

**PUBLIC WORKS AND
GOVERNMENT SERVICES CANADA**

**Correctional Service Canada
Chiller Replacement**

Ref.: R.073166.001

Technical Specifications
Architectural/Structural/Mechanical/Electrical

ISSUED FOR TENDER

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Mechanical / Electrical

SIGN-OFF SHEET

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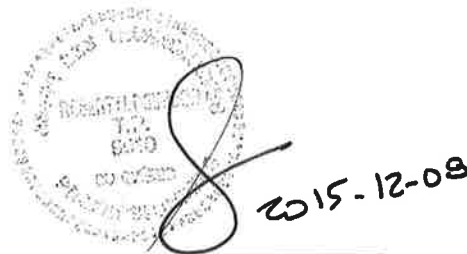
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RECORD OF REVISIONS AND ISSUES

Revision #	Date	Description of Modification and/or Issue
00	2015-12-08	Issued for Tender « This document shall not be used for construction »
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**ARCHITECTURAL / STRUCTURAL /
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DIVISION 01

General Requirements

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Sections of Division 01 - General Requirements.
- .2 Section 21 05 01 - Common Work Results for Mechanical.
- .3 Division 03 - Structure (on drawings).
- .4 Division 04 to 09 - Architecture
- .5 Sections of Division 22 - Plumbing.
- .6 Sections of Division 23 - Heating, Ventilating and Air Conditioning (HVAC).
- .7 Sections of Division 25 - Integrated Automation.
- .8 Sections of Division 26 - Electrical.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the renovation of the cooling system of the personal College of Correctional service Canada situated in Laval. Work include:
 - .1 Architecture:
 - .1 Demolition and reconstruction of a the penthouse roofing;
 - .2 Construction of a new security rail.
 - .2 Structure:
 - .1 The modification of the concrete bases for the pumps and the chiller in the penthouse;
 - .2 Percing of the penthouse concrete slab;
 - .3 Patching of the existing penthouse.
 - .3 Mechanical:
 - .1 Furnish and install of a new chiller;
 - .2 Furnish and install two new condensing unit;
 - .3 Furnish and install two new circulating pumps;

-
- .4 Furnish and install two of a new 3-way;
 - .5 Furnish and install two new balancing valves for the existing cooling coil;
 - .6 Equipments connections.
 - .4 Integrated automation:
 - .1 Chiller and related equipments controls;
 - .2 BACnet integration of the chillers, variable frequency drives and other related equipments;
 - .3 The second floor cooling coil controls;
 - .4 Plots programming at the control station.
 - .5 Electrical:
 - .1 Connection of the news equipments;
 - .2 To relocate existing equipments.
 - .6 Demolition as indicated;
 - .7 Commissioning;
 - .8 Training of the staff and site maintenance.
 - .2 The work subject to this Contract consists of the supply and transportation of the equipment to its final site, settings, installation, support, connection, identification, testing, start-up, calibration, balancing and programming of the cooling system as well as automatic regulation as indicated in the drawings and/or the specifications.
 - .3 Work to include temporary arrangement required at site to finish the work, such as site fence, temporary protection, vehicle access, and pedestrian circulation.
 - .4 Construction and demolition waste management shall be executed in accordance with Section 01 74 21 - Construction Waste Management and disposal.
 - .5 It is highly recommended to assist to the tenders site visit to be able to see all the site restrictions and specially the restriction related to the building mechanical room acces.
-

1.3 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance, while respecting specified working hours.
 - .1 Working hours to be from 7:30 to 16:00.
 - .2 Working hours for noisy work to be from 18:00 to 22:00.
 - .3 Departmental Representative must be aware 72 hours before any works requiring service interruption affecting users
 - .4 The general contractor could use the parking space, maximum six indicated on the mechanical drawing No. M01. The general contractor is responsible for the parking space identification.
- .2 Limit use of premises for Work, to allow:
 - .1 Departmental Representative occupancy.
 - .2 Work by other contractors.
- .3 Contractor must install for his own use a trailer with a maximum length of 6 m. The trailer location is indicated on the mechanical drawing M01.
- .4 Co-ordinate use of premises under direction of Departmental Representative.
- .5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .6 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .7 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .8 At completion of operations condition of existing work: equal to or better than that which existed before new work started.
- .9 Keep access for fire fighting purposes; provide means for fire fighting.
- .10 Supply at least two workers to do the site signalization when equipments are present on site (materials, shipping, trash compactor, lifting crane,...).

1.4 DEPARTEMENTAL REPRESENTATIVE OCCUPANCY

- .1 Departmental Representative will occupy premises during entire construction period for execution of normal operations.

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

1.5 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises. Arrange with Departmental Representative 72 hours before the work began to facilitate execution of work.
- .2 Use only access and circulating means existing in building for moving workers and material.
 - .1 Accept liability for damage, safety of equipment and overloading of existing equipment.
 - .2 Refer to section 01 35 13 - Safety Requirements for the site security.

1.6 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 72 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to vehicular traffic and tenant operations.
- .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 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.

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

1.7 DOCUMENTS REQUIRED

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

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 52 00 - Construction Facilities.
- .4 Section 01 56 00 - Temporary Barriers and Enclosures.
- .5 Section 01 78 00 - Closeout Submittals.

1.2 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2 Site meetings will be held by the Departmental Representative.
- .3 Provide a trailer space and make arrangements for meetings.
- .4 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.3 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, Departmental Representative will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, Engineer, Contractor, major Subcontractors, and field inspectors will be in attendance.
- .3 Departmental Representative will establish time and location of meeting and notify parties concerned.
- .4 Mutually agreed variations to Contract Documents will be incorporated into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).

- .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 Delivery schedule of specified equipment.
- .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Monthly progress claims, administrative procedures, photographs, hold backs.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

1.4 PROGRESS MEETINGS

- .1 Schedule progress meetings at the call of Departmental Representative.
- .2 Contractor, major Subcontractors involved in Work, Departmental Representative, and SCC representative are to be in attendance.
- .3 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 Safety on site.
- .11 Maintenance of quality standards.
- .12 Review proposed changes for affect on construction schedule and on completion date.
- .13 Other business.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

1.2 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 Actual Finish Date (AF): point in time that Work actually ended on activity.
- .3 Actual Start Date (AS): point in time that Work actually started on activity.
- .4 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.
- .5 Baseline: original approved plan (for Project, work package, or activity), plus or minus approved scope changes.
- .6 Milestone: event corresponding generally to the achievement of a product (deliverable).
- .7 Constraint: applicable restriction that will affect performance of Project. Factors that affect activities can be scheduled.
- .8 Control: process of comparing actual performance with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.
- .9 Critical Activity: any activity on a critical path. Most commonly determined by using critical path method.
- .10 Critical Path: series of activities that determines duration of Project. In deterministic model, critical path is usually defined as those activities with float less than or equal to specified value, often zero. It is longest path through Project.
- .11 Critical Path Method (CPM): network analysis technique used to predict Project duration by analyzing which sequence of activities (which path) has least amount of scheduling flexibility (least amount of float).
- .12 Data Date (DD): date at which, or up to which, Project's reporting system has provided actual status and accomplishments.

- .13 Duration (DU): number of work periods (not including holidays or other non-working periods) required to complete activity or other Project element. Usually expressed as workdays or work weeks.
- .14 Early Finish Date (EF): in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can finish, based on network logic and schedule constraints. Early finish dates can change as Project progresses and changes are made to Project plan.
- .15 Early Start Date (ES): in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can start, based on network logic and schedule constraints. Early start dates can change as Project progresses and changes are made to Project Plan.
- .16 Finish Date: point in time associated with activity's completion. Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
- .17 Float: amount of time that activity may be delayed from its early start without delaying Project finish date. Float is mathematical calculation, and can change as Project progresses and changes are made to Project plan. .
- .18 Lag: modification of logical relationship that directs delay in successor task.
- .19 Late Finish Date (LF): in critical path method, latest possible point in time that activity may be completed without delaying specified milestone (usually Project finish date).
- .20 Late Start Date (LS): in critical path method, latest possible point in time that activity may begin without delaying specified milestone (usually Project finish date).
- .21 Lead: modification of logical relationship that allows acceleration of successor task.
- .22 Logic Diagram: see Project network diagram.
- .23 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .24 Milestone: significant event in Project, usually completion of major deliverable.
- .25 Monitoring: capture, analysis, and reporting of Project performance, usually as compared to plan.
- .26 Near-Critical Activity: activity that has low total float.
- .27 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .28 Project Control System: fully computerized system utilizing commercially available software packages.

- .29 Project Network Diagram: schematic display of logical relationships of Project activities. Always drawn from left to right to reflect Project chronology.
- .30 Project Plan: formal, approved document used to guide both Project execution and Project control. Primary uses of Project plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines. Project plan may be summary or detailed.
- .31 Project Planning: development and maintenance of Project Plan.
- .32 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of Project Work in relation to established milestones.
- .33 Project Schedule: planned dates for performing activities and 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.
- .34 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
- .35 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on Project's objectives.
- .36 Scheduled Finish Date (SF): point in time that Work was scheduled to finish on activity. Scheduled finish date is normally within range of dates delimited by early finish date and late finish date.
- .37 Scheduled Start Date (SS): point in time that Work was scheduled to start on activity. Scheduled start date is normally within range of dates delimited by early start date and late start date.
- .38 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.
- .39 Work Breakdown Structure (WBS): deliverable-oriented grouping of project elements that organizes and defines total Work scope of Project. Each descending level represents increasingly detailed definition of Project Work.

1.3 SYSTEM DESCRIPTION

- .1 Construction Progress Schedule (Project Time Management): describes processes required to ensure timely completion of Project. These processes ensure that various elements of Project are properly co-ordinated. It consists of planning, time estimating, scheduling, progress monitoring and control.

- .2 Planning: this is most basic function of management, that of determining presentation of action and is essential.
 - .1 It involves focusing on objective consideration of future, and integrating forward thinking with analysis; therefore, in planning, implicit assumptions are made about future so that action can be taken today.
 - .2 Planning and scheduling facilitates accomplishment of objectives and should be considered continuous interactive process involving planning, review, scheduling, analysis, monitoring and reporting.
- .3 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made. This implies progressively more reliability of scheduling data. Detail Project schedule is used for analysis and progress monitoring.
- .4 Ensure project schedule efficiencies through monitoring.
 - .1 When activities begin on time and are performed according to estimated durations without interruptions, original Critical Path will remain accurate. Changes and delays will however, create an essential need for continual monitoring of Project activities.
 - .2 Monitor progress of Project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
 - .3 Monitoring should be done sufficiently often so that causes of delays are immediately identified and removed if possible.
- .5 Project monitoring and reporting: as Project progresses, keep team aware of changes to schedule, and possible consequences. In addition to Bar Charts and CPM networks, use narrative reports to provide advice on seriousness of difficulties and measures to overcome them.
 - .1 Narrative reporting begins with statement on general status of Project followed by summarization of delays, potential problems, corrective measures and Project status criticality.

1.4 CPM REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedule are practical and remain within specified Contract duration.
- .2 Master Plan and Detail Schedule deemed impractical by Departmental Representative to be revised and resubmitted for approval.

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

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative Project Control System for planning, scheduling, monitoring and reporting of project progress.

- .3 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.
- .4 Refer to article "Progress monitoring and reporting" of this specification Section for frequency of Project control system submittals.
- .5 Submit Project planning, monitoring and control system data as required by Departmental Representative in following form.
 - .1 Electronic files in original scheduling software Microsoft Project containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update.
 - .2 Master Plan Bar Chart.
 - .3 Construction Detail schedule Bar Chart.
 - .4 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.
 - .5 Criticality report listing activities and milestones with total float used as first sort for ready identification of critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
 - .6 Progress report including columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

1.6 QUALITY ASSURANCE

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

1.7 PROJECT MEETING

- .1 Meet with Departmental Representative within 5 working days of Award of Contract date, to establish Work requirements and approach to project construction operations.

1.8 WORK BREAKDOWN STRUCTURE (WBS)

- .1 Prepare construction Work Breakdown Structure (WBS) within 10 working days of Award of Contract date. Develop WBS through at least five levels: Project, stage, element, sub-element and work package.

1.9 MASTER PLAN

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Plan (CPM logic diagram) and dependent Cash Flow Projection to confirm validity or alternates of identified milestones.
 - .1 Master Plan will be used as baseline.
 - .1 Revise baseline as conditions dictate and as required by Departmental Representative.
 - .2 Departmental Representative will review and return revised baseline within 5 work days.
- .3 Reconcile revisions to Master Plan and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Plans will include:
 - .1 CD containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.
 - .2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
 - .3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
 - .4 Actual/projected monthly cash flow: expressed monthly and shown in both graphical and numerical form.

1.10 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within 15 working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
 - .1 Shop drawings.
 - .2 Complete Security forms for all the workers present on site.
 - .3 Samples.
 - .4 Safety prevention program.
 - .5 Permit demand.

- .6 Approvals.
- .7 MobilisationProcurement.
- .8 Demoliton.
- .9 Construction.
- .10 Equipment delivery.
- .11 Installation.
- .12 Site works.
- .13 Testing.
- .14 Commissioning and acceptance.
- .2 Detail CPM schedule to cover project duration.
 - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
- .3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Plan.
- .4 Clearly show sequence and interdependence of construction activities and indicate:
 - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
 - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
 - .1 Time for submittals, resubmittals and review.
 - .2 Time for fabrication and delivery of manufactured products for Work.
 - .3 Interdependence of procurement and construction activities.
 - .3 Include sufficient detail to assure adequate planning and execution of Work.
- .5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.

- .6 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.
- .7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Departmental Representative for review effects created by insertion of new Change Order.

1.11 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE

- .1 Allow 5 work days for review by Departmental Representative of proposed construction Detail Schedule.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Departmental Representative for review within 5 work days.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Departmental Representative.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.12 COMPLIANCE WITH DETAIL SCHEDULE

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after receipt of approval by Departmental Representative.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel on site for effected activities or work package.
 - .2 Increase in materials and equipment.
 - .3 Overtime work and additional work shifts.

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

1.13 PROGRESS MONITORING AND REPORTING

- .1 On ongoing basis, Detail Schedule on job site must show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update monthly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes. The updated schedule must be submit with all the payment demands to be able to complete the payment recommendation.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Departmental Representative (1) electronic copy of updated Detail Schedule.

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

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 45 00 - Quality Control.

1.2 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 co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify 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 co-ordinated.
- .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 review.
- .10 Keep one reviewed copy of each submission on site.

1.3 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.

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- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Quebec Province of 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 co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
 - .4 Allow ten (10) 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, 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.
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- .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 three (3) prints and one (1) electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
 - .11 Submit three (3) prints and 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.
 - .12 Submit one (1) electronic copie 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 accord with specified requirements.
 - .2 Testing must have been within three (3) years of date of contract award for project.
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- .13 Submit three (3) copies 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.
 - .14 Submit three (3) copies of manufacturers 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.
 - .15 Submit three (3) copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
 - .16 Submit three (3) copies 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.
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- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 SAMPLES

- .1 Submit for review samples in as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's site office.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by 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 samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

1.6 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, fine resolution monthly with progress statement and as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 2 locations.
- .4 Frequency of photographic documentation: monthly or as directed by Departmental Representative.

1.7 CERTIFICATES AND TRANSCRIPTS

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

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

1.8 SPECIAL CONDITION

- .1 Submit the chiller and the condenser unit shop drawing two weeks after the contract granting.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 PURPOSE**

- .1 To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.

1.2 DEFINITIONS

- .1 "Contraband" means:
 - .1 An intoxicant, including alcoholic beverages, drugs and narcotics;
 - .2 A weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization;
 - .3 An explosive or a bomb or a component thereof;
 - .4 Currency over any applicable prescribed limit \$50.00, and;
 - .5 Any item not described in paragraphs .1 to .4 that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
 - .2 "Unauthorized Smoking Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing or snuffing tobacco, cigarette making machines, matches and lighters.
 - .3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
 - .4 "CSC" means Correctional Service Canada.
 - .5 "Director" means Director or Warden of the Institution as applicable or their representative.
 - .6 "Construction employees" means persons working for the general contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
 - .7 "Departmental Representative" means the Public Works and Government Services Canada (PWGSC) or the Correctional Service Canada (CSC) project manager depending on project.
 - .8 "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.
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- .9 "Construction zone" means the area as shown on the contract drawings where the contractor will be allowed to work. This area may or may not be isolated from the security area of the institution.

1.3 PRELIMINARY PROCEEDINGS

- .1 Prior to the commencement of work, the contractor shall meet with the Director to:
- .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 The contractor will:
- .1 Ensure that all construction employees are aware of the CSC security requirements.
 - .2 Ensure that a copy of the CSC security requirements is always prominently on display at the job site.
 - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all construction employees.

1.4 CONSTRUCTION EMPLOYEES

- .1 Submit to the Director a list of the names with date of birth of all construction employees to be employed on the construction site and a security clearance form for each employee.
- .2 Allow two (2) weeks for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at the institution where the project is taking place.
- .3 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .4 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
- .1 Appear to be under the influence of alcohol, drugs or narcotics.
 - .2 Behave in an unusual or disorderly manner.
 - .3 Are in possession of contraband.

1.5 VEHICLES

- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the owner or an employee of the company that owns the vehicle.
- .2 The director may limit at any time the number and type of vehicles allowed within the Institution.
- .3 If the Director permits trailers to be left inside the secure perimeter of the Institution, these trailer doors will be locked at all times. All windows will be securely locked when left.
- .4 Unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter must be locked when not in use.

1.6 PARKING

- .1 Refer to section 01 11 11 - General Works Informations for the parking restriction.

1.7 SHIPMENTS

- .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the institution's own shipments. The contractor must have its own employees on site to receive any deliveries or shipments. CSC staff will **NOT** accept receipt of deliveries or shipments of any material equipment or tools for the contractor.

1.8 TELEPHONES

- .1 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, BlackBerries, telephones used as 2-way radios, are in the work area., the cellular telephone uses is restricted for any inmate.
- .2 The Director may approve but limit the use of two way radios.

1.9 WORK HOURS

- .1 Work hours within the Institution are: Monday to Friday 07:30 a.m. to 4:00 p.m.
 - .2 Work will not be permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waved by the Director.
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1.10 OVERTIME WORK

- .1 No overtime work will be allowed without permission of the Director. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such as the completion of a concrete pour or work to make the construction safe and secure, the contractor shall advise the Director as soon as this condition is known and follow the directions given by the Director. Costs to Canada for such events may be attributed to the contractor.
- .2 When overtime work, weekend statutory holiday work is required and approved by the Director, extra staff members may be posted by the Director or his designate, to maintain the security surveillance. The actual cost of this extra staff may be attributed to the contractor.

1.11 TOOLS AND EQUIPMENT

- .1 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
- .2 Store all tools and equipment in approved secure locations.
- .3 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor.
- .4 Scaffolding shall be secured and locked when not erected and when erected, shall be secured in a manner agreed upon with the director.
- .5 All missing or lost tools or equipment shall be reported immediately to the Director.
- .6 If propane or natural gas is used for heating the construction, the institution will require that an employee of the contractor supervise the construction site during non-working hours.

1.12 PRESCRIPTION DRUGS

- .1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.

1.13 SMOKING RESTRICTIONS

- .1 Contractors and construction employees are not permitted to smoke inside correctional facilities or outdoors within the perimeter of a correctional facility and must not possess unauthorized smoking items within the perimeter of a correctional facility.
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- .2 Contractors and construction employees who are in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist, will be directed to leave the institution.
- .3 Smoking is only permitted outside the perimeter of a correctional facility in an area to be designated by the Director.
- .4 The cigarette end must be disposed in the ashtrays installed in the area designated by the Director.

1.14 CONTRABAND

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.
- .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.
- .3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.
- .4 Presence of arms and ammunitions in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the drivers of the vehicles.

1.15 SEARCHES

- .1 All vehicles and persons entering institutional property may be subject to search.
- .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband or unauthorized items, he may order that person to be searched.
- .3 All employees entering the Institution may be subject to screening of personal effects for traces of contraband drug residue.

1.16 ACCESS TO AND REMOVAL FROM INSTITUTIONAL PROPERTY

- .1 Construction personnel and commercial vehicles will not be admitted to the institution after normal working hours, unless approved by the Director.

1.17 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY

- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.

- .2 However, notwithstanding paragraph above, the Director may:
 - .1 Prohibit or restrict access to any part of the institution.
 - .2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when escorted by a member of the CSC security staff or a Commissionaire.
 - .3 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to leave the institution. The construction employees are only permitted to eat within their construction trailer.

1.18 SURVEILLANCE AND INSPECTION

- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

1.19 STOPPAGE OF WORK

- .1 The Director may order at any time that the contractor, its employees, sub-contractors and their employees to not enter or to leave the work site immediately due to a security situation occurring within the Institution. The contractor's site supervisor shall note the name of the CSC staff member giving this instruction, the time of the request and obey the order as quickly as possible.
- .2 The contractor shall advise the Departmental Representative of this interruption of the work within 24 hours.

1.20 CONTACT WITH INMATES

- .1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any construction employee doing any of the above will be removed from the site and his security clearance revoked.
- .2 It is to be noted that cameras are not allowed on CSC property.
- .3 Notwithstanding the above paragraph, if the Director approves of the usage of cameras, it is strictly forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this contract.

1.21 COMPLETION OF CONSTRUCTION PROJECT

- .1 Upon completion of the construction project or, when applicable, the takeover of a facility, the Contractor shall remove all remaining construction material, tools and equipment that are not specified to remain in the Institution as part of the construction contract.

END OF SECTION

PART 1 - GENERAL**1.1 SECTION INCLUDES**

- .1 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 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 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.

1.4 SUBMITTALS

- .1 Submit the documents required according to section 01 33 00 - Submittal procedures.
- .2 Submit to Departmental Representative, the site-specific safety program, as outlined in 1.7 at least 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 Departmental Representative the site inspection sheet, duly completed, at the intervals indicated in 1.12.1.
- .4 Submit to Departmental Representative within 24 hours a copy of any inspection report, correction notice or recommendation issued by federal or provincial inspectors.
- .5 Submit to Departmental Representative within 24 hours an investigation report for any accident involving injury and any incident exposing a potential hazard.

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- .6 Submit to Departmental Representative all safety data sheets for hazardous material to be used at the site at least three days before they are to be used.
 - .7 Submit to 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 in confined spaces;
 - .5 Lockout procedures;
 - .6 Wearing and fitting of individual protective gear;
 - .7 Forklift truck;
 - .8 Positioning platform;
 - .9 Any other requirement of Regulations or the safety program.
 - .8 Medical examinations: wherever legislation, regulations, directives, specification or a safety program require medical examinations, Contractor must:
 - .1 Prior to start-up, submit to 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 1.7.3, 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 Departmental Representative.
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- .11 Plans and certificates of compliance: Submit to the CSST and to Departmental Representative a copy signed and sealed by 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 rule with the CSST, i.e. that he had pay out all the benefits concerning this contract. This document must be delivered to Departmental Representative at the end of the work.

1.5 HAZARDS ASSESSMENT

- .1 The contractor must identify all hazards inherent in 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 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 Departmental Representative a certificate of compliance signed by a qualified mechanic. Whenever he suspects a defect or accident risk, 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 Departmental Representative.

1.6 MEETINGS

- .1 Contractor 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.4).

1.7 SITE-SPECIFIC CONDITIONS

.1 At the site, the contractor must take account of the following specific conditions:

.1 Roofing works:

.1 Fall protection:

.1 Guardrails:

.1 Installation of guardrails is mandatory. PWGSC may specify certain restrictions with regard to anchoring, in which case the Contractor must make sure that the guardrails meet all of the requirements in section 3.8 of the *Safety Code for the Construction Industry (L.R.Q., S-2.1, r.4)*

.2 The Contractor agrees not to remove the guardrails until the project is completed. The Engineer will authorize their removal when he is able to attest that all of the work, inspections and corrections required have been carried out.

.2 Harnesses:

.1 Workers installing the guardrails shall wear safety harnesses.

.2 Workers installing and modifying guardrails or flashing shall wear safety harnesses in the event guardrails must be moved temporarily.

.3 Workers shall wear safety harnesses when receiving material and giving directions to the crane operator next to a drop.

.4 Safety harnesses shall be worn when carrying out work next to a drop where collective protection is not sufficiently safe.

.5 The Contractor shall provide a fastening method and safety cable system compliant with section 2.10.12 of the *Safety Code for the Construction Industry (L.R.Q., S-2.1, r.4)* for each work site or location.

.3 Ladders:

.1 All ladders must be at least three rungs taller than the access landing.

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- .2 All ladders must be attached at their summit so that they cannot slide sideways. The Contractor shall implement a system so that this regulation is abided by during finishing (flashing, etc.).
 - .4 Scaffolding:
 - .1 All scaffolding must be inspected and assembled as outlined in the *Safety Code for the Construction Industry (L.R.Q., S-2.1, r.4)*.
 - .2 As needed, plans and compliance certifications must be provided to the Engineer before work begins.
 - .3 The Contractor shall make sure that all workers are always protected from falls during scaffolding assembly, as provided in article 3.9.4.5 of the *Safety Code for the Construction Industry (L.R.Q., S-2.1, r.4)*.
 - .2 Lifting material:
 - .1 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.
 - .2 For all winch installations, the Contractor shall provide the Engineer 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 loadbearing capacity, the amount, weight and location of counterweight and any other detail that may affect the capacity and stability of the device.
 - .3 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.
 - .4 Lifting devices shall be positioned in such a way that loads are not carried over workers, occupants or the public.
 - .5 The entire lifting area shall be closed off to prevent non-authorized people from entering it.
 - .6 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.
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- .7 The Contractor shall carefully inspect all of the slings and lifting accessories and make sure that those in poor condition are destroyed or scrapped.
 - .8 Compressed-gas cylinders shall be lifted with a basket specially designed for this purpose.
 - .3 Protection against burns:
 - .1 Individuals assigned to the boilers shall wear long sleeves, safety glasses and a face shield when filling the boilers.
 - .2 Individuals working with asphalt or other hot liquids shall wear gloves, long sleeves and safety glasses.
 - .4 Protection against fire:
 - .1 At the beginning of each shift on every site, the Contractor shall obtain a Hot Work Permit issued by the person in charge of the work location.
 - .2 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.
 - .3 An individual shall be appointed to inspect (fire) continuously for a period of one hour 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 one hour period.
 - .4 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.
 - .5 Compressed gas, fuel tanks or containers must be stored at least 10 m from any buildings.
 - .6 The number of propane cylinders on the roof shall not exceed the number of cylinders necessary for a day's work, and cylinders shall at all times be secured upright or held in a cart designed for this purpose.
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- .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 the CAN/CSA B149.2 standard is approved and authorized by the Engineer.
- .5 Material and waste management.
- .1 On the roof, light material and sheet material shall be kept in containers or be securely fastened. In the event this requirement is disregarded in the slightest way, the Engineer may disallow the storage of materials on the roof.
 - .2 The preceding paragraph also applies to waste.
 - .3 Waste shall be discarded as produced using a waste chute or appropriate containers.
 - .4 All waste must be removed from the roof at the end of shifts.
 - .5 Unless otherwise authorized by the Engineer, all waste bins must be placed at least 3 m from any structure or building.
- .6 General protection and work site organization.
- .1 Regardless of the circumstances and the nature of the work, individuals with access to the work site must wear protective footwear and hard hats. The Contractor shall provide chin cups or ratchet suspension helmets to workers who must bend over or crouch down.
 - .1 Covered passageways shall be set up to protect all entrances and exits.
 - .2 A safety perimeter on the ground must be placed under the work zone in order to protect the public and the occupants.
 - .3 The ground work site, material handling area and boiler area shall be clearly sealed off to prevent occupants or the public from accessing the site and areas.
 - .4 Before installing any device that may emit gas or fumes, the Contractor shall receive authorization from the person in charge of the work site, who shall make sure that there is no risk of gas or fumes infiltrating the building's ventilation system.
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- .2 The Contractor shall make sure that the work site is kept clean and tidy for the duration of the work.
 - .3 Copies of material safety data sheets of all controlled products shall be forwarded to the Engineer and to the person responsible of the work site before work begins.
 - .4 The Contractor shall provide sanitary facilities and rest areas compliant with requirements of the *Safety Code for the Construction Industry*.
- .2 Lifting material works:
- .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 Engineer 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 plan of lifting for the handling of loads above occupied buildings. Engineer can, if judge necessary, impose work of evening and weekend.
 - .3 All mobile cranes manufactured after January 1st 1980 must be equipped with a safety device against overload.
 - .4 All mobile cranes with cables manufactured after January 1st 1970, except if they are used for other end than lifting loads, must be provided with a safety device against two-blocking. Regarding mobile cranes with cables manufactured before January 1st 1970, they will have to be equipped with the device at the latest on December 31st 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 Engineer 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.
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- .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.
- .3 Work in high:
- .1 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.
 - .2 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.
 - .3 Every person using an elevating platform must have a training regarding this equipment.
 - .4 Wearing of safety harness is obligatory in any elevating platform with telescopic, articulated or rotary boom.
 - .5 Delimit a danger zone in any place where equipment for work in height is used.
 - .6 Everyone who works within 3 m from the edge of a roof must use a safety harness in accordance with the regulation, unless there is presence of a guardrail on the perimeter of the roof which is between 900 mm to 1,100 mm high.
- .4 Hot work:
- .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 "Hot Work Permit" of PWGSC (ELF 367) completed by the Manager in Charge of Worksite when the duties to be undertaken involve hot work.
 - .3 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.
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- .4 An individual shall be appointed to do continuous monitoring of the fire risks for a period of one hour 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 one hour period.
- .5 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.
- .6 All of the cylinders used or stored on the work site shall be equipped with a collar designed to protect the valve.
- .7 Filling the cylinders on the work site is forbidden, unless a procedure compliant with the *CAN/CSA B149.2* standard is approved and authorized by the Engineer.
- .8 Welding and cutting:

Note: For welding and cutting activities, make sure that the following conditions are met moreover that the ones mentioned above.

- .1 The works must be carried out in accordance with the sections "3.13 Compressed gas supply" and "3.14 Welding and cutting" of the *Safety Code for the construction industry, S-2.1, r. 6*.
- .2 The welding and cutting devices are excessively dangerous with regard to the fire risk on the building work place. The following precautions must be taken at the time of this type of work:
 - .1 Store all compressed gas cylinder on a fireproof fabrics 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 the article 3.13.4 of the *Safety Code for the construction industry, S-2.1, r. 6*.
 - .3 Set up fireproof fabrics when work of welding is done in superposition and that there is risk of spark fall.
 - .4 Store the bottles far from all heat sources.

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- .5 Not to store the bottles close to the staircases, exits, corridors and elevators.
 - .6 Not to put acetylene in contact with metals 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 equipments with electric arc has the necessary tension and are grounded.
 - .8 Ensure that the conducting wire of the electric welding equipment are not damaged.
 - .9 Place the welding equipment on a flat ground away from the bad weather.
 - .10 Move away or protect the combustible materials which can be near the welding equipment.
 - .11 Prohibition to weld or cut any closed container.
 - .12 Envisage protection measures when welding or cutting is carried out near drains, tanks or other containers containing inflammable materials.
 - .13 Do not perform any cutting, welding or work with naked flame on a container, a tank, a pipe or other container containing a flammable or explosive substance unless:
 - .1 Air Samples indicating that work can be made without danger has been taken; or
 - .2 Provisions to ensure the safety of the workers has been done.
- .5 Silica:
- .1 Preventive measures to apply to the work site:
 - .1 Source reduction methods:
 - .1 Work in wet environment or use tools with inflow of water in order to reduce dustiness, if not, 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.
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- .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 equipments:
 - .1 Wear individual respiratory protection equipments (mask) during all the operations that could generate silica dust. Select respiratory protection in accordance with the « *Guide des appareils de protection respiratoire utilisés au Québec* » http://www.prot.resp.csst.qc.ca/Guid_APR.pdf
 - .2 Wear an ocular protection (glasses or visors).
 - .3 Wear a coveralls to prevent contamination outside the worksite.
- .3 Personal hygiene:
 - .1 Do not eat, drink, or smoke in a dusty environment.
 - .2 Wash the hands and the face before drinking, eating or smoking.
- .6 Lockout:
 - .1 For every 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 Worksite.

Although the hereunder list 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 Notwithstanding the previous paragraphs, the Contractor shall, in emergency situation, receive an oral guarantee of isolation of the Manager in Charge of Worksite and immediately countersign the request of electrical isolation.
- .3 The procedure requested at paragraph 1 must comply with the principles listed in the "*Le cadenassage*" pamphlet published by the *Association paritaire pour la santé et la sécurité du travail secteur construction (ASP Construction)*.
- .4 Supervisors and all workers concerned must have followed ASP Construction's "*Les techniques de cadenassage*" course (514 355-6190 or 1-800-361-2061) or an equivalent course given by another firm.
- .5 Identify every work that must absolutely be done on live equipment and establish the safety measures that will be applied, including the personal protective equipment and complete a work permit for live equipment.

1.8 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 site containing hazardous or toxic materials.
- .3 Regardless of the publication date shown in the construction safety code, always use the most recent version.

1.9 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 take account of 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 responsibility.
 - .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 1.4. 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 the light of the site characteristics.
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1.10 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

1.11 COMMUNICATIONS AND POSTING

- .1 Make all necessary arrangements to ensure effective communication of safety and health information at the site. As they arrive on site, all workers must 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 affected workers.
- .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.

1.12 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 Departmental Representative, both verbally and in writing. Then the Contractor must modify or update the site specific safety program in order to resume work in safe conditions.

1.13 INSPECTION OF SITE AND CORRECTION OF HAZARDOUS SITUATIONS

- .1 Inspect the work site and complete the site inspection sheet at least once every 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 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 1.7 and 1.8, Departmental Representative may order cessation of work if, in his/her view, there is any hazard or threat to the safety or health of site personnel or the public or to the environment.

1.14 POWDER ACTUATED DEVICES

- .1 Use of power hammers and other explosive-actuated devices must be authorized by 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 device shall be used in accordance with the manufacturer's directions and applicable standards and regulations

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

.1 Not Used.

END OF SECTION

PART 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 instructions, or law of Place of Work.
- .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.

1.2 INDEPENDENT INSPECTION AGENCIES

- .1 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .2 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 Co-operate to provide reasonable facilities for such access.

1.4 PROCEDURES

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

1.5 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by 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 four (4) copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to manufacturer or fabricator of material being inspected or tested.

1.7 MILL TESTS

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

1.8 EQUIPMENT AND SYSTEMS

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

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 REFERENCES**

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water.
- .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 INSTALLATION AND REMOVAL

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

1.3 WATER SUPPLY

- .1 Supply of potable water for construction use is provided.
- .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.

1.4 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
- .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

1.5 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone, fax, and data hook up, line equipment necessary for own use and use of Departmental Representative.

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.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 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.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water.
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 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.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 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 and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists and cranes to be operated by qualified operator.
- .3 The lifting plan must be coordinated and approved by the Departmental Representative to avoid the technical tunnels positions present on site to assure that no damage will be done on site.

1.5 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.6 CONSTRUCTION PARKING

- .1 Refer to section 01 11 11 - Project informations for the parking restrictions description.

1.7 SECURITY

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.8 OFFICES

- .1 Provide office heated to 22°C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Keep area clean.

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.

1.10 SANITARY FACILITIES

- .1 Existing facilities located on the 2nd floor near the mechanical room access door may be used.

1.11 CONSTRUCTION SIGNAGE

- .1 Provide project identification site sign comprising, framing, and one 1,200 x 2,400 mm signboard as detailed and as described below.
 - .1 Foundations: 15 MPa concrete to CSA-A23.1 minimum 200 mm x 900 mm deep.
 - .2 Framework and battens: SPF, pressure treated minimum 89 x 89 mm.
 - .3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.
 - .4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CAN/CGSB 1.189.
 - .5 Fasteners: hot-dip galvanized steel nails and carriage bolts.
 - .6 Vinyl sign face: printed project identification, self adhesive, vinyl film overlay, supplied by Departmental Representative.
- .2 Locate project identification sign as directed by Departmental Representative and construct as follows:
 - .1 Build concrete foundation, erect framework, and attach signboard to framing.
 - .2 Paint surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
 - .3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.
- .3 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .4 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project.
- .5 No other signs or advertisements, other than warning signs, are permitted on site.

1.12 CLEAN-UP

- .1 Remove construction debris, waste materials, 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.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 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-0121-M1978(R2003), Douglas Fir Plywood.

1.2 INSTALLATION AND REMOVAL

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

1.3 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.

1.4 FIRE ROUTES

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

1.5 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.

1.6 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 locations and installation schedule three (3) days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 REFERENCES**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .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 born 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 in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 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 and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of 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 name plates.

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 with products. Obtain written instructions directly from manufacturers.
- .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 co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 REMEDIAL WORK

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

1.10 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.

1.11 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.

1.12 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 in greenhouses and outdoor.
- .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.

1.13 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.

1.14 EXISTING UTILITIES

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

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

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2 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.

1.3 MATERIALS

- .1 Required for original installation.
-

- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.4 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.

1.5 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, 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 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.

- .12 Refinish surfaces to match adjacent finishes; Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
- .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.
- .12 Maintain clean all area used for the completion of the project including the corridors, the stairway, the principal building entrance and the pathway between the building and the trailer.

1.3 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
 - .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 products and debris other than that caused by Owner or other Contractors.
 - .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
 - .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
 - .7 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.
 - .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, fitments 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 Clean and sweep roofs, gutters, areaways, and sunken wells.
 - .15 Sweep and wash clean paved areas.
 - .16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
 - .17 Clean roofs, downspouts, and drainage systems.
 - .18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
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- .19 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 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 Plan and Goals.
- .2 PWGSC's Waste Management Goal 75 percent of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.
- .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 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.
- .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling 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.
- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate Condition: refers to waste sorted into individual types.
- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.4 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Reduction Workplan.

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
 - .1 Submit two (2) copies of completed Waste Reduction Workplan (WRW): Schedule A.
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
 - .1 Failure to submit could result in hold back of final payment.

1.6 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 for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Provide waybills for separated materials.

1.7 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, or 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 from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.
- .6 Dispose of all the toxique or dangerous waster in the bin accordingly to the hazardous materials regulation, all the hazardous materials must accord with the elimination and/or disposition requirements.
- .7 The destruction certificate or the proof that dangerous product has been recycled or recuperated must be submit to the Departmental Representative.

1.8 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility.

1.9 SCHEDULING

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

PART 2 - PRODUCTS

- .1 Not Used.

PART 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 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

- .1 Schedule B - Government Chief Responsibility for the Environment:

Province	Address	General Inquires	Fax
Québec	<i>Ministère de l'Environnement et de la Faune, Siège social 150, boul, René-Lévesque Est Québec (Qc) G1R 4Y1</i>	418.643.3127 800.561.1616	418.646.5974
	<i>Conseil de la conservation et de l'environnement 800, place d'Youville, 19^e étage Québec (Qc) G1R 3P4</i>	418.643.3818	

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 74 11 - Cleaning.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify 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 English and 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 Utility companies: submitted.
 - .5 Operation of systems: demonstrated to the Departmental Representative.
 - .6 Commissioning of mechanical systems: completed in accordance with Section 01 91 00 - Commissioning - Mechanical and Electrical Installation and

copies of final Commissioning Report submitted to Departmental Representative.

.7 Work: complete and ready for final inspection.

.4 Final Inspection:

.1 When completion tasks are done, request final inspection of Work by Departmental Representative and Contractor.

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

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

PART 2 - PRODUCTS

.1 Not Used.

PART 3 - EXECUTION

.1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 31 19 - Project Meetings.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one (1) week prior to contract completion with 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, three (3) final copies of operating and maintenance manuals in English and French. The substantial performance of the work will be done only after the reception of the closeout documentation submittal.

- .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 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 91 41 - Commissioning: Training.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
 - .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.
- .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 co-ordination drawings, with installed colour coded piping diagrams.
 - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
-

- .15 Additional requirements: as specified in individual specification 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.
 - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

1.10 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to 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 specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.

- .4 Receive and catalogue items.
 - .1 Submit inventory listing to 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 specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to 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 approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.

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- .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 Conduct joint four (4) month and nine (9) month warranty inspection, measured from time of acceptance, by Departmental Representative.
 - .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include HVAC balancing, greenhouse equipment, transformers, and commissioned systems such as greenhouse control system.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
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- .4 Name and phone numbers of manufacturers or suppliers.
- .5 Names, addresses and telephone numbers of sources of spare parts.
- .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .4 Contractor's plans for attendance at four (4) and nine (9) month post-construction warranty inspections.
- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
- .1 Failure to respond will be cause for the 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.

PART 2 - PRODUCTS

.1 Not Used.

PART 3 - EXECUTION

.1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 CODES AND STANDARDS**

- .1 ASHRAE Guideline 0-2005.
- .2 ASHRAE Guideline 1.1-2007.
- .3 Building Commissioning Association Standard (BCA).
- .4 ACG - Commissioning Guideline.
- .5 Commissioning Guide for the New Construction ("CanmetÉnergie/Ressources naturelles Canada").
- .6 CSA-Z320-11 - Building Commissioning.

1.2 OBJECTIVES

- .1 The commissioning is a quality process that aims to ensure that all building systems reach the planned objectives. This methodology begins with the design phase and continues to project construction and acceptance with the verification of system performance, and validation, optimization of operating sequence. The main goals of the commissioning are:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent;
 - .2 Complete project on schedule;
 - .3 Verify and document performance of all systems and equipments;
 - .4 Ensure appropriate documentation is compiled into the Building Management Manual;
 - .5 Effectively train O&M staff;
 - .6 Optimize life cycle costs of equipment and improve the energy performance of systems;
 - .7 Reduce operating costs and maintenance.

1.3 RELATED DOCUMENTS

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

- .2 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .3 Section 23 08 02 -Cleaning and Start-Up of Mechanical Piping Systems
- .4 Section 23 21 14 - Hydronic Accessories.
- .5 Section 23 21 23 - Hydronic Pumps.
- .6 Section 23 25 00 - HVAC Water Treatment Systems.
- .7 Section 23 64 16 - Chillers.
- .8 Section 23 65 10 - Cooling Tower.
- .9 Section 25 90 01 - EMCS : Site Requirements, Applications and Systems Sequences of Operation.
- .10 Section 26 29 10 - Starter.
- .11 Section 26 50 00 - Lighting.

1.4 DEFINITION

- .1 The Cx Authority/Agent (Stantec): Person appointed by the Departmental Representative to lead the process of CX and submit a final report to the Departmental Representative on performance of the systems and the whole process.
- .2 Cx Team: The team members are Cx Authority, the project manager, the representative of the Departmental Representative, the Architect, the design Engineer, the General Contractor, the equipment suppliers and the Subcontractors.
- .3 Commissioning Plan: An evolutive document that defines the activities of the Cx project, the schedule, the documentation requirements, and the roles and responsibilities of team members.
- .4 Cx Calendar: General Contractor shall coordinate with the Cx Authority to establish a protocol and a timetable for Cx systems and equipment, which will be updated with progress.
- .5 Deficiencies and Noncompliances Register: It is an official and evolutive directory of the deficiencies and anomalies (with solution when required) that the Cx Authority or other member of the Cx team will have observed during the process.
- .6 Cx Form: Document containing the performance data collected during the static tests (dynamic) carried out on equipment and systems.
- .7 Installation Control Form: Forms provided by the manufacturer or the engineer, which include checklist for proper installation of equipment.

- .8 Cx Coordinator of the Contractor: Person at the service of the Contractor, responsible for coordinating the activities of the commissioning.
- .9 Cx Coordinator of the Owner: Person at the service of the Owner, responsible for coordinating the activities and for supporting the commissioning activities.

1.5 ACRONYMS

- .1 Cx: Commissioning.
- .2 OPR: Owner's Project Requirements.
- .3 BOD: Basis of design.
- .4 TAB: Testing, Adjusting and Balancing.
- .5 A/E: Architect/Design Engineers.
- .6 CxRO: Commissioning Representative for the Owner.
- .7 CxRC: Commissioning Representative for the Contractor.
- .8 BAS: Building Automation System.

PART 2 - CX STEPS

2.1 CX PROCESS

- .1 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx;
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures;
 - .3 Sets out deliverables relating to O&M, process and administration of Cx;
 - .4 Describes process of verification of how works meet design requirements;
 - .5 Produces a complete functional system prior to issuance of the certificate of occupancy;

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- .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx;
 - .2 Commissioned systems (refer to Commissioning plan appendix 1);
 - .3 Construction checklists (refer to Commissioning plan appendix 2);
 - .4 The overview of the Cx activities during the pre-design, design, construction, occupation, and operation phases;
 - .5 Cx schedule;
 - .6 Process and methodology for successful Cx;
 - .7 The expected objectives and results of the Cx;
 - .8 The list of team members, their responsibilities and expected deliverables;
 - .9 The training documents.
 - .2 Refinement of Cx Plan: During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from Client program modifications;
 - .2 Approved design and construction changes;
 - .3 Results of previous steps.
 - .3 Overview of the process:
 - .1 Develop the Owner's Project Requirements (OPR), and ensure they are included in the basis of design (BOD).
 - .2 Develop a Cx plan and presenting it to the Cx team at the starting meeting.
 - .3 Coordinate with Contractors to establish a methodology for functional tests of equipments.
 - .4 Develop a record of anomalies and deficiencies.
 - .5 Oversee staff training.
 - .6 Reviewing operation and maintenance manuals.
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- .7 Optimize and validate the sequences of operation and solve the identified problems.

2.2 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.

2.3 COMPOSITION AND RESPONSIBILITIES OF CX TEAM

- .1 Cx Authority:
 - .1 Organize and lead the Cx team.
 - .2 Develop a Cx plan and include it in the construction document as well as updating it regularly.
 - .3 Organize and conduct Cx meetings, and draw up the minutes.
 - .4 Provide the Construction Checklists.
 - .5 Perform site inspections, check functional performance and attend tests.
 - .6 Oversee the process of training staff.
 - .7 Review operation and maintenance manuals.
 - .8 Maintain up to date the list of the validity dates of the guarantees.
 - .9 Approve or oversee the Cx balancing reports and sequences of control in collaboration with the Engineer.
 - .10 Prepare a final Cx report summarizing undertaken works and the results of all tests.
 - .11 Issuing a Cx acceptance report to validate the certificate of provisional acceptance.
- .2 Engineers and architects:
 - .1 Assist to Cx meetings.
 - .2 Verify installations.
 - .3 Attend selectively to installation Cx.

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- .4 Make lists of deficiencies relating to the installation and testing.
 - .5 Provide appropriate training sessions on the concept and the objectives of different systems.
 - .6 Verify Cx reports.
 - .7 Help resolve any problem related to the design, equipment, installation or operation.
- .3 Contractors, Contractor's representative and Sub-contractors:
- .1 Assist to Cx meetings.
 - .2 Consolidate Cx steps in the construction schedule.
 - .3 Perform tests and functional tests on equipments and systems.
 - .4 Fill the Construction Checklists.
 - .5 Complete and provide to the Cx Authority the Cx schedule.
 - .6 Submit the different required reports.
 - .7 Coordinate and convene manufacturer representatives at the different steps of the Cx and to the meetings when requested.
 - .8 Produce operation and maintenance manuals.
 - .9 Provide training sessions required for installed equipments as recommended by the Cx Authority.
 - .10 Correct deficiencies.
 - .11 Issue the appropriate warranties.
- .4 Departmental Representative, Users and Operation and Maintenance Members:
- .1 Attend Cx meetings.
 - .2 Participate to training sessions.
 - .3 Facilitate the coordination work between the Cx Authority and the General Contractor.
 - .4 Raise any issues found during the Cx.
 - .5 Follow the process and work with the Cx Authority.
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2.4 MANUFACTURER'S INVOLVEMENT

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor.
 - .1 Equipment and systems except as noted.
- .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer:
 - .1 To include performance verification.
- .3 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing;
 - .2 Provide testing documentation for approval by Cx Authority;
 - .3 Arrange for Cx Authority to witness tests;
 - .4 Obtain written approval of test results and documentation from Cx Authority before delivery to site.
- .4 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Cx Authority:
 - .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.
- .5 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
 - .3 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems;
 - .2 Ability to interpret test results accurately;
 - .3 To report results in clear, concise, logical manner.

- .6 Specialized companies: required participation in the case of equipments and systems supplied and installed by a specialist company.

2.5 COMMISSIONED SYSTEMS

- .1 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems.
 - .1 Domestic CWS and HWS.
 - .2 Regular sanitary waste systems.
 - .3 Sewage pumps.
 - .4 Storm water systems.
 - .5 Sump pumps.
 - .6 Cooling and heating systems.
 - .2 HVAC and exhaust systems.
 - .1 HVAC ducts and systems.
 - .2 Exhaust systems.
 - .3 Chiller and boilers.
 - .3 Fire and life safety systems.
 - .1 Wet pipe sprinkler systems.
 - .2 Standpipe and hose systems.
 - .3 Fire extinguishers.
 - .4 Noise and vibration control systems for mechanical systems.
 - .5 Seismic restraint and control measures.
 - .6 IAQ environmental control systems.
 - .7 Building management system (BMS).
 - .8 Energy metering systems, hot water, chilled water and electricity.

- .2 Commission electrical systems and equipment:
 - .1 High voltage.
 - .1 High voltage switch gear and transformation equipment.
 - .2 High voltage distribution systems.
 - .2 Low voltage below 750 V.
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Lighting systems.
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
 - .4 Fire exit emergency signage.
 - .4 Fire alarm systems, equipment.
 - .1 Detection system.
 - .2 Signalling system.
 - .5 Other systems and equipment.
 - .1 Intrusion and access security and safety systems.

2.6 INSTRUMENTS

- .1 Each report must indicate what tools were used for measures in the report.
 - .1 Balancing devices.
 - .2 Thermometers and manometers.
 - .3 Air quality devices.
 - .4 Multimeters.
 - .5 Luxmeter.

- .2 The operation and maintenance manual must include the list of instruments used, including: serial number, the current certificate of calibration, calibration date, date of expiration of the calibration and the accuracy of the calibration.
- .3 Upon request, submit the instruments and equipments for the examination and approval by the Cx Authority.

2.7 DELIVERABLES RELATING TO THE CX PROCESS

- .1 Audit of the principles of basis of design, ensure that they meet the requirements of the Departmental Representative.
- .2 Cx Plan.
- .3 Static verification of installation and components.
- .4 Quality and performance control by using functional tests on systems and equipments.
- .5 Training Plans.
- .6 Operation and maintenance manual.
- .7 Final Cx Reports.

2.8 COMMISSIONING MEETINGS

- .1 Convene Cx meetings.
- .2 Purpose: to explain process, resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, Departmental Representative must call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter, Contractor must call CX meetings with Sub-Contractor, to be held until project completion and as required during equipment start-up and functional testing period.

- .6 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at Cx meetings when there as required.

2.9 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 Include certificates of approval, acceptance and compliance with the operation and maintenance manual, and provide copies upon request Departmental Representative.

2.10 AERAULIC AND HYDROLIC BALANCING

- .1 Perform aeraulic and hydrolic balancing, as specified in the relevant sections. Validate the balancing method with the Cx Authority or the Departmental Representative. Produce reports within 10 days after a series of interventions. Reports must indicate the observed anomalies.

2.11 CONTROL CX

- .1 Perform Cx control, as required in the relevant sections.
- .2 Submit graphic trends (30 days) for the main control loop.
- .3 Produce reports and verifications as Cx forms.

2.12 STARTUP OF INTEGRATED EQUIPMENTS

- .1 Make the startup of equipments that require prior completion of the various disciplines. These devices can be started when:
 - .1 The installation is complete.
 - .2 The power supply is checked.
 - .3 Water network balancing is completed.
 - .4 Auxiliary services are completed.

- .2 Obtain the list of manufacturers to confirm compliance of the installation before the Cx equipment.
- .3 Fill in the Cx forms of equipments, submitted by the Cx Authority or manufacturers, if they include all required information.
- .4 Cx reports shall specify the conditions under which the startup was made. These conditions include:
 - .1 External ambient conditions.
 - .2 The supply voltage.
 - .3 The pressure and supply temperature of auxiliary services.
 - .4 Any special condition that may influences the performance.
- .5 Integrated systems include the following:
 - .1 Systems related to indoor air quality.
 - .2 Automatic regulation systems for rooms.
 - .3 Fire alarm systems.
 - .4 Fire pumps and controllers.
 - .5 Emergency lighting systems.

2.13 CONSTRUCTION CHECKLISTS (STATIC VERIFICATION FORMS)

- .1 These control forms of the installation must include the following:
 - .1 Installation instructions provided by the manufacturer and controls recommended by the manufacturer.
 - .2 Specific procedures established in technical relevant section.
 - .3 Procedures considered as good practice in installation and construction of mechanical/electrical, and deemed necessary to a proper and effective operation of the equipments and systems.
- .2 The control forms for the installation, provided by the manufacturer, are also acceptable. If the Cx Authority deems them necessary, lists of additional data will be required in case of projects with special conditions.

- .3 Use control forms to verify the installation of equipments and systems involved. Confirm on the document the verifications carried out, indicate anomalies and deficiencies identified and corrective measures implemented.
- .4 Provide to the Cx Authority the control forms which have been duly signed by the subcontractor concerned or the representative of the manufacturer, once the process is completed, to confirm that the audits and inspections were actually performed. These forms will be required at the time of Cx and will be joined in the operation and maintenance manual at the project completion.
- .5 The control forms that are used in the Cx must be strictly complied with at the time of equipments and systems Cx.

2.14 FUNCTIONAL TESTINGS (DYNAMICS)

- .1 Before testing begins, check:
 - .1 That the Construction Checklist forms are available and filled.
 - .2 That the installation of components, equipments, systems and related subsystems is completed.
 - .3 That the requirements and test procedures are well understood by all interveners.
 - .4 That the design criteria, the design intention and characteristics are well understood.
 - .5 That complete Cx documentation is up to date and available.
 - .6 That the Cx calendar is up to date.
 - .7 That all systems are completely cleaned.
 - .8 That the required tests in the different sections were made and reports were submitted.
 - .9 That the TAB operations of equipments and systems are completed and that relevant reports have been submitted to Departmental Representative, for consideration and approval.
 - .10 That the provisions related to records are taken.
- .2 Length of Testing:
 - .1 All equipments and systems specified in Cx plan must be subjected to functional tests for a continuous period of 30 days. During this period, the Contractor shall correct the deficiencies and make necessary adjustments to optimize the systems

and obtain the specified performance. The changes must be recorded and documented.

- .2 During the testing period, conduct periodic audits and produce reports every three days to confirm the sequence of tests.
- .3 The Cx forms are documents on which are recorded the results of audits, functional tests (dynamic) and adjustments that have been carried out on equipments and systems concerned in order to ensure they work efficiently and effectively, alone or in interaction with others, as required by work.
- .4 The Cx forms also include documents on which the Contractor has recorded the readings and the data measured during functional testing and in the control process of the performance of equipments and systems concerned.

2.15 TESTS RECORDING

- .1 Before testing starts, the Contractor shall take required dispositions and set up recording equipments required to produce reports that assess test compliance.
- .2 When possible, the permanent monitoring equipment can be used if the equipments were calibrated following the procedures and using instruments with calibration certificates that have been submitted.
- .3 Equipments must be able to record the required measures every 15 or 30 minutes throughout the duration of the tests, or more frequently if required for the test validation, when requested by Departmental Representative or Cx Authority.
- .4 The required measures must allow to certify:
 - .1 The stability of the equipments and measured values.
 - .2 The proper functioning of equipments with required efficiencies under different loads, including operation at full load and at minimum conditions.
 - .3 The startup sequence of equipments.
- .5 If testing and measurement does not confirm the operation under conditions considered representative, the Cx Authority may require additional specific tests. At least one additional test will be asked for verification of networks in heating or cooling mode, depending on whether the official 30-day trials have been carried out in summer or winter.
- .6 The General Contractor shall assume the responsibilities and inspection costs, including disassembly and reassembly after approval, testing and adjustment of equipments and systems, as well as the provision of test equipment.

2.16 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 $\pm 10\%$ 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 $\pm 2\%$ of recorded values.

2.17 COMMISSIONING SCHEDULE

- .1 The General Contractor, in collaboration with the Cx Authority, prepare a detailed Cx schedule, which must include the following:
 - .1 Cx meeting program.
 - .2 Sequence of testing of equipments and systems, interrelation between the various tests, test duration and periods of training.
 - .3 Expected date of installation control of each equipment and system.
 - .4 Expected date for the Cx of each equipment and system.
 - .5 Expected date for the transmission of operation and maintenance manuals.
 - .6 Expected date for training.
 - .7 Expected date for the delivery of Cx final report.
 - .8 Expected date of seasonal tests if applicable.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over.
- .3 After approval, incorporate Cx Schedule into Construction Schedule.
- .4 The Cx team must monitor the progress of the Cx with respect to schedule and update as needed.

2.18 STANDARDS AND PROCEDURES FOR CX OF MECHANICAL INSTALLATIONS

- .1 Main piping for domestic water and fire protection water and fire hydrants.
 - .1 Start the equipments and systems as soon their installation is completed, following the procedures described in NFPA reference standards, and this, in order to protect the envelope of the new building during construction.
- .2 New domestic water connections to the main entrance.
 - .1 Place the equipment into service as soon as a temporary heat source is used to isolate this new entry of water into a temporary structure that can retain heat from the temporary heating.
- .3 Networks of Standpipe and Hose Systems.
 - .1 Provide temporary fire cabinets.
 - .2 Install equipment to ensure fire protection during construction; this equipment shall be operated only after the building is closed.
 - .3 Perform tests of installed systems in accordance with NFPA 14.
- .4 Wet automatic sprinkler systems.
 - .1 Perform tests of installed systems in accordance with NFPA 13.
- .5 Fire pumps, pressure regulators, transfer switches and controllers.
 - .1 Perform tests in accordance with NFPA 20.
 - .2 Ensure regulatory pumps have sufficient capacity to prevent the repetition start of fire pumps.
- .6 Fire protection systems integrated.
 - .1 Upon testing different systems completed, test the integrated systems to ensure that the different components work together as designed.
 - .2 Once the fire alarm connections and the Cx regulatory pressure pumps are completed, test the flow sprinklers.
- .7 Energy meters for hot water systems, chilled water and electricity.
 - .1 Make Cx of energy meters after the power systems, in order to modify the ranges and make necessary adjustments to reflect actual operating conditions.

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- .8 Plumbing systems.
 - .1 Place the water plumbing systems; conduct inspections prior to the Cx. Then proceed with rinsing, cleaning and disinfecting the systems.
 - .2 Make testing of plumbing systems and associated piping in conjunction with the test systems and water treatment systems, control/regulation related.
 - .9 HVAC systems.
 - .1 Prior to conceal HVAC systems, test and certify the air ducts, pipes and ducts to conceal in accordance with the standards indicated;
 - .2 Perform the initial audit checklists HVAC systems, subjecting them to a trial run in stand-alone mode and conduct inspections prior to the Cx.
 - .3 Do not proceed with the Cx of the HVAC systems until the construction dust generating is completed and the areas concerned have been dusted.
 - .4 Turn on HVAC systems to replace the temporary heating source, after obtaining the written approval of the Departmental Representative.
 - .5 Operate HVAC systems to allow the holding TAB operations and ensure they are fully compliant with the contract documents, once installed fire damper, caulking and sealing envelope completed, bulkheads and interior doors installed, and return air plenums in place.
 - .10 Hydraulic systems.
 - .1 Perform cleaning and rinsing of these systems once they were completed, and proceed with the initial startup of the pumps in stand-alone mode and inspections prior to the start-up were performed.
 - .2 Perform Cx hydraulic systems and ensure that water treatment systems have been commissioned.
 - .11 HVAC and hydraulic systems related.
 - .1 Test these systems in conjunction with the testing of system power management and fire and smoke detection systems.
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- .12 At this stage, the elements that may have a negative effect on the operation and maintenance must be the subject of a preliminary intervention. These elements must be commissioned simultaneously with the integrated equipments and systems.
 - .1 Integrated systems.
 - .1 Monitor performance of Building Management Systems, fire protection and other integrated systems once TAB operations of these systems are completed, to ensure their compliance with prescribed requirements.
 - .2 Vibration isolation and measurements and seismic protection devices.
 - .1 Test these devices at the same time as the test systems which they are connected to.
 - .3 Equipments and systems subject to standards and codes specified or approved by a competent authority.
 - .1 Make Cx of the equipments and systems as required by codes, standards and authorities concerned.
 - .2 Where tests are subject to regulatory requirements and that there are appropriate procedures for Cx, ensure that these tests are actually carried out in accordance with these requirements (eg codes). For the purposes of quality assurance, these tests must be performed in the presence of the Departmental Representative and Cx Authority.
- .13 Building Automation System.
 - .1 The system test performance and point to point must be performed by the Contractor under the supervision of the Departmental Representative or Cx Authority, and then checked through the control system.
 - .2 Demonstrate the operation of all systems in all operating conditions, before the trial period of 30 days, in the presence of the Departmental Representative and Cx Authority. This demonstration must include simulated trials in opposite seasons. Conduct an audit of programming and operating sequences of ECMS after TAB operations completed during the probationary period prescribed for 30 days. Data gathered during these tests must be registered to control panels or ECMS.

2.19 STANDARDS AND PROCEDURES FOR THE CX OF THE ELECTRICAL INSTALLATIONS

- .1 Facilities to be commissioned as required by applicable codes.
 - .1 When the tests are subject to regulatory requirements and appropriate Cx procedures, ensure that these tests are actually carried out in accordance with these requirements (eg. Codes).

- .2 For the purposes of quality assurance, conduct these tests in the presence of professional.
- .2 Network main distribution.
 - .1 Testing and Cx should be defined in the construction specifications.
 - .2 Submit cable feeders to insulation resistance trials.
 - .3 An independent testing agency must conduct tests preliminary to powering and prior to it.
- .3 Low voltage systems.
 - .1 These systems include low voltage lighting systems.
- .4 Backup power systems.
 - .1 Verify if the equipments connected to emergency power are properly fed.
- .5 Lighting security systems.
 - .1 Verify the operation of these systems by cutting the normal supply.
 - .2 Then verify if the area illuminated by the devices is appropriate.
- .6 Fire alarm systems.
 - .1 Make functional tests after considering all other aspects of the safety of persons and property.
 - .2 Testing shall be reviewed fully in accordance with the requirements of ULC.

2.20 CORRECTION OF DEFICIENCIES

- .1 The Cx Authority must give Cx lists of deficiencies in accordance with specific conditions.
- .2 If equipments, systems, components and control/regulation devices have been incorrectly installed or have anomalies during the Cx, correct anomalies, repeat equipments and components verification of the non operating system, including related systems therefore, if the Engineer and the Cx Authority ask for them to ensure that the system works as it should.
- .3 The Contractor shall assume all costs associated with corrections, inspections and additional tests to determine the acceptability and performance of these elements. These costs will be deducted from payments or will be retain.

2.21 VERIFICATION OF THE RESULTS

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

2.22 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Departmental Representative and Cx Authority for third and subsequent verifications where:
 - .1 Verification of reported results fails to receive Departmental Representative's approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 Departmental Representative and Cx Authority deems Contractor's request for second verification was premature.

2.23 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results according to Departmental Representative or Cx Authority, 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.

2.24 SEASONAL TESTING:

- .1 If requested by the Cx Authority, additional testing during the opposite season may be performed.

2.25 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.

2.26 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.

2.27 DEPARTMENTAL REPRESENTATIVE'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.

2.28 ACTIVITIES DURING WARRANTY PERIOD

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

2.29 TRAINING SCHEDULE

- .1 The Cx Authority, after consultation with the Departmental Representative of infrastructures and the Engineers will determine training needs. The Departmental Representative and the Cx Authority must decide the rigor of the appropriate equipment training.
- .2 Include in Commissioning Schedule time for training. Submit the training schedule and training plan for approval by the Cx Authority.
- .3 Each training responsible must provide:
 - .1 Training plan.
 - .2 List of persons that must attend training.
 - .3 Training location.

-
- .4 Objectives.
 - .5 Subjects (description, time, techniques, etc.).
 - .6 Training duration for each subject.
 - .7 Training methods.
 - .4 Coordinate trainings to be given according to the requirements of the different sections, with the initial training will be given by the Engineer.
 - .5 The training by the Engineer must include the following:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Verification of operation and maintenance documents.
 - .5 Review of all systems using simplified diagrams for the cooling water systems, water condensers or heat exhausts, heating systems, gas supply, fuel, air and exhaust system.
 - .6 The training by the Contractor must include the following:
 - .1 Review of system layout, equipment, components and controls.
 - .2 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .3 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.
 - .4 Maintenance and servicing.
 - .5 Trouble-shooting diagnosis.
 - .6 Inter-Action among systems during integrated operation.
 - .7 Deliver training during regular working hours, training sessions to be 3 hours in length.
 - .8 Training to be completed prior to acceptance of facility.
 - .9 Visual recordings of trainings can be requested by the Departmental Representative.
-

2.30 OPERATION AND MAINTENANCE MANUAL

- .1 Operating and maintenance manuals must be checked by the Cx Authority before final inspection by the Departmental Representative who retains the final copies.
- .2 Operation and maintenance manuals must include the following:
 - .1 A summary.
 - .2 The list of the Contractors and emergency information.
 - .3 Command and regulation network diagrams of each network, including ambient circuit.
 - .4 A description of each system or each installation and its control device.
 - .5 A description of the operation of each system or each installation, under various loads, with program of setpoint and indication of seasonal variations modifications.
 - .6 Instructions on the operation of each system or each facility and each component.
 - .7 A description of measures to be taken in case of equipment failure.
 - .8 A color code.
 - .9 Instructions for maintenance, repair, operation and how to identify defects in each piece of equipment.
 - .10 The information on the periodicity of tasks to be done, as well as tools, parts and time needed for all these tasks.
 - .11 The performance data provided by the equipment manufacturer stating the points of use of equipment, once the Cx is completed.
 - .12 The Cx forms for all equipments and systems.
 - .13 Any other specific performance data specified elsewhere in the contract documents.
 - .14 TAB reports for each system.
 - .15 The name, address and phone number of the manufacturer or supplier and the Contractor who performed the installation.
 - .16 The shop drawings approved.

- .17 The "As-built " drawings.
- .18 The description of the exact operation, step by step, of each system installed.
- .19 The description of the procedure, step by step, for the start up and stopping, in order to have a safe and reliable operation.
- .20 A list of the different parts of the equipment that could be replaced on a regular basis, giving the replacement interval.
- .21 The list of spare parts and the names, address and telephone numbers of suppliers of all equipment, engines and accessories supplied and installed, with reference to the appropriate section.
- .22 The final Cx report.
- .3 Approval:
 - .1 For approval, submit to the Cx Authority and to the Departmental Representative, the copy of the operation and maintenance manual draft. Unless otherwise directed by the Cx Authority and the Departmental Representative, the forms must not be submitted individually.
 - .2 Make the necessary changes in the operation and maintenance manual and resubmit as directed by the Cx Authority and the Departmental Representative.
 - .3 Provide a final copy of the operation and maintenance manual to the Cx Authority and 3 final copies to the Departmental Representative.
- .4 Additional information:
 - .1 Prepare additional information forms and attach them to the operation and maintenance manual when the demonstrations or the instruction execution described above demonstrate that such records are necessary.
- .5 The operation and maintenance manual must be presented in a ring binder and must respect the order of the sections in the specifications.

Refer to "Commissioning Plan" attached to this document.

END OF SECTION

APPENDIX

Commissioning Plan

**PUBLIC WORKS AND GOVERNMENT
SERVICES CANADA**

**Correctional Service Canada
Chiller Replacement**

Ref.: R.073166.001

**Commissioning Plan
Final Issue**



Prepared for:

PWGSC

Prepared by:

**Aboubakeur Bensikhelifa, P.Eng., CBCP
Commissioning Agent**

December 8, 2015

O/Ref.: 157100008-203-GN-S-0005-01

Sign-off Sheet

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RECORD OF REVISIONS AND ISSUES		
Revision No.	Date	Description of the modification and/or the issue
01	2015-12-08	Version 2
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INTRODUCTION

The commissioning (hereafter Cx) of a new installation is an intensive process of quality assurance which starts with the design, which continues during both the construction and operation phases.

This process guarantees that the new building operates according to the initial expectations, that it meets the Owner's requirements, that the electromechanical installations is operating according to the design criterion, and that the building maintenance staff is able to operate and to look after the various equipments and systems.

This Cx Plan is an evolutionary document that will define the Cx Activities of this project, the Cx Schedule, the documentation requirements, as well as the roles and responsibilities of the Commissioning Team.

Among other things, this plan will include:

A description of the Cx Process used in this project.

The Cx Team.

The details of the Cx Activities.

Additional details concerning the Cx Process can be found in Section 01 91 00 (Commissioning of Mechanical and Electrical System) found in the specification of works.

1.0 OVERVIEW OF THE PROCESS

1.1 DESIGN PHASE

Here is a brief description of the Cx Process during the Design Phase:

- Definition of the Cx Objectives.
- Definition of the Owner's project requirements, which will be used as guidelines for the design, the construction, and the operation of the future building.
- Development of a preliminary Cx Plan, as well as updates.
- Incorporation of Cx Requirements into Construction Specification.
- Review of the design in order to ensure that it reflects the Owner's project requirement.

1.2 CONSTRUCTION PHASE

Here is a brief description of the Cx Process during the Construction Phase:

- Organization of Cx Coordination Meetings.
- Establishment of a Cx Schedule.
- Hold a review of Workshop drawings (operation access).
- Review of the installation as well as the performance of commissioned electromechanical systems.
- Verification and optimization of the functioning sequences.
- Training updates, as well as revision of Operation and Maintenance (O&M) Manuals.
- Submission of a final Cx Report (final version of the Cx Plan).

1.3 OPERATION PHASE

Here is a brief description of the Cx Process during the Operation Phase:

- Seasonal tests to verify the operation of the systems under various conditions, when required.
- Carry out recordings and tendency analyses in order to supervise the operation parameters.

2.0 ACTIVITIES AND OBJECTIVES OF THE COMMISSIONING PROCESS

During the Construction Phase, the fixed objectives are:

- Ensure that all the Cx Team Members understand their roles.
- Establish a Cx Schedule for the Construction Phase.
- Carry out the global verification of the installation.
- Provide a set of system performance data sheets.
- Do the training follow-up as well as verify the O&M Manuals.

3.0 COMMISSIONING TEAM

TEAM MEMBER	COMPANY	RESOURCE PERSON/ TELEPHONE/ E-MAIL
Cx Authority	Stantec	Aboubakeur Bensikhelifa 514.281.1033, ext. 1617 aboubakeur.bensikhelifa@stantec.com
Owner (Technical Services)	SCC	Michel-Eric Mercier
Cx Owner Representative	PWGSC	Éric Guy Eric.Guy@tpsgc-pwgsc.gc.ca
General Contractor		
Electrical Contractor		
Balancing Contractor		
Control Contractor		
Ventilation Contractor		
Plumbing Contractor		
Fire Alarm Contractor		
Consultant		
Architects and Engineers	Stantec	Simon Nolin Simon.Nolin@stantec.com

4.0 ROLES AND RESPONSIBILITIES

ACTIVITIES	Cx A	OR	A/E	GCS
DESIGN PHASE				
Definition of Requirements Related to Operation and Maintenance	P	P	P	
Review of Basic Design	P	P	P	
Organization and Management of the Cx Team	R	P	P	
Incorporation of Cx Specifications in Construction Bid Documents	R	P	P	
CONSTRUCTION AND OPERATION PHASES				
Elaboration of a Register of Deficiencies and Anomalies, and Regular Updates	R		P	
Follow the Cx Plan and Provide Help to Solve the Deficiencies Registered	R	P	P	P
Organization of Cx Meetings	P			
Attend Cx Meetings	P	P	P	P
Submit Workshop Drawings of Systems and Equipment				
Hold a Review of a Workshop Drawings				
Develop Test Procedures to Carry Out the Tests that are Accomplished				
Hold a Review of the Cx Plan				
Develop and Hold a Record of Deficiencies and Anomalies				
Follow the Cx Plan and Help Resolve the Deficiencies				
Verify Conformity of the Installations and Solve the Deficiencies	P	P	R	P
Elaboration of a Cx Schedule and Submission to the Cx Authority for Approval	P	P	P	R
Fill the Construction Checklist Forms	P			R
Perform the Performance Tests	P	P	P	R
Submission of Various Reports and Operation Manuals Production				R
Training Sessions			P	R
Reports Verification	P	P	R	
Follow-up of the Training and Verification of Operation Manuals	P	P	P	R
Carry out the Warranty Review	P			P
Completion of a Cx Final Report Summarizing the Work Done so far	R			

P: Participant | CxA: Commissioning agent OR: Owner representative | A/E: Engineer/Architect
R: Responsible | GCS: General contractor and subs

5.0 COMMISSIONING PROCESS

This section details the Cx Activities.

5.1 DESIGN PHASE

During this phase, we have to ensure that the Owner's requirements are reflected in the basic of design and we have to obtain the required documentation as well. The needs related to the O&M must also be taken into consideration.

5.1.1 The Owner Project Requirements and the Basic of Design

The documentation of the basic of design must include the following items:

- Energy performance.
- Codes and standards applied to the project.
- Characteristics of the building's shell.
- Calculation of heat loads.
- Vibration and sound level.
- Design parameters (temperature and humidity).
- Equipment dimensioning.
- Indoor air quality.
- Lighting.
- Fire alarm zoning.
- Emergency supply systems.

5.1.2 Commissioning Plan

Elaborate a Cx Plan which will be used as guidelines during the project. This Cx Plan must include the required information and must be updated on a regular basis. The final version of the document will be used for the Cx Execution.

5.1.3 Training Requirements

The Cx Authority, in collaboration with Owner and A/E, will evaluate the needs for training, as well as its strictness, and will inform and provide this information to the people responsible of the personnel training.

Also include the training into the Cx Schedule and submit it for approval, as well as the course outline to the Cx Authority.

The training sheets are provided in Appendix 4.

5.1.4 Specifications of the Commissioning in the Bid Documents

The Cx must be incorporated in the bid documentations in order to enable tenderers to evaluate the actual needs. Moreover, tests procedures as well as responsibilities must be duly developed in the "Commissioning" section of the bid documents.

5.1.5 Design Review

A general overview of design and drawings at 40%, 95%, and 100% stages is necessary, and must include the following items:

- Make sure PWGSC Standards are met in the Design Phase.
- Verify O&M requirements.
- Ensure that the tools required for the balancing of the installation are available.
- Verify the needs for training.

5.2 CONSTRUCTION PHASE

The Cx Activities during the Construction Phase must be carried out starting from the lowest to the highest level of both systems and subsystems complexity. In general, the tests must be done in the following order:

- Static verification (e.g.: verification of components and tightness test).
- Equipment start-up (start-up and dynamic verifications).
- Verification stage-by-stage of the control.
- Balancing.
- Interaction between the systems and performance verification.

Refer to Appendix 2 for the Construction Checklist Forms.

5.2.1 Review of Workshop Drawings

The Cx Authority must carry out a selective review of workshop drawings as per Cx Requirements. This verification must include the following items:

- Make sure the equipments meet the specifications.
- Verification of information availability.
- This review does not replace the one carried out by Design Engineers.

5.2.2 Site Observation

The Cx Authority schedules periodic visits in order to supervise the system and equipment installations, those will be coordinated with the Contractors and the Owner.

The Cx Authority will develop and update the register of the deficiencies and anomalies. This register will include pictures and actions foreseen to correct these deficiencies.

Also, the Cx Authority selectively attends site meetings to be kept informed of job progress.

5.2.3 Commissioning Schedule

The General Contractor must provide, for approval, a Cx Schedule for each equipment and system. This schedule must be updated as the project progresses. Refer to Appendix 3 for the Cx Schedule.

5.2.4 Construction Checklists Forms

These verifications will allow ensuring that all equipments and systems are connected and operational, prior to conduct performance testing (examples of controlled point: oil level, the fan belt tension, labels affixed, the alignment, calibration probes, etc.).

No sampling strategy is used. In general, the Contractors will complete the forms for all equipments and systems before beginning the performance tests (see Appendix 2 for the Construction Checklist Forms).

5.2.5 Functional Testing Procedure

The functional test will serve to verify the complete operation of the systems or the equipments (rather than just components). The test procedure will include the evaluation of different modes (low load, high load, heating, cooling, unoccupied, the interaction with the fire alarm, and emergency operation, if applicable) as well as the full review of the control sequences.

The TAB of hydraulic and ventilation systems must be completed and the results approved to make the performance testing.

After each test, reports or test results will be provided to the Owner, findings and recommendations will be annotated.

These tests will be using the Energy Monitoring and Control System (EMCS).

Here are the prerequisites for these tests:

- All features of BSA are programmed, the graphics completed, as well as the fine tuning of the loops (PID).
- All plumbing pipes flushed.
- The water treatment systems functional.
- TAB air and water completed and approved.
- Deficiencies corrected.

The Contractor, under the supervision of the Cx Authority, must carry out required tests and verifications (static and dynamic) on systems and equipments in order to evaluate their performance. Results must be documented in the Cx Sheets by the Cx Authority.

5.2.6 30-day Testing

All equipments and systems specified in Cx Plan must be subjected to functional tests for a continuous period of 30 days. During this period, the Contractor shall correct the deficiencies and make necessary adjustments to optimize the systems and obtain the specified performance. The changes must be recorded and documented.

During the testing period, conduct periodic audits and produce reports every seven days to confirm the sequence of tests.

5.2.7 Commissioning Meetings

Periodic meetings must be organized with the Cx Team in order to explain the process, to obtain the information concerning the progress of the Cx, and to solve possible problems observed. Minutes of meetings will be issued by the Cx Authority.

5.2.8 Operation and Maintenance Manuals

The documentation related to Operation and Maintenance Manuals must be gathered and submitted to the Cx Authority for approval. O&M Manuals must include the following:

- Summary.
- List of Contractors and any critical information.
- Verified workshop drawings.
- Equipment data sheets.
- Preventive maintenance sheets.
- "As-built" drawings.
- Warranties.
- Workshop tests certificates and in-situ test certificates of equipments or specified systems.
- Reports of tests and networks cleaning.
- Balancing report.

5.2.9 Commissioning Final Report

The Cx Authority will provide a Cx final report which will include the following items:

- Construction Checklists.
- Various tests results.
- Training program and O&M Manuals.
- Outstanding questions.
- Recommissioning Plan.

APPENDIX 1

Commissioned Systems

COMMISSIONED SYSTEMS

ITEMS	SYSTEMS	PRESENCE REQUIRED AT THE START-UP	COMMISSIONING DOCUMENTATION	CX SCHEDULE*
HVAC Systems				
1_23 31 14	Metal Ducts	General Contractor, Ventilation, Cx Agent.	Installation Checklist, Duct Leakage Report (SMACNA Duct Leakage Test Manual)	
2_23 05 93	Testing, Adjusting and Balancing for HVAC	General Contractor, Ventilation, Control, Cx Agent.	Preliminary Report, Certification of Measuring Equipment, Balancing Report	
3_23 08 02	Cleaning and Start-Up of Mechanical Piping Systems	General Contractor, Plumbing, Control, Cx Agent	Installation Checklist, Cx Report (in Accordance with Section 23 08 02)	
4_23 21 14	Expansion Tank	General Contractor, Plumbing, Control, Cx Agent	Installation Checklist	
5_23 21 14	Backflow	General Contractor, Plumbing, Control, Cx Agent	Cx Report	
6_23 21 23	Pump	General Contractor, Plumbing, Control, Cx Agent	Installation Checklist	
7_23 65 10	Cooling Tower	General Contractor, Plumbing, Control, Cx Agent	Cx Report	
8_23 64 16	Chillers	General Contractor, Plumbing, Control, Cx Agent	Cx Report	
9_25 90 01	Operation Sequences	General Contractor, Ventilation, Plumbing, Control, Cx Agent	Installation Checklist, Cx Report (Sequences and Point-to-Point Check)	
Electrical System				
10_26 29 10	Starter	General Contractor, Electrician, Cx Agent	Installation Checklist	
11_26 50 00	Lighting Equipment	General Contractor, Electrician, Cx Agent	Installation Checklist	

APPENDIX 2

Commissioning Forms

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 1	No.:
		1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

VENTILATION SYSTEM

IDENTIFICATION	Identification:	Drawing Number:
	Location:	
	Description of System:	

REPORT	INCLUDED	N/A	COMMENTS
Cleaning	<input type="checkbox"/>	<input type="checkbox"/>	
Balancing	<input type="checkbox"/>	<input type="checkbox"/>	
Commissioning and Control	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Test	<input type="checkbox"/>	<input type="checkbox"/>	
Earthquake-Resistant Report	<input type="checkbox"/>	<input type="checkbox"/>	

MAINTENANCE REQUIREMENTS

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be completed
	<input type="checkbox"/> Out of service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 3
		1 of 2
APPENDIX 2 - COMMISSIONING FORM		

HYDRAULIC SYSTEM

IDENTIFICATION	Identification:	Drawing Number:
	Location:	
	Description of System:	

REPORT	INCLUDED	N/A	COMMENTS
Cleaning	<input type="checkbox"/>	<input type="checkbox"/>	
Balancing	<input type="checkbox"/>	<input type="checkbox"/>	
Commissioning and Control	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Test	<input type="checkbox"/>	<input type="checkbox"/>	
Concentration of Glycol/Ethanol	<input type="checkbox"/>	<input type="checkbox"/>	
Sound Level	<input type="checkbox"/>	<input type="checkbox"/>	
Earthquake-Resistant Report	<input type="checkbox"/>	<input type="checkbox"/>	

MAINTENANCE REQUIREMENTS

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



Stantec

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 3
		2 of 2
APPENDIX 2 - COMMISSIONING FORM		

HYDRAULIC SYSTEM

Equipments Related with the System:

[illegible]

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJET : 157100008	PWGSC Correctional Service Canada Chiller Replacement	Fiche : 4	No :
1 de 2			
APPENDIX 2 - COMMISSIONING FORM			

EXPANSION TANK

IDENTIFICATION	Equipment Tag:	Serial Number:
	Location:	
	Model Number:	Contractor:
	Type:	Manufacturer:
	Description of System:	

*attach the contractor installation checklist.

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJET : 157100008	PWGSC Correctional Service Canada Chiller Replacement	Fiche : 4	No :
		2 de 2	
APPENDIX 2 - COMMISSIONING FORM			

EXPANSION TANK

ACCESSORIES	TANK		
	Manufacturer:		
	Model / Size:		Serial Number :
	Capacity:		Maximum Operating Pressure :
	PRESSURE RELIEF VALVE SYSTEM		
	Manufacturer:		
	Model / Size:		Serial Number:
	Adjustment:		
	LIQUID LEVEL GAUGES		
	Manufacturer		
	Model / Size:		Serial Number:
	RELIEF VALVE TRIM WATER		
	Manufacturer:		
	Model / Size:		Serial Number:
	Adjustment:		
	BACKFLOW OF WATER FROM COUNTERVAILING		
	Manufacturer:		
	Model / Size:		Serial Number:

PERFORMANCE	OPERATING	DESIGN	MEASURE

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

Project: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 6	No.:
		1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

PUMP (PLUMBING)

IDENTIFICATION	Equipment Tag:	Serial Number:
	Type:	Location:
	Make:	Contractor:
	Model Number:	Manufacturer:
	Dimensions:	
	System:	
	Sector:	
	Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Pneumatic Communication/Integration: <input type="checkbox"/> Internal <input type="checkbox"/> Electric <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> External <input type="checkbox"/> Digital <input type="checkbox"/> N/A	

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	OPERATION DATA	DESIGN	READING
	Water Flow:		
	Inlet Pressure:		
	Outlet pressure:		
	Head:		
	Amperage:		
	Voltage:		

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form : 9	No.:
		1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

SEQUENCE OF OPERATIONS

IDENTIFICATION	Name of System:
	Description of System:
	<div> <div>Controls:</div> <div> <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External </div> </div> <div> <div>Communication/Integration:</div> <div> <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital </div> </div> <div> <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A </div>

SEQUENCE OF OPERATION	VERIFIED	COMMENTS
All sensors and actuators are calibrated, correctly positioned and working properly.		
Configuration of occupation schedule and pre-start-up mode or night set back temperature.		
Minimum position for fresh air damper.		
Modulation of valves and dampers		
Pressure, temperature and humidity control loops		
Supply and mixed air control loops		
Hardware protections (freeze, high pressure, proof of flow, high temperature, high humidity)		
Static pressure set point (also see bypass and variable frequency drives)		
Positioning of systems when stopped		
Variable frequency drives (minimum speed, acceleration ramps, deceleration) and bypass circuit		
Pressure, temperature, and CO ₂ alarms		
Functionality of terminal boxes		
Heating and cooling loops		
Special systems (recovery, energy measurement, gas detection)		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 10	No.:
		1 of 3	
APPENDIX 2 - COMMISSIONING FORM			

STARTER

IDENTIFICATION	Identification:		Drawing Number:	
	Brand:		Location:	
	Catalogue Number:		Motor Reference:	
	Type: <input type="checkbox"/> Manual <input type="checkbox"/> Full Voltage <input type="checkbox"/> Wye-Delta <input type="checkbox"/> Autotransformer <input type="checkbox"/> Other:			
	Action: <input type="checkbox"/> 1-way <input type="checkbox"/> 2-way		Mounting: <input type="checkbox"/> Separated <input type="checkbox"/> In a MCC:	
	NEMA Rating:		NEMA Housing:	
	Voltage:		Phase/Poles: /	Command Voltage:
	Switch: <input type="checkbox"/> Yes <input type="checkbox"/> No		Fuse Type:	Dimensions:
	Moulded Case Breaker: <input type="checkbox"/> Yes <input type="checkbox"/> No		Type :	Trip:
	Overload Relay: <input type="checkbox"/> Yes <input type="checkbox"/> No		Type :	Adjustment:

INSPECTION ET ESSAIS	Description	Yes	No	N/A	Comments/Observations
	Clear Labelling:				
	Adequate Clearance for Disconnect:				
	Functional LED Lights:				
	Functional Start/Stop Push Buttons:				
	Functional Relays:				
	Functional Overload:				
	Reset Push Button:				
	Functional Overheat Relay:				
	Correct Control Sequence:				
	Functional Security Interlock:				

MEASURE	Measure		Comments/Observations
	V _{A-B} : V	I _A : A	
	V _{B-C} : V	I _B : A	
	V _{C-A} : V	I _C : A	

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 10	No.:
		2 of 3	
APPENDIX 2 - COMMISSIONING FORM			

STARTER

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 10	No.:
		3 of 3	
APPENDIX 2 - COMMISSIONING FORM			
STARTER			

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 11	No.:
		1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

LIGHTING

IDENTIF.	Block:		Level:		Sector:	
	Panel with Relay:		Brand:		Model:	
	Drawing No.:					

TESTS	VERIFICATION OF LIGHTNING AND LIGHTNING CONTROL	Y	N	N/A	Nos.
	Devices installed per manufacturer's instructions and specifications				
	All the lamps work correctly (no burned lamps, no blinking, etc.)				
	The level of illumination is adequate				
	The illumination is uniform (no black spots, etc.)				
	The commands by switches work				
	The commands by motion detectors work correctly				
	The commands by gradation work correctly				
	The illumination is normal at every level of gradation since the minimum until 100 %				
	The panel with relay works correctly				

DEFECTS/DISCREPANCIES	No.	Room	Item	Description of the Defect/Comments
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157100008	PWGSC Correctional Service Canada Chiller Replacement	Form: 11	No.:
		2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

LIGHTING

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

APPENDIX 3

Commissioning Schedule



DETAILED COMMISSIONING SCHEDULE

[illegible]

APPENDIX 4

Training

TRAINING PROGRAM

(To be completed by the Commissioning Authority)

Equipment/System	Spec Section	Total Hours (if spec'd)	Trainee Level (List No. of each) ⁵	Trainers' Company	Trainer	Planned Training Date(s)
Mechanical/HVAC/Electrical						
Controls						
HVAC						
Sprinkler						
Plumbing						
Security						
Lighting and Fire Alarm System						
Recommissioning¹						
Architect²						
Mechanical Designer³						
Electrical Designer⁴						

¹Recommissioning: The Commissioning Agent will provide instruction on the use of blank functional test forms for periodic recommissioning of equipments and systems, as per the specification.

²Architect: The Architect will provide a general overview of the facility, its use, special features, tenant and public considerations, etc.

³Mechanical Design Engineer: The Mechanical Designer will provide an overview of the major systems and equipments in the facility, including for each system: the design intent, why the system was chosen, an overview of its operation, and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

⁴Electrical Design Engineer: The Electrical Designer will provide an overview of the major electrical systems and equipment in the facility, particularly the lighting control systems, fire alarm, security and emergency power, focusing on the design intent, why the system was chosen, an overview of its operation, and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

⁵General Scope Codes: (Refer to the specifications and to the specific equipment Training Agenda for additional details.)

A Provide an **overview** of the purpose and operation of this equipment, including required interactions of trainees with the equipment.

B At an **intermediate level**, provide technical information regarding the purpose, operation and maintenance of this equipment, expecting that serious malfunctions will be addressed by factory reps.

C At a **very technical level**, provide information regarding the purpose, operation, troubleshooting, and maintenance of this equipment, expecting that almost all operation, service, and repair will be provided by the trainees.

TRAINING AND ORIENTATION AGENDA
Project: _____ **Date:** _____

Equipment/System: _____ **Spec Section:** _____

Section 1. Audience and General Scope [Owner and Commissioning Authority fill out this section and transmit entire form to responsible contractors. Attach training specification section.]

Intended Audience Type (enter number of staff): ___ Facility Manager ___ Facility Engineer
___ Facility Technician, ___ Project Manager, ___ Tenant, ___ Other: _____

General objectives and scope of training: (check all that apply)

- ___ A. Provide an overview of the purpose and operation of this equipment, including required interactions of trainees with the equipment.
- ___ B. Provide technical information regarding the purpose, operation and maintenance of this equipment at an intermediate level, expecting that serious malfunctions will be addressed by factory reps.
- ___ C. Provide technical information regarding the purpose, operation, troubleshooting, and maintenance of this equipment at a very detailed level, expecting that almost all operation, service and repair will be provided by the trainees.

Section 2. Instructors (Commissioning agent fills in Company. Trainer fills out the balance, prior to training.)

ID	Trainer	Company	Position/Qualifications
1)	_____	_____	_____
2)	_____	_____	_____
3)	_____	_____	_____

Section 3. Agenda [The responsible contractors have their trainers fill out this section and submit to Owner and Commissioning Agent for review and approval prior to conducting training.]

Location: _____ **Date** _____

Agenda of General Subjects Covered

when completed)

	<u>Duration</u> (min.)	<u>Instructor</u> (ID)	<u>Completed</u> (√)
___ General purpose of this system or equipment (design intent)	_____	_____	_____
___ Review of control drawings and schematics (have copies for attendees)	_____	_____	_____
___ Startup, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable	_____	_____	_____
___ Integral controls (packaged): programming, troubleshooting, alarms, manual operation	_____	_____	_____
___ Building automation controls (BAS): programming, troubleshooting, alarms, manual operation, interface with integral controls	_____	_____	_____
___ Interactions with other systems, operation during power outage and fire	_____	_____	_____

PROJECT

**PWGSC | Correctional Service Canada
Chiller Replacement**

___ Relevant health and safety issues and concerns and special safety features	_____	_____	_____
___ Energy conserving operation and strategies	_____	_____	_____
___ Any special issues to maintain warranty	_____	_____	_____
___ Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics	_____	_____	_____
___ Special requirements of tenants for this equipment's function	_____	_____	_____
___ Service, maintenance, and preventative maintenance (sources, spare parts inventory, special tools, etc.)	_____	_____	_____
___ Question and answer period	_____	_____	_____

Other subjects covered, specific to the equipment:

Duration Instructor Completed

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Total duration of training (hrs) ----->

Section 4. Approvals and Use *(Once the Agenda has been filled out by the Trainer, the Owner and Commissioning Agent review, make edits, sign and return to Contractor who provides to the Trainer for use during training. Copies of Agenda shall be provided to trainees.)*

Section 5. Comments Concerning the Training (To be fill out by trainee)

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.....

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.....

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.....

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.....

This *plan* has been approved by the following individuals, subject to the additions and clarifications noted in the left columns marked "add." *(This is not an approval of training completion.)*

Owner's Representative

Date

Commissioning Authority

Date

PARTICIPANT SIGN-IN SHEET

Equipment or System: _____

Signature	Total Hours Specified	Total Hours Received	Date	Instructor's Signature	CxA Initials
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Supplied Notes (Y/N) : ____

Training Final Approval :

 Owner

 Date

 Commissioning Agent

 Date

ARCHITECTURAL

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
Correctional Services Canada - Laval
Chiller Replacement
R 073166-001



Travaux publics et
Services gouvernementaux
Canada

Région du Québec

Public Works and
Government Services
Canada

Quebec Region



Service correctionnel
Canada

Correctional Service
Canada

ARCHITETURAL SPECIFICATIONS
TENDER / 6 NOVEMBER 2015



OWNER

Correctional service of Canada
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H7X 1N7

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ENGINEERS (see engineer seals page)

STANTEC
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J4H 4A6
Téléphone : (514) 281-1033
RESPONSABLE : M. Simon Nolin, engineer

END OF SECTION

DIVISION 02

Existing Conditions

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 74 21 - Construction / demolition waste management and disposal.
- .2 Section 01 35 29.06 - Health and safety requirements including Hot work permit.
- .3 Section 01 56 00 - Temporary barriers and enclosures.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA S350-[M1980(R1998)], Code of Practice for Safety in Demolition of Structures.
- .2 Unless otherwise specified, execute all demolition work according to prescriptions of the Code de construction du Québec – Chapter 1, Bâtiment, of the National Building Code of Canada 2005 (modified), part 8 “Safety Measures at Construction and Demolition Sites”, of the “Code canadien de sécurité en construction” and of the “Sécurité sur les chantiers de construction” by-law in force from the CSST.

1.3 DEFINITIONS

- .1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Where required by authorities having jurisdiction, submit for approval drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning.
- .3 Submit drawings stamped and signed by qualified professional engineer registered or licensed in Province of Quebec, Canada.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Divert excess materials from landfill to site approved by Departmental Representative.

1.6 ENVIRONMENTAL PROTECTION

- .1 Ensure that demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .2 Fires and burning of waste or materials is not permitted on site.
- .3 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout project.

- .4 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.
- .6 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .7 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

1.7 EXISTING CONDITIONS

- .1 Review "Designated Substance Report" and take precautions to protect environment. Refer to section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Should 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 immediately. Do not proceed until written instructions have been received from Departmental Representative.
- .3 Motorised vehicle are not permitted on roofs.

1.8 SCHEDULING

- .1 Employ necessary means to meet work organisation and project time lines. Submit, before work, an organisation work schedule for approval by the Departmental representative.

Part 2 Products

2.1 MATERIAL

- .1 Materials and products to provide temporary weatherproofing of walls which have their cladding removed: wood framing, weatherproof sheeting, polyethylene, adhesive tape, self-adhering elastomeric membrane or other approved materials and methods.
- .2 The choice of material and products for demolition work shall be the contractor's responsibility. In the event that solvents are necessary, advise the ministerial representative.

Part 3 Execution

3.1 PROTECTION

- .1 Protect existing works that must remain in place and the materials to be recovered. If damaged, replace or repair them immediately to the satisfaction of Departmental Representative at no cost to the latter.
- .2 Take necessary measures to prevent displacement, subsidence or other damage to structures, utilities pipes, landscaping works and portions of the building to keep. Ensure the shoring and bracing of structures necessary.
- .3 Adequately support structures or existing works. If the demolition work appears to constitute a danger to the rest of the structure or the work or adjacent structures or works, take appropriate precautionary measures, stop work and notify the Departmental Representative.

- .4 Minimize dust and noise produced by the work and inconvenience to occupants.
- .5 Protect devices, systems and mechanical and electrical installations of the building and the pipeline utilities.
- .6 Provide dust screens, tarpaulins, railings, support members and other necessary protective devices.
- .7 Ensure that the demolitions do not obstruct the water drainage system.
- .8 Install all the barricades and security lighting for public protection.

3.2 PREPARATION

- .1 The requirements of this section apply to all the demolition work to be performed and can be prescribed in this section and other related sections.
- .2 Perform Work in accordance with Section 01 35 29.06 - Health and Safety.
- .3 Inspect the building the Departmental Representative and verify the location and extent of the elements that must be removed, disposed of and those that must remain in place.
- .4 Perform all necessary work required for protection of adjacent structures.
- .5 Coordinate the disconnection mechanical devices and seal all openings in order to meet the requirements of local authorities.
- .6 Advise the utility companies and acquire necessary approvals before starting demolition work.
- .7 Perform any required installation, such as garbage chute, for the safe evacuation of demolition materials.
- .8 Disconnect, close or redirect, as necessary, existing services located on the ground that hinder the execution of the work, as required by the competent authorities. Identify the location of these services, as well as those already abandoned in the field, and specify (horizontal and vertical) on all drawings after the completion of the work. Adequately support, brace and maintain up pipes and conduits encountered during the execution of the work.
 - .1 Immediately inform Departmental Representative and the appropriate utility company of any damage caused to a service to be maintained.
 - .2 Notify Departmental Representative immediately of the discovery of any unlisted service and await for written instructions.
- .9 Do not block any means of egress during the course of the work.
- .10 Disconnect and reroute electrical connections as required.

3.3 SAFETY CODE

- .1 Do demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

3.4 REMOVAL OF HAZARDOUS WASTES

- .1 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

3.5 DEMOLITION

- .1 All work described in this section include, but not limited to, labor, materials, tools and equipment required for all demolition work required for a complete work in a broad sense, as per drawings and specifications. Demolish everything that is specifically indicated on drawings.
- .2 Demolition work shall be based on the existing conditions the day of the award of the contract.
- .3 Coordinate demolition work with other related sections.
- .4 Dismantle, remove and/or demolish all roofing system described on drawings, as well as all rotten or damaged carpentry beneath said roofing system, until reaching the deck. Remove all items not required for reuse or as per on-site instructions by the Departmental Representative, to prepare site for all other work described on drawings and in specifications.
- .5 Provide all temporary weather proofing and protection.
- .6 Demolish all building parts to allow for prescribed work.
- .7 Remove all materials, installations, services and other equipment that prevents further work. Reinstall immediately following work.
- .8 Do not store and accumulate debris and do not store in existing building.
- .9 Stick with adhesive a polyethylene film to all openings to prevent work-related dust from entering building.
- .10 Clean thoroughly, at the end of every shift, exterior spaces.
- .11 At the end of every shift, ensure that no work can sag nor collapse. Completely close off parts of the building that shall not be demolished to protect its interior against the weather.
- .12 Work using methods that will generate the least amount of dust. Dampen dusty materials.
- .13 Repair and make good all surfaces touched by demolition work.
- .14 The contractor shall not burn, sell or bury demolition debris on site.
- .15 Collect all demolition debris, contaminated and/or dangerous or not, and evacuate them following required security measures.

3.6 DRILLING, CUT OFF AND REPAIRS

- .1 Authorisation:
 - .1 Prior to work, submit a written demand for all drilling or cut off work that will influence:
 - .1 Structural integrity of an element;
 - .2 Weather and/or water resistance of exposed elements;
 - .3 Performance, maintenance or security of any element operated by the owner;
 - .4 The aesthetics of apparent elements;
 - .5 Work executed by the master of work or any other contractor.
- .2 Inspection:
 - .1 Verify all existing conditions, including elements that could be damaged or that could move while drilling or cut off work is done.
 - .2 Once elements are revealed by demolition work, inspect for any conditions that could block other work.
 - .3 Beginning any drilling work implies the acceptance of the existing conditions.

.3 Execution:

- .1 Plan and execute work to prevent any damage to other work.
- .2 Prepare surfaces to allow for future work.
- .3 Use appropriate power saw or core drill to cut rigid conduits. No percussive or pneumatic tools shall be used.
- .4 Bring back existing work to their original condition with new material, as per present specifications.
- .5 Adjust to ensure tightness all conduits, pipes, lines, ducts and other penetrating objects.
- .6 Plan and execute all drilling, cutting, adjusting and repair work for a finish and complete work.
- .7 Remove and replace any damaged or unsatisfactory work.

3.7 REMOVAL FROM SITE

- .1 Remove stockpiled material as directed by the Departmental Representative, when it interferes with operations of project construction.
- .2 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.

END OF SECTION

DIVISION 05

Metals

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
 - .1 ANSI/NAAMM MBG531-00, Metal Bar Grating Manual.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A53/A53M-12, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - .2 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .3 ASTM A325M-10, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Canadian Standards Association
 - .1 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
 - .2 CAN/CSA-G164-M92 (C2009), Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 CSA W59-1989 (R2001), Welded Steel Construction (Metal Arc Welding/Imperial Version).
- .5 National Association of Architectural Metal Manufactures (NAAMM)
 - .1 AMP 510-92, Metal Stair Manual.
- .6 Steel Structures Painting Council (SSPC), Systems and Specifications Manual, Volume 2.

1.2 CALCULATION CRITERIA

- .1 Guardrails must be designed to resist dynamic loads to which they could be submitted vertically or horizontally, to National building code (NBC) prescriptions.
- .2 The drawings only present schematically the element geometry, their aesthetic disposition and generalities, the dimensioning to respect and materials. While conforming to the presently imposed restrictions, the choice of work, the methods and procedures of manufacturing assembling, anchoring, the members sizes are under the contractor's responsibilities while been subject to DCC Representative.
- .3 Design guardrail construction and connections to NBC vertical and horizontal live load requirements.
- .4 If dimensions indicated on drawings must be upscale, proceed without plus-value.

1.3 SUBMITTALS

- .1 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 These drawings must indicate the details of construction, the dimensions of the steel sections and thickness of the steel sheet, anchors, supports, joints, joints, supports and accessories.
- .3 All shop drawings submitted must bear the seal of a professional engineer member in good standing of the OIQ. This requirement applies to both guardrails and anchors. Provide calculations relating to the overload resistance in the vertical and horizontal directions in accordance with the NBC.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

- .1 Steel sections: to CAN/CSA-G40.20/G40.21 Grade 300W.
- .2 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.
- .3 Steel tubing: to CAN/CSA-G40.20/G40.21, Grade 350, sizes and dimensions as indicated.
- .4 Welding materials: to CSA W59.
- .5 Bolts: to ASTM A307.
- .6 High strength bolts: to ASTM A325M.

2.2 FABRICATION

- .1 Fabricate guardrail according to standards of NAAMM's Metal Stair Manual.
- .2 Weld connections whenever possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .3 Accurately form connections with exposed faces flush; mitres and joints tight. Make risers of equal height.
- .4 Grind or file exposed welds and steel sections smooth.
- .5 Assemble stairs at shop in sections as large and complete as practicable.

2.3 PIPE/TUBING GUARDRAILS

- .1 Construct balusters from steel tubing.
- .2 Cap and weld exposed ends.

- .3 Guardrails must consist of steel elements anchored to building masonry walls as indicated in the drawings
- .4 Fabricate roof guardrails as indicated and details in architectural drawings..

2.4 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600g/m² to CAN/CSA-G164.
- .2 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

Part 3 Execution

3.1 INSTALLATION OF GUARDRAILS

- .1 Install guardrails as described in architectural drawings.
- .2 Affix guardrail to structural elements every 1200mm on center or as described in architectural drawings.

3.2 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.3 MOUNTING

- .1 Unless otherwise indicated, perform welding work in accordance with CAN / CSA-M1989-W-59.
 - .2 Welding company must be certified either under the provisions of Division 1 or by virtue of Article 2.1 of the CAN / CSA-W47.1-92 standard in the fusion welding framework or standard CAN / CSA-W55.3-1965 in the case of resistance welding.
 - .3 Provide a certificate that all welded joints are certified by the Canadian Welding Bureau.
 - .4 Mount the metal structures square, plumb level of, alignment with close fitting, tight joints with crosses.
 - .5 Provide appropriate anchoring, such as bolts, chemical anchors with strainer, staples, rods, bolts and expandable pads, toggle bolts, depending on the materials (concrete, masonry, wood, etc.).
 - .6 Execute on-site connections using high-strength bolts in accordance with CAN / CSA-S16-01 or perform welds conform to the requirements of CAN / CSA-S16-01.
 - .7 Apparent fixation devices must be compatible with the material they pass through or to which they are subject; in addition, the finish of the attachment devices must be the same as that of said material.
-

- .8 After the assembly, retouch using a zinc coating rivets, spot welds, bolts, as well as burned or scratched surfaces.
- .9 Apply primer zinc on the places burned by on-site welding of galvanized surfaces,.

END OF SECTION

DIVISION 06

Wood, Plastics and Composites

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings or Iron and Steel Products
 - .2 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .3 ASTM D1761-06, Standard Test Methods for Mechanical Fasteners in Wood
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
 - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA O121-1978 (R2003), Douglas Fir Plywood.
 - .4 CSA O141-05, Softwood Lumber.
 - .5 CSA O151-04, Canadian Softwood Plywood.
- .3 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2005.

1.2 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood panels in accordance with pertinent CSA and ANSI standards.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Protect materials against dampness and damage during and after delivery.
 - .2 Store materials in ventilated areas, protected from extreme changes of temperature or humidity.

1.4 WASTE MANAGEMENT AND DISPOSAL:

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

Part 2 Products

2.1 FRAMING AND STRUCTURAL MATERIALS

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard SPS, are acceptable.
- .3 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 S2S is acceptable for any element that is not in sight.
 - .2 Board sizes: Standard or better grade.
 - .3 Dimension sizes: Standard light framing or better grade.
 - .4 Post and timbers sizes: Standard or better grade.

2.2 PANEL MATERIALS

- .1 Douglas fir plywood (DFP): to CSA O121, Standard Construction.
- .2 Canadian softwood plywood (CSP): to CSA 0151, Standard Construction.

2.3 INSULATION

- .1 Inorganic fibreglass. Thermal RSI 0.60/25mm thickness. Meet ASTM C655 standard, type 1, for use in the parapets and other spaces as specified in drawings having the required thickness to fill void.

2.4 ACCESSORIES

- .1 Nails, spikes and staples: in accordance with CSA B111.
- .2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

2.5 FASTENER FINISHES

- .1 Galvanizing: in accordance with CAN/CSA-G164, use galvanized fasteners for exterior work and interior highly humid areas.

Part 3 Execution

3.1 INSTALLATION

- .1 Comply with requirements of NBC 2010 Part 9 supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.

- .3 Construct continuous members from pieces of longest practical length.
- .4 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

3.2 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.

END OF SECTION

DIVISION 07

Thermal and Moisture Protection

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 16.01 – Structure demolition.
- .2 Section 06 10 00 – Rough carpentry.
- .3 Section 07 62 00 – Sheet metal flashing and trim.
- .4 Section 07 92 00 – Joint sealants.

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D2178-04, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
 - .2 ASTM D6162-00a, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
 - .3 ASTM D6163-00e1, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
 - .4 ASTM D6164-05, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-56M (9th AMEND), Modified Bituminous membrane, Prefabricated, and Reinforced for Roofing.
- .3 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual, most recent edition
- .4 CSA, Canadian standard Association
 - .1 A123.21-14 - Standard test method for the dynamic wind uplift resistance of membrane-roofing systems
A123.3-05 (R2010) - Asphalt Saturated Organic Roofing Felt
- .5 Workplace Hazardous Materials Information System (SIMDUT)
 - .1 MSDA of products
- .6 ULC, Underwriters Laboratories of Canada
 - .1 CAN/ULC-S702-14, standard for mineral fibre thermal insulation for buildings
- .7 Quebec Master Roofers Association (QMRA)
 - .1 Roofing specification manual AMCQ / QMRA.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 One (1) week prior to commencement of work, demand a meeting with the Departmental Representative, as per section 01 32 16.06 – Construction progress table barr (Gantt) chart, during which will be discussed;
 - .1 Project details requirements;
 - .2 Existing conditions of roofs;
 - .3 Coordination between work included in this section and work to be executed by other trades;
 - .4 Installation specifications submitted by the product manufacturers and the guaranties offered.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide digital versions of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of the MSDA data sheet in accordance with SIMDUT, section 01 35 29.06 health and security and section 01 35 43, environment protection. The data shall indicate the COV contents for:
 - .1 Primers
 - .2 Bituminous
 - .3 Water sealing products
- .3 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .4 Manufacturers' install procedures: indicate any special precautions pertaining to lapping of membrane sheets.
- .5 Submit all reports done by manufacturers upon visiting the site, as per section 01 45 00. Reports have to indicate installation methods used, ambient temperature and wind speed while installing.

1.5 CONTRACTOR QUALIFICATIONS

- .1 Installer's qualification: contractor and/or worker specialized in the construction of modified bituminous roofing systems, with at least five (5) years' experience and approved by membrane manufacturer. At all time, foreman and at least one worker to have at least five (5) years' experience. Other workers to have all certification required for this roofing system. Modified bitumen membranes have to be installed by qualified workers, who have attended training in prevention and fire hazards protection when using combustible material, propane gas and open flames.

1.6 FIRE PROTECTION

- .1 Fire Extinguishers:
 - .1 Maintain one stored pressure rechargeable type with hose and shut-off nozzle,
 - .2 ULC labelled for A, B and C class protection.
 - .3 Size 9 kg on roof per torch applicator, within A 6 m reaching distance.
- .2 Maintain fire watch for 1 hour after each day's roofing operations cease or any time work has to be halted. The employee will have the following equipment: telephone, extinguisher and an infrared thermometer.

1.7 DELIVERY, STORING AND HANDLING

- .1 Deliver, store and handle materials and equipment according to manufactures' instructions and as per Section 01 61 00 – Common product requirements.
- .2 Storage and handling:
 - .1 Security: conform to procedures from the Système d'information sur les matières dangereuses utilisées au travail (SIMDUT) pertaining to usage, handling, storage and elimination of bitumen, as well as for all primers, caulking and sealants.
 - .2 Store materials in a dry, protected against weather conditions place, and avoiding all contact with the ground.
 - .3 All felt and membrane rolls to be store vertically; in the case of membranes, selvedge facing up.
 - .4 Remove from storage only materials to will be applied that day.
 - .5 Protect work with plywood runways for workers and equipment.
 - .6 Ensure that all adhesives, primers and sealants are stored at least at 5 Celsius degree temperature. In the case of polyurethane based products, ensure 20 Celsius degree temperature during twelve (12) hours and until usage.
 - .7 Protect all insulation products against direct sunlight, weather conditions and other harmful factors.

DELIVERY, STORAGE, AND HANDLING

- .3 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .4 Deliver materials in their originals containers, sealed and bearing intact labels. Make certain that materials stocking period is not superseded.
- .5 Make sure that the following information in clearly inscribed on the containers and wrapping:
 - .1 Manufacturer's name and trademark.
 - .2 Product or material conformity to relevant references.

.6 Storage and Handling Requirements:

- .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
- .2 Provide and maintain dry, off-ground weatherproof storage.
- .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
- .4 Remove only in quantities required for same day use.
- .5 Place plywood runways over completed Work to enable movement of material and other traffic.
- .6 Store sealants at +5 degrees C minimum.
- .7 Store insulation protected from daylight and weather and deleterious materials.
- .7 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 FIELD CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install roofing when temperature remains below -10 degrees C, including wind chill factor, for torch application, or 5 degrees Celsius in the case of cold applied membranes.
 - .2 Minimum temperature for solvent-based adhesive is 5 degrees C or the temperature indicated on the manufacturer spec sheet.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- .3 According to the requirements of AMCQ, finishing membrane must be laid within a maximum of five (5) business days after the laying of the underlayer.

1.9 QUALITY ASSURANCE

- .1 Roofing materials representative will have access to the site during the period of this work. The observations on the installation quality shall be transmitted to the Departmental Representative.
- .2 Roofing contractor to ensure close coordination between all required roofing work to guarantee that all materials shall not be damaged in any way.
- .3 Roofing work inspection described herein and relevant tests will be carried out by an independent inspection firm, specialized in the roofing field, accredited by the Association des maîtres couvreurs du Québec, designated and paid by the Departmental Representative.
- .4 This firm will have to proceed with a preliminary inspection as to verify the substrates prior to receive roofing materials, verify its slopes, its soundness, its cleanliness, and all work related preparation for approvals, such as: walls, parapets, eaves, downspouts, plumbing vents, and any other required work.

- .5 Furthermore prior commencing work, this firm shall verify conformity between the specifications and the Quebec Master Roofers Association the minimal prescriptions.
- .6 As such, all through the roofing materials installation period, the firm inspector presences on site shall be continuous without interruption. If he must leave the site for valid reasons, he shall take all dispositions to ascertain at his return that work have been properly executed since he assumes full responsibilities in the respect of the specifications prescriptions.
- .7 The inspector presence is not required during the substrates cleaning, no matter if it regards getting rid of the materials surplus m of snow and/or ice accumulations or drying of surfaces. If the roofing contractor convenes the inspector by mistake for period is presence is not required, the contractor will have to assume inspector's fees.
- .8 After metal installation, the inspector will make sure that the sheet metal work is conforming to drawings and specifications and meets applicable installation prescriptions. The continuous presence of the inspector is not required during sheet metal installation.
- .9 Roofing work inspection will assure the execution conformity with drawings and specifications and will include among others the following verifications:
 - Surfaces to seal cleanliness and soundness.
 - Sealing membranes types, thickness, weight, and layer numbers.
 - Joints sealing and overlapping.
 - Bituminous and metal flashing construction at walls or control or expansion joints.
 - Mechanical, electrical and other equipment base sealing,
 - Rain water run-off to different drains.
- .10 After work acceptance, the inspector shall give to the roofing contractor a certificate that attests work quality and the respect of installation prescriptions.

1.10 WARRANTY

- .1 Provide required safeguards in accordance with the requirements of the General Conditions and additional section 01001 Conditions.
 - .2 The roofing contractor must provide a written and signed document from the membrane materials manufacturer, issued in the name of Canada, certifying that its products comply with Canadian standards specified and guarantee against defects in materials. The 12-month warranty period prescribed the general conditions, is extended to 120 months.
 - .3 Provide a written and signed document, issued in the name of Canada, certifying that the waterproofing works and implementation (labor and materials) are jointly guaranteed by the roofing contractor and manufacturer of membranes materials against defects. The 12-month warranty period prescribed the general conditions, is extended to 60 months.
-

Part 2 Products

2.1 PERFORMANCE CRITERIA

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.
- .2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 VAPOUR BARRIER

- .1 One-ply bituminous membrane.
 - .1 Complying with CGSB 37.56-M, armed with a glass veil and modified bitumen, heat weldable underside and sandblasted top side, having a minimum thickness of 2,2mm.
 - .2 Solvent based primer for welded vapour barrier as recommended by manufacturer.

2.3 MEMBRANE

- .1 Horizontal base sheet: compliant with CGSB 37-GP-56M, reinforced with polyester fibres to ASTM D6164.
 - .1 Atactic Polypropylene (APP) thermoplastic polymer prefabricated sheet, polyester reinforcement, having nominal weight of 180 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class C - plain surfaced.
 - .4 Grade 1 - standard service.SPEC and polyethylene surfaces for torch application.
 - .5 Top and bottom surfaces:
 - .1 sanded/polyethylene.SPEC NOTE: The following properties are typical for 180 grams/metre membrane. Edit to suit project requirements.
 - .6 Base sheet membrane properties: to CGSB 37-GP-56M
 - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 17.0/12.5 N/5 cm.
 - .3 Ultimate elongation (longitudinal/transversal): 60/65 %.
 - .4 Tear resistance: 60 N.
 - .5 Cold bending at -30 degrees C : no cracking.
 - .6 Softening point: \geq 110 degrees C.
 - .7 Static puncture resistance: > 400.
 - .8 Dimensional Stability: -0.4 / 0.3 %.

- .2 Vertical base sheet : base sheet membrane composed of SBS modified bitumen reinforced with a composite reinforcement. Surface covered with thermofusible plastic film. Underface covered with a release protection film.
 - .1 In compliance with : CAN/CGSB 37.56-M (9th draft).
 - .2 Properties :
 - .1 Strain energy (kN/m) 7,8/7,2 kN/m
 - .2 Breaking strength (kN/m) 15/13,5 kN/m
 - .3 Ultimate elongation (%) 60-65%
 - .4 Tear resistance (N) 125 N
 - .5 Static puncture resistance (N) 560 N
 - .6 Cold bending –
 - .1 Initial -30 °C
 - .2 90 days at 70 °C -30 °C
- .3 Cap sheet membrane: compliant with CGSB 37-GP-56M, reinforced with polyester fibres in compliance with ASTM D6163
 - .1 Atactic Polypropylene (APP) thermoplastic polymer, prefabricated sheet, polyester reinforcement, having nominal weight of 250 g/m².
 - .2 Type 1, fully adhered.
 - .3 Class A-granule surfaced
 - .1 Colour for granular surface: gray
 - .4 Grade 1-standard service.<
 - .5 Bottom surface polyethylene.<
 - .6 Cap sheet membrane properties: to CGSB 37-GP-56M.
 - .1 Strain energy (longitudinal/transversal): 10.0/10.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 18.0/16.0 kN/m.
 - .3 Ultimate elongation (longitudinal/transversal): 60/65 %.
 - .4 Tear resistance: 75 N.
 - .5 Cold bending at -30 degrees C: No cracking.
 - .6 Softening point: ∃ 110 degrees C.
 - .7 Static puncture resistance: > 420N.
 - .8 Dimensional Stability: -0.8 / 0.2 %.

2.4 ADHESIVE

- .1 Adhesive for securing overlay board and insulation: asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive.
- .2 Adhesives should be chosen according to the materials to be bonded and must meet the updated technical bulletin 9B of AMCQ.

2.5 INSULATION

- .1 Type 1 : Rigid insulation expanded polystyrène panel type II, compliant to CAN/ULC-S701, RSI =0,70/25 mm, 20,01 kg/m3 density; thickness as indicated on drawings, shiplapped edges.
- .2 Type 2 : Rigid insulation expanded polystyrène panel type II, compliant to CAN/ULC-S701, RSI =0,70/25 mm, 20,01 kg/m3 density, tapered shape to ensure slope having a ratio of 1: 50 to which a flame retardant wood fiberboard (see insulation type 3) was asphalt laminated in the plant: the minimum thickness at the drain will be 104mm (including the fibreboard wood) or otherwise indicated.
- .3 Type 3 : Rigid fiber panels fireproof timber, compliant with CAN / CSA-A247, Type 1 and CAN / CGSB-11.3, SIR = 0.27 / 25 mm x 1220 panels 1220 mm x 12.7 mm thickness.

2.6 SEALERS

- .1 Plastic cement: asphalt.
- .2 Sealing compound: bitumen and rubber caulking
- .3 Sealants: Refer to Section 07 92 00 - Sealants for joints, regarding sealants and caulking.

2.7 CARPENTRY

- .1 Refer to section 06 10 00.01 – Rough Carpentry.

2.8 ROOF DRAINS

- .1 Copper drain comprised of sleeve and flange entirely made of MIG welded 24on copper as per QMRA and CRCA spec books, stainless steel fasteners, dimensions as per existing, with moulded aluminum dome strainer, with tamperproof lid, and equipped with a pole flag. Conform to ANSI A112.21.2.
- .2 Adjust all drains to new roof level following the plan details. Connect to existing water leader with flexible and adjustable seal installed from the top, conform to ASTM D-2136 and ASTM D-746. Provide owner with adjustable pin. In case of ventilated roofs, open and close off deck to allow insulating the length of water leader in attic.

2.9 VENT FLASHING

- .1 One piece molded aluminum flashing cap, as per existing diameters (allow for 25mm insulation), with screwed-on cap.
- .2 Use pre-moulded foam insulation between roof vent and flashing.

2.10 ACCESSORIES

- .1 Joint backing: extruded polyethylene foam, hardness 20 on shore A scale, traction resistance 140 to 200 kPa, oversized by 30 to 50%, compatible with primers and sealants.
- .2 Reinforcing band: Weldable reinforced SBS elastomeric membrane as recommended by the membrane manufacturer.
- .3 Rubber mats made from recycled materials. Hex embossed surface type (honeycomb). Below compound of longitudinal grooves every 25 mm to allow for drainage of water. Grooves 4.8 mm wide by 3.2 mm deep. 19 mm thick and 1220 x 1830 mm. To cut to the required dimensions and applications.

Note: Always provide and install an additional welded cap sheet on the rubber mat.

Part 3 EXECUTION

3.1 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Clean off drips and smears of bituminous material immediately.
- .3 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .4 Protect roof from traffic and damage. Comply with precautions deemed necessary by [Departmental Representative] [Engineer] [Consultant] [____].
- .5 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .6 Metal connectors and decking will be treated with rust proofing or galvanization.

3.2 QUALITY OF WORK

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and the AMCQ. Execute work in compliance with CSA 123.21 and/or FM-4470, the most recent version, and any and all pertinent Canadian standards.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 The interface of the walls and roof assemblies will be fitted with durable rigid material plywood providing connection point for continuity of air barrier.
- .4 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.3 EXAMINATION OF ROOF DECKS

- .1 Verification of Conditions:
 - .1 Inspect with Departmental Representative and inspection firm deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
- .2 Evaluation and Assessment:
 - .1 Prior to beginning of work ensure:
 - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
 - .2 Curbs have been built.
 - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
 - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
 - .5 That all repairs have been approved by the Departmental Representative;
 - .6 Drive in all nails/screws that would protrude.
 - .3 Do not install roofing materials during rain or snowfall.

3.4 VAPOUR RETARDER (CONCRETE DECK)

- .1 The vapor barrier will be torch welded on the support according to the manufacturer's written recommendations. The vapor barrier will be dry primed for alignment. Each edge will overlap the previous 75 mm laterally along the lineage for this purpose, and 150 mm to the end pieces. Divide the transverse joints at least 300 mm. Starting work from the bottom of the slope. This application will melt the bitumen membrane so as to see a bitumen bead as we place the membrane, ensuring total adherence of the vapor barrier.
- .2 The primer must be dry at the moment of installation.
- .3 At the perimeter of the insulation and vis-à-vis each element therethrough, overlap vapour barrier to allow a tight connection with the sublayers.

3.5 VAPOR RETARDANT FLASHING

- .1 On all roof joinery components including parapets, control joints, expansion joints, mechanical and other bases, install a self-adhesive membrane flashing on the horizontal membrane such that the vapor barrier membrane forms separate and distinct sealed pools.
- .2 In the case of exterior walls, bring up flashing membranes against the inside, the crowning of the parapet and fold it on the outside.

3.6 THERMAL INSULATION

- .1 Install insulation, one or two panels thick, as indicated in drawings and specifications.
- .2 Install insulation in accordance with a regular arrangement to obtain a uniform insulating value over the entire roof surface.
- .3 Adhere the insulation vapor barrier by means of the adhesive according to the strict recommendations of the adhesive manufacturer. Use the applicator of the adhesive manufacturer. Apply continuous parallel beads of 13 to 19 mm width to 300 mm on the main portion of the roof. A width of at least 1 830 mm perimeter, bring the cords 150 mm. Meet corner perimeters, close to all the cords 100 mm.
- .4 Butt joints of the insulation boards so that there is no free space, and keep them free of adhesive joints.
- .5 At the end of each shift, ask an elastomeric membrane on surfaces and exposed edges, and on the vapor barrier to the étanchéiser. Remove the membrane at the time of resumption.
- .6 Ensure a minimum overlap of 12.7 mm of insulation over the slope of insulation. Apply adhesive with the same rate as for the insulation. All joints must be firmly abutting and overlapping of half the length of the adjacent panels of polystyrene.

3.7 LAMINATED PANELS AND HORIZONTAL MEMBRANES

- .1 Unroll membranes and lie flat for at least 20 minutes, taking into account weather conditions and the manufacturer's instructions.
- .2 Installation of base sheet:
 - .1 Starting from the bottom of the slope from perpendicular to the axis of the slope, the paste laminated panel of a sub-layer with the adhesive according to manufacturer's recommendations;
 - .2 Overlap sheets by at least 75 and 150 mm, sides and ends, respectively;
 - .3 The base sheet shall be free from swelling or wrinkling or yawn;
 - .4 Weld the transverse and longitudinal overlaps;
 - .5 All vertical joints between the support and the membranes will be shifted in the vertical plane and in the horizontal plane;
 - .6 Vertical anchor: navigate the membrane at a height of approximately 51 mm on the parapet and anchor with an aluminum profile of 2.5 mm min. x 25.4 mm wide - installed with steel screw treated against corrosion, 12 gauge x 32 mm min.
- .3 Installation of cap sheet
 - .1 Starting at the bottom of the slope, unwinding the topcoat taking care to align parallel to one of the eaves and perpendicularly to the axis of the slope;
 - .2 Distribute joints a minimum distance of 300 mm;
 - .3 Solder topcoat directly on the underlayer while simultaneously merging the two bituminous surfaces to achieve a homogeneous welding and continuous;

- .4 All granular coverings should be installed on surfaces prepared for this purpose; where the granules have been previously embedded in the bitumen (degranulated);
 - .5 Overlap joints 75 mm top layer on the long side and 150 mm on the transverse side. Although spread the seals to avoid extra thickness;
 - .6 Cap sheet must not show any swelling or wrinkling or yawn;
 - .7 To the accompanying rollers, the bitumen will be apparent and regranulated if necessary according to the requirements of AMCQ.
- .4 Installation of vertical base sheet:
- .1 General:
 - .1 In the modified bitumen membrane systems, all flashing membranes must have a self-adhesive underlay, nailed to the top, and a welded finish torch layer;
 - .2 Sub-layer must cover and be folded at least 75 mm vertically on the outside;
 - .3 Sub-layer will be placed on its primer which has been applied to it on the wooden surface;
 - .4 Soldering directly on masonry is not acceptable for laying under flashing membrane layer;
 - .5 The granulated cap sheet, type (GP) will be torch installed;
 - .6 Depending on site conditions, the sub-layer will be flashing nailed with galvanized nails with large head (top round) every 30 cm staggered and overlapping should be self-adhered directly on the previously primed wood;
 - .7 The granulated cap sheet must cover the inside vertical face parapets (horizontal and vertical surfaces), walls and projections, bases and control joints
 - .2 Installation:
 - .1 Complete the installation of flashings (base foil strips) before installing the membrane covering film;
 - .2 Overlapping the flashing strip of at least 150 mm with respect to the base sheet of the membrane;
 - .3 Overlapping the flashing cover film of at least 250 mm from the membrane surface of sheet; welding torch;
 - .4 Ensure an overlap at least 75 mm on the sides and seal;
 - .5 Properly secure flashings to their support; the work must not show any sagging or swelling or yawn or puckering;
 - .6 Ask flashings according to manufacturer's recommendations.

3.8 COUNTER SLOPE

- .1 In places required and identified on the drawings, lay on the surface tapered insulation, against the slope forming counter slopes to ensure a positive slope towards the drains.

3.9 EAVES

- .1 Install metal deck (minimum 102 mm) primed with an elastomeric sealant as recommended by the manufacturer.
- .2 Nail the flange firmly at about 102 mm and in a zigzag pattern, add a reinforcing strip (152 mm welded sub-layer), welded to the metal eaves of 51 mm and 101 mm on the sub-layer.
- .3 The topcoat should overlap the underlayer by 102 mm.

3.10 ROOF DRAINS

- .1 Install roof drains as recommended by the AMCQ. Provide a depression in the insulation on a square of about 600 mm. This depression will be approximately 13 mm deep and the flange must be chamfered.
- .2 Install deck, coated with a primer and bonded to the underlay with a modified bitumen sealant as recommended by the manufacturer.
- .3 Cover with a welded reinforcing strip 1000 x 1000 mm centered on the deck.
- .4 Follow with topcoat.
- .5 Install strainers on drains.
- .6 Perform the connection between the hood and the existing pipe with appropriate sealant.

3.11 OTHER

- .1 Install sleeves and other necessary flashings whenever elements cross through roofing system. Seal according to the details and the manufacturer's recommendations.

3.12 EXPERTISE

- .1 The laboratory that will monitor the work will be allowed to take samples for analysis. The tests will be performed according to ASTM D3617.
- .2 Repair elements affected by the tests.

3.13 PROTECTION OF COMPLETED WORK

- .1 Should it be necessary to undertake work on the finished surface, protect roofing system by plywood at least 12mm thick.

3.14 CLEANING

- .1 Remove all debris on the surface of the roof.
- .2 Clean to the architect's satisfaction soiled surfaces prescribed under this section; also repair the damage.
- .3 Verify that drains are clear and if they function properly. Rid the site of surplus materials, debris and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 02 41 16.01 – Structure demolition.
- .2 Section 06 10 00 – Rough carpentry.
- .3 Section 07 52 00 – Modified bituminous roofing membrane.
- .4 Section 07 92 00 – Joints sealants.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A606-09a, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
 - .2 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual [1997].
- .3 Association des Maîtres Couvresseurs du Québec (AMCQ)
 - .1 Devis, couverture, 2013.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .5 Green Seal Environmental Standards
 - .1 Standard GS-03-93, Anti-Corrosive Paints.
 - .2 Standard GS-11-97, Architectural Paints.
 - .3 Standard GS-36-00, Commercial Adhesives.
- .6 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 for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.
- .3 Shop Drawings:
 - .1 Shop drawings: submit drawings stamped as required.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 One (1) week prior to commencement of work, demand a meeting with the Departmental Representative, as per section 01 32 16.06 – Construction progress table barr (Gantt) chart, during which will be discussed;
 - .1 Project details requirements;
 - .2 Existing conditions of roofs;
 - .3 Coordination between work included in this section and work to be executed by other trades.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 SHEET METAL MATERIALS

- .1 Prepainted galvanized steel sheet, 0,701mm (cal. 24), commercial quality, in compliance with ASTM A653/A653M, with zinc plating Z275 (G-90). Provide for two colors; a color similar to the existing and the other chosen by the architect.

2.2 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
 - .2 Plastic cement: to CAN/CGSB 37.5.
 - .3 Base layer metal flashing: dry coating compliant with CAN / CGSB-51.32 standard.
 - .4 Sealants: as per section 07 92 00 – joint sealants.
-

- .5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packing.
- .8 Soldering flux: rosin, dilute hydrochloric acid or other commercial preparation compatible with the materials to be welded.
- .9 Paint retouching: as per prefinished steel manufacturer's recommendations.

2.3 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details and as indicated.
- .2 Form pieces in 2400 mm maximum lengths.
 - .1 Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm.
 - .1 Mitre and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.4 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated galvanized prefinished steel.

2.5 REGLETS AND CAP FLASHINGS

- .1 Form recessed reglets metal cap flashing of indicated thickness sheet metal for base flashings as detailed in accordance with CRCA FL series details, FL.
 - .1 Provide slotted fixing holes and steel/plastic washer fasteners.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details, FL as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Lock end joints and caulk with sealant.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over continuous hook strips. Hook strips to be installed in sealant.
- .5 Insert metal flashing into reglets to form weather tight junction.
- .6 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .7 Caulk flashing at reglet with sealant.

3.3 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 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C794-06, Standard Test Method for Adhesion-in-peel of Elastomeric Joint Sealants.
 - .2 ASTM C919-02, Standard Practice for Use of Sealants in Acoustical Applications.
 - .3 ASTM C920-08, Standard Specification for Elastomeric Joint Sealants.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .2 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .3 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's product to describe.
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.3 QUALITY ASSURANCE/MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up to show location, size, shape and depth of joint [s] complete with back-up material, primer, caulking and sealant.
- .3 Mock-up will be used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Locate where directed.
- .5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with sealant work.

- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may not remain as part of finished Work.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.5 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5 degrees C.
 - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

1.7 GARANTIE

- .1 The 12-month warranty period is extended to 36 months. Provide a written warranty to that effect.

Part 2 Products

2.1 GENERAL

- .1 Primer: use type recommended by manufacturer of waterproofing elements.
- .2 Non-corrosive cleaning products compatible with the materials forming the gaskets and sealants, and recommended by the manufacturer of these.
- .3 Color: the color is to be matched to membranes if the product is placed in contact with the membrane or the color of the metal when installed between two (2) pieces of metal or metal and other material .

2.2 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
- .3 Where sealants are qualified with primers use only these primers.

2.3 SEALANT MATERIAL DESIGNATIONS

- .1 Three-component sealant, urethane based, chemically-curing, non-slagging, conform to CAN/CGSB-19.24, type 2, class B, color Navy Blue and other based on adjoining materials.
- .2 One-component sealant, silicone based, moisture-curing, flexible, conform to CAN/CGSB-19.13.
- .3 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 30 to 50 %.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid rod, Shore A hardness 70.
 - .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.
- .4 Extruded weather gaskets for glazing pressure plates
 - .1 Gaskets conform to ASTM C 864-05 (2011), compatible with silicone based sealant. Shape and dimensions according to slot in existing pressure plates.

2.4 JOINT SEALANTS – USE

- .1 Perimeter of all openings in exterior walls (bricks, concrete masonry units, metal cladding or precast concrete units) and that are contiguous to work: use a three components polyurethane based sealant.
- .2 All joints in metal flashings: use a single component silicone based sealant.

Part 3 Execution

3.1 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.
- .3 Following manufacturer's specifications, inspect and correct openings to ensure depth to be equal to width in case of joints of 6.4 to 12.7mm. For joints bigger than 12.7mm, depth shall not exceed 12.7mm. No joint shall be less than 6.4 x 6.4mm.

3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

- .1 Sealant.
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .3 Apply sealant in continuous beads.
 - .4 Apply sealant using gun with proper size nozzle.
 - .5 Use sufficient pressure to fill voids and joints solid.
 - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing.
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.
- .3 Cleanup.
 - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
 - .2 Remove excess and droppings, using recommended cleaners as work progresses.
 - .3 Remove masking tape after initial set of sealant.

END OF SECTION

DIVISION 09

Finishes

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 51 29 – Metal stairs and ladders.

1.2 RÉFÉRENCES

- .1 Steel Structures Painting Council (SSPC).
 - .1 SSPC-SP-1-82, Solvent Cleaning.
 - .2 SSPC-SP-3-00, Power Tool Cleaning.
 - .3 SSPC-Vis-1-89, Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs) Editorial Changes September 1, 2000 (Steel Structures Painting Manual, Chapter 2 - Surface Preparation Specs.).
 - .4 SSPC-PA-02, Measurement of Dry Coat Thickness with Magnetic Gauges.
 - .5 SSPC Good Painting Practices, Volume 1, 4th Edition.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions
 - .1 Submit manufacturer's installation instructions.

1.4 ACCEPTABLE PRODUCTS OR MATERIALS

- .1 When materials or products are prescribed by their trademark, consult *Instructions to Bidders* in order to know the procedure for the application for approval of materials or substitutes.

1.5 QUALITY ASSURANCE

- .1 Test Reports: submit test reports certifying that all products comply with specifications for physical characteristics and performance criteria.
- .2 Certificates: submit documentation signed by manufacturer certifying that all products comply with specifications for physical characteristics and performance criteria.

1.6 WASTE MANAGEMENT

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction Waste Management and Disposal.
- .2 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by employees, individuals, or organizations for verifiable re-use or re-manufacturing.

Part 2 Products

2.1 MATERIALS

- .1 Repair work according to 5.1D system from MPI.
 - .1 Anti-rust alkyde primer specially formulated for metal surfaces.
 - .2 Two layers of paint: enamel paint having a alkyd, urethane and silicon base with at least 50% solids.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's requirements and written data, including product technical bulletins, instructions appearing in the product catalogue. Comply with literature appearing on the packaging of products and datasheets

3.2 PREPERATION

- .1 Already coated metal surfaces that need to be refurbished
 - .1
 - .1 Clean surfaces by removing loose, cracked, brittle or non-adherent paint, rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with following.
 - .1 Commercial blast cleaning: SSPC-SP-6.
 - .2 Brush-off blast cleaning: SSPC-SP-7.
 - .3 Solvent cleaning: SSPC-SP-1.
 - .4 Hand tool cleaning: SSPC-SP-2.
 - .5 Power tool cleaning: SSPC-SP-3.
 - .2 Commercial blast clean rusted and bare metal surfaces where existing paint system has failed.
 - .3 Brush-off blast clean remaining metal surfaces to be painted.
 - .4 Scrape edges of old paint back to sound material where remaining paint is thick and sound, feather exposed edges.
 - .2 Compressed air to be free of water and oil before reaching nozzle.
 - .3 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, by blowing with clean dry compressed air, or by vacuum cleaning.
 - .4 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.
 - .5 Prior to commencing paint application the degree of cleanliness of surfaces to be in accordance with SSPC-Vis1.

- .6 Protection of surfaces.
 - .1 Protect surfaces not to be painted and if damaged, clean and restore such surfaces as directed by professional.
 - .2 Apply primer, paint, or pretreatment after surface has been cleaned and before deterioration of surface occurs.
 - .3 Clean surfaces again if rusting occurs after completion of surface preparation.
 - .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.
 - .5 Protect cleaned and freshly painted surfaces from dust to approval of Departmental Representative.
- .7 Mixing paint.
 - .1 Do not dilute or thin paint for brush application; use as received from manufacturer.
 - .2 Mix ingredients in container before and during use and ensure breaking up of lumps, complete dispersion of settled pigment, and uniform composition.
 - .3 Do not mix or keep paint in suspension by means of air bubbling through paint.
 - .4 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to professional.
- .8 Number of paint coats. for film thicknesses for specific paints.
 - .1 Repainting existing metal surfaces.
 - .1 One primer coat to minimum dry film thickness of 35 microns to bare and commercial sand blasted areas.
 - .2 Two alkyd enamel coats to minimum dry film thickness of 2 microns per coat.

3.3 APPLICATION

- .1 Apply paint by either brush or roller.
- .2 If the surface to be painted is not sheltered, avoid applying the paint in the following cases:
 - .1 When the temperature of the ambient air is below 5 degrees Celsius or when it has to go down to 0 degrees Celsius before the paint dries;
 - .2 When the surface temperature exceeds 50 degrees Celsius, unless the paint is specifically formulated to be applied at high temperature.
 - .3 When there is fog or mist, it rains or snows, there is a risk of rain or snow, or when the relative humidity is above 85%;
 - .4 When the surface to be painted is wet, wet or frosted;
 - .5 When the previous layer is not completely dry.
- .3 Supply and install a shelter when it the application of paint must be undertaken wet or cold weather. Protect, shelter or heat the painted surfaces and the ambient air so as to meet the temperature humidity requirements described in section 3.2.4. Protect painted surfaces until the paint dries or weather conditions make such protection redundant.

- .4 Remove the layers of paint that have been exposed to frost, excessive moisture, rain, snow or condensation. Prepare and paint the surfaces again.
- .5 Apply each paint layer so as to obtain a continuous film of uniform thickness. Repaint surfaces where the paint layer is too thin so that the exposed surfaces prior to applying the next coat of paint.
- .6 Wipe drips and festoons with the brush.
- .7 Once completed, rid the surfaces of festoons, drips or trademarks of brushstrokes, and reapply a coat of paint.
- .8 Handling painted metal elements
 - .1 Avoid moving metal parts painted as the paint is dry, unless it is necessary to return the painting or stacked for drying.
 - .2 Scrape surfaces damaged during the handling and touch up using the same number of layers of the same types of paint applied initially.

3.4 CLEANING

- .1 Upon completion remove surplus materials, rubbish, tools and barriers used to protect the equipment.

END OF SECTION

STRUCTURAL

(Refer to the drawings)

MECHANICAL / ELECTRICAL

DIVISION 21

Fire Suppression

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Sections of Division 22 - Plumbing.
- .6 Sections of Division 23 - Cooling, Ventilating and Air-Conditioning (HVAC).
- .7 Sections of Division 25 - Integrated Automation.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

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- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Manufacturer's Equipment performance datasheets with point of operation as left after commissioning completion.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
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- .6 Approvals:
 - .1 Submit two copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual any additional data, when necessity becomes apparent during specified demonstrations and instructions.
 - .8 Site records:
 - .1 Departmental Representative will provide one set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .9 As-built drawings:
 - .1 Prior to start testing, adjusting and balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .10 Submit copies of as-built drawings for inclusion in final TAB report.
-

1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION**3.1 CLEANING**

- .1 Clean interior and exterior of all systems, including strainers. Vacuum interior of ductwork and air handling units.

3.2 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.3 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Cooling units.
 - .2 Control Sequency.

- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative will record these demonstrations on video tape for future reference.

3.4 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust and other foreign materials with materials appropriate to system.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

1.2 REFERENCES

- .1 Unless otherwise indicated, the works will be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the Works will be done in accordance to any other code or standard having jurisdiction, notably including, but not limited to:
 - .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA).
 - .1 NFPA 101-2010, « Life Safety Code ».
 - .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM E2174-2010, Standard Practice for On-site Inspection of Installed Fire Stops.
 - .3 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S102, Seventh Edition Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies
 - .3 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems
 - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

- .2 Shop Drawings.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
- .3 Tests :
 - .1 In accordance with CAN/ULC-S101 and CAN/ULC-S102.
 - .2 Submit test reports issued by recognized independent laboratories certifying that firestop products, materials and equipments comply with specified physical characteristics and performance criteria.
- .4 Certificates :
 - .1 Submit signed manufacturer documents, certifying that products, materials and equipments comply with specified physical characteristics and performance criteria.
- .5 Manufacturer's Instructions:
 - .1 Submit manufacturer installation instructions, including particular information regarding handling, installation and cleaning. .
- .6 Manufacturer's Field Services :
 - .1 Submit manufacturer's written reports within three days after executing field services regarding compliance of Work, as specified in FIELD QUALITY CONTROL of PART 3.

1.4 CLOSEOUT SUBMITTALS

- .1 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance data :
 - .1 Maintenance data to include :
 - .1 Product description, including manufacturer's name, type, model, year of manufacture and specifications;
 - .2 Detailed instructions regarding operation, maintenance and upkeep;
 - .3 List of recommended spare parts. .

1.5 DESCRIPTION OF WORKS

- .1 Provide staff as well as materials, equipment and services necessary for the installation of firestop and smoke control around mechanical services that penetrate through fire resistant building elements.

1.6 QUALITY ASSURANCE

- .1 Work must be carried out by a qualified person, approved by firestop systems manufacturer, employing skilled, certified and experienced personnel in the installation of firestop systems and smoke control installations.
- .2 Work must comply with manufacturer's written specifications and be considered of high quality according to best industry practice.
- .3 Site Meetings : Manufacturer's Field Services specified in FIELD QUALITY CONTROL of PART 3 should include site visits as follows :
 - .1 Once, after product delivery and storage on site as well as preparatory work and other preliminary work is completed, but before the start of installation work;
 - .2 Once work progress is at 60% of completion;
 - .3 Once work is completed and work site is cleaned.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .2 Storage and Protection:
 - .1 Store and handle materials in accordance with manufacturer's written instructions in a clean, dry and well ventilated area.
 - .2 Replace defective or damaged materials by new materials.
-

PART 2 - PRODUCT**2.1 GENERAL**

- .1 All installed firestop system products must be officially « cUL », « ULC » and « FM » approved and must be labelled as such.

2.2 MATERIALS

- .1 Firestop and smoke barrier systems
 - .1 Efficient, asbestos-free flame, smoke and gas barrier materials and systems, in accordance with CAN/ULC-S115. Dimensions should not exceed those of the penetrations or access points that they are intended for.
 - .2 Assembly of stopfire and smoke control systems: ULC certified in accordance with CAN/ULC-S115.
 - .3 Fire resistance rating of installed firestop systems must not be less than fire resistance rating of floor and surrounding walls in accordance with architectural plans.
 - .4 Acceptable products : 3M, model FD-150+ for steel, cast iron and copper pipes and model CP-25WB+ for plastic pipes; HILTI.
- .2 Firestop systems for penetrations made by utility services: tested in accordance with CAN/ULC-S115.
- .3 Firestop system elements for penetrations made by utility services: certified by a test laboratory in accordance with CAN/ULC-S115.
- .4 Fire resistance rating of installed firestop systems must comply to the CNB.
- .5 Firestop and smoke barrier systems installed on access points of hidden equipments, cables for example : elastomer seals.
- .6 Firestop and smoke barrier systems installed around penetrations made by pipes, ducts or other mechanical materials needing acoustic and shock-absorbent insulation: elastomer seals.
- .7 Firestop devices:
 - .1 Ultrafast firestop devices for plastic pipes, made of intumescent material that dilates when exposed to temperatures of 149 °C and more. Material may dilate up to 25 times its original volume to seal openings created by plastic pipes.

- .2 Devices should be certified to CAN/ULC-S115, according to tests performed at a differential pressure of 50 Pa (0.2 in. of water) with a one or two hour fire resistance rating.
- .3 Acceptable products : 3M, model Fire Strap up to DN3; model Fire Stop for DN4 and more; HILTI.
- .8 Primers : Comply with manufacturer's recommendations regarding materials, supports and intended use.
- .9 Water (if applicable) : clean drinking water free of excessive amounts of harmful substances.
- .10 Rock wool : rock and slag fibres agglomerated by a heat resistant binder. Maximum service temperature of 1 035 °C. Practically pH- neutral.
- .11 Safety restraints, supports and anchoring : according to manufacturer's recommendations. Shall be compatible with implemented systems, tested and deemed acceptable by competent authorities.
- .12 Sealing materials for vertical joints : product must not collapse in accordance with ULC assembly tests.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARITORY WORK

- .1 Examine size and condition of gaps to be filled in order to determine required material thickness and installation method.
 - .1 Make sure surfaces are clean, dry and not frozen.
- .2 Prepare surfaces that will be in contact with firestop and smoke barrier systems as in accordance with manufacturer's instructions.
- .3 Ensure integrity of insulation around pipes and ducts that penetrate fire resistant partitions as well as the vapor barrier.
- .4 Cover adjacent surfaces to protect them from drips and splashes, and clean away stains and undesirable deposit, once work is completed.

3.3 INSTALLATION

- .1 Install firestop and smoke barrier systems as well as their components in accordance with manufacturer's instructions regarding tested and approved systems.
- .2 Seal gaps and spaces around pipes or devices which fully or partially penetrate fire resistant partitions and seal openings destined for later use as well as their joints in order to preserve continuity and integrity of smoke and fire protection systems.
- .3 If necessary, install temporary safety restraints until initial curing is completed and materials have acquired sufficient strength.
- .4 Shape apparent surfaces or even out with a trowel until achieving a smooth finish.
- .5 Quickly remove excess product as work progresses and once it is completed.

3.4 WORK SCHEDULING

- .1 Install only after submittals have been reviewed by Departmental representative.
- .2 Implement floor firestop systems before installing interior partitions.
- .3 Bonding to metal support : firestop protection must be implemented before spraying of fireproof coating in order to ensure required bonding.
- .4 Insulation of mechanical pipes : consisting of approved firestop system.
 - .1 Pipe insulation shall be installed before firestop protection.

3.5 FIELD QUALITY CONTROL

- .1 Inspections : before dissimulating or covering materials or firestop systems, inform Departmental representative that works are ready for inspection.
- .2 Manufacturer's field services :
 - .1 Obtain manufacturer's written report confirming that work complies with specified criteria regarding product handling, installation and application as well as protection and cleaning of Work before submitting report in accordance with SUBMITTALS, loaf PART 1.
 - .2 Manufacturer must provide recommendations regarding use of products and conduct periodic visits to verify if implementation is such as recommended.
 - .3 Site visits shall be in accordance with QUALITY ASSURANCE , of PART 1.

3.6 SITE CONDITIONS

- .1 Application and drying of stopfire and smoke barrier materials must be in accordance with manufacturer recommendations regarding temperature, relative humidity and moisture content of background layers.
- .2 Protect all work against potential damage and deterioration caused by other trades and protect other trade installations against dirt and potential damage originating from this work.
- .3 Once completed, correct all imperfections and leave workplace in impeccable condition.

3.7 VERIFICATION

- .1 Check all stopfire surfaces to be sealed. Provide a written report stating conditions that are non-compliant or deemed unacceptable by the contractor, before starting work.
- .2 Delay work until surface conditions are acceptable.

3.8 MIX

- .1 Mix materials in strict compliance with manufacturer's instructions.
- .2 Components must be well prepared and mixed by qualified personnel.

3.9 COATING MATURATION

- .1 Allow coatings to mature according to manufacturer's recommendations.
- .2 Do not cover materials before maturation is complete.

3.10 INSPECTION OF WORK

- .1 Inform Departmental representative when work is ready for inspection. Work shall not yet be covered by fireproof shield, control material or all other services penetrating fire resistant partitions.
- .2 Inspect penetrations in firestop systems in accordance with ASTM E2174.

3.11 CLEANING

- .1 Once implementation and performance monitoring finished, remove extra materials, rubbish and tools from site.
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- .2 Take off temporary safety restraints once initial setting is complete.

3.12 TESTS

- .1 Perform smoke penetration simulation tests.
- .2 If joint finishing, gaps or openings described in this section show clear smoke emission during tests, correct all defects and start smoke test again at no additional costs to the Owner.
- .3 Smoke simulation product must not be toxic nor staining and must provide fog density of 80 mg/m³ with acceptable air concentration levels of 50 ppm.
- .4 Create smoke at a rate of 4 seconds/2,8 m³ and maintain fog density until inspection is complete.

3.13 FIRESTOP SYSTEM LOCATION

- .1 Ensure firestop and smoke barrier protection to building elements that are fire resistant, including the following places:
 - .1 Penetrations through partitions, masonry walls, concrete and gypsum that are fire resistant.
 - .2 Penetrations through floor slab, ceiling and roof that are fire resistant.
 - .3 Access openings and penetrations made in fire resistant partitions for further use.
 - .4 Around pipes and other mechanical and electrical material that penetrate fire resistant partitions.
 - .5 Rigid conduits with sections above 129 cm² : fire protection by means of a fire resistant joint located between angle bracket and fire resistant partition as well as between angle bracket and conduit on each side of the fire resistant partition.

END OF SECTION

DIVISION 22

Plumbing

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2 CODES AND REFERENCE STANDARDS

- .1 Unless otherwise indicated, all of the works will be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance to any other code or standard having jurisdiction, notably including but not limited to:
 - .1 ASTM B32-08, Specification for Solder Metal;
 - .2 ASTM B306-02, Specification for Copper Drainage Tube (DWV);
 - .3 ASTM C564-03a, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings;
 - .4 CAN/CSA B70-F06, Cast Iron Soil Pipe, Fittings, and Means of Joining;
 - .5 CAN/CSA B125.3-F05, Plumbing Fittings;

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit required specifications sheets and manufacturer documentation regarding adhesives. Specifications sheets must show products characteristics, performances criteria, dimensions, limits, and finishes.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.5 QUALITY CONTROL

- .1 An ISO 9000 quality control certificate for gray cast iron parts must be provided on demand.
- .2 An ISO 140001 environmental control certificate for gray cast iron parts must be provided on demand.
- .3 Ferrous matters used for gray cast iron parts production to be installed must be subject to a radiation detection test, complying with CSA B70, article 4.1.1 standard. Documentation must be provided on demand, according with this article.
- .4 The manufacturer of previous parts must have all certificates and approvals, in order to know its exact origin and the links between product and certificate.
- .5 All assembled parts, such as gray cast iron piping and fittings must come from the same manufacturer to ease the responsibility and warranty.
- .6 All products and materials to be installed, such as stainless steel sheath couplings (MJ joint), must come from the same manufacturer to ease the responsibility and warranty.

1.6 SHOP DRAWINGS AND DATA SHEETS

- .1 Submit the shop drawings and data sheets in accordance with Sections of 22 and 23 Divisions.

1.7 MAINTENANCE SHEETS

- .1 Supply the maintenance sheets required and add them to the "Exploitation and Maintenance Manual".
- .2 The maintenance files must contain or indicate the following:
 - .1 A description of the appliances, including the manufacturer's name, the type, model, year of manufacture and the power, supply or output.
 - .2 The pertinent details regarding the exploitation, servicing and maintenance.

- .3 A list of recommended spare parts.

PART 2 - PRODUCTS

2.1 COPPER PIPES AND CONNECTED FITTINGS

- .1 The drainage pipes for sanitary water, sump pumps, storm water and ventilation, of a nominal diameter less than NPS 3, made to be installed above ground, as well as the connected fittings, will be of DWV type and in accordance with the ASTM B306 Standard.
- .1 Fittings.
- .1 Fittings in cast brass: in accordance with CAN/CSA-B125 and CAN/CSA B158.1 Standards.
- .2 Fittings in forged copper: in accordance with the CAN/CSA-B125 Standard.
- .2 Soft solder: lead free, tin/antimony 95/5, in accordance with the ASTM B32 Standard.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Unless otherwise indicated, install the piping and elements in accordance with the requirements of the National Plumbing Code and of the local competent authorities.
- .2 Install the piping to be buried on a clean, washed sand bed, of a 150 mm thickness, wrought in a way that marries the shape of fittings and female end pieces of jointing pipes. Respect the slope, the lines and the levels indicated. Backfill with a layer of 150 mm of washed-out sand.
- .3 Install the above-ground piping parallel to the walls and ceilings and near them to reduce as less as possible the effective space of rooms. Respect the slope and levels indicated.
- .4 Carry out tests in accordance with National Plumbing Code and local authorities having jurisdiction.
- .5 Lay a copper drainage piping of NPS 1¼, to link to, the nearest floor drain, the drainage fittings (with deep water guard trap) the drip pans for coils, the air inlets and outlets and the drip bowls of air ducts.

3.2 VENTS

- .1 Extend vents without size diminution up to 450 mm below roof level and increase size from this point using conic fitting, to at least NPS 4.

3.3 TESTS

- .1 Every opening and piping outlet of the entire installation must be perfectly sealed as well as the sanitary waste and rain water drainage installations, including upward vents, connections, horizontal drains and main ducts. Piping must be filled with water up to the highest level for at least two (2) hours. If it is not possible to test the whole installation at once, it can be divided in sections, individually tested as described before. However, water level in column must be at least 3 m over the tested section.
- .2 Piping must be tested up to the roof.
- .3 Tests must comply with the National Plumbing Code and be carried out in presence of the plumbing inspector or the Departmental Representative.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts.
 - .1 Ensure accessibility and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal, airtight.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage.
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows at every floor or 4.5 m (whichever is less).

3.5 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

1.2 CODES AND REFERENCE STANDARDS

- .1 Unless otherwise indicated, the works will be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the Works will be done in accordance to any other code or standard having jurisdiction, notably including, but not limited to:
 - .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A126-04 (2009), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
 - .2 American Water Works Association (AWWA).
 - .1 AWWA C700-09, Cold Water Meters - Displacement Type, Bronze Main Case.
 - .2 AWWA C701-12 Cold Water Meters - Turbine Type for Customer Service.
 - .3 AWWA C702-1-10, Cold Water Meters - Compound Type.
 - .3 Canadian Standards Association (CSA International).
 - .1 CSA-B64-F11, Backflow Preventers and Vacuum Breakers.
 - .2 CSA-B79-F08, Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
 - .3 CSA-B356-F10, Water Pressure Reducing Valves for Domestic Water Supply Systems.

- .4 National Plumbing Code of Canada 2010.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
 - .2 Indicate dimensions, construction details and materials for specified items.
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate materials, finishes, dimensions, construction, and assembly details.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
 - .5 Fold up metal and plastic banding, flatten, and place in designated area for recycling.

PART 2 - PRODUCTS**2.1 FLOOR DRAINS**

- .1 Floor and trench drains: To CSA B79 standard.
- .2 Type General purpose: Cast iron body, round, adjustable grille, integral sediment basket, nickel or bronze strainer, and sealing collar.
 - .1 Acceptable products:
 - .1 Concrete floors: Zurn ZZN-415-A; Watts-Drainage FD100-C-5-1; Jay R. Smith, 2005-AHD.
- .3 Type Funnel: Cast iron body, integral sediment basket, sealing collar, bronze or nickel adjustable grille and integral funnel.
 - .1 Acceptable products: Zurn, ZN-415-BF; Watts-Drainage FD100-C-EG-1; Jay R. Smith, 2005-AHD-B.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada, provincial codes and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 COMMISSIONING

- .1 For the current article, "verify" a characteristic or "ensure" a component's state or operation also means to demonstrate to the Departmental Representative.
- .2 Carry out commissioning only once every failure detected during start-up has been corrected.
- .3 Verify visit doors' dimensions as well as their location towards elements to visit.

3.3 DRAINS

- .1 Clean out the p-traps and sediment baskets of floor drains and prime them.
 - .2 Clean roof drains.
-

- .3 Correct any defects discovered during start-up.
- .4 All floor drains must be equipped with a P-trap.

3.4 TESTING AND ADJUSTING

- .1 General.
 - .1 In accordance with Section 01 91 00 - Commissioning - Mechanical and Electrical Installation: General Requirements, supplemented as specified.
 - .2 Roof drains.
 - .1 Verify if the roof drains are installed at the lowest point of the roof.
 - .2 Verify if the grill is properly fixed in place and if it is easily removable.
 - .3 Adjust the spillway to the real roof slop and to meet the calculation requirements.
 - .4 Assure that roof movement has been taken in consideration for the installation.
 - .5 Clean the drain basket.
- .2 Access Doors.
 - .1 Verify size and location relative to items to be accessed.
- .3 Commissioning Reports.
 - .1 In accordance with Section 01 91 00 - Commissioning - Mechanical and Electrical Installation: Reports, supplemented as specified.
- .4 Training.
 - .1 In accordance with Section 01 91 00 - Commissioning - Mechanical and Electrical Installation: Training of O&M Personnel, supplemented as specified.

END OF SECTION

DIVISION 23

Heating, Ventilating and
Air Conditioning (HVAC)

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 74 11 - Cleaning.
- .2 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

- .1 The Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION**3.1 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components without interrupting operation of other system, equipment, components. Space must be sized in accordance with indications on drawings or manufacturer's recommendations, whichever is highest.

3.3 DRAINS VALVES

- .1 Install piping with grade in direction of flow, except as otherwise indicated.
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- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be clearly visible.
- .4 Drain valves: NPS $\frac{3}{4}$ gate or globe valves unless indicated otherwise, with hose end male thread, cap, and chain.

3.4 AIR VENTS

- .1 Install manual air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal or dismantling without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts, and similar items parallel or perpendicular to building lines.

- .7 Install concealed pipework to minimize furring space, maximize headroom, and preserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible, as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves.
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use ball or butterfly valves at branch take-offs for isolating purposes, except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Use chain operators on valves NPS 2½ and larger where installed more than 2,400 mm above floor in mechanical rooms.
- .15 Check Valves.
 - .1 Install swing check valves in horizontal lines on discharge of pumps, and elsewhere as indicated.

3.7 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.

- .3 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .4 Installation.
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .5 Sealing.
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEON

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Use one piece type escutcheon, chrome or nickel plated brass or type 302 stainless steel, with set screws.
- .3 Outside diameter to cover opening or sleeve. Inside diameter to fit around outside of pipe or insulation.

3.9 PREPARATION FOR FIRE STOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Fire Stopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible supple material to permit pipe movement without damaging fire stopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in Divisions 22 and 23.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of Mechanical Division.
- .3 Maintain specified test pressure without loss for 4 hours minimum, unless specified for longer period of time in relevant sections of Mechanical Division.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.
- .8 Complete the "Leak test notice for refrigeration system and air-conditioning system formulary" once the test is successfully completed and affix it on the system in accordance with the Federal halocarbure regulation article 10(1).

3.12 EXISTING SYSTEMS

- .1 Connect new piping into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval 10 days minimum, prior to commencement of Work.
- .3 Be responsible for damage to existing plant by these Works.
- .4 Ensure daily clean-up of existing areas.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 78 00 - Closeout Submittals.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Submit two (2) copies of the material safety data sheets as required by the Workplace Hazardous Materials Information System (WHMIS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Closeout Submittals.
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading.
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS**2.1 GENERAL**

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors 373 W (½ HP) and larger: EEMAC Class B, 3-phase, 600 V, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, unless otherwise indicated.
- .3 Motors connected to variable frequency drives must be of "Inverter Duty" or "Inverted Ready" type and conform to NEMA MG-1, part 31 norms.

PART 3 - EXECUTION**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 All equipment and elements have to be removable for servicing, easily returned into, and fixed in position.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 CLEANING

- .1 Execute all cleaning work in accordance with section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .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 23 05 05 - Installation Pipework.

1.2 REFERENCES

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
 - .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A53/A53M-05, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A105/A105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data sheets:
 - .1 Data sheets must include the following:
 - .1 Manufacturer's name, model number, type of fluid, as well as rated temperature and pressure of the network and the equipment.
 - .2 Movement type; axial, lateral or angular compensation and maximum movement for each case.
 - .3 Element diameter and nominal dimension as well as construction details of relevant assemblies.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance data sheet:
 - .1 Maintenance data sheet must include the following:
 - .1 Equipment description, including the manufacturer's name, type, model, year, capacity, head and flow rate.
 - .2 Pertinent details related to maintenance.
 - .3 Supply spare parts.

1.5 WASTES MANAGEMENT

- .1 Sort out and recycle wastes in accordant with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS**2.1 FLEXIBLES METAL FITTINGS**

- .1 Use: according to movement.
- .2 Fittings must be of minimal length according to Manufacturer's recommendations regarding movement.
- .3 Inner pipe: flexible stainless steel corrugated pipe.
- .4 Exterior lining: stainless steel mesh.
- .5 End component, size and type: as indicated on plan.
- .6 Flexible fittings must be designed to support respective operating pressure and temperature of 1,034 kPa and 93°C.
 - .1 Operation conditions must comply with network requirements .
- .7 Fittings must absorb lateral movements of 150 mm. Ratio between the length of the flexible portion and fitting diameter must not be less than 6. Flexible pipe length must not be greater than 600 mm.
- .8 Tips: suitable for pipes.

- .9 Acceptable products:
 - .1 NPS 2 and under: Connectall, series Style-19 ou Style-A1.
 - .2 Over NPS 2: Connectall, Style-A1 series.

2.2 FLEXIBLE POLYMER FITTINGS

- .1 EPDM flexible fittings, equipped with enamel painted ductile iron flanges, retaining rings and a reinforcing ring, designed for a rated operation pressure of 1,725 kPa.
- .2 Fittings must absorb longitudinal movements in tension or compression of 19 mm.
- .3 Use: chiller and cooling tower pipes.
- .4 Acceptable products: Mason Industries, SFDEJ.

2.3 ANCHORING AND PIPE GUIDES

- .1 Anchoring: according to section 23 05 29.
- .2 Pipe guide components: galvanised steel.
- .3 Acceptable products: Anvil, figure 255.

PART 3 - EXÉCUTION

3.1 INSTALLATION

- .1 Expansion joints must be installed under cold tension conditions as indicated by manufacturer. Tension value shall be documented.
- .2 Flexible fittings and expansion joints shall be installed according to manufacturer's instructions.
- .3 Anchoring and pipe guides shall be installed as indicated. Anchoring must absorb an axial movement of 150%.

3.2 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 23 21 13.02 - Hydronic Systems Steel.

1.2 REFERENCES

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
 - .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
 - .1 ANSI/ASME B31.1-2007, Power Piping.
 - .2 ANSI/ASME B31.3-2006, Process Piping appendix A.
 - .3 ANSI/ASME B31.3-2007, Process Piping appendix B
 - .4 ANSI/ASME Boiler and Pressure Vessel Code-2007:
 - .1 BPVC 2007 Section I: Power Boilers.
 - .2 BPVC 2007 Section V: Nondestructive Examination.
 - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
 - .3 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.

- .4 American Welding Society (AWS).
 - .1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA W47.2-M1987(C2008), Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W48-F06, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA B51-F03(C2007), Boiler, Pressure Vessel and Pressure Piping Code.
 - .4 CSA-W117.2-F06, Safety in Welding, Cutting and Allied Processes.
 - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
 - .6 CSA W178.2-2008, Certification of Welding Inspectors.

1.3 QUALITY ASSURANCE

- .1 Qualifications of Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to Departmental Representative.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
 - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

1.4 QUALIFICATION OF INSPECTORS

- .1 Inspectors qualified to CSA W178.2.

1.5 CERTIFICATIONS

- .1 Registration of welding procedures in accordance with CSA B51.

- .2 Copy of welding procedures available for inspection.
- .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

PART 2 - PRODUCTS

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

PART 3 - EXECUTION

3.1 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing Rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets.
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.

- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
 - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 standards and approved by Departmental Representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test 100% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle" tests) and spot gamma ray radiographic (hereinafter referred to as "radiography" tests).
- .2 Hydrostatically test welds to ANSI/ASME B31.1 standard.
- .3 Visual Examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of Visual Examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic tests.

3.5 DEFECTS CAUSING REJECTION

- .1 Generality :
 - .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, chilled water systems below 1,000 kPa:
 - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
 - .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
 - .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
 - .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1,500 mm length of weld depth of such defects being greater than 0.8 mm.

- .5 Repair cracks and defects in excess of 0.8 mm in depth.
- .6 Repair defects whose depth cannot be determined accurately on basis of visual examination.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 23 05 53.01 - Mechanical and Network Identification.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
 - .1 Pressure gauges;
 - .2 Stop valve;
 - .3 Thermometers;
 - .4 Thermometric wells.

1.4 HEALTH AND SAFETY

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

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 Collect, separate and place in designated containers for recycling paper, plastic, corrugated cardboard packaging Steel, Metal and Plastic in accordance with Waste Management Plan.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- .4 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial digital thermometers, with light emitting diode (LED), 12 mm height, accuracy of 1% and a solar battery.
- .2 The thermometers will be of rigid rectangular type with aluminum frame and adjustable angle.
- .3 These thermometers will have a combined grading (°C and °F).
- .4 Scale : -40°C à 150°C (-40°F à 302°F).
- .5 Acceptable products: Terice n° SX9 Solar Therm; Weiss no. DVU35.

2.3 THERMAL CONDUCTIVE GEL

- .1 Thermal conductive gel to fill the gap between the Gel thermometric well and thermometer probe.
- .2 Acceptable product: Terice n° 107-0001.

2.4 THERMOMETRIC WELLS

- .1 In the case of an assembling inside a copper or plastic pipe, use copper or bronze wells.
- .2 In the case of an assembling inside a steel duct, wells in brass or stainless steel.
- .3 Acceptable products: Terice.

2.5 MANOMETERS

- .1 Manometers with 90 mm diameter, dial filled with liquid, in accordance with ANSI/ASME B40.100, standards, class 1A, accurate to 1%.
 - .1 Polished stainless steel casing and ring, stainless steel mechanism with adjustable needle.
 - .2 Graduated scale in order to operate in a third of the range.
 - .3 Manometers built to resist to a minimum pressure of 5,500 kPa.
 - .4 Threaded joint 1/4 in made of copper or bronze for copper or plastic piping and made of brass or stainless steel for steel piping.
 - .5 5-year warranty.
 - .6 Acceptable products: Trerice, 700 series.
- .2 The following characteristics or elements must be considered for every installed thermometer and manometer:
 - .1 Shock absorber if the network undergoes pressure pulsations.
 - .2 Separating membrane if the network contains corrosive fluids.
 - .3 Bronze globe valve with drainage joint at every manometer.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Always set the thermometers in thermometric wells fitted with a heat conducting material.
- .2 Install the thermometers at the described places as well as at the entrance and the exit of the following appliances:
 - .1 Chillers;

- .3 Use extensions for thermometers fixed on insulated piping.
- .4 Provide and install the thermometric wells necessary for the balancing and adjusting of networks.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
 - .1 Upstream and downstream of the pumps;
 - .2 Upstream and downstream of pressure reducers;
 - .3 At the entrance and the exit, water side, of the cooling and heating coil and heat exchangers;
 - .4 At the expansion tank;
 - .5 At every location indicated.
- .2 Install gauge cocks for balancing purposes.
- .3 Use extensions where pressure gauges are located behind equipment.

3.4 NAMEPLATES

- .1 Install engraved Lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Network Identification, identifying medium.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 23 05 05 - Installation of Pipework.
- .2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
 - .1 ANSI/ASME B31.1-04, Power Piping.
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A125-1996(R2007), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-07b, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS).
 - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC).

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements.
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support piping, air ducts, systems and mechanical equipments under operating conditions of, allow free expansion and contraction of supported elements, prevent excessive stress from being introduced into piping or connected equipments.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements.
 - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events as specified Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submitted shop drawings and product data sheets must be sealed and signed by a competent engineer, who is accredited in the province of Quebec.
- .3 Submit shop drawings and product data sheets for the following:
 - .1 Bases, supports and suspensions.
 - .2 Linkages to the framework.
 - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions :
 - .1 The Departmental Representative will provide the personnel one (1) copy of the manufacturer's installation instructions.
- .5 Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading.
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
 - .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
 - .3 Perforated metal strips will not be accepted.
 - .4 "Ramset" type anchors permitted only in poured concrete. Use beam clamps to avoid piercing steel beams.
-

2.2 PIPE HANGERS

- .1 Finishes.
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated epoxy coated.
- .2 Anchors for suspensions fixed to poured concrete elements:
 - .1 Items to anchor to ceiling: stirrups, plates, fasteners, bushings with welded eye rod made of carbon steel, with an eyelet nut made of cast iron without any welds. The eyelet must be 6 mm greater in diameter than the rod.
 - .1 Acceptable products: Anvil, plate, fig. 49 and eyelet nut, fig. 290.
 - .2 Expanding fasteners:
 - .1 Acceptable products: Phillips Red Head.
 - .3 Wedge type concrete insert for poured concrete, complete with corner and plate protections and a knockout plate, approved by UL, ULC and FM and conforming MSS-SP-69 standards.
 - .1 Acceptable products: Anvil, fig. 281.
- .3 Assemblies made in a shop or on site:
 - .1 Suspension with rollers.
 - .2 Steel supports.
 - .3 Bracing items for earthquake systems: conforming to section 23 05 48.
- .4 Threaded suspension rods: conforming to MSS-SP-58 standard:
 - .1 Rods are only submitted to tension forces.
 - .2 Provide elements that will enable the horizontal and vertical movements of the supported piping.
 - .3 Acceptable products: Anvil, fig. 146.

- .5 Support elements installed on top of the insulating material.
 - .1 Steel or copper piping, with less than 25 mm of movement: adjustable stirrups, conforming to UL, ULC and FM and MSS-SP-69 standards.
 - .1 Acceptable products: Anvil, fig. 260.
 - .2 Steel or copper piping, with more than 25 mm of movement: stirrups with rollers conforming to MSS-SP-69, type 43 standards.
 - .1 Acceptable products: Anvil, fig. 181.
 - .3 Steel or copper piping for hot water supported by the underside: base with rollers conforming to MSS-SP-69, type 44 standards.
 - .1 Acceptable products: Anvil, fig. 271.
- .6 Support elements installed directly on the piping:
 - .1 Steel or plastic piping with less than 25 mm of movement: adjustable stirrups conforming to MSS-SP-69, type 10 standards and approved by UL and FM.
 - .1 Acceptable products: Anvil, fig. 69.
 - .2 Copper piping with less than 25 mm (1 in) of movement: copper adjustable stiffups conforming to MSS-SP-69, type 10 standards.
 - .1 Acceptable products: Anvil, fig. CT-69.
 - .3 Steel or plastic piping with greater than 25 mm of movement: stirrups with rollers conforming MSS-SP-69, type 43 standards.
 - .1 Acceptable products: Anvil, fig. 181.
 - .4 Steel or plastic piping supported from the underside: base with rollers conforming to MSS-SP-69, type 44 standards.
 - .1 Acceptable products: Anvil, fig. 175, 177 and 271.
 - .5 Vent and drain piping made of cast iron with adjustable steel iron joints, for NPS 2 NPS 6 and with a cast iron mounting place for NPS 8 to NPS 10.
 - .1 Acceptable products: Bibby-Ste-Croix, 66xxx.
- .7 "U" bolts: made of carbon steel conforming to MSS-SP-69 standards, complete with two (2) nuts conforming to ASTM A563 standards on each end.
 - .1 Galvanized finish for steel piping.

- .2 Plastic finish for copper, glass, brass or aluminum piping.

2.3 CLAMPS ON RISER PIPING

- .1 Steel or cast iron pipe: carbon steel in accordance to MSS SP58, type 42, UL listed or MSS-SP69, type 8.
 - .1 Acceptable products: Anvil, fig. 261.
- .2 Copper pipe: carbon steel copper plated in accordance to MSS SP58, type 42 or MSS-SP69, type 8
 - .1 Acceptable products: Anvil, fig. CT-121.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 For protection shells, use high density insulation with continuous vapour-barrier for cold coolants.
- .2 Horizontal suspension for saddles and shells for insulated pipes, with the following characteristics:
 - .1 Stiff copper piping, greater than NPS 1¼: protection shell.
 - .2 Ferrous metal pipes, greater than NPS 1¼:
 - .1 On stirrups: protection shell;
 - .2 On rollers: protection shells.
 - .3 Acceptable products:
 - .1 Shells: Anvil, fig. 167.
 - .2 Saddles: Anvil, fig. 160 to 166, according to manufacturer specifications.

2.5 SPRING SUSPENSION WITH CONSTANT LOADING:

- .1 Springs: made of alloyed steel conforming to ASTM A125 standards, having been subjected to shot peening and magnetization control, with the following tested characteristics: unloaded height, loaded height and stiffness (±5% allowable deviation). A testing certificate must be supplied for each spring.

- .2 Load adaptable: $\pm 10\%$ of the rated loading. Adjustment to the spring must not require any special tools and must not influence the spring's travel distance.
- .3 Limit stops installed at the top and the bottom of the spring.
- .4 A scale with the designed loadings for on site adjustments.
- .5 Total travel distance of the spring must be 20% greater than the designed travel distance. The difference between the total travel and the designed travel distances must be lower than 25 mm.
- .6 The calibrated scales must be available on each side of the spring before delivery. The calibration records must also be provided.
- .7 Acceptable products: Vibro-Acoustics; Vibra-Sil; Kinetics Noise Control.

2.6 SPRING SUSPENSION WITH VARIABLE LOADING

- .1 Vertical range between 13 mm and 50 mm: suspension with a single pre-compressed spring for variable loading.
- .2 Vertical range greater than 50 mm: suspension with double pre-compressed springs for variable loading; the springs are mounted in series in a single casing.
- .3 Suspension for variable loading complete with factory adjusted limit stops. A calibration certificate must be supplied for each suspension.
- .4 Springs: made of alloyed steel conforming to ASTM A125 standards, having been subjected to shot peening and magnetization control, with the following tested characteristics: unloaded height, loaded height and stiffness ($\pm 5\%$ allowable deviation). A testing certificate must be supplied for each spring.
- .5 Acceptable products: Vibro-Acoustics; Vibra-Sil; Kinetics Noise Control.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of structural plans. Submit calculations with shop drawings.

2.8 ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate positioning of anchor bolts.

2.9 ASSEMBLY BASE

- .1 For equipment on a frame: base made of poured concrete at least 100 mm high, extending 200 mm the equipment frame all around, with chamfered edges.
- .2 Conforming to structural plans.

PART 3 - EXECUTION**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 INSTALLATION

- .1 Install anti-vibration equipment on pump, boiler, chiller equipment and cooling tower piping and all other places indicated.
- .2 Clamps on riser piping.
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .3 Anchorage components for hangers mounted on concrete structure.
 - .1 Attach elements (plates and stirrup) using at least four (4) concrete inserts, one at each corner.
- .4 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .5 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.

- .2 Variation in supporting effect does not exceed 25% of total load.

3.3 SPACING BETWEEN SUPPORTS AND SUSPENSIONS

- .1 Follow the requirements of the Quebec Construction Code, chapter III, Plumbing.
- .2 Install supports/suspension at each 1.5 m for NPS ½ or smaller copper piping
- .3 Install a support/suspension at a maximum of 300 mm from each elbow.
- .4 Conform to MSS-SP-69 standards for all piping with greater than NPS 12 diameter.
- .5 Install supports/suspensions at each joint for piping with notched extremities using flexible joints.
- .6 Support cast iron piping at all joints. The maximum distance between supports must not exceed 3 m. For piping with mechanical joints, this distance must be reduced to 1 m when adjacent joints are spaced less than 300 mm away.
- .7 Support all vertical piping at its base, at the top and at all floors.
- .8 In addition to the above required supports, install supports and suspensions on the straight lengths of the piping as described in the tables below:

HEATING, COOLING AND PLUMBING PIPING			
MAXIMUM SPACING FOR HORIZONTAL PIPING, IN METERS			
Ø PIPING (NPS)	Ø ROD mm	STEEL	COPPER
Up to ½	10	2.1	1.5
¾	10	2.1	1.5
1	10	2.1	1.8
1¼	10	2.1	2.1
1½	10	2.7	2.4
2	10	3.0	2.4
2½	13	3.4	2.7
3	13	3.6	3.0
3½	13	3.9	3.4
4	16	4.2	3.7
5	16	4.8	---
6	19	5.1	---
8	19	5.7	---

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Provide all piping that is subject to temperature variations with supports, guides, anchors, and elbows in order to facilitate the natural expansion of the piping.
- .5 Fix support and suspension elements to the frame. Provide and install all additional steel frame parts that are required.
- .6 Piping and equipment must be supported independently from one another.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4° from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 SUSPENDING PIPING FROM METALLIC STRUCTURE

- .1 For piping greater than NPS 4, support the piping in order to spread the loading over several elements of the frame.
- .2 For piping greater than NPS 4 that are installed perpendicular to a series of beams, install the piping at the center of two beams and install angle beams to distribute the loading evenly between the adjacent beams.

3.7 FINAL ADJUSTMENT

- .1 Adjust hangers and supports.
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis.
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.

- .3 C-clamps.
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps.
 - .1 Hammer jaw firmly against underside of beam.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services.
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Section 23 05 49.01 - Seismic Restraint Systems.

1.2 REFERENCES

- .1 National Building Code of Canada (NBC) - 2005.

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include performance criteria, and limitations.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Provide shop drawings for the whole installation, complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance criterion and physical properties.
 - .2 Manufacturer's field reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, Shipping, Handling, and Unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

- .1 Construction/Demolition waste management and disposal: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 USE OF VIBRATION AND SEISMIC CONTROL EQUIPMENT

.1 Install vibration control equipments to the following table:

Equipment	Power (HP) and Others	RPM	Localisation of Equipments											
			Ground Base			Base - Size								
						Up to 6 m			6 to 9 m			9 to 12 m		
			Base	Isolator	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)	Base	Isolateur	Flexion min. (mm)	Base	Isolator	Flexion min. (mm)
Chillers and Other Cooling Equipments														
Centrifugal, screw type vis, Scroll	All	All	A	1	6	A	4	20	A	4	40	A	4	40
Centrifugal Pumps														
Vertical in line	5 à 25	All	A	3	20	A	3	40	A	3	40	A	3	40
	≥ 30	All	A	3	40	A	3	40	A	3	40	A	3	65

Base Types: A. No base, isolators attached to equipement.

Isolators Types:

1. Elastomeric pads (2.2).
 - 1.1 Elastomeric pads, rubber/steel/rubber (2.2, EP4).
2. Elastomeric mounts or suspension (2.3, 2.6).
3. Floor springs or suspension (2.6).
4. Spring mounts (2.5).

PART 2 - PRODUCTS**2.1 GENERAL**

- .1 Size and shape of bases type and performance of vibration isolation as indicated.
- .2 All products must conform to anti-seismic standards.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - Neoprene waffle or ribbed; 12 mm minimum thick; 50 durometer; maximum loading 621 kPa.
 - .1 Acceptable products: Vibro-Acoustics, type R, Vibra-Sil; Ingenia "Amber/Booth".
- .2 Type EP2 - Rubber waffle or ribbed; 12 mm minimum thick; 30 durometer natural rubber; maximum loading 345 kPa.
 - .1 Acceptable products: Vibro-Acoustics, type R, Vibra-Sil; Ingenia "Amber/Booth".
- .3 Type EP3 - Neoprene-steel-neoprene; 12 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 621 kPa.
 - .1 Acceptable products: Vibro-Acoustics, type NSN, Vibra-Sil; Ingenia "Amber/ Booth".
- .4 Type EP4 - Rubber-steel-rubber; 12 mm minimum thick rubber bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 345 kPa.
 - .1 Acceptable products: Vibro-Acoustics, type RSR, Vibra-Sil; Ingenia "Amber/Booth".

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - Colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.
 - .1 Acceptable products: Vibro-Acoustics, type MD, Vibra-Sil; Ingenia "Amber/Booth".

2.4 SPRINGS

- .1 Design Stable Springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

- .3 Cadmium plate for all installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
 - .1 Type M2 - Stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
 - .1 Acceptable products: Vibro-Acoustics, type SL, Vibra-Sil; Ingenia "Amber/Booth".
 - .2 Type M4 - Restrained stable open spring: supported on bonded 12 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
 - .1 Acceptable products: Vibro-Acoustics, type CSR or CT, Vibra-Sil; Ingenia "Amber/Booth".
 - .3 Type M5 - Enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
 - .1 Acceptable products: Vibro-Acoustics, type SWSR, Vibra-Sil; Ingenia "Amber/Booth".
- .2 Performance: minimum damping efficiency: 95%.

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
 - .1 Type H1 - Neoprene - In-shear, moulded with rod isolation bushing which passes through hanger box.
 - .1 Acceptable products: Vibro-Acoustics, type HD, Vibra-Sil; Ingenia "Amber/Booth".
 - .2 Type H2 - Stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
 - .1 Acceptable products: Vibro-Acoustics, type SH, Vibra-Sil; Ingenia "Amber/Booth".

- .3 Type H3 - Stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
 - .1 Acceptable products: Vibro-Acoustics, type SHR, Vibra-Sil; Ingenia "Amber/Booth".
- .4 Type H4 - Stable spring, elastomeric element with precompression washer and nut with deflection indicator.
 - .1 Acceptable products: Vibro-Acoustics, Vibra-Sil; Ingenia "Amber/Booth".
- .2 Performance: minimum damping efficiency: 95%.

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.
 - .1 Acceptable products: Vibro-Acoustics, Vibra-Sil; Ingenia "Amber/Booth".

2.8 HORIZONTAL THRUST RESTRAINT

- .1 Type L1: Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable Products: Vibro-Acoustics, type HSC; Vibra-Sil; Ingenia "Amber/Booth".

2.9 ROOF CURB ISOLATION RAILS

- .1 General: Type, B4, completely factory assembled.
- .2 Lower Member: continuous rectangular steel tube or "C" extruded aluminum channel.
- .3 Upper Member: continuous rectangular steel tube or extruded aluminum "C" shaped channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.
- .4 Springs: steel, adjustable, removable, selected for 50 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
- .5 High Frequency Isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.

- .6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum or neoprene.
- .7 Hardware: cadmium plated or galvanized.
- .8 Acceptable Products: Vibro-Acoustics, type C; Vibra-Sil; Ingenia "Amber/Booth".

2.10 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 Following systems and/or equipment to conform to protection level indicated in section 23 05 49.01
 - .2 Seismic control systems to work in every direction.
 - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .4 Drilled or power driven anchors and fasteners not permitted.
 - .5 No equipment, equipment supports nor mounts to fail before failure of structure.
 - .6 Supports of cast iron or threaded pipe not permitted.
 - .7 Seismic control measures not to interfere with integrity of firestopping.
- .2 Static Equipment:
 - .1 Anchor equipment to equipment supports. Anchor supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods depending upon site conditions, and as indicated:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.

- .3 Vibration Isolated Equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
 - .3 As indicated.
- .4 Piping Systems:
 - .1 Fire protection systems: to NFPA 13.
 - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing Methods:
 - .1 Structural angles or channels.
 - .2 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC 2005.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.
- .7 Place ventilation units on elastomeric pads with 4 mm static flexion, with a maximum distance of 2,400 mm between centers.

3.3 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Division 21 - Fire Suppression.
- .2 Division 22 - Plumbing.
- .3 Division 23 - Heating, Ventilating and Air Conditioning (HVAC).
- .4 Division 26 - Electrical.

1.2 CODES AND REFERENCES NORMS

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
 - .1 American Iron and Steel Institute (AISI).
 - .1 AISI, Specification for the Design of Cold-Formed Steel Structural Members.
 - .2 American Society of Civil Engineers (ASCE).
 - .1 ASCE 96, Structural Applications of Steel Cables for Buildings.
 - .3 American Society for Testing Materials (ASTM).
 - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - .2 ASSTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A475, Standard Specification for Zinc-Coated Steel Wire Strand.
 - .4 ASTM A603, Standard Specification for Zinc-Coated Steel Structural Wire Rope.
 - .5 ASTM A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

- .6 ASTM E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
- .4 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE, A Practical Guide to Seismic Restraint.
- .5 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 13, Installation of Sprinkler Systems.
- .6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA, Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd Edition, ANSI-SMACNA 001-2008.
- .7 National Building Code of Canada (NBC).
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .9 Requirements from CSA S832-01 - Guideline for Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.

1.3 SEISMIC RESTRAINT SYSTEMS CHARACTERISTICS

- .1 Every seismic restraint systems must be entirely integrated and compatible with the following items:
 - .1 Prescript acoustic and anti-vibrations devices;
 - .2 Design characteristics of building and electrical and mechanical installations.
- .2 Each division is responsible for seismic restraints systems regarding its field.
- .3 On a seismic event, electromechanical systems don't have to be fully functional following the event. Seismic restraints systems are intended to prevent equipments from moving or rolling over in order to protect occupants during a seismic event.
- .4 Design of seismic restraints systems must be done by an engineer, specialized in paraseismic engineering and recognized in the Province of Quebec.

1.4 SUBMITTAL PRODUCTS

- .1 Submit the shop drawings in accordance with the specifications of Divisions 21, 22, 23, and 26.
- .2 The documents to be submitted are:
 - .1 A detailed version of the design criteria.
 - .2 Execution drawings (of same quality and format as the drawings part of the contractual documents), lists of materials and equipments, schematic representations as well as detailed specifications for all the elements of each of the foreseen devices and earthquake-resistant devices.
 - .3 The design documents, work sheets and charts, including the calculation of the strain rates that can be attributed to seismic forces, as per the CNB.
 - .4 Distinct shop drawings for each earthquake-resistant device or system as well as for each of their elements.
 - .5 A document specifying the location of every device or system.
 - .6 Lists of the different types of earthquake-resistant devices or systems and their related elements.
 - .7 A document showing or indicating the details of the anchoring and mounting devices, the anchoring loads as well as the mounting methods to the frame elements.
 - .8 A document specifying the instructions and installation methods.
- .3 Submit to the Departmental Representative, for review, location of seismic restraints systems and equipments attachments points to building structure. Submit one sample of shop drawings and technical sheets.
- .4 Submit documents signed and sealed by an engineer, specialized in paraseismic engineering and recognized in the Province of Quebec, certifying that seismic restraints systems meet the characteristics and performances requirements.
- .5 Submit installation instruction provided by manufacturer.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit required documents at closeout and join them, to the "Operation and maintenance manual", complying with Divisions 21, 22, 23, and 26.
- .2 Include instructions regarding control of seismic restraint systems and devices to maintenance sheets.

1.6 WASTE MANAGEMENT

- .1 Sort wastes for reuse and recycling, in compliance with Divisions 21, 22, 23, and 26.

1.7 PROTECTION LEVEL

- .1 Install seismic anchorage and stabilisation devices on piping, else than fire protection piping and ventilation ducts, in accordance with prescriptions from the "Seismic Restraint Manual" published by SMACNA.
 - .1 Design criteria:
 - .1 City: Laval;
 - .2 Risk category: low;
 - .3 Sit category: E.
 - .2 Protection level required for current building:
 - .1 SHL-"B" for equipments;
 - .2 SHL-"D" for piping and ducts.

PART 2 - PRODUCTS

2.1 SUPPLY SOURCE

- .1 The devices and seismic restraint systems must be supplied by only one manufacturer possessing experience in that subject area.
 - .1 Acceptable products: Mason Industries; Hilti; Tolco.
- .2 Seismic restraint systems for fire protection piping in accordance with NFPA 13 standard. Protection level required is $V_p = 0.5 W_p$.

2.2 GENERAL

- .1 The seismic restraint devices must prevent the permanent displacements as well as the damages caused by horizontal, vertical and reversing movements.
- .2 The seismic restraint devices must be compatible with the electromechanical conception. They must not impede the normal operation of the electromechanical systems.
- .3 The seismic restraint devices must act flexibly and in every directions. They must not impede the sound damping and anti-vibration elements.

- .4 The mountings and attachment points must be able to resist to the same maximal loads as the seismic restraint devices.
- .5 Mounting of the seismic restraint devices and systems to reinforced concrete frames:
 - .1 The anchors used must be of expansive type and must present a high degree of mechanical strength.
 - .2 No anchor must be fixed by a needle-gun nor laid by holes bored to that effect.
 - .3 Acceptable products: Hilti, HSL type.
- .6 No device, nor connected holder, nor electrical contact rivet must yield before the frame or the structure yields.
- .7 The seismic restraint devices composed of cast iron, threaded tubes or other frangible materials will not be accepted.
- .8 The seismic restraint devices must not obstruct the operation of fire-stop devices nor compromise their integrity.
- .9 To stabilize all the accessories, such as diffusers and lighting appliances installed in suspended ceilings, do not have to be stabilized, unless inside an exit corridor, or if the ceiling is specifically made to resist seism.

2.3 STEEL ANGLES

- .1 Angles made from cold shaped steel plate and meeting AISI requirements, with minimum ultimate stress value, $F_u = 410 \text{ MPa}$ and an elastic limit stress of $F_y = 300 \text{ MPa}$.

2.4 "C" CHANNELS

- .1 "C" channels manufactured following ASTM A1011/A1011M GR 33 standard.

2.5 STRUCTURAL PIPING

- .1 Structural piping, manufactured following ASTM A53/A53M standard, type E or S, grade B.

2.6 CABLE

- .1 Cable, manufactured following ASTM A603 or ASTM A475 standard, with at least seven wires, and Class A coating.
- .2 Connection parts, meeting ASCE 19 standard requirements and tested to hold at least 110% of the ultimate tensile stress of the cable.

2.7 BOLTS

- .1 Bolts manufactured in accordance with ASTM A307 standard, grade A, hex head.

2.8 SEISMIC RESTRAINT FOR EQUIPMENT REQUIRING STATIC SUPPORT

- .1 Attach equipments to hanging supports mounted on the structure.
- .2 Install devices in order to avoid horizontal oscillation, vertical tipping over as well as axial sliding or buckling.
- .3 Use buckling resistant suspension rods.

2.9 SEISMIC RESTRAINT FOR EQUIPMENT REQUIRING ELASTIC SUPPORT

- .1 Attach equipments to hanging supports attached to the structure by the means of rigid rods on the three axes.
- .2 Restraint devices must act with flexibility and in a continuous manner. To do so, those must contain elastomeric elements, or any other parts meant to minimize impact effects.
- .3 Seismic restraint devices must not impact the efficiency of the noise and antivibration elements. During normal operation, the clearance between seismic restraint devices and material must be between 6 mm and 12 mm.
- .4 If paraseismic isolators are used, those shall be designed and installed in order to hold minimum acceleration forces.
- .5 Devices must never be compressed at the point of loss of efficiency.
- .6 Seismic restraint devices must avoid the complete discharge of anti-vibration devices.
- .7 If standard isolators are used, seismic restraint devices must be incorporated to anti-vibration elements in order to prevent those from tipping over.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Attachment points and fastening devices:
 - .1 Carefully verify that the anchoring bolts, the diameters of dowels, the depth of recesses in the concrete as well as the length of welds are in conformity to the drawings submitted for approval.

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- .2 Bolt to the frame or structure all the material that is not insulated against the transmission of vibrations.
 - .3 The oblong drillings for the adjustment of bolts is prohibited.
 - .4 For earthquake-resistant purposes, the lines of a small diameter can be attached to lines of bigger diameter that will hold them. The reverse practice is prohibited.
 - .5 The anchoring points inside concrete slabs must be kept away from the edges as per ASTM E-488 standard and the recommendations of the manufacturer of the anchors.
 - .6 The depth of anchorage in concrete slabs must be at least eight times the hole diameter.
 - .7 Install restraining straps on every C-clamp used to support piping, in order to hold those in place in the occurrence of a seism. Straps must be provided by the C-clamp manufacturer.
- .2 Holding cables:
- .1 Link the holding cables to the hanging appliances in a manner that their axial incidence corresponds to the gravity center of the protected appliances.
 - .2 Tighten the cables attaches following the manufacturer's recommendations.
 - .3 Use wire ways, lugs and other appropriate hardware to ensure the alignment of the earthquake-resistant devices and to prevent the cables from bending at the fastening points.
 - .4 In the case of equipment hanging on the ceiling, set the holding cables at a 90° angle one from each other in the plans, and fix them to the frame of the building at a 45° angle.
 - .5 Adjust the tension of the lines in a manner that they do not seem loose but that they do not bother the normal operation of the anti-vibration devices.
 - .6 Tighten the cables in a manner that reduces the slack to 40 mm (1½ in) under a thumb pressure. In normal operation, the lines must not support the weight of the equipment held.
- .3 Tighten bolts to the C-channel with following torque:
- .1 NS ½: 68 Nm.
 - .2 NS ¾: 169 Nm.
- .4 Install the earthquake-resistant devices and systems to at least 25 mm from any other appliance or utility line.
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- .5 Miscellaneous equipments not insulated against vibrations:
 - .1 Bolt the equipment to the assembly base then to the frame using crossing anchor bolts.
- .6 Coordinate the connecting operations with the other building trades.
- .7 Vertical tanks:
 - .1 Anchor the tanks to their assembly base then to the frame using crossing anchor bolts.
 - .2 Lay retaining collars in steel strips above the gravity center.
- .8 Horizontal tanks:
 - .1 Foresee at least two bucking straps, with anchoring bolts fixed to the frame.
- .9 Brace the equipments independently from the ventilation ducts.
- .10 Never use two types of bracing in the same direction.
- .11 Do not stabilize equipments which hanging rods are smaller than 300 mm long.
- .12 Do not install seismic restraint devices at an angle over 60° or under 45° from the horizontal.
- .13 Install transversal seismic restraint devices, square to the direction of the duct or pipe, with a maximum variation angle of 2.5°.
- .14 Install longitudinal seismic restraint devices parallel to the direction of the duct or pipe, with a maximum variation angle of 2.5°.
- .15 Install at least two transversal and one longitudinal seismic restraint device or system on every straight piping segment.
- .16 Install transversal and longitudinal seismic restraint devices at a maximum distance of 100 mm from a vertical support, which must be reinforced as needed.

3.2 MANUFACTURER INSTRUCTIONS

- .1 Comply with manufacturer's requirements, recommendations and written specifications, including any available technical bulletin, as well as with any instructions regarding handling, storage and installations of the products, and indications from the technical sheets

3.3 ONSITE QUALITY CONTROL

- .1 Once the works achieved, seismic restraint devices must be inspected and certified by an engineer specialized in this field and recognized within the Province of Quebec.
- .2 Provide a written report with the conformity certificate to the Departmental Representative.
- .3 If needed, the Contractor must apply required modifications and settings, according with the report presented by the specialized engineer.

3.4 DOCUMENTS NEEDED FOR STARTING UP

- .1 Once the certification is completed and the report accepted, submit to the Departmental Representative a complete copy of the project record reviewed and annotated in a manner that displays the conditions after execution.

3.5 INSTALLATION FOR PLUMBING PIPING

- .1 Do the installation and design of the earthquake-resistant systems as per the "ASHRAE, A Practical Guide to Seismic Restraint" manual and the ANSI/SMACNA 001-2008 standard.
- .2 The earthquake-resistant devices and systems must permit the observance of the requirements relating to the anchoring and guiding of pipes.
- .3 Stabilize the piping of NPS 3 and more.
- .4 Stabilize the fuel, NPS 1 and more compressed air running lines.
- .5 Install the devices for mechanical restraint for piping at the following frequency:
 - .1 For the transversal stabilization:
 - .1 NPS 8 and less: 12.2 m.
 - .2 NPS 10 and more: 6.1 m.
 - .3 Reduce by two those lengths in the case of non-ductile or screwed piping.
 - .2 For the longitudinal stabilization:
 - .1 NPS 5 and less: 24.4 m.
 - .2 NPS 6 and NPS 8: 12.2 m.
 - .3 NPS 10 and more: 6.1 m.
 - .4 Reduce by two those lengths in the case of non-ductile or screwed piping.

- .6 In the case of plastic piping, a standard support must be provided, in accordance with manufacturer's recommendations or halfway between joints.
- .7 The transversal seismic restraint system or device of a piping section can also be used as a longitudinal seismic restraint system or device for a piping section of the same dimension installed square to the first section, if the bracings are located within 610 mm from an elbow or a "T" fitting.
- .8 Install seismic separation assemblies wherever piping crosses a seismic separation within the building. Stabilize transversally and longitudinally this assembly within 1.83 m on each side of the separation.
- .9 Stabilize each side of a 90° direction change of cast iron, copper, steel and stainless steel piping.
- .10 Do not stabilize piping hanging by supports of 300 mm in length or less, measured from one connecting point to the other.

3.6 INSTALLATION FOR VENTILATION DUCTS

- .1 Do the installation and design of the seismic restraint systems as per the ANSI/SMACNA 001-2008 norm.
- .2 Stabilize the rectangular and oblong ventilation ducts whose surface is 0.55 m² and more and the circular ducts whose diameter is of 700 mm or more.
- .3 A transversal seismic restraint device or system installed to stabilize a duct section can also be used as a longitudinal seismic restraint device or system to stabilize another duct section of same or smaller dimensions, if the two duct sections are mounted square to each other and if the seismic restraint device or system is installed within 610 mm from the intersection.
- .4 A wall (including gypsum wall) can be used as a transversal seismic restraint system, if the duct is solidly attached at it's surrounding, to the wall.
- .5 Install the mechanical restraint devices at the follow frequency:
 - .1 For the vertical stabilization:
 - .1 The vertical stabilization is ensured by regular supports.
 - .2 For the transversal stabilization: 9.1 m.
 - .3 For the longitudinal stabilization: 18.3 m.
- .6 Do not stabilize ducts hanged by supports, which are located less than 300 mm below structure. Supports must be mounted on ducts using at least two no.10 metal screws, installed at least 50 mm from the upper side of the duct.

3.7 ELECTRICAL INSTALLATIONS

- .1 Do the installation and design of the seismic restraint systems as per the "ASHRAE, A Practical Guide to Seismic Restraint" manual.
- .2 Provide supports with longitudinal and transversal bracing, rigid type or cables.
- .3 Do not stabilize material with hanging supports of 305 mm in length or less.
- .4 Stabilize electric conduits of 35 mm nominal diameter and above, indoor.
- .5 Stabilize electric conduits of 63 mm nominal diameter and above, outdoor.
- .6 Install the mechanical restraint devices at the follow frequency:
 - .1 For the transversal stabilization: 9.1 m.
 - .2 For the longitudinal stabilization: 18.3 m.

3.8 RIGID RODS AND ATTACHMENT POINTS

- .1 Link the restraint rods to the hanging equipment in a manner that their axial incidence go through the gravity center of the equipment to protect.
- .2 Use rod diameters as needed and in accordance with the requirements of the manufacturer of the seismic supports.
- .3 The vertical, lateral and longitudinal rods must be installed as per the recommendations of the manufacturer of the supports.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA).
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 SUBMITTALS

- .1 Product Data.
 - .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product data to include paint colour chips, other products specified in this section.
- .2 Samples.
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality control.
-

- .2 Health and Safety:
 - .1 Apply pertinent safety rules in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading.
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 IDENTIFICATION

- .1 Mechanical and network identification must be in accordance with Client's identification system.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours.
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction.

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

.3 Sizes.

- .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

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

.4 Locations.

- .1 Terminal cabinets, control panels: use size # 5.
- .2 Equipment in Mechanical Rooms: use size # 9.
- .3 Indicate the number and the type of system as well as the service and the area it serves.

.5 Identification for PWGSC Preventive Maintenance Support System (PMSS).

- .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
- .2 Equipment in Mechanical Room:
- .1 Main identifier: size #9.
- .2 Source and Destination identifiers: size #6.
- .3 Terminal cabinets, control panels: size #5.
- .3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms.
 - .1 In accordance with Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .3 Legend.
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

Exterior pipe or insulation diameter	Letters height
(mm)	(mm)
30	13
50	19
150	32
250	63
Larger than 250	88

- .4 Arrows showing direction of flow.
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking.
 - .1 To full circumference of pipe or insulation.

- .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows.
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 15°C (300°F) and intermittent temperature of 200°C (390°F).
- .7 Colours and Legends.
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
<i>Add design temperature</i>		
<i>Add design temperature and pressure</i>		
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Liquid refrigerant	Green	REF. Liq.
Gaz refrigerant	Green	REF GAZ
Water - Sprinklers	Red	SPRINKLERS

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

- .1 Inscriptions used for system identification must be written in French and English.
- .2 French and English identification must be written on the same identification plate, label, etc.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXECUTION

- .1 Start network and equipment identification work only when painting is done.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.
- .4 Materials for background color, lettering and arrow markings:
 - .1 Affix the tape to dry and clean surfaces prepared for this purpose. Roll the tape around the pipe with an overlap equivalent to at least one pipe diameter.

3.4 NAMEPLATES

- .1 Locations.
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs.
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection.
 - .1 Do not paint, insulate or cover.
- .4 Submit a nameplate list for approval before engraving.
- .5 The following systems are to be identified:
 - .1 Pumps;
 - .2 Chillers;
 - .3 Condensing units.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 Affix identification tags on the following pipe and ductwork locations:
 - .1 On long straight runs in open areas, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping or ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
 - .7 At beginning and end points of each run and at each piece of equipment in run.

- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
 - .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .10 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
- .2 Mark the piping with a stencil once the last paint layer has been applied.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 In accordance with section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .2 Division 23 - Heating, Ventilation and Air-Conditioning (HVAC).
- .3 Division 26 - Electrical.

1.2 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for air systems and hydronics systems.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.3 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAaC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design, and installation pertinent to success of TAB.

- .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in contractual documents.

1.9 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.10 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, and caulking.
 - .3 Pressure, leakage, other tests specified elsewhere in Specifications.
 - .4 Provisions for TAB installed and operational.
 - .5 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including, but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.

- .5 Fire, smoke, volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 Outlets installed, volume control dampers open.
- .3 Hydronics systems:
 - .1 Liquid systems flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.11 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 Air systems: plus or minus 10%.
 - .2 Hydronic systems: plus or minus 5%.

1.12 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.14 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB, if different from referenced standards.

1.15 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.16 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in both official languages, in D-ring binders, complete with index tabs.

1.17 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
 - .2 Provide personnel and instrumentation to verify up to 30% of reported results.
 - .3 Number and location of verified results as directed by Departmental Representative.
 - .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.
-

1.18 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.20 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, SMACNA or ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified in contractual documents.
- .3 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .4 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .5 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 HYDRONICS SYSTEMS

- .1 For the needs for this section, the systems hydronic include the systems of cooling using the following fluids: chilled water and glycol.
- .2 The operations of TAB must be carried out in accordance with the most strict requirements stated in the present section or the standards and the relevant reference documents of the AABC of the SMACNA or the ASHRAE.
- .3 Carry out the test, the adjustment and the balancing of the systems, the apparatuses, the elements and the regulation and control devices.

- .4 The persons charged to carry out the operations of TAB must be members in good standing and be entitled to provide the services prescribed, according to standards of the AABC.
- .5 The TAB operations of the systems must be carried out under the direction of a recognized supervisor entitled to provide the services prescribed according to standards of the AABC.
- .6 The readings to be done will carry in particular on followings, according to systems, the apparatuses, the elements or the control devices and regulation concerned: the static pressure, the flow rate, the pressure drop, the temperature, the density, the number of revolutions, the power, the voltage, levels of noise and vibration.
- .7 The points of measurement, in the case of the apparatuses, will be located at the following places, according to the case:
 - .1 At the entry and the exit side of the heat exchangers (primary and secondary sides), cooling coils, condensers, pumps, pressure regulators, control valves and regulation and any other apparatus causing conditions changements;
 - .2 At the regulators and the regulation control devices.
- .8 The points of measurement, in the case of the systems, will be located at the following places, according to the case: on the supply and the return of the primary and secondary loops (principal drains, principal and secondary drain connections, supply lines of the final elements of the hydronic systems, connections of admission of the auxiliary water circuits).

1.22 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter and summer design conditions at all times.
- .3 Measure equipments' noise level measure, as prescript in 23 and 26 Divisions.
- .4 Measure ambient noise level.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

.1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 CODES AND REFERENCES NORMS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM B209M-07, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-05ae1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-05, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-07e1, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-02e1, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-01, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-03a, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-52Ma-89, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC), National Insulation Standards (2005).
- .5 Underwriters Laboratories of Canada.
 - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.3 DEFINITIONS

- .1 For the present section the following definitions apply:
 - .1 Concealed elements: insulated piping, ductwork and mechanical equipment located above suspended ceilings or in inaccessible construction spaces.
 - .2 Visible elements: elements that are not concealed (as per the definition above).
 - .3 Insulation: includes the insulating material, accessories for fixing and jackets.
 - .4 Ductwork: overall duct network including the ducts, the joints and all related accessories.
- .2 Insulation thickness is the thickness needed to cover every component of the insulated element, including reinforcements, angles, T-joints, flanges etc.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data.
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples.
 - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12 mm plywood board.

- .3 Affix typewritten label beneath sample indicating service.
- .4 Manufacturers' Instructions.
- .1 Provide manufacture's written duct insulation jointing recommendations and special handling criteria, installation sequence, cleaning procedures.

1.5 QUALIFICATIONS

- .1 Installation: a specialist in performing work specified in this section, having at least 3 years of experience with this type and size of project and member of TIAC.
- .2 Work must be completed by skilled insulation workers.

1.6 QUALITY ASSURANCE

- .1 The mechanical quality insulation standards manual of the Thermal Insulation Association of Canada (TIAC), as well as its authorized amendments, must be used as the standard reference and is part of the specifications of this project.
- .2 The Contractor responsible for the thermal insulation installation must keep a copy of this quality standard manual as a reference on the jobsite.

1.7 WASTES MANAGEMENT

- .1 Sort out and recycle wastes in accordant with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Thermal conductivity coefficient (coefficient "K") must not exceed the prescribed value at mean temperatures of 24°C, in accordance with ASTM C335 standards.

-
- .2 Type **D-1 insulation**: rigid panels made of mineral fibres in accordance with ASTM C612 standards, with a factory installed vapour barrier envelop in accordance with CGSB 51-GP-52Ma standards.
 - .1 Thermal conductivity coefficient "K" no greater than 0,035 W/m•°C (0.234 Btu-in/h•ft²•°F) at mean temperatures of 24°C.
 - .2 Temperature limit: 120°C.
 - .3 Acceptable product: Manson AK Board FSK.
 - .3 Type **D-2 insulation**: bat made of mineral fibres in accordance with ASTM C553 standards, with factory installed vapour barrier envelop in accordance with CGSB 51-GP-52Ma standards.
 - .1 Mineral fibers: in accordance with ASTM-C553 standards.
 - .2 Vapour barrier: in accordance with CGSB 51-GP-52Ma standards.
 - .3 Thermal conductivity coefficient "K" no greater than 0,035 W/m•°C (0.234 Btu-in/h•ft²•°F) at mean temperature of 24°C.
 - .4 Temperature limit: 120°C.
 - .5 Density: 24 kg/m³.
 - .6 Acceptable product: Manson Alley Wrap FSK.
 - .4 Type **D-3 insulation**: rigid ducts made of mineral fibres in accordance with ASTM C547 standards, with factory installed vapour barrier envelop in accordance with CGSB 51-GP-52Ma standards.
 - .1 Mineral fibers: in accordance with ASTM-C553 standards.
 - .2 Vapour barrier: in accordance with CGSB 51-GP-52Ma standards.
 - .3 Thermal conductivity coefficient "K" no greater than 0.037 W/m•°C (0.26 Btu-in/h•ft²•°F) at mean temperature of 38°C.
 - .4 Density: 40 kg/m³.
 - .5 Temperature limit: 454°C.
 - .6 Acceptable products: Knauf KwikFlex Pipe & Tank with FSK liner.
-

2.3 JACKETS

- .1 Canvas.
 - .1 To utilise to the exposed elements 220 gm/m² cotton ULC approved, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Acceptable products: S. Fatall Thermocanvas.
 - .3 Lagging adhesive: compatible with insulation.

2.4 GLUES, TAPES AND ATTACHMENTS

- .1 Tapes: self-adhesive aluminum, of 100 mm in width, approved by the ULC for the following characteristics: flame spread index inferior to 25 and a fumigant property index of at most 50.
- .2 Quick set contact glue.
- .3 Sealing glue for overlaps: quick set glue used to seal the joints and the overlaps of the vapour barriers.
- .4 Glues for jackets in canvas web.
 - .1 Washable glue used to stick the jacketing on the insulating material.
- .5 Pegs.
 - .1 Pegs to weld to the duct once the insulation is set, of a 4 mm diameter, with a 35 mm head diameter, of an appropriate length to the thickness of the insulator.
 - .2 Pegs to weld on the duct before the insulation is set, of a 2 mm diameter, of an appropriate length to the thickness of the insulator, equipped with a nylon square holding small plate of 32 mm side.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.

- .2 Apply materials in accordance with manufacturers' instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 If there are elevated joints, cover them by overlapping sections or with a flexible insulating material with an integrated vapour barrier.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .6 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .7 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: conform to following table:

NETWORKS AND EQUIPMENTS		THICKNESS OF INSULATION mm	TYPE OF INSULATION
.1	The fresh air ducts, starting from the louvers to the cooling tower	50	D-1
.2	The networks of hidden rectangular supply conditioning air ducts whose greatest dimension does exceed 1,000 mm	25	D-2
.3	The fresh air ducts, starting from the louvers to the heating coils	75	D-1

3.4 FINISHING

- .1 Visible ducts located inside de building: canvas jacket.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .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.

1.2 REFERENCES

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ANSI/ASHRAE/IESNA 90.1-SI, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C335-05ae1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C449/C449M-07, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C533-07, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .4 ASTM C547-07, Specification for Mineral Fiber Pipe Insulation.
 - .5 ASTM C553-02, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .6 ASTM C612-04e1, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

- .8 ASTM C921-03a, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC).
 - .1 National insulation standards (2005).
- .4 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-07, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .5 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CGSB 51-GP-53M-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples.
 - .1 Samples must include:
 - .1 Complete assembly of each proposed insulation system, including insulation, coating and adhesive. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DEFINITION

- .1 Insulation thickness shall be such that it covers all parts of the components that must be insulated, such as: reinforcements, angles, joints and flanges, etc.

1.6 QUALIFIED PERSONNEL

- .1 The installer must be an expert in the field and have at least three years of relevant experience in carrying out work of a similar type and scale to that described in the present document and must be a TIAC member or have equivalent required qualifications.
- .2 Work must be carried out by skilled workers in insulation.

1.7 QUALITY ASSURANCE

- .1 The TIAC (Thermal insulation Association of Canada) Mechanical Insulation Best Practices Guide as well as all official additions and amendments, must be used as standard reference and is considered part of this project's specifications
- .2 Mechanical insulation contractor must keep a copy of the Best Practices Guide as reference.

1.8 WASTES MANAGEMENT

- .1 Sort out and recycle wastes in accordant with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS**2.1 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Thermal conductivity "K" must not exceed required values for an average temperature of 24°C, when tested according to requirements in the ASTM C335 standard.
- .2 Insulation of E-1 type: flexible and tubular, unicellular elastomer.
 - .1 Insulate components according to ASTM C534 standard.
 - .2 Thermal conductivity "K" must not exceed 0,039 W/m•°C for an average temperature of 24°C.

- .3 Temperature limit: -57°C to 105°C.
- .4 Components must be certified stress-cracking agent free, in order to avoid corrosion stress cracking.
- .5 Acceptable products: Armaflex AP, sheet insulation.

2.3 JACKETS

- .1 Canvas jackets:
 - .1 220 g/m² cotton, plain weave, treated with diluted ULC certified fire retardant and fire resistive lagging adhesive in accordance with to ASTM C921 standard.
 - .2 Lagging adhesive: compatible with insulation.
 - .3 Acceptable products: Fattal Thermocanvas.

2.4 INSULATION CEMENT

- .1 Thermal insulation and finishing cement.
 - .1 According to ASTM C449/C449M standard.
- .2 Hydraulic or air setting, on mineral wool according to ASTM C449 standard.

2.5 GLUES, TAPES AND ATTACHMENTS

- .1 Tape: aluminium, self-adhesive, reinforced, at least 50 mm width.
- .2 Quick-set contact glue.
- .3 Canvas jacket glue must be washable. .
- .4 Strapping: 1.5 mm diameter, stainless steel.
- .5 Banding: stainless steel, 0.5 thick and 19 mm wide.
- .6 Cladding: galvanised steel mesh with 25 mm hexagonal mesh, installed on both sides of insulation or on one side with other side covered by an metal lath.
- .7 Attachments: 4 mm diameter pins, length should be compatible with insulation as well as 35 mm diameter or length retainer plates.

2.6 GLUE TO SEAL VAPOUR BARRIER OVERLAPS

- .1 Water based fireproof glue must be compatible with insulation.

2.7 VAPOUR BARRIER COATING FOR INDOOR PIPES

- .1 Vinyl emulsion, acrylic type, compatible with insulation material.

2.8 ACCEPTABLE PRODUCTS

- .1 Specified products or approved equivalents of Owens Corning, Johns Manville, Knauf, Certain Teed.

PART 3 - EXECUTION**3.1 PRE-INSTALLATION REQUIREMENT**

- .1 Hydraulic testing of piping and adjacent equipment completed, witnessed and certified by a competent authority, before installation of insulation material.
- .2 Surfaces meant to be insulated must be clean, dry and free from foreign material

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
 - .1 Cold material: in accordance with TIAC 1503-C code.
- .2 Elastomeric insulation: always keep elements dry. Perform tight overlapping joints according to manufacturer's instructions.
- .3 Provide vapor barrier according to manufacturer's recommendations.
- .4 Install insulation as instructed by mechanical material manufacturer and according to instructions in the present section.
- .5 If required nominal insulation thickness is over 75 mm, accomplish work in two layers with joints offset.
- .6 Install vapor barrier and apply finish coatings seamlessly.
 - .1 Hangers and supports must not break through the vapor barrier.

.7 Hangars and supports:

- .1 Install high compression strength insulation, suitable for service conditions, where insulation saddles protection shields have not been provided.

3.3 TABLE - INSULATION OF PIPING AND ADJACENT COMPONENTS

.1 Unless otherwise specified, equipment insulation also includes insulation of valves, valve bonnets, strainers, flanges and fittings.

.2 Cold material.

- .1 Insulation of E-1 type fastened by mechanical attachments or banding.

.1 Insulation thickness

TYPE OF SERVICE	INSULATION THICKNESS
Chiller except for those already factory-installed	50 mm
Chilled water storage tanks	50 mm

.3 When more than one type of insulation is specified in the table, choice is left to the contractor.

.4 Finishes: 13 mm insulating cement cladding and canvas jacket.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: pumps, access-doors, expansion joints, valves, flow measuring devices, flanges, mechanical joints, fittings and other accessories.

.2 Design: should allow periodic removal and replacement without damage to adjacent insulation.

.3 Insulation.

- .1 Insulation type recommended for the component or piping network, shaped to fit elements destined to be insulated.

.2 Thickness: twice the recommended thickness of the component or piping network.

.3 Vapor barrier should be added for cold water installations or other cold surfaces.

.4 Enclosure: 1.3 mm thick aluminum or 0.6 mm thick stainless steel with exterior cladding and quick release coupling straps.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 21 05 01 - Common Work Results for Mechanical.
- .5 Section 23 05 05 - Installation Pipework.
- .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipments.
- .7 Section 23 21 13.02 - Hydronic Systems Steel.

1.2 REFERENCES

- .1 Unless otherwise indicated, all the works must be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance with any other code or norm having jurisdiction, as per the latest edition, notably including, but not limited to:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
 - .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

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- .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Manufacturer's Trade Associations.
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
 - .4 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.
 - .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
 - .6 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.
 - .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
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1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance.
 - .1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.

- .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335 standard.
- .2 TIAC Code P1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547 standards.
 - .2 Vapour retardant to CGSB 51GP-52Ma standard.
 - .3 Maximum "k" factor: of 0.033 W/m°C at an average temperature of 24°C.
 - .4 Temperature limits: -29°C à 454°C.
 - .5 Acceptable products: Manson Alley-K, Knauf, Johns-Manville.
- .3 TIAC Code P3: flexible, unicellular, elastomer tubes.
 - .1 Insulating element: to CAN/CGSB-51.40 standard.
 - .2 Maximum "k" factor: of 0.039 W/m°C at an average temperature of 24°C.
 - .3 Temperature limits: -57°C à 105°C.
 - .4 Insulation must be certified by the manufacturer as being exempt of any agent likely to cause cracking due to stress corrosion.

2.3 INSULATION SECUREMENT

- .1 P-1 and P-2 insulation securement.
 - .1 Tape: self-adhesive, aluminum reinforced, 50 mm wide minimum.
 - .1 Acceptable products: tape Fattal Insultape made by S. Fattal Canvas Inc.
 - .2 Vapour Retarder Lap Adhesive.
 - .1 Water based, fire retardant type, compatible with insulation.
 - .2 Acceptable products: Foster 87-75 without asbestos fiber, with a coverage density of 6 m²/L.

- .3 Indoor Vapour Retarder Finish.
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Acceptable products: Foster 30-36 without asbestos fiber, with a coverage density of 1.25 m²/L.
- .2 P-3 insulation securement.
 - .1 Contact adhesive: air dried, rapid setting adhesive for sealing transversal and longitudinal joints in the insulation.
 - .1 Acceptable products: RUBATEX, modèle 373.
 - .2 Tape: self-adhesive PVC.
 - .1 Acceptable products: Armstrong 520, Foster 85-20 without asbestos fibre with a coverage density of 5 m²/L.
 - .3 Protective coating for P-3 insulation: water based, semi-gloss, indoor/outdoor, flexible coating to be applied on all visible piping. Coating is to be white colored and applicable by brush or spray.
 - .1 Acceptable products: RUBATEX, modèle 374

2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 standard with pre-formed shapes as required.
 - .2 Colours: by Departmental Representative.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0,5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.

- .3 Pressure sensitive vinyl tape of matching colour.
- .8 Acceptable products: Zeston.
- .2 Aluminum pipe jacket:
 - .1 According to norme ASTM B209.
 - .2 Thickness: 0.5 mm thick sheet.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die shaped fitting covers with factory attached protective liner.
 - .6 Retaining sheets and seals: Stainless steel, 19 mm wide and 0.5 mm thick, at 300 mm intervals.

2.5 ACCEPTABLE PRODUCTS

- .1 Specify product or equivalent of Owens Corning, Johns Manville, Knauf, Certain Teed.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 PIPING INSULATION SCHEDULES

- .1 Unless otherwise specify, the insulation of the piping include the insulation of the valve, filters, and accessories
- .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
- .3 Insulate the piping and equipment as indicated in the following table:

Systems and equipments	Fluid temperature °C	Insulation Type
.1 Chilled water	7	P-1
.2 Exposed vent pipe on a 5 m length starting from the roof, on main and branch pipe	--	P-1
.3 Chilled water pump body, 25 mm insulation thickness	--	P-3
.4 Chilled water cap and sieve, 25 mm insulation thickness	--	P-3
.5 Hidden vent pipe on a 5 m length starting from the roof, on main and branch pipe, thickness of insulation 25 mm.	--	P-2
.6 Drainage piping of HVAC units and air plenum, thickness of insulation 25 mm.	--	P-1
.7 Cold water make up	4	P-1
.8 On expansion joint, thickness of insulation 25 mm	--	P-2

- .4 Thickness of the P-1 insulation type.

FLUID TEMPERATURE °C	NOMINAL DIMENSION OF THE PIPING (NPS)			
	1 and less	1¼ to 2	2½ to 4	5 and more
	Thickness in mm			
50-95	25		38	
14-49	25		38	
5-13	25	38		
5	25	38		

3.5 FINISHES

- .1 Exposed Indoors: PVC jacket.
- .2 Concealed, indoors: canvas on valves, fittings. No further finish.
- .3 Exposed outdoors: aluminium jacket.
- .4 Installation: to appropriate TIAC.

3.6 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
- .1 Insulation, fastenings and finishes: same as system.
- .2 Jacket: PVC.

3.7 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 SECTION CONTENTS**

- .1 Control of the piping performance for the mechanicals systems.

1.2 RELATED SECTIONS

- .1 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .1 Section 21 05 01 - Common Work Results for Mechanical.
- .2 Section 22 42 01 - Plumbing Specialties and Accessories.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Section 23 08 02 - Cleaning and Start-up for Mechanical Piping Systems.

1.3 REFERENCES

- .1 American National Standard Institute/American Society of Mechanical Engineers (ANSI/ASME).
- .1 ANSI/ASME B31.1-2010, Power Piping.

1.4 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.5 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests.
 - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.

- .2 Chiller operation.
- .3 Relief valve bypass open/close.
- .4 Control pressure failure.
- .5 Pressure valve failure
- .6 Maximum cooling demand.
- .7 Chiller failure.

1.6 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:
 - .1 TAB has been completed.
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system's capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system's capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Cooling system capacity test:
 - .1 Perform test when room temperature is less than 10% of design temperature. Simulate design conditions as follows:
 - .1 Increase room temperature by starting building's heating system or by doing the following:
 - .1 Increase room temperature by stopping building ventilation and cooling systems long enough before test and by preheating until room temperature, is equal to, at least, summer design temperature (for occupied periods) Set fresh air and return air dampers to allow a minimum of fresh air intake, if outdoor air temperature is almost equal

to design temperature. Set air dampers to maximum return air position if return air temperature is higher than outside air temperature. Return air temperature must be at least 23°C.

- .2 Test procedures shall be as follows:
 - .1 Fully open cooling coil control valves.
 - .2 Set thermostats on associated devices and AHU's for maximum cooling.
 - .3 Set devices and AHU's for design maximum air flow rates.
 - .4 Set load or demand limiters on chillers to 100%.
 - .5 After system has stabilized, record chilled water temperature, condenser water temperature, air flow rates as well as supply and return air temperatures simultaneously.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .2 Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

PART 2 - PRODUCTS**2.1 HYDRONIC SYSTEM**

- .1 Cleaning Agent:
 - .1 Cleaning agent with the following properties: slightly basic, biodegradeable, with wetting agents, dispersing agents, sodium nitrate, basic additives, a pH level of 10.69, a specific gravity of 1.105, a yellow color and slightly hazy appearance.
 - .2 Acceptable products: Magnor, Magsol 20A; Drew; Klenzoid.
- .2 Corrosion Inhibitor:
 - .1 Organic and dispersing corrosion inhibitor for closed loops made of borate, respecting environmental requirements, containing a biostatic preventing the spread of bacteria, having a pH of 10.92, having a specific gravity of 1.101 with a clear amber appearance.
 - .2 Acceptable products: Magnor, Magcare 104; Drew; Klenzoid.

PART 3 - EXECUTION**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 GENERAL SERVICES

- .1 Submit, with the approval of the Departmental Representative, a document copy listing the methods and the chemical cleaning products recommended.
- .2 Thoroughly rinse the heating, cooling and condensate conduits with approved chemical products designed to eliminate grease, scales, protective agents and other foreign products. The chemicals must not attack any of the materials used in the network and must not present any danger for handling or usage.
- .3 During the circulation of the cleaning solution, examine and clean out regularly the filters while controlling pressure losses in the various equipments.
- .4 Empty and rinse the network until the pH of the rinsed water is equal to the make-up water. After, fill with clean, treated water to prevent tartar and corrosion.

- .5 The cleaning products disposal method must be approved by the appropriate authority.

3.3 PRELIMINARY CONDITIONS

- .1 The cleaning work must be performed by qualified workers for this type of work.
- .2 One month before the date of the cleaning work, submit a report explaining the expected procedure. The report must contain the following:
 - .1 The method, the flow rate and time of the operation.
 - .2 The chemical products and their concentrations.
 - .3 The inhibitors used and their concentrations.
 - .4 Particular requirements concerning the work to be done.
 - .5 Particular rules in order to protect the piping and the connected equipments.
 - .6 A complete analysis of the water used for cleaning to assure it will not damage the system and it's equipments.
- .3 Preliminary conditions to satisfy before starting the network cleaning are the following:
 - .1 The networks have to be free of construction debris, dust and other inappropriate materials.
 - .2 The networks have to be functional, including their safety devices.
 - .3 The networks must have underwent the hydrostatic tests.
 - .4 Valves, controls equipment and other accessories must be functional and positioned to be completely open so that end of line equipment can also be cleaned.
 - .5 Strainers and filters must be cleaned before the initial filling.

3.4 DOMESTIC WATER

- .1 Provide the material and the chemical product to sanitize, rinse and to drain out the network in accordance with the appropriate authority requirements.
- .2 Water must undergo a laboratory analysis. Water quality must be acceptable, if not, sanitize again until water becomes of drinkable quality.
- .3 Once sanitizing and cleaning work is done, provide a water quality test report.

3.5 CLOSED HYDRONIC NETWORK, CLEANING AND THRESHOLD TREATMENT

- .1 Rinse the system with domestic water to remove debris, suspended matters and others.
- .2 Install pocket filters, 5 microns, in by-pass to reduce water consumption. Filters capacity must be at least 10% of total flow rate.
- .3 Make sure the pump capacity is sufficient to allow water circulation speed of 0.6 m/s inside the pipes.
- .4 Fill the network with water and remove all the air accumulated inside.
- .5 Fill the expansion vessels, with replaceable bladders, until a safe pressurisation of the network.
- .6 Use a water meter to measure the liquid volume in the network, considering an accuracy of more or less 0.5%.
- .7 Add the prescribed chemical product. This operation must be done under the treatment manufacturer supervision.
- .8 Add the cleaning agent in order to obtain 0.75% concentration.
- .9 Let the cleaning solution circulation long enough to have a complete network cycle, take a sample for analysis. The (NaNO₂) concentration must be higher than 500 ppm, otherwise add more cleaning agent until that concentration is reached.
- .10 Let the water circulate during 4 hours at ambient temperature.
 - .1 For the heating network, increase slowly the temperature until it reaches the nominal set point; keep circulating the water until its temperature drops under 38°C.
- .11 During the recirculation period, it is recommended every 2 hours to drain the system for several seconds through the pump filters and strainers located in lower parts of the network.
- .12 Completely drain the system and rinse it until the water is clean and foam free. Make sure all the lower points of the network are completely empty and rinsed. Circulate the water 30 minutes for each rinse cycle.
- .13 Take a sample of the water in the network and order a test at the lab of the cleaning agent manufacturer. The rinsing is considered acceptable when the following parameters are achieved:
 - .1 Conductivity and pH values similar to those of the aqueduc water.
 - .2 Foam free.

- .3 Without oil or grease film.
 - .1 Target tolerance - Oil and grease > 1.0 mg/L < 3.0 mg/L.
 - .2 Target tolerance - Total iron > 1.0 mg/L < 3.0 mg/L.
 - .3 Target tolerance - Dissolved iron > 0.5 mg/L < 1.0 mg/L.
- .4 No nitrites detected.
- .5 Iron content below 2 ppm.
- .14 Perform a first treatment at half dosage.
 - .1 Fill the system with fresh water.
 - .2 Add the inhibitor in order to obtain 0.075% to 0.09% concentration.
 - .3 Take a sample once the solution has gone through a complete cycle of the network and analyze for corrosion inhibitor. The concentration should be near 60 ppm otherwise, add enough inhibitor to obtain that value.
 - .4 Let it circulate for 6 hours.
 - .5 Perform the iron content test. It has to be lower than 2 ppm, if not, redo this step.
- .15 Empty and rinse the system to obtain clean water. The quality of the drained water must be validated by the manufacturer of the treatment agents.
- .16 Perform a second treatment at full dosage.
 - .1 Fill the system with fresh water.
 - .2 Add the inhibitor in order to obtain 0.15% to 0.18% concentration.
 - .3 Circulation must continue for at least 24 hours before stopping the pumps.
- .17 Perform the final fill up and start the usual chemical treatment.
- .18 Perform the required tests to assure the correct chemical product concentration.

3.6 REPORT

- .1 Instrumentation and control element like flowmeters, Pitots and others, will be installed after network cleaning certification.
- .2 After the cleaning work, submit a report with the compliance certificate provided by the cleaning product manufacturer.

3.7 START-UP

- .1 Once the network is cleaned, filled up and equipped with its control elements like flowmeters, Pitots and others, the start-up procedure can start:
 - .1 Put the network under pressure, fill up the expansion vessels with replaceable bladders and adjust the pressure regulator set points.
 - .2 Bleed off all air from the network.
 - .3 Adjust the control devices temperature set points.
 - .4 When the water reaches its set points, check the pumps and make sure there are no leaks, no air infiltrations and no cavitation.
 - .5 Dismantle the pumps used for the network cleaning, clean them and replace damaged parts and seals.
 - .6 Start the chemical treatment systems.
 - .7 Verify the expansion tank water level, in stopped mode, and in operating mode.
 - .8 Check network pressure and make sure there are no negative pressure points at the air bleeders.
 - .9 Verify bleeder operation.
 - .10 Once the network conditions are stable, adjust the seals.
 - .11 Make sure every balancing valve is properly adjusted.
 - .12 Verify pump superheat protection device operation.
- .2 The set points for temperature and pressure must be achieved slowly, over a period around 48 hrs.
- .3 Perform ERE operations, in accordance with indications.
- .4 Inspect and adjust the suspension and fixing devices.
- .5 Make sure expansion equipment function properly, inspect the rigidity of their anchors. If adjustments are necessary, stop the network, adjust then start up the system again.
- .6 Tighten all bolts with a torque wrench to compensate changes due to temperature change. This step will be repeated as required during the start-up process.
- .7 Monitor the movements of the piping and verify the compensators, elastic couplings, guides and anchors.

- .8 Adjust the alignment of the pump pipes to give the pump enough flexibility and to prevent the transmission of noise and vibrations.

END OF SECTION

PART 1 - GENERAL**1.1 SECTION INCLUDES**

- .1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .7 Section 21 05 01 - Common Work Results - Mechanical.
- .8 Section 23 05 05 - Installation Pipework.
- .9 Section 23 05 17 - Pipe Welding.
- .10 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .11 Section 23 08 01 - Performance Verification of Mechanical Piping.
- .12 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.3 REFERENCE

- .1 Unless otherwise indicated, all of the works will be done in accordance with the in force edition of the "Code de construction du Québec".
- .2 Furthermore, the works will be done in accordance to any other code or standard having jurisdiction, as per the latest edition, notably including, but not limited to:
 - .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1-10, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3-06, Malleable Iron Threaded Fittings.

- .3 ASME B16.5-09, Pipe Flanges and Flanged Fittings.
- .4 ASME B16.9-07, Factory-Made Wrought Buttwelding Fittings.
- .5 ASME B18.2.1-10, Square and Hex Bolts and Screws (Inch Series).
- .6 ASME B18.2.2-10, Square and Hex Nuts (Inch Series).
- .2 American Water Works Association (AWWA).
 - .1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A47/A47M-99(2009, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536-2009, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CAN/CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02a, Butterfly Valves.
 - .2 MSS-SP-70-06, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Cast Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.

- .5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
 - .1 Special servicing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling, in accordance with Waste Management Plan.
 - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 BLACK STEEL PIPE

- .1 Steel Pipe for Heating: complying with ASTM A53/A53M standard, grade B, standard class.
- .2 Acceptable products: Douglas Barwick.

2.2 PIPE JOINTS FOR BLACK STEEL

- .1 Two inches and under: screwed fittings with PTFE tape or lead-free pipe dope in accordance to ASTM-47M standard, grade 32510.
- .2 NPS 2½ and over: welding fittings and flanges to CSA W47.1 and CSA W47.1S1 standards.

- .3 Orifice Flanges: raised face, slip-on raised face, 2,100 kPa.
- .4 Flange Gaskets: in accordance to ANSI/AWWA C111/A 21.11 standard.
- .5 Pipe Thread: taper.
- .6 Bolts and Nuts: in accordance to ASME B18.2.1 and ANSI/ASME B18.2.2 standards.

2.3 FITTINGS FOR BLACK STEEL

- .1 Screwed Fittings: malleable iron, to ASME B16.3 standard, Class 150.
- .2 Pipe Flanges and Flanged Fittings:
 - .1 Cast iron: to ASME B16.1 standard, Class 150.
 - .2 Steel: to ANSI/ASME B16.5 standard.
- .3 Butt-Welding Fittings: steel schedule 40, to ANSI/ASME B16.9 standard.
- .4 Unions: malleable iron, in accordance to ASTM A47/A47M and ASME B16.3 standards.

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2½ and larger: flanged ends.
- .2 Gate Valves: to MSS-SP-70 and to MSS-SP-80 Application: Isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Rising stem, in accordance with MSS-SP-80 standard, type 2, class 125, category 860 kPa, bronze cast body. .
 - .2 Acceptable products: Crane n° 428; Nibco T 111; Jenkins n° 810J; Milwaukee n° 148; Toyo-R/W n° 293; Kitz n° 24.
 - .2 NPS 2½ and over:
 - .1 Rising stem, exterior screw and yoke and in accordance with MSS-SP-70 standard, class 125, category 860 kPa, iron cast body, , bronze inside pieces, flat face flange.

- .2 Acceptable products: Crane n° 465 1/2; Nibco FE 617 O; Jenkins n° 454J; Milwaukee n° F-2885; Toyo-R/W n° 421A; Kitz n° 72.
- .3 Butterfly valves:
 - .1 NPS 2½ and over: flangeless model with flaps.
 - .1 In accordance with MSS-SP-67 standard, class 150, category 1 MPa, type EHG, iron-steel cast body, stainless steel gate, stainless steel stem, replaceable EPDM rubber seat lever and locking handle gear drives for valves with diameters of NPS 6 and over.
 - .2 Acceptable products: Keystone, model AR2; Anvil n°s L5271 and L5272 for NPS 8 and over; Milwaukee n° ML224E; Romatec, ABZ series, Fig. 102.
 - .4 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves angle body ("Y"), as specified this section.
 - .2 NPS 2 and under.
 - .1 Bronze/Copper body die casting, screw ends, Teflon seat and copper gate, screw-on threaded bonnet, that can support an effective maximum pressure of 1.7 MPa and a maximum temperature of 121°C.
 - .2 Flow control: at least four complete wheel revolutions, digital display type with mechanical memory, hidden and secure.
 - .3 NPS 2½ or over.
 - .1 Iron cast body with epoxy resin based coating, internal devices and bonnet made of dezincification-resistant copper and zinc alloy, class 125 with flanged ends according to ANSI; that can support an effective maximum pressure of 1.7 MPa and a maximum temperature of 121°C.
 - .2 Flow control: at least eight complete wheel revolutions with adjusting rings and mechanical memory, hidden and secure.
 - .4 Applicable products:
 - .1 Globe valve: Tour and Anderson; Gruvlok no. GBV.
 - .5 Drain fittings.
 - .1 NPS ¾ plug and faucet, for flexible pipe connexion, body integrated or provided separately.

- .6 Ball Valves:
 - .1 Faucets: NPS 2 or less, to screw.
 - .1 In accordance with ASTM B62 standard, category 4 MPa, bronze body cast, TFE seal, sturdy massive chrome gate (rotating), Teflon seat and lever-handle
 - .2 Acceptable products: Anvil F 171 N; Milwaukee n° BA-100; Jenkins n° 201J; Toyo-R/W n° 5044 A/MAS B-3; Kitz n° 58.

2.5 CHECK VALVES

- .1 NPS 2 or less, screw on.
 - .1 In accordance with MSS-SP-80, type 3, class 125, category 860 kPa, bronze cast body, bronze hinged disc, screw-on threaded bonnet, and adjustable seat.
 - .2 Acceptable products: Crane n° 37; Nibco T 413 B; Jenkins n° 4092J; Milwaukee n° 509-T; Toyo-R/W n° 236; Kitz n° 22.
- .2 Clappers NPS 2½ or more, flangeless.
 - .1 In accordance with MSS-SP-71 standard, class 125, category 860 kPa, iron cast body, Buna-N seat, 304 stainless steel hinged disc, flangeless.
 - .2 Acceptable products: Prince, R series; Check Rite, 200 series 200; Moygro W12A-I6V (seat: viton).

2.6 GROOVED JOINT PIPING SYSTEM

- .1 Grooved joint piping is permitted, as an equivalent, on the following pipe networks:
 - .1 Only on the connection of the chilled water network to the chiller.
- .2 Piping:
 - .1 Grooved end steel pipes conforming to the norm ASTM A53, grade B, class "STD", the schedule number being established by the following criteria:
 - .1 Up to DN 10: schedule 40.
- .3 Joints:
 - .1 Standard grooved couplings, conforming to norms CSA B242 and ANSI B-3620 (API-5L).

- .2 Prelubricated EHP type gasket for grooved end pipes, compatible with the fluid being transported and designed to be used at temperatures ranging from -34°C to 121°C, conforming to norms ASTM D2000 and NSF/ANSI 61, UL approved, for use with potable cold water at 30°C and potable hot water at 82°C.
- .3 Acceptable products:
 - .1 Victualic, flexible model: 177 QuickVic (6,900 kPa), 77 (6,900 kPa), W77 (5,100 kPa) to be used in spaces where there is a need to attenuate vibration or reduce thermal stress.
- .4 Fittings:
 - .1 Fittings for pipes with roll grooved ends, malleable cast-iron conforming to norm ASTM A47M or ductile cast-iron conforming to norm ASTM A536.
 - .2 Acceptable products: Victualic; Gruvlok.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.2 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

3.5 BALANCING

- .1 Balance water systems to within plus or minus 5% of design output.

- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME-13, Boiler and Pressure Vessel Code.
- .2 American Society for Testing and Materials, (ASTM).
 - .1 ASTM A47/A47M-99(2009), Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A278M-01(2011), Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
 - .3 ASTM A516/A516M-10, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A536-84(2009), Specification for Ductile Iron Castings.
 - .5 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B51-F09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Shop Drawings: Submit software design print-out, control schematic and shop drawings indicating loop layout, manifold locations, loop flow balance settings, slab profiles, and product components, including anchorage, accessories and finishes.
 - .1 Include installation drawings of tubing layout indicating loop length, loop spacing, tube size and detail notes to aid in installation of system.
 - .2 Include control schematic indicating heat source, mechanical piping and accessories from heat source to manifolds, circulators, water tempering and zone controls. Also indicate supply water temperatures and flow rates to manifolds.
- .3 Closeout submittals.
 - .1 Provide maintenance sheets in accordance with Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and safety requirements.
 - .1 In accordance with section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 EXPANSION TANK

- .1 Expansion tank: cylindrical, horizontal, replacable bladder.
- .2 Capacity: as indicated in the "Expansion tank" table on plans.
- .3 Bladder: made of butyl, maximum service temperature of 115°C.
- .4 Service pressure: 690 kPa, approved by ASME.
- .5 Preload: air at initial system pressure.
- .6 Acceptable products: Expanflex.

2.2 AUTOMATIC AIR VENT

- .1 Bleed tap with float, standard type: body in bronze or iron with NPS 1/8 joint designed for nominal work pressure of 860 kPa, to be used for water system only.
 - .1 Usage:
 - .1 On piping diameter less than 2 inches.
 - .2 At other locations indicated.
 - .2 Acceptable products: Watts, FV-4M1; Bell & Gossett; Armstrong.
- .2 Air vent with float, industrial type: body in iron with NPS 1/2 joint designed for nominal work pressure of 860 kPa.
 - .1 Float: designed for working temperature of 115°C.
 - .2 Usage:
 - .1 On piping diameter greater than 2.5 inches with any fluids.
 - .2 At other locations indicated.
 - .3 Acceptable products: Amtrol, 747; Bell & Gossett.
- .3 Install a bronze globe valve at every air vent.

2.3 STRAINER

- .1 Inclined (Y) strainer, body tested for gauge pressure of 860 kPa with removable strainer made of monel, bronze or stainless steel.
- .2 Piping up to NPS 2:
 - .1 Body: bronze in accordance with ASTM B-62 standards, or iron in accordance with ASTM A278M, class 30 standards.
 - .2 Joints: threaded.
 - .3 Filter: stainless steel with 0.8 mm holes.
 - .4 Strainer joint: NPS fit with filter, globe valve and cap.
 - .5 Acceptable products: Armstrong, F4SC - A1SC.

- .3 Piping for greater than NPS 2½:
 - .1 Body: made of iron in accordance with ASTM A278M, class 30 standards.
 - .2 Joint: flanged.
 - .3 Filter: stainless steel with 0.8 mm holes.
 - .4 Bleed tap joint: NPS fit with filter, globe valve and cap.
 - .5 Acceptable products: Armstrong, F4SC - A1SC; Conbraco, 59-00X-06; Zurn Wilkins, series S; Newman, Hattersley T807; Mueller, 351M; Watson-McDaniel, series WCSY.
- .4 Filter diameters from NPS 2 to NPS 12: "T" type, cast iron body in accordance with ASTM A536.

2.4 LOW PRESSURE RELIEF AND SAFETY VALVE

- .1 Install the relief valve, in accordance with the requirements and as indicated to protect the network against overpressure.
- .2 Valve with spring, made of bronze, with high flow capabilities and maximum opening capabilities for pressure relief as per indications, in accordance with ASME code requirements.
- .3 Material:
 - .1 Body made of forged copper alloy.
 - .2 Valve housing made of bronze or cast iron.
 - .3 Spring made of cadmium plated steel.
 - .4 Internal pieces made of bronze and brass.
- .4 Relief valve adjusted to 35 kPa or 105% of maximal working pressure, whichever is most stringent. Relief valve adjustment and capacity determined in order to prevent the fluid pressure to increase over system elements working pressure while preventing valves from opening erratically.
- .5 Relief valve discharge towards the closest drain.
- .6 Discharge toward glycol tank for the glycol water network.
- .7 Low pressure check valve on the supply pipes.
- .8 Removable filter.
- .9 Acceptable products: Kunkle.

PART 3 - EXECUTION**3.1 GENERAL**

- .1 Install accessories as specified by the manufacturer.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain adequate clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .5 In accordance with manufacturer's shop drawings.
- .6 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.
- .7 If elements accessories are shipped separately, verify the assembly method with the manufacturer.

3.2 STRAINER FILTERS

- .1 Install filters in horizontal or downwards flow pipes.
- .2 Provide clearance to remove the filter.
- .3 Install a filter upstream to every pump and control valves (except at radiators), and elsewhere indicated.

3.3 AIR VENT

- .1 Install air vent on piping and for equipment, upstream at high points, before each fluid drop, and where specifically indicated.
- .2 Air vent must comply with indications and have an isolation valve.
- .3 Install a globe valve upstream to any industrial bleed tap and send the discharge to the closest floor drain.

3.4 EXPANSION TANKS

- .1 Adjust expansion tank pressure as indicated.
- .2 Install expansion tanks where indicated in accordance with manufacturer recommendations.

- .3 Install a lockshield type valve on the expansion tank inlet.

3.5 SAFETY VALVES

- .1 Install the relief valves where indicated.
- .2 Send the discharge pipe to the closest floor drain.

3.6 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification - Mechanical Piping Systems.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .4 Section 21 05 01 - Common Work Results for Mechanical.
- .5 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

1.2 REFERENCES

- .1 Unless otherwise indicated, work will be performed in accordance with the applicable edition of the Quebec Construction Code.
- .2 In addition, perform work complying with any other standard having jurisdiction, including:
 - .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
 - .1 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250 and 800.
 - .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
 - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.
 - .4 ANSI/ASME B16.9, Factory-Made Wrought Steel Butt Welding Fittings.
 - .5 ANSI/ASME B18.2.1, Square and Hex Bolts and Screws.
 - .6 ANSI/ASME B18.2.2, Square and Hex Nuts.
 - .2 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

- .3 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 Standard 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .4 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A48/A48M, Standard Specification for Gray Iron Castings.
 - .3 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .4 ASTM A536, Specification for Ductile Iron Castings.
 - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202, Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .5 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.
 - .2 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .3 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures
- .6 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .7 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1, Motors and Generators.

1.3 SUBMITALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Shop Drawings to show:
 - .1 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged

- equipment or required for controlling devices or ancillaries, accessories and controllers.
- .2 Wiring diagrams.
- .3 Recommended dimensions and installation mode.
- .4 Pump performance curves.
- .5 Final in field location of the controllers, pipes, valves, and fittings that are shipped separately by the manufacturer.
- .3 Data sheets:
 - .1 Submit required data sheets and manufacturer's specification document for the proposed equipment.
- .4 Certificates:
 - .1 Submit signed documents by the manufacturer, certifying that the product, material and equipments comply with the required characteristics and performance criteria.
- .5 Instructions:
 - .1 Submit manufacturer's installation instructions.
- .6 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .7 Submit, for verification, the pump curves showing the duty point.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance data sheet:
 - .1 Maintenance data sheet must include the following:
 - .1 Equipment description, including the manufacturer's name, type, model, year, capacity, head and flow rate.
 - .2 Pertinent details related to maintenance.
 - .3 Supply spare parts.

PART 2 - PRODUITS

2.1 INLINE PUMPS, VERTICAL TYPE

- .1 Volute: cast iron class 30 (ASTM No. A159), with screwed or flanged suction and discharge connections, with tapped openings for venting. Volute for working pressure of 1,200 kPa.
- .2 Impeller: cast bronze (ASTM No. B 584), close type, dynamically balanced, stainless steel shaft held by a locked bolt.
- .3 Shaft: stainless steel, with bronze sleeve bearing and integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C.
- .5 For pumps less than 5 HP; no coupling. For pumps greater than 5 HP a self-aligning coupling, made of aluminum which enables maintenance on the mechanical joint without having to move the motor.
- .6 Wet parts are sealed at the shaft by a self-cleaning mechanical joint. The joint is made of a ceramic seat and a rotating part made of carbon. It must be designed for continuous operation at 107°C (standard mechanical joint), max. 1,206 kPa.
- .7 Motor: as prescribed by section 23 05 13 - Common Motor Requirements for HVAC Equipment, monobloc with the pump and designed for vertical assembly. Built with lubricated ball bearings, adapted for the maximum loads that the pump can withstand.
- .8 Motor must be chosen to allow use without overload at any operating condition.
- .9 Each pump must undergo a test in factory under the required operating conditions.
- .10 Dimension and capacities: as indicated on plans.
- .11 Acceptable products: Bell and Gossett ;Grundfos, Armstrong;.

2.2 SUCTION GUIDE

- .1 Angular suction guide with the following specifications:
 - .1 Designed with a combination of guide/cylindrical orifice strainer, straightening vanes, start-up strainer, permanent magnet and an adjustable support.
 - .2 Combination guide/cylindrical orifice strainer designed to withstand an equal differential pressure to the maximum pump head at zero flow. The sum of the perforated area must be equal to five times the cross section of the pump suction opening
-

- .3 The length of the straightening vanes must be at least twice the diameter of the pump suction opening.
- .4 The straightening vanes must be made of strong cast iron, with flanged connection and have a combination guide/strainer with 4.76 mm perforations made of carbon steel to protect the pump.
- .2 The full length of the straightening vanes must provide a laminar flow at the pump suction port.
- .3 The permanent magnet is located in the flow of the fluid to protect the mechanical joints of the pump. It must be removable to allow cleaning.
- .4 The start-up strainer must have a 16 mesh bronze screen, that will be removed after the system start-up. A support pipe will eliminate strain on the device and the pump connection. All interior parts must be replaceable.
- .5 Maximum pressure loss 13.8 kPa.
- .6 Characteristics: as indicated on plans.
- .7 Acceptable products: Bell and Gossett; Armstrong; Grundfos;

2.3 FLEXIBLE FITTINGS

- .1 Internal pipe: flexible made of braided stainless steel.
- .2 Exterior braiding consisting of a stainless steel mesh.
- .3 Flexible fittings must be designed for 1,034 kPa working pressure at 93°C.
 - .1 The operating conditions must meet the piping network requirements.
- .4 Fittings must be able to absorb 150 mm of lateral displacement; the ratio of the length of the flexible part to the fitting diameter must be greater than six. The length of the flexible part must be no greater than 600 mm.
- .5 Acceptable products:
 - .1 NPS 2 or less:
 - .1 Flexi-Tube, type TSN; Railmex, type R-BSN.
 - .2 NPS 2½ and greater:
 - .1 Flexi-Tube, type PSF; Railmex, type BSF.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 In accordance with CAN/CSA-B214 standard.
- .2 Base mounted type: supply templates for anchor bolt placement. Include anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer's recommended tolerance. Check oil level and lubricate. After run-in, tighten glands.
- .3 Install the support elements or suspension for the body of the pumps did not support the piping or equipments. Refer to details and instructions of the manufacturer.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

3.2 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 00 - Commissioning - Mechanical and Electrical Installation; supplemented as specified herein.
 - .2 In accordance with manufacturer's recommendations.
 - .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
-

- .7 Eliminate air from scroll casing.
- .8 Adjust water flow rate through water-cooled bearings.
- .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .10 Adjust alignment of piping and conduit to ensure true flexibility.
- .11 Eliminate cavitation, flashing and air entrainment.
- .12 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

END OF SECTION

PART 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.

1.2 REFERENCES

- .1 Unless otherwise indicated, work will be performed in accordance with the applicable edition of the Quebec Construction Code.
- .2 In addition, perform work complying with any other standard having jurisdiction, including:
 - .1 ASME.
 - .1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.
 - .2 ASTM International.
 - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - .3 CSA Group.
 - .1 CSA B52-05(R2009), B52 Package, Mechanical Refrigeration Code.
 - .4 Environment Canada (EC).
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.3 SUBMITALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for piping, fittings and equipment.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: Submit manufacturer's installation instructions.
- .6 Submit all piping sizing calculation and the installation drawing in accordance with ASHRAE calculation criteria

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance data sheet:
 - .1 Maintenance data sheet must include the following:
 - .1 Equipment description, including the manufacturer's name, type, model, year, capacity, head and flow rate.
 - .2 Pertinent details related to maintenance.
 - .3 Supply spare parts.

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.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
- .2 Hard copper: to ASTM B88M0, type ACR,L.

- .3 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Brazed Fittings: wrought copper to ASME B16.22.
- .2 Flanged: Bronze or brass, to ASME B16.24, Class 150 and Class 300.
- .3 Flared: Bronze or brass, for refrigeration, to ASME B16.26.
- .4 Only use long rays elbows.

2.3 JOINTS

- .1 Braze welding: Copper-phosphorus-silver (80-5-15%) brazing conforming to norm AWS BCUP-5 for copper to copper joints; Silver-copper-zinc-cadmium (45-15-16-24%) brazing according to norm AWS A5.8 Bag-1 for copper to bronze or copper to brass joints.
 - .1 Quality required: Sil-Fos 15.
- .2 Flange fittings: In conformity with norm ANSI/AWWA C111/A21.11, non-metallic.

2.4 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.5 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5

3.3 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or reducing the diameter.
 - .2 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil from returning to the compressor during operation.
 - .2 Provide trap at base of risers greater than 2,400 mm high and at each 7,600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Perform tests according to norm CSA B52.

- .3 The high and low pressure sides of each system must be tested and certified leak-proof at a pressure that at least equals the lowest value of the calculation pressure (see table 4 of CSA B52) or the test pressure of the discharge device protecting the high and low pressure sides of the system. The system must support the test pressure for at least two hours or as determined by authorities having jurisdiction.

- .1 Extract of table 4 - Minimum calculation pressure:

Refrigerant	Low Pressure Side (kPa)	High Pressure Side *
R-410A	1 626	3 064

* Air cooled

3.6 DEHYDRATATION

- .1 Work is to be performed in the presence of a Ministerial representative.
- .2 Use a two-stage vacuum pump with gas ballast on the 2nd stage capable of creating an absolute vacuum of 50 microns. The pump must be filled with new oil and dehydrated.
- .3 The use of a refrigeration compressor to create the vacuum is not permitted.
- .4 The ambient temperature of the network must be equal to or superior to 13°C during the dehydration process and for at least twelve hours prior.
- .5 Flexible bypass lines: Use a flexible hose appropriate for very high vacuum or un-welded copper tubes, connected to the high and low pressure sides. The nominal diameter of the pipes for equipment having an interior volume equal of inferior to 70 liters must not be inferior to 6 mm and not inferior to 10 or 12 mm for equipment with an internal volume greater than 70 liters.
- .6 Install a thermocouple vacuum gauge with graduations in microns to measure the pressure of the network. Install a manual sectional valve between the pump and the vacuum gauge and take readings only when the network is isolated from the pump.
- .7 If the holding charge of a compressor-condenser group is intact, the service valves must remain closed while performing the evacuation. Any equipment containing dry nitrogen, dirty refrigerant or having lost its holding charge must be evacuated.
- .8 The evacuation of equipment installed on site must be done in three steps.
- .9 For the first two steps the pressure must attain 1,500 microns and be maintained at this value for a period of 4 hours. Break the vacuum by injecting refrigerant fluid once the manometric pressure reaches 14 kPa. For the third evacuation, continue pumping for at least twelve hours after attaining a pressure of 500 microns. After completing the third step, isolate the pump from the rest of the network and perform graphic readings of the rate of vacuum increase that occurs during the following hours. Continue to take

readings until the vacuum is stabilized. During the charging operation the refrigerant fluid must pass through the filter-dehydrator.

3.7 DEMONSTRATION

- .1 Post instructions in frame with glass cover in accordance CSA B52.

3.8 CLEANING

- .1 Cleaning in accordance with the manufacturer specification

3.9 REFRIGERANT

- .1 Fill up the piping in accordance with the manufacturer and coordinate with the other concerned section.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements .
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .4 Section 21 05 01 - Common Work Results for Mechanical.
- .5 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).;ASME Boiler and Pressure Vessel Code, Section VII-2001.
- .2 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Guideline 12-2000, Minimizing the Risk of Legionellosis Associated with Building Water Systems.
- .3 Québec Official Gazette.
 - .1 Code de sécurité, B-1.1.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance material to include:
 - .1 Log sheets as recommended by manufacturers.
 - .2 Brochures and bulletins related to installed water treatment.
 - .3 Instruction manuals, including full description of treatment methods used the goals of the operation, chemical test to be carried out, sampling and chemical; values to be maintained.
 - .4 Written instructions for sensing and cleaning.
-

1.4 TRAINING OF OPERATION AND MAINTENANCE PERSONNEL

- .1 For two days running, give to operation and maintenance personnel, training regarding operation, maintenance and chemical test procedures.
- .2 Courses to be both theoretical and practice and using current installed equipment.

1.5 SERVICES

- .1 Water cooling system only shall be equipped with a chemical treatment system.
- .2 Because of the small amount of make-up water involved, chemicals shall be added by hand.
- .3 See more details in a further clause of this specification.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with section 01 74 21 - Waste Management and Disposal.
- .2 Unused metal and wiring materials are to be diverted from landfill to a metal recycling facility as approved by the Departmental Representative.
- .3 Dispose of unused water treatment chemicals at official hazardous material collections site approved by the Departmental Representative.
- .4 Do not dispose of unused water treatment chemicals into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Dispose of corrugated cardboard polystyrene plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 - PRODUCTS**2.1 MANUFACTURER**

- .1 Equipment, chemicals, service by one supplier.

2.2 CONDUCTIVITY METER

- .1 Entirely semiconductor devices, designed for wall or flush panel mounting, measuring range from 0 to 5,000 microhms, reading must be linear over the entire range.

- .2 Devices must not be sensitive to phase shifts and must operate with supply voltage between 95 and 130 V, without disturbing precision or power indicator and purge.

2.3 CONDUCTIVITY PROBE

- .1 Two carbon electrodes in a steal support, quick connection and automatic locking.

2.4 CORROSION COUPON MONITORING STATION

- .1 Provide a preassembled corrosion coupon station according to ASTM, including:
 - .1 Flow indicator, 25 mm, 0.25-1.76 L/s, 1,500 kPa at 27°C;
 - .2 Three steel coupons with steal support, Schedule 40;
 - .3 Copper coupon with steal support, Schedule 40;
 - .4 All support pipes including fittings, tees, elbows and others.
 - .5 Acceptable products: Magnor.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Unless indicated otherwise, install all water treatment system as indicated in section VII of the "ASME Boiler Code" and of the competent authority.
- .2 Install to assure enough clearance for the maintenance and reparation.
- .3 Pipe all flushing piping to the nearest floor.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 35 29.06 - Health and Safety Requirements.
- .2 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4 Section 23 05 93 - Testing, adjusting and Balancing for HVAC.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings.
 - .1 Catalogue or published ratings are those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and safety:
 - .1 Apply pertinent safety rules in accordance with section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal.
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Collect and separate packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .3 Separate for reuse and recycling and place in designated containers waste in accordance with Waste Management Plan.
 - .4 Place materials defined as hazardous or toxic in designated containers.
 - .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS**2.1 SEAL CLASSIFICATION**

- .1 Seal classification for ductwork is to be determined by the following table:

Maximum pressure	Seal Classification
500 Pa	B (SMACNA)
750 Pa	B (SMACNA)

- .2 Seal Classification:

- .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant and tape.
- .2 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.2 SEALANT

- .1 Transverse joints:

- .1 Rectangular or round ducts with slotted or "S" joints.
- .1 Laminated tape kraft/canvas/aluminum ULC certified.
- .1 Acceptable products: MACtac FSK; Venture Tape FSK.
- .2 "T" joints and flanged joints.
- .1 Waterproof tape.
- .1 Acceptable products: Ductmate 440 Gasket tape.

- .2 Longitudinal joints:

- .1 Round duct.
- .1 Laminated tape kraft/canvas/aluminum ULC certified.
- .1 Acceptable products: MACtac FSK.

- .2 Rectangular duct.
 - .1 Tube sealant.
 - .1 Acceptable products: Mulco-Butyle; Ductmate No. 5511M.
- .3 Miscellaneous:
 - .1 For operating temperature higher than -7°C.
 - .1 Sealing product: sealing product for air duct, water based, ULC certified, with fire spread factor smaller than 26 and smoke density rating lower than 51, usable within -7°C to 93°C temperature range.
 - .1 Acceptable products: Duro Dyne DWN.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
 - .1 Acceptable products: Duro Dyne FT-2.

2.4 FITTINGS

- .1 Fabrication: according to SMACNA.
- .2 Rounded elbows:
 - .1 Rectangular ducts: elbows bend radius equal to one times the width of the duct.
 - .2 Ducts round: elbows bend radius equal to 1.5 times the diameter of the pipe "Standard manufacturers."
- .3 90° elbows: rectangular ducts:
 - .1 Ducts whose largest dimension is less than or equal to 400 mm equipped with baffles elbows single thickness.
 - .2 Ducts whose largest dimension is greater than 400 mm equipped with baffles elbows double thickness.
- .4 Bypass fittings:
 - .1 Main and branch ducts, rectangular:
 - .1 Lateral entry at 90°: with damper in the branch closest to the main duct.

- .2 Lateral entry to 45°: radius of curvature equal to one time the width of the duct with damper in the branch closest to the main duct.
- .2 Ducts, main and branch, round: entering the main duct with conical fitting.
- .5 Transition elements:
 - .1 Divergent elements: transition angle of up to 20°.
 - .2 Elements converging transition angle exceeding 30°.
- .6 Offsets: 90° bends or elbows rounded, as indicated.
- .7 Deflectors for obstacles to keep the same effective area. The angles of maximum transition must be the same as in the case of regular transformations.

2.5 FLEXIBLE FITTINGS

- .1 Metal components: 1.3 mm thick galvanised steel to which flexible fitting is attached by double seam joints.
- .2 Material:
 - .1 Fibreglass with fire retardant self-extinguishing neoprene coating, that can support temperatures ranging from -40°C to 90°C , with density of 1.3 kg/m³.

2.6 DUCT ACCESS DOORS

- .1 Insulated ducts: double skinned doors (sandwich construction type), made of duct material with next superior thickness, (thickness should not be less than 0.6 mm, with metal angle frame and rigid fibreglass insulation; 25 mm thick.
- .2 Seals: neoprene 20 mm x 10 mm.
- .3 Accessories:
 - .1 Doors measuring up to 1,000 mm: continuous piano hinge with at least two Duro-Dyne SL-1 latches.
 - .2 Doors measuring over 1,000 mm: continuous piano hinge and three manoeuvrable levers inside and outside.
 - .3 Door-stop: device that maintains door in open position.

2.7 FIRE STOPS

- .1 Restraining angles must be installed around sleeves on each side of firestop systems.

- .2 Firestop material and its installation must not distort duct.

2.8 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Design criteria: pressure of 500 Pa.
- .3 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA recommendations.
- .4 Joints.
- .1 Complying with ASHRAE and SMACNA for following uses:
- .1 Ducts, with greater dimension up to 1,200 mm.
- .2 Prefab trade marked flanged joints for air ducts, for following uses
- .1 Ducts, with greater dimension up to 1,200 mm.
- .2 Acceptable products: Ductmate Canada.

2.9 HANGERS

- .1 Hanging straps: used for ducts with greater dimension up to 500 mm. Same material as suspended duct, one gauge thicker than suspended duct material.
- .2 Hangers configuration: in accordance with ASHRAE and SMACNA recommendations.
- .3 Angles and hanger rods; angles made from galvanized steel, retained by galvanized steel rods, in accordance with ASHRAE and SMACNA recommendations and following table:

DUCT SIZE mm	ANGLES SIZE mm	RODS SIZE mm
Up to 750	25 x 25 x 3	6
From 751 to 1,050	40 x 40 x 3	6
From 1,051 to 1,500	40 x 40 x 3	10
From 1,501 to 2,100	50 x 50 x 3	10
From 2,101 to 2,400	50 x 50 x 5	10
Over 2,400	50 x 50 x 6	10

- .4 Hanger attachment devices.
 - .1 Attachment for concrete works; prefab concrete anchorage.
 - .1 Acceptable product: Myatt, fig. 485.
 - .2 Steel beam attachment: prefab concrete clamps.
 - .1 Acceptable product: Anvil fig. 61 or 86 for U-bolts and Anvil fig. 60 support plates.
 - .3 Steel beam attachment: prefab clamps.
 - .1 Acceptable product: Anvil fig. 60.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA, as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .4 Support risers in accordance with ASHRAE, and SMACNA, as indicated.
- .5 Install breakaway joints in ductwork on sides of fire separation.
- .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .7 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining, as indicated.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.

- .3 Hanger spacing: in accordance with ASHRAE and SMACNA recommendations, as follows:

Duct Size (mm)	Spacing (mm)
To 1,500	3,000
1,501 and over	2,500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
- .1 Exhaust.
 - .2 Fresh air intake.
 - .3 All duct, as indicated.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder weld joints of bottom and side sheets. Seal other joints with duct sealer.
- .3 Install a 150 mm depth pan at the bottom of the main vertical ducts, weld every joint.
- .4 Install in the following areas a NPS 1¼ drain pipe with a deep trap P siphon; the trap must be 1.5 times greater than the measured static pressure in that area, while being no smaller than 300 mm
- .1 At the bottom of the outside and exhaust air plenums.
 - .2 At the bottom of the main vertical duct pans.
 - .3 At the bottom of the waterproof horizontal ducts.
 - .4 As indicated.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.
- .3 Seal every opening in air ducts (i.e.: openings for instruments, dampers liking parts, coils, etc.), using sealing product or neoprene or silicone trim. Equipment installed within the duct must be allowed to move freely as required.

3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2 REFERENCES

- .1 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories Inc. (UL).
 - .1 UL-555-10, Standard for Safety Fire Dampers.
 - .2 UL-555S-07, Standard for Smoke Dampers.
 - .3 UL-555C-1974, Standard for Ceiling Dampers.
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
 - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.

- .6 Design details of break-away joints.
- .3 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Submit manufacturer's instructions, printed product literature and data

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide: six fusible links of each type.

1.5 WASTE MANAGEMENT

- .1 Separate waste with the intention to reuse or recycle it in conformity with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: Arrangement type listed and bear label of ULC and UL meet requirements of Fire Commissioner of Canada (FCC), CFFM, and ANSI/NFPA 90A, and authorities having jurisdiction. Fire damper assemblies' fire tested, in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Automatic operation type damper having a dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .4 Top hinged: multi-blade hinged or interlocking type; guillotine type; sized to maintain full duct cross section, as indicated.
- .5 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

- .6 Fire dampers must be as defined by SMACNA, (Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems), for high pressure tightness.
 - .1 Rectangular ducts: Type B; Type C
- .7 Fire dampers factory-mounted within a sleeve, minimum thickness of the sleeve must meet recommendation from SMACNA and UL 555 Standards.
- .8 Fire dampers made with a galvanized steel frame installed so that it does not interrupt the continuity of the duct in which it is installed or impede the operation of the damper.
- .9 Penetration hole frames/sleeves made of stainless steel with angle beams fixed on each side of the wall or floor. When the floor/ceiling or ceiling/roof assembly have a degree of fire resistance, conduits must conform to penetrating hole ULC Standards.
- .10 Dampers designed and built so that they do not reduce the size of duct or opening in which they are installed.
- .11 Holding Angles: To be installed on the sleeve's periphery, on each side of the fireproof separation.
 - .1 Sleeve with greater dimension up to 1,200 mm: folded galvanized steel, minimal dimensions 40 x 40 x 2.8 mm.
 - .2 Sleeve with greater dimension over 1,200 mm: folded galvanized steel, minimal dimensions 40 x 40 x 3 mm.
- .12 Protection Time: In accordance with Quebec and City Building Codes, but no less than 1.5 hr.
- .13 Acceptable Products: Controlled Air Manufacturing Ltd.; Nailor; Penn Ventilator Canada Ltd.; Ruskin (Kerr-Hant); AML.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install equipments complying with ANSI/NFPA 90A standards, according with ULC approval requirements and following the "Basic Fire Damper Installation Details" from SMACNA.

- .2 Complete works without altering the fire resistance level of casing within which equipments are mounted.
- .3 Install fire dampers in ductwork each time it goes through a fire resistant partition.
 - .1 Floors that separate two levels.
 - .2 Everywhere else required, but not mentioned in this list.
- .4 If needed, wait for approval from the authority having jurisdiction, before hiding any components.
- .5 Install one access door next to each damper.
- .6 Coordinate work with those installing fire/smoke stopper materials.
- .7 Install the devices where the access doors, the fuse links and servo-motors are visible and easily accessible.
- .8 Install approved isolation joints on each side of the fire stopper partition.
- .9 Mounting: Follow the "Basic Fire Damper Installation Details" from the "Fire, Smoke and Radiation Damper, Installation Guide for HVAC Systems" section provided by SMACNA.
 - .1 Floor mounted: "Case 3: Horizontal Fire Damper Installation".

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

1.2 REFERENCES

- .1 Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - .1 AHRI 550/590-11, Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII.
 - .2 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
 - .3 ANSI/ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .4 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .5 ANSI/ASME B16.9, Factory Made Wrought Steel Buttwelding Fittings.
 - .6 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .7 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .8 ANSI/ASME B16.25, Buttwelding Ends.
 - .9 ANSI/ASME B18.2.1, Square and Hex Bolts and Screws.
 - .10 ANSI/ASME B18.2.2, Square and Hex Nuts.
- .3 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.

- .2 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
- .3 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .4 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .5 ASTM B32, Standard Specification for Solder Metal.
- .6 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .7 ASTM B75, Specification for Seamless Copper Tube.
- .8 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B52-99, Mechanical Refrigeration Code.
- .5 Environment Canada/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Space requirements for operation and maintenance.
 - .5 Type of refrigerant used.

1.4 CLOSEOUT SUBMITTALS

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

- .2 Data to include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity and serial numbers.
 - .2 Provide part load performance curves.
 - .3 Details on operation servicing and maintenance.
 - .4 Recommended spare parts list.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and with Waste Reduction Workplan.

1.6 PREVENTIVE MAINTENANCE SERVICE

- .1 Manufacturer's contract price should include a preventive maintenance contract for one year starting on the date of chiller commissioning
- .2 Provide preventive maintenance contract costs for a period of one year starting on the provisional acceptance date. Detailed description of preventive maintenance contract must meet minimum requirements described in this section.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Chiller group consisting of two modules each containing at least two 15 nominal ton scroll compressors. Each refrigerant circuit is composed of a compressor, an evaporator, an expansion valve and a control system. To ensure the continued production of chilled water, in the event of a defective refrigerant circuit, each circuit is to be constituted independently. Each circuit shall contain no more than 50 lbs. of refrigerant.
- .2 Each module must include supply and return collectors for the chilled and condenser water. These collectors must have threaded ends to permit the connection of pipes having a nominal diameter of 150 mm.
- .3 Refrigerants Type R410A.

2.2 CHARACTERISTICS

- .1 Certified nominal characteristics, in compliance with AHRI 550/590-11 standard.
 - .1 In accordance with Chiller Schedule on drawing.
- .2 The total power demand must not exceed 301 kW and the equipment must be able to function with a 600 V/3/60 power supply.
- .3 A hot gas bypass must be supplied and integrated on each module of the chiller group..
- .4 See Chiller Schedule on drawing.

2.3 DIMENSIONS

- .1 Chiller, including all its components and external transformer (if required) must fit inside a volume of 3,350 mm long x 900 mm wide x 2,000 mm high.

2.4 ACOUSTICAL PERFORMANCE

- .1 Chiller acoustical performance levels must not exceed levels in the following table:

Sound Power Level at Octave Band (dB)							
63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz
35	49	52	52	57	56	53	51

2.5 COMPRESSOR AND MOTOR

- .1 Compressor, hermetic, scroll type.
- .2 Unloaded start with capacity modulation by continuous linear modulation of slide valve in response to load change.
- .3 Compressor to include suction and discharge shut-off valves; oil sight glass; separate circuit crankcase heater; and cylinder unloading device.
- .4 Each module consists of two scroll compressors on independent circuits mounted on vibration insulators.
- .5 Provide nameplate to show capacity at design temperature, type of refrigerant used and total weight in system.

2.6 COMPRESSOR MOTOR

- .1 Hermetic type with overload protection and manual restart: 600 V.

2.7 EVAPORATOR

- .1 Direct expansion evaporator consisting of no. 316 stainless steel plate heat exchangers. These exchangers must be designed for an operating pressure of 2,068 kPa on the evaporator side, and 2,482 kPa on the condenser side. They must be installed under the compressor to avoid the migration of refrigerant towards the evaporator. The evaporators and condensers must be thermally insulated using 19 mm thick Armaflex.

2.8 CONTROL CENTRE

- .1 To EEMAC standard and including:
 - .1 Control circuit "ON/OFF" switch.
 - .2 Oil pressure safety switch.
 - .3 High and low pressure safety switch.
 - .4 Water temperature controller.
 - .5 Suction and discharge pressure gauges and shut-off valves.
 - .6 Chilled water flow switch.
 - .7 Compressor short cycling and restart delay timer.
 - .8 Starting sequence switches.
 - .9 Compressor circuit breakers.
 - .10 Reset low water temperature cut-out switch.
 - .11 Motor contactors, control relays and indicator lights to include: "start-stop" switch; anti-recycle 30 minute time delay; low chilled water temperature cut-off and automatic reset; excess purge signal light and reset switch; manual/automatic oil pump operating switch and signal light; oil heater signal light; manual power failure reset and signal light; chilled water flow interruption light metre to indicate number of compressor starts and elapsed running time.
 - .12 Field power and control circuit terminal blocks.
 - .13 Alarm for refrigerant leakage.

- .14 RS485 interface under BACnet MSTP protocol. Provide the information and support required for the integration of the points to the control system.

2.9 OPERATING ENGINEERS ACT

- .1 Chiller to meet provincial standards and to be exempt from Quebec law relating to operating engineers.

2.10 GUARANTEE

- .1 Chillers must have a one year guarantee, covering pieces and labour.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install unit as indicated, to manufacturer's recommendations, and in accordance with EPS1/RA/2.
- .3 Ensure adequate clearances for servicing and maintenance.
- .4 Manufacturer to approve installation, to supervise start up and to instruct operators.
 - .1 Include 3 days per unit.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .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 00 - Commissioning - Mechanical and Electrical Installation.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A48/A48M-03(2012), Standard Specification for Gray Iron Castings.
 - .2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .4 ASTM B117-2011, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .5 ASTM C67-2012, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 - .6 ASTM D520-00(2011), Standard Specification for Zinc Dust Pigment.
- .2 Canadian Standard Association (CSA)/CSA International
 - .1 CSA B52-1999(C2004), Refrigeration Standard.
- .3 Cooling Technology Institute (CTI)
 - .1 CTI-ATC-105-2000, Acceptance Test Code.
 - .2 CTI-STD-201-2011, Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102.2-10, Surface Burning Characteristics of Building Materials and Assemblies.
- .6 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG 1 2011, Motors and Generators.

1.3 PERFORMANCE REQUIREMENTS

- .1 Performance certified in accordance with CTI-STD-201.
- .2 Condensing units: as indicated in plan's condensing units table.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings: stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Indicate:
 - .1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Vibration and seismic control measures.
 - .5 Manufacturers recommended clearances.

- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit certified test reports for cooling towers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .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.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in cooling towers installations with five (5) years documented experience.
 - .2 Supply all employees the professional certification (refrigeration) and a copy of the certificate indicating successful completion of an environmental awareness course in recycling, recovery and handling procedures in respect of halocarbon refrigerants to the Departmental Representative before the beginning of the construction.
- .2 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial and Federal regulations.

.3 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Storage and Protection:

- .1 Store materials in dry location.
- .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.7 WASTE MANAGEMENT AND DISPOSAL:

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

1.8 MAINTENANCE

- .1 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings and not later than one month prior to date of occupancy.
- .2 Include with data complete list of parts and supplies, recommended spare parts list for one year of operation, and list of parts recommended by manufacturer to be replaced on routine basis.

1.9 PREVENTIVE MAINTENANCE SERVICE

- .1 Manufacturer's contract price should include a preventive maintenance contract for one year starting on the date of condensing units commissioning.
- .2 Provide preventive maintenance contract costs for a period of one year starting on the provisional acceptance date. Detailed description of preventive maintenance contract must meet minimum requirements described in this section.

PART 2 - PRODUCTS**2.1 GENERAL**

- .1 The dry cooling condenser must be certified ULC.
- .2 The fans and refrigerant circuits must be factory tested before being mounted in the condenser.

2.2 DESCRIPTION

- .1 The condenser shall consist of 4 fans on two independent refrigerant circuits. The fan motors must be permanently lubricated and ball bearings must be sealed.
- .2 The fans must be statically and dynamically balanced.
- .3 The condensers must be equipped with an electronic Aquastat autonomous water temperature control permitting five stages of cooling.
- .4 Fan motors must be equipped with fuses. The complete assembly of fans must have a single electrical connection. A non-fused disconnect switch for the liquid chiller must be factory installed.
- .5 The condenser and chiller must be from the same manufacturer.
- .6 Condenser characteristics:
 - .1 Two condensers each with two circuits connected to the chiller.
 - .2 See characteristics indicated on drawings.

PART 3 - EXECUTION**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 GENERAL

- .1 Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.
- .3 Maintain system in clean condition until final acceptance.
- .4 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DIVISION 25

Integrated Automation

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittal.
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .4 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:
 - .1 Controller automatically and correctly operated in stand-alone mode.
 - .2 Failure was not due to failure of any specified EMCS equipment.
 - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

- .1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to Departmental Representative.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor.
 - .3 Report format to be approved by the Departmental Representative before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative and to Consultant in accordance with Section 01 78 00 - Closeout Submittals.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review by the Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

- .1 Do the system commissioning in accordance with section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
 - .2 Complete commissioning under the supervision of the Departmental Representative.
 - .3 Inform the Departmental Representative in writing, at least 14 days before the start of commissioning or before each test. In order to obtain approval submit the following information:
 - .1 Location and section of the system to be tested.
-

- .2 Test procedures and anticipated results.
- .3 Name of the persons who will perform the tests.
- .4 Correct deficiencies, re-test in until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform the tests in accordance with the requirements.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed PWGSC Commissioning Manager.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system.
 - .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
 - .3 An independent laboratory must certify testing materials compliance no more than two months before the tests.
 - .4 Locations to be approved, readily accessible and readable.
 - .5 Application: to conform to normal industry standards.
-

PART 3 - EXECUTION**3.1 PROCEDURES**

- .1 Test each system independently and then in unison with other related systems.
- .2 Follow the Departmental Representative's start-up procedures for each system.
- .3 Follow the Departmental Representative's start-up procedures for integrated systems.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .6 Beyond the testing material, the Contractor must also provide the following: inclined tube manometer, digital micromanometer, milliammeter and a pressure gauge with a range of 0 Pa to 500 Pa, which can maintain a constant pressure at any value and with an output to the milliammeter.
 - .7 After initial calibration, verify the zero value and the range by 10% increments (by increasing and decreasing values).

-
- .8 The Departmental Representative must write "approved for installation" on instruments having an accuracy of 0.5% or less in both directions.
 - .9 Transmitters above 5% error will be rejected.
 - .10 DP switches to open and close within 2% of setpoint.
 - .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Test all analog-digital converters.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Blow out static pressure stations with high air pressure at 700 kPa.
 - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final start-up testing.
-

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- .3 Final start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:
 - .1 Two technicians capable of calibrating the equipment and modifying the software on the field.
 - .2 A detailed daily program, indicating the elements to be tested and the available personnel.
 - .3 Acceptance by the Engineer in writing, for every execution and application program.
 - .4 Commissioning to commence during final start-up testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel.
 - .7 Start-up of the security systems before any of the concerned areas are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
 - .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning, demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
-

- .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 The Commissioning Manager must verify the results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of the two phase training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative reserves right to approve instructors.

1.5 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
 - .2 Training to be project-specific.
-

1.6 TIME FOR INSTRUCTION

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

- .1 Training will be given in two parts over a six month period.
- .2 One day training program to begin before the 30 day test period at time mutually agreeable to Contractor, and Departmental Representative.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communications and other points touching the modified systems.
 - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

1.9 MONITORING OF TRAINING

- .1 The Departmental Representative will monitor training program and may modify schedule and content.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

.1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 25 05 02 - EMCS: Submittals and Review Process.
- .5 Section 25 05 54 - EMCS: Identification.
- .6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

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 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-FM89(C1995), Canadian Metric Practice Guide.
- .4 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .5 Departmental of Canada's Justice (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1997, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .6 Electrical and Electronic Manufacturers Association (EEMAC).
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

- .7 Health Canada - Workplace Hazardous Materials Informations System (WHMIS).
 - .1 Data Sheet (DS).
- .8 Transport Canada (TC).
 - .1 Transportation of Dangerous Good Act, 1992, c. 34

1.3 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level.
 - .2 AI - Analog Input.
 - .3 AIT - Agreement on International Trade.
 - .4 AO - Analog Output.
 - .5 BACnet - Building Automation and Control Network.
 - .6 BC(s) - Building Controller(s).
 - .7 BECC - Building Environmental Control Center.
 - .8 CAD - Computer Aided Design.
 - .9 CDL - Control Description Logic.
 - .10 CDS - Control Design Schematic.
 - .11 COSV - Change of State or Value.
 - .12 CPU - Central Processing Unit.
 - .13 DI - Digital Input.
 - .14 DO - Digital Output.
 - .15 DP - Differential Pressure.
 - .16 ECU - Equipment Control Unit.
 - .17 EMCS - Energy Monitoring and Control System.
 - .18 HVAC - Heating, Ventilation, Air Conditioning.
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- .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 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.4 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware connected 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 25 character field for each point identifier.
 - .2 Point expansion: comprised of three 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 fields 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 inputs.

- .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 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.
- .2 The above-mentioned sections aim at the modification of the existing system. Any new part of equipment will have to be similar to those existing and compatible with the system in place. Include what follows:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 Workstations.
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Software/Hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface co-ordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Engineer prior to installation.
 - .3 Location of controllers as reviewed by Engineer prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.

- .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
 - .1 Provide passwords to use the system in English as well as in French.
 - .2 Use non-linguistic symbols for displays on graphic terminals. Display other information in English and French.
 - .3 Operating system executive: provide primary hardware-to-software interface.
 - .4 System manager software: 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 Software has to include, in French and English:
 - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's 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. These functions have to be in French in all the prescribed work station.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers within 48 hours after award of contract.
- .3 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 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process Label or listing of specified organization is acceptable evidence.
- .4 In lieu of such evidence, submit certificate from testing organization, approved by Engineer, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .5 For materials whose compliance with organizational standards/ codes/specifications 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.
- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Submit an acceptance certificate provided by the competent authority to the Engineer.
- .8 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project, staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems.
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and safety:
 - .1 Apply pertinent safety rules in accordance to Section 01 35 29.06 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Engineer and Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste disposal and management:
 - .1 Sort out wastes for re-use or recycling in accordance with section 01 74 21 - Construction/Demolition Waste Management and Disposal.

- .2 Evacuate all wrapping material off the job site to the appropriate recycling facilities.
- .3 Place wrapping material made of paper, plastic, polyester and corrugated cardboard in appropriate bins located on site for recycling, in accordance with the wastes management plan.
- .4 Sort out the steel and plastic waste for re-use and drop them in designated bins, in accordance with the wastes management plan.
- .5 Drop in designated bins the elements corresponding to the definition of hazardous and toxic wastes.
- .6 Manipulate and dispose of the hazardous wastes in accordance with the municipality regulations.
- .7 Identify the storing location for the salvaged material and protect it with a fence and a security system.
- .8 Make sure that empty containers are sealed and safely stored.
- .9 Bring the unused metallic elements to a recycling facility approved by the Engineer.
- .10 Fold metal and plastics straps, flatten and place them in the designated area for recycling.

1.9 EXISTING CONTROL/REGULATION ELEMENTS

- .1 As indicated, use existing controls conduits.
- .2 Reusable controls elements can be reused if they comply to the codes, the standards and the prescriptions that apply.
 - .1 It is forbidden to modify the initial design of an existing element without having a written approval from the Engineer.
 - .2 If there is doubt about an element's reusability, provide new elements with the appropriate design criteria to this project.
- .3 The existing elements to be reused must be inspected within 30 days of contract award, but before the installation of new devices.
 - .1 Provide, within 40 days of contract award, the test reports listing each reused device, while indicating if it meets requirements or needs to be repaired. In the latter case, the Engineer will take action on it.
 - .2 If the Contractor fails to provide test reports, it is assumed that the Contractor accepts the existing devices.

- .4 Defective elements:
 - .1 Provide, with the test reports, specifications or functional requirements that back the results.
 - .2 The Engineer will request the repair or the replacement of the defective existing elements.
- .5 Before starting work, submit in writing an authorization request to power down the control elements and put the material out of service.
- .6 The Contractor's responsibility concerning the control elements that must be integrated to the EMCS, starts after receiving the authorization from the Engineer.
 - .1 The Contractor is responsible for the repaired elements requested by the Engineer.
 - .2 The Contractor is responsible for extra repair costs due to negligence or abusive material usage.
 - .3 The Contractor's responsibility concerning existing control elements ends at the moment where the complete EMCS including all modified systems have been received with entire satisfaction from the Engineer.
 - .4 Collect the existing control elements that will not be reused. Store them in an approved storage area, in order to dispose of them following the Departmental Representative's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 and ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

2.3 ACCEPTABLE SYSTEMS

- .1 For reasons of compatibility with the existing EMCS, the system will be provided, installed, wired, programmed and commissioned by Régulvar (Delta system).

PART 3 - EXECUTION**3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

3.2 PAINTING

- .1 Perform painting in accordance with the following requirements:
 - .1 Clean and retouch the surfaces that were scratched so that they have the same original finish.
 - .2 Where retouches are not sufficient, a complete reconditioning (primer coat and finishing coat) of the damaged surfaces is required.
 - .3 Clean and use a primer coating on visible elements like supports, equipment frames and any other fixing devices.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.
- .3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

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

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local contractor office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 List of spare parts.
 - .5 Location of spare parts stock.
 - .6 Names of sub-contractors and site-specific key personnel.
 - .7 Sketch of site-specific system architecture.
 - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .9 Descriptive brochures.
 - .10 Sample CDL and graphics (systems schematics).
 - .11 Response time for each type of command and report.
 - .12 Item-by-item statement of compliance.
 - .13 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.
 - .5 Auxiliary control cabinet locations.
 - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
 - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
 - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
 - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
 - .10 Compressor schematic and sizing data.

1.5 DETAIL SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 30 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.

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- .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 The schematics and nomenclature for pneumatic material.
 - .5 Complete Point Name Lists.
 - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .7 Software and programming details associated with each point.
 - .8 Manufacturer's recommended installation instructions and procedures.
 - .9 Input and output signal levels and pressures where new system ties into existing control equipment.
 - .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
 - .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plan as specified.
 - .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
 - .9 Listing and example of specified reports.
 - .10 Listing of time of day schedules.
 - .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
 - .12 Type and size of memory with statement of spare memory capacity.
 - .13 Full description of software programs provided.
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- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .16 Provide and submit a complete control device network schematic showing links between the systems.
- .17 Provide and submit a thirty (30) day report with graphic schematics showing trends.
- .18 System sequence descriptions and a list of materials.

1.6 QUALITY ASSURANCE

- .1 Preliminary design review meeting: no later than 45 days before contract being awarded, summon a meeting in order to:
 - .1 Verify the preliminary design documents and resolve any issues.
 - .2 Resolve the differences between the requirements in the contract document and real item characteristics (example: irregularities in the points list).
 - .3 Review the material interface requirements provided by others.
 - .4 Review the sequence of operation.
- .2 The Contractor's programmer must be present at this meeting.
- .3 The Departmental Representative has the right to review the sequence of operation and control logic before completion of programming, without any extra cost to the Departmental Representative.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .3 Section 25 05 01 - EMCS: General Requirements.
- .4 Section 25 05 02 - EMCS: Submittals and Review Process.

1.2 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements. OWS - Operator Work Station.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit Record Documents, As-built drawings, Operation and Maintenance Manual to Departmental Representative in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be $\frac{2}{3}$ maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.
 - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to contract documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.
 - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
 - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
 - .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
 - .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
 - .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
 - .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
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- .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
- .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
- .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device.
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
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- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with EMCS, including interfacing schematics, signal identification, timing diagrams, and fully commented source listing of applicable driver/handler.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English and French.

1.5 SUBMITTALS

- .1 Submit required documents and samples specified in section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

PART 2 - PRODUCTS**2.1 NAMEPLATES FOR TABLES**

- .1 Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 5 mm high, black.

- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .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: as directed by Departmental Representative.
- .3 Letter size: minimum 5 mm high.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative.

2.5 WIRING IDENTIFICATION

- .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 communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT IDENTIFICATION

- .1 Colour code EMCS conduit.
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- .2 Pre-paint box covers and conduit fittings. Paint conduits every 2 metres if joints or box covers are not pre-painted.
- .3 Coding: use fluorescent orange paint or 25 mm width tape and confirm colour with Departmental Representative during "Preliminary Design Review".

PART 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 nameplates and legends to reflect changes made on system.

END OF SECTION

PART 1 - GENERAL**1.1 SECTION CONTAINS**

- .1 Requirements and procedures relating to the electrical installation of components and cabling of EMCS.

1.2 RELATED SECTIONS

- .1 Section 21 05 01 - Common Work Results for Mechanical.
- .2 Section 26 05 00 - Common Work Results - Electrical.
- .3 Section 25 05 54 - EMCS: Identification.
- .4 Section 25 08 20 - EMCS: Warranty and Maintenance.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C2, National Electrical Safety Code.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 70, National Electrical Code.
- .4 Canadian Standards Association (CSA)/CSA International.
 - .1 CSA C22.1, Canadian Electrical code, Part 1.
 - .2 CSA C22.2, Canadian Electrical code, Part 2.
 - .3 CAN/CSA C22.3 No. 1, Networks.
 - .4 CAN/CSA C22.3 No. 7, Underground Networks.
 - .5 CSA 22.2 n° 45, Rigid Steel Conduits.

1.4 SYSTEM DESCRIPTION

.1 Electrical:

- .1 Provide power wiring from existing power and emergency panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
- .2 Hard wiring between field control devices and EMCS field panels.
- .3 Communication wiring between EMCS field panels and OWS including main control centre.
- .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
- .5 Refer to wiring diagrams included as part of flow diagrams. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by Departmental Representative before commencing work.

.2 Mechanical:

- .1 Pipe taps required for EMCS equipment will be supplied and installed according to the applicable sections.
- .2 Wells and control valves shall be supplied by EMCS contractor and installed according to the applicable sections.
- .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be installed according to the applicable sections.

.3 VAV Terminal Units:

- .1 Air flow probe for VAV boxes to be supplied and installed. Air flow dp sensor, actuator and associated VAV controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate air flow adjustments with balancing trade.

.4 Structural:

- .1 Special steelwork as required for installation of work.

1.5 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

1.6 EXISTING CONDITIONS

- .1 Drilling and repairs: as per requirements of sections 21 05 01 and 26 05 00 and hereafter prescriptions.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

PART 2 - PRODUCTS

2.1 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.

2.2 WIRING

- .1 As per requirements of Division 26 - Electricity.
- .2 For 70 V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600 V. Colour code to CSA 22.1.
- .3 For wiring under 70 V, use FT4 rated wiring.
- .4 Sizes:
 - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
 - .3 Field wiring to digital device: at least 20AWG stranded twisted pair.
 - .4 Analog input and output: shielded #20 minimum stranded twisted pair. Wiring must be continuous without joints.

.5 Terminations:

- .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.3 CONDUIT

- .1 As per requirements of Division 26 - Electricity.
- .2 Conduits must have a minimum of 20 mm diameter.
- .3 Electrical metallic tubing to CSA C22.2 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 56. Rigid steel threaded conduit to CSA C22.2 45.
- .4 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.
- .5 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .6 Outlet boxes: 100 mm minimum, square.
- .7 Conduit boxes, fittings:
- .1 Bushings and connectors: with nylon insulated throats.
- .2 With push pennies to prevent entry of foreign materials.
- .8 Fittings for rigid conduit:
- .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.
- .9 Fittings for thin wall conduit:
- .1 Connectors and couplings: steel, set screw type.

2.4 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA.

- .2 Receptacles:
 - .1 Duplex: CSA type 5-15R.
 - .2 Single: CSA type 5-15R.
 - .3 Cover plates and blank plates: finish to match other plates in area.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
 - .1 50 mm diameter and smaller: one-hole steel straps.
 - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
 - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
 - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Conduits for wiring.
 - .1 All wiring must be installed in EMT conduits:
 - .1 In exposed areas, mechanical and electrical rooms.
 - .2 In gyps ceilings and other non accessible ceilings.
 - .3 Masonry walls.
 - .2 In suspended ceilings, protected wires can be installed without conduit if they are properly affixed to the structure.

- .3 Use rigid conduits and weatherproof joints for conduits installed outside the building.

3.2 SUPPORTS

- .1 Install special supports as required and as indicated.

3.3 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Division 26 - Electricity and this specification.
 - .2 CSA 22.1 Canadian Electrical Code.
 - .3 ANSI/NFPA 70.
 - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA C22.3 No. 7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1,000 and 2,000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

- .1 Install telecommunication cables in conduits.
- .2 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .3 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .4 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. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .5 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .6 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .7 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .8 Limit conduit length between pull boxes to less than 30 m.
- .9 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .10 Use flexible conduits to make the transition between control elements and the EMT conduits. Flexible conduits must not exceed 500 mm in length.
- .11 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.
- .12 Install polypropylene fish cord in empty conduits for future use.
- .13 Where conduits become blocked, remove and replace blocked sections.
- .14 Pass conduits through structural members only after receipt of Departmental Representative written approval.

- .15 Conduits may be run in flanged portion of structural steel.
- .16 Group conduits wherever possible on suspended or surface channels.
- .17 Pull 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.
- .18 Install terminal blocks or strips indicated in cabinets to Section 26 - Electricity
- .19 Install bonding conductor for 120 V and above in conduit.

3.5 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 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.
- .7 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.
- .8 Do not allow wiring to come into direct physical contact with compression screw.

- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.

3.7 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.8 TESTS

- .1 Perform following tests in addition to tests specified Section 25 08 20.
 - .1 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Measure all circuits, feeders, equipment for 120 - 600 V with 1,000 V instrument. Resistance to ground to be more than required by Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.

- .2 Give 14 days written notice of intention to test.
- .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to Departmental Representative in writing.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204-F94(C1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.3 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

- .1 In accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
 - .3 Submit detailed inspection reports to Departmental Representative.
 - .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
-

- .5 Calibration detail.
- .6 Indication if adjustment required.
- .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Maintain records and logs of each maintenance task on site.
 - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
 - .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

1.6 MAINTENANCE CONTRACT

- .1 Provide complete technical support and expertise to the Departmental Representative and the Commissioning Manager in order to help prepare and implement the maintenance and preventative maintenance contracts.
- .2 Maintenance contracts must include:
 - .1 Annual control points verification, on the field, in order to verify their functionality and calibration.
 - .2 Annual visits.
 - .3 Emergency visits during occupied hours, per year.
 - .4 Emergency visits during unoccupied hours, per year.
 - .5 Complete inventory of installed system.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION**3.1 ON FIELD QUALITY CONTROL**

- .1 Perform at least three minor and one major inspection (or more if the manufacturer requires so) per year. Provide a detailed report to the Departmental Representative for each inspection.
- .2 Perform the inspections during normal office hours, between 8 h 00 AM and 4 h 30 PM, from Monday to Friday, except holidays.
- .3 The following inspections are minimum requirements and their results should not be considered as a satisfactory operating state.
 - .1 All calibrations must be completed with testing equipment that is certified to be at least 50% more accurate than the values used by the system.
 - .2 Verify and calibrate every input/output on the field in accordance with Canada Labour Code, Part 1 and CSA Z204 standards.
 - .3 Provide a dated maintenance tasks list in accordance with the Submittal Procedure articles.
- .4 Minor inspections must include, but are not limited to the following:
 - .1 Visual and operation control of the building controllers, hardware, interface panel and other panels.
 - .2 If needed, fan verification and replacement of filters and controls.
 - .3 Review the system performance with the Departmental Representative to discuss the changes required.
- .5 Major inspections must include, but are not limited to the following:
 - .1 Minor inspections.
 - .2 Work station peripheral equipment cleaning, building controllers, controller interfaces and other panels, outer and inner microprocessor faces.
 - .3 Signal verification, voltage and system insulation, buildings controllers, hardware, interfaces and other panels.
 - .4 Verify the calibration of every input/output element and recalibrate or replace them if necessary.
 - .5 Diagnostic tests of the system software, if needed.

- .6 Software installation and update to make sure every component works on the latest version.
 - .1 Perform network analysis and provide a report in accordance with the Submittals Procedure section.
- .6 Correct the flaws found during the maintenance inspections and ambient controls.
- .7 Continue flaws corrections and system optimization.
- .8 The testing of systems that are affected by normal occupation and seasonal variations must be done during four consecutive seasons, after the job site has been received, transferred and occupied.
 - .1 Systems that are affected by the climate must be submitted to two tests: during winter and summer conditions when the work is almost complete.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
 - .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements.
 - .1 IEEE Std 802.3™-2002, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA).
 - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 - General Requirements, Part 2 - Balanced Twisted-Pair Cabling Components, Part 3 - Optical Fiber Cabling Components Standard.
 - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
 - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

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

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
 - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Network interface cards.
 - .3 Network management hardware and software.
 - .4 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
 - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
 - .2 Each EMCS-LAN to be capable of supporting at least 50 devices.
 - .3 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
 - .4 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
 - .5 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
 - .6 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

- .2 Dynamic Data Access.
 - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
 - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
 - .1 Network medium: shielded twisted cable compatible with network protocol to be used within buildings.

PART 2 - PRODUCTS

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL**1.1 SECTION CONTAINS**

- .1 Building controllers, material and installation.
 - .1 MCU - Master control unit.
 - .2 LCU - Local control unit.
 - .3 TCU - Terminal control unit.

1.2 RELATED SECTIONS

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Submittals and Review Process
- .3 Section 25 05 03 - EMCS: Project Record Documents.
- .4 Section 25 30 02 - EMCS: Field Control Devices.
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.3 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2003, 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.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD250005 2009, Energy Monitoring and control Systems (EMCS) Design Guidelines (document provided upon request).

1.4 DEFINITIONS

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

1.5 SYSTEM DESCRIPTION

- .1 The network of controllers is existing. The controllers are Delta Controls. The new required controllers must communicate perfectly with the existing controllers. Modify the existing controllers as required by the new equipments.
- .2 A network of controllers using LCU, MCU and TCU must be provided in accordance with the architectural system schematic. The network must be compatible with building systems and related operation sequences describe in this section:
 - .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.
- .3 Controllers: stand-alone intelligent Control Units. They have to:
 - .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 its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as 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.
- .4 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
 - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
 - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.6 DESIGN REQUIREMENTS

- .1 Controllers must be able to execute the following functions:
 - .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 Control points within a building system must be controlled by the same controller. Also, one controller must be used for each main ventilation system or water system network portion. Refer to network architecture.
- .4 Controllers and related material and software must work properly in an environment where temperature can fluctuate from 0 to 44°C and relative humidity from 20% to 90% without condensation.
- .5 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.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Interconnection cable connections must protect against over voltage and decrease in voltage.

1.7 SUBMITTALS

- .1 Make submittals in accordance with section 01 33 00 - Submittal Procedures, and section 25 05 02 - EMCS: Submittal and Review Process.
- .1 Submit product data sheets for each product item proposed for this project.

1.8 MAINTENANCE PROCEDURES

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

PART 2 - PRODUCTS

2.1 MASTER CONTROL UNIT (MCU)

- .1 General: primary function of MCU is to provide co-ordination 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 support the existing Siemens protocol.
- .3 Capacity input/output of MCU include the following conditions:
 - .1 MCU I/O points as allocated in I/O Summary Table referenced in IM 250005 - 2009.
 - .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.

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- .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 CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be down line loadable from OWS.
 - .4 Include uninterruptible clock accurate to plus or minus 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): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
 - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by 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 English and 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.
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- .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 controller 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 OWS's 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 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 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 (70 V 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. 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 CONTROL UNIT (TCU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU functional specifications.
 - .1 TCU 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 setpoints, flow setpoints, 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.
 - .5 The Controls Contractor will provide the VAV manufacturer all the controls necessary for a factory installation.
- .4 Acceptable products: Siemens TEC controllers.

2.4 SOFTWARE

- .1 General.
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
 - .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.

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- .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 setpoints, 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 English like 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 Operating and control functions include:
 - .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 point. 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).
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- .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. Departmental Representative 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 inter-locking 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.
 - .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 system wide requirement. This approach will insure 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 air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
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- .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 requested by the Departmental Representative.
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- .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 MCUs 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 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, tonnes, 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.
 - .1 Display analog values digitally to 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 PWGSC point naming convention specified in Section 25 05 01 - EMCS: General Requirements.

PART 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 directed by Departmental Representative.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Equipments that must be functional in emergency and coordination mode are connected to an uninterrupted power supply (UPS).

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
- .2 Section 25 05 01 - EMCS: General Requirements.
- .3 Section 25 05 02 - EMCS: Submittals and Review Process.
- .4 Section 25 05 54 - EMCS: Identification.
- .5 Section 25 05 60 - EMCS: Field Installation.
- .6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- .4 Canadian Standards Association (CSA).
 - .1 CSA-C22.1SB-F02, Canadian Electrical Code, Part 1 (19th Edition) Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
-

- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

- .1 Cutting and adjusting: in accordance with the architectural section.
- .2 If needed, repair surfaces that were damaged during work execution.
- .3 Hand over to the Departmental Representative all removed material that cannot be reused.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, vibration-proof assembly.
- .3 Operating conditions: 0 - 32°C with 10 - 90% relative humidity (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 The operating ranges of the installed instruments must be selected such as normal process variable reading that should be within the first and the second third of the instrument full span.
- .9 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .10 Measure range: as required by each system.

2.2 TEMPERATURE SENSORS

- .1 General - except in the case of ambient temperature sensors, the sensors type must be of the resistance or thermistance type and have the following characteristics.
 - .1 Resistance: platinum, valued at 500 or 1,000 ohms at 0°C (± 0.2 ohms) and designed to help minimize the effect of constraints, including three conductors wiring integrated with a coefficient of resistivity of 0.00385 ohm/ohm degrees Celsius.
 - .2 Thermistance; 10 kohms at 21°C, NTC characteristic. Sensors must be linearized in the controllers.
 - .3 Sensing element: fully sealed.
 - .4 Rod and tip: copper or stainless steel grade 304.
 - .5 Response time: less than three seconds for a temperature variation of 10°C.
 - .6 Immersion wells: NPS ¾, stainless steel spring loaded construction, with heat transfer compound compatible with sensor.

2.3 STATIC OR DIFFERENTIAL PRESSURE TRANSMITTERS (LIQUIDS)

- .1 Characteristics:
 - .1 Linear output signal of 4 - 20 mA into at 500 ohms maximum load.
 - .2 Measuring range must not to exceed 150% of maximum value read.
 - .3 Accuracy less than $\pm 1\%$ over the full span.
 - .4 Reliability up to 0.5% of the output signal
 - .5 Linearity up to 1.5% of the full span.
 - .6 Dead zone or hysteresis less than 0.1% of the full span.
 - .7 Integral zero and span adjustment.
 - .8 Unit must be 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.
 - .9 Integrated 3 way manifold for instrument calibration and insulation (differential pressure).

2.4 REFRIGERANT DETECTION SYSTEM (R-410A)

.1 General:

- .1 Installation should include complete gas detection and monitoring system, as indicated on the drawings. It should be CSA approved and must go through a quality control according to IPC-D-275 standard. The warranty period should begin at the expertise certificate date, and should cover the material and labor for a year period.

.2 Transmitters:

- .1 The transmitters are designed to analyze concentrations of toxic gasses and explosives: R-11, R-12, R-22, R-123, R-125, R-134a, R-410A and R-500. The transmitters must be installed at such a height as to detect gas concentrations quickly. Generally, they must be installed at one foot from the floor.
- .2 Transmitters must have the following characteristics:
 - .1 Protection filters against magnetic and electric fields.
 - .2 Infrared sensor.
 - .3 0-1,000 ppm scale.
 - .4 Three levels of alarms.
 - .5 RS-485 output.
 - .6 Time-delay before and after alarm.
 - .7 LCD screen with keypad.
 - .8 Visual and audible alarms.
 - .9 Microprocessor.
- .3 Select and calibrate the transmitters according to the new chillers selected.
- .4 Transmitter must be compatible with the existing central gas panel.

.3 Controller:

- .1 Three levels of alarm.
- .2 Up to 32 transmitters on a RS-485 loop.
- .3 LCD display and keyboard.

- .4 Visual and audible alarms.
- .5 Microprocessor controlled
- .6 Install to 1,525 mm above the floor on an adequate support, see the mechanical installation plans.
- .4 Remote annunciator panel:
 - .1 Visual alarm with a pilot light.
 - .2 Audible alarm with an alarm buzzer.
 - .3 Push button to silence the audible alarm on an alarm acknowledgement.
 - .4 Install to 1,525 mm above the floor on an adequate support, see the mechanical installation plans.
- .5 Start-up and Commissioning
 - .1 Have the start-up and commissioning performed by the manufacturer. An expertise certificate with a detailed report joined should be produced to testifies the quality of the installation.
 - .2 The systems start-up includes the following:
 - .1 Systems verification;
 - .2 Systems installation verification;

2.5 CALIBRATION AND TESTS. CURRENT TRANSDUCER (ANALOG)

- .1 Requirements:
 - .1 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-1 volt DC.
 - .3 0-10 volts DC.
 - .4 0-20 volts DC.
 - .2 Frequency insensitive from 10 - 80 Hz.
 - .3 Accuracy to 0.5% full scale.

- .4 Zero and span adjustments. Field adjustable range to suit motor applications.
- .5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.6 CONTROL VALVE

- .1 Body: characterized ball.
 - .1 Flow characteristic as indicated on control valve schedule: linear (steam), equal percentage (liquids), two positions.
 - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally close or normally open, as indicated on control valve schedule.
 - .4 Two or three way, as indicated.
 - .5 ANSI class IV Leakage rate, 0.01% of flow (valve fully open).
 - .6 NPS 2 and smaller:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 ANSI Class 250, valves to bear ANSI tag.
 - .3 Range adjustment of 100 :1 minimum.

2.7 ELECTRONIC CONTROL VALVE ACTUATORS

- .1 Characteristics:
 - .1 Steel, cast iron or aluminum construction.
 - .2 Command signal of 0-10 V DC or 4-20 mA.
 - .3 Positioning time as required by application, but maximum 90 seconds.
 - .4 Fail safe operation, as indicated.
 - .5 Visual indication of actual position of valve.
 - .6 Characteristics allowing to satisfy requirements, as well as performance requirements of the valve.
 - .7 Modulating actuator for terminal heating and cooling units.
 - .8 Minimal close off pressure, as indicated on the valve list.

2.8 CONTROL PANELS

- .1 Install new equipment in the existing panels. Provide new panels as required.
- .2 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .3 Multiple panels as indicated to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .4 Panels to be lockable with same key.

2.9 WIRING

- .1 In accordance with Section 25 05 60 - EMCS: Field Installation.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18 AWG twisted pairs.
 - .2 Analog input and output: shielded #18 minimum solid copper twisted pair.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install equipment, 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 1 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 Electrical system:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - Electrical.

- .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
- .3 Refer to electrical control schematics included as part of control design schematics on drawings mentioned in section 25 90 01 EMCS: Site Requirements, Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Conduit filling should not exceed 40% of their capacity.
 - .4 Design drawings do not show conduit layout.
- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative review before beginning work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .6 Provide to the plumbing contractor the control valves.

3.2 TEMPERATURE SENSORS

- .1 Install to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 PRESSURE TRANSMITTERS AND SENSORS

- .1 When allowed by regulations, install an isolation valve and a snubber between the transmitter and the pressure source measured.
- .1 On steam and high temperature water networks, protect the transmitter sensible elements with a pigtail trap installed between the isolating valve and the transmitter.

3.4 CONTROL 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.

3.5 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.6 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

PART 1 - GENERAL**1.1 SECTION CONTAINS**

- .1 Detailed narrative description of each system sequence of operation, including staging period and reset schedules.
- .1 Command logic of each system.

1.2 RELATED SECTIONS

- .1 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
- .1 MD250005 2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines (document provided upon request).

1.3 SEQUENCES

- .1 Present sequencing of operations for systems, in accordance with IM 250005 - 2009: Energy Management and Control Systems (EMCS) Design Manual.

1.4 GENERAL

- .1 Following sequences apply for all the mechanical systems, when it is necessary.
- .2 Critical protections or those required by codes (detection of gas, fire, etc.) will not have to be by-passed in any way, neither manually, nor by computer. If an input is required to the centralized system, supply a relay to execute the double function of control and alarm.
- .3 When there is an input of information for proof of operation, a total of hours of operation of mechanical equipment (compressors, water tower, ventilators, pumps, air conditioning devices, etc.) will automatically be made, complete with operator control resetting.
- .4 Program alarms for all the following situations:
 - .1 Discrepancy between command and state signals.
 - .2 Room temperature at more than 2°C from the set point.
 - .3 System temperature at more than 2°C from the set point for longer than 30 minutes.
 - .4 Hydronic network temperature at more than 1°C from the set point for longer than 30 minutes.

- .5 Other values: greater than 5% discrepancy with the set point.
- .5 When the program switches control modes (example: cooling with heating), a dead range must be included on set points. Also, several control stages in sequence contain a minimum time IN and OUT. These measures eliminate the danger of equipment cyclic functioning.
- .6 When restarting after breakdown, systems will be restarted with 15 minutes intervals (adjustable delay).
- .7 All control valves will be corrected by software programming or by characterised connecting rod and actuators to maintain a proportional valve flow with the control signal.
- .8 The following sequences must be read together with drawings and list of points. Supply all the control points necessary for the control sequences performing, listed or implicit.
- .9 Program trend log points for all the input and output analog points and variables that change in the time.
- .10 Unless otherwise specified, alarms will be transfer to following devices when these are a part of planned system in drawings or existing:

POINTS	ALARM	OPERATION HOURS	TENDANCE	ALARM DESTINATION	COMMENTS
ANALOG INPUTS	X		X	F,P,S	
ANALOG OUTPUTS	X		X	F,P,S	
DIGITAL INPUTS	X	X		F,P,S	Related to the corresponding output
DIGITAL OUTPUTS		X		F,P,S	
SET POINTS	X		X	F,P,S	
VARIABLES	X			F,P,S	
SYSTEM CONTROL	X			F,P,M	

F: File

M: Modem

P: Printer

S: Screen

PART 2 - SEQUENCES OF OPERATION**2.1 CHILLED WATER SYSTEM**

- .1 System off:
 - .1 The chiller is stopped.
 - .2 The P-1 and P-2 chilled water pumps are stopped.
- .2 System running:
 - .1 In the cooling season, the chilled water system is started when ventilation systems cooling demand is sufficient and the outside air temperature is higher than the outside air temperature system enable set point of 12°C (adjustable). Provide a start/stop dead band to avoid short cycling.
 - .2 In the cooling season, the chilled water system is started when the outside air temperature is higher than the outside air temperature system start-up set point 18°C (adjustable). Provide a start/stop dead band to avoid short cycling.
 - .3 At the system start-up, the chilled water priority pump is started.
 - .4 The chiller is started after a two-minute delay.
 - .5 The chiller internal controller commands the cooling stages according to the chilled water return temperature and the chilled water return temperature readjustment set point of 0°C (adjustable from 0°C to +5.6°C).
 - .6 The chilled water return temperature readjustment set point is readjusted according to the chilled water system cooling demand.
 - .7 At the system shutdown, after a two-minute delay, the chilled water pump is stopped.
 - .8 On priority pump failure, the standby pump is started.
 - .9 P-1 and P-2 pumps are alternated weekly.
 - .10 Alarms:
 - .1 Chiller general alarm.
 - .2 Chiller unwanted stop.
 - .3 Chilled water high and low temperatures.
 - .4 Pumps unwanted start/stop.

- .5 Chilled water low pressure.

2.2 REFRIGERANT DETECTION SYSTEM (R-410A)

- .1 On a refrigerant gas leak detection near the chiller, a visual and a sound alarm are generated at the refrigerant detection system central panel and at the remote annunciator panel.
- .2 Alarms:
 - .1 Refrigerant gas detection.

2.3 CHILLED WATER THREE-WAY VALVE (SYSTEM N° 4, 2ND FLOOR)

- .1 System off:
 - .1 The chilled water three-way valve is closed, in position at 0% on the cooling coil.
- .2 System running:
 - .1 The chilled water three-way valve is modulated according to the room temperature sensors for the highest cooling demand of the supplied zone.

2.4 CHILLERS INTEGRATION

- .1 The following points must be available at the computer to be integrated in the control sequences and graphics:
 - .1 Reading and writing points:
 - .1 Temperature set point.
 - .2 Start and stop command.
 - .3 Maximum load.
 - .2 Reading points only:
 - .1 Temperature.
 - .2 System status.
 - .3 Compressor operation mode.
 - .4 Demand signal.

- .5 Compressor operation level (%).
- .6 Local set point.
- .7 Evaporator and condenser pressure and temperature.
- .8 Warnings.

PART 3 - INSTALLATION

3.1 GRAPHICS PROGRAMMATION

- .1 Program the system graphical interface including:
 - .1 One graphic per main system;
 - .2 One alarm page;
 - .3 An access to sequences of operation and related equipment technical data sheets on each graphical page.
- .2 Incorporate the graphics to existing menu.
- .3 All physical points, set points and trends must be accessible on a single screen.
- .4 The time schedule programs should also be easily modifiable by the operator.

3.2 EXISTING EQUIPMENT DEMOLITION AND MODIFICATION

- .1 Modify the existing controllers to adapt to the new mechanical equipment.
- .2 Remove the control equipment related to the equipment to be removed, such as the existing chiller, the condenser, and the wire conduits that will no longer be used. Refer to the demolition plans.
- .3 Hand over the removed control equipment to the Departmental Representative.

END OF SECTION

DIVISION 26

Electrical

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 This Section includes requirements common to various sections of Division 26, and in addition to general requirements of Division 01.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-07, Canadian Electrical Code, Part 1 (latest edition in force at work), Quebec modifications, Safety Standard for Electrical Installations.
 - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Manufacturers Association of Electrical and Electronic Equipment of Canada (EEMAC).
 - .1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC).
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, latest Edition.

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 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for both languages.

1.5 SUBMITTALS

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, 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 co-ordinated 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 of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit ten copies of drawings of at least 216 mm x 280 mm, and sheets, to the competent authority inspection.
 - .6 If changes are required, notify Engineer of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Reports of spot checks by the manufacturer: Departmental Representative to submit, not later than three days after execution of inspections and tests the installation and electric instruments prescribed in Article CONTROL FIELD QUALITY PART 3, a written report of the manufacturer showing that the work complies with specified criteria.

1.6 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 who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within two weeks after award of Contract.

1.8 SYSTEM START-UP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start-up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed
- .5 The operating instructions should be exposed to the weather-resistant material or shall be placed in a weatherproof enclosure.
- .6 Ensure that the operating instructions will not fade when exposed to sunlight.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified.
- .3 Control panels and related components must be assembled at the manufacturer's facility.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Control wiring and conduit there for must be provided under Division 26, except ducts, wiring and connections operating at a voltage below 50 V, and related control systems prescribed by the supplier mechanical equipment and included in his drawings.

2.3 WARNING SIGNS

- .1 Warning signs: in accordance with Departmental Representative requirements.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper or aluminum conductors.
 - .2 All wiring terminals must be the correct size for compression.
-

2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, lettering accurately aligned and engraved into core, faced white and black soul mechanically attached with self tapping screws. For devices connected to the emergency, the plates must have a red face and a white soul.

.2 Sizes as follows:

NAMEPLATE SIZES

Size	Dimensions	Number of lines	Letters (height)
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

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

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

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

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

.6 Disconnects, starters and contactors: indicate equipment being controlled, the number of the disconnect, starter or contactor, the number of the feeding panel with the respective circuits.

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

.8 All new panels must have typed circuit lists, and circuit lists in modified panels must be updated. Project number must be inscribed on the schedule. Schedules must be approved by Departmental Representative prior to manufacture and/or installation.

.9 Identify the receptacles and lighting switches with plastic pressure sensitive label (Brother P-touch), indicating the number of the feeding panel with the respective circuits. The labels must be white with black letters or as per building standard.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Assign a color code to the ductwork and metal sheathed cables.
 - .1 Each and every wire leads must wear a band-reference (≥ 20 mm wide) color as shown in the table below, except for conduits "alarms" that are wholly "RED" and "Communication" fully "BLUE" with the movie references required.
 - .1 Departure and arrival of the duct.
 - .1 Indicate also the origin (panel, circuit, etc.).
 - .2 All 15 m.
 - .3 At each change of direction.
 - .4 Each input/output, wall, or floor box.
 - .1 When passing through walls and floors, also include the source (panel, circuit, etc.).
 - .2 Assign a color code to the boxes:
 - .1 Paint all sides of the junction boxes by color code, described below, but not the cover. Using a large permanent marker, identified on the cover of the junction box or pull the source (the panel) and (s) number (s) of any circuit wiring through junction boxes and draw, when in a space only or unfinished in a between ceiling.
 - .2 Indicate also the use of wiring (see table below).

Note:

- Normal; Network from Hydro-Quebec

USE OF WIRING IN THE DUCT	PRIMARY COLOR	SUPPLEMENTARY COLOR
Grounding (Ground)	GREEN	"—"
Electricity - Normal/0 - 250 V	YELLOW	"—"
Electricity - Normal/251 - 600 V	YELLOW	GREEN
Telephone	GREEN	"—"
Emergency Communication	RED	BLUE
Fire Alarm	RED	"—"
Other security systems	RED	YELLOW
Other communication networks	GREEN	BLUE

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .1 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.
- .2 Clean and touch up the painted surfaces in the workshop have been scratched or damaged during shipment and installation, use a paint harmony to the original painting.
- .3 Clean and prime the hooks, brackets, fasteners and other fasteners apparent, not galvanized to protect against rust.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Do complete installation in accordance with Construction Code of Quebec, CSA C22.10 (current edition in the works).

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduits and sleeves before the pouring of concrete.
 - .1 Thimble concrete structures: steel pipe, schedule 40, in diameter allowing free passage of the conduit and above the concrete surface of 53 mm per side.
- .2 When using plastic sleeves for penetrations of walls or floors with a degree of fire resistance, remove them before installing the pipes.
- .3 Install cables, pipes and fittings to be embedded or plastered, placing them neatly against the building structure so as to minimize the thickness of fur.

3.4 DRILLING AND CUT

- .1 All openings, each opening or cutouts all required wiring and electrical equipment shall be performed by:
 - .1 The Contractor General, when they must be made on any finish material or any material appearance of the building. The Electrical Contractor should indicate the location of any opening.
 - .2 The Electrical Contractor in all other cases.
- .2 Any drilling or cutting in any structural member must be under the control of the structural engineer must give approval.
- .3 Perform any drilling into the concrete using a rotary drill.
- .4 When the work is performed in an existing building, take appropriate means to detect the presence of ducts in the slabs. Any damage to existing pipes must be repaired by the Contractor at his expense in accordance with existing finishes.
- .5 It must also maintain the fire integrity of the floors, ceilings and walls, filling the entire wool insulation between the hole in the concrete and pipe, and seal with caulk firewall (HILTI FS-ONE or 3M), the two sides of floors, ceilings and walls.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3,000 mm, and information is given before installation.

- .4 Locate light switches on latch side of doors.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches and dimmers: 1,200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of counters or counter splash backs: 175 mm.
 - .3 In mechanical rooms: 1,200 mm.
 - .3 Panelboards: as required by Code or as indicated.

3.7 LOAD BALANCING

- .1 Measure the current phase distribution panels under normal loads (lights) at the time of final acceptance. Divide the branch circuit connections so as to obtain the best balance of power between the various phases and record changes to the original connections.
- .2 Measure phase voltages to the elements and adjust the charges made transformers for voltage is obtained within 2% of the rated voltage of the devices.
- .3 On completion, deliver the report to load balancing required under Article DOCUMENTS/SUBMITTALS PART 1. This report should indicate the current system under normal load readings on the phases and neutral distribution panels, transformers and dry motor control centers. Specify the time and date that each drop was measured and the voltage of the circuit at the time of the audit.

3.8 UNIFORMITY

- .1 The Contractor shall comply with a perfect homogeneity between the different systems for each specialty.

- .2 The Engineer may at any time before the installation, if deemed necessary, to move within 3 m of ancillary devices such as fans, light fixtures, switches, sockets, fuses circuits, transformers, lighting, and without any additional charges if the Notice was given prior to installation. It is incumbent upon the Contractor to coordinate with other trades and contractors, and obtain the necessary approvals engineer.
- .3 Lighting fixture shall not be placed above the pipes, ducts or other obstructions.
- .4 The pull boxes and junction boxes must be selected according to the requirements of CSA C22.10-07, taking into account the number and the conductor and conduit in question.
- .5 The pull boxes and junction boxes must be located in protected areas and easily accessible. They must remain accessible after installation finishes and appliances.
- .6 The Contractor shall note that his plans are provided as a guide and are sometimes reduced to scale and may not have ratings. It must use common sense and ensure that these systems accessories fit well with the structure and architecture of the building.

3.9 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure that the circuit protection devices such as trigger overcurrent relays and fuses are installed, they are of the caliber you want and they are set to required values.

3.10 FIELD QUALITY CONTROL

- .1 The Contractor shall ensure the presence of skilled personnel and availability of measuring devices and testing to perform the tests requested by the Engineer to his satisfaction. In addition, any test requested by the Departmental Representative shall be executed at no additional charge. The Engineer shall be notified verbally and in writing two weeks in advance of the proposed tests and may, if desired, inspect the facility and attend trials.
- .2 All tests should take place with the permission of the Engineer and other Contractors involved. Any imperfection or defects discovered during testing must be corrected to the satisfaction of the Engineer.
- .3 Provide measuring devices, equipment and personnel needed to carry out testing during the installation and completion.
- .4 Perform the following tests in accordance with Section 01 45 00 - Quality Control:
 - .1 Electricity distribution network, including the phase control, voltage and grounding, and load balancing.
 - .2 Circuits from panels.
 - .3 Lighting system and controls/regulation.

- .4 Motors, heaters and controls/regulation related, including operating controls sequential systems as appropriate.
- .5 Measurement of insulation resistance.
 - .1 Measure, using a 500 V megger, the value of isolation circuits, cables and distribution equipment with a rated voltage not exceeding 350 V.
 - .2 Measure, using a megger 1,000 V, the value of isolation circuits, arteries and appliances with a rated voltage between 350 V and 600 V.
 - .3 Verify the value of earth resistance before powering up.
- .6 Check continuity of the grounding.
- .5 Perform tests in presence of Departmental Representative.
- .6 Provide equipment, gauges and personnel required for carrying out the tests during the construction work and the completion thereof.
- .7 Spot checks by the manufacturer.
 - .1 Obtain a written report from the manufacturer confirming that the work conforms to the criteria specified in regard to handling, implementation, application products and the protection and cleaning of the book then submit this report pursuant to Article DOCUMENTS/ITEMS TO SUBMIT PART 1.
 - .2 The manufacturer shall make recommendations regarding the use of the product, and make periodic visits to check if the implementation was carried out according to its recommendations.
 - .3 Provide site visits in accordance with section QUALITY ASSURANCE PART 1.
- .8 Submit test results to the Departmental Representative.

3.11 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

PART 1 - GENERAL**1.1 DEMOLITION**

- .1 Remove all existing electrical equipment indicated on the plans. This equipment must be removed in due course.

1.2 EQUIPMENT EXISTING

- .1 Means all existing equipment or components existing materials relevant to the existing electrical installations at the time of signing the contract associated with this estimate and plans related thereto.
- .2 All existing equipment to remove:
 - .1 To be completely removed from its supply point to its point of use, unless the plan.
 - .2 Becomes the property of the Contractor when the owner does not recover. The Contractor shall dispose promptly.
- .3 All existing equipment to remove and relocate:
 - .1 To be relocated to a location specified by redevelopment plans.
 - .2 Where indicated plans, wiring of an existing unit to remove and relocate may be reused in whole or in part if the wiring is in excellent condition. However, it must respect the existing function of the wiring by allocating the same function.
- .4 Where existing fixtures are relocated, they must be with new lamps, ballasts having any defective lighting; lenses broken and otherwise damaged must be returned in perfect condition with the appearance of a new device.

1.3 CONTINUITY OF ELECTRIC SERVICE

- .1 Ensure the full continuity of electrical services to building occupants during and after construction.
- .2 Where changes to the existing electrical installation affect areas adjacent to works, supply and install conduits, conductors, equipment and accessories necessary for the permanent redistribution of services.

1.4 POWER INTERRUPTION

- .1 Interruptions of power supply should be minimized and shall be implemented in close coordination with the Departmental Representative, who must be notified at least fifteen (15) working days in advance and recalled forty-eight (48) hours before work begins.
- .2 Interruptions of power supply must be planned and documented. The Contractor shall submit for approval a detailed description explaining the actions and work in each step. The duration of each operation must be adequately prepared to enable the Departmental Representative to decide to proceed with the work.
- .3 In the event of a cons order from the Departmental Representative, the Contractor shall provide the opportunity to restore power supply in operation in less than twenty (20) minutes.

PART 2 - PRODUCTS

- .1 Not used.

PART 3 - EXECUTION

- .1 Not used.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65, Wire Connectors.
 - .1 CSA C22.2 n° 41, Equipment Grounding and Bonding.
- .2 Manufacturers Association of Electrical and Electronic Equipment of Canada (EEMAC).
 - .1 EEMAC 1Y 2, Connectors and Terminals Crossing Aluminum Adapters (rated 1,200 A).
- .3 National Electrical Manufacturers Association (NEMA).

PART 2 - PRODUCTS**2.1 MATERIALS**

- .1 Pressure type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors according to the requirements of this project.
- .2 Fixture type splicing connectors conform to CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable.flexible conduit, as required, in accordance with standard CAN/CSA C22.2 No. 18.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply a layer of joint compound based on zinc aluminum splices cables before installing the 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. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y 2.
 - .5 If needed, make the grounding and bonding in accordance with CSA C22.2 No. 41.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - Electrical.
- .3 Section 26 05 20 - Wire and Box Connectors (0-1,000 V).
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2, No. 0.3, Test Methods for Electrical Wires and Cables.
 - .2 CAN/CSA-C22.2, No. 131, Type TECK 90 Cable.
- .2 Underwriters Laboratories of Canada (ULC).
 - .1 ULC-S139-00, Method of Fire Test for Evaluation of Integrity of Electrical Cables.

1.3 PRODUCT DATA

- .1 Produce product data in accordance with Section 01 33 00 - Submittals Procedures.

1.4 DRAWINGS

- .1 Conductors numbers and sizes are indicated on drawings. If not indicated, the Contractor must never take class lower than Construction Code of Quebec, Chapter V - Electricity requirements with a minimum acceptable size of 12 AWG for copper conductors.
- .2 Not all cabling is indicated on drawings. Indicated cabling is represented schematically and is used to identify circuit number to use. Provide and install all required cabling.

PART 2 - PRODUCTS**2.1 BUILDING WIRES**

- .1 Conductors twisted if they are size 10 AWG or more; minimum size: 12 AWG.

- .2 Copper conductors: size as indicated, with 600 or 1,000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90 XLPE.
- .3 Each circuit must have a bonding wire (Green Wire). EMT conduit is not acceptable for bonding.
- .4 Each circuit must have a dedicated neutral conductor.

2.2 TECK 90 CABLE

- .1 Cables conform to CAN/CSA C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated in drawing.
- .3 Insulation:
 - .1 Cross-linked polyethylene RW XLPE, 1,000 V.
- .4 Inner Jacket: polyvinyl chloride (PVC) material.
- .5 Armour: galvanized steel.
- .6 Overall covering: PVC, compliant to FT-4 flammability standards.
- .7 Fastenings:
 - .1 One hole aluminum straps to secure surface cables 53 mm and smaller. Two holes galvanised steel straps for cables larger than 53 mm.
 - .2 Stands "U" for groups of two or more cables, placed at 1,000 mm centers
 - .3 Threaded rods: 6 mm diameter to support suspended channels in a "U".
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.

- .4 Connectors: anti-short connectors.

2.4 CONTROL CABLES

- .1 Type: LVT: 2 or more soft annealed copper conductors, sized as indicated in drawing, as insulation: thermoplastic sheath: thermoplastic jacket, and armour of closely wound aluminum wire.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated in drawing, insulation: PVC, TW 40 degrees C, or polyethylene, overall covering: PVC jackets FT-4 or protected with armour Steel strip.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION OF TECK 90 CABLE (0 -1,000 V)

- .1 Install cables:
 - .1 Where possible, group the cables on supports "U".
- .2 Finish the ends of cables in accordance with Section 26 05 20 - Connectors for cables and boxes (0-1,000 V).

3.3 INSTALLATION OF ARMoured CABLES

- .1 In general, all wiring is in conduit. However, the following options are allowed in the following special cases:
 - .1 Where the ceilings are open (removable tiles) the basic frame of the lighting circuits must be in conduit with junction boxes anchored to the building structure and spread evenly over the entire surface of the facility. From junction boxes distributed, it is possible to connect each fixture individually with armoured cable AC-90. However, it should not be more than four fixtures individually connected to each junction box and the maximum allowable cable length is 3 m.

- .2 The armoured cable AC-90 can also be used in the same manner and under the same conditions as for luminaries in paragraph 3.4.1.1 for vertical descents in the walls and/or walls covered with gypsum board to connect the wiring devices to a junction box in between ceiling. The maximum allowable cable length is 3 m.
- .3 The connection type garland ("Daisy Chain") is not allowed.
- .2 Group cables wherever possible.
- .3 Finish the ends of cables in accordance with Section 26 05 20 - Connectors for cables and boxes (0-1,000 V).
- .4 Unless otherwise indicated, all wiring is hidden in the architectural elements. Unless otherwise specified, no surface installation is permitted without prior approval of the Engineer.

3.4 INSTALLATION OF CONTROL CABLES

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

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

PART 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.
- .3 Busbars earth: copper, size as indicated in drawing, with insulators, fasteners and connectors.
- .4 Accessories necessary corrosion system grounding, including:
 - .1 Bits of grounding and bonding.
 - .2 Brides protection.
 - .3 Bolted connectors.
 - .4 Connectors soldering electrical connections.
 - .5 Cavaliers, braids and barrettes to bond.
 - .6 Connectors wire clamp.

PART 3 - EXECUTION**3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including conductors, connectors, and accessories. Where EMT is used, run green ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect against damage conductors grounded posed uncovered.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 The welded joints are prohibited.
- .6 Install a jumper on the flexible conduits, laid carefully on the outside of the conduit and connected at each end to a tip grounded, a seamless terminal, a wire clamp or screw with Belleville washer.
- .7 Arrange grounding conductors in radial form and route all the connections directly to a single point of common ground. Avoid loopbacks.
- .8 Connect one end of the metal armor of single core box at the source and install a non-metallic inlet plate to the other end.
- .9 Ground secondary service pedestals.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, pipes, frames of motors, motor control centers, starters, control panels, frame steel, and distribution panels.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and approved by the Departmental Representative and the competent local authorities.
- .3 Perform tests before energizing electrical system.

.4 During the tests, disconnect indicator earth leakage.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

PART 2 - PRODUCTS**2.1 SUPPORT CHANNELS**

- .1 "U" shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.
- .2 Supports of equipments must be in galvanised steel.
- .3 Supply all the supports for all equipments in order to have a complete installation. For example, the supports for junction boxes, receptacles, conduits etc., are not shown in drawings but they must be supplied and installed. Supply and install support channels in galvanised steel on vertical between the wall and the panel for all new panel installed on the wall. For precast supports, follow the installation recommendations from the manufacturer.
- .4 Fixation fasteners must be metallic. Plastic fasteners are not permitted.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable anchors.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole galvanized steel clamps to secure surface conduits and cables 53 mm and smaller.
 - .2 Two-hole galvanized steel clamps for conduits and cables larger than 53 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.

- .5 Suspended support systems:
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support two or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support, unless it has obtained permission from the latter and the approval of the Departmental Representative.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Unless otherwise specified, perform all Work in accordance with the current edition of "Building Code of Quebec".
- .2 In addition, do the Work in accordance with any code or any other standard having jurisdiction, according to the current edition, including, but not limited to:
 - .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Applications Handbook (SI).
 - .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - .3 NRC-CNRC, Quebec Construction Code - Chapter 1 - Building and National Building Code - Canada version.
 - .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA, Addendum No. 1, September 2000 to Seismic Restraint Manual, Guidelines for Mechanical Systems.
 - .2 SMACNA, Seismic Restraint Manual, Guidelines for Mechanical Systems.
 - .5 CAN/CSA-S832-F06 - Diminution des risques sismiques concernant les composantes fonctionnelles et opérationnelles des bâtiments (CFO).

1.3 DOCUMENTS/SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit, for information, shop drawings required, all showing installation details, calculations and technical measures planned seismic to meet the standards.

- .2 All hardware must be provided by a single manufacturer with experience in the field.
- .2 Data Sheet:
 - .1 Submit the technical requirements.
- .3 Samples:
 - .1 Not applicable.

1.4 RESPONSIBILITY

- .1 Each contractor is responsible for seismic measurements related to their discipline.
- .2 During an earthquake, it is not necessary that the equipment and electromechanical systems remain operational after the earthquake. Seismic devices used to prevent mechanical and electrical systems to move, fall over and cause injury to occupants during the earthquake.
- .3 The design of seismic devices and systems must be developed by a professional engineer in the province of Quebec, mandated by the Contractor. Documents must be sealed and signed by the engineers.

1.5 EARTHQUAKE PARAMETERS (VALUES FOR MONTREAL)

- .1 Seismic measurements should be chosen to meet the requirements of the latest edition of the Building Code of Quebec.
- .2 The lateral seismic force design is given by the equation:
 $V_p = 0.3 * F * H_{is} (0.2) * I * S_p * W_p$.
- .3 For the Montreal area, $H_{is} (0.2)$ is: 0.68 / 0.69.
- .4 Depending on the type of application, a seismic importance factor should be applied:
 - .1 Ordinary Buildings: $I = 1.0$;
 - .2 Schools: $I = 1.3$;
 - .3 Buildings Civil Protection: $I = 1.5$.
- .5 Depending on the type of installation, a horizontal force coefficient " S_p " must be applied:
 - .1 The value of this coefficient is defined in Section 4.1.8.17.1 of the NBC 2005.

1.6 DETERMINE LEVEL OF PROTECTION

- .1 For pipes and electrical conduits, installing anchors and seismic stabilization as prescribed in the guide "Seismic Restraint Manual" as published by SMACNA.
- .2 Following the calculation of the seismic lateral force design, determine the level of protection to apply. The level of protection SHL-A is designed to withstand a seismic lateral force equivalent to 48% by weight of the equipment. The level SHL-B is designed to withstand lateral seismic force equal to 30% by weight of the equipment. Finally, the SHL-C level is designed to withstand a seismic lateral force equivalent to 15% by weight of the equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All accessories such as speakers and lighting fixtures mounted on the ceilings, should be fixed directly to the building structure.
- .2 Seismic devices must prevent displacement and permanent damage caused by horizontal movements, vertical, and overturning.
- .3 Seismic devices must be compatible with the electromechanical design. They should not impede the normal operation of electromechanical systems.
- .4 Devices for protection against earthquakes should act flexibly and in all directions. They should not interfere with acoustic elements and vibration.
- .5 Fasteners and attachment points must be able to withstand the same maximum loads that guards against earthquakes.
- .6 The use of anchors and fixings laid the gun nailer or in holes drilled for this purpose is prohibited.
- .7 No device or any related or support pad should be transferred prior to the frame or structure does not yield.
- .8 Using media made of cast iron or threaded pipe is prohibited.
- .9 Seismic devices should not interfere with the operation of firewalls or compromising its integrity.

2.2 PROVISIONS FOR PROTECTION AGAINST EARTHQUAKES

- .1 The supports must be provided with longitudinal and transverse bracing. They may be of rigid or rope.

- .2 Do not stabilize the material, the length of the suspension rods is less than 305 mm.
- .3 Stabilize pipes and electrical conduits of 35 mm nominal diameter and located inside a mechanical room.
- .4 Stabilize pipes and electrical conduits of 63 mm nominal diameter and located outside a mechanical room.
- .5 Install mechanical restraints at the following frequency:
 - .1 For the stabilization section:
 - .1 SHL-A: 6.1 m all linear;
 - .2 SHL-B: every 10 linear feet;
 - .3 SHL-C: 12.2 m all linear.
 - .2 For the longitudinal stabilization:
 - .1 SHL-A .1: every 12 linear feet;
 - .2 SHL-B: every 20 linear feet;
 - .3 SHL-C: 24.4 m all linear.
- .6 A cross bracing may be used as longitudinal bracing, if it is installed within 600 mm of change in direction of the pipe.

2.3 EQUIPMENT STATIC

- .1 The material must be attached to the hanging brackets that must be attached to the frame.
- .2 Use one or more methods listed below or as directed plans:
 - .1 Attach firmly to the suspension frame;
 - .2 Brace suspensions in all planes;
 - .3 Brace suspension to the frame;
 - .4 Perform mechanical stabilization using cables.
- .3 The devices must prevent the oscillation of the apparatus in the horizontal plane and switching devices in the vertical plane.
- .4 The suspension rods used must be resistant to buckling.

2.4 MATERIAL WITH SUSPENDED INSULATORS

- .1 The material must be attached to the hanging brackets that must be held to the frame using cables.
- .2 The devices must act flexibly and continuously.
- .3 Devices for protection against earthquakes should in no way interfere with the action of vibration and acoustic elements. Under normal operation, the clearance between the devices for protection against earthquakes and equipment must be 6 mm to 12 mm.

2.5 ROLLING SUPPORTED WITH INSULATORS

- .1 Where type seismic isolators are used, they must then be designed and installed to withstand the acceleration forces minimal.
- .2 Devices should never be compressed to the point of losing their effectiveness.
- .3 In the case of standard insulators are used, devices for protection against earthquakes should be incorporated in the vibration to prevent overturning of the latter.
- .4 Devices for protection against earthquakes should in no way interfere with the action of vibration and acoustic elements. Under normal operation, the clearance between the devices for protection against earthquakes and equipment must be 6 mm to 12 mm.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Protective measures against earthquakes shall be in accordance with the requirements of the Quebec Construction Code, current edition.
- .2 Ensure that the anchor points and fastener can withstand the same maximum loads that the seismic devices.
- .3 Ensure that the connection of pipes and electrical conduits to remote devices in no way diminishes the flexibility of the vibration elements and the pipes or conduits passing through walls or floors do not transmit vibrations.
- .4 For equipment not equipped with attachment points, provide for the addition of these items or arrange to install belt attachment.
- .5 The structural basis of the equipment must be stabilized to prevent their reversal.
- .6 A clearance of at least 25 mm must be provided between a device and other seismic equipment and service element.

3.2 FASTENING

- .1 Be sure the anchor bolts, the diameters of the ankles, the depth of depressions in the concrete and the length of welds conform to the drawings submitted for approval.
- .2 Bolt to the frame structure or any equipment that is not insulated against the transmission of vibrations.
- .3 The oblong openings for adjusting bolts are prohibited.
- .4 For purposes earthquake, pipes of small diameter may be attached to larger diameter pipes that will hold. The opposite practice is prohibited.
- .5 The anchors in the concrete slabs should be removed from the banks following the standard ASTM E488 and recommendations of the manufacturer of the anchors.

3.3 RETAINING CABLES

- .1 Connect the cables holding the hanging hardware so that their impact is through the axial center of gravity of the equipment to be protected.
- .2 Use password-son, lugs assembly and other hardware to ensure proper alignment with seismically and prevent the cables from bending at the points of attachment.
- .3 In the case of electrical or mechanical suspension, have tethers to 90° against each other, and fix the structural ceiling of the building at an angle not exceeding 90°.
- .4 Adjust tethers so as to obtain a slack of 19 mm. In normal operation, the tethers should not bear the weight of material to be protected.

3.4 VERIFICATION FACILITY BY THE MANUFACTURER

- .1 The Engineer Designer of seismic devices and systems must visit the worksite to verify the installation and assembly are in compliance. Then he must submit to the Engineer a report and its recommendations in this regard.
- .2 Tell the Engineer's visit to the Design Engineer at least 24 hours in advance.
- .3 Where applicable, the Contractor shall make corrections and adjustments necessary on the basis of the written report submitted by the supplier.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
- .1 CSA C22.1, Canadian Electrical Code, Part 1, Effective version.

PART 2 - PRODUCTS**2.1 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure, with lids screwed flat for mounting.
- .2 Lids, with an edge of at least 25 mm, adapted to pull boxes and junction mounted outcrop.

PART 3 - EXECUTION**3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes in order to avoid more than 30 m distance and three elbows with a right angle or equivalent between boxes for the electrical distribution and two elbows with a right angle for other conduit networks or empty conduits.
- .4 All pull and junction boxes must have the appropriate size depending of the numbers and size of conductors.

3.2 IDENTIFICATION

- .1 Supply and install identification tags of equipment in accordance with Section 26 05 00 - Electrical - General Requirements for the results of the work.
-

- .2 Install a type 2 label indicating the name of the network, voltage and number of phases.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 CSA C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings, and Associated Hardware.

PART 2 - PRODUCTS**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 OUTLET BOXES STEEL PLATE

- .1 Boxes, electro-galvanized steel, for single and multi-gang flush device boxes for flush installation, minimum size 102 mm x 102 mm x 65 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Square outlet boxes of 102 mm side with extension and plaster rings for flush mounting devices in finished plaster or ceramic tile.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONDUIT BOXES

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface mounting of switches and receptacles, when installed in locations that are not protected from weather.

2.5 FITTINGS - GENERAL

- .1 Sleeves and collar connectors with nylon insulation.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armored cable connections. Do not install reducing washers.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

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

1.3 SUBMITTALS

- .1 Provide product data 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.

1.4 GENERAL

- .1 Conduits are not fully indicated on drawings. Indicated conduits are schematic.
- .2 All conduit to have 21 mm diameter or larger.

PART 2 - PRODUCTS**2.1 CABLES AND REEL**

- .1 The cables should be supplied on reels. Each cable or cable winding drum shall be marked or labeled to indicate the length of cable, voltage rating, conductor size, number and batch number of the reel.

- .2 Each reel or coil should be continued without a cable connection.
- .3 Identify cables used exclusively for DC applications.

2.2 CONDUITS

- .1 Rigid metal conduit: conform to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT) according to CSA C22.2 No. 83, with couplings with expanded ends and a green wire to bonding.
- .3 Flexible metal conduit in accordance with CSA C22.2 No. 56, and steel liquid-tight flexible metal.
- .4 All conduit to have 21 mm diameter or larger.

2.3 CONDUIT FASTENINGS

- .1 One hole galvanized steel straps to secure surface conduits 53 mm and smaller. Brides two holes steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work. Stirrups "U" to support more conduits arranged to 1,500 mm wheelbase.
- .3 Channel type supports in galvanized steel for two or more conduits.
- .4 Threaded rods in galvanized steel, 6 mm diameter, to support suspended channels.
- .5 Fixation fasteners must be metallic. Plastic fasteners are not permitted.

2.4 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90° bends for 27 mm and larger conduits.
- .3 Steel watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings for linear expansion of 100 mm.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 21 mm deflection.

- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene twisted of 6 mm from a tensile strength of 5 kN.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with the requirements, recommendations and manufacturer's written specifications, including all technical bulletin available, instructions for handling, storage and installation of products, and Data Sheets

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid hot dipped galvanized steel threaded conduit for surface installations below 2.4 m if subject to mechanical injury (ex.: electrical room, mechanical room, corridor, etc.).
- .4 Use electrical metallic tubing (EMT) except in cast concrete, and when they are not subject to mechanical injury.
- .5 Armored cables are permitted between the connection box in the ceiling and the fixture or wiring devices installed in gypsum walls, when the circuits have 2, 3 or 4 conductors No. 12 size. Maximum length: 5 m.
- .6 Use rigid PVC conduit underground or water proof.
- .7 Use flexible metal conduit in case of installation of removable metallic partition.
- .8 Use flexible metal conduit for connection to motors and other equipment subject to vibrations in dry areas. Total length not to exceed 1 m.
- .9 Daisy chain connections are not permitted.
- .10 Bend Conduit Cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 21 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 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .15 Dry conduits out before installing wire.
- .16 Install a metal support in the ceiling "T" for installation of exit signs and fire detectors.
- .17 Install an expansion fitting for all conduits which pass through a building expansion joint.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Group conduits wherever possible on suspended or surface channels.
- .3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- .6 Pass ducts along the beams of concrete to minimize the visual impact.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 It is forbidden to drown in books ducts terrazzo or concrete copings.
- .4 Anchor solidly all the concealed conduit, including those installed above the suspended ceilings

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Not Used.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)/CSA International.
 - .1 CSA-C22.2 No. 5, Circuit Breakers and Molded Case Circuit Breaker Casing (Tri-National standard, with UL 489, Tenth Edition, and NMX-J-266-ANCE, second edition).

1.3 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 breakers 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 with ampacity of 200 A and over].
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

- .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 List of circuit breakers.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

- .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 with temperature compensation for 40°C ambient.
- .3 Common-trip Breakers: with single handle for multi-pole applications.
- .4 Plug-in Moulded Case Circuit Breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
 - .1 Breakers fitted with triggers that can be adjusted between 3 and 8 times the rated current.
- .5 Breakers must have at least the interrupting capacity as the panelboard where they are installed, with minimum 10 kA for all breakers up to 240 V and minimum 14 kA for all breakers to 600 V.

2.2 THERMAL MAGNETIC BREAKERS MODEL A

- .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.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2, No. 4, Enclosed Switches.
 - .2 CSA C22.2 No. 39, Fuseholders.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS**2.1 DISCONNECT SWITCHES**

- .1 Non-fusible, disconnect switch in NEMA1 for indoor use, industrial type, according to the CAN/CSA C22.2 No. 4, size as indicated.
- .2 Provision for padlocking in on-off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in "ON" position.
- .4 Fuses: size as indicated plans to comply with Section 26 28 13.01.
- .5 Closing mechanism and abrupt cut-off.
- .6 "ON-OFF" switch position indication on switch enclosure cover.
- .7 Fuseholders: appropriate, without an adapter, the type and fuse rating indicated.
- .8 All switches installed outdoors must be of the weatherproof.
- .9 Switches installed in the circuits between the variable frequency drives and motors, switches and motors for elevator shall be equipped with an electric lock includes one NO and one NC contact to open the circuit command before the switch contacts to open.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on Size 4 nameplate.

2.3 RECOGNIZED MANUFACTURER

- .1 Recognized Manufacturer: Cutler-Hammer, Square-D, Siemens.

PART 3 - EXECUTION**3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Install disconnect switches in order to operate easily the handle with left arm.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.
- .2 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No. 60947-4-1.

1.3 SHOP DRAWINGS AND TECHNICAL DATA

- .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.

PART 2 - PRODUCTS**2.1 MATERIALS**

- .1 Starters conform to CSA C22.2 No. 60947-4-1.
-

2.2 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic starters and combined, size, type and rating as indicated under CSA box type 1 unless otherwise indicated, provided the following:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Terminals for supply and control cables.
 - .4 Wiring and schematic diagram inside starter enclosure in visible location.
 - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
 - .1 Locking in "OFF" position with up to three padlocks.
 - .2 Locking in "Auto" position.
 - .3 Independent locking of enclosure door.
 - .4 Provision for preventing switching to "ON" position while enclosure door open.
 - .5 Install three lock "OFF".
- .3 Accessories:
 - .1 Selector switches: three-positions "ON-OFF-AUTO" heavy duty labelled as indicated.
 - .2 Indicating lights: heavy duty LED, oil tight type, color: green: ready/red: ON/yellow: overload.
 - .3 Two spare auxiliary contacts NO and NC unless otherwise indicated.
 - .4 Phase failure detector and the phase inversion for any motors of 10 HP and above.
 - .5 Each starter supply an engine of 25 HP or over must be fitted with a trigger unit for thermistors and a white lamp on the front of the starter with the annotation "Overheating".

2.3 CONTROL TRANSFORMERS

- .1 Control transformers, dry, single, with primary voltage as indicated and the secondary voltage of 120 V, equipped with a secondary fuse connected in circuit with the starters as indicated.
- .2 Rated control transformers determined by the load control circuit with safety margin of 20%.

2.4 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Magnetic starter designation label, white plate, black letters, Size 1 engraved as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 If the motor is not visible from the starter or the disconnect switch, the contractor must supply a disconnect switch at less than 1,500 mm from the motor.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical, and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Management and Disposal of Construction/Demolition.
- .3 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C82.1-1997, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4,-2002 Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE C62.41-1995 Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM).
 - .1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 United States of America, Federal Communications Commission (FCC).
 - .1 FCC (CFR47), EM and RF Interference Suppression.

1.3 SHOP DRAWINGS AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .3 These photometric data must include the following: the photometric curve on paper and on CD, luminance ratio, Table TBV criteria for separation of aircraft, total power consumption (watts), light intensity in 5 shots, on beam patterns polar curves, luminous flux zonal fixture performance standard, CIE designation, utilization factor, type of lamp luminous flux (lumens) as IESNA testing and the type and finish of the diffuser and louver. Submit leaflets also
-

proposed device and its components with the characteristics of each. Approval to all the Departmental Representative.

1.4 GUARANTEE

- .1 Replace incandescent bulbs roasted within three months after acceptance of the facility.
- .2 Replace fluorescent lamps roasted within twelve months after acceptance of the facility.
- .3 5 year warranty regardless of the annual operating time, and allowance of \$25.00 per ballast for labor when the owner replaces the defective ballasts. If a ballast no longer meets the specifications set out above or can operate the lamps according to ANSI applicable, it is deemed defective and must be replaced by the Contractor.

1.5 ACCEPTABLE MATERIALS OR PRODUCTS

- .1 When materials or products are specified by make or brand name, the Instructions for tender are to be consulted to follow method of approval of materials or replacement products.

1.6 MANAGEMENT AND DISPOSAL OF WASTE

- .1 Separate and recycle waste in accordance with the requirements of Section 01 74 21 - Management and Disposal of Construction/Demolition.
- .2 Remove from site all packaging materials and transport them to appropriate facilities for recycling.
- .3 Place all packing materials in bins appropriate on-site for recycling, according to the plan of waste management.
- .4 Place in designated containers and insulating materials and accessory products in surplus or unused.
- .5 Route unused metal components to a recycling facility approved by the Project Manager.
- .6 Route unused adhesive products to an approved collection of hazardous materials approved by the Project Manager.

PART 2 - PRODUCTS

2.1 LAMPS

- .1 Fluorescent Lamps to be:
 - .1 Rapid start.

- .2 Form T-8.
- .3 Power 32 W.
- .4 Initial flux 3,100 lumens.
- .5 CRI 86.
- .6 Colour temperature 4,100 K.
- .7 Lamp life 30,000 hours.

2.2 BALLASTS

- .1 Fluorescent Ballast: CBM and CSA certified, energy efficient type, IC electronic.
 - .1 Rating: 347 V, and / or 120 V 60 Hz, for use with 2-3 lamp T8 or 32W T-5.
 - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
 - .3 Ambient temperature: ballast to start lamps up to a minimal ambient temperature of 10°C.
 - .4 Power factor: minimum 90% with 95% of rated lamp lumens.
 - .5 Sound rated: Class A.
 - .6 Mounting: integral with luminaire.
 - .7 Harmonics: 10% maximum THD, including 49th harmonic. Harmonic distortion not to increase with aging of the ballast.
 - .8 Electromagnetic emissions: not to exceed Class A, as defined by FCC, part 18, 15C, concerning electromagnetic interference (EMI) and radio frequency interference (RFI).
 - .9 Protection against transient voltages: ballast to withstand transient voltage fluctuation and electric noise, as described in ANSI C62.41 and IEEE 587, with and without lamps in secondary circuit.
 - .10 Thermal protection: according to CSA C22.2 No. 74-1969, item 1.6.7.3 or according to technical information letter (T.I.L.) No. 37 of July 25, 1988.
 - .11 Supply voltage: ballast to withstand 10% input voltage variation without damage.
 - .12 Ballast factor: greater than 0.90.
 - .13 Connection: plug and socket.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

- .1 Luminaire type F1 :
 - .1 Industrial type striplight, formed steel, acceptable for humid areas with an ambient temperature of 25°C;
 - .2 CSA certified;
 - .3 With 2 fluorescent lamps type T8-32W, and electronic ballast with a maximum THD of 10%;
 - .4 Voltage of 120 V, 60 Hz;
 - .5 Acceptable products:
 - .1 Lithonia, model C232-120-GEB10IS-CSA;
 - .2 Peerless, model LS4-232-120-IS;
 - .3 Columbia, model CS4-232-E-U;
 - .4 Materials or replacement products approved by addenda conforming to the instructions for tender.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Arrange and install lights as indicated.
- .2 The Contractor electrician is responsible for the suspension of luminaires. For suspending fluorescent-type surface tile suspended ceilings, the Contractor shall provide and install a metal bar specially designed for this use, located above the suspension to screw the fixture with screws of appropriate lengths.
- .3 In mechanical rooms, the suspension of the luminaires will be using suspension chains and exact location will be determined on site.

3.2 REPLACEMENT

- .1 Replace all lenses, reflectors, fittings, etc. that have been damaged during or after installation, before acceptance of work.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION



Imaginer, réaliser... dans l'intérêt commun