services to complete the work included in the present section and as shown on drawings.
- .2 The present section of the specification includes the supply, the shop preparation and the placing of all steel reinforcement and accessories for all reinforced cast-in-place concrete works shown on drawings.
- .3 Contractor shall foresee and perform at his expense all works other than those described in the specifications and which are required and necessary to complete the work.

1.2 Related Sections

- .1 Section 03 10 00 "Concrete Formwork and Falsework".
- .2 Section 03 30 00 "Cast-in-Place Concrete".

1.3 Reference Standards

- .1 CSA A23.1-09 "Concrete Materials and Methods of Concrete Construction".
- .2 CSA A23.3-04 "Design of Concrete Structures".
- .3 CSA G30.3-M1983 "Cold-Drawn Steel Wire for Concrete Reinforcement".
- .4 CSA G30.5-M1983 "Welded Steel Wire Fabric for Concrete Reinforcement".
- .5 CSA-G30.14-M1983 "Deformed Steel Wire For Concrete Reinforcement".
- .6 CSA G30.18-09 "Carbon Steel Bars for Concrete Reinforcement".
- .7 CSA W186-M1990 "Welding of Reinforcing Bars in Reinforced Concrete Construction".

1.4 Source Quality Control

- .1 Upon Departmental Representative's request, provide two certified copies of mill test report of reinforcing steel, showing physical and chemical analysis, prior to commencing reinforcing work.

1.5 Shop Drawings

- .1 Submit shop drawings at least two weeks before fabrication in accordance with administrative clauses.
- .2 Indicate sizes, spacing, location, overlaps and quantities of reinforcement and mechanical splices. The reinforcement must be marked following an identification code to permit correct placement without reference to structural drawings. Indicate sizes, spacing and location of chairs, spacers and hangers. Do drawings in accordance with the "*Manuel de normes recommandées*" by "*Institut d'acier d'armature du Québec*".
- .3 Supply reinforcement schedule lists in accordance with the "*Manuel de normes recommandées*" by the "*Institut d'acier d'armature du Québec*".
- .4 Detail placement of reinforcement where special conditions occur.

1.6 Substitutes

- .1 Substitution of different size bars permitted only upon written authorization of Departmental Representative.

2. PRODUCTS

2.1 Materials

- .1 Reinforcing steel: carbon steel deformed bars conforming to CSA G30.18. Each reinforcing bar must be identified by the name of the manufacturer, by the grade and the diameter. Any non-identified bar will be refused. Reinforcing steel shall be produced and manufactured in Canada. All steel shall be brand new material.
- .2 Welded steel bar: low alloy and weldable steel deformed bars, conforming to CSA G30.18 with "W" identification.
- .3 Cold-drawn annealed steel wire: conforming to CSA G30.3, latest edition.

- .4 Deformed steel wire for concrete reinforcement: conforming to CSA G30.14, latest edition.
- .5 Welded steel wire fabric: conforming to CSA G30.5, latest edition. Provide in flat sheets only.
- .6 Chairs, bolsters, bar supports, spacers: conforming to CSA A23.1. Chairs material: plastic or galvanized steel wire or steel wire with plastic ends.
- .7 Mechanical or welded splice devices shall develop 125% of tension or compression capacity of spliced reinforcement. Use and type of splice devices to be approved by Departmental Representative.

3. EXECUTION

3.1 Reinforcement Laps

- .1 Place reinforcement laps as shown on drawings.
- .2 Obtain Departmental Representative's approval before canceling or adding any lap in the reinforcement.
- .3 When the lengths of the laps are not identified on the drawings, use: for walls, beams, slabs and foundations, a class "B" tension lap length if more than half the bars are lapped at the same location or a class "A" tension lap length if less than half the bars are lapped at the same location, in accordance with CSA A23.3 (see Table below).

REINFORCEMENT LAPS		
	LAP LENGTH (MM)	
Bar Size	Class "A"	Class "B"
10 M	340	450
15 M	500	650
20 M	660	850
25 M	990	1 290
30 M	1 380	1 810
35 M	1 980	2 580

- .4 Unless otherwise indicated on drawings, use compression laps for columns and pilasters working in compression in accordance with CSA A23.3.

- .5 Use a 200 mm lap for welded wire fabric.

3.2 Shop Preparation

- .1 Shop cut and bend reinforcement in accordance with CSA A23.1 and CSA A23.3.
- .2 Cold bend reinforcement with minimum curve diameter as specified in CSA A23.1.
- .3 Make standard hook conforming to CSA A23.1 when length of hook is not specified on drawings.
- .4 Obtain Departmental Representative's approval for location of reinforcement splice devices other than those shown on structural drawings.
- .5 Obtain Departmental Representative's approval before welding. Welding to be done in accordance with CSA W186 using weldable steel bars.

3.3 Shipping and Storing

- .1 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.
- .2 Store reinforcing bars and wiremesh on wood pieces to protect them from rust and soil contact.
- .3 Protect reinforcing bars and wiremesh against snow and ice.

3.4 Field Bending

- .1 Do not field bend reinforcement except where indicated on structural drawings or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure using minimum curve diameter specified in CSA A23.1.
- .3 Replace bars which develop cracks or splits.

3.5 Placing Reinforcement

- .1 Place reinforcing steel as indicated on reviewed shop drawings and in accordance with CSA A23.1. Supply and install required support chairs, bars, and spacers.
- .2 Steel reinforcement shall be free of flaky rust, mud, formwork releasing agents, oil, ice and other materials that are harmful the steel concrete bond. Remove dried concrete splatters.
- .3 Solidly attach reinforcement to avoid any movement during concreting. Bend attaching wires through inner side of element to be poured.
- .4 Use continuous chairs for slab bottom reinforcement. Spacing between chairs shall be less than 75 times the supported bar diameter.
- .5 Use concrete blocks with steel wire to keep reinforcement to the specified distance from formwork.
- .6 It is forbidden to place reinforcing steel into freshly poured concrete. All reinforcement, including dowels, shall be completely installed before pouring concrete.

3.6 Inspection

- .1 Obtain Departmental Representative's approval of reinforcement steel and position before pouring concrete.
- .2 Inform Departmental Representative at least 24 hours in advance of formwork closing.
- .3 All reinforcing of a part to be concreted shall be placed one half of a working day before closing the formwork, so Departmental Representative can inspect them.

END OF SECTION

1. GENERAL**1.1 Work Description**

- .1 All general requirements described in the other sections of the specifications as well as the addenda are relevant to the work described below. Contractor shall supply all materials, equipment, labour and services to complete the work included in the present section and shown on drawings.
- .2 The present section of the specifications includes supply, malaxing, transport, pouring, vibration, finishing, curing, protection, hot and cold weather protection for all cast-in-place concrete shown on the drawings.
- .3 Contractor shall foresee and perform at his expense all works other than those described in the specifications and which are required and necessary to complete the work.

1.2 Related Sections

- .1 Section 03 10 00 "Concrete Formwork and Falsework".
- .2 Section 03 20 00 "Concrete Reinforcement".

1.3 Reference Standards

- .1 ASTM C260/C260M-10a "Standard Specification for Air-Entraining Admixtures for Concrete".
- .2 ASTM C309-11, "Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete".
- .3 ASTM C494/C494M-11, "Standard Specification for Chemical Admixtures for Concrete".
- .4 ACI 304.2R-96 "Placing Concrete by Pumping Methods".
- .5 CSA A23.1-09 "Concrete Materials and Methods of Concrete Construction".
- .6 CSA A23.2-09 "Methods of Test Concrete".
- .7 CSA A3000-08, "Cementitious Materials Compendium".

1.4 Certificates

- .1 At least two (2) weeks prior to starting work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.
- .2 Submit the Manufacturer's test data, dating less than 18 months, to the Departmental Representative. Additionally, provide certification that the following materials will meet specified requirements (certification to be performed by a qualified independent inspection and testing laboratory):
 - .1 Portland cement.
 - .2 Admixtures.
 - .3 Aggregates.
 - .4 Water.
- .3 Provide certification that the mixing plant, equipment and materials to be used in concrete comply with requirements of CSA A23.1.

1.5 Concreting Schedule

- .1 For each two (2) week interval, supply, at least one (1) week in advance, a concreting schedule with all concreting areas, dates, volume of concrete to be poured, construction joint locations, placing methods, protection measures for hot and cold weather and curing methods.
- .2 The Departmental Representative has the right to add dowels or reduce stirrup spacing for non-mentioned construction joints at points where the shear is high. The additions are at Contractor's expense.

2. PRODUCTS**2.1 Materials**

- .1 Portland cement: conforming to CSA A3000, latest edition (no supplementary cementing materials).
- .2 Water: conforming to CSA A23.1.

- .3 Aggregates: normal density, conforming to CSA A23.1. Aggregates shall not promote alkali-aggregate chemical reactions.
- .4 Air entraining admixtures: conforming to ASTM C260.
- .5 Chemical admixtures: conforming to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .6 Superplasticizing admixtures: conforming to ASTM C494.
- .7 Concrete admixtures and their usage: in accordance with CSA A3000.
- .8 Latex concrete adhesive: polymer-acrylic bonding agent.
- .9 Repair mortar: cement based mortar with high initial resistance, with a compressive strength of 40 MPa at 28 days.

2.2 Concrete Mixes

- .1 Supply mixing formulas at least two (2) weeks in advance indicating the material proportion used, including additives.
- .2 Prepare normal density concrete in accordance with CSA A23.1 and as shown on drawings.
- .3 Unless otherwise indicated on drawings, use type GU cement and 20 mm for nominal size of coarse aggregates.
- .4 Unless otherwise indicated on drawings, slump at time and point of discharge: 50 to 100 mm. When using a pump, the slump at entry shall be less than 120 mm.
- .5 Dry density: 2 250 to 2 400 kg/m³.
- .6 It is forbidden to use calcium chloride or an additive containing it.
- .7 Follow manufacturer's instructions for use of additives.
- .8 Contractor is responsible to ensure the compatibility of the different additives and with materials composing concrete.

- .9 The use of an additive shall not reduce concrete durability and resistance to frost action.
- .10 Do not change concrete mix without prior authorization of Departmental Representative. Should change in material source be proposed, new mix design shall be verified by Departmental Representative.
- .11 Verification of mixing formulas by Departmental Representative does not disengage Contractor from his responsibility to supply concrete with properties, for fresh and hardened concrete, in accordance with required specifications.

3. EXECUTION

3.1 Delivery and Storing

- .1 The unloading of all concrete delivered by a mixer truck has to be completed within two (2) hours from the time the dosage starts. If this criteria is not complied with, the concrete will be refused.
- .2 For each concrete delivery, present to Departmental Representative, before unloading, the supplier's bill of materials indicating the mix used, size of aggregate, additives, volume of the concrete delivered, loading time at the plant and all information requested by Departmental Representative.
- .3 It is forbidden to add water to the concrete without written authorization from Departmental Representative.

3.2 Workmanship

- .1 Obtain Departmental Representative's authorization before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Do not execute concrete work within a 100 m distance radius from rock dynamiting or pile driving work that may be done within 24 hours after pouring.
- .3 Placing, consolidating, vibrating, curing and protection of concrete from hot or cold weather shall be performed in accordance with CSA A23.1.
- .4 Two (2) hours before pouring, wet existing contact surfaces of construction joints without creating puddle.

- .5 When concrete work is done outside of normal working hours or when it is impossible to get equipment within 3/4 hour, provide at least two vibrators on site.
- .6 Provide concrete with its temperature ranging between following limits at placing time:

Element shortest dimension	Concrete Temperature (°C)	
	Minimum	Maximum
Less than 0.3 m	10	30
From 0.3 m to 1 m	5	30
From 1 m to 2 m	5	25
More than 2 m	5	20

- .7 Pump concrete according to ACI 304.2R, "Placing Concrete by Pumping Methods".
- .8 Use bed-ways, hoppers, conduits or openings in forms to limit the concrete free fall to 1.5 m.
- .9 Do not place concrete on frozen ground or backfill.
- .10 Protect freshly poured concrete against rain, snow and others disturbances.
- .11 Provide a humid cure of concrete for at least three (3) days after pouring. Lay plastic sheets that prevent water from evaporating or keep concrete surface constantly wet. Protect concrete against frost and excessive heat for at least seven (7) days after the pouring to preserve a concrete surface temperature within the limits of the preceding table. In cold weather, after that seven (7) day period, the temperature shall be reduced gradually to a maximum of 10°C per day until it reaches exterior temperature.
- .12 Use a curing agent conforming to ASTM C309 when humid curing is not feasible. Apply two coats of the curing agent according to manufacturer's recommendations. Do not use curing agents on surfaces in contact with future pours, surfaces that will be painted or surfaces that will receive other protective agents.
- .13 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

3.3 Concrete Finishing

- .1 Finish concrete surfaces in accordance with CSA A23.1.
- .2 Finish top of visible walls with a steel trowel. Round sharp edges with an approximate 3 mm radius.
- .3 Grind all seams, rough areas and ledges on visible concrete surfaces.
- .4 Clean all visible concrete surfaces to prevent trace of rust, bleaching, dirt and oil.
- .5 Unless otherwise indicated on architectural drawings, structural drawings or in the section related to formwork, fill all form ties with repair mortar.

3.4 Field Quality Control

- .1 Inspection and testing of concrete and concrete materials will be carried out by a testing laboratory designated by Departmental Representative in accordance with CSA A23.1 and CSA A23.2.
- .2 Departmental Representative will pay for costs associated with the tests.
- .3 Cooperate for test sampling and execution, give free access to work, provide required concrete, protect and supply a storage area for samples.
- .4 Temperature, air content and slump tests will be performed on site. Three sample cylinders will be taken for every 75 m³ of poured concrete or a minimum of three sample cylinders for each day if quantity is less than 75 m³.
- .5 Additional test cylinders will be collected during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they are representative of.
- .6 Non-destructive methods for testing concrete shall be in accordance with CSA 23.1 and CSA A23.2.
- .7 Inspection or testing by laboratory will not increase or replace Contractor's quality control nor relieve him of his contractual responsibility.

3.5 Unsound Concrete

- .1 Inform Departmental Representative of any defects before repairing them.
- .2 On highly visible architectural surfaces, repair mortar color and texture shall match surrounding concrete. Do tests in presence of the architect.
- .3 Clean voids, cold joints and other defaults with a jack hammer up to sound concrete. Clean with air jet and moisten the concrete surfaces. Departmental Representative must approve repaired concrete surface. Apply latex-based bonding agent according to manufacturer's recommendations. Fill hole with repair mortar according to manufacturer's recommendations. Keep air and concrete temperature above 7°C during repair and during the next three (3) days. Humid cure for three (3) days. Repairs are at Contractor's cost.
- .4 Requirements concerning compressive resistance of concrete:
 - .1 The compressive resistance of concrete will be accepted if the average of the resistance values of any combination of three (3) consecutive tests is equal to or greater than the specified resistance and if no test has a resistance value less than 3.5 MPa of the specified resistance.
 - .2 The concrete will be acceptable if the average of the resistance values of three consecutive tests for a section of the work is between 90 and 100% of the specified resistance, but no test shall have a resistance value less than 80% of the specified resistance. The costs paid for the section of the work represented by these tests will be readjusted as follows:

$$\text{Cost Paid} = \text{bid price} \times \frac{\text{average of the resistance obtained}}{\text{specified resistance}}$$

- .3 If the average of the resistance values of three consecutive tests for a section of the work is less than 90% of the specified resistance or if a test produces a resistance value less than 80% of the specified resistance, Departmental Representative will require the reinforcement or reconstruction of the work at Contractor's expense or he will readjust the cost for this section of work if the structural resistance is still adequate (see formula for readjusting the cost in the previous article).

- .4 Contractor will not be paid more if the resistance is greater than the specified resistance.
- .5 Contractor could perform his own concrete testing at his expense following CSA A23.2 requirements. The laboratory performing these tests must be a qualified laboratory.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 33 71 16.01 Electrical Poles Line and Hardware.

1.2 References

- .1 American Wood-Preservers' Association (AWPA)
 - .1 AWP M2-01, Standard for Inspection of Treated Wood Products.
 - .2 AWP M4-06, Standard for the Care of Preservative-Treated Wood Products.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA O80 Series-97(R2002) - O80S2-[05], Wood Preservation.
 - .2 CSA O80.20-1.1-M97(R2002), This Standard applies to the fire-retardant treatment of lumber by pressure processes.
 - .3 CSA O80.27-1.1-M97(R2002), This Standard covers the fire-retardant treatment of Douglas Fir, hardwood, softwood, and Poplar plywood by pressure processes.
 - .4 CSA O80.201-M89, This Standard covers hydrocarbon solvents for preparing solutions of preservatives.
 - .5 CSA O322-02, Procedure for Certification of Pressure-Treated Wood Materials for Use in Preserved Wood Foundations.
- .3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.

2. PRODUCTS**2.1 Materials**

- .1 Preservative: to CSA-O80 Series, oil-borne for stained finish.
 - .1 SCAQMD Rule #1113, Architectural Coatings.
- .2 Preservatives: maximum VOC limit 350 g/L.

3. EXECUTION**3.1 Application: Preservative**

- .1 Treat to CSA O80 Series using preservative.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-1995(2001), Fire Tests of Fire stop Systems.

1.2 Definitions

- .1 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

1.3 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit one (1) sample showing actual fire stop material proposed for project.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installation: company specializing in fire stopping installations approved by manufacturer.

1.5 Delivery, Storage And Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2. PRODUCTS**2.1 Materials**

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Fire stop system rating: 2 hr.
- .2 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

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 Preparation

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation.

3.3 installation

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Where required, provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

3.4 Sequences of Operation

- .1 Proceed with installation only when submittals have been reviewed by Departmental Representative.
- .2 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

- .3 Mechanical pipe insulation: fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 Field Quality Control

- .1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.6 Cleaning

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

1. GENERAL**1.1 Summary**

- .1 Section includes
 - .1 General requirements for Division 25 – building Energy Monitoring and Control System (EMCS).
- .2 Related sections
 - .1 Division 26 – Electricity.

1.2 References

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-R2001, BACNET – Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-89 (C1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

- .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .10 Quebec Construction Code (*Code de construction du Québec*)
 - .1 Chapter I – Buildings and the National Building Code Canada 2005.
- .11 Quebec Construction Code (*Code de construction du Québec*)
 - .1 Chapter V – Electricity 2010 (C22.10-10).

1.3 Acronyms and Abbreviations

- .1 Acronyms used in EMCS:
 - .1 AC – Applications Controller.
 - .2 AEL – Average Effectiveness Level.
 - .3 AI – Analog Input.
 - .4 AIT – Agreement on International Trade.
 - .5 AO – Analog Output.
 - .6 BACnet – Building Automation and Control Network as developed by ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers).
 - .7 CA – Circuit Analyser.
 - .8 CAD – Computer Aided Design.

- .9 CDL – Control Description Logic.
- .10 CMS – Centralized Management System.
- .11 COSV – Change of State or Value.
- .12 CPU – Central Processing Unit.
- .13 CS – Control schematics.
- .14 DI – Digital Input.
- .15 DO – Digital Output.
- .16 ECU – Equipment Control Unit.
- .17 EMCS – Energy Monitoring and Control System.
- .18 HVAC – Heating, Ventilation, Air Conditioning.
- .19 IDE – Interface Device Equipment.
- .20 I/O – Input/Output.
- .21 ISA – Industry Standard Architecture.
- .22 LAN – Local Area Network.
- .23 LCU – Local Control Unit.
- .24 LonWorks – Trademark open communication protocol developed by ECHELON.
- .25 MCU – Master Control Unit.
- .26 Modbus – Trademark communication protocol developed by Modicom.
- .27 NAFTA – North American Free Trade Agreement.
- .28 NC – Normally Closed.
- .29 NO – Normally Open.

- .30 OPC – Trademark open communication protocol mainly used in industrial automation, developed by OPC Foundation.
- .31 OS – Operating System.
- .32 OWS – Operator Work Station.
- .33 O&M – Operation and Maintenance.
- .34 PC – Personal Computer.
- .35 PCMCIA – Personal Computer Micro-Card Interface Adapter.
- .36 PID – Proportional, Integral and Derivative.
- .37 RAM – Random Access Memory.
- .38 ROM – Read Only Memory.
- .39 TCU – Terminal Control Unit.
- .40 UPS – Uninterruptible Power Supply.
- .41 USB – Universal Serial Bus.
- .42 VAV – Variable Air Volume.

1.4 Definitions

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as totals, counts, derived corrections and may include, but not limited to result of and statements in CDLs.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

- .2 Point name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, “area” descriptor, “system” descriptor and “point” descriptor, for which database to provide 25-character field for each point identifier. “System” is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier “area”, “system” and “point” will be shortforms or acronyms. Database must provide 2-character field for each point identifier.
 - .2 Point expansion: comprised of three (3) fields, one for each descriptor. Expanded form of shortform or acronym used in “area”, “system” and “point” descriptors is placed into appropriate point expansion field. Database must provide 32-character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point object type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse signals.

- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54 – EMCS: Identification.

1.5 Responsibility

- .1 The sections of Division 25 fall under the responsibility of a single contractor called the Controls Contractor.
- .2 The Controls Contractor must become familiar with overall mechanical and electrical drawings, specifically (but not limited to) for locating equipment that he must connect (ex.: starters, chillers, etc.) as well as location of his own equipment (sensors, valves, actuators, etc.).
- .3 The Controls Contractor is responsible for all control strategies and must anticipate future expansion of system capacity. If control components must be added or if modifications with regard to operating sequences are necessary for optimal performance, the Contractor must do so at his own costs.
- .4 The Controls Contractor must examine the site to determine if anything may hinder work execution and quality.
- .5 Provide an experienced project manager with regular site presence and responsible for the direct supervision of the design, coordination, installation start-up and commissioning of the building management system.
- .6 Provide local and experienced manpower in sufficient quantity to carry out the work.
- .7 Provide complete services of local branches to coordinate all services and warranties. Keep essential change parts on hand or use a local supply source.
- .8 Remain responsible at all times for all activities identified in the Contractor's construction and commissioning schedule and commit to respecting the dates outlined in the provisional and final work acceptance.

1.6 Scope of Work

- .1 This list is not restrictive in nature and does not relieve the Controls Contractor of his responsibility to provide all material, equipment and manpower in order to execute his contract. In fact, this list does not remove any portion of work as defined in other sections.
- .2 Supply and installation of a complete operating system and building management system which integrates digital control and equipment supervision and comprised of a station (server) and OWSs on personal computers with colour graphic display. The control system must meet the specifications of this section to ensure compatibility with hardware and future software. If a control system manages specific aspects of these specifications differently, the Controls Contractor must obtain approval from the Departmental Representative within five (5) days prior to tender date.
- .3 The Controls Contractor must reuse all existing control equipment and add expansion cards when applicable or provide complete controllers to respect systems operations. The existing centralized management system is EBI brand and to be kept. Anticipate required licences to allow for complete point expansion for the work cited in the present section.
- .4 Dismantle all control equipment that is no longer operational. Overall pneumatic equipment and lines must be removed from the systems affected by work. Secondary air lines must be removed and sealed at the main air line to maintain integrity of other air networks. Existing control panels must be cleaned and free from pneumatic and electronic equipment that are no longer useful. Identify existing components and add cable concealers when necessary. Replace control panel door if unnecessarily punctured.
- .5 Work includes manpower, supply and installation of equipment, programming, warranty, start-up, tooling and all other items necessary for complete and meticulous control work in order for the systems to be complete and operational as described in the present section and as illustrated on drawings.

- .6 Control drawings are qualitative in nature, i.e., they only describe type of components (electrical connections, pneumatic lines, AO, AI, DO, DI, etc.) and do not indicate the number of components necessary. The Contractor must refer to overall mechanical and electrical sections and control sequences in Section 25 90 01 – EMCS – Site Requirements, Applications and Systems Sequences of Operation, to determine what is required to comply with such.
- .7 Provide, install, program and configure all software, cards and/or interfaces required for complete and functional installation of the EMCS ensuring autonomy for system users. It must be possible to program dynamic graphics in HTML format on the centralized management system and add and implement new digital controllers on the network without the need for components or technical support from the EMCS building management manufacturer or distributor. Provide programming software to access configuration parameter and controllers' programming as well as the possibility to program new control points, algorithms and new control loops.
- .8 Provide assistance to the Balancing Contractor in adjusting air systems, water systems and terminal equipment.
- .9 As indicated, control devices reusable in their original configuration may be reused provided that they comply with codes, standards and requirements. If there is any doubt with regard to reusing existing devices, provide newly designed equipment suitable to the project. Provide a list of equipment included in the tender. Also indicate the unit price for all equipment items.
- .10 The Controls Contractor must adjust and calibrate existing equipment to be reused.
- .11 For sectors not retrofitted in the present work, the removal and reinstallation of ceilings, cutting and patching of ceilings and walls damaged by works and cleaning of premises will fall under the responsibility of the present contractor.
- .12 Provide and install all control equipment not indicated on drawings or in specifications but necessary for system operating.
- .13 Unless otherwise indicated, control devices must be from a single manufacturer.

- .14 Verify and adjust the control systems every three (3) months for the first year following the installation acceptance date. Submit a written report on the operation status or on adjustments performed.
- .15 For software licences subject to a specific number of physical or virtual points, plan for at least 15% spare points upon the date of provisional acceptance of completed project.
- .16 Program an HTML dynamic graphic for each electro-mechanical system. Program a dynamic graphic per room indicating (as required) room number, position and ID for terminal unit, temperature sensor, heating element and lighting status and control of required components. Program architecture penetration (plan view) for floors or floor section providing access to each room dynamic graphic. Summary tables providing overall control room information are prohibited.
- .17 Automatic controls work to consist in connecting a new metering device at the selected distribution station to measure electrical consumption parameters. The link will be done using an open protocol to ASHRAE standards on the RNP-5 digital controller to replace the existing one. Current control sequences are to be kept, namely boiler heating stage shedding. Replace pulsed signals with analog reading in real time via analog input CTs with dedicated I/Os for metering and integrated into the RNP-5 controller. Wiring is to be new between the digital controller and metering device.
- .18 Anticipate time for additional programming and commissioning to optimize operating sequences and equipment functioning to the entire satisfaction of the Departmental Representative. No additional amounts will be accepted for modification to programming.

1.7 System Description

- .1 Refer to CDL schematics for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, the following:
 - .1 Unless otherwise indicated, provide, install and connect equipment and other components, including the following, without limited to such:

- .1 Server, OWS and computer.
- .2 Interface software, management software, programming software, dynamic graphic generation software, and data communications equipment necessary to effect EMCS data transmission system including gateways.
- .3 MCU, LCU and required TCU/ECU.
- .4 Field control devices including, but not limited to, sensors, actuators, valves, humidity and pressure transmitters, end-of-line switches, frost and differential pressure detection.
- .5 Control panels (main, auxiliary and interface).
- .6 All conduits and wiring connecting system components.
- .7 Electrical and pneumatic modifications.
- .8 Identification of components, etc.
- .9 Complete O&M manuals, on-site training for operators, programmers and maintenance personnel.
- .10 Acceptance tests, technical support during commissioning, full documentation.
- .11 Interface wiring coordination of equipment supplied by others.

1.8 Design Criteria

- .1 Design and provide conduits and wiring linking elements of system.
- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
- .3 Location of controllers as reviewed by Departmental Representative prior to installation.
- .4 Provide utility power and emergency power to EMCS as indicated.

- .5 Metric references: in accordance with CAN/CSA Z234.1.
- .6 Language operating requirements
 - .1 Provide French operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in French.
 - .3 Operating system executive: provide primary hardware-to-software interface with associated documentation to be in French.
 - .4 System manager software: include in French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in French:
 - .1 Input and output commands and messages from operator-initiated functions, field related changes, alarms as defined in CDLs or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
 - .2 Graphic “display” functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.9 Action and Informational Submittals

- .1 Submit for review:
 - .1 Equipment list and systems manufacturers within 48 hours after award of contract.
 - .2 List of existing field control devices to be re-used included in tender along with unit price.
- .2 Quality control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .4 For materials whose compliance is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .5 Permits and fees: in accordance with general conditions of contract.
 - .6 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
 - .7 Existing devices intended for re-use: submit test report.

1.10 Controls Contractor Qualifications

- .1 Automated controls work must be executed by an specialized automated controls firm and as per the requirements of the Electrical Examiners Bureau. Contractors who do not fabricate the components that they propose must submit a letter from the manufacturer indicating that they are authorized distributors or certified installers.
- .2 The system is to be designed, programmed, installed and started up by qualified technicians, mechanics and electricians who are regularly employed by the firm. The firm shall have a minimum of ten (10) years of experience in the design and installation of DDC systems. It will also be a manufacturer or distributor of the proposed product for a minimum of ten (10) consecutive years.
- .3 Have a local office within 50 km of project staffed by trained personnel capable of providing instruction and routine maintenance on EMCS.
- .4 Provide record of successful previous installations showing experience with similar EMCS installations.
- .5 Have access to local supplies of essential parts and provide ten (10) year guarantee of availability of spare parts after obsolescence.
- .6 Ensure qualified supervisory personnel continuously direct and monitor work and attend site meetings.

1.11 Existing Control Equipment

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards and requirements.
 - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
 - .2 Provide for new, properly designed devices where re-usability of components is uncertain.

- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair.
 - .2 Failure to produce test report will constitute acceptance of existing devices by Controls Contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with work.
- .6 Controls Contractor to assume responsibility for controls to be incorporated into EMCS after written receipt of approval.
 - .1 Contractor is responsible for items repaired or replaced.
 - .2 Contractor is responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility of Contractor for existing devices terminates upon final acceptance of EMCS.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

2. PRODUCTS

2.1 Adaptors

- .1 Provide adaptors between metric and imperial components.
- .2 Quality of acceptance: Honeywell as existing.

3. EXECUTION**3.1 Manufacturer's Recommendations**

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

1. GENERAL

1.1 Summary

- .1 Section includes
 - .1 Requirements and procedures for identification of devices, sensors, wiring, tubing, conduits and equipment for building Energy Monitoring and Control System (EMCS) work and nameplates, materials, colours and lettering sizes.

1.2 References

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1.02, Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 System Description

- .1 Language operating requirements: provide identification for control items in French.

1.4 Submittals

- .1 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

2. PRODUCTS

2.1 Nameplates for Panels

- .1 Identify by plastic laminate, 3 mm thick melamine, melamine black finish, white core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 50 x 125 mm minimum.
- .3 Lettering: minimum 7 mm high, white.
- .4 Inscriptions: machine engraved to identify function.

2.2 Nameplates for Field Devices

- .1 Identify by plastic encased cards attached by plastic tie or chain.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: name, description, point name and point address, as well as other pertinent data.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 Nameplates for Room Sensors

- .1 Identify by stick-on labels using point identifier.
- .2 Location: sensor facade.
- .3 Letter size: to suit, clearly legible.
- .4 Anticipate nameplates for room sensors such as, but not limited to, room temperature sensors, room humidity sensors, room pressure sensors, room CO₂ level, etc.

2.4 Warning Signs

- .1 Equipment including motors, starters under remote automatic control: supply red coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "*Attention – Commande automatique à distance*".

2.5 Wiring

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communication cables, matched throughout system.

- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 Pneumatic Tubing

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 Conduits

- .1 EMCS conduits to be orange.
- .2 Pre-paint box covers and conduit fittings.
- .3 Marking: paint or tape, orange, 25 mm wide.

3. EXECUTION

3.1 Nameplates and Labels

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 Existing Panels

- .1 Correct existing legends to reflect changes made during work.

END OF SECTION

1. GENERAL**1.1 Summary**

- .1 Section includes:
 - .1 Materials and installation for building automation controllers including:
 - .1 Master Control Unit (MCU).
 - .2 Local Control Unit (LCU).
 - .3 Equipment Control Unit (ECU).
 - .4 Terminal Control Unit (TCU).
- .2 Related sections
 - .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
 - .2 Section 01 91 31 – Commissioning (Cx) Plan.
 - .3 Section 01 91 33 – Commissioning (Cx) – Forms.
 - .4 Section 01 91 41 – Commissioning (Cx) – Training.
 - .5 Section 25 05 01 - EMCS: General Requirements.
 - .6 Section 25 30 02 - EMCS – Field Control Devices.
 - .7 Section 25 90 01 - EMCS - Site Requirements, Applications and Systems Sequences of Operation.

1.2 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2011, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
 - .1 C22.2 No.205-M1983(R1999), Signal Equipment.

- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.3 Language Requirements

- .1 The English version of the present document is an integral translation of the original French version. In the case of discrepancy between the two versions, the French version has precedence over the English translation.

1.4 Definitions

- .1 Acronyms and definitions: refer to Section 25 05 01 – EMCS: General Requirements.

1.5 Description

- .1 Network of controllers comprised of MCU(s), LCU(s), ECU(s) or TCU(s) to be provided as indicated in system architecture diagram to support building systems and associated sequences of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.
 - .2 Controller quantity and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units that must do the following:
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication to LANs to exchange information with other controllers.
 - .3 Capable of interfacing with operator interface device.

- .4 Execute their logic and control using primary inputs and outputs connected directly to their onboard input/output field terminations or slave devices, and without need to interact with other controllers. Secondary input used for reset or modification to a set point (i.e. outdoor air temperature) may be located in other controllers.
- .1 Secondary input used for reset such as outdoor air temperature may be located in other controllers.

1.6 Design Requirements

- .1 Controllers must be capable of the following:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
 - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
 - .3 Perform analog control using programmable logic (including PID) with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25% of each point type distributed throughout the MCUs and LCUs.
- .3 Field termination and interface devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logic devices and associated field equipment.

- .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input-Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
- .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4–20 mA;
 - .2 0–10 VDC;
 - .3 100/1000 ohm RTD input.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
- .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4–20 mA.
 - .2 0–10 VDC.

- .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 20 Hz. Add multiplier module for quicker frequencies.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 VAC with external fuse protection.
 - .2 Switch up to 5 amps at 220 VAC with external fuse protection or using optional interface relay.
 - .3 Controllers and associated hardware and software: operate in conditions of 0°C to 50°C and 20% to 90% non-condensing RH.
 - .4 Controllers (MCU, LCU): mount in wall-mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
 - .5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
 - .6 Provide surge and low voltage protection for interconnecting wiring connections.

2. PRODUCTS

2.1 Master Control Unit (MCU)

- .1 Primary function of MCU is to provide coordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for peer-to-peer communications with OWS(s) and other MCU level devices.
 - .1 MCU must be able to support BACnet protocol and be compatible with existing DELTA station.
- .3 MCU local I/O capacity as follows:
 - .1 MCU I/O points as allocated in I/O Summary Table.
 - .2 LCUs may be added to support system functions.
- .4 Central Processing Unit (CPU)
 - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
 - .2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.
 - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
 - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
 - .2 Battery backed (72-hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, set points, alarm limits, PID constants and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

- .4 Include uninterruptible clock accurate to \pm five (5) secs/month, capable of deriving year/month/day/hour/minute/second with rechargeable batteries for minimum 72-hour operation in event of power failure.
- .5 Local Operator Terminal (OT): unless otherwise indicated in 25 90 01 - EMCS - Site Requirements, Applications and Systems Sequences of Operation, provide OT for each MCU.
 - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU and approved by the Departmental Representative.
 - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
 - .3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in French.
 - .4 Functions to include, but not be limited to, following:
 - .1 Start and stop points.
 - .2 Modify set points.
 - .3 Modify PID loop parameters.
 - .4 Override PID control.
 - .5 Change time/date.
 - .6 Add/modify/start/stop weekly scheduling.
 - .7 Add/modify set point weekly scheduling.
 - .8 Enter temporary override schedules.
 - .9 Define holiday schedules.
 - .10 View analog limits.
 - .11 Enter/modify analog warning limits.
 - .12 Enter/modify analog alarm limits.

- .13 Enter/modify analog differentials.
- .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controllers in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWSs for access of points at OT to eliminate cross-reference or look-up tables.

2.2 Local Control Unit (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one building system to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum two (2) interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
 - .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

- .4 Include power supplies for operation of LCU and associated field equipment.
- .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control functions. Controllers that use defaults or fail to open or close positions not acceptable.
- .6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 Terminal/Equipment Control Unit (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
 - .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature set points, flow set points and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
 - .3 VAV terminal controller
 - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
 - .2 Controller to support point definition; in accordance with Section 25 05 01 – EMCS: General Requirements.
 - .3 Controller to operate independent of network in case of communication failure.
 - .4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 Software

- .1 General
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation – CDLs.
 - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
 - .3 Include initial programming of controllers, for entire system.
- .2 Program and data storage
 - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
 - .2 Maintain CDL and operating data including set points, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages
 - .1 Program Control Description Logic software (CDL) using advanced language or graphical, high level, general control language.
 - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.
- .4 Operator terminal interface
 - .1 MCU must include operating and control functions as follows:
 - .1 Multi-level password access protection to allow user/manager to limit workstation control.
 - .2 Alarm management: processing and messages.
 - .3 Operator commands.
 - .4 Reports.
 - .5 Displays.

- .6 Point identification.
- .5 Pseudo or calculated points
 - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo points. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
 - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL)
 - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
 - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. set points) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
 - .3 Perform changes to CDL on-line.
 - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or interlocking control.
 - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
 - .6 MCU to be able to perform following pre-tested control algorithms:
 - .1 Two-position control.
 - .2 Proportional Integral and Derivative (PID) control.

- .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
- .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads. Note: specific to "Brown Out" conditions designer and contractor must verify that use of latching start stop relays versus momentary relays will not cause unexpected equipment failure or malfunction.
- .9 Power fail restart: upon detection of power failure system to verify availability of emergency power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and alarm management: use management by exception concept for alarm reporting. This is a system-wide requirement. This approach will ensure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are operational temperature alarms limits which are exceeded when main AHU is stopped, or general fire condition shuts AHUs down, only fire alarm status shall be reported. Exception is when an AHU group is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports with date stamp indicating sensor details which activated and or terminated feature.
 - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
 - .1 Time of day scheduling.
 - .2 Calendar based scheduling.
 - .3 Holiday scheduling.

- .4 Temporary schedule overrides.
- .5 Optimal start-stop.
- .6 Night setback control.
- .7 Enthalpy (economizer) switchover.
- .8 Peak demand limiting.
- .9 Temperature compensated load rolling.
- .10 Fan speed/flow rate control.
- .11 Cold deck reset.
- .12 Hot deck reset.
- .13 Hot water reset.
- .14 Chilled water reset.
- .15 Condenser water reset.
- .16 Chiller sequencing.
- .17 Night purge.
- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
- .3 Apply programs to equipment and systems as specified or as instructed by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
 - .1 MCU to accumulate and store automatically run-time for binary input and output points.
 - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.

- .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
- .4 Totalization routine to have sampling resolution of one (1) min. or less for analog inputs.
- .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tons, etc.).
- .6 Store event totalization records with minimum of 9,999,999 events before reset.
- .7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 Levels of Address

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator. EMCS must also do the following:
 - .1 Display analog values digitally to one (1) place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2-second intervals.

2.6 Point Name Support

- .1 Controllers (MCU, LCU) to support point naming convention as defined in Section 25 05 01 – EMCS: General Requirements.

3. EXECUTION

3.1 Location

- .1 Location of controllers to be approved by Departmental Representative.

3.2 Installation

- .1 Install Controllers in secure locking enclosures as indicated or as instructed by Departmental Representative.
- .2 Provide necessary power from local 120 V branch circuit panel connected to emergency for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and coordinating mode.

END OF SECTION

1. GENERAL**1.1 Summary**

- .1 Section includes
 - .1 Control devices integral to the building Energy Monitoring and Control System (EMCS).

1.2 Submittals

- .1 Pre-installation tests:
 - .1 Submit samples performed at random from equipment shipped for testing before installation. Replace devices not meeting specified performance and accuracy.
- .2 Manufacturer's instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.3 Existing Conditions

- .1 Cutting, adjusting and patching: to replace existing devices.
- .2 Repair surfaces damaged during execution of work.
- .3 Turn over to Departmental Representative existing removed materials.

2. PRODUCTS**2.1 General**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, heat resistant assembly.
- .3 Operating conditions: 0–32°C with 10–90% RH (non-condensing), unless otherwise specified.

- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not to exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity and pressure.

2.2 Electromechanical Relays

- .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120 VAC or 24 VDC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 VAC.
 - .4 Relay to have visual status indication.
 - .5 Override button.

2.3 Time Relays

- .1 Characteristics
 - .1 0–10 min. adjustable range.
 - .2 Operating voltage between 24 and 600 VAC as per application.
 - .3 Configurable time delay between start delay and stop delay.

- .4 Indicator light for operating mode.

2.4 Solid State Relays

- .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED indicator.
 - .3 Input and output barrier strips to accept 14 to 28 AWG wire.
 - .4 Operating temperature range to be -20°C to 70°C.
 - .5 Relays to be CSA certified.
 - .6 Input/output isolation voltage to be 4,000 VAC at 25°C for 1 second maximum duration.
 - .7 Operational frequency range: 45 to 65 Hz.
- .2 Input:
 - .1 Control voltage: 3 to 32 VDC.
 - .2 Drop out voltage: 1.2 VDC.
 - .3 Maximum input current to match AO (analog output) board.
- .3 Output:
 - .1 AC or DC output model to suit application.

2.5 Panels

- .1 Wall-mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as indicated to handle requirements with additional space to accommodate 25% additional capacity without adding additional cabinets.
- .3 Panels to be lockable with same key.

3. EXECUTION**3.1 Installation**

- .1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after Commissioning is complete.
- .2 Install field control devices in accordance with manufacturers' recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.

3.2 Panels

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.3 Identification

- .1 Suitably identify field devices.

3.4 Testing and Commissioning

- .1 Calibrate and test field devices for accuracy and performance.

END OF SECTION

1. GENERAL

1.1 Summary

- .1 Section includes
 - .1 General requirements for the installation of electrical wiring with regard to Energy Management Control System (EMCS).

1.2 Qualifications

- .1 Systems and related controls to be installed by qualified workers with permits issued by the Province of Quebec.
- .2 Qualified factory trained supervisory personnel to continuously direct and monitor all work and attend all site meetings.

1.3 Existing Conditions

- .1 Repair surfaces damaged during execution of work.
- .2 Turn over to Departmental Representative existing materials removed from work not identified for re-use. If Departmental Representative does not wish to keep said materials, remove from site as per environmental regulations in effect.

1.4 References

- .1 All temporary and permanent installations shall comply with the Canadian Electrical Code and the Bureau of Electrical Examiners (*Bureau des examinateurs électriciens*).
- .2 All components shall be CSA approved or UL listed, when applicable.

2. PRODUCTS

2.1 Wiring

- .1 Unless otherwise indicated, ductless FT4 conductors are permitted only in suspended ceilings and gypsum walls. In suspended ceilings, wiring must be secured every three (3) metres and must follow the building's architectural lines.

- .2 In ceiling spaces, low voltage wiring must be grouped and secured to the structure with brackets and not nylon Tiewraps attached to conduits whether electric, plumbing or ventilation.
- .3 Unless otherwise indicated, all conductors will be installed in EMT conduits in mechanical utility rooms or other exposed locations as well as inside ventilation units. In addition, all wiring in concrete block walls or other inaccessible locations, as well as conductors 120 V and greater must be installed in EMT conduits. Conduits will be 13 mm minimum.
- .4 Flexible conduits will be used for transitions between control components and EMT conduits when wiring is to be within conduits. Flexible conduits will not exceed 500 mm. In humid locations, conduits and hardware to comply with the type of application.
- .5 Wiring must be in compliance with the requirements of Division 26.
- .6 70 V and higher: use copper conductors with cross-linked thermosetting polyethylene material, RW90, 600 V nominal, at least 12AWG for 120V supply and at least 14AWG for motor control centres, colour code as per CSA 22.1.
- .7 Less than 70 V: use copper conductors, FT4 type. The wire must be certified and orange in colour. Select minimum type and gauge as per the following requirements:
 - .1 Control wiring (for connecting starters or interlocking): #16AWG, stranded.
 - .2 Output signal wiring (relays, actuators, etc.): #18AWG, stranded.
 - .3 Input signal wiring (sensors, transmitters, etc.): #18AWG, stranded.
 - .4 Intelligent room temperature sensor wiring: #20AWG, stranded.
 - .5 Variable speed wiring: #18AWG, stranded and shielded.
 - .6 Communication wiring: #20AWG, stranded and shielded.

If cable size is not respected, provide manufacturer's documentation and have Departmental Representative approve cable size before installation.
- .8 Conductors must be continuous from their electrical source up to connected point. Pressure-type connectors will not be accepted for wires.

2.2 Conduit System

- .1 For mechanical utility rooms and in other exposed locations, plan for conduit system to connect field instrumentation to EMCS. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fills not to exceed 40%. Design drawings do not show conduit layout.
- .2 As per requirements of Electrical Division 26.
- .3 Electrical metallic tubing to CSA C22.3 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.
- .4 Fittings for rigid conduits:
 - .1 Couplings and fittings: threaded type steel.
 - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
 - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .5 Fittings for thin wall conduits:
 - .1 Connectors and couplings: steel, set screw type.
- .6 50 mm dia. and smaller: steel straps, one (1) hole. Larger than 50 mm dia.: steel straps, two (2) holes.
- .7 Identify conduits using orange coloured tape at all transitions and every three (3) metres. Tape identification is not necessary when orange conduits are used.

2.3 Pull and/or Outlet Boxes

- .1 Junction and pull boxes: welded steel.
 - .1 Surface mounting cast FS: screw-on flat covers.
 - .2 Flush mounting: covers with 25 mm minimum extension all round.

- .2 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, two (2) keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and/or entire contract as approved.
- .3 Outlet boxes: 100 mm minimum, square.
 - .1 Moulded type and fittings for conduits.
 - .2 Bushings and connectors: with nylon insulated throats.
- .4 Boxes with push pennies to prevent entry of foreign materials.
- .5 Junction and pull boxes are painted orange.

3. EXECUTION

3.1 General

- .1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after Commissioning is complete.
- .2 Provide and install required electrical wiring and conduits to connect the various components of the centralized control system in compliance with the requirements of the Quebec Electrical Code and the Bureau of Electrical Examiners.
- .3 Identify tubing and/or wiring at each end, connection, piece of equipment, etc., with a wire marker such as model from Thomas & Betts or equivalent.
- .4 Tubing and wiring must follow building lines and be securely fastened to equipment. Do not insulate.
- .5 Conform to manufacturer's recommendations for storage, handling and installation.
- .6 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .7 Install electrical equipment between 1,000 and 2,000 mm above finished floor wherever possible and adjacent to related equipment.

- .8 Protect exposed live equipment such as panels, mains, outlet wiring during construction for personnel safety.
- .9 Install complete, permanent and continuous grounding system for equipment including conductors, connectors and accessories.

3.2 Wiring

- .1 Install multiple wiring in ducts simultaneously. Do not pull spliced wiring inside conduits or ducts.
- .2 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .3 Tests: use only qualified personnel. Demonstrate the following:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits should not to be less than 50 Megohms.
- .4 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .5 Install all strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.
- .6 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.

3.3 Conduit System

- .1 Install conduits and sleeves prior to pouring of concrete.
- .2 Install conduits parallel or perpendicular to building lines to conserve headroom and to minimize interference.

- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduits to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduits up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
 - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
 - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Departmental Representative's written approval.
- .13 Group conduits wherever possible on suspended or surface channels.
- .14 Install bonding conductor for 120 V and above in conduit.
- .15 Holes through exterior wall and roofs: flash and make weatherproof.

- .16 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduits, cables, pull boxes and outlet boxes.
- .17 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 Pull and/or Outlet Boxes

- .1 Install in inconspicuous but accessible locations.
- .2 Support boxes independently of connecting conduits.
- .3 Fill boxes with paper or foam to prevent entry of construction material.
- .4 Provide correct size of openings. Reducing washers not permitted.
- .5 Mark location of pull boxes on record drawings.
- .6 Identify AC power junction boxes, by panel and circuit breaker.

END OF SECTION

1. GENERAL

1.1 Summary

- .1 Section includes
 - .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
 - .1 Control Description Logic (CDL) for each system.
 - .2 Input/Output Point Summary Tables for each system.
 - .3 System Diagrams consisting of the following: Control Design Schematic for each system (as viewed on OWS), system flow diagram for each system with electrical ladder diagram for MCC starter interface.

2. SEQUENCING

2.1 General

- .1 The starts/stops and occupied/unoccupied periods for zones and systems must be programmed from the EMCS according to building schedule. Each zone and/or system must be able to be programmed individually or as a group, seeing that the schedules are not necessarily the same for all parts of the building.
- .2 Provide and install an analog type current transformer within each magnetic starter, pump and fan. Connect transformers to EMCS to provide current reading and proof of equipment operation. Operating status for each piece of equipment is indicated on the related graphics. If a piece of equipment does not operate or if an overload is detected by a motor, an alarm is sent to the EMCS and the back-up equipment shall start (if applicable).
- .3 All systems and their components, unless otherwise indicated, are controlled by DDC via the EMCS. Unless otherwise indicated, all thermostats, valves and actuators will be electronic type. All set points must be able to be re-adjusted from the EMCS.
- .4 Outside temperature is read via the Text sensor whose value is displayed on the graphics of all supply systems.

- .5 Operating sequences for fans and pumps in automatic mode are dependent on the selector switches of their magnetic starter in “automatic” position.
- .6 Provide an adjustable high humidity limit and flow switch. The Controls Contractor shall install these components and provide electrical interlocking with the humidifier control to prevent humidifier from operating when 80% RH is measured in the duct or when the fan is not operating.
- .7 Supply systems with outside air intake are equipped with freeze protection (DPDT electric thermostat) with adjustable time relays to stop the entire system when the temperature at the supply fan’s outlet is 4°C or lower. Protection will be automatic reset type. Bypass this protection for three (3) minutes upon system start-up. The stop control for an AHU fan at low temperature level will be done directly by the electronic freeze protection thermostat at the AHU fan’s magnetic starter and not by the DDC system. A low freeze limit alarm in the supply system will be transmitted to the EMCS. Fresh air and exhaust dampers close completely via electrical interlocking.
- .8 The Controls Contractor is responsible for 120V power supply for all control equipment from the emergency distribution panels. Provide required breakers if there are no available breakers.
- .9 Each filter bank shall be equipped with an analog differential pressure transmitter combined with digital field display and EMCS display. An alarm is transmitted to the EMCS once the set point has been reached.
- .10 Ambient static pressure differentials are measured as a reference for outside static pressure.
- .11 All room temperature sensors are not necessarily indicated on drawings. The Controls Subcontractor must anticipate all room temperature sensors and all thermostats required to control the various heating and cooling equipment.
- .12 All control points for a particular system must reside in the same circuit analyser (CA). Allow for a minimum of 10% spare points in each controller (see specifications).
- .13 Control connections between the following equipment fall under the responsibility of Division 26 – Electricity.
 - .1 Between magnetic starters and thermistors for motors equipped with such.

- .2 Between fire alarm system and starters.

All other connections, unless otherwise indicated, fall under the responsibility of the Controls Subcontractor.

- .14 In addition to the specified indications, the following alarms will be transmitted to the EMCS:
 - .1 Low or high supply temperature alarm: 3°C deviation (or greater) from the set point.
 - .2 Abnormal mixing temperature alarm.
 - .3 Low or high supply static pressure alarm: 75 Pa deviation from the set point for a period of more than two (2) consecutive minutes.
 - .4 Motor abnormal current intensity via the current transformers in the magnetic starters.
- .15 Operating programming and feedback from the systems' control components must be optimized based on temperature, flow and pressure balancing within ten (10) minutes of a system being started up.
- .16 Further to a general power failure, the systems are restarted sequentially.

3. NARRATIVE SEQUENCES

3.1 Boiler Heating Stage Shedding

- .1 General
 - .1 Existing sequencing is to be kept.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

1.2 Related Sections

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).

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 General Information Concerning Work

- .1 The following list describes the scope of work, without being limited to such. Perform detailed work to deliver a complete, operational and performing installation. Unless otherwise indicated, work includes the supply, installation and connection of equipment.
- .2 For the power station replacement:
 - .1 Provide, install and connect 600V and 120/208V distribution.
 - .2 Provide, install and connect 4.16-kV distribution.
 - .3 Existing 4.16 kV station works.

**COMMON WORK RESULTS
FOR ELECTRICAL**

- .4 Provide, install and connect 25 kV aerial network, including switch, fuse, pole, and accessories.
- .5 Coordinate modification work for connection with electrical utility company. Coordinate modification work to telephone line, reserved for Hydro-Québec metering. Notify Hydro-Québec that the cost of this work is to be invoiced to the Contractor. See Section 01 21 00 – Allowances.
- .6 Provide and install wiring raceways, poke-through fittings, conduits and wiring.
- .7 Indoor lighting.
- .8 Paraseismic protection.
- .9 Grounding and bonding networks.
- .10 Underground duct bank network.
- .11 Transformer dry type.
- .12 Temporary and permanent electrical supply to Building.
- .13 Training on the systems and preparation of operating and maintenance manuals.
- .14 Tagging of all electrical equipment which poses arc flash hazard. Provide calculation and tags.
- .15 Perform all testing on cables and equipment.
- .16 Provide and install all temporary electrical services for construction work: lighting, distribution and others.
- .17 Provide and install conduit network, outlet boxes and pull cords for the control and phone.
- .18 Provide a coordination and an arc flash study relating to protection and electric components. The study is to be signed and sealed by an engineer certified in the province where building construction takes place.
- .19 Provide all qualified labour, all equipment, all materials and all tools necessary to walls and/or floors and other elements, as required for the installation of electrical equipment.
- .20 Perform all necessary works for acoustic and air-sealing systems for all electrical conduit and wiring penetrations through walls, floors and any other partition.

- .21 Fire stop sealing systems and holes made by cutting.
- .22 Work in confined areas. Provide supervisory personnel.

1.5 Design Requirements

- .1 Operating voltages to CAN3-C235.
- .2 In the case of divergence from content, drawings and specifications in French have priority over English version.
- .3 Control/safety devices able to operate sufficiently at 60 Hz and within the limits established in the above-mentioned standard.
 - .1 Devices able to withstand operation under extreme conditions without damage as defined in this standard.
 - .2 Drawings and specifications in French have priority over English version.
- .4 Operating and display language: for identification and display purposes, control devices to include nameplates in French and English.
- .5 Use one (1) nameplate for both languages.

1.6 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province within Canada.
 - .2 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.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

- .4 Indicate on drawings clearances for operation, maintenance, and replacement of equipment devices.
- .5 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00 – Quality Control.
 - .1 Provide CSA certified equipment.
 - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of work, load balance report as described in PART 3 – LOAD BALANCE.

1.7 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00 – Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the province in which work is to be executed.
 - .1 Employees registered in provincial apprentice 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 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.8 System Start-up

- .1 Instruct the Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

1.9 Operating Instructions

- .1 Provide operating instructions for each main system and 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 main 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.

1.10 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 in clean, dry, well-ventilated area and in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.
- .4 Packaging waste management: in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.11 Seismic Mounting

- .1 Each subcontractor in each speciality trade is responsible for the compliance of seismic restraint systems.
- .2 Refer to Section 26 05 30 – Vibration and Seismic Control for Equipment.

1.12 Coordination and Adjustment Study – Protection Devices

- .1 The Electric Contractor is responsible for performing a coordination and adjustment study on protection devices by the manufacturer of electrical distribution equipment as indicated in the related sections of the specifications.
- .2 The coordination study must be performed from Hydro-Québec protection up to the distribution equipment protection devices indicated in the related sections of the specifications.
- .3 Protection devices including overcurrent releases, long and short time delay releases, instantaneous releases, ground fault and relays must be adjusted to desired capacities and set to values as indicated in the manufacturer's study.

1.13 Incident Energy Analysis

- .1 The Contractor must produce a detailed incident energy analysis in compliance with Z462-15 for all new and modified equipment within this project. Include SEXT-0 and PEXT-0 panels.

2. PRODUCTS**2.1 Materials/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 are not available, submit such equipment to inspection authorities for approval before delivery to site and submit such approval as described in PART 1 – SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 Wiring Terminations

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

2.3 Equipment Identification

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: Lamicoid 3 mm thick plastic engraving sheet, black face and white core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .2 Wording on nameplates to be approved by the Departmental Representative prior to manufacture.
 - .3 Nameplates for terminal cabinets and junction boxes to indicate network and/or voltage characteristics.
 - .4 Transformers: indicate capacity, primary and secondary voltages.

2.4 Wiring Identification

- .1 Identify wiring with permanent indelible markings using numbered plastic tape on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.

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

2.5 Labelling System

.1 Labelling

- .1 All labels are to be machine fabricated and of professional quality; labels are to be either transparent heat-shrinkable film or stickers.
- .2 Stickers may be used for patch cords.
- .3 Ink is to be indelible.
- .4 No handwritten labels will be accepted.

2.6 Equipment, Conduit and Cable Identification

- .1 Identify equipment with nameplates and labels in accordance with the following specifications:

- .1 Nameplates: Lamicoid 3 mm thick plastic engraving sheet, black matt face, white core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
- .2 Format in accordance with table below:

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

- .3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by the Departmental Representative prior to manufacture.
- .5 Allow for at least twenty-five (25) letters per nameplate and label.
- .6 Terminal cabinets and pull boxes: indicate system and voltage on nameplates.

- .2 Colour code conduits, boxes and metallic sheathed cables.
- .1 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .2 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

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

- .3 Identify wiring with permanent indelible identifying markings, using numbered plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .4 Maintain phase sequence and colour coding throughout.
- .5 Colour coding: to CSA C22.1.
- .6 Use colour coded wires in communication cables.
- .7 Update typewritten card inside modified panels and add the new panels identifying power circuits.
- .8 Identify power outlets with a self-adhesive plastic label indicating the panel number and power circuit. Labels must be white with black lettering.
- .9 For identification inside junction boxes, paint entire edge of junction boxes as per colour code, but not the cover. Using a thick indelible marker, identify the source (panel) and circuit numbers on the cover for all wiring penetrating junction and pull boxes when located in an unfinished or ceiling space.

3. EXECUTION**3.1 Examination**

- .1 Verification of conditions: verify that conditions of substrate previously under other sections or contracts are acceptable for installation in accordance with manufacturer's written.
 - .1 Visually inspect substrate in presence of Department Representative.
 - .2 Inform Department Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department Representative.

3.2 Installation

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.
- .3 All free-standing electrical equipment must be installed on housekeeping pads 100 mm high and dimensions as per equipment.

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 Field Quality Control

- .1 Conduct following tests in accordance with Section 01 45 00 – Quality Control.
 - .1 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.
- .2 Carry out tests in presence of the Departmental Representative.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of work.
- .4 Manufacturer's field services. Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of product.
- .1 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.

3.5 Cleaning

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian Standards Association (CSA International)
- .2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)
 - .1 ICEA S-94-649/NEMA WCWG-02, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.
 - .2 ICEA S-93-639 5-46 Shielded Power Cable for Use in the Transmission and Distribution.
 - .3 IEEE 400.2 Guide for Field Testing of Shielded Power Cable Using VLF.

1.2 Related Sections

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.3 Submittals

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Provide two (2) 800-mm sections of cable for approval.

2. PRODUCTS

2.1 Concentric Neutral Power Cable 28 kV

- .1 Concentric neutral single conductor power cable, 33% conductivity, UD type, 28 kV heat shrunk polyethylene, TRXLPE, 100% insulation level, with minimum 7 mm thick exterior jacket, minimum allowable temperature of -40°C, as per CSA C68.3-M1992. Overall diameter not to exceed 35 mm.
- .2 Compact stranded conductor made of annealed copper, untinned, size as per drawings.
- .3 Strand Fill Blocked Conductor, tested to ICEA T-31-610.
 - .1 Free space to be filled during cable manufacturing process.
- .4 Maximum admissible conductor temperature:
 - .1 Normal service: 90°C.
 - .2 Emergency service: 130°C.
 - .3 Short circuit: 250°C.
- .5 Extruded chemically thermosetting polyethylene jacket insulation.

2.2 Cable 5 kV

- .1 Power cable, single conductor, insulation polyethylene XLP, with jacket of PVC.
- .2 Compact stranded conductor made of annealed copper, untinned, size as per drawings.
- .3 Maximum admissible conductor temperature:
 - .1 Normal service: 90°C.

2.3 28-kV and 5 kV Splices

- .1 Splices shall be in compliance with standard IEEE-404.
- .2 Splices shall be non-detachable type, submersible and compatible with cable characteristics.

- .3 Submit shop drawings and installation instructions to the Departmental Representative.

2.4 Cable Ends

- .1 Elbow connectors, according to the IEEE 386-2001.
- .2 2-hole connection lugs and cable ends.

3. EXECUTION

3.1 Installation

- .1 Install primary cables in ducts in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and Ducts.
- .2 It is forbidden to pull cables with a splice within the conduits.
- .3 To reduce pulling tension, use CSA approved lubricants that are compatible with the cable's outside jacket.
- .4 Provide a drawing illustrating 28-kV cable pulling sealed by an engineer in the province of Quebec for approval.
- .5 Before pulling cables within conduits, and until they have been permanently connected, seal 28-kV cable ends using a waterproof sealant.
- .6 Once cables have been installed, seal conduit ends with a product designed for conduit sealing.

3.2 Testing

- .1 Perform tests in accordance with the requirements of section 26 05 00 – Common Work Results for Electrical.
- .2 28-kV cable testing:
 - .1 Testing must be performed in the presence of the Departmental Representative.

- .2 Provide equipment and instruments necessary to ensure that:
 - .1 The circuits are continuous and free of short circuits (value in Ω).
 - .2 The circuits are connected according to wiring diagrams.
 - .3 The circuits fulfill their anticipated functions, in both desired manner and order.
 - .4 The ground resistance of cables alone is measured using a 28-kV megaohmmeter for 120 seconds to ensure that resistance is at least 500 M Ω at 25 000 V.
 - .5 That each circuit is able to withstand:
 - .1 At least ten (10) power-on procedures followed by operation at each intensity level (5).
 - .2 A power-on procedure followed by operation at full load, for at least eight (8) continuous hours.
- .3 Perform tests in DC (VLF) at 80 kV for a duration of five (5) minutes.
- .4 Testing must be performed by an independent testing laboratory such as GE (Bussi res & Fr chette) or Siemens/Westinghouse or equivalent, as per AEIC-CS5-87.
- .5 Provide to the Departmental Representative a test results list indicating the location of each test point, circuit tested, and results of each test.
- .3 5 kV cable testing:
 - .1 Use test process as specification IEEE 400.2.

END OF SECTION

1. GENERAL**1.1 Section Contents**

- .1 Materials and installation for wire and box connectors.

1.2 Related Sections

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.
- .7 Section 26 05 21 – Wires and Cables (0-1000 V).

1.3 References

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65-93(R1999), Wire Connectors.
- .2 National Electrical Manufacturers Association (NEMA).

2. PRODUCTS**2.1 Equipment**

- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper or aluminum conductors as required.
- .2 Clamps or connectors for armoured cables and flexible conduits as required to: CAN/CSA-C22.2 No.18.

- .3 Fixture type splicing connectors to: CAN/CSA C22.2 No. 65 with current carrying parts of copper alloy S12B6 to fit copper conductors 10 AWG or less.

3. EXECUTION

3.1 Installation

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No. 65. Replace insulating cap.

END OF SECTION

1. GENERAL**1.1 Product Data**

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

1.2 Related Sections

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.
- .7 Section 26 05 20 – Wire and Box Connectors 0-1000 V.
- .8 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

2. PRODUCTS**2.1 Building Wiring**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE for indoor use and RWU90 XLPE for underground use or exterior use.
- .3 Branch circuit wiring power supply cables for receptacles, lighting fixtures, or by direct connection must be minimum 12 AWG.

2.2 Armoured Cables

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type AC90 cables.

- .3 Armour: aluminum strip.
- .4 Cable type: ACWU90 PVC jacket over thermoplastic armour and compliant to applicable Building Code classification for this project in wet locations.
- .5 Connectors: anti short connectors.

2.3 Control Cables

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated.
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Low energy control cables: 300 V, soft annealed copper conductors, stranded and shielded in pairs with polypropylene jacket. Number of pairs and conductors sized as indicated on drawings.
 - .1 Grounding conductor: stranded for each pair and unique colour for each insulator.
 - .2 Overall covering: FT4 thermoplastic.

3. EXECUTION

3.1 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 the Departmental Representative and local authority having jurisdiction.
- .3 Perform tests before energizing electrical system.

3.2 General Cable Installation

- .1 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors (0–1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.

- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Concealed wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend.
- .8 Install a green bonding conductor in each rated conduit as defined by the requirements of the *Code de l'électricité du Québec*, table 16.

3.3 Installation of Building Wires

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings;
 - .2 In underground raceways in accordance with Section 33 65 76.

3.4 Installation of Armoured Cables

- .1 Group cables wherever possible on channels.
- .2 To be installed in wall runs for outlet connections only. Maximum length 1 500 mm.
- .3 To be installed in ceilings for lighting fixtures only. Maximum length 1 500 mm.

3.5 Installation of Control Cables

- .1 Install control cables in conduits.
- .2 Ground control cable shield.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 26 05 14 – Power Cable and Overhead Conductor.

1.2 References

- .1 CSA Group
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

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 connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from inspection authority and include it with as-built drawings.

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 connectors and terminations for incorporation into manual.

2. PRODUCTS**2.1 Connectors and Terminations**

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Terminations for cables 28 kV and 5 kV.

3. EXECUTION**3.1 Installation**

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

END OF SECTION

1. GENERAL**1.1 References**

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
- .1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.2 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

2. PRODUCTS**2.1 Materials**

- .1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- .2 Conductors: bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, ground connections.
- .3 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat.
- .4 Bolted removable test links.

- .5 Gradient control mat: galvanized steel, size 1828 mm x 1219 mm.
- .6 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .7 Wire connectors and terminations: as indicated.

3. EXECUTION

3.1 Installation

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Install connectors and cadweld in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors during and after construction.
- .4 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.
- .7 Use tinned copper conductors for aluminum structures.

3.2 Electrode Installation

- .1 Install ground rod electrodes. Make grounding connections to station equipment.
- .2 Install ground rod electrodes at transformer and switchgear locations.
- .3 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 Equipment Grounding

- .1 Install grounding connections as indicated to typical station equipment including: metallic water main, neutral, gradient control mats. Non current carrying parts of: current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, potential transformers. Meter and relay cases.

3.4 Pole Mounted Switching Device Grounding

- .1 Drive four ground rods 3 m long at base of each pole on which group-operated line switching devices are mounted.
- .2 Arrange rods in square formation with 3 m sides, located so that operator must stand within square to operate switch.
- .3 Interconnect ground rods with No. 2/0 AWG stranded annealed copper conductor and join to switch operating handle ground wires.
- .4 Connect operating handle of switch to handle base with No. 3/0 AWG extra flexible copper conductor.

3.5 Pole Mounted Transformer Grounding

- .1 Drive ground rods at base of each pole on which transformers are mounted and interconnect transformer, lightning arresters and ground rods.

3.6 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.
- .5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

END OF SECTION

1. GENERAL**1.1 Related Sections**

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.2 References

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association (CSA International).

2. PRODUCTS**2.1 Equipment**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Insulated grounding conductors: green, type RW90 for indoor use or RWU90 for exterior use.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastening and connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.

- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

3. EXECUTION

3.1 Installation – General

- .1 Install complete permanent, continuous grounding system including, ground bus, conductors, connectors, accessories. Where EMT or flexible conduits are used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from damage.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Ground secondary service pedestals.

3.2 Equipment Grounding

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, switchgear, duct systems, distribution panels and lighting.

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 the Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

2. PRODUCTS**2.1 Support Channels**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.
- .2 Rod, bolts, washers, spring nuts, and all accessories.

3. EXECUTION**3.1 Installation**

- .1 Secure equipment to 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 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole 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.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.

- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

1. GENERAL**1.1 References**

- .1 National Building Code 2010 (NBC).
- .2 User's Guide – Structural Commentaries on the National Building Code 2010 (Part 4).
- .3 SMACNA – Seismic Restraint Manual Guideline for Mechanical Systems.

1.2 Related Sections

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) Forms.
- .4 Section 01 91 41 – Commissioning (Cx): Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Identify specified elements on the manufacturer's documentation:
 - .1 Anchoring.
 - .2 Supports.
 - .3 Bracing.
 - .4 Seismic protection.
- .3 Produce a drawing indicating types of seismic protection devices and their location.

- .4 Submit shop drawings and calculations for seismic restraint systems for approval. These documents must be stamped by a member of the *Ordre des ingénieurs du Québec*.
- .5 Upon completion of work the Contractor must submit a signed and stamped certificate from Departmental Representative confirming that the work has been carried out in accordance with standards in effect.
- .6 Provide separate shop drawings for each system, shop drawings of the overall system, complete with performance and product data.
- .7 Provide separate shop drawings and performance data for each seismic restraint system and devices used for equipment.
- .8 The Contractor must hire an experienced manufacturer to design, supply and supervise installation of all seismic control measures.
- .9 All manufacturers of seismic control measures are responsible for designing, supplying and supervising installation of seismic control measures. The manufacturer remains responsible for the structural integrity of seismic control measures.
- .10 The manufacturer shall hire a professional engineer specializing in seismic design to perform design calculations and develop seismic control measure installations.

1.4 Seismic Control Measures

- .1 Seismic restraints must meet the requirements in the standards and guides listed in section 1.2.
- .2 Design, supply and install a complete seismic restraint system for electrical equipment, both vibration isolated and statically supported against vibrations and related systems.
- .3 The seismic restraint system is to be fully integrated, and compatible with noise and vibration controls of electrical equipment and related systems as specified on the drawings and elsewhere.
- .4 The seismic restraint system is to be fully compatible with the mechanical, electrical and structural design of the building.

1.5 Seismic Supports – Scope of Work

- .1 The Contractor must, without being limited to, supply and install all materials necessary to seismically restrain electrical equipment.
- .2 The Contractor shall supply and install two (2) suspension cables (without obligatory lateral crossbracing) able to resist seismic loads for the following equipment:
 - .1 Recessed, inversed T lighting fixtures or another type of suspended ceiling.
 - .2 Lighting fixtures (less than 10 kg) suspended more than 50 mm above the fixture up to the structural support.
 - .3 Any other equipment that is recessed and inversed T equipment or any other type of suspended ceiling.
 - .4 Any other equipment that is suspended more than 305 mm above the fixture up to the structural support.
- .3 The Contractor shall supply and install seismic restraints for the following equipment:
 - .1 Freestanding electrical equipment such as:
 - .1 Electrical sub-station.
 - .2 Switchgear centres.
 - .3 Transformers.
 - .2 Suspended electrical equipment (with mandatory lateral bracing) such as:
 - .1 Lighting fixtures (10 kg and heavier) suspended more than 305 mm from the structure.
 - .2 Transformers.
 - .3 Emergency power conduits suspended more than 305 mm from the structure.
 - .4 Electrical conduits 100 mm and larger.

- .5 Cabletrays.
- .6 Shielded bus ducts.
- .3 Electrical equipment secured to wall consoles such as:
 - .1 Transformers.
 - .2 Back-up batteries.

2. PRODUCTS

2.1 General

- .1 The dimensions and shape of pads, as well as performance characteristics on vibration isolation devices must be in accordance with indications.
- .2 The seismic restraint systems must be able to sustain forces in all directions.
- .3 Fasteners and attachments to structure must be able to resist the same loads as the seismic restraint materials.
- .4 High resistance chemical anchoring must be used to fasten seismic protection holes to the concrete structure. Drilled or power driven anchors and fasteners are not permitted.
- .5 Unless otherwise indicated, the seismic control measures must be designed and chosen to meet the requirements of the latest edition of the National Building Code 2010 and its supplement:
 - .1 Seismic zone:
 - .1 Sept-Îles: $Z_a = 4$, $Z_v = 2$, $v = 0.10$.
 - .2 Seismic importance factor:
 - .1 With regard to this work, the seismic importance factor (I) will be equal to 1.5.
 - .3 The other coefficients (C_p , A_r , A_x) will be taken from the Code and its supplement.
- .6 The seismic restraint system shall prevent the mechanical and electrical systems and equipment and related systems from causing personal injury

and moving from their normal position during a seismic event. The anchored equipment must remain in operation as if in normal conditions during a seismic event.

- .7 The manufacturer of the seismic restraint systems must obtain all information relating to the equipment and electrical conduits necessary for seismic restraint system design calculations (weight, number, thermal insulation, run, spacing between supports, and grouping on supports).
- .8 The manufacturer of the seismic restraint systems must obtain the information listed below from the equipment manufacturers:
 - .1 Weight, location of centre of gravity, number of fastening points, location of fastening points' centre of gravity, rotation speed, seismic sensitivity of internal components and so on.
- .9 The design calculations and installation details with regard to anchoring bolts and seismic restraint systems must be verified by a professional engineer specializing in seismic design.
- .10 Provide seismic restraint systems shop drawings and calculations.
 - .1 Provide for each piece of equipment:
 - .1 Identification.
 - .2 Manufacturer's name and model.
 - .3 Physical dimensions.
 - .4 Weight.
 - .5 Location of centre of gravity (indicate if location was obtained by equipment manufacturer or speculated).
 - .6 Location and number of fastening points.
 - .7 Location of fastening points' centre of gravity (if centre of gravity is different than the equipment's centre of gravity).
 - .8 Rotation speed (if necessary).
 - .9 Seismic sensitivity of equipment's internal components.

- .2 Anchoring bolt calculations indicating:
 - .1 Type of bolts, manufacturer and model.
 - .2 Diameter.
 - .3 Embedment in concrete.
 - .4 Concrete compression force.
 - .5 Minimum spacing between bolts and concrete edges or joints.
 - .6 Applied and allowable loads in shear and tension.
- .3 Types of seismic restraint systems for each piece of equipment and indicate characteristics of cables and rigid members.
- .11 The seismic restraint systems manufacturer must provide written proof confirming that the drawings, specifications, shop drawings, as well as the installation, were verified by a professional engineer specializing in seismic design and are adequate and compatible with the overall building and meet seismic standards.
- .12 All seismic control measures must be entirely integrated and compatible with sound attenuating standards, vibration isolation systems for electrical equipment and related systems, as specified on drawings and elsewhere.
- .13 All seismic control measures must be compatible with the electrical and structural design of the building. Seismic control measures must not impede on the normal functioning of electrical systems.
- .14 Do not add seismic control measures to existing electrical conduit supports without verifying the capacity of these supports to resist any additional forces.
- .15 Seismic restraint measures must not interfere with functioning or integrity of firestopping equipment.
- .16 When required to prevent buckling, stiffeners must be added to suspension rods.

2.2 Fasteners and Equipment Supports

- .1 Expansion anchors to be recessed in order to secure equipment to the surfaces of poured concrete.

- .2 Toggle bolts to secure equipment to hollow masonry walls or suspended ceilings.
- .3 Protection against mechanical damage of all instruments, ducts, etc., that are prone to breakage.
- .4 Components of the seismic restraint systems are to be manufactured in accordance with the following standards:
 - .1 Cold formed angles must be in accordance with standards CSA S136-M89 and CSA S136.1-M91 for a minimum F_y equal to 230 MPa and a maximum F_y equal to 260 MPa. The following thicknesses must be respected.

Gauge	Minimum Thickness before Painting (mm)	Minimum Thickness after Galvanisation (mm)
12	2.66	2.75
14	1.90	1.99
16	1.52	1.61

- .2 Steel structural members: standard channels and plates must be in accordance with standard CSA G40.21, latest edition, grade 350W.
- .3 Steel tubing used as bracing must be in accordance with standard ASTM A53.
- .4 Bolts for assembly must be in accordance with standard ASTM A325. Anticipate an opening 2 mm larger than bolt diameter.
- .5 Provide technical data sheets and resistance of bolts to be secured to concrete.
- .6 Welding must be in accordance with standard CSA W59, latest edition and carried out by experienced welders according to standard CSA W47.1, latest edition.
- .7 Oblong openings for adjusting bolts are not permitted.

2.3 Conduits and Cable Fasteners and Supports

- .1 Flanges to fasten exposed cables or conduits to the building structure or support system.

- .1 One-hole malleable iron or steel flanges for surface fastening of conduits and cables 50 mm diameter or less.
- .2 Two-hole steel flanges to fasten conduits and cables of more than 50 mm diameter.
- .3 Steel frames to fasten conduits to exposed structural steel work.
- .2 Suspended support systems:
 - .1 Support each cable or conduit with threaded rods and spring clips.
 - .2 Support at least two (2) cables or conduits on suspended U channels to threaded suspended rods, when impractical to fasten them to the building structure.
 - .3 Surface-mounted supports to stabilize two (2) or more conduits to the U channels. Use surface-mounted or suspended U channel supports of 41 mm x 41 mm x 2.5 mm thick. Acceptable products: Burndy, Unistrut or Canstrut.
 - .4 Provide metallic brackets, mounting, hooks, clamps and other types of supports in locations indicated or as needed to support the conduits and cables.
 - .5 Do not use tie wires or perforated iron hangers to support or fasten conduits or cables.
 - .6 Ensure adequate support for equipment with vertical-installed conduits when there is no wall support.
 - .7 Do not use other trades' supports or installed equipment as conduit supports, unless otherwise permitted by other trades and with the Departmental Representative's approval.
 - .8 Use of Ramset nails is not permitted.

2.4 Seismic Restraint Systems for Static Equipment (without need for vibration isolated equipment)

- .1 Floor-mounted equipment:

- .1 Anchor equipment to supports, which must be anchored to structure by using bolt sizes as indicated on shop drawings.
- .2 Suspended equipment:
 - .1 Use one or a combination of the following methods as per site conditions:
 - .1 Anchor equipment tightly to structure.
 - .2 Cross-brace equipment in all directions.
 - .3 Brace back to structure.
 - .4 Anchor equipment with slack cables.
 - .2 Seismic restraint system to allow for cushioning action to be gentle and steady by utilizing elastomeric material or other means to avoid high impact loads.
- .3 Supports must be able to resist all static and dynamic conditions, including the following:
 - .1 Their weight, plus accessories, insulation and internal fluids.
 - .2 Forces imposed by thermal effect of expansion and contraction.
 - .3 Reactions as a result of start-ups and stops.
 - .4 Vibrations.
 - .5 Other occasional loads such as ice, wind and seismic forces.

2.5 Seismic Restraint Systems for Vibration Isolated Equipment with Springs

- .1 Floor-mounted equipment:
 - .1 Apply one or more of the following methods according to the site conditions:
 - .1 Use vibration isolation devices with integrated shock absorbing system.

- .2 Use independent shock absorbers in addition to the vibration isolation devices.
- .3 Use a manufactured shock absorbing system composed of structural elements and an elastomeric layer, with the Departmental Representative's approval.
- .4 Reinforce equipment in all directions.
- .2 Seismic restraint system must not hinder performance of sound attenuating and vibration isolation systems. Anticipate a clearance of 4 mm to 8 mm—under normal operating conditions of equipment and systems—between the seismic restraint system's shock absorbers and equipment.
- .3 Incorporate seismic restraints into vibration isolation systems to resist complete isolator unloading.
- .4 Cushioning action, by utilizing elastomeric material or other means, must be gentle and steady to avoid high impact loads.
- .2 Suspended equipment:
 - .1 Use one or a combination of the following methods as per site conditions:
 - .1 Anchor equipment with slack cables.
 - .2 Reinforce equipment fastening points to the structure via vibration isolation devices with integrated shock absorbers or additional independent shock absorbers.
 - .3 Supports must be able to resist all static and dynamic conditions, including the following:
 - .1 Their weight, plus accessories, insulation and internal fluids.
 - .2 Forces imposed by thermal effect of expansion and contraction.
 - .3 Reaction as a result of start-ups and stops.
 - .4 Vibrations.
 - .5 Other occasional loads such as ice, wind and seismic forces.

- .4 Seismic restraint system must provide gentle and steady cushioning action to avoid high impact loads.

3. EXECUTION

3.1 Installation

- .1 Install vibration isolation equipment in accordance with the manufacturer's instructions and adjust mountings to level equipment.
- .2 Ensure conduit and cable connections to vibration isolation equipment and instruments do not reduce vibration isolation system flexibility and that conduits and cables passing through walls or floors do not transmit vibrations.
- .3 When vibration isolation equipment is bolted to floor, use vibration isolation rubber washers.
- .4 Block and shim level bases so that conduits and cables can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no contact between the isolated equipment and building structure.
- .5 All fastening and attachment points to resist same maximum load as seismic restraint in accordance with the most recent edition of the National Building Code 2010 and its supplement.
- .6 Connect cable protection devices to suspended equipment so that axial projection of wires passes through centre of gravity of equipment.
- .7 Install cables using grommets, assembly lugs and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
- .8 Orient restraint cables on ceiling-hung equipment at approximately 90° to each other (on drawing), tie back to structure at maximum 45° to structure.
- .9 Clearance of at least 25 mm is to be anticipated between seismic restraint equipment and any other equipment or service element.
- .10 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
- .11 Bolt all equipment that is not isolated to the structure.

- .12 Install fasteners and supports according to each type of equipment, conduit or cable, while following the manufacturer's guidelines.
- .13 Brace all conduits and cables as follows:
 - .1 All conduits and cables 32 mm and larger nominal diameter in corridors, boiler rooms, mechanical, electrical and telecommunication rooms and generator set rooms.
 - .2 All conduits and cables 64 mm and larger nominal diameter.
 - .3 However, the conduits or cables fastened by a suspension rod 300 mm long and smaller do not require bracing. The rod length is taken above the conduit or cable up to the structural fastener.
- .14 Use a flexible joint when conduits pass through a building expansion joint, or when conduits are securely fastened to equipment resting on vibration isolation systems.
- .15 Rigid conduits and cables must not be cross-braced to another cross-brace system within the same building because the systems will react differently during an earthquake.
- .16 Riser pipes must be laterally supported at each floor.
- .17 Conduit supports must be equipped with longitudinal and transverse cross-bracing. They may be rigid or cable supports. Always use identical crossbeams within the same bracing (never use a rigid crossbeam with a cable).

END OF SECTION

1. GENERAL**1.1 References**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

1.2 Related Sections

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.3 Submittals

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data
 - .1 Provide manufacturer's printed product literature, specifications and datasheets 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 Provide drawings stamped and signed by professional engineer registered or licensed in Quebec.

1.4 Delivery, Storage and Handling

- .1 Waste management and disposal
 - .1 Separate waste materials for reuse and recycling.

2. PRODUCTS**2.1 Junction and Pull Boxes**

- .1 Construction: welded steel enclosure.
- .2 Covers flush mounted: 25 mm minimum extension all around.
- .3 Covers surface mounted: screw-on flat.

3. EXECUTION**3.1 Junction, Pull Box and Cabinet Installation**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.
- .4 Install access panels when boxes are inaccessible.

3.2 Identification

- .1 Equipment Identification: to Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

1. GENERAL**1.1 Related Sections**

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.
- .7 Section 26 05 21 – Wire and Cables (0-1000 V).

1.2 References

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada.

1.3 Submittals

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

- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality Assurance
 - .1 Test reports: submit certified test reports by recognized independent laboratories.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

2. PRODUCTS

2.1 Cables and Reels

- .1 Provide cables on reels.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.

2.2 Conduits

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid tight.
- .5 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.
- .6 Minimum diameter: 21 mm.

2.3 Conduit Fastenings

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.
- .5 Maximum spacing of conduit supports:
 - .1 All rigid metal conduits of the same size shall be securely attached to hangers or to a solid surface with the maximum spacing of the points of support not greater than:
 - .1 1.5 m for 21 mm conduits.
 - .2 2 m for 27 mm and 35 mm conduits.
 - .3 3 m for 41 mm and greater conduits.
 - .2 Where rigid metal conduits of mixed sizes are run in a group, the conduit supports should be so arranged that the maximum support spacing will be that shown in subrule (1) for the smallest conduit.
 - .3 When flexible metal conduit is installed, it shall be secured at intervals not exceeding 1.5 m and within 300 mm on each side of every outlet box or fitting except where flexible metal conduit is fished and except for lengths of not over 900 mm at terminals where flexibility is necessary.

2.4 Conduit Fittings

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

.3 Watertight connectors and couplings for EMT.

.1 Set-screws are not acceptable.

2.5 Expansion Fittings for Rigid Conduits

.1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

2.6 Fish Cord

.1 Polypropylene.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 General

.1 When conduits are illustrated on drawings, they are represented in schematic form only. Install conduits to conserve headroom in exposed locations. Before beginning work, verify location of all conduits with Department Representative.

.2 Daisy chain connections are not permitted.

.3 Parallel running conduit runs must be the same length.

.4 Take necessary measures for cutting holes and making openings and other structural works necessary for the installation of electrical conduits, cables, fish cords, pull boxes and outlet boxes.

.5 Openings made in concrete beams, walls and floors must be approved by the Department Representative.

3.3 Installation

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use electrical metallic tubing (EMT) except in cast concrete and when conduits are located more than 2.4 m above ground and not subject to mechanical damage.
- .4 Use rigid PVC conduit underground.
- .5 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Use explosion-proof flexible connection for connection to explosion-proof motors.
- .8 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .9 Minimum conduit size for all applications: 19 mm.
- .10 Bend conduit cold.
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 19 mm diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.

- .14 Run two (2) 50 mm spare conduits up to ceiling space and two (2) 50 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .15 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

3.4 Surface Conduits

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.5 Concealed Conduits

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.6 Conduits in Cast-in-Place Concrete

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.

- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize crossovers.

3.7 Underground Conduits

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL**1.1 Related Sections**

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.2 References

- .1 Canadian Standards Association (CSA International).
- .2 Insulated Cable Engineers Association, Inc. (ICEA).

2. PRODUCTS

- .1 Not used.

3. EXECUTION**3.1 Cable Installation in Ducts**

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multiconductor control cables, reel off in same direction during installation.

- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.2 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests
 - .1 After installing cable and terminating, perform insulation resistance test with 1000 V megger on each phase conductor for 600 V cables.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .7 Provide the DCC Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1. GENERAL**1.1 Section Includes**

- .1 Materials, components, cabinets, instruments and installation for metering and switchboard Instruments.

1.2 Related Sections

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3 Section 01 91 31 – Commissioning (Cx) Plan.
- .4 Section 01 91 33 – Commissioning (Cx) – Forms.
- .5 Section 01 91 41 – Commissioning (Cx) – Training.
- .6 Section 01 91 51 – Building Management Manual (BMM).
- .7 Section 26 05 00 – Common Work Results – Electrical.
- .8 Section 26 23 00 – Low Voltage Switchgear.

1.3 References

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C39.1-[1981], Requirements, Electrical Analog Indicating Instruments.
- .2 Canadian Standards Association, (CSA International)
 - .1 CAN3-C17-[M84(R1999)], Alternating - Current Electricity Metering.

1.4 Product Data

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

- .2 Indicate meter, instrument, outline dimensions, panel drilling dimensions and include cut-out template.

2. PRODUCTS

2.1 Meter

- .1 Three-phase digital energy meter: in compliance with CAN3-C17 and capable of resisting overvoltage and transition testing in accordance with ANSI/IEEE C37-90A.
- .2 Combination energy and demand meter: to CAN3-C17.
- .3 Accuracy: 0.2%.
- .4 Ratings: as indicated.
- .5 Register: instrument transformer operated, range as indicated, pulse contacts for transmitting signal.
- .6 Provision for remote sensing.
- .7 Equipped with RS-232C and RS-485 communication port.
- .8 Equipped with Ethernet 100BaseT communication port.
- .9 Provide software and licence for interfacing with the base's main system.

2.2 Instrument Transformer

- .1 Potential and current transformers.

2.3 Terminal Block Test

- .1 Test terminal blocks: as required.

2.4 Display and Recording Instruments

- .1 Recording instruments: 1% accuracy switchboard mounting :
 - .1 Ammeter: 0-3000 A.

- .2 Voltmeter: 0-600 V.
- .3 Wattmeter: 0-2000 kW.
- .4 Varmeter: 0-2000 kW.
- .5 Frequency meter: 0-60 Hz.
- .6 Power factor meter: -100 to +100.
- .7 Pulsed output for 15-minute integration period.
- .8 Analog 4-20 mA output provides instantaneous power (kW).
- .9 Output pulse provide power used (kWh).

2.5 Shop Installation

- .1 Install meters and instrument transformers in separate compartment of switchboard.
- .2 Ensure adequate spacing between current transformers installed on each phase.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, and electrical supplies.

2.6 Acceptable Product

- .1 Model 7650 from Power Measurement Ltd ION from Schneider or equivalent Cutler-Hammer, QMC Metering Solution, Veris Industries.

3. EXECUTION**3.1 Field Quality Control**

- .1 Conduct tests in accordance with Section 26 05 00 – Common Work Results – Electrical and in accordance with manufacturer's recommendations.
- .2 Assist mechanic division to put in service the demand peak control system.
- .3 The manufacturer's presence is required during system start-up.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 26 13 18 – Primary Switchgear Assembly 25 kV.
- .2 Section 26 23 00 – Low Voltage Switchgear.

1.2 References

- .1 CSA International
 - .1 CSA C9-02(R2007), Dry-Type Transformers.
 - .2 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC GL1-3-1988, Transformer and Reactor Bushings.
- .3 National Electrical Manufacturers Association (NEMA)
- .4 CSA International
 - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

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 transformers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.

- .2 Indicate on drawings:
 - .1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.
 - .2 Technical data:
 - .1 kVA rating.
 - .2 Primary and secondary voltages.
 - .3 Frequency.
 - .4 Three phase.
 - .5 Polarity or angular displacement.
 - .6 Full load efficiency.
 - .7 Regulation at unity pf.
 - .8 BIL.
 - .9 Insulation type.
 - .10 Sound rating.
 - .11 Impedance.
 - .12 Output cabling.
- .4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.

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 dry type transformers for incorporation into manual.
- .3 Operation and maintenance instructions to include:
 - .1 Tap changing.

- .2 Recommended environmental conditions.
- .3 Recommended periodic inspection and maintenance.
- .4 Bushing replacement.
- .5 Temperature supervising relay.

1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 Extra Materials

- .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide replacement parts list.
- .3 Provide the following replacement parts: two (2) control fuses.

2. PRODUCTS**2.1 Materials**

- .1 Dry-type transformers: to CSA C9.
- .2 Bushings: to EEMAC GL1-3.

2.2 Transformer 1

- .1 Transformer 1 Characteristics
 - .1 Type: ANN / ANF.
 - .2 Rating: 1500/2000 kVA, 3 phases, fan forced air cooling, 60 Hz.
 - .3 220 insulation system class, 80 degrees C temperature rise, class H.
 - .4 Impedance: 5-6 %.
 - .5 Primary winding: 24,940 V, delta, BIL 125 kV.
 - .6 Secondary winding: 347/600 V, star, BIL 10 kV, four wire with neutral brought out and effectively grounded.
 - .7 Full load and no load losses not to exceed Hydro-Québec specifications.
 - .8 No load and full load losses to exceed those indicated in CAN/CSA-C802.2.
- .2 Enclosure
 - .1 Fabricated from sheet steel with drip shield.
 - .2 Bolted hinged removable panels for access to tap connections, enclosed terminals and fans.
 - .3 Conductor entry:
 - .1 Knockouts.
 - .2 Potheads.
 - .3 Junction boxes.
 - .4 Bushings.
 - .5 Clamping rings.
 - .6 Entry for busbars on primary side. Coordinate this busbar with supplier of load-break switch

- .7 Output for busbars. Coordinate these busbars with supplier of low voltage switchgear.
- .4 Designed for floor mounting.
- .5 Indoor, ventilated, self and forced air cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.
- .6 Secondary winding: 347/600 V, star, BIL 10 kV, four wire with neutral brought out and effectively grounded.
- .7 Ground lug.
- .3 Voltage Taps
 - .1 Standard 4 taps, at 2.5% intervals below and over nominal.
- .4 Tap Changer
 - .1 Bolted-link type.
- .5 Windings
 - .1 Primary and secondary coils:
 - .1 Copper.
 - .2 Vacuum cast epoxy.
 - .2 Coil and core assembly:
 - .1 Taps located at front of coils for accessibility.
 - .3 Sound level: not to exceed 71 dB.
 - .4 Accessories
 - .1 Winding temperature sensors.
 - .2 Electronic temperature monitoring (fan start, alarm, breaker actuation) and temperature indication.

- .3 As per technical data sheet, air natural convection cooling (ANN) plus forced air cooling (AFN) with selector for the fans' manual or automatic start to be directly enabled from the transformer with overcurrent protection and voltage transformers suitable to type of motor used with fans.
- .4 Anti-vibration cushions will be secured to the transformer core to reduce vibrations through the floor and enclosure.
- .5 Primary terminals to be connected to 24.94 kV buses using flexible joints. Secondary terminals to be connected to low voltage buses using flexible joints.
- .6 Ground bus.
- .7 Lifting eyes.
- .8 Four (4) all-directional seismic snubbers, composed of a neoprene cushion, adjustment bolt and anchor plate, capacity according to load, from Mason Industries or approved equivalent.
- .9 RTD sensor fan controller, one per phase, with digital display and keypad providing access to control menu:
 - .1 Accepts three (3) RTD sensors, three-wire input, with bonding conductor compensation.
 - .2 Temperature and set point display.
 - .3 Password to protect against modification of set points without authorization.
 - .4 Highest temperature recall for each sensor.
 - .5 Fan control outputs.
 - .6 Alarm circuit output.
 - .7 Local audible alarm.
 - .8 Adjustable set points from 0 to 250°C as follows:
 - .1 130°C for forced air cooling.

- .2 200°C to indicate excessive temperature, connected to the building monitoring system.
- .3 215°C to indicate an unacceptable temperature, connected to the building monitoring system.
- .9 Alarm point for defective sensor.
- .10 Manual fan control.
- .11 Weekly fan exerciser.
- .12 Nonvolatile memory to back up set points during a power failure.
- .13 Plug-in type.
- .14 Compact and robust housing.
- .15 Weatherproof enclosure.
- .16 Qualitrol model, series 505.
- .10 All transformer controls will be within a locked and hinged enclosure that is accessible from outside the transformer enclosure. All connections must be directly accessible from the outside without having to open the transformer enclosure.
- .6 Equipment Identification
 - .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
 - .2 Equipment labels: nameplate size 7.

2.3 Transformer 2

- .1 Transformer 2 Characteristics
 - .1 Type: ANN.
 - .2 Rating: 150 kVA, 3 phases, 60 Hz.

- .3 220 insulation system class, 150 degrees C temperature rise, class H.
- .4 Impedance: 5-6 %.
- .5 Primary winding: 4160 V, BIL 60 kV.
- .6 Secondary winding: 600-347 V, star, BIL 10 kV, four wire with neutral brought out and grounded.
- .7 Full load and no load losses not to exceed Hydro-Québec specifications.
- .8 No load and full load losses to exceed those indicated in CAN/CSA-C802.2.
- .2 Enclosure
 - .1 Fabricated from sheet steel with drip shield.
 - .2 Bolted removable panels for access to tap connections, enclosed terminals.
 - .3 Conductor entry:
 - .1 Knockouts.
 - .2 Potheads.
 - .3 Junction boxes.
 - .4 Bushings.
 - .5 Clamping rings.
 - .6 Entry for cable.
 - .4 Designed for floor.
- .3 Voltage Taps
 - .1 4 taps, at 2.5% intervals below and higher nominal.

- .4 Tap Changer
 - .1 Bolted-link type.
- .5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.
- .6 Ground lug.
- .7 Windings
 - .1 Primary and secondary coils:
 - .1 Copper.
 - .2 Vacuum cast epoxy.
 - .2 Coil and core assembly:
 - .1 Taps located at front of coils for accessibility.
 - .3 Sound level: not to exceed 71 dB.

2.4 Transformer 3

- .1 Transformer 3 Characteristics
 - .1 Type: ANN.
 - .2 Rating: 750 kVA, 3 phases, 60 Hz.
 - .3 220 insulation system class, 80 degrees C temperature rise, class H.
 - .4 Impedance: 5-6 %.
 - .5 Primary winding: 4160/2400 V, delta, BIL 60 kV.
 - .6 Secondary winding: 600-347 V, star, BIL 10 kV, four wire with neutral brought out and effectively grounded.
 - .7 Full load and no load losses not to exceed Hydro-Québec specifications.

- .8 No load and full load losses to exceed those indicated in CAN/CSA-C802.2.
- .2 Enclosure
 - .1 Fabricated from sheet steel.
 - .2 Bolted removable panels for access to tap connections, enclosed terminals.
 - .3 Conductor entry:
 - .1 Knockouts.
 - .2 Potheads.
 - .3 Junction boxes.
 - .4 Bushings.
 - .5 Clamping rings.
 - .6 Entry for cable.
 - .4 Designed for floor.
 - .5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.
- .3 Voltage Taps
 - .1 4 taps, at 2.5% intervals below and higher nominal.
- .4 Tap Changer
 - .1 Bolted-link type.
- .5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.
- .6 Ground lug.

.7 Windings

- .1 Primary and secondary coils:
 - .1 Aluminum.
 - .2 Vacuum cast epoxy.
- .2 Coil and core assembly:
 - .1 Taps located at front of coils for accessibility.
- .3 Sound level: not to exceed 71 dB.

2.5 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Equipment labels: nameplate size 7.

3. EXECUTION**3.1 Factory Quality Control**

- .1 Factory tests: to ACNOR C9.
- .2 Submit certificates for the following tests performed during fabrication:
 - .1 Turn ratio (voltage).
 - .2 Polarity or angular displacement.
 - .3 No load losses.
 - .4 Load losses.
 - .5 Impedance.
 - .6 Dielectric resistance (applied and induced voltage).
 - .7 Excitation current.

- .8 Resistance.

3.2 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.3 Installation

- .1 Locate, install and ground transformers in accordance with manufacturer's instructions.
- .2 Set and secure transformers in place, rigid plumb and square.
- .3 Connect primary terminals to high voltage circuit.
- .4 Connect secondary terminals to secondary feeder circuit.
- .5 Use flexible conduit to make connections to transformer 2.
- .6 Energize transformers and check secondary no-load voltage.
- .7 Adjust primary taps as necessary to produce rated secondary voltage at no-load.
- .8 Wire one set of contacts on winding temperature detector relay to wire trip transformer circuit breaker.
- .9 Locate cooling fans.
 - .1 Connect thermostat control.

- .2 Connect sequence contacts of temperature indicator:
 - .1 First contact closure: start fan.
 - .2 Second contact closure: sound alarm.
 - .3 Third contact closure: trip secondary breaker.
- .10 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.
- .11 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.4 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize transformers and apply incremental loads:
 - .1 0% for 4 hours.
 - .2 Full load.
 - .3 At each load change, check temperatures ambient enclosure ventilating air and winding.
 - .4 Adjust cooling fan controls if required.

3.5 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 – Cleaning#.

3.6 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by transformers installation.

END OF SECTION

1. GENERAL**1.1 Section Contents**

- .1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 Related Sections

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3 Section 01 91 31 – Commissioning (Cx) Plan.
- .4 Section 01 91 33 – Commissioning (Cx) – Forms.
- .5 Section 01 91 41 – Commissioning (Cx) – Training.
- .6 Section 01 91 51 – Building Management Manual (BMM).
- .7 Section 26 05 00 – Common Work Results for Electrical.

1.3 References

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-C22.2 No. 47 – Air-Cooled Transformers (Dry Type).
 - .2 CSA C9 – Dry-Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA).

1.4 Product Data

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

2. PRODUCTS**2.1 Transformers**

- .1 Use transformers of one manufacturer throughout project.
 - .1 Type: ANN.
 - .2 1 phase, 600 V input; 1-phase, 120/240 V, output, 60 Hz.
 - .3 Voltage taps: four (4) at 2½%, 2 ANFC and 2BNFC.
 - .4 Winding: copper.
 - .5 Insulation: Class 220, 150°C temperature rise.
 - .6 Basic Impulse Level (BIL): standard.
 - .7 Hipot: standard.
 - .8 Average sound level: standard.
 - .9 Impedance at 17°C: standard.
 - .10 Enclosure: AMEEC 2, removable metal front panel.
 - .11 Mounting: floor.
 - .12 Finish: in accordance with Section 26 05 00 – Common Work Results for Electrical.

2.2 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Nameplate wording: as required in Section 26 05 00.

3. EXECUTION**3.1 Installation**

- .1 Mount dry type transformers on floor.

- .2 Ensure adequate clearance around transformer for ventilation as required by manufacturer.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Use neoprene pads to isolate vibrations to the floor.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 If possible, energize transformers immediately after installation is complete.

3.2 Connection

- .1 Make primary and secondary connections in accordance with wiring diagram.

3.3 Field Quality Control

- .1 Perform testing in accordance with specifications.
- .2 Perform the following tests:
 - .1 Verify insulation resistance.
 - .2 Verify grounding of exposed conductive part at a single point only.
 - .3 Verify transformation ratio for all transformer taps.
- .3 Submit the testing reports and integrate them into the Operating and Maintenance Manual.
- .4 Ten (10) days after transformer start-up, perform a thermographic survey of equipment. Perform a second thermographic survey ten (10) months after partial work acceptance. Provide a separate report for each survey.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 26 12 16 – Dry Type Switchgear Assembly 25 kV.
- .2 Section 26 18 41 – Interlock Systems.

1.2 References

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C57.12-2010, General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- .2 CSA International
 - .1 CSA C22.2 No.14-10, Industrial Control Equipment.
 - .2 CSA C22.2 No.31-10, Switchgear Assemblies.
 - .3 CSA C22.2 No.58-M1989(R2010), High-Voltage Isolating Switches.
 - .4 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC G1-1-1958, Indoor and Outdoor Switch and Bus Insulators.
 - .2 EEMAC G8-3.3, Metal-Enclosed Interrupter Switchgear Assemblies.
- .4 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 switchgear assembly and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Primary switchgear assembly to include:
 - .1 Enclosure.
 - .2 Load interrupter switch.
 - .3 Circuit breakers.
 - .4 Busbar.
 - .5 Infrared Viewing Windows.
 - .6 Grounding Studs with insulating boots.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
- .2 Indicate on drawings:
 - .1 Floor anchoring method and dimensioned foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned cable termination [and pothead] height.
 - .4 Dimensioned position and size of busbars and details of provision for extension.
 - .5 Dimensioned positions of main connections, including air clearances and support insulators.
 - .6 Layout of internal and front panel components suitably identified.

.7 Time current characteristics curves of protection devices.

.4 Certificates:

.1 Submit manufacturer's test certificates.

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 primary switchgear assembly for incorporation into manual.

1.5 Quality Assurance

.1 Submit manufacturer's type test certificates indicating switchgear cubicles and components tested as integrated assembly.

.2 Submit test procedures, at least 10 days prior to testing.

.3 Submit production test results before equipment is shipped from factory.

1.6 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 Ship and store switchgear assembly in upright position.

.2 Keep doors locked and protect instruments from damage and dust.

.3 Ship channel base sills, anchoring devices in advance of switchgear.

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

- .5 Store and protect switchgear assembly from nicks, scratches, and blemishes.
- .6 Replace defective or damaged materials with new.

1.7 Scheduling

- .1 Coordinate time-current characteristics of protective fuses and relays.
- .2 Submit with drawings a time-current coordination study of the protective devices. This study must include curves representing the protective devices' values from the Hydro-Québec distribution station up to secondary breakers. Refer to HQ station's time-current curves that will be transmitted to you once they become available. Indicate settings for 600 V breakers, 25 kV and 4,160 V fuses.
- .3 Ensure that all circuit protection devices such as overcurrent trips, relays and required fuses are installed and set to the recommended values.
- .4 Retain and defray the services of an engineer from the manufacturing company or a specialized engineering firm for this type of work for the settings described in article .1 for all electrical distribution equipment.

1.8 Extra Materials

- .1 Submit maintenance materials in accordance with 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Un (1) set power fuses of each type installed.
 - .2 Six (6) of each type of indicator light bulbs installed.

2. PRODUCTS#

2.1 Materials

- .1 Switchgear assembly: to CSA C22.2 No.31 and EEMAC G8-3.3.
- .2 Steel for cubicles: to CSA G40.21.

- .3 Insulators: to CSA C22.2 No.58 and EEMAC G1-1.
- .4 Enclosure finish to ANSI C57.12.

2.2 Primary switchgear

- .1 Primary switchgear: indoor , 25 kV, 600 A, 3 phases, 3 wires, short circuit capacity 46 kA, BIL 125kV.

2.3 Primary Enclosure

- .1 Primary enclosure: metal clad free standing, floor mounted, dead front, indoor CSA Enclosure 1 cubicle unit. Constructed from rolled flat steel sheets.
- .2 Ventilating louvres: insect, proof with easily replaceable fiberglass filters.
- .3 Use non-corrosive bolts and hardware.
- .4 Access from front only and back.
- .5 Hinge doors on same side.
- .6 Gaskets on removable covers.
- .7 Allow for extension on right sides of cubicle unit to new transformer.
- .8 Inner door: hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.
- .9 Provide access control as follows:
 - .1 Equip doors providing access to interrupter switches with fuses with key interrupter to guard against:
 - .1 Opening door if interrupter switch on source side of fuse is closed.
 - .2 Closing interrupter switch if door is open.
 - .3 Operation of interrupter if main feeder's breaker is opened.
- .10 One (1) compartment for cables to enter from above.

- .11 Primary transformer connection via compartment side cable.
- .12 Three (3) 28 kV cable endings.
- .13 Three (3) compression connectors, two-hole wide-bellied entry design from Burndy.
- .14 One (1) screened compartment to Hydro-Québec standards.
- .15 Six (6) ground fittings from Hydrocom equipped with insulated caps, to Hydro-Québec standards.
- .16 One (1) manual control.

2.4 Bus Bars

- .1 Three phase busbars, continuous current rating 600 A extending to transformer suitably supported on insulators.
- .2 Main connections between busbars, major switching component and fuses of continuous current rating to match major switching components.
- .3 High conductivity copper for busbars and main connections.
- .4 Brace busbar system including ground bus to withstand stresses resulting from short circuit currents specified.
- .5 Tin surfaced joints, secured with non-corrosive bolts and Belleville washers, tightened with torque wrench in accordance with manufacturer's recommendations.
- .6 Identify phases of busbars by suitable marking.
- .7 Busbar connectors when switchgear shipped in more than one section.
- .8 Include full capacity neutral as indicated.
- .9 Coordinate busbar with transformer supplier for a direct connection.

2.5 Grounding

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of cubicle and situated at bottom.

- .2 Lugs at each end for size 4/0 AWG grounding cable.
- .3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

2.6 Lightning Arresters

- .1 Supply and install lightning arresters.

2.7 Interlocks

- .1 See section 26 18 41 - Interlock Systems.

2.8 Infrared Viewing Windows

- .1 Model C, range type 075 for infrared inspection.

2.9 Finishes

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Cubicle exteriors: gray.
- .3 Cubicle interiors: white.
- .4 Supply 2 spray cans touch up paint.

2.10 Equipment Identification

- .1 Identify equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplates:
 - .1 Switchgear designation: label - white plate, black letters, size 7, engraved.

2.11 Warning Signs

- .1 Include warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.12 Source Quality Control

- .1 Departmental Representative will conduct plant inspection.
- .2 Departmental Representative will witness standard factory testing of complete switchgear assembly, including operation of switches, circuit breakers and controls.
- .3 Notify Departmental Representative in writing, 5 days prior to testing, that equipment is ready for inspection.

3. EXECUTION**3.1 Examination**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for switchgear assembly installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Installation

- .1 Set and secure switchgear assembly in place on channel base, rigid, plumb and square.
- .2 Make field connections in accordance with manufacturer's recommendations.

- .3 Connect ground bus to building system ground.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Check fuse sizes against shop drawings.

3.3 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Operate load interrupter closing and tripping mechanisms, to verify correct functioning.
- .3 Check insulation of switchgear assembly with DC Hi-Pot tester in accordance with manufacturer's approved methods. If values are not satisfactory, clean and dry switchgear and repeat tests until readings acceptable to Departmental Representative.
- .4 Check insulation of switchgear assembly with megger. If values not satisfactory, clean and dry switchgear and repeat tests until readings acceptable to Departmental Representative.
- .5 Check phase rotation of each feeder.
- .6 Place primary switchgear in service and check ammeter readings to ensure proper functioning of instruments and satisfactory phase balance and power factor of loads.
- .7 Check fuses for correct type and rating.
- .8 Check for grounding and neutral continuity between station ground and system neutral.
- .9 Have factory representative commission final installation and certify proper operation and installation.

3.4 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.

3.5 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by primary switchgear assembly installation.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 26 13 18 - Primary Switchgear Assembly 25 kV.
- .2 Section 26 23 00 – Low Voltage Switchgear.

1.2 References

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C37.20.1-02, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.
 - .2 ANSI/IEEE C37.20.2-1999, Standard for Metal-Clad and Station-Type Cubicle Switchgear.
 - .3 ANSI/IEEE C37.35-1995, Guide for the Application, Installation, Operation, and Maintenance of High-voltage Air Disconnecting and Interrupter Switches.
 - .4 ANSI/IEEE 241-1990, Recommended Practice for Electric Power Systems in Commercial Buildings.
 - .5 ANSI/IEEE 1015-06, Blue Book IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- .2 CSA International
 - .1 CSA C22.2 No.31-10, Switchgear Assemblies.

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 interlock systems and include product characteristics, performance criteria, physical size, finish and limitations.

2. PRODUCTS**2.1 Interlock Systems**

- .1 Kirk key interlocks, Type F for load interrupter switch and Type D for switchgear cubicle door to prevent:
 - .1 Opening cubicle door for access to fuses while load interrupter is in closed position.
 - .2 Closing load interrupter while cubicle door is open.
- .2 Kirk key interlocks, Type T, key transfer with one key Type F for main isolating switch and one feeder circuit breakers to prevent:
 - .1 Opening isolating switch until circuit breakers are open.
 - .2 Closing main circuit breakers while isolating switch is open.

3. EXECUTION**3.1 Examination**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for interlock systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3 Section 01 91 31 – Commissioning (Cx) Plan.
- .4 Section 01 91 33 – Commissioning (Cx) Forms.
- .5 Section 01 91 41 – Commissioning (Cx): Training.
- .6 Section 01 91 51 – Building Management Manual (BMM).
- .7 Section 26 05 00 – Common Work Results for Electrical.
- .8 Section 26 09 23.01 – Metering and Switchboard Instruments.
- .9 Section 26 12 16 – Dry Type Medium Voltage Transformer.
- .10 Section 26 13 18 – Primary Switchgear Assembly to 25 kV.
- .11 CSA International
 - .1 CSA C22.2 No.31-10, Switchgear Assemblies.

1.2 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for low voltage switchgear and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Canada.

- .2 Indicate on drawings:
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth of complete switchgear.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .4 Certificates:
 - .1 Submit certified factory test results.
 - .2 Submit certified factory test results.

1.3 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for low voltage switchgear and components for incorporation into manual.

1.4 Extra Stock Materials

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

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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect low voltage switchgear from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

- .1 Switchgear assembly: to CSA C22.2 No.31.

2.2 Rating

- .1 Secondary switchgear: indoor, 600-347 V, 3000 A, 3 phases, 4 wires, 60 Hz, minimum short circuit capacity 42 kA (rms symmetrical).

2.3 Enclosure

- .1 Distribution sections to contain:
 - .1 Insulated case power circuit breaker sized as indicated.
 - .2 Copper bus, from main section to distribution sections including vertical bussing.
- .2 Blanked off spaces with bus stabs and hardware for mounting future units.
- .3 Metal enclosed, free standing, floor mounted, dead front, indoor, CSA Enclosure 1 cubicle unit.
- .4 Ventilating louvres: vermin, insect proof with easily replaceable fibre glass filters.
- .5 Access from front and rear.
- .6 Steel channel sills for base mounting in single length common to multi-cubicle switchboard.

- .7 Provision for future extension right side.

2.4 Busbars

- .1 Three phase and 100% rated bare busbars, continuous current rating 3000 A self-cooled, extending full width of multi-cubicle switch board, suitably supported on insulators.
- .2 Main connections between bus and major switching components to have continuous current rating to match major switching components.
- .3 Busbars and main connections: 99.30% minimum conductivity copper.
- .4 Allow for extension of bus on both sides of unit without need for further drilling or preparation in field.
- .5 Tin plated joints, secured with non-corrosive bolts and Belleville washers.
- .6 Identify phases of busbars by suitable marking.
- .7 Busbar connectors, when switchboard shipped in more than one section.

2.5 Grounding

- .1 Copper ground bus not smaller than 50 mm x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.
- .2 Lugs at each end for size 4/0 AWG grounding cable.

2.6 Main Circuit Breakers (2,000 A and greater)

- .1 Insulated case circuit breaker in separate enclosure.
- .2 600 V class circuit breaker, stationary type, manual operation, with the following characteristics:
 - .1 100% continuous current rated: as indicated on drawing.
 - .2 Minimum short circuit rating: 42 kA symmetrical efficiency or as indicated on drawing.
 - .3 Shunt trip with 120 VAC coil.

- .4 Device will be microprocessor-based trip unit that includes, among others, a current sensor for each pole and electronic actuator. System must provide LSIG trip functions: long-time, short-time, instantaneous and ground-fault.
- .3 Breaker with normal stored energy, closing mechanism to provide quick-make operation for all ratings.
- .4 Breaker with on-off indicator and spring charged/discharged indicator.

2.7 Feeder Circuit Breakers

- .1 Bolt-on moulded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with 40°C ambient temperature compensation.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 to 8 times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Terminal lugs suitable to copper or aluminum wires.
- .6 Moulded case circuit breakers to operate automatically by means of thermal and magnetic tripping devices to provide inverse time-current tripping and instantaneous tripping for short circuit protection.
- .7 Minimum interrupting capacity rating coordinated with panel characteristics.

2.8 Instruments

- .1 See Section 26 09 23.01 – Metering and Switchboard Instrument.

2.9 Finishes

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results for Electrical.
 - .1 Cubicle exteriors gray.
 - .2 Cubicle interiors gray.

2.10 Equipment Identification

- .1 Identify equipment in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete switchgear labelled: voltage, system configuration and main bus ampacity.
 - .3 Main cubicle labelled: "Main Breaker".
 - .4 Distribution units labelled: "Feeder No.1", "Feeder No.2".

3. EXECUTION**3.1 Examination**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for low voltage switchgear installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Installation

- .1 Locate switchgear assembly as indicated and bolt to floor.
- .2 Connect main secondary power supply to main breaker.
- .3 Connect load side of breakers in distribution cubicles to distribution feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run one grounding conductor 4/0 AWG bare copper in 25 mm conduit from ground bus to ground.
- .6 Check trip unit settings against coordination study to ensure proper working and protection of components.
- .7 Put in service equipment.

3.3 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – 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 11 – Cleaning.

3.4 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by low voltage switchgear installation.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 – Closeout Submittals.
- .4 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .5 Section 01 91 31 – Commissioning (Cx) Plan.
- .6 Section 01 91 33 – Commissioning (Cx) – Forms.
- .7 Section 01 91 41 – Commissioning (Cx) – Training.
- .8 Section 01 91 51 – Building Management Manual (BMM).
- .9 Section 26 05 00 – Common Work Results for Electrical.

1.2 References

- .1 American National Standards Institute (ANSI))/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE C37.46-2010, Specifications for High Voltage Explosion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches.
- .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC)
 - .1 EEMAC G1-1-1958, Indoor and Outdoor Switch and Bus Insulators.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA SG2-1993, High-Voltage Fuses.

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 [outdoor load break switches and fuses] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Canada.
 - .1 Indicate on drawings:
 - .1 Load break mechanism.
 - .2 Switching type.
 - .3 Mounting design.
 - .4 Fuse holder mechanism.
 - .5 Gang operating mechanism.
 - .6 Load rating.

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 outdoor load break switches and fuses for incorporation into manual.

1.5 Maintenance Material Submittals

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include: 3 fuses.

1.6 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect outdoor load break switches and fuses from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2. PRODUCTS**2.1 Materials**

- .1 Fuses: to NEMA SG2 and ANSI C37.46.
- .2 Insulators: to EEMAC G1-1.

2.2 Full Load Air Break Switches

- .1 Upright mounted, gang operated, single throw, 3 pole.
- .2 Rating 900 A, 26.4 kV.
 - .1 Momentary RMS asymmetrical A: 12 kA.
- .3 BIL: 137 kV.
- .4 Insulators: three per pole, standard station post type.
- .5 Contacts:
 - .1 Silver-nickel alloy multi-contact fixed contacts.

- .2 Silver-nickel alloy spring loaded multi-contact switch blade contacts.
- .6 Interrupter unit to permit opening and closing under rated full load currents consists of:
 - .1 Mechanism actuated by levers for operating contacts.
 - .2 Bolted to fixed contact assembly of switch.
 - .3 Shunt contact bolted to switch blade actuates interrupter unit when blade is moved to open or closed position.
- .7 Switch base: 5 mm formed channel galvanized steel drilled for universal mounting on wood.
- .8 Interphase mechanism assembly.
 - .1 Poles interconnected by articulated pipe assembly to allow for minor misalignment.
- .9 Manual operating mechanism with:
 - .1 Offset bearings.
 - .2 Pipe shaft.
 - .3 Pipe guides.
 - .4 Pipe couplings.
 - .5 Position indicator.
 - .6 Foot bearing.
 - .7 Operating handle with padlock.

2.3 Primary Fuses

- .1 Disconnect vertical 180 degrees opening type.
- .2 Voltage rating: 26.5 kV.
- .3 Continuous current rating: 200 A.

- .4 Three phase symmetrical short circuit ratings:
 - .1 12 kA.
- .5 Refill unit consisting of:
 - .1 Fusible element: nickel chrome.
 - .2 Arcing rods: main rod copper, silver clad, auxiliary rod stainless steel.
 - .3 Solid material arc-extinguishing medium contained in filament wound glass-epoxy tube.
- .6 Product:
 - .1 S&C SMD-20 or equivalent.

3. EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for outdoor load break switches and fuses installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Installation

- .1 Install in accordance with manufacturer's instructions.
- .2 Connect switch terminals to primary feeder and load feeder.
- .3 Locate, mount and connect fuses.

3.3 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize and load feeders controlled by load break switches.
- .3 Open and close load break switches at least ten times to ensure proper mechanical and electrical performance of installation.
- .4 Check fuse and switch contact resistance with low resistance meter.
 - .1 Do not use more than rated current on fuse.
- .5 Megger switch across each pole, from pole to pole, and from pole to ground.

END OF SECTION

1. GENERAL**1.1 Section Contents**

- .1 Materials and equipment for moulded case circuit breakers.

1.2 References

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 Related Sections

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .3 Section 01 91 31 – Commissioning (Cx) Plan.
- .4 Section 01 91 33 – Commissioning (Cx) – Forms.
- .5 Section 01 91 41 – Commissioning (Cx) – Training.
- .6 Section 01 91 51 – Building Management Manual (BMM).
- .7 Section 26 05 00 – Common Work Results for Electrical.
- .8 Section 26 23 00 – Low Voltage Switchgear.

1.4 Submittals

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

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breaker and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation. Contractor must submit 1 copy of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Department Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify an extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Department Representative. Unless complying with this requirement, reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate or origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.

**MOULDED CASE
CIRCUIT BREAKERS**

- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 List of circuit breakers.

2. PRODUCTS**2.1 General Requirements**

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Circuit breakers to have interrupting capacity rating as indicated.

2.2 Thermal Magnetic Breakers

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

3. EXECUTION**3.1 Installation**

- .1 Provide and install a breaker for each outlet shown on drawings.
- .2 Install circuit breakers as indicated by the Manufacturer.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 33 71 16.01 - Electrical Pole Lines and Hardware.

1.2 References

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE C62.1-1989, Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits.

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 primary lighting arresters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Canada.

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 primary lighting arresters 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.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect primary lighting arresters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

- .1 Arrester component parts: to ANSI/IEEE-C62.1.
- .2 Arrester characteristics:
 - .1 Distribution arrester; 21 kV-17 kV, 10 kA.
 - .2 System highest voltage line to line direct grounded: 25 kV.
 - .3 Outdoor type.
 - .4 Product from Hubbell part 213617-5152 or Alstom Varisil HD 21SD or Joslyn ZHP021-0024129-OK #5.

3. EXECUTION

3.1 Installation

- .1 Mount arresters on cross arms adjacent to service cable pot head and as close to transformers as possible.
- .2 Connect line terminals to phase conductors.
- .3 From arrester ground terminal run copper ground wire down pole to ground rod.
- .4 From arrester ground terminal run shortest possible conductor.

- .5 Mount arresters adjacent to primary bus cable of substation and connect line terminals to phase conductors. Connect ground terminals to ground electrode.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 26 23 00 – Low Voltage Switchgear.

1.2 References

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 UL 1449-2010, Standard for Surge Protective Devices.

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 secondary lighting arresters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Canada.

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 secondary lighting arresters for incorporation into manual.

2. PRODUCTS**2.1 Equipment**

- .1 Arrester component parts: to ANSI/IEEE C62.41 and UL 1449.
- .2 Arrester characteristics:
 - .1 System voltage: 600.
 - .2 Rated voltage of arrester: 650 V.
 - .3 Indoor type.

3. EXECUTION**3.1 Installation in Shop**

- .1 Install arresters and connect to secondary bus and ground bus inside low voltage switchgear.

END OF SECTION

1. GENERAL**1.1 Related Sections**

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.2 References

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ASTM International Inc.
 - .1 ASTM F1137, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 Canadian Standards Association (CSA International).
- .4 ICES-005-07, Radio Frequency Lighting Devices.
- .5 Underwriter's Laboratories of Canada (ULC).

1.3 Submittals

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

.2 Product data:

- .1 Provide manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 Quality Assurance

- .1 Submit required samples in accordance with Section 01 45 00 – Quality Control.

1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Waste management and disposal:
- .1 Separate waste for reuse/recycling.
- .2 Divert unused metal materials from landfill to metal recycling facility.
- .3 Dispose and recycle fluorescent lamps as per local regulations.
- .4 Dispose of old PCB filled ballasts.

2. PRODUCTS

2.1 Finishes

- .1 Light fixture finish and construction to meet ULC listing and CSA certification related to intended installation.

2.2 Ballasts

- .1 Fluorescent ballasts: CSA certified, electronic, energy efficient type.
- .1 Rating: 120 V, 60 Hz.

- .2 RFI / EMI suppression circuit.
- .3 Totally encased and designed for 40 degree Celsius ambient temperature.
- .4 Power factor: with 95% of rated lamp lumens.
- .5 Current crest factor: 1.7 maximum.
- .6 Capacitor : thermal protection.
- .7 Thermal protection.
- .8 Harmonics: total harmonic distortion rate maximum 10%.
- .9 Ballast operating frequency: between 10 and 20 kHz.
- .10 Sound level: Class A.
- .11 Mounting: integral with lighting fixture.
- .12 Program Start.
- .13 Lamps and ballasts from same manufacturer.
- .2 Ballast T8 fixture:
 - .1 Model:
 - .1 Osram Sylvania, Quicktronic, High efficiency PROStart.
 - .2 Or equivalent:
 - .1 Philips, Optanium T8.
 - .2 GE, series UltraStart.

2.3 Lighting Fixtures

- .1 Model:
 - .1 CFI-FF-248-120.
 - .2 Lithonia-LA-2-32-120.

- .3 Peerless-ILS-4-2-32-120.

2.4 Lamps

- .1 Fluorescent lamps: T8, 32 W, 4000 K, 2850 initial lumens, CRI 85, 65 000 hour lamp life.
 - .1 Model:
 - .1 Osram/Sylvania, ECO3-Octron 800XL (F032 /841 / XP / XL /EC03) series.
 - .2 Or equivalent:
 - .1 Philips, XLL Alto (F32T8/TL841 XLL ALTO) series.
 - .2 GE, Ecolux Startcoat (73095 – GE Ecolux Startcoat T8 - Office) series.
 - .3 Lamps and ballasts from same manufacturer.

3. EXECUTION

3.1 Installation

- .1 Locate and install lighting fixtures as indicated.
 - .1 Connect lighting fixtures to distribution network via conduits, with maximum 3 m length of reinforced cable per fixture for moved, recessed or suspended installations.
- .2 For surface-mounted fixtures, connect directly to conduits.

3.2 Wiring

- .1 Connect lighting fixtures to lighting circuits.
 - .1 Install wiring in rigid or flexible conduits as indicated.

3.3 Supports for Lighting Fixtures

- .1 Support suspended lighting fixtures in continuous rows on channels.

3.4 Alignment of Lighting Fixtures

- .1 Align lighting fixtures in continuous rows to form straight line.
- .2 Align lighting fixtures mounted individually parallel or perpendicular to building grid lines.

3.5 Cleaning

- .1 Perform cleaning in accordance with Section 01 74 11 – Cleaning.
 - .1 Remove surplus materials and equipment, waste, tools and equipment.

END OF SECTION

1. GENERAL**1.1 Related Sections**

- .1 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Section 01 91 31 – Commissioning (Cx) Plan.
- .3 Section 01 91 33 – Commissioning (Cx) – Forms.
- .4 Section 01 91 41 – Commissioning (Cx) – Training.
- .5 Section 01 91 51 – Building Management Manual (BMM).
- .6 Section 26 05 00 – Common Work Results for Electrical.

1.2 References

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A82/A82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A185/A185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM C139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .4 ASTM C 478/C478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .5 ASTM D1056-00, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-03(R2005), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.

- .2 CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .3 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for conduits.

1.4 Quality Assurance

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Departmental Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.

2. PRODUCTS**2.1 PVC Conduits**

- .1 PVC conduits model DB2, size as indicated on drawings with all accessories.
- .2 Glue.
- .3 Warning tape with inscription “ATTENTION – CÂBLE ENFOUÏ”.

2.2 PVC Duct Fittings

- .1 PVC opaque solvent welded translucent pushfit type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

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 General

- .1 Clean each duct (new or existing) before laying cable.
- .2 Install underground duct banks including formwork.
- .3 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.
- .4 Open trench completely between manholes before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.

- .6 Install base spacers at maximum intervals of 1.2 m levelled to grades indicated for bottom layer of ducts.
- .7 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75 mm horizontally and vertically.
- .8 Stagger joints in adjacent layers at least 150 mm and make joints watertight.
 - .1 Encase duct bank with 100 mm thick concrete cover.
 - .2 Use galvanized steel conduit for sections extending above finished grade level.
- .9 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
- .10 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .11 Allow concrete to attain 50% of its specified strength before backfilling.
- .12 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete.
 - .1 Tie ducts to spacers with twine or other non-metallic material.
 - .2 Remove weights or wood braces before concrete has set and fill voids.
- .13 Clean ducts before laying:
 - .1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .14 Duct cleaning:
 - .1 Pull 150 mm long x diameter 6 mm less than internal diameter of duct wooden mandrel through each duct, immediately after placing of concrete.
 - .2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.

- .3 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .15 Install four 1.2 m lengths of reinforcing rods, one in each corner of duct bank when connecting duct to existing duct bank.
 - .1 Wire rods to dowels at existing duct bank and support from duct spacers.
 - .2 Place concrete down sides of duct bank filling space under and around ducts.
 - .3 Rod concrete with flat bar between vertical rows filling voids.
- .16 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.3 Field Quality Control

- .1 Site Tests/Inspections:
 - .1 Inspection of duct will be carried out by Departmental Representative prior to placing.
 - .2 Placement of concrete and duct cleanout to be done with Departmental Representative present.

3.4 Cleaning

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL**1.1 Related Requirements**

- .1 Section 06 05 73 – Wood Treatment.
- .2 Section 26 05 22 – Connectors and Terminations.
- .3 Section 26 05 27 – Grounding Primary.
- .4 Section 26 28 13.02 – Outdoor Load Break Switches and Fuses.
- .5 Section 26 41 00.01 « Primary Lightning Arresters »

1.2 References

- .1 American National Standards Institute (ANSI)/National Electrical Manufacturers (NEMA)
 - .1 ANSI/NEMA C29.3-1986(R2002), Wet-Processed Porcelain Insulators-(Spool Type).
 - .2 ANSI/NEMA C29.4-1989(R2002), Wet-Processed Porcelain Insulators (Strain Type).
 - .3 ANSI/NEMA C29.5-1984(R2002), Wet-Process Porcelain Insulators (Low- and Medium-Voltage Pin Type).
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G12-92(R2007), Zinc-Coated Steel Wire Strand.
 - .2 CAN/CSA-C83-96(R2005), Communication and Power Line Hardware.
 - .3 CAN/CSA-O80 Series-08, Wood Preservation.
 - .4 CAN/CSA-O15-05, Wood Utility Poles and Reinforcing Stubs.
 - .5 CSA O116-1969(R2008), Power and Communication Sawn Wood Crossarms.

- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1B-1, 1957, Standard for Wet Process Porcelain Insulators (Strain Type).
 - .2 EEMAC 2B-1, 1957, Standard for Wet Process Porcelain Insulators (Spool Type).
- .4 Local Utility Standards Hydro-Québec B41.11, E21.12 and F.22-01.

1.3 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Canada indicating:
 - .1 Materials.
 - .2 Method of anchorage.
 - .3 Number of anchors.
 - .4 Supports.
 - .5 Reinforcement.
 - .6 Assembly details.
 - .7 Accessories.

1.4 Quality Assurance

- .1 Health and Safety Requirements: worker protection:
 - .1 Workers must wear gloves, respirators, eye protection, and protective clothing when applying preservative materials.
 - .2 Workers must not eat, drink or smoke while applying preservative material.
 - .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to sanitary landfill.
 - .4 Workers must wear personal protective wear: hardhat and safety shoes.
- .2 Perform work to comply with applicable Provincial/Territorial regulations.

2. PRODUCTS**2.1 Materials**

- .1 Wood preservation: to CAN/CSA O80 Series.
- .2 Power line hardware: to CAN/CSA-C83.
- .3 Wood utility poles: to CAN/CSA-O15, wood species red pine, Class 2, preservative treated.
 - .1 11 m long poles for primary circuits only.
- .4 Reinforcing stubs: to CAN/CSA-O15, wood species red pine, Class 2.
 - .1 Wood preservative: in accordance with Section 06 05 73 - Wood Treatment.

2.2 Crossarms

- .1 Wood crossarms: to CSA O116, pressure or vacuum treated with preservative:
 - .1 For primary circuits 2 per pole, 4 pin.

- .2 For dead end transformer poles double arms.
- .3 For mounted primary load-break switches double arms.
- .4 For each crossarm:
 - .1 Insulator pins: to CSA 0124.
 - .2 Two -32 x 6 mm galvanized steel braces.
 - .3 One -9 x 38 mm galvanized steel lag screw.
 - .4 Two -9 x 114 mm galvanized steel bolts.
 - .5 Through bolts and double arm bolts as required.
- .2 Galvanized bolt eye (1 per suspension/dead end insulator) for dead end:
 - .1 Strain insulator rod and link installed as required.

2.3 Insulators

- .1 Primary insulators:
 - .1 Pin type: to ANSI/NEMA C29.5 for low and medium voltages, nominal rating 25 kV, for primary conductors.
- .2 Guy strain insulators:
 - .1 Strain type: to EEMAC1B-1 and ANSI/NEMA C29.4, nominal rating 25 kV, one per guy wire.
- .3 Suspension/dead end insulators nominal rating 25 kV.

2.4 Guys and Anchors

- .1 Guy wire: to CAN/CSA-G12, 9 mm nominal diameter, stranded, galvanized steel for dead ends and guys.
- .2 Guy clamps: three-bolt heavy duty or preform grip type.
- .3 Eye bolt: 19 mm thimble, length to suit, four hole guy straps and 16 mm machine bolt with square washer to attach guy wire to pole.

- .4 Anchor rod: 19 mm diameter x 2.7 m long, galvanized steel with thimble eye.
- .5 Anchor: manufacturer's standard.
 - .1 Heavy duty expanding type, four way, expanded area.
- .6 Guy guard: plastic, colored yellow, 2.1 m long.

2.5 Primary Conductors

- .1 In accordance with Section 26 05 14 - Power Cable and Overhead Conductors (1001 V).

2.6 Measurement Transformers

- .1 Supplied by Hydro-Québec.

2.7 Load Break Switches

- .1 In accordance with Section 26 28 13.02 - Outdoor Load Break Switches and Fuses.

2.8 Lightning Arresters

- .1 In accordance with Section 26 41 00.01 - Primary Lightning Arrestors.

2.9 Wire Connectors

- .1 In accordance with Section 26 05 22 - Connectors and Terminations.

2.10 Ground Rods, Ground Conductors and Gradient Mat

- .1 In accordance with Section 26 05 27 - Grounding - Primary.

2.11 Equipment Identification

- .1 Rustproof number nails with 50 mm high designated number.

3. EXECUTION

3.1 Manufacturer's Instructions

- .1 Install electrical pole lines and hardware in accordance with manufacturer's written recommendations and specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Preparation of Poles

- .1 Where poles require shortening, cut piece from top only.
- .2 Roof top of poles with single slope bevelled top.
- .3 Treat roof top, gains, bored holes with preservative before assembly.
- .4 Cut parallel plane crossarm gains in face of pole for single and double arming, spacing as indicated.
- .5 Bore hole in center of each gain for crossarm bolt.
- .6 Drill crossarms for pins, through bolts, double arm bolts and brace bolts.
 - .1 Pre-drill treated crossarms to standard spacing.
- .7 Fasten insulator pins to crossarms with galvanized steel nails.
- .8 Install crossarms and braces.
- .9 Attach stand-off insulators and eye-bolts.

3.3 Installation

- .1 Locate and dig pole holes.
 - .1 Make holes large enough to allow space for tamping backfill.
- .2 Set poles.
- .3 Align poles with crossarms at right angles to pole line on straight runs.

- .4 At change in direction of line, set crossarms to bisect angle formed by change.
- .5 Set poles to maintain even grade.
 - .1 Allow for contour of terrain and do not exceed grading of 1.5 m per pole.
- .6 Replace backfill in 150 mm layers.
 - .1 Tamp each layer, and apply final layer to drain water away from pole.
- .7 Locate and install guy wires and anchors at dead-ends, at non-tangent poles, corner poles, and start of branch feeders.
- .8 Insert anchor at least 1.8 m into ground. Backfill and tamp in 150 mm layers.
- .9 Install insulators.
- .10 Locate and install transformer platform.
- .11 Install number nails on each pole.

3.4 Field Quality Control

- .1 Perform tests and field inspection for pole lines and hardware prior to energization.
- .2 Use qualified tradespersons for installation, termination and testing of high voltage power lines and hardware.
- .3 Engage an independent testing agent to perform test and inspection on high voltage power lines and equipment.
- .4 Submit test result and inspection certificate for review.

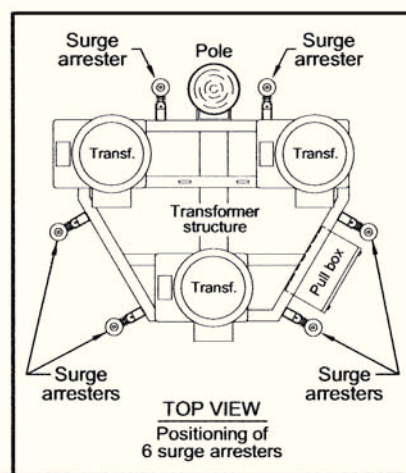
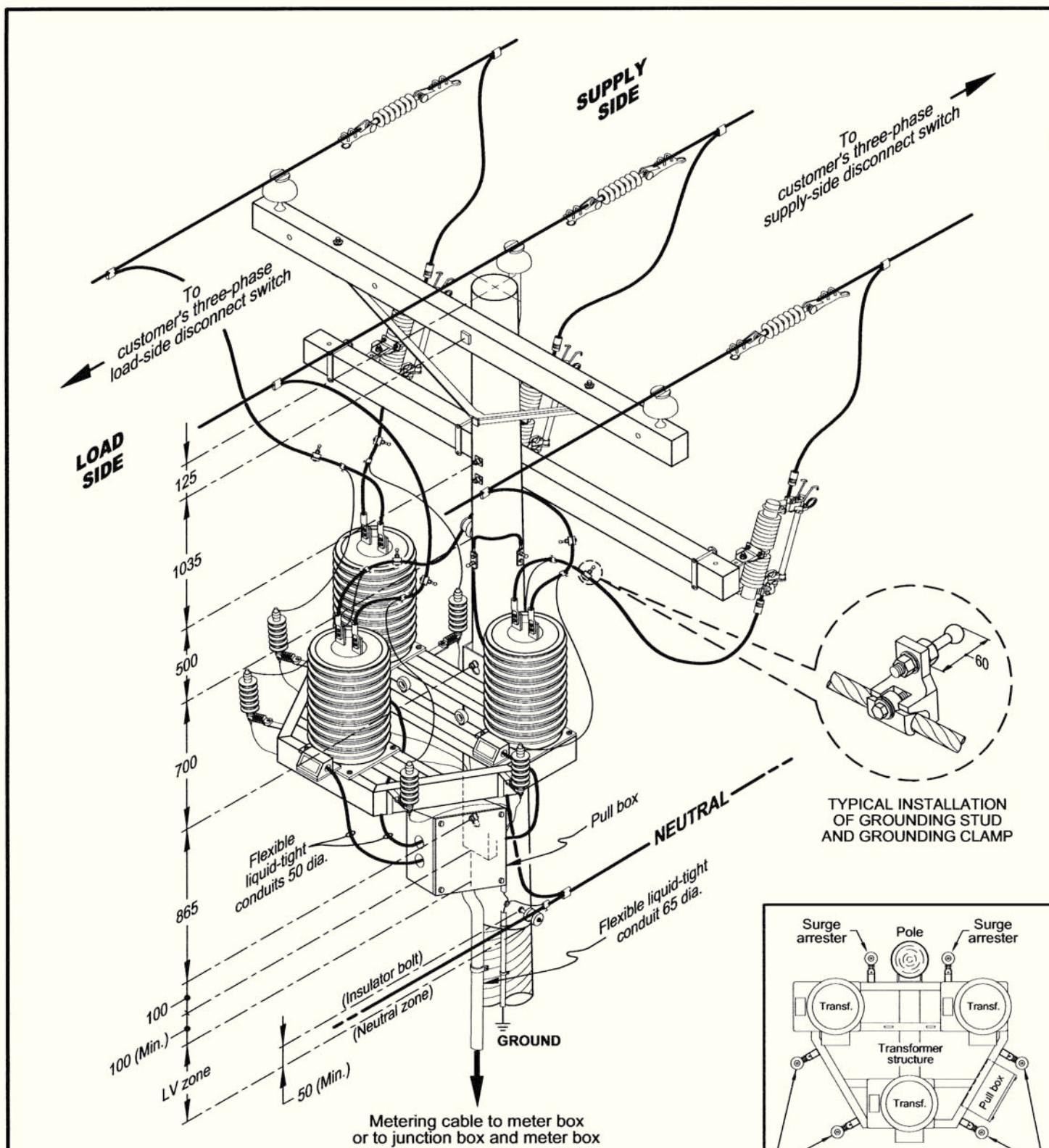
3.5 Cleaning

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

APPENDIX 1

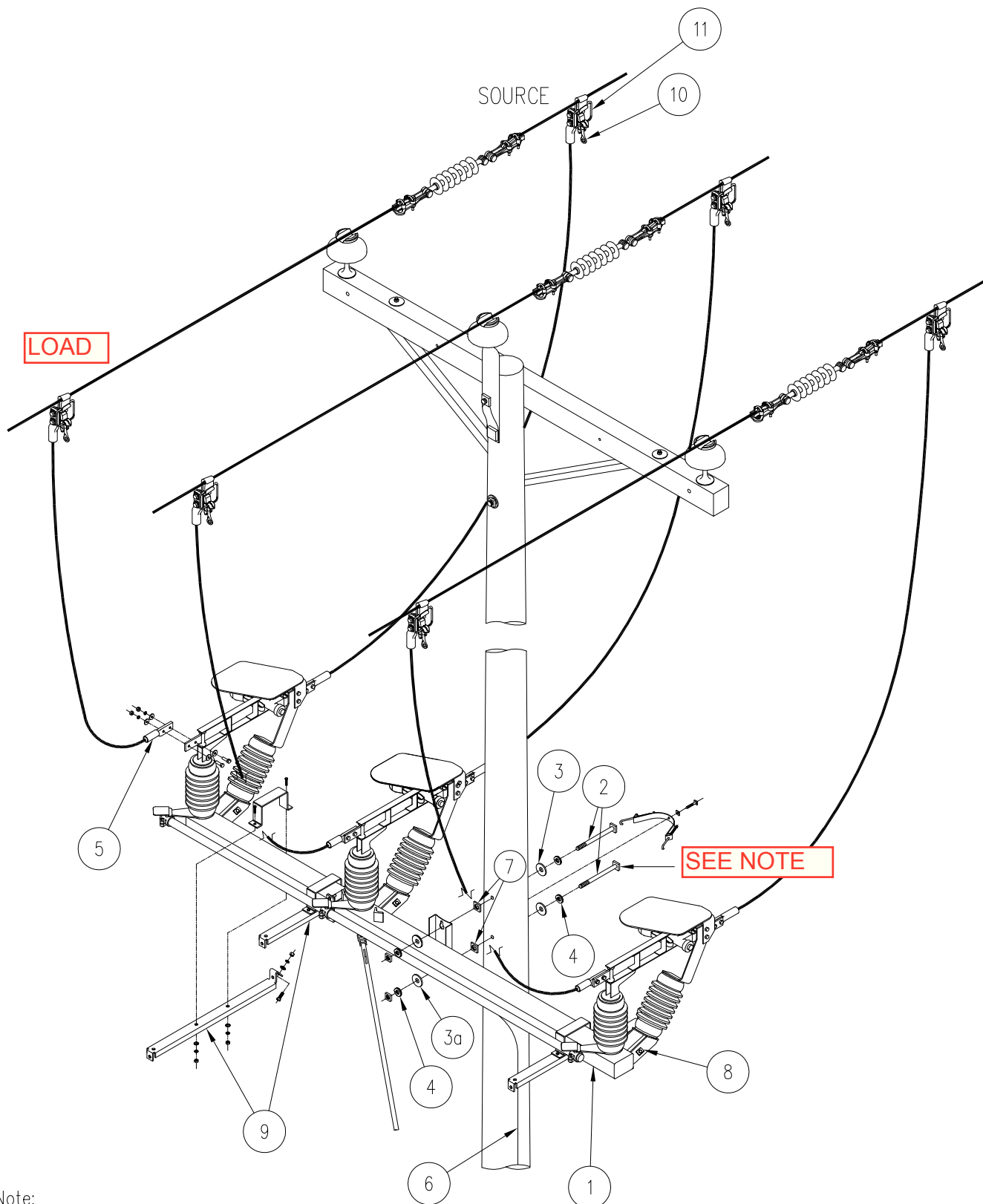
DRAWING AS PER HYDRO-QUÉBEC F22-01 SPECIFICATION



-Dimensions are in millimetres, unless otherwise indicated.
 -REFERENCES: Sections 5.2, 11.1, 11.2, 11.3, 11.4, 11.5, 11.9.1, 11.9.2, 11.9.3 and 11.9.5

-N.B.: Only secondary connections are made by Hydro-Québec.


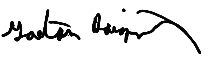

<p>Approved</p> <p>Dir. Expert. & Supp. tech. du rés. de distrib.</p>		<p>Title</p> <p>COMBINED MEDIUM-VOLTAGE INSTRUMENT TRANSFORMERS FOR A 25-KV POLYPHASE LINE</p>	<p>Standard F.22-01</p> <p>Date 2003-12</p> <p>Illustration 10</p>
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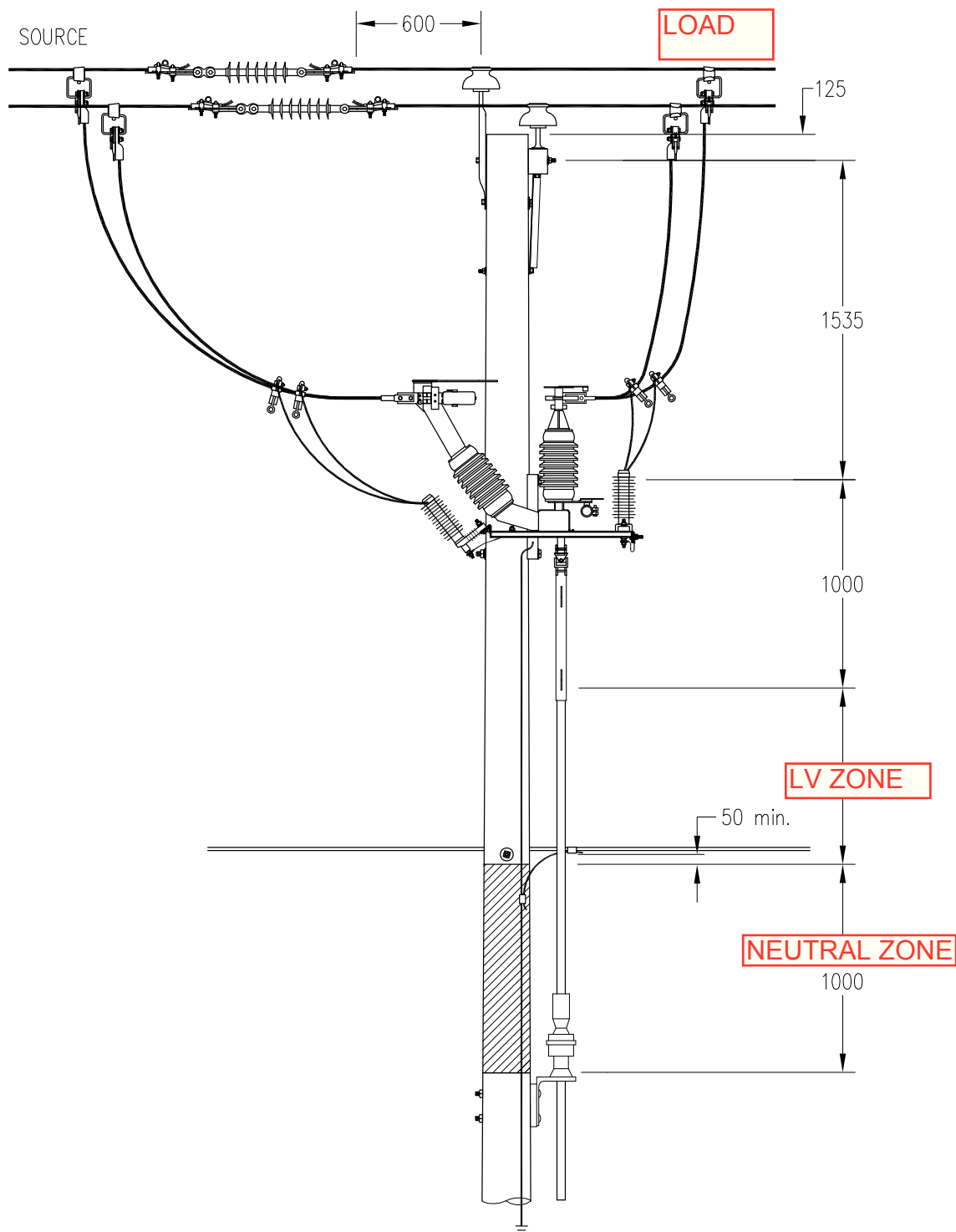
Note:

CHECK FOR CORRECT BOLT 3/4 INCH ORIENTATION


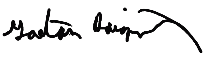
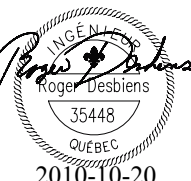
Élaboré par: Maxime Boudreau, ing. jr

 <p>Approbation</p> 	 <p>010-10- 0</p>	<p>ACCESSOIRES DU SECTIONNEUR-INTERRUPTEUR TRIPOLAIRE À COMMANDE MANUELLE S&C</p> <hr/> <p>SECTIONNEMENT</p>	<p>Norme N 3200</p> <p>Volume B.41.11</p> <p>Statut 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/></p> <p>Date 2010-06 Rév. E</p> <p>Page 1 de 2</p>
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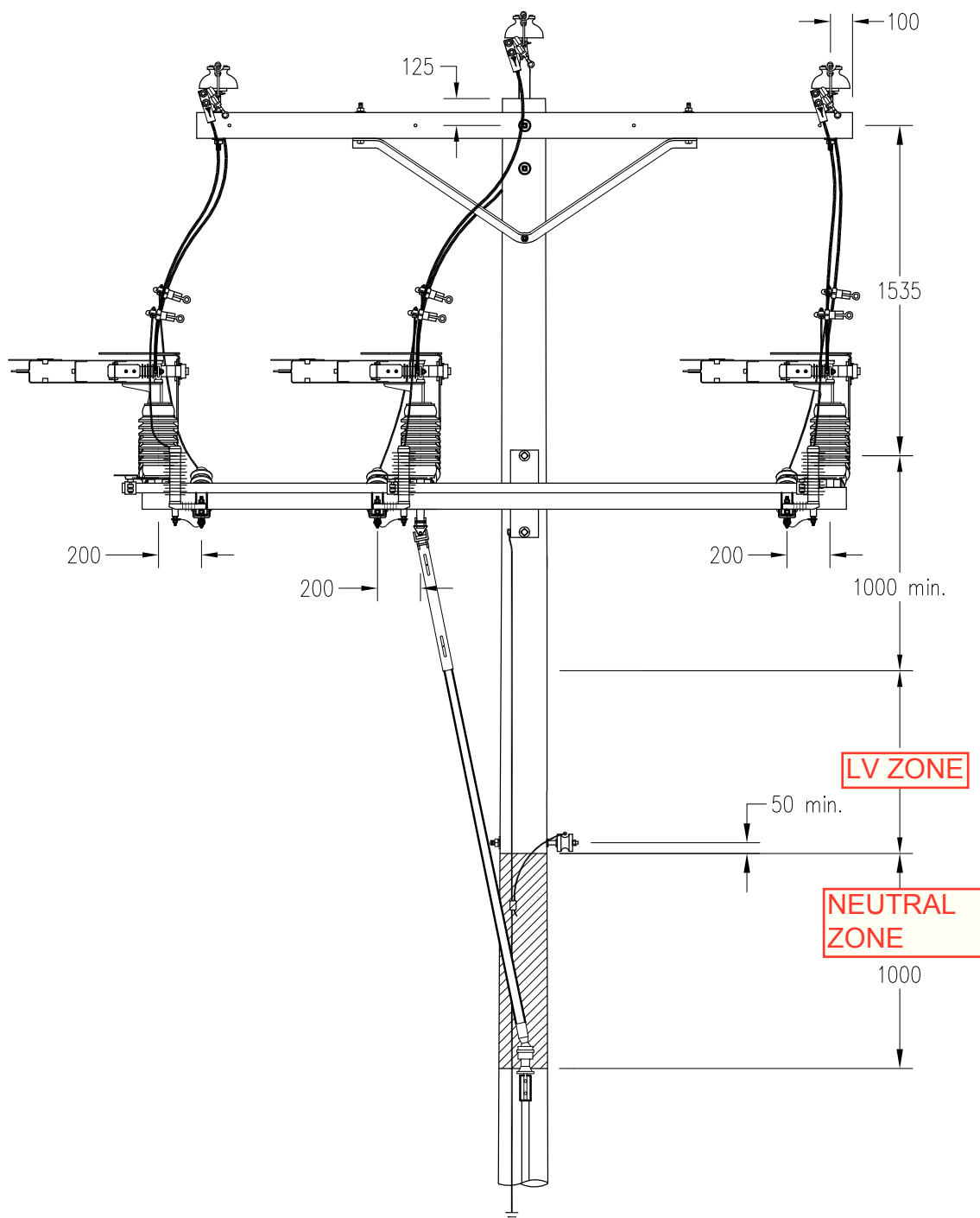
OPEN POSITION - SIDE VIEW




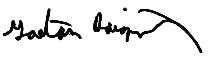

Élaboré par: Maxime Boudreau, ing. jr

 <p>Approbation</p> 	 <p>2010-10-20</p>	<p>MONTAGE D'UN SECTIONNEUR-INTERRUPTEUR TRIPOLAIRE À COMMANDE MANUELLE S&C AVEC PARAFODRES POUR UNE LIGNE TRIPHASÉE EN COURSE</p> <p>SECTIONNEMENT</p>	<p>Norme N 3510</p> <p>Volume B.41.11</p> <p>Statut 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input checked="" type="checkbox"/></p> <p>Date 2010-06 Rév. B</p> <p>Page 1 de 2</p>

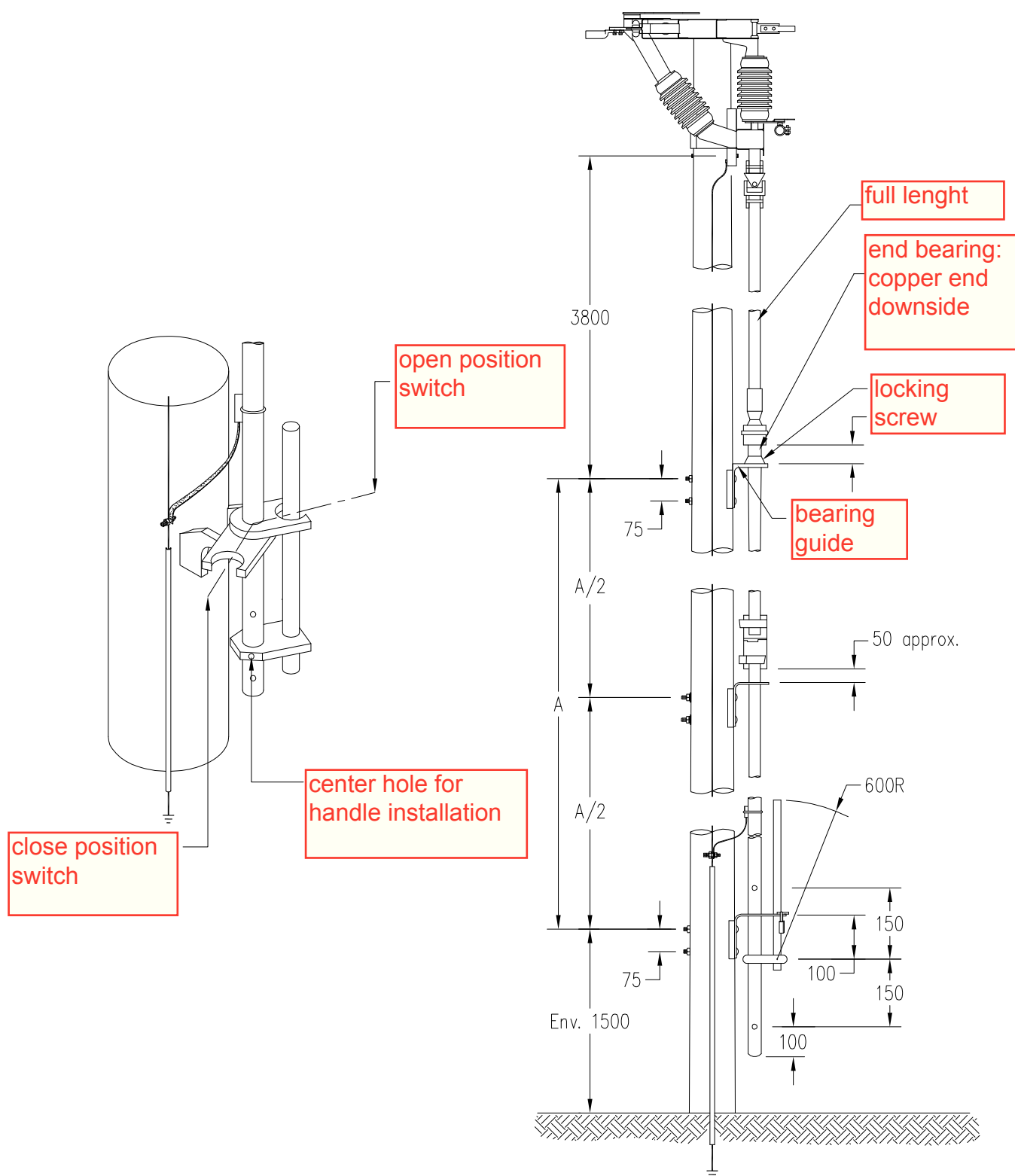
Normally open position - elevation view



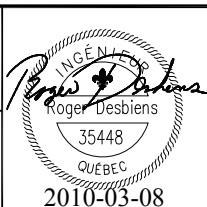
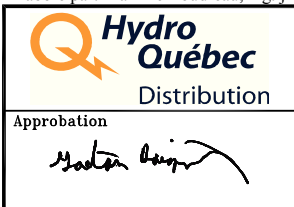
Élaboré par: Maxime Boudreau, ing. jr

 <p>Approbation</p> 	 <p>2010-10-20</p>	<p>MONTAGE D'UN SECTIONNEUR-INTERRUPTEUR TRIPOLAIRE À COMMANDE MANUELLE S&C AVEC PARAFOUDRES POUR UNE LIGNE TRIPHASÉE EN COURSE</p> <p>SECTIONNEMENT</p>	<p>Norme N 3510</p> <p>Volume B.41.11</p> <p>Statut 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input checked="" type="checkbox"/></p> <p>Date 2010-06 Rév. B</p> <p>Page 2 de 2</p>

Handle of switch



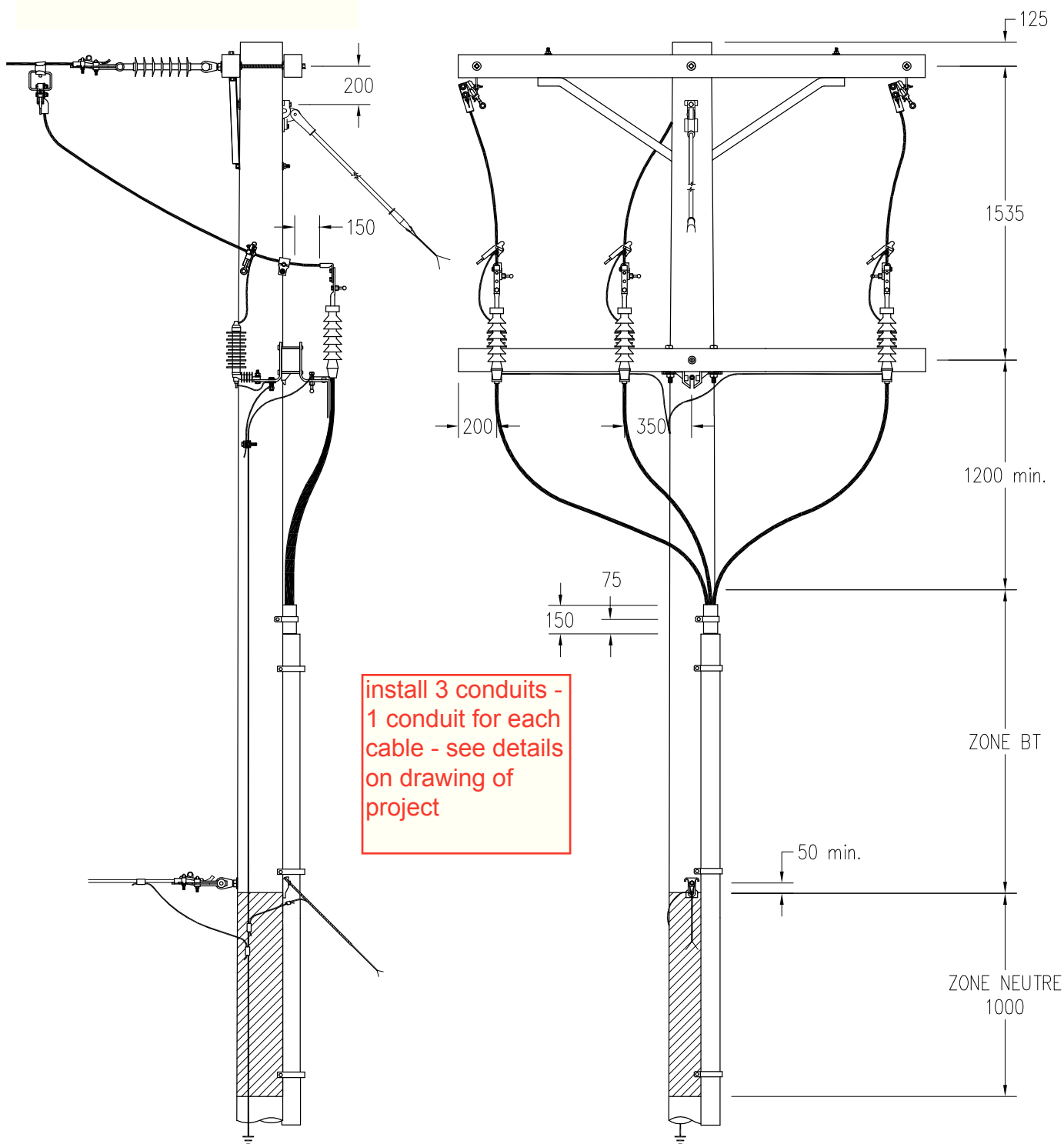
Élaboré par: Maxime Boudreau, ing. jr



MONTAGE DE LA TRINGLERIE
D'UN SECTIONNEUR-INTERRUPTEUR
À COMMANDE MANUELLE S&C


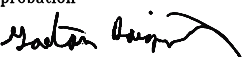

SECTIONNEMENT

Norme	N 3530
Volume	B.41.11
Statut	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/>
Date	2010-03
Page	1 de 1



Note:

—Les protège-câbles doivent être aboutés en nombre suffisant de façon à ajuster la hauteur du dernier protège-câble à 150 mm sous la séparation des phases du câble souterrain.

 <p>Approbation</p>  <p>Distribution</p>	 <p>2011-09-28</p>	<p>MONTAGE D'UNE LIAISON AÉROSOUTERRAINE TRIPHASÉE DIRECTEMENT RELIÉE À UNE LIGNE TRIPHASÉE EN ARRÊT</p> <p>LIAISONS AÉROSOUTERRAINES</p>	<p>Norme P 1580</p> <p>Volume B.41.11</p> <p>Statut 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/></p> <p>Date 2011-09 Rév. 0</p> <p>Page 1 de 2</p>
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APPENDIX F

SURGE ARRESTERS FOR 25-kV AND 34.5-kV SYSTEMS

1.0 PURPOSE

The purpose of this appendix is to indicate what type of surge arrester to use to protect instrument transformers in 25-kV and 34.5-kV systems. This appendix applies to the following types of installations:

- mounted on a wood pole with a metallic structure;
- mounted between two wood poles with a metal platform.

See Appendix A, Illustrations 08 to 12.

2.0 25-kV SYSTEM

Product to use:

Distribution surge arrester 21 kV - 17 kV, 10 kA	
Supplier	Product number
Ohio Brass Canada (Harvey Hubbell Canada)	OB-213617-5152
Alstom	Varisil HD 21SD
Joslyn	ZHP021-0024129-OK#5

APPENDIX G**GROUNDING STUDS AND CLAMPS FOR 25-kV SYSTEMS****1.0 PURPOSE**

The purpose of this appendix is to state the specifications for grounding studs for metal-clad substations and mountings on wood poles in a 25-kV system.

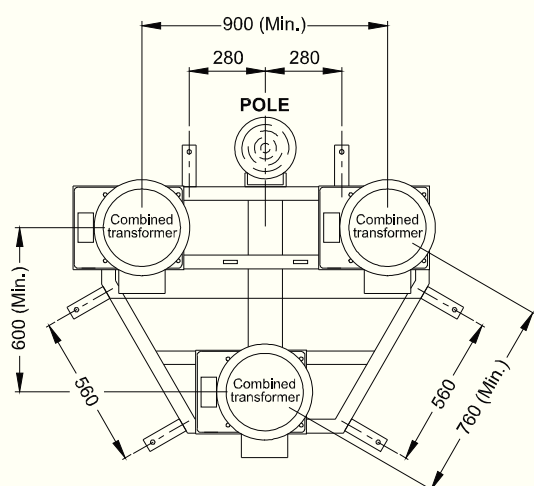
2.0 25-kV SYSTEM

Grounding studs and clamps must comply with the Illustrations in Appendix A.

Products to use:

Grounding studs, 99.9% non-tin-coated copper and stainless steel grade 304, 305 or 316		
Supplier	Description	Product number
Hydrocom International	Rod ½" diameter X 1 ½"	03-M006-1.5
Hydrocom International	Rod ½" diameter X 2"	03-M006-2

Grounding clamps, aluminium with a 20-mm spherical grounding stud		
Supplier	Description	Product number
Hydrocom International	Aluminium conductor 1/0 to 4/0 AWG	03-M-017
Hydrocom International	Aluminium conductor 4/0 AWG to 350 MCM	03-M-018
Hydrocom International	Aluminium conductor 350 to 500 MCM	03-M-019



**Metallic structure
for polyphase line**
(Combined instrument transformers)

N.B.: All dimensions are in millimetres.